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

Aguirre Offshore GasPort Project
Draft Environmental Impact Statement

Aguirre Offshore GasPort, LLC

August 2014
Docket Nos. CP13-193-000 and PF12-4-000
FERC/EIS-0253

Cooperating Agencies:

U.S. Environmental Protection Agency
U.S. Coast Guard
U.S. Army Corps of Engineers
Puerto Rico Permits Management Office
Puerto Rico Environmental Quality Board
Puerto Rico Planning Board
Puerto Rico Department of Natural and Environmental Resources
Puerto Rico Department of Health

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FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, D.C. 20426

OFFICE OF ENERGY PROJECTS

In Reply Refer To:
OEP/DG2E/Gas 4
Aguirre Offshore Gasport, LLC
Aguirre Offshore GasPort Project
Docket No. CP13-193-000

TO THE PARTY ADDRESSED:

The staff of the Federal Energy Regulatory Commission (FERC or Commission) has prepared a draft environmental impact statement (EIS) for the Aguirre Offshore GasPort Project, proposed by Aguirre Offshore GasPort, LLC (Aguirre LLC), a wholly owned subsidiary of Excelerate Energy, LP in the above-referenced docket. Aguirre LLC is seeking authorization from the FERC to develop, construct, and operate a liquefied natural gas (LNG) import terminal off the southern coast of Puerto Rico.

The draft EIS assesses the potential environmental effects of the construction and operation of the Aguirre Offshore GasPort Project in accordance with the requirements of the National Environmental Policy Act (NEPA). The FERC staff concludes that approval of the proposed project, with the mitigation measures recommended in the EIS, would ensure that impacts in the project area would be avoided or minimized and would not be significant. Construction and operation of the project would result in mostly temporary and short-term environmental impacts; however, some long-term and permanent environmental impacts would occur.

The U.S. Environmental Protection Agency (EPA), U.S. Army Corps of Engineers, U.S. Coast Guard, Puerto Rico Permits Management Office, Puerto Rico Environmental Quality Board, Puerto Rico Planning Board, Puerto Rico Department of Natural and Environmental Resources, and Puerto Rico Department of Health 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. In addition, other federal, state, and local agencies may use this EIS in approving or issuing permits for all or part of the proposed project. 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.

Aguirre LLC is developing the project in cooperation with the Puerto Rico Electric Power Authority (PREPA) for the purpose of receiving, storing, and regasifying the LNG for delivery to PREPA's existing Aguirre Power Complex (Aguirre Plant) in Salinas, Puerto Rico. The project will help diversify Puerto Rico's energy sources, allow the Aguirre Plant to meet the EPA's Mercury and Air Toxics Standard rule, reduce fuel oil barge traffic in Jobos Bay, and contribute to price stabilization for power in the region. The draft EIS addresses the potential environmental effects of the construction and operation of the following project facilities:

- an offshore berthing platform;
- an offshore marine LNG receiving facility;
- a Floating Storage and Regasification Unit moored at the offshore berthing platform; and
- a 4.1-mile-long (6.6 kilometer) subsea pipeline connecting the Offshore GasPort to the Aguirre Plant.

The FERC staff mailed copies of the draft EIS to federal, state, and local government representatives and agencies; elected officials; environmental and public interest groups; other interested individuals and groups; newspapers and libraries in the project area; and parties to this proceeding. The draft EIS was also translated in Spanish. Paper copy versions of this EIS, in English or Spanish, were mailed to those specifically requesting them; all others received a CD version. In addition, the draft EIS is available for public viewing on the FERC's website (www.ferc.gov) using the eLibrary link. A limited number of copies are available for distribution and public inspection at:

Federal Energy Regulatory Commission
Public Reference Room
888 First Street NE, Room 2A
Washington, DC 20426
(202) 502-8371

If you would like a hard copy of the draft EIS, please contact the Public Reference Room.

Any person wishing to comment on the draft EIS may do so. To ensure consideration of your comments on the proposal in the final EIS, it is important that the Commission receive your comments before **September 29, 2014**.

For your convenience, there are four methods you can use to submit your comments to the Commission. In all instances, please reference the project docket number (CP13-193-000) with your submission. The Commission encourages electronic filing of comments and has expert staff available to assist you at (202) 502-8258 or efiling@ferc.gov.

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:

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 meeting its staff will conduct in the project area to receive comments on the draft EIS. The Puerto Rico Permits Management Office will jointly conduct this meeting. We encourage interested groups and individuals to attend and present oral comments on the draft EIS. Transcripts of the meetings will be available for review in eLibrary under the project docket numbers. The meeting will begin at 4 pm and is scheduled as follows:

Date	Location
September 9, 2014	Lions Club Avenida Los Veteranos (Entrance by Pizza Hut) Guayama, Puerto Rico 00785
September 10, 2014	Marina de Salinas P.R. 701 (end) Playa Ward Salinas, Puerto Rico 00751

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).[1] Only intervenors have the right to seek rehearing of the

[1] See the previous discussion on the methods for filing comments.

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 (www.ferc.gov) using the eLibrary link. Click on the eLibrary link, click on "General Search," and enter the docket number excluding the last three digits in the Docket Number field (i.e., CP13-193). 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; for TTY, contact (202) 502-8659. The eLibrary link also provides access to the texts of 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 http://www.ferc.gov/docs-filing/esubscription.asp.

Kimberly D. Bose
Secretary

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TECHNICAL ACRONYMS

ACHP	Advisory Council on Historic Places
Acropora BRT	Acropora Biological Review Team
Aguirre LLC	Aguirre Offshore GasPort, LLC
AQCR	Air Quality Control Region
ASD	Automatic Shut Down
ASME	American Society of Mechanical Engineers
ATBA	area to be avoided
ATWS	additional temporary workspace
BA	Biological Assessment
BTU/ft^2-hr	British thermal units per square foot per hour
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CFMC	Caribbean Fishery Management Council
CFR	Code of Federal Regulations
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COC	Certificate of Compliance
COE	U.S. Army Corps of Engineers
COTP	Captain of the Port
CSP	Cost Sharing Plan
CWA	Clean Water Act
CZMA	Coastal Zone Management Act of 1972
CZMP	Coastal Zone Management Program
dB	decibels
dBA	decibels on the A-weighted scale
DDT	dichlorodiphenyltrichloroethane
DFDE	dual-fuel diesel electric
DNER	Puerto Rico Department of Natural and Environmental Resources
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EBRV	Energy Bridge Regasification Vessel
ECA	Emission Control Area
EEZ	U.S. Exclusive Economic Zone
EFH	essential fish habitat
EI	Environmental Inspector
EIA	U.S. Energy Information Administration
EIS	environmental impact statement

TECHNICAL ACRONYMS (cont'd)

EPA	U.S. Environmental Protection Agency
EQB	Puerto Rico Environmental Quality Board
ERL	effects range low
ERM	effects range median
ERP	Emergency Response Plan
ESA	Endangered Species Act
FEED	Front End Engineering Design
FERC	Federal Energy Regulatory Commission
FMP	Fishery Management Plans
FR	Federal Register
FSP	Facility Security Plan
FSRU	Floating Storage and Regasification Unit
FWS	U.S. Fish and Wildlife Service
GHG	greenhouse gas
GWP	global warming potential
H1H	highest first highest
HAP	hazardous air pollutants
HAZID/HAZOP	Hazard Identification and Operability Study
HDD	horizontal directional drill
HFO	heavy fuel oil
IMO	International Marine Organization
ISPS Code	International Ship and Port Facility Security Code
JBNERR	Jobos Bay National Estuarine Research Reserve
kPa	kilopascal
kW	kilowatt
kW/m^2	kilowatt per square meter
L_{dn}	day-night noise level
L_{eq}	equivalent sound level
LFL	lower flammability limit
LNG	liquefied natural gas
LOI	Letter of Intent
LOR	Letter of Recommendation
MARPOL	International Convention for Prevention of Pollution from Ships
MATS rule	Mercury and Air Toxics Standard
MBTA	Migratory Bird Treaty Act
MGPS	marine growth preventative system
MMBtu	million British thermal units per hour
MMPA	Marine Mammal Protection Act of 1972
MMscf/d	million standard cubic feet per day

TECHNICAL ACRONYMS (cont'd)

MP	milepost
MSA	Magnuson-Stevens Fishery Conservation and Management Act
mtpy	metric tons per year
MW	megawatt
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act of 1969
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NFPA	National Fire Protection Association
NGA	Natural Gas Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NO_x	nitrous oxides
NPDES	Nation Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NSA	noise-sensitive area
NSPS	New Source Performance Standards
NSR	New Source Review
NVIC	Navigation and Vessel Inspection Circular
NWI	National Wetlands Inventory
O_2	oxygen
OCD	Offshore and Coastal Dispersion Model
OEP	Office of Energy Projects
P&ID	piping and instrumentation diagram/drawing
Pa	pascals
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl congener
PHMSA	Pipeline and Hazardous Materials Safety Administration
PI	point of inflection
PIC	Vessel Operator's Person in Charge
Plan	*Upland Erosion Control, Revegetation and Maintenance Plan*
PM_{10}	particulate matter (10 micrometers or less)
$PM_{2.5}$	particulate matter (2.5 micrometers or less)
PMO	Permits Management Office
PRDH	Puerto Rico Department of Health
PREPA	Puerto Rico Electric Power Authority
Procedures	*Wetland and Waterbody Construction and Mitigation Procedures*

TECHNICAL ACRONYMS (cont'd)

PRPB	Puerto Rico Planning Board
PRSC34	Puerto Rico Coastal Segmentation Unit, South Region Coastal Shoreline
PRWQSR	Puerto Rico Water Quality Standards Regulation
PSD	Prevention of Significant Deterioration of Air Quality
PSV	port service vessel
RHA	Rivers and Harbors Act
RPT	rapid phase transition
SA	spectral acceleration
SAV	submerged aquatic vegetation
SCR	selective catalytic reduction
SHPO	State Historic Preservation Office
SO_2	sulfur dioxide
SOLAS	International Convention for the Safety of Life at Sea
SOPEP	Shipboard Oil Pollution Emergency Plan
SPA	Special Planning Area
UFL	upper flammability limit
USC	United States Code
USCG	U.S. Coast Guard
USGS	U.S. Geological Survey
VOC	volatile organic compounds
WSA	Waterway Suitability Assessment
WSR	Waterway Suitability Report

EXECUTIVE SUMMARY

INTRODUCTION

On April 17, 2013, Aguirre Offshore GasPort, LLC (Aguirre LLC), a wholly owned subsidiary of Excelerate Energy, LP (Excelerate Energy), filed an application with the Federal Energy Regulatory Commission (Commission or FERC) under Section 3 of the Natural Gas Act (NGA) and Part 153 of the Commission's regulations. The application was assigned Docket No. CP13-193-000, and a Notice of Application was issued on April 30, 2013, and noticed in the Federal Register on May 6, 2013. Aguirre LLC is seeking authorization from the FERC to develop, construct, and operate a liquefied natural gas (LNG) import terminal off the southern coast of Puerto Rico.

The purpose of the 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 Aguirre Offshore Gasport Project (Project) and its alternatives, and recommend mitigation measures that would reduce adverse impacts to the extent practicable. We [1] prepared this draft EIS to assess the environmental impacts associated with construction and operation of the Project as required under the National Environmental Policy Act (NEPA) of 1969, as amended. Our analysis was based on information provided by Aguirre LLC and further developed from data requests, field investigations, scoping, literature research, and contacts with or comments from federal, state, and local agencies, and individual members of the public.

The FERC is the lead agency for the preparation of the draft EIS. The U.S. Environmental Protection Agency (EPA), U.S. Army Corps of Engineers (COE), U.S. Coast Guard (USCG), Puerto Rico Permits Management Office, Puerto Rico Environmental Quality Board (EQB), Puerto Rico Planning Board, Puerto Rico Department of Natural and Environmental Resources (DNER), and Puerto Rico Department of Health are participating in the NEPA review as cooperating agencies. [2]

PROPOSED ACTION

The Project is being developed in cooperation with the Puerto Rico Electric Power Authority (PREPA) for the purpose of receiving, storing, and regasifying LNG to be acquired by PREPA; and delivering natural gas to PREPA's existing Aguirre Power Complex (Aguirre Plant) in Salinas, Puerto Rico. The Project would include the construction and operation of an offshore marine LNG receiving facility (Offshore GasPort) and a 4.1-mile-long (6.6 kilometers [km]) subsea pipeline connecting the Offshore GasPort to the Aguirre Plant. A Floating Storage and Regasification Unit (FSRU) would be moored at the Offshore GasPort on a semi-permanent basis. Ships would dock at the Offshore GasPort and deliver LNG to the FSRU. Both the ships and the FSRU would be under the jurisdiction of the USCG. The LNG receiving facility would be located approximately 3 miles (4.8 km) off the southern coast of Puerto Rico, about 1 mile (1.6 km) outside of Jobos Bay, near the towns of Salinas and Guayama. Aguirre LLC is also proposing to utilize a construction office, contractor staging area, and existing access construction pier within the Aguirre Plant property.

The purpose of the Project is to provide LNG storage capacity and sustained deliverability of natural gas directly to the Aguirre Plant, which would facilitate PREPA's conversion of the Aguirre Plant from fuel oil only to a dual-fuel generation facility, capable of burning diesel and natural gas for the combined cycle units and fuel oil and natural gas for the thermoelectric plant. The Project would contribute to the diversification of energy sources in Puerto Rico, allow the Aguirre Plant to meet the requirements of the EPA's Mercury and Air Toxics Standard rule, reduce fuel oil barge traffic in Jobos

[1] "We," "us," and "our" refer to the environmental staff of the Federal Energy Regulatory Commission'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.

Bay, and contribute to energy price stabilization in the region. Aguirre LLC is proposing to place the Project facilities in service in 2016.

AGENCY AND PUBLIC REVIEW AND COMMENT OPPORTUNITIES

On December 21, 2011, Aguirre LLC filed a request with the FERC to implement the Commission's pre-filing process for the Project. On January 1, 2012, we granted Aguirre LLC's request and established a pre-filing docket number (PF12-4-000) in which to place information filed by Aguirre LLC, comments provided by stakeholders, and documents issued by the FERC and other agencies into the public record. Aguirre LLC held three informational open houses in February 2012, September 2012, and May 2013. The purpose of the open houses was to provide the general public with information about the Project and to give them an opportunity to ask questions and express their concerns. We participated in the open houses and provided information regarding the Commission's environmental review process to interested stakeholders. The substantive questions and concerns raised by the public at the open houses are addressed in the draft EIS.

On February 28, 2012, we issued a *Notice of Intent to Prepare an Environmental Impact Statement for the Planned Aguirre Offshore GasPort Project, Request for Comments on Environmental Issues, and Notice of Public Scoping Meetings*. The notice was published in the Federal Register on March 5, 2012, and mailed to more than 130 interested parties, including federal, state, and local government representatives and agencies; elected officials; environmental and public interest groups; other interested parties; and local libraries and newspapers. The notice briefly described the Project and the EIS process, provided a preliminary list of environmental issues identified by us, invited written comments on the environmental issues that should be addressed in the draft EIS, listed the date and location of two public scoping meetings to be held in the Project area, and established a closing date for receipt of comments of March 30, 2012. We received approximately 25 comment letters from various stakeholders, including the U.S. Fish and Wildlife Service (FWS); National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS); National Park Service; Governor of the Commonwealth of Puerto Rico; PREPA; Puerto Rico Federal Affairs Administration; Puerto Rico Pilotage Commission; Government Development Bank of Puerto Rico; Comité Diálogo Ambiental; the Center for Biological Diversity; and Captain Jimmy Vazquez-Aran.

We held two public scoping meetings to provide an opportunity for agencies, stakeholders, and the general public to learn more about the Project and participate in the environmental analysis by commenting on the issues to be addressed in the draft EIS. The first meeting was in the Town of Guayama on March 20, 2012; the second meeting was in the Town of Salinas on March 21, 2012. Approximately 30 people attended the meeting in Guayama and 45 people attended the meeting in Salinas. The transcripts of the public scoping meetings, summaries of the interagency scoping meetings, and all written scoping comments are part of the public record for the Project and are available for viewing on the FERC internet website (http://www.ferc.gov). [3]

We also coordinated several interagency scoping meetings in the Project area to solicit comments and concerns about the Project from other permitting and resource agencies in March 2012, May 2012, September 2012, May 2013, November 2013, and June 2014. We also conducted a field visit with Aguirre LLC on February 2, 2012, to review the proposed locations and construction methods of the onshore and offshore facilities. On September 5, 2012; February 18, 2013; April 15, 2013; and December 4, 2013, we issued Project Updates, which outlined the status of the environmental review process and included a summary of the issues identified through the scoping process.

[3] Using the "eLibrary" link, select "General Search" from the eLibrary menu, enter the desired date range and Docket Number (i.e., CP13-193 or PF12-4), and follow the instructions.

We issued a Notice of Schedule on May 2, 2014, and it indicated that the final EIS for the Aguirre GasPort Project would be issued December 19, 2014. This draft EIS has been filed with the EPA and mailed to interested parties. This draft EIS has also been translated to Spanish to facilitate public review. The distribution list for the draft EIS is in appendix A. A formal Notice of Availability indicating that the draft EIS will be available for review and comment was published in the Federal Register. The public has 45 days after the date of publication in the Federal Register to review and comment on the draft EIS both in the form of written comments and at public meetings to be held in the Project area. The dates and locations of these public meetings are listed in the To the Party Addressed letter that is included in the front of this draft EIS, as well as in the Notice of Availability. All comments received on the draft EIS related to environmental issues will be addressed in the final EIS.

ENVIRONMENTAL IMPACTS AND MITIGATION

We evaluated the Project impacts on geology; soils and sediments; water resources; wetlands; vegetation; wildlife and aquatic resources; threatened, endangered, and special status species; land use, recreation, and visual resources; socioeconomics (including transportation and traffic); cultural resources; air quality and noise; and reliability and safety. We also considered the cumulative impacts of this Project with past, current, and reasonably foreseeable future actions in the Project area.

Overall, construction of the Project would temporarily disturb approximately 158.2 acres (162.9 cuerdas) of land, surface water, and the seafloor, including 1.5 acres (1.5 cuerdas) of land within the existing Aguirre Plant property. As proposed, the construction of the offshore facilities, including the berthing platform, subsea interconnecting pipe, and lay barge construction areas, would require approximately 156.7 acres (161.3 cuerdas) at the water surface and would directly impact 116.9 acres (120.4 cuerdas) of the seafloor. Operation of the offshore facilities would permanently impact approximately 25.3 acres (26.1 cuerdas) of seafloor.

Important issues identified as a result of our analyses, scoping comments, and agency consultations include impacts on marine wildlife, essential fish habitat (EFH), and benthic species; impacts on threatened or endangered species; impacts on land use and recreation; and air and noise impacts. Where necessary, we are recommending additional mitigation measures to minimize or avoid these and other impacts. Section 5.2 of the EIS contains our conclusions and a compilation of our recommended mitigation measures.

Geologic Resources

The proposed offshore terminal and pipeline construction and operation would have minimal impacts on the geologic resources of the area. However, some hazards such as seismic ground motion, liquefaction events, wind and wave loadings, and tsunamis could impact the Project during operation. Therefore, we are recommending that Aguirre LLC file updated offshore wave analysis, marine terminal structure and pile foundation design and construction details, seismic specifications used in conjunction with the procuring equipment, quality control procedures, and identification of an inspector employed by Aguirre LLC to observe the construction of the Project and furnish inspection reports.

Soils and Sediments

Construction activities, including the installation of the subsea pipeline, temporary piles, and permanent structures at the offshore berthing platform, would result in the resuspension of seafloor sediment into the water column. When suspended during construction, the fine silt particles would descend through the water column relatively slowly and could travel hundreds of yards (hundreds of meters [m]) under mean current speeds due to the spatial and temporal asymmetry of the tidal currents. To ensure that impacts associated with the resuspension, transport, and redeposition of sediments disturbed during construction activities are addressed, we are recommending that Aguirre LLC conduct sediment transport modeling, prior to the end of the public comment period on the draft EIS, to support its determination that the redeposition of sediments disturbed during the construction activities would be limited to within 100 feet (30 m) of the pile foundations at the offshore berthing platform footprint and within 10 feet (3 m) of the pipeline centerline. Based on the information that would be provided by Aguirre LLC, we will further evaluate the construction-related impacts associated with the resuspension of seafloor sediment in the final EIS.

Water Resources

Construction activities of the offshore berthing platform and pipeline would cause the displacement of sediments on the seafloor and the resuspension of sediments into the water column. Sediment disturbed during construction would also be resuspended in the water column and transported by currents. The effects of the construction activities on turbidity levels would vary with the length and severity of disturbance, grain size composition, and resettling rates. As discussed above, we are recommending that Aguirre LLC conduct sediment transport modeling to support its determination regarding the redeposition of sediments disturbed during the construction activities.

Spills or leaks of hazardous materials (e.g., fuel, lubricants) from equipment working in the onshore areas could also result in adverse impacts on water resources. Construction contractors and port operations personnel would be required to comply with all laws and regulations. We are recommending that Aguirre LLC file a site-specific spill prevention and control plan for the construction and operation phases of the Project (onshore and offshore) prior to construction.

Vegetation Resources

Based on the sparse vegetation within the proposed onshore temporary workspace area, no significant impacts on terrestrial vegetation resulting from construction or operation of the Project are anticipated.

Submerged aquatic vegetation is the most common benthic cover type in Jobos Bay. Seagrass is the dominant cover in approximately 30 percent of the bay; macroalgae (seaweed) is the dominant cover in an additional 20 percent. Seagrasses provide food and shelter to commercial and recreational fishery species as well as invertebrates and birds. Seagrasses also reduce wave and current action and improve water clarity and quality. Both seagrass and macroalgae are distributed throughout Jobos Bay, providing habitat for commercially and recreationally important fish and invertebrates. To ensure that impacts on seagrass are minimized and/or properly mitigated, we have recommended that Aguirre LLC consult with NMFS, FWS, DNER, and other appropriate agencies in developing the seagrass mitigation and monitoring plan. The mitigation plan should be developed in compliance with the COE's mitigation requirements for the Project. Aguirre LLC should file a draft of this plan along with agency comments on the draft with the Secretary prior to the end of the public comment period on the draft EIS. We will further evaluate the Project's impacts on seagrass based on Aguirre LLC's draft seagrass mitigation and monitoring plan in the final EIS.

Wildlife Resources

The proposed offshore terminal and subsea pipeline are located in marine areas that support habitat for marine wildlife and fisheries. Construction would result in temporary impacts on marine wildlife habitats, including 19.8 acres (20.4 cuerdas) of seagrass, 77.4 acres (79.7 cuerdas) of macroalgae, 5.2 acres (5.4 cuerdas) of coral reef, and 14.5 acres (14.9 cuerdas) of soft bottom habitat. Construction of the Project would create short-term adverse impacts on a rich and diverse assemblage of wildlife species including manatees, sea turtles, reef fish, sharks, corals, and invertebrates found within these habitats.

Hydrostatic testing involves filling pipelines with water, performing pressure tests in accordance with applicable regulations, and discharging the test water following completion of the test. Aguirre LLC would withdraw the water used for testing from Jobos Bay or the Caribbean Sea, depending on the section of pipeline being tested. NMFS raised concerns regarding entrainment of fish during this process. To ensure that the entrainment of fish and other organisms is minimized or avoided, we recommend that Aguirre LLC consult with NMFS regarding the type of screen (e.g., wedge-wire) that would be used for water withdrawals during the construction.

The Offshore GasPort would create a permanent impact on marine wildlife habitat. These permanent impacts would include approximately 3.7 acres (3.8 cuerdas) of seagrass, 20 acres (20.6 cuerdas) of macroalgae, 0.5 acre (0.5 cuerda) of reef, and 1.1 acres (1.1 cuerdas) of soft bottom habitat. The Project would result in direct impacts from mortality of coral colonies within the footprint of the pipeline across the coral reef and unconsolidated hardbottom, as well as indirect impacts resulting from shading of patch reef below the offshore terminal (including the FSRU and LNG carrier) and degradation of seagrass and macroalgae foraging habitats. The FSRU and LNG carriers stationed at the terminal would also locally impact wildlife resources from thermal plume and anti-fouling agent discharge, plankton entrainment, noise, and lighting.

Environmental regulatory agencies, including NMFS, have expressed concern over impacts on protected coral species and habitat along the subsea pipeline route, specifically in the area of the Boca del Inferno pass. Aguirre LLC's proposed direct lay construction method would adversely impact the protected coral species and habitat located in the area. We are recommending that Aguirre LLC consult with NMFS, FWS, DNER, and other appropriate agencies in developing a coral reef mitigation and monitoring plan prior to the end of the draft EIS comment period, allowing us to assess the potential of facilitating a recovery of impacted benthic resources. The mitigation plan should be developed in compliance with the COE's mitigation requirements for the Project. We will further evaluate the Project's impacts on protected coral species based on Aguirre LLC's draft coral reef mitigation and monitoring plan in the final EIS. Further, we are recommending that Aguirre LLC conduct a feasibility analysis of a horizontal directional drill (HDD) crossing under Boca del Infierno pass with the intent to alleviate NMFS' concerns and substantially reduce impacts on coral reef habitat. If Aguirre LLC finds that the HDD construction method is feasible, implementation of this construction technique as a method of avoidance or minimization of impacts would likely expedite formal consultation with NMFS.

We also identified noise impacts, both from the subsea and offshore terminal, to have the potential to disturb marine species. We are recommending additional acoustic modeling be completed, prior to the end of the public comment period on the draft EIS, and consultations with the FWS, NMFS, and DNER to identify acceptable mitigations measures to reduce noise levels from construction. We will analyze the results of the acoustic modeling and further evaluate the construction-related noise impacts on marine species in the final EIS.

Several species of birds may be found in the Project area resting or nesting along the shoreline. Due to concerns raised by the DNER, we are recommending that Aguirre LLC provide an assessment of potential noise impacts on resting and nesting birds during the construction and operation of the Project, and identify mitigation measures that could be implemented to minimize or avoid these impacts.

The Project would necessitate the installation of temporary lighting to facilitate construction activities during evening hours as well as for safety requirements. During operations, the FSRU and offshore berthing platform would be lit 24 hours per day by security lighting, navigation lights, and Federal Aviation Administration warning lights. We are recommending that Aguirre LLC develop and file a lighting plan that identifies specific measures that would be implemented to minimize or avoid impacts associated with the Project's operational nighttime lighting on avian species, fish species, marine mammals, and individuals on the shoreline.

Threatened and Endangered Species

We have identified 23 federally listed threatened or endangered species and 10 species proposed for Endangered Species Act (ESA) listing occurring or potentially occurring in the Project area. Due to the distance of their primary habitat from the Project area, it was determined that the Project would have no effect on 9 of the listed or proposed species and may affect, and is not likely to adversely affect an additional 14 species based on behavioral characteristics; habitat requirements; and the construction, operation, and mitigative measures proposed by Aguirre LLC. The remaining 10 species we have determined would be adversely impacted by the Project. The construction and/or operation of the Project would impact the Antillean manatee and nine species of listed or proposed corals. Our ESA consultation with the FWS and NMFS concerning federally listed species and critical habitats is ongoing.

With mitigation techniques such as the use of trained marine mammal observers and a 0.3-mile (0.5 km) zone of exclusion around vibratory pile driving activities, the temporary impact on manatees including the risk of strikes and stress caused by excessive noise would be greatly reduced. As previously stated, environmental regulatory agencies, including NMFS, have expressed concern over impacts on protected coral species along the subsea pipeline route, specifically in the area of the Boca del Inferno pass. Therefore, we are recommending that Aguirre LLC conduct a feasibility analysis of an HDD crossing under the Boca del Infierno pass. Aguirre LLC should file this analysis prior to the end of the public comment period on the draft EIS. The final EIS will present our analysis of impacts on protected coral species along the subsea pipeline route considering Aguirre LLC's HDD feasibility analysis.

Operation of the Project would also result in impacts on coral larvae due to loss of individuals entrained in sea water intakes for the FSRU and the LNG carriers while at berth at the Offshore GasPort. During spawning periods, there is potential for entrainment of coral larvae with the highest risk occurring near the depth of the intake of the FSRU. Section 4.5.4.3 provides an entrainment analysis associated with seawater intakes during Project operations. Entrainment of coral larvae would likely result in a permanent, moderate impact on coral populations in the region. We reviewed the information submitted by Aguirre, performed our own research, and consulted directly with the agencies regarding federally listed species in the Project area. Our analysis of the potential for Project-related impacts on these species and their designated critical habitats is discussed below and in appendix D to this EIS.

As required by Section 7 of the ESA, we are requesting that the FWS and NMFS consider appendix D, along with information in this EIS and survey reports prepared by Aguirre LLC (submitted separately), as our Biological Assessment for the Project and are requesting formal consultation. To ensure that impacts on ESA-listed species are addressed, we are recommending that Aguirre LLC not begin construction activities until we have completed formal consultation with the FWS and NMFS.

Land Use and Recreational Resources

Construction of the Project would alter the land use, recreation, and visual resources of the area by temporarily increasing vessel traffic, therefore impacting recreational boating and fishing. Operation of the Project would permanently alter the existing visual resources as well as impact boating, fishing, and other marine uses near the offshore facility.

Construction activities would require the use of a variety of vessels including lay barges, dive support vessels, support tugs, crew boats, pipe transport barges, and pipe haul barge tugs, increasing the current levels of large vessel traffic in Jobos Bay, which is typically limited to small recreation and commercial fishing vessels. Operation of the Project would have minimal impact on marine use within the bay. National Oceanic and Atmospheric Administration navigational charts of the area would need to include the subsea pipeline for recreational or commercial users of the bay. The subsea pipeline may prevent deep draft vessels from entering Jobos Bay through the Boca Del Inferno pass. The USCG's proposed safety zone located around the FSRU and LNG carriers would have direct impacts on boating, fishing, and other marine uses in the area, as it would prohibit their transiting or using an area within 500 yards (457 m) from the facility. Conversely, the Project would result in a decrease of oil barge traffic within Jobos Bay and along the barge channel to the Aguirre Plant due to the plant's conversion to natural gas as a fuel source.

Construction of the offshore berthing platform and subsea pipeline requires a coastal zone consistency be completed with the Puerto Rico Planning Board to ensure that the Project is consistent with Coastal Zone Management Program policies. We are recommending that: Aguirre LLC not begin construction of the Project until it files with the Secretary of the Commission (Secretary) a copy of the determination of consistency with the Coastal Zone Management Program issued by the Puerto Rico Planning Board.

The presence of the FSRU and offshore berthing platform would visually affect wildlife viewing from the Cayos Caribes lookout tower and other places within the Jobos Bay National Estuarine Research Reserve that have views of the ocean. The FSRU and offshore berthing platform would be lit 24 hours per day by security lighting, navigation lights, and Federal Aviation Administration warning lights. To minimize impacts associated with nighttime lighting, as previously stated, we are recommending that Aguirre LLC develop a lighting plan to minimize the impacts on individuals on the shore and on wildlife.

Cultural Resources

The area of potential effect for the onshore portion of the Project is within the existing fenced Aguirre Plant property. The Project proposes to disturb approximately 1.5 acres (1.5 cuerdas) of the industrial site during the construction for use as a temporary construction staging and support area. The offshore construction would include the construction right-of-way and temporary workspace for the 4.1-mile-long (6.7 km) subsea pipeline and the construction area for the offshore berthing platform. Aguirre LLC conducted archival research and marine surveys of these areas to identify cultural resources including locations for potential prehistoric and historic archaeological sites.

No sites were identified through archival research within the Project area. Aguirre LLC did not conduct an archeological survey within the previously disturbed, terrestrial portion of the Project because of the low potential for intact cultural deposits. In a letter dated August 15, 2012, the SHPO concurred that no archaeological survey is necessary. We concur as well.

The marine area of potential effect includes about 155 acres (160 cuerdas) of submerged land that could be affected by the construction and operation of the subsea pipeline and the offshore berthing platform. Aguirre LLC completed evaluative testing in March 2013, prepared a report of findings in April 2013, and submitted a copy to the State Historic Preservation Office (SHPO) for review in June 2013. We are currently waiting on SHPO comments on the evaluation report. To ensure that the FERC's responsibilities under the National Historic Preservation Act and its implementing regulations are met, we are recommending that Aguirre LLC not begin construction until the SHPO's comments are filed, the Advisory Council on Historic Places is provided an opportunity to comment, we review the reports and plans, and the Director of the Office of Energy Projects has notified Aguirre LLC that construction may proceed.

Air Quality and Noise

Construction of the Project would create emissions from fossil-fueled construction equipment. Such air quality impacts would generally be temporary and localized, and are not expected to cause or contribute to a violation of applicable air quality standards.

Operating the Project, which would include equipment on the FSRU, the terminal platform, and LNG carriers, support vessels, and tugs would create long-term air emissions. Potential impacts of air emissions from Project operations would be reduced by incorporation of operating restrictions and use of emission reduction technologies on the FSRU to limit pollutant emissions. Overall, the Project would reduce emissions at the Aguirre Plant, including almost 800 tons per year of nitrogen oxides and 5,816 tons per year of sulfur dioxide. In meeting the Project objective of compliance with the EPA Mercury and Air Toxics Standard rule, the local and regional air quality would improve.

Noise would be generated during construction and operation of the Project. Construction of the Offshore GasPort would occur in three phases: the marine infrastructure including berth facilities; topside mechanical and electrical facilities; and the subsea interconnecting pipeline. If an HDD under the Boca del Infierno pass is found to be feasible, additional construction noise would be generated by the HDD equipment. Construction noise would exceed the EQB's nighttime noise limits at two noise-sensitive areas (NSA). Aguirre LLC proposes to consult with EQB to develop the appropriate mitigation measures should actual sound levels measured during construction activities exceed the nighttime EQB noise limits. These mitigation measures could include establishing appropriate work hours and development of a Construction Noise Abatement Plan where Aguirre LLC would monitor onshore sound levels in the vicinity of active pipeline construction. If sound levels at residential areas onshore do not meet EQB criteria for an extended time, noise mitigation measures would be adjusted appropriately. In addition to consulting with the EQB for noise impacts on NSAs, we are recommending that Aguirre conduct noise modeling to determine the impacts of subsea and ambient noise on wildlife in the area. Further, we recommend that Aguirre LLC consult with the FWS, NMFS, and DNER regarding appropriate mitigation measures to reduce noise levels.

The estimated operational noise of the FSRU would be below existing ambient sound levels at each of the NSAs. We are recommending, however, that Aguirre LLC file a noise survey no later than 60 days after placing the facilities into service to ensure that the noise levels are at or below our criteria of a day-night noise level of 55 decibels on the A-weighted scale at the nearest NSAs.

Safety and Reliability

We evaluated the safety of the proposed Offshore GasPort, the related FSRU operation, LNG carrier transits, and the subsea pipeline. As part of our evaluation of the Offshore GasPort, we performed a technical review of the preliminary engineering design to ensure sufficient layers of protection would be included in the facility designs to mitigate the potential for an incident that could impact the safety of the public. The USCG reviewed the suitability of the waterway along the proposed LNG carrier transit route and determined that the waterway would be suitable for the type and frequency of LNG marine traffic associated with this proposed Project. In addition, Aguirre LLC would be required to comply with all regulations in Title 33 Code of Federal Regulations (CFR) Part 105 (33 CFR 105) and 33 CFR 127 for its proposed LNG facilities and 49 CFR 192 for the proposed subsea pipeline. Based on our engineering design analysis and recommendations presented in section 4.11 for the Offshore GasPort, the Letter of Recommendation issued by the USCG for the LNG carrier transit, and the regulatory requirements for the pipeline and the Offshore GasPort, we conclude that the Project would not result in significantly increased public safety risks.

ALTERNATIVES CONSIDERED

As an alternative to the proposed action, we evaluated the No Action Alternative, system alternatives, facility siting alternatives, offshore terminal site alternatives, major pipeline route alternatives, and pipeline route variations. While the No Action Alternative would eliminate the short- and long-term environmental impacts identified in the EIS, the stated objectives of the proposed action would not be met. We also evaluated the use of alternative energy sources and the potential effects of energy conservation, but determined that these sources and measures would not be a practicable alternative to the proposed Project.

One system alternative would be the expansion of the existing EcoEléctrica LNG (EcoEléctrica) facility, which is approximately 35 miles (56 km) east of the Aguirre Plant. For the EcoEléctrica facility to be a viable system alternative to the proposed Project, the facility would have to construct new LNG storage capacity, regasification facilities, and a new pipeline to connect the EcoEléctrica facility to the Aguirre Plant. As the proposed Project does not require construction of onshore LNG storage facilities and additional gasification facilities, the expansion at the EcoEléctrica facility with associated pipeline would result in greater environmental impacts than the proposed Project. We conclude that the expansion of the existing EcoEléctrica facility is not considered to be environmentally preferable to the proposed Project, and it was removed from further consideration.

Our evaluation of alternative sites also considered construction and operations of two land-based sites and two dockside sites. Two industrial facilities are located on the north shore of Las Mareas Bay: the Chevron-Philips (CP) chemical facility and the AES Puerto Rico, L.P. 454-megawatt coal-fired power generation facility. Las Mareas Bay is approximately 6 miles (9.7 km) east of the Aguirre Plant with access to the area off Puerto Rico Highway 3. This industrial area has sufficient land to allow for the development of an onshore LNG facility; however, it would require the construction of a new onshore or dockside terminal at either the CP chemical facility or AES Puerto Rico, L.P. facility, a large dredging and bay development project to accommodate large LNG carriers, and a 6-mile (9.7 km) pipeline to the Aguirre Plant. Impacted areas would mainly consist of previously developed upland but would also include areas of palustrine emergent wetland located along the coastal area. We found that the associated environmental impacts with either a land-based or dockside terminal alternative would be greater than the proposed Project. For these reasons, we conclude that a new land-based or dockside LNG facility within Las Mareas Bay would not present any significant environmental advantage compared to the proposed Project.

The Aguirre Plant was also considered as an alternative for either a land-based or dockside terminal location. About 30 acres (31 cuerdas) would be required to construct storage tanks, regasification equipment, and other infrastructure to support the facility. In reviewing the area around the Aguirre Plant, 30 contiguous acres (31 cuerdas) are not available that would avoid population centers. In addition, the land-based terminal would require a deepwater access and a turning basin. The lack of available land, the need to create a deepwater access and turning basin, and the proximity to a population center makes a land-based terminal less environmentally preferable than the proposed action. A dockside terminal facility would also require deepwater access and a turning basin large enough for both the FSRU and the LNG carrier as well as modification at the Aguirre Plant to build a pier for the FSRU. The existing jetty at the facility cannot accommodate an FSRU as well as the LNG carrier. Considering its proximity to the Aguirre community, and the extensive amount of in-water work (dredging and pier construction) that would be required, we consider that the environmental impacts of a dockside terminal would be equal or greater than the proposed Project.

We evaluated four alternative offshore terminal sites with pipelines to the terminal and Aguirre LLC conducted field review of each site and corresponding pipeline. All four terminals had similar water depths and seafloor conditions; however, the length of pipeline required and distance to the closest population centers varied. We also analyzed five major terminal/pipeline alternatives in response to concerns from the public and NMFS, EPA, FWS, and DNER concerning impacts from the proposed pipeline route through the Boca del Inferno pass on federally threatened and endangered coral species, coral reef habitat, seagrass within Jobos Bay, and the Antillean manatee. The construction techniques included direct lay and trenching for burial of the pipeline in the Jobos Bay barge channel. We determined that each of the terminal locations and pipeline routes avoiding the Boca del Inferno pass would have environmental impacts greater than or similar to the proposed terminal location and, therefore, were not environmentally preferable to the proposed site and pipeline route.

A pipeline route variation review was completed on four pipeline route variations from the proposed terminal site to the Aguirre Plant, each passing through Boca del Infierno pass. For each pipeline route variation, the pipeline length, number of bends in the pipeline, and disturbance of submerged aquatic vegetation and coral reef habitat was compared to the corresponding segment of the proposed route. None of the route variations were determined to provide significant environmental advantages over the proposed route and were not evaluated further.

CONCLUSIONS

We determined that construction and operation of the Project would result in limited adverse environmental impacts that would mostly occur during construction. This determination is based on our review of the information provided by Aguirre LLC and further developed from data requests; field investigations; scoping; literature research; alternatives analyses; and contacts with federal, state, and local agencies, and individual members of the public. We conclude that approval of the Project would have moderate adverse environmental impacts, but these impacts would be reduced to less-than-significant levels if mitigation measures are implemented. Although many factors were considered in this determination, the principal reasons are:

- Aguirre LLC would be required to obtain all necessary federal authorizations prior to beginning construction.
- Aguirre LLC would implement Project-specific construction, restoration, and mitigation plans that would avoid, minimize, or mitigate impacts on natural resources.
- The FERC would complete the process of complying with Section 7 of the ESA prior to construction.
- The FERC would complete the process of complying with Section 106 of the National Historic Preservation Act prior to construction.
- An environmental inspection program would be implemented to ensure compliance with the mitigation measures that become conditions of the FERC authorization.

In addition, we developed 65 mitigation measures that Aguirre LLC should implement to further reduce the environmental impacts that would otherwise result from construction and operation of the Project. We are recommending that these mitigation measures be attached as conditions to any authorization issued by the Commission. These recommended mitigation measures are presented in section 5.2 of the draft EIS.

1.0 INTRODUCTION

On April 17, 2013, Aguirre Offshore GasPort, LLC (Aguirre LLC), a wholly owned subsidiary of Excelerate Energy, LP (Excelerate Energy), filed an application with the Federal Energy Regulatory Commission (Commission or FERC) under Section 3 of the Natural Gas Act (NGA) and Part 153 of the Commission's regulations. The application was assigned Docket No. CP13-193-000, and a Notice of Application was issued on April 30, 2013, that was also noticed in the Federal Register on May 6, 2013. Aguirre LLC is seeking authorization from the FERC to develop, construct, and operate a liquefied natural gas (LNG) import terminal off the southern coast of Puerto Rico.

Aguirre LLC's proposal, referred to as the Aguirre Offshore GasPort Project (Project), is being developed in cooperation with the Puerto Rico Electric Power Authority (PREPA) for the purpose of receiving, storing, and regasifying the LNG to be acquired by PREPA; and delivering natural gas to PREPA's existing Aguirre Power Complex (Aguirre Plant) in Salinas, Puerto Rico. The Aguirre Plant is PREPA's largest power facility with an installed generation capacity of 1,492 megawatts (MW), which represents approximately one-third of Puerto Rico's total installed generating capacity. The Project would consist of an offshore berthing platform; LNG receiving facility (Offshore GasPort); and a 4.1-mile-long (6.6 kilometer [km]) subsea pipeline connecting the Offshore GasPort to the Aguirre Plant (see figure 1-1). The Offshore GasPort would be attended by a Floating Storage and Regasification Unit (FSRU) and ships delivering LNG. Both the FSRU and the LNG Ships would be under the jurisdiction of the U.S. Coast Guard. Aguirre LLC is proposing to place the Project facilities in service in 2016. The proposed Project facilities and schedule are described in detail in section 2.0.

The environmental staff of the FERC prepared this environmental impact statement (EIS) to assess the environmental impacts associated with the construction and operation of the facilities proposed by Aguirre LLC in accordance with the requirements of the National Environmental Policy Act of 1969 (NEPA), as amended. NEPA, and the Council on Environmental Quality's (CEQ) regulations for implementing NEPA in Title 40 Code of Federal Regulations Part 1501.6 (40 CFR 1501.6), call on federal, state, and local government agencies to cooperate in the preparation of EISs. In accordance with these provisions, the following agencies are participating as cooperating agencies[1] in the preparation of this draft EIS:

- U.S. Environmental Protection Agency (EPA);
- U.S. Army Corps of Engineers (COE);
- U.S. Coast Guard (USCG);
- Puerto Rico Permits Management Office (PMO);
- Puerto Rico Environmental Quality Board (EQB);
- Puerto Rico Planning Board (PRPB);
- Puerto Rico Department of Natural and Environmental Resources (DNER); and
- Puerto Rico Department of Health (PRDH).

The roles of the FERC and the cooperating agencies in the Project review process are described in section 1.2.

[1] 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.

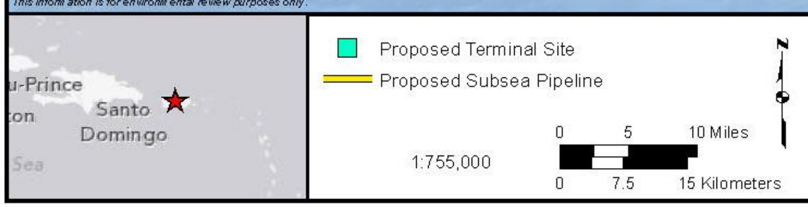

Figure 1-1
General Location Map
Aguirre Offshore GasPort Project

1.1 PROJECT PURPOSE AND NEED

According to Aguirre LLC, the purpose of the Project is to provide LNG storage capacity and sustained deliverability of natural gas directly to the Aguirre Plant, which would facilitate PREPA's conversion of the Aguirre Plant from fuel oil only to a dual-fuel generation facility, capable of burning diesel and natural gas for the combined cycle units and fuel oil and natural gas for the thermoelectric plant. The Project would have a storage capacity of 197,400 cubic yards (yd^3) (150,000 cubic meters [m^3]) and sendout capacity of 50 million standard cubic feet per day (MMscf/d) to the Aguirre Plant.

Aguirre LLC's stated benefits of the Project are:

- contributing to the diversification of energy sources, thereby reducing the use of fuel oils, as outlined in PREPA's Corporate Strategic Plan 2011–2015;
- allowing the Aguirre Plant to meet the requirements of the EPA's Mercury and Air Toxics Standard (MATS rule);
- reducing fuel oil barge traffic in Jobos Bay, thereby reducing the potential for fuel spills, reducing potential encounters with certain endangered species, and minimizing impacts on recreational boat traffic; and
- contributing to price stabilization, which is not enjoyed under the current supply scenario.

The Project was developed in response to an Expression of Interest and Pre-Qualification process that was conducted by PREPA in December 2010 to identify a qualified company to develop, permit, finance, construct, and operate an LNG import terminal off the coast of Salinas, Puerto Rico. Excelerate Energy submitted its technical proposal and company qualification to PREPA in January 2011 and was selected by PREPA in February 2011 as the most qualified company to pursue a solution to PREPA's goals.

Under Section 3 of the NGA, the FERC considers, as part of its decision to authorize natural gas facilities, all factors bearing on the public interest. Specifically, regarding whether to authorize natural gas facilities used for importation or exploration, the FERC shall authorize the proposal unless it finds that the proposed facilities will not be consistent with the public interest.

1.2 PURPOSE AND SCOPE OF THE EIS

Our[2] principal purposes for preparing the EIS are to:

- identify and assess the potential impacts on the natural and human environment that would result from the implementation of the Project;
- describe and evaluate reasonable alternatives to the Project that would avoid or substantially lessen any significant adverse effects of the Project on the environment;
- identify and recommend specific mitigation measures, as necessary, to avoid or minimize significant environmental effects; and
- encourage and facilitate involvement by the public and interested agencies in the environmental review process.

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

This EIS focuses on the Offshore GasPort and pipeline that are under the FERC's jurisdiction. The topics addressed in this EIS include 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; cumulative impacts; and alternatives. This draft EIS describes the affected environment as it currently exists, discusses the potential environmental consequences of the proposed Project, and compares the Project's potential impact to that of alternatives. The following sections describe the roles and responsibilities of the FERC and the cooperating agencies.

1.2.1 Federal Energy Regulatory Commission

The FERC is an independent federal agency whose responsibility includes evaluating applications filed for authorization to construct and operate LNG terminals for the importation or exportation of natural gas. The Energy Policy Act of 2005 provides that the FERC shall act as the lead agency for coordinating all applicable authorizations related to jurisdictional natural gas facilities and for purposes of complying with NEPA. As such, the FERC is the lead federal agency for the preparation of the EIS in compliance with the requirements of NEPA, the CEQ regulations for implementing the procedural provisions of NEPA (40 CFR 1500–1508), and the FERC's regulations implementing NEPA (18 CFR 380).

As the lead federal agency for the Project, the FERC is also required to comply with Section 7 of the Endangered Species Act of 1973 (ESA), the Migratory Bird Treaty Act (MBTA), the Bald and Golden Eagle Protection Act, the Magnuson–Stevens Fishery Conservation and Management Act (MSA), the Marine Mammal Protection Act of 1972 (MMPA), Section 106 of the National Historic Preservation Act (NHPA), and Section 307 of the Coastal Zone Management Act of 1972 (CZMA). These and other statutes have been taken into account in the preparation of the EIS.

The Commission will consider the findings of the final EIS as well as non-environmental issues in its review of Aguirre LLC's application to determine whether or not to authorize the proposed Project. An authorization will be granted only if the FERC finds that the evidence produced on financing, rates, market demand, gas supply, existing facilities and service, environmental impacts, long-term feasibility, and other issues demonstrates that the Project is consistent with the public interest. Environmental impact assessment and mitigation development are important factors in the overall public interest determination.

This effort was undertaken with the participation and assistance of the EPA, COE, USCG, PMO, EQB, PRPB, DNER, and PRDH as "cooperating agencies" under NEPA. Cooperating agencies have jurisdiction by law or special expertise with respect to environmental impacts involved with a proposal. The roles of the cooperating federal and commonwealth agencies in the Project review process are described below. The EIS provides a basis for coordinated federal decision-making in a single document, 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 Project are discussed in section 1.5.

1.2.2 U.S. Environmental Protection Agency – Region 2

The EPA is an independent 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 Clean Water Act [CWA]) to the jurisdiction of individual state agencies, but the EPA may assume this authority if no state program exists, if the state program is not functioning adequately, or at the request of a state. The National Pollutant Discharge

Elimination System (NPDES) program is not delegated to the Commonwealth of Puerto Rico. The EPA implements the NPDES program and issues NPDES permits to dischargers. In addition, the EPA will review and comment on the COE's decision regarding the Section 404 permits pursuant to the CWA.

The EPA has jurisdictional authority to control air pollution under the Clean Air Act (CAA) (42 United States Code [USC] Chapter 85 [42 USC 85]) by developing and enforcing rules and regulations for all entities that emit air pollutants into the air. Under this authority, the EPA has developed regulations for major sources of air pollution. To implement these regulations, the EPA implements the program directly, delegates the authority to implement these regulations to state and local agencies, or approves state/local agencies' major source air programs that meet the CAA requirements. Furthermore, state and local agencies need to develop their own regulations for non-major sources.

The EPA also has jurisdictional authority in Puerto Rico in the case of the federal Prevention of Significant Deterioration of Air Quality (PSD) regulations codified in 40 CFR 52.21. In addition, the EPA establishes general conformity applicability thresholds, with which a federal agency can determine whether a specific action requires a general conformity assessment.

In addition to its permitting responsibilities, 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.

1.2.3 U.S. Army Corps of Engineers – Jacksonville District

The COE is a federal agency within the U.S. Department of Defense responsible for regulating the discharge of dredged or fill material into waters of the United States under Section 404 of the CWA (33 USC 1344), and works or construction of any structure affecting navigable waters of the United States under Section 10 of the Rivers and Harbors Act (RHA) (33 USC 403). The COE is also responsible for regulating the transportation of dredged material to be discharged into the ocean under Section 103 of the Marine Protection Research and Sanctuaries Act of 1972 and regulating moorings, buoys, markers that are maintained by private individual or organizations under 33 CFR Part 66, Private Aids to Navigation. 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 public interest review factors as well as concerns presented during the permit application review process that are relative to the permit program.

As an element of its review, the COE must consider whether a proposed project 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 may require a Coastal Zone Management Consistency Certificate with the Puerto Rico Coastal Zone Management Program (CZMP) and a Water Quality Certification from the EQB to issue a permit, as applicable. No permit would be granted until required certifications have been obtained or waived. Based on its participation as a cooperating agency and its consideration of the final EIS (including responses to public comments), the COE would issue a Record of Decision to formally document its decision on the proposed action and required environmental mitigation commitments.

Aguirre LLC filed its application with the Jacksonville District of the COE on July 9, 2013, and provided additional information in August and September 2013 in response to comments from the COE. The COE issued a public notice for Aguirre LLC's application on October 1, 2013, which opened a 30-

day comment period. After review of Aguirre LLC's permit application, public comments, and the final EIS, the COE will document its permit decision, including any required mitigation commitments, in a Record of Decision.

1.2.4 U.S. Coast Guard – Sector San Juan

The USCG is the federal agency within the U.S. Department of Homeland Security responsible for assessing the suitability of the Project Waterway (defined as the waterways that begin at the outer boundary of the navigable waters of the United States and extend to the FSRU) for LNG carrier traffic to and from the offshore berthing platform. The USCG exercises regulatory authority over LNG facilities that affect the safety and security of port areas and navigable waterways under Executive Order 10173; the MSA (50 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 (46 USC 701). The USCG is responsible for matters related to navigation safety, vessel 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. As appropriate, the USCG (acting under the authority in 33 USC 1221 et seq.) also will inform the FERC of design- and construction-related issues identified as part of safety and security assessments. If the Project is approved, constructed, and operated, the USCG would continue to exercise regulatory oversight of the safety and security of this facility, in compliance with 33 CFR 127. The USCG will coordinate with the COE to ensure that Private Aids to Navigation are installed and maintained by Aguirre LLC.

On May 2, 2014, the USCG Captain of the Port (COTP), Sector San Juan, issued a Letter of Recommendation (LOR) regarding the suitability of the Project Waterway for LNG carrier traffic to and from the proposed FSRU. The LOR determination was based on the LOR Analysis (see appendix B), which included a detailed review of the final Waterway Suitability Assessment (WSA) and outlined the USCG's assessment of potential navigation safety and maritime security risks and identified strategies for managing potential risks. The LOR recommended that the waterway surrounding Jobos Bay be considered suitable for accommodating the type and frequency of LNG marine traffic associated with this Project. The COTP made this determination following his review of the factors listed in 33 CFR 127.007 and 33 CFR 127.009.

As part of the LOR analysis, the USCG identified the need for a safety zone around the offshore terminal and the LNG carriers. The safety zone is intended to protect what is outside of the zone from what is inside the zone. As proposed by the USCG, it will establish a moving 100-yard (91-meter [m]) safety zone for all LNG carriers entering the surrounding areas of Jobos Bay while on approach and departure to the offshore terminal. The Aguirre Offshore GasPort will have a fixed 500-yard (457-m) safety zone at all times encompassing an area of about 303.3 acres (312.3 cuerdas). Once the LNG vessel is moored, the vessel will be part of the 500-yard (457-m) safety zone regulation. Vessels not related to the operation of the terminal would not be permitted to enter this area or within the water column or sea floor beneath the safety zone without proper authorization from the COTP Sector San Juan. All unauthorized vessels would be prohibited from anchoring or transiting the safety zone at any time.

If the FERC approves the LNG facility, Aguirre LLC subsequently would be required to submit plans or procedures for USCG approval and may submit alternative standards in accordance with 33 CFR 127.017. The USCG also would initiate rulemaking procedures to establish a safety zone around the offshore terminal and LNG carriers. Some of these actions and their impacts are described in this EIS. Others are considered Sensitive Security Information and are not releasable to the public (in accordance with 49 CFR 1520). These future actions would be subject to additional environmental review in accordance with the USCG's *National Environmental Policy Act Implementing Procedures and Policy for Considering Environmental Impacts*, as described in the USCG Commandant Instruction Manual.

1.2.5 Commonwealth of Puerto Rico Agencies

1.2.5.1 Puerto Rico Permits Management Office

The PMO was created under the Puerto Rico Permits Process Reform Act (Act No. 161; December 2009) and is responsible for issuing final determinations and permits, licenses, inspections, certifications, and any other government documents through interagency agreements required for the purposes of construction, land use, and conducting or operating businesses in Puerto Rico. The PMO participates in the environmental planning process by evaluating environmental documents, and through investigation and analysis of proposed activities and impacts. This includes obtaining comments and recommendations from other agencies with expertise, jurisdiction, and interest in a matter as well as from the community when necessary.

In regards to the proposed Project, the PMO will conduct a review of and hold public hearings regarding the EIS for the Project. After careful evaluation, the PMO will issue an Environmental Compliance Determination and a Final Resolution for the Project.

1.2.5.2 Puerto Rico Environmental Quality Board

The EQB was created under the Puerto Rico Environmental Public Policy Act (Act No. 416; September 2004) and is responsible for protecting environmental quality by exercising control over the air, water, and soil pollution, as well as noise pollution, and using all practical means and measures to create and maintain conditions under which man and nature are able to coexist in productive harmony and to meet the needs that may arise for the present and the future generations of Puerto Ricans.

In regards to the proposed Project, the EQB will provide its conclusions regarding potential impacts on air quality and water resources to the PMO to include in its determination and facilitate the issuance of the necessary permits.

1.2.5.3 Puerto Rico Planning Board

The PRPB was created under the Puerto Rico Planning Board Organic Act (Act No. 75; June 1975) and is responsible for guiding the development of Puerto Rico in a manner which, according to the present and future social needs and human environmental, physical, and economic resources, will best promote the health, safety, order, coexistence, prosperity, defense, culture, economic stability, and general welfare of the present and future inhabitants.

In regards to the proposed Project, the PRPB is the state agency responsible for the review and issuance of the Federal Consistency Certificate with the CZMP. The PRPB will provide its conclusions regarding federal consistency of the required federal permits with the CZMP enforceable policies. The PRPB will also provide the required analysis and recommendations about other potential land use impacts and facilitate the issuance of required state permits.

1.2.5.4 Puerto Rico Department of Natural and Environmental Resources

The DNER was created under the Organic Act of the Department of Natural and Environmental Resources (Act No. 23; June 1972) and is responsible for protecting, conserving, and managing Puerto Rico’s natural and environmental resources in a balanced way to guarantee their enjoyment by future generations and promote a better quality of life.

In regards to the proposed Project, the DNER will provide its conclusions regarding potential impacts on water resources, wildlife, and submerged lands to the PMO to include in its determination and facilitate the issuance of the necessary permits.

1.2.5.5 Puerto Rico Department of Health

The PRDH was created under the Health Department Law (Act. No. 81; March 2012). The PRDH is responsible for regulating and overseeing all matters provided by law related to public health, sanitation, and welfare, except those related to maritime quarantine services.

In regards to the proposed Project, the PRDH does not have a permit that would apply; the Sanitary License for the Aguirre Plant would be modified to include the added facilities.

1.3 PUBLIC REVIEW AND COMMENT

On December 21, 2011, Aguirre LLC filed a request with the FERC to implement the Commission's pre-filing process for the Project. At that time, Aguirre LLC was in the preliminary design stage of the Project and no formal application had been filed with the FERC. The purpose of the pre-filing process is to encourage the early involvement of interested stakeholders, facilitate interagency cooperation, and identify and resolve issues before an application is filed with the FERC. On January 1, 2012, the FERC granted Aguirre LLC's request and established a pre-filing docket number (PF12-4-000) to place information related to the Project into the public record.

Aguirre LLC held three informational open houses in February 2012, September 2012, and May 2013. The purpose of the open houses was to provide affected landowners, elected and agency officials, and the general public with information about the Project and to give them an opportunity to ask questions and express their concerns. We participated in the open houses and provided information regarding the Commission's environmental review process to interested stakeholders and to take comments about the Project and the alternatives. The substantive questions and concerns raised by the public at the open houses are addressed in the EIS.

On February 28, 2012, the Commission issued a *Notice of Intent to Prepare an Environmental Impact Statement for the Planned Aguirre Offshore GasPort Project, Request for Comments on Environmental Issues, and Notice of Public Scoping Meetings*. The notice was published in the Federal Register on March 5, 2012, and mailed to more than 130 interested parties, including federal, state, and local government representatives and agencies; elected officials; environmental and public interest groups; other interested parties; and local libraries and newspapers. The notice briefly described the Project and the EIS process, provided a preliminary list of environmental issues identified by us, invited written comments on the environmental issues that should be addressed in the draft EIS, listed the date and location of two public scoping meetings to be held in the Project area, and established a closing date for receipt of comments of March 30, 2012. In addition to comments received from the cooperating agencies, we received approximately 25 comment letters from various stakeholders, including the U.S. Fish and Wildlife Service (FWS); National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS); the U.S. National Park Service; the Governor of the Commonwealth of Puerto Rico; PREPA; the Puerto Rico Federal Affairs Administration; the Puerto Rico Pilotage Commission; the Government Development Bank of Puerto Rico; the Comité Diálogo Ambiental; the Center for Biological Diversity; and Captain Jimmy Vazquez-Aran.

We held two public scoping meetings to provide an opportunity for agencies, stakeholders, and the general public to learn more about the proposed Project and participate in the environmental analysis by commenting on the issues to be addressed in the draft EIS. The first meeting was in the Town of Guayama on March 20, 2012; the second meeting was in the Town of Salinas on March 21, 2012.

Approximately 30 people attended the meeting in Guayama and 45 people attended the meeting in Salinas. Each meeting was recorded, and the transcripts were placed into the public record for the Project. We received a total of 15 verbal comments from the public scoping meetings.

FERC coordinated several interagency scoping meetings in the Project area to solicit comments and concerns about the Project from other permitting and resource agencies. The date, location, and attendees for these meetings are summarized in table 1.3-1. We conducted a field visit with Aguirre LLC on February 2, 2012 to review the proposed locations of the onshore and offshore facilities. We also attended the USCG's public hearing for the Aguirre Offshore GasPort Safety Zone Regulation on June 20, 2014.

TABLE 1.3-1

Interagency Scoping Meetings for the Aguirre Offshore GasPort Project

Date	Agencies in Attendance	Location
March 19, 2012	USCG	USCG Office, San Juan
March 20, 2012	EPA; COE; USCG; FWS; EQB; PRPB; and Governor of Puerto Rico's Office	EPA Office, Guaynabo
May 10, 2012	EPA	EPA Office, New York, NY
September 20, 2012	FWS; NMFS	FWS Office, Boqueron
May 8, 2013	EQB	EQB Office, San Juan
May 9, 2013	FWS	FWS Office, Boqueron
May 10, 2013	PRPB	PRPB Office, Hato Rey
November 6, 2013	EPA; COE; USCG; FWS; NMFS, EQB; PRPB; PMO; DNER; PRDH; and State Historic Preservation Office	COE Office, San Juan
June 19, 2014	PMO	PMO Office, San Juan

The transcripts of the public scoping meetings, summaries of the interagency scoping meetings, and all written scoping comments are part of the public record for the Project and are available for viewing on the FERC internet website (http://www.ferc.gov)[3]. On September 5, 2012; February 18, 2013; April 15, 2013; and December 4, 2013, we issued Project Updates, which outlined the status of the environmental review process and included a summary of the issues identified through the scoping process.

Table 1.3-2 lists the environmental issues that were identified during scoping and indicates the section of the draft EIS where each issue is addressed. Additional issues we independently identified are also discussed in the draft EIS.

[3] Using the "eLibrary" link, select "General Search" from the eLibrary menu, enter the desired date range and Docket Number (i.e., CP13-193 or PF12-4), and follow the instructions.

TABLE 1.3-2

Issues and Concerns Identified During the Scoping Process for the Aguirre Offshore GasPort Project

Issue/Concern	EIS Section Addressing the Comment
Project need	1.1
Natural gas capacity on the FSRU	2.8
Alternative sites and alternative construction techniques	3.0
Water use and quality	4.3
Threatened and endangered species and habitat, including coral resources	4.6
Commercial and recreational fishing and boating	4.7 and 4.8
Marine navigation and traffic	4.7 and 4.11
Social and economic concerns	4.8
Air quality and emissions	4.10.1
Noise from construction and operation	4.10.2
Safety	4.11

This draft EIS has been filed with the EPA and mailed to federal, state, and local government agencies; elected officials; environmental and public interest groups; local libraries and newspapers; property owners affected by the proposed facilities; interveners in the FERC's proceeding; and other interested parties (i.e., individuals and groups who provided scoping comments or asked to remain on the mailing list). This draft EIS has been translated to Spanish to facilitate public review. The distribution list for the draft EIS is included in appendix A. A formal Notice of Availability indicating that the draft EIS is available for review and comment was published in the Federal Register. The public has 45 days after the date of publication in the Federal Register to review and comment on the draft EIS both in the form of written comments and at public meetings to be held in the Project area. The dates and locations of these public meetings are listed in the To the Party Addressed letter that is included in the front of this draft EIS and in the Notice of Availability. All comments received on the draft EIS related to environmental issues will be addressed in the final EIS.

1.4 NON-JURISDICTIONAL FACILITIES

FERC is required to consider, as part of a decision to authorize 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.

Two non-jurisdictional actions were identified in association with the proposed Project: new piping and associated facilities including the conversion of the steam power plant and the combined cycle power plant, all within the Aguirre Plant; and the FSRU at the proposed Offshore GasPort. These facilities are addressed below and are also addressed in our cumulative impacts analysis in section 4.12 of this EIS.

1.4.1 Aguirre Power Complex

The Aguirre Plant is PREPA's largest power facility with an installed generation capacity of approximately 1,492 MW. PREPA developed the Aguirre Plant from 1972 to 1977 to generate electricity using No. 2 oil and No. 6 oil with twelve fuel combustion sources located in three plant areas, including a combined cycle power plant, a steam power plant, and a simple cycle power block. In response to the new EPA MATS rule, and in response to the Puerto Rico Government's policy to promote the use of natural gas to lower energy cost and reduce Puerto Rico's carbon footprint, PREPA is planning to provide the capability to burn natural gas in both the two-unit, 900-MW steam power plant (AG 1 and 2) and the two-unit, 600-MW combined cycle power plant (CC 1 and 2) at the Aguirre Plant. The two-unit steam plant consists of two boilers and two steam generators, and the two-unit combined cycle power plant consists of eight combustion turbines and two steam generators. The schedule for the modifications to the steam power plant would coincide with the completion of the proposed Project.

PREPA would construct piping and associated facilities within the Aguirre Plant property, beyond the flange at the end of Aguirre LLC's subsea pipeline and as required to complete the connection to the combined cycle plant and the thermoelectric plant power station. These facilities would include a metering station, pressure reduction equipment, process gas heat exchangers, and interconnecting pipework. The onshore pipeline would have a diameter between 12 to 20 inches (30 to 51 centimeters [cm]) and would extend approximately 3,000 feet (914 m) to reach Units 1 and 2 from the subsea pipeline.

All of the activities associated with conversion of the Aguirre Plant would occur within the fence line of the power plant. Access to the power plant would be via state road PR-7710, which is accessed from state road PR-3. There would be little to no associated impact on vegetation within the fence line as the affected area has been subject to heavy industrial activities for nearly 40 years. The area of disturbance would be about 40 feet (12 m) wide for each pipeline that would connect to the steam power plant and the combined cycle power plant.

Construction would not affect any waterbodies; the nearest waterbody is the Caribbean Sea at a distance of 525 feet (160 m). National Wetlands Inventory (NWI) mapping identifies portions of the plant as wetland, it has been previously filled and developed for industrial use. About 300 gallons (1,140 liters [L]) per day of water would be used for the consumption of the workers during construction, and PREPA would use about 20,000 gallons (75,700 L) of water for hydrostatic testing of the subsea pipeline to be discharged through the power plant's water treatment plant. All of this water would be supplied by the power plant's internal distribution system. In addition, the construction workers would generate about 200 gallons (7,570 L) of used water per day by use of the sanitary services available at the power plant and connected to the Puerto Rico Aqueduct and Sewer Authority. No potable water wells are within a radius of 1,510 feet (460 m) to the conversion activities, and the area is not located in a classified flood prone zone.

The conversion activities would generate about 3 tons (910 kilograms [kg]) of recyclable material (e.g., scrap metal) and about 3 yd^3 (2.3 m^3) of common waste (e.g., cardboard, wood, cable, etc.). The common waste would be stored in the power plant's waste bins and would be disposed of with the power plant's common waste. Similarly, the recyclable material would be stored in the recycling container for metals and would be eventually sold to an authorized facility.

According to the proposed Territorial Zoning Plan for the Municipality of Salina, the conversion project qualifies as 100 percent rustic land specially protected; however, the conversion activities would not have an impact on the power plant's surroundings. In addition, there are no known cultural resources within the construction area, demonstrated in a Phase 1A and 1B August 2012 study conducted for a previous project in the power plant. However, if any archeological or cultural resources are found during construction, PREPA would stop work and immediately notify the Institute of Puerto Rican Culture.

The nearest tranquility zone (as defined by PREPA) is about 1,390 feet (425 m) to the Project while the nearest home is about 295 feet (90 m) away. PREPA estimates that conversion of the plant would not cause noise to increase above the current noise levels. The noise level during operation of the subsea pipeline is estimated to be 51 decibels (dB) on the A-weighted scale (dBA) or less at the closest community noise-sensitive area (NSA) in relation to the pipeline lateral. To reduce the operational noise level of the pipeline, PREPA will use the Emerson Fisher Whisper Trim and the Downstream Whisper Disk as necessary to ensure a quieted design. These noise attenuation devices are anticipated to reduce the noise generated by turbulent gas flow noise and associated vibration across control valves and pressure gauges. No noise control measures would be employed during construction; however, the EQB governs construction noise and procedures for obtaining a special variance during times when exceedances of the limits are identified. PREPA's construction contractor would adhere to all requirements of the ordinance and obtain special variances, if necessary.

The operational air emissions at the Aguirre Plant would be reduced as a result of the conversion from oil to natural gas as the combustion source. Further details regarding the cumulative air quality impacts of the Aguirre Plant and the proposed Project are discussed in section 4.12, Cumulative Impacts.

PREPA submitted the necessary permits for the fuel conversion to the EQB in July and August 2013 and plans to complete the equipment modifications by third quarter of 2015. Aguirre LLC assisted PREPA in preparation of a Non-Jurisdictional Facility Environmental Report for the conversion activities. [4]

1.4.2 Floating Storage and Regasification Unit

Aguirre LLC would utilize one of Excelerate Energy's existing Energy Bridge Regasification Vessels (EBRV) as the FSRU for the Project. EBRVs are purpose-built LNG tankers capable of ocean travel that incorporate onboard equipment for the vaporization of LNG and delivery of high-pressure natural gas. EBRVs utilize a steam-generating plant in the vessel for propulsion and overall vessel operations. These vessels were developed jointly by Excelerate Energy, Exmar NV, and Daewoo Shipbuilding & Marine Engineering Co., Ltd. Excelerate Energy currently has eight EBRVs in its fleet, all of which are classified under survey of Bureau Veritas classification society, and a ninth is under construction for a project in South America. Construction of a new FSRU for this Project would not be required. The EBRV placed into service for the proposed Project would have a storage capacity of up to 197,400 yd^3 (150,900 m^3) of LNG, an overall length of 955 feet (291 m), and a design draft of 38 feet (11.6 m).

The FSRU would be moored to the north side of the offshore berthing platform to perform regasification operations. Periodic maintenance of the FSRU must be performed, however, in order to keep vessel class certificates and ensure commercial reliability. Additionally, scheduled dry-docking would be performed as per class requirements, which is typically done once every 5 years. A normal dry-dock period is about 21 days, excluding transit time to and from the respective dry-dock port. Excelerate Energy would use reasonable efforts to provide a similar FSRU during dry-dock periods.

The FSRU for the Project would be subject to and would comply with USCG Subchapter O Endorsement and Port State Inspections for a foreign flag vessel operating in U.S. waters. The vessels delivering LNG to the Offshore GasPort would be conventional LNG carriers that could include vessels owned and operated by Excelerate Energy or by other third-party LNG carrier owners/operators. These LNG carriers would also comply with applicable Class, USCG, and Port State requirements.

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[4] Provided as part of the public record for Docket No. CP13-193-000 on the FERC website at http://ferc.gov/docs-filing/elibrary.asp; Accession No. 20140220-5214.

1.5 PERMITS, APPROVALS, CONSULTATIONS, AND REGULATORY REQUIREMENTS

As a federal agency, the FERC is required to comply with a number of regulatory statutes including, but not limited to NEPA, Section 7 of the ESA, the CAA, CWA, the RHA, Section 106 of the NHPA, and Section 307 of the CZMA. 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 provides the dates or anticipated dates when Aguirre LLC commenced or anticipates commencing formal permit and consultation procedures. Aguirre LLC would be responsible for obtaining all permits and approvals required to implement the Project regardless of whether they appear in this table.

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)). The 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 NMFS, if necessary. If, upon review of existing data or data provided by Aguirre LLC, the FERC determines that these species or habitats may be affected by the Project, the FERC is required to prepare a Biological Assessment (BA) to identify the nature and extent of adverse impact, and to recommend measures that would avoid the habitat and/or species, or would reduce potential impact to acceptable levels. Section 4.6 provides information on the status of this review.

Section 106 of the NHPA requires that the FERC take into account the effects of its undertakings on properties listed, or eligible for listing, in the National Register of Historic Places (NRHP), including prehistoric or historic sites, districts, buildings, structures, objects, or properties of traditional religious or cultural importance, and to afford the Advisory Council on Historic Preservation (ACHP) an opportunity to comment on the undertaking. Aguirre LLC, as a non-federal party, is assisting the FERC in meeting its obligations under Section 106 by preparing the necessary information, analyses, and recommendations under ACHP regulations in 36 CFR 800. Section 4.9 of this EIS provides information on the status of this review.

Aguirre LLC 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. Water used for hydrostatic testing that is point-source discharged into waterbodies would require an NPDES permit (Section 402) issued by the EPA.

The Energy Policy Act of 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 any military installations. The U.S. Department of Defense in a letter on July 21, 2014 indicated that there would likely be no impacts from the proposed action.

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 Puerto Rico, the PRPB administers the CZMP and would conduct a consistency determination concurrent with Aguirre LLC's filing of an application for a conditional use permit. The CZMP is discussed further in section 4.7.3.

TABLE 1.5-1

Major Permits, Approvals, and Consultations for the Aguirre Offshore GasPort Project

Agency	Permit/Approval/Consultation	Status
Federal		
COE	Section 10 RHA Permit [a]	Filed application July 2013; anticipate receipt December 2014
	Permission to establish Private Aids to Navigation (placement authority)	Would obtain prior to construction
EPA	Spill Prevention, Control and Countermeasure Plan	Would obtain prior to construction
	NPDES	Permit application submitted July 2013; EPA completeness determination August 2013; anticipate receipt prior to construction
	PSD and Nonattainment New Source Review air permits	Filed PSD Non-Applicability Analysis September 2013; EPA provided comments November 2013
USCG, Sector San Juan	LOR and WSA and Report	WSA submitted April 2013; responses to USCG comments filed July 2013; LOR received May 2014
	Permission to establish Aids to Navigation (marking authority)	Would obtain prior to construction
FWS	Consultation regarding Threatened and Endangered Species and Incidental Take Permit (if required)	Initiated March 2012; revised draft BA filed February 2014; anticipate complete 4th quarter 2014
	Consultation regarding West Indian Manatee	Initiated March 2012; revised draft BA filed February 2014; anticipate complete 4th quarter 2014
NMFS	Consultation regarding Threatened and Endangered Species and Incidental Take Permit (if required)	Initiated March 2012; revised draft BA filed February 2014; anticipate complete 4th quarter 2014
	Consultation regarding EFH	Initiated March 2012; EFH analysis filed April 2013; anticipate complete 4th quarter 2014
	Consultation regarding marine mammals (except West Indian Manatee)	Initiated March 2012; a revised draft BA filed February 2014; anticipate complete 4th quarter 2014
ACHP	Provide opportunity to comment under Section 106 of the NHPA	No submittal anticipated; ACHP may comment on FERC proceeding
U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration	Application for Special Permit – Waiver of Certain Cover and Burial Requirements	Anticipate receipt November 2014
U.S. Department of Defense	Consultation regarding impacts on military operations	Initiated by FERC April 2012; July 21, 2014 letter received indicating no impacts.
Commonwealth		
DNER	Federal and Commonwealth Joint Permit Application for Water Resource Alterations In Waters, Including Wetlands, and submerged lands under state coastal waters, of Puerto Rico [a]	Filed application July 2013; responses to comments filed August 2013; anticipate receipt December 2014
PRPB	Puerto Rico Coastal Zone Management Consistency Certificate [a]	Filed application July 2013; responses to comments filed January 2014; anticipate receipt December 2014
	Transaction Consultation and Location Pre-Consultation	Transaction Consultation accepted March 2014; Location Consultation initiated May 2014; anticipate receipt 4th quarter 2014
EQB	Section 401 Water Quality Certification [a]	Filed May 2014; anticipate receipt December 2014
	Emission Source Construction Permit according to Rule 203 of the Regulations for the Control of Atmospheric Pollution (RCAP)	Filed application August 2013; anticipate receipt October 2014.

TABLE 1.5-1 (cont'd)

Major Permits, Approvals, and Consultations for the Aguirre Offshore GasPort Project

Agency	Permit/Approval/Consultation	Status
	Title V permit shield approval by application of renewal of final Title V operating permit of PREPA Aguirre or revision to initial Title V operating permit application to include Offshore GasPort Project	Anticipated filing after issuance of Emission Source Construction Permit and Location Approval
	New final Title V emission source operating permit	Anticipated filing in 4th Quarter 2014
State Historic Preservation Office	Consultation regarding cultural resources issues according to Section 106 of the NHPA	SHPO concurrence received July 2013
Puerto Rico Institute of Culture	Consult and issue recommendation for construction to the Puerto Rico Permit and Endorsement Management Office	Initiated October 2013; anticipate complete December 2014
PMO	Environmental document according to Puerto Rico Environmental Public Policy Act	Anticipated filing in June 2014
	Construction Permit	Anticipated filing in January 2015; anticipate receipt in March 2015
	General Consolidated Permit • Erosion and Sediment Control • Dust and Fugitive Emissions • Solid Waste Generation and disposal (Recycling Plan)	Anticipated filing in January 2015; anticipate receipt in March 2015
	Use Permit • Health Department Endorsement • Fire Department Endorsement	Anticipated filing in January 2015; anticipate receipt in March 2015
Puerto Rico Ports Authority	Concession for use of territorial waters and submerged lands	Filed March 2014; anticipate receipt 3rd quarter 2014

[a] Joint permit application with the COE, DNER, EQB, and PRPB.

The CAA was enacted by 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. Air quality impacts that could occur as a result of construction and operation of the Project are evaluated in section 4.10.1 of this EIS.

Aguirre LLC is responsible for all permits and approvals required to implement the Aguirre Offshore GasPort 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. Although the FERC encourages cooperation between applicants and state and local authorities, this does not mean that state and local agencies, through application of state and local laws, may prohibit or unreasonably delay the construction or operation of facilities approved by the FERC.

2.0 DESCRIPTION OF PROPOSED ACTION

2.1 DETAILED DESCRIPTION OF PROPOSED PROJECT

The Project would involve the construction and operation of an offshore LNG terminal and subsea pipeline linking the receiving facility to PREPA's existing onshore Aguirre Plant. The Project would consist of an offshore berthing platform, an Offshore GasPort, and a 4.1-mile-long (6.6 km) subsea pipeline. A nonjurisdictional FSRU would be moored at the offshore berthing platform. The LNG terminal would be located approximately 3 miles (5 km) off the southern coast of Puerto Rico, about 1 mile (1.6 km) outside of Jobos Bay, near the towns of Salinas and Guayama. Aguirre LLC is also proposing to utilize a construction office, contractor staging area, and existing pier within the Aguirre Plant property. Figure 2.1-1 shows an overview map of the Project location and facilities.

2.1.1 Offshore Berthing Platform

The offshore berthing platform would be a fixed platform carrying topside facilities and two berths, one on each side of the fixed platform. The platform would be designed for long-term mooring of an FSRU and for receipt of LNG carriers ranging in size from 163,500 to 283,800 yd^3 (125,000 to 217,000 m^3). The FSRU would be moored at a berth on the north (landward) side of the platform, and the LNG carriers would temporarily dock on the south (seaward) side of the platform while unloading LNG cargo. LNG cargo would be transferred from the LNG carrier via topside conventional LNG loading arms and cryogenic piping to the FSRU for storage. Figures 2.1.1-1 and 2.1.1-2 show a model diagram and schematic drawing of the facilities, respectively.

Specific components of the proposed offshore berthing platform include:

- two LNG vessel berths on opposing sides;
- berthing fenders and mooring and breasting dolphins at each berth;
- at each berth, LNG loading arms, LNG drain tanks, and LNG piping between the LNG loading arms to facilitate transfer of LNG between vessels;
- high-pressure gas loading arms at one berth to connect to the FSRU and facilitate natural gas discharge to the send-out pipeline;
- utility platforms providing docking facilities for lifeboats and service vessels, control and switch gear rooms, utility equipment, personnel access/egress, and laydown and work areas; and
- utility systems, including process support systems, electrical systems, safety systems, gas- and diesel-fueled electricity generators, nitrogen generators, electric seawater pumps, diesel fire pumps, diesel storage tanks, lubrication oil storage tanks, potable water and waste water tanks, sewage treatment unit, and fire water monitors.

2.1.2 Floating Storage and Regasification Unit

Aguirre LLC would utilize one of Excelerate Energy's existing EBRVs as the FSRU. EBRVs are purpose-built LNG tankers that incorporate onboard equipment for the vaporization of LNG and delivery of high-pressure natural gas.

Figure 2.1-1
Project Location Map
Aguirre Offshore GasPort Project

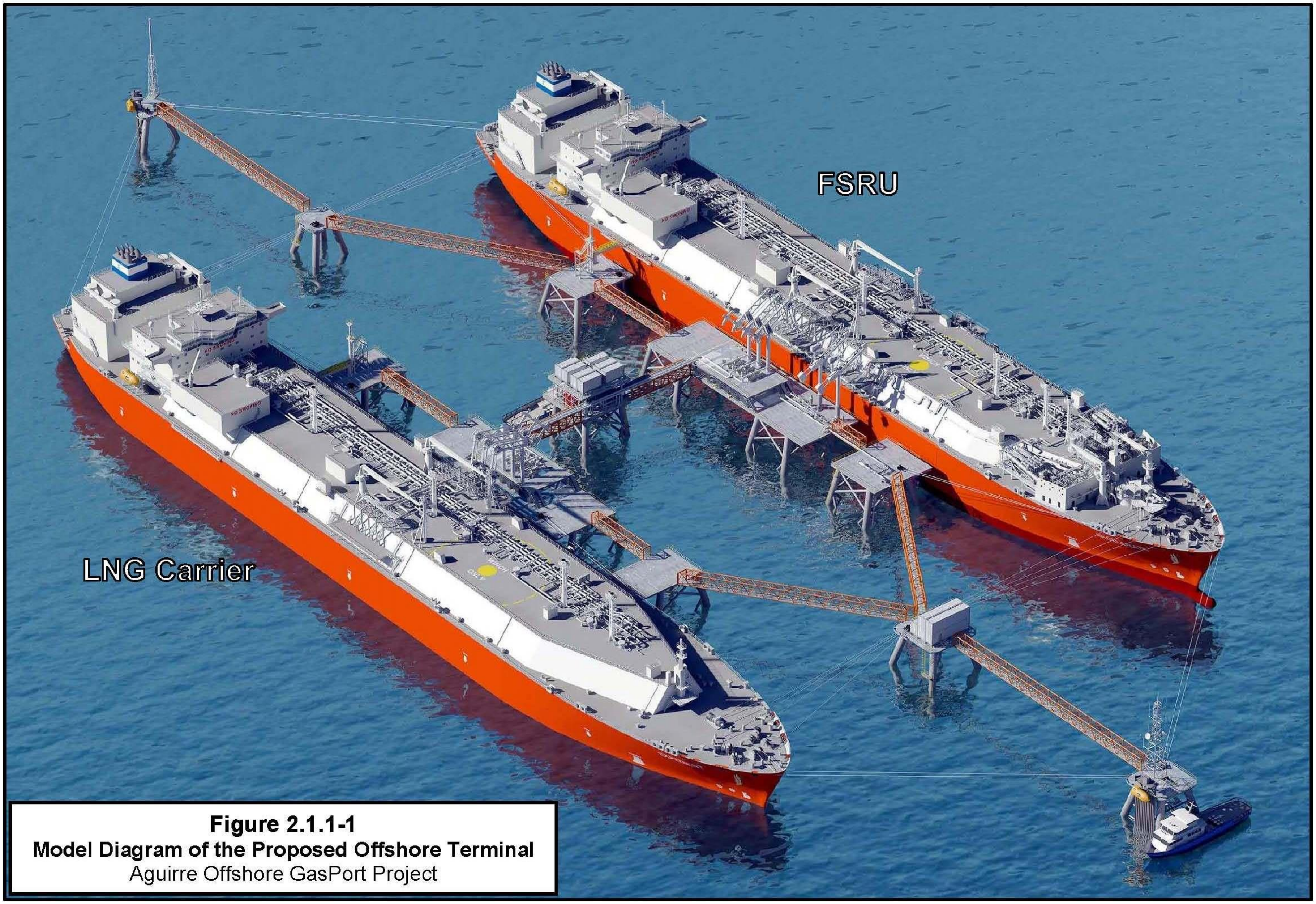


Figure 2.1.1-1
Model Diagram of the Proposed Offshore Terminal
Aguirre Offshore GasPort Project

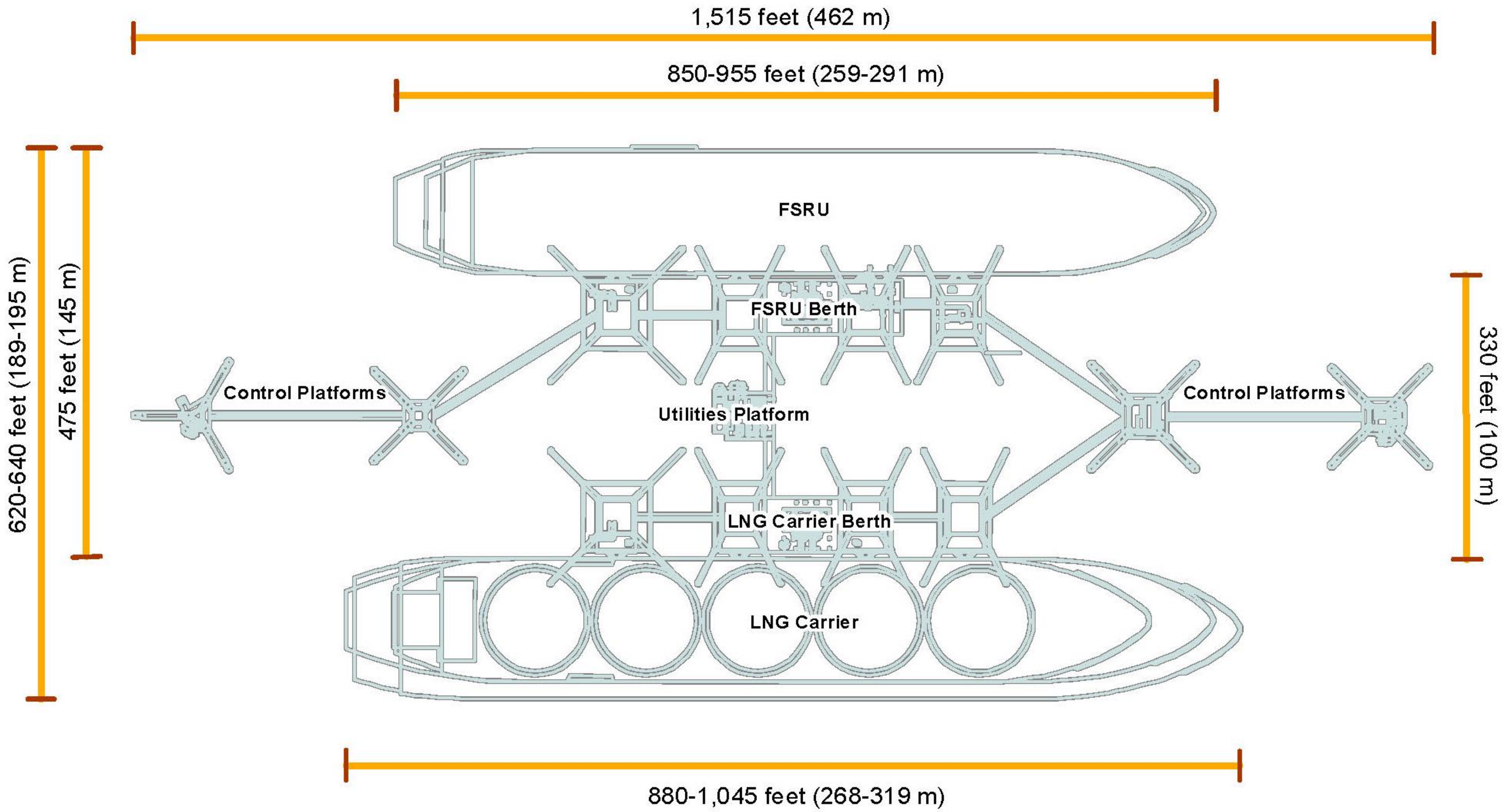


Figure 2.1.1-2
Schematic Drawing of the Proposed Offshore Terminal
Aguirre Offshore GasPort Project

Excelerate Energy currently has eight EBRVs in its fleet and a ninth is under construction. The EBRV that would be utilized for the Project, referred to as the FSRU throughout the remainder of the document, would have an overall length of approximately 955 feet (291 m) and a design draft of 38 feet (11.6 m). The FSRU would provide 197,400 yd^3 (150,900 m^3) of LNG storage capacity and would be capable of discharging regasified LNG at a contractually guaranteed sustained rate of up to 500 MMscf/d, with peaking rates of up to 600 MMscf/d. However, based on the information provided by Aguirre LLC, the Aguirre Plant would only be able to utilize 225 MMscf/d. The additional capacity on the FSRU is discussed further in section 2.8. The LNG regasification process is discussed in section 2.6.3.

The FSRU would employ a Membrane Cargo Containment System composed of reinforced tanks with a membrane of high nickel alloy stainless steel and an insulation system that allows greater resistance to LNG movement during adverse sea conditions if the FSRU needs to depart the offshore berthing platform.

2.1.3 Subsea Interconnecting Pipeline

The subsea interconnecting pipeline would extend approximately 4.1 miles (6.6 km) from the offshore berthing platform in the Caribbean Sea, northward through the Boca del Infierno inlet, and across the basin of Jobos Bay to the Aguirre Plant property where it would interconnect with existing Aguirre Plant piping (see figure 2.1-1). The subsea interconnecting pipeline would consist of an 18-inch-diameter (46 cm) steel pipe with a maximum allowable operating pressure of 1,450 pounds per square inch (psi) (9,997 kilopascals [kPa]). Prior to shipment of the pipe to the Project site, the manufacturer would coat the pipe with concrete for an outside diameter of approximately 24 inches (61 cm). About 1.5 acres (1.5 cuerdas) of previously disturbed area at the Aguirre Plant would be used to stage and construct the proposed subsea pipeline.

2.2 LAND REQUIREMENTS

The land requirements for the Project are summarized in table 2.2-1 and illustrated on figure 2.2-1. As discussed above, the majority of the Project facilities would be located offshore, including the offshore berthing platform and subsea pipeline. The construction of these facilities would require approximately 156.7 acres (161.4 cuerdas) at the water surface and would directly impact 116.9 acres (120.4 cuerdas) of the seafloor. Operation of the offshore facilities would permanently impact approximately 25.3 acres (26.1 cuerdas) of seafloor. In addition, 1.5 acres (1.5 cuerdas) of land within the existing Aguirre Plant property would be required for a temporary staging and support area where the subsea pipeline would reach landfall (see figure 2.2-2).

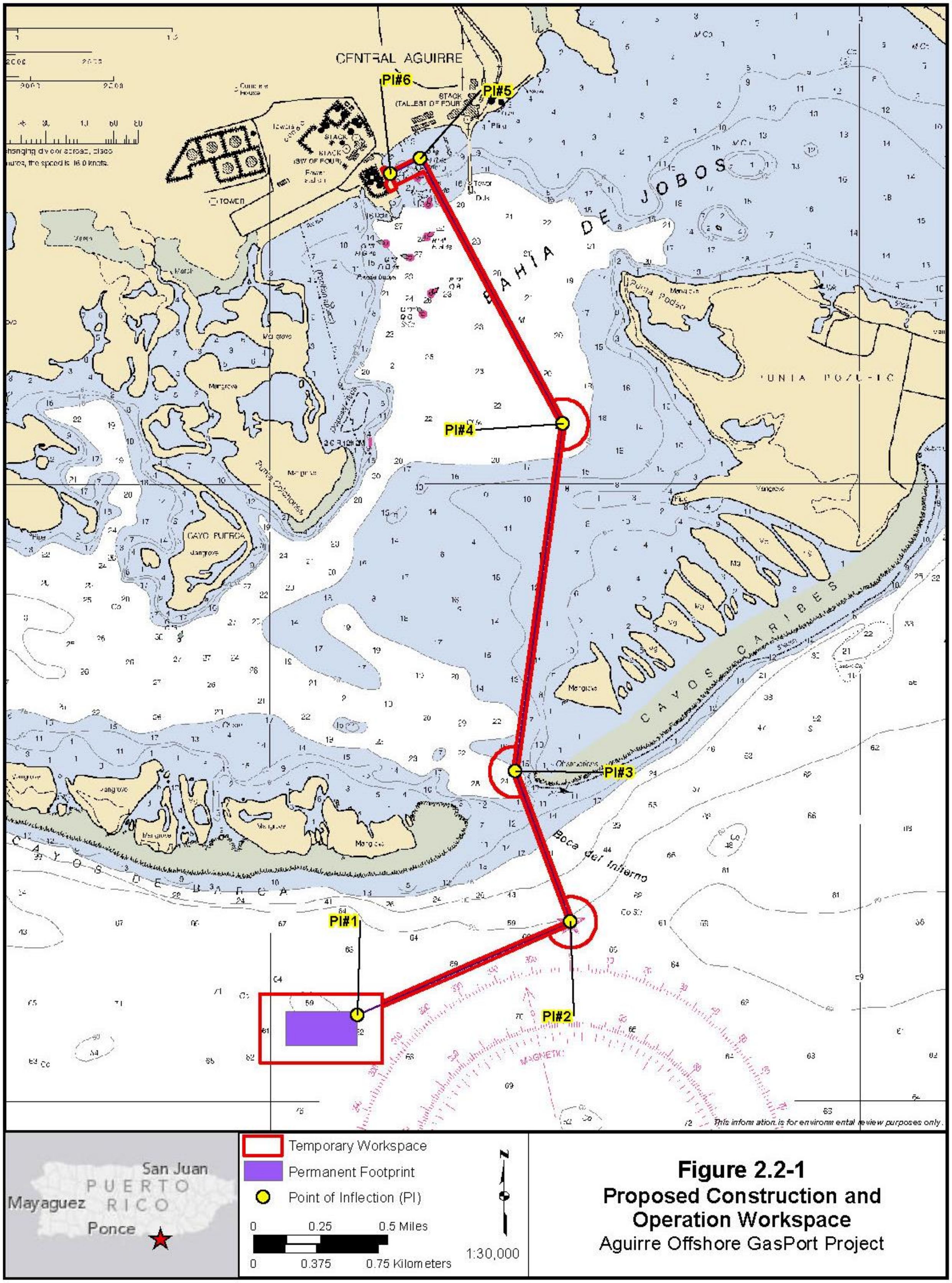


Figure 2.2-1
Proposed Construction and Operation Workspace
Aguirre Offshore GasPort Project

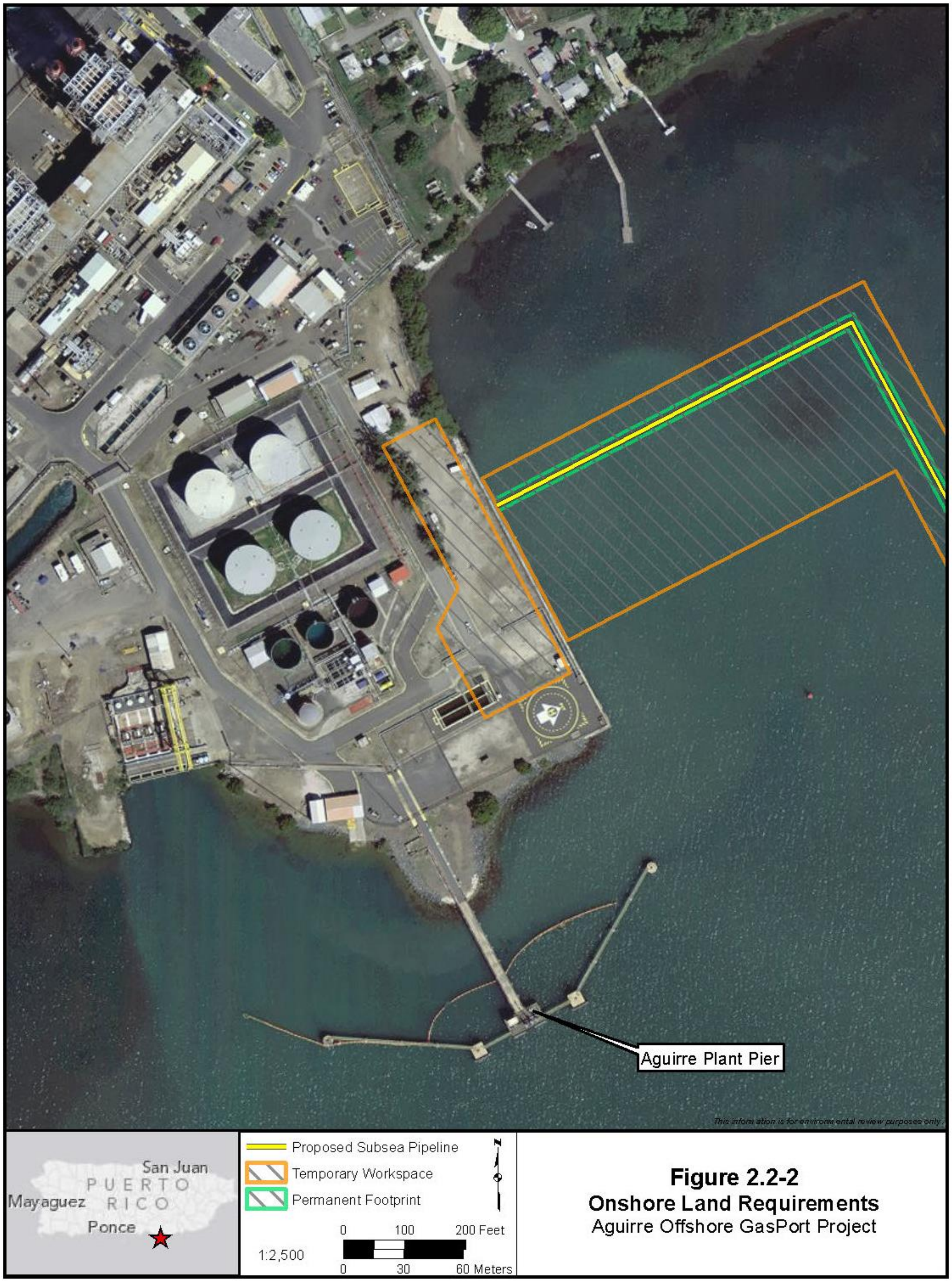


Figure 2.2-2
Onshore Land Requirements
Aguirre Offshore GasPort Project

TABLE 2.2-1

Summary of Proposed Construction and Operation Impacts Associated with the Aguirre Offshore GasPort Project

Project Component	Temporary Impacts During Construction (acres [cuerdas]) Water Surface	Temporary Impacts During Construction (acres [cuerdas]) Seafloor [a]/Upland	Permanent Impacts During Operation (acres [cuerdas])
Offshore Berthing Platform	75.5 (77.7)	75.5 (77.7)	22.3 (23.0)
Subsea Interconnecting Pipeline	49.7 (51.2)	9.9 (10.2)	3.0 (3.1)
Lay Barge Construction Areas	31.5 (32.4)	31.5 (32.4)	0.0
Temporary Staging and Support Area [b]	0.0	1.5 (1.5)	0.0
USCG Safety Zone	0.0	0.0	303.3 (312.3)
TOTAL	**156.7 (161.4)**	**118.4 (121.9)**	**328.6 (338.4)**

[a] Includes direct impacts on the seafloor from mechanical activities (e.g., pile and pipeline installation) and associated sedimentation. The proposed construction methods for the subsea interconnecting pipeline do not include use of mooring anchors or cables; therefore, no temporary workspace would be required for the sweep of mooring anchor chains or cables. Estimates of the offshore berthing platform construction includes mooring and anchor chain acreages.

[b] Located within the existing Aguirre Plant property.

2.3 CONSTRUCTION PROCEDURES

2.3.1 Construction and Support Vessels

The construction of the Project facilities would require the use of a variety of marine vessels, including:

- crane barges used during the fabrication of the offshore terminal and the lowering of some pipeline segments;
- a shallow water lay barge, secured to the bottom with temporary piles, used for the pipeline fabrication (e.g., welding and inspection);
- a dive support vessel, typically a spud barge, used for activities such as tie-ins, hydrotesting, and other dive-related functions;
- vessel support tugs used to spot the lay barge, other floating equipment, and to float pipeline segments into place;
- crew/supply boats used to shuttle personnel and supplies from the landside pier to the lay barge and dive support vessels; and
- pipe transport barges, shuttled by tugs, used to transport pipe segments from the pipe yard and the lay barge.

2.3.2 Offshore Berthing Platform

The offshore berthing platform would consist of tubular steel structures (jackets), pile structures, steel decks, and topside equipment. Aguirre LLC would pursue the use of prefabricated modular designs, made up of precast elements fabricated prior to delivery rather than on site. Use of precast elements would reduce the time and labor required on site, thereby reducing the potential safety and environmental impacts associated with working in a marine environment.

Aguirre LLC would place 13 structures into the seafloor, 9 structural jackets for the utilities platform and berthing dolphins, and 4 tri/quad pile structures for the smaller mooring dolphins. Aguirre LLC would use a barge-mounted crane to lift these structures from transport barges and then lower them into the water. Each structural jacket would be placed on mud mats on the seafloor prior to installation. A vibratory pile driver or diesel pile hammers would be used to drive the main piles through hollow jacket sleeves into the seafloor. The tri/quad piles would also be installed using vibratory or diesel pile hammers.

Aguirre LLC would install the deck sections, module support frames, and module packages following the installation of the structural jackets and tri/quad piles. The modules would then be connected to the jackets or pile structures as designed.

Aguirre LLC would transport the topside equipment to the platform on prefabricated skid packages and use a barge crane to lift the equipment into place and secure them to the pier. All necessary connections would then be completed and the equipment would be tested.

2.3.3 Floating Storage and Regasification Unit

As discussed above, Aguirre LLC would utilize one of Excelerate Energy's existing EBRVs as the FSRU; therefore, construction of a new FSRU would not be required for the Project.

2.3.4 Subsea Interconnecting Pipeline

The pipeline segments would be fabricated on shallow water pipe lay barges that would be secured to the bottom with temporary piles and would not use dynamic positioning or anchors. Figure 2.3.4-1 illustrates the typical layout for the subsea pipeline lay technique. The subsea pipeline would be installed in five segments that are defined by points of inflection (PI) along the pipeline (see figure 2.2-1). The segments include:

- Segment 1 – PI 1 (offshore platform) to PI 2, mileposts (MP) 0.0 to 1.0;
- Segment 2 – PI 2 to PI 3, MPs 1.0 to 1.6;
- Segment 3 – PI 3 to PI 4, MPs 1.6 to 3.0;
- Segment 4 – PI 4 to PI 5, MPs 3.0 to 4.0; and
- Segment 5 – PI 5 to PI 6 (shore approach and tie-in), MPs 4.0 to 4.1.

Segment 1 would be fabricated on a lay barge located west of PI 1, pulled into position on temporary floats using cables connected to temporary piles at PI 1 and PI 2, then flooded to lower the pipeline to the seafloor. The pipeline would be connected to the topside facilities on the offshore berthing platform through a vertical section (riser) that would be installed on a support structure.

Segment 2 would be fabricated on a lay barge located north of PI 4, pulled towards PI 3 until the entire segment is fabricated, then towed into position on temporary floats using tug boats. The segment would then be attached to temporary piles at PI 2 and PI 3 and flooded to lower the pipeline to the seafloor.

Segments 3 and 4 would be fabricated on a lay barge near PI 4 then installed using a push-pull construction technique. The pipeline would be laid on the seafloor and pushed/pulled into the correct position using a series of cables that would run between winches mounted on the lay barge and pulleys anchored on the temporary piles.

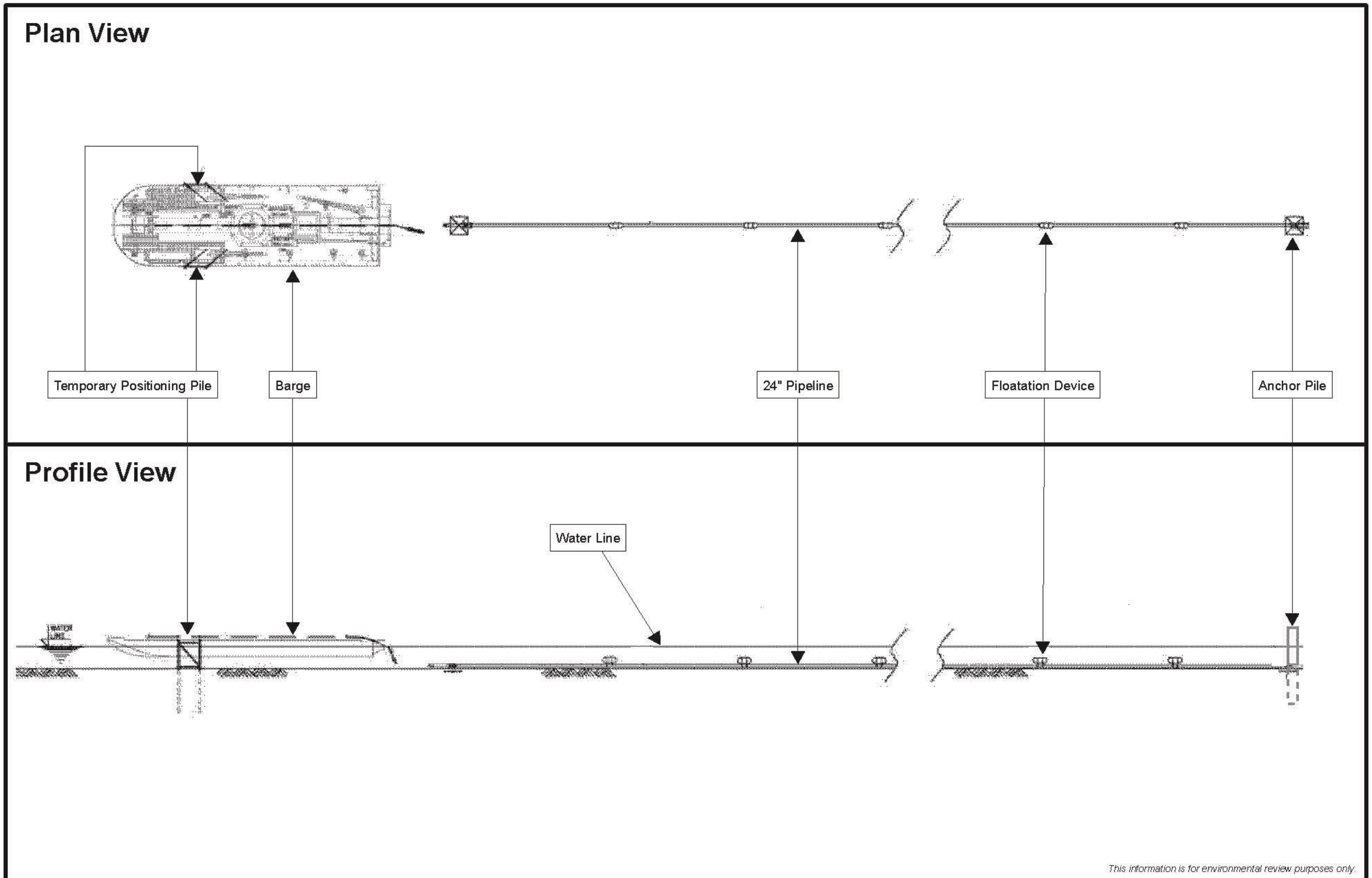


Figure 2.3.4-1
Subsea Pipeline Lay
Aguirre Offshore GasPort Project

Segment 5 would be fabricated on a crane barge located south of the pipeline landfall (PI 6) and lowered directly into place using a crane. The shore approach would include a riser that would be attached to the bulkhead wall and an aboveground horizontal section on the landward side fixed to a concrete support.

After all pipeline segments are in position they would be connected to the adjacent segments. As proposed, Aguirre LLC would use augers placed into the seafloor to anchor each end of Segment 2, which would cross the Boca del Infierno pass. However, in section 4.5.2.4 we are recommending that Aguirre LLC consider the potential use of a water-to-water horizontal directional drill (HDD) in Segment 2 to avoid direct impacts on coral reef habitat.

Prior to the final tie-in with the Offshore GasPort and Aguirre Plant, the entire pipeline would be hydrostatically tested in accordance with 49 CFR 192 and applicable permit conditions, to ensure that the system is free from leaks and provides the required margin of safety at operating pressures.

The hydrostatic testing would involve filling the pipeline with seawater using portable, high-volume pumps located on the offshore lay barge. The intake rate would be dependent upon the speed of the pipe pig[1] used in the test, which would range between 1.5 to 3 feet (0.5 to 1 m) per second. The water intake would be fitted with a 100-micron screen to prevent intake of organisms. About 240,000 gallons (908,500 L) of water would be required to fill the pipeline and complete one full hydrostatic test. During the test, the water within the pipeline would be pressurized and monitored for consistent pressure over an 8-hour period. Aguirre LLC does not anticipate the need for more than one full test, although some water replenishment may be required if isolated connections or flanges need depressurizing and retightening.

Aguirre LLC would follow the FERC staff's *Upland Erosion Control, Revegetation, and Maintenance Plan* (Plan) and *Wetland and Waterbody Construction and Mitigation Procedures* (Procedures) for construction of the small portion of onshore pipeline (see appendix C).

2.3.5 Restoration

The temporary piles and other support equipment would be removed from the Project area following construction. Because the subsea pipeline would be laid directly on the seafloor, the majority of the impacts on the seafloor would be permanent. Aguirre LLC would implement measures, developed in consultation with appropriate agency staff, to restore areas temporarily disturbed by construction activities. Potential impacts on sensitive resources and Aguirre LLC's proposed mitigation measures are discussed in section 4.0.

2.4 CONSTRUCTION SCHEDULE AND WORKFORCE

Aguirre LLC anticipates that construction of the Project facilities would take approximately 12 months and would begin when all the necessary permits and regulatory approvals have been received. The estimated duration of the major construction activities is summarized in table 2.4-1. Aguirre stated that the final selection of the specific FSRU from the Excelerate Energy fleet would be made after issuance of the FERC authorization.

[1] A pipeline "pig" is a devise used to clean or inspect the pipeline.

TABLE 2.4-1

Construction Schedule for the Aguirre Offshore GasPort Project

Project Component	Duration [a]
Offshore Berthing Platform	
Marine Infrastructure [b]	9 months
Topside Facilities	8 months
Subsea Pipeline [c]	4 months

[a] Durations would be overlapping; total duration of the Project is estimated to be 12 months.
[b] Includes support infrastructure and platform decking.
[c] Includes 14 to 21 days for each of the pipeline segments.

Aguirre LLC anticipates that approximately 350 workers would be required over the 12-month construction period, at least 10 percent of which would be hired locally (see section 4.8.3.2).

2.5 ENVIRONMENTAL COMPLIANCE, INSPECTION, AND MONITORING

Aguirre LLC would conduct all Project activities in accordance with applicable federal, commonwealth, and local regulations, permits, and approvals. Aguirre LLC would employ an Environmental Inspector (EI) to ensure that the measures contained in the FERC Plan and Procedures, Aguirre LLC's Project-specific plans, and any other environmental permit conditions or agreements are followed during construction and restoration activities. The EI would have authority to stop construction activities that violate the measures set forth in the Project documents and authorizations, as well as authority to order corrective actions.

Aguirre LLC would develop and implement an environmental training program tailored to the Project and its requirements. The program would be designed to ensure that:

- qualified environmental staff would provide focused training sessions to all personnel before they begin work;
- adequate training records would be maintained; and
- refresher training would be provided as needed to maintain high awareness of environmental requirements.

All personnel would receive a special marine mammals observation and awareness training prior to conducting any on-water activities. In addition, NOAA-certified marine mammal observers would be present on all construction vessels for the duration of the construction activities.

2.6 OPERATION AND MAINTENANCE PROCEDURES

Operation of the Project would involve receiving LNG at the offshore berthing platform from LNG carriers, transferring the LNG to the FSRU for temporary storage, and regasification of the LNG for delivery as natural gas through the subsea pipeline to the existing Aguirre Plant. Operation of the Project facilities would be supported by a land-based office and an existing pier at the Aguirre Plant (see figure 2.2-2).

A port service vessel (PSV) would transport personnel to the offshore platform. The PSVs would also assist with routine operations and the delivery of supplies. The PSVs would range in length from 110 to 125 feet (34 to 38 m) with a deck load of about 30 tons (27,200 kg) and a passenger load of approximately 30 to 40 personnel. In addition to the PSV, personnel may be transported via smaller vessels (25 to 30 feet [8 to 9 m] in length). PSV and other watercraft would provide transportation on a daily basis during routine operations.

Nitrogen would be required at the offshore berthing platform to purge the facility in preparation for maintenance or startup after a lengthy shutdown. A nitrogen generator sufficient to sustain normal offshore operations would be included on the platform. Gas/diesel-fueled generators on the platform would generate electric power for the offshore berthing platform. The platform would also include switchgear, transformers, and motor control centers as needed to distribute power throughout the facility. The electrical equipment would be housed in a climate-controlled switch room.

2.6.1 LNG Carriers

LNG would be transferred from the LNG carrier to storage tanks in the FSRU via unloading arms and cryogenic piping on the topside of the platform. LNG transfer from the LNG carrier would involve cooling of the loading arms and liquid LNG pipes located on the topside of the offshore berthing platform. During transfer, some LNG vapor would accumulate within the LNG storage tanks as a result of changes in heat and pressure and through displacement from the carrier as LNG is loaded into the FSRU. The vapor-handling system would collect the natural gas and direct it back to the LNG carrier, to the process heaters for use as fuel, or to the recondenser that would re-liquefy the vapor and send it to the storage tanks on the FSRU. Transfer of LNG from the LNG carrier to the FSRU would take approximately 72 hours to complete.

During transfer, the LNG carriers would take on ballast seawater to maintain constant draft. No imported ballast water would be discharged during any phase of the overall operation. The LNG carriers would be subject to USCG and Port State requirements and would comply with standards for ballast water exchange established by the International Marine Organization (IMO) (IMO, 2004).

While docked, the LNG carriers would require seawater for cooling the engines that generate electrical power for the offloading pumps and other onboard systems. An LNG carrier’s engines are powered up while at dock; therefore, the cooling water needed during the entire time each LNG carrier is at the offshore berthing platform is estimated to be up to approximately 88 hours per carrier. Seawater would be used as a source for the cooling water. Seawater use during operation of the Project facilities is discussed in section 4.3.1.3.

2.6.2 Floating Storage and Regasification Unit

LNG would be transferred from the FSRU storage tanks by submersible pumps to vaporizers on the offshore berthing platform. Following revaporization, the natural gas would flow to shore via the subsea pipeline using the high-pressure gas manifold and loading arms. A schematic drawing of a high pressure gas loading arm is shown on figure 2.6.2-1. The loading arms would be in a stowed position on the platform without internal pressure when not in use. A hydraulic power system would be used to move, connect, or disconnect the loading arms during operation.

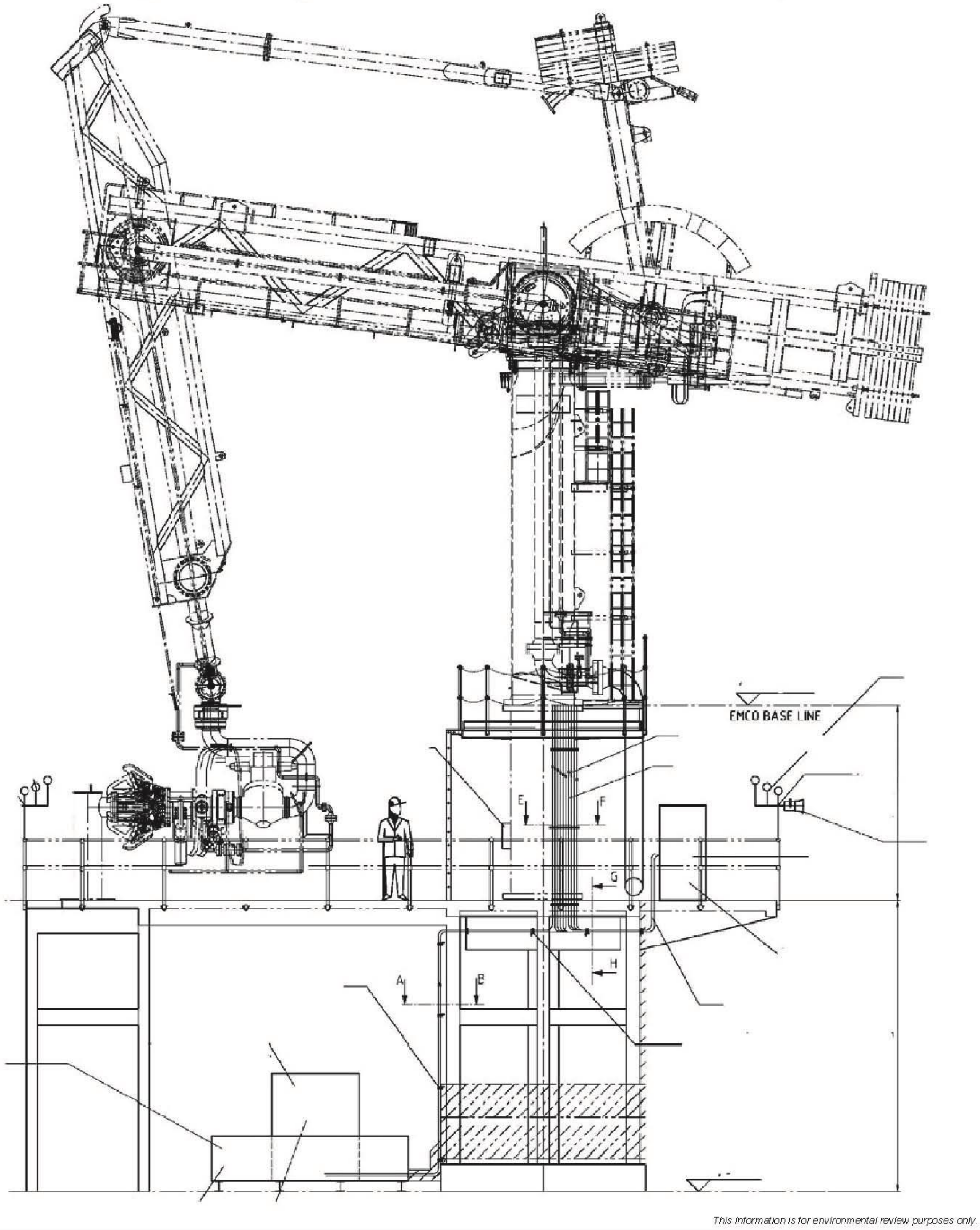


Figure 2.6.2-1
Schematic Drawing of High Pressure Gas Loading Arm
Aguirre Offshore GasPort Project

Once operational, the loading arms connected to the FSRU would be monitored by potentiometers. The loading arm position would be tracked both via a monitoring system located in the control room on the offshore berthing platform and a communications link on the FSRU. Independent proximity switches would monitor the position of the arm against predefined operating limits and these would initiate sequential safety actions in the event that the position of the arm exceeds the operating limits.

Regasification would be accomplished with a closed-loop vaporization system, which would not require the intake and discharge of seawater. The LNG regasification process is discussed in section 2.6.3. However, other routine operations would require seawater use, whether the FSRU was in standby mode or vaporization mode. These operations would involve maintenance of the vessel's main and auxiliary cooling systems, regulation of ballast water, provision of a safety water curtain during LNG transfer and regasification, maintenance of a desalination system to provide freshwater for hoteling and sanitary purposes, and maintenance of a marine growth preventative system. Seawater use during operation of the Project facilities is discussed in section 4.3.1.3

The FSRU would be subject to USCG Subchapter O Endorsement and Port State inspections for foreign flag vessels operating in U.S. waters. The USCG would conduct inspections of the FSRU. Scheduled maintenance of the FSRU would involve periodic service outages. During these outages, maintenance, and repairs on the main boilers and auxiliary and regasification systems would take place in order to maintain vessel class certificates. The FSRU would undergo dry-dock maintenance about every 5 years. During scheduled dry-dock periods, PREPA may require Aguirre LLC to use a similar FSRU to meet contractual send-out rates.

2.6.3 LNG Regasification Process

The LNG offloaded from the carriers would be stored in the cargo tanks on the FSRU at a pressure slightly above atmospheric. The LNG would then be pumped by low-pressure feed pumps to a suction drum that would serve as an accumulator and surge vessel for the high-pressure LNG pumps. Two small high-pressure pumps, each with a capacity of approximately 10 MMscf/d, would be used to increase the liquid pressure of the LNG gradually during start up to avoid the generation of excessive boil-off gas. Once a regasification flow rate of 10 MMscf/d has been achieved, the LNG vaporizer outlet control valves would be set to control the vaporization process at a pressure of at least 1,088 psi (7,501 kPa). A single high-pressure pump would increase the LNG flow rate to the minimum operating flow rate of 50 MMscf/d, which could then be increased up to 100 MMscf/d with an additional pump.

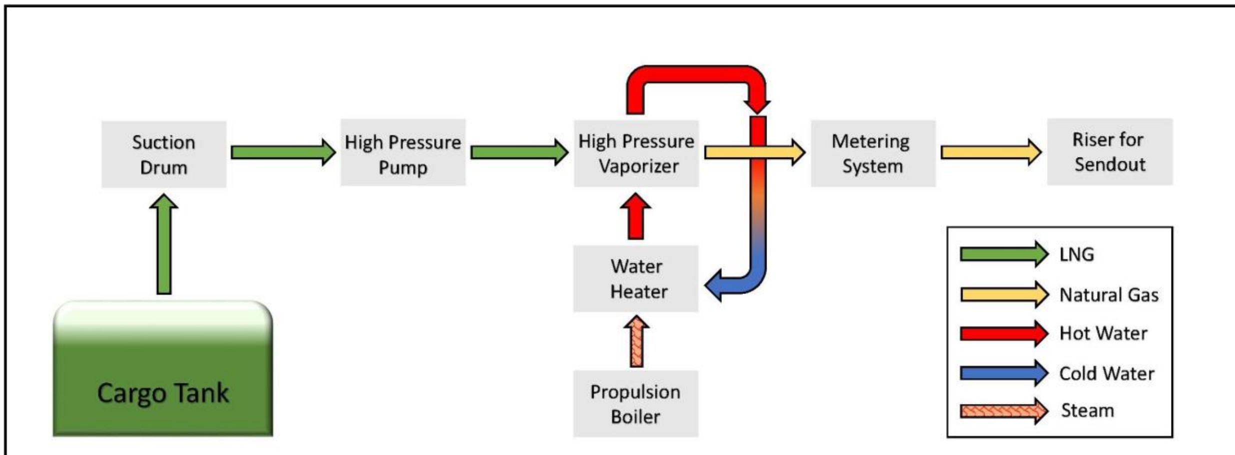


Figure 2.6.3-1 FSRU LNG Regasification Process

The FSRU would be equipped with six 100 MMscf/d capacity high-pressure pumps that would be used to send the cold LNG (approximately −260 degrees Fahrenheit [°F] [−162 degrees Celsius (°C)]) to the LNG vaporizers. The LNG vaporizers would consist of shell-and-tube heat exchangers that would use the vessel's internal heating system (closed-loop mode) to vaporize to natural gas and heat it to approximately 39 °F (4 °C). These units would be designed for a nominal delivery rate of 50 MMscf/d and a peak send-out rate of 600 MMscf/d when all six vaporizers and high-pressure pumps are operating. This variability in send-out rate would allow for the Aguirre Plant to receive the 225 MMscf/d it can utilize. The natural gas leaving the LNG vaporizers would pass through a regulating station to ensure that the operating pressure of the gas flowing to the loading arm is maintained.

2.6.4 Subsea Pipeline Facilities

During commissioning, Aguirre LLC would purge the subsea pipeline of low pressure nitrogen, vented to the atmosphere at the Aguirre Plant, and fill it with natural gas from the offshore facilities. Once operational, the subsea pipeline would operate at a maximum allowable operating pressure of 1,450 psi (9,997 kPa). Normal sustained delivery capacity would be approximately 500 MMscf/d, with peak delivery up to 600 MMscf/d of natural gas. Facilities associated with the pipeline would include metering and pressure monitoring instrumentation.

Pipeline operation monitoring includes measuring discharge rate and pressure and would be handled from the continuously manned FSRU. Supervisory Control and Data Acquisition systems would be employed to monitor operations. The subsea pipeline would be equipped with automatic and manual shutdown systems that would be activated in the event of a pipeline leak or equipment failure. Pipeline maintenance would include regularly scheduled activities including pigging at intervals specified in Aguirre LLC's operations plans, which would be based on regulatory requirements of the PREPA and U.S. Department of Transportation (DOT) and as conditions dictate. Operation and maintenance records would be maintained in accordance with the requirements of 49 CFR 192.

2.7 SAFETY CONTROLS

The Project could pose potential hazards during operation affecting public safety and port function. Primary concerns involve events or incidents that could lead to either an accidental or intentional release of LNG from offshore facilities creating a hazard. Consequences from a release could include cryogenic structural damage, burns, asphyxiation, mechanical damage, and fire. The offshore facilities would be approximately 3 miles (5 km) offshore from the Aguirre Plant in water at least 60 feet (18 m) in depth. Minimal impacts on land-based infrastructure and communities would be expected in the event of an LNG-related accident. All facilities would be subject to stringent design, construction, operation, and maintenance requirements. Aguirre LLC would follow extensive safety procedures and employ systems to monitor, detect, and control potential hazards. Safety controls for the Project are described below.

2.7.1 LNG Offshore Facility

The offshore berthing platform would include fire and gas detection systems that would alert personnel in the event of an emergency. These systems would be automated, warning personnel and allowing emergency contingency procedures to be implemented. An Emergency Shut Down (ESD) system would have redundancy to ensure response reliability in the event of a safety-related upset condition. The offshore berthing platform ESD system would be linked to the FSRU ESD system via ship-to-shore communication links.

Fire protection for the offshore facility would conform to standards established by the National Fire Protection Association (NFPA) 59A Standard for the Production, Storage, and Handling of LNG. Components of fire protection include:

- gas and fire detection instruments;
- wet ring-main system;
- ESD system;
- main and auxiliary fire pumps;
- oscillating monitors for deluge of the FSRU and offshore berthing platform equipment;
- water spray rails for the loading arms and gangways;
- hydrants and IMO ship connections;
- water curtain systems for personnel escape protection;
- deckwash under cold drain tanks for dispersion of LNG drips; and
- deckwash for protection of LNG loading manifold and decks and side shells.

The FSRU would be subject to USCG Subchapter O Endorsement and Port State inspections.

2.7.1.1 Spill Impoundment System

The FSRU LNG tanks would be double-containment tanks, with a complete inner tank inside of a complete outer tank. The tanks would be designed in accordance with the IMO's International Gas Carrier Code.

Ships, including the FSRUs, are required by the International Convention for Prevention of Pollution from Ships (MARPOL) to maintain a Shipboard Oil Pollution Emergency Plan (SOPEP). Regulation 26 of Annex I of MARPOL 73/78 requires that oil tankers of 150 gross tonnage or more and all ships of 400 gross tonnage or more carry an approved SOPEP (IMO, 1983). SOPEPs contain measures and plans for responding to and mitigating the effects of a pollution incident originating with a vessel. The plans include contact information for emergency response organizations to respond to a pollution incident.

Vessels calling in the United States are required to have contracted the services of a response organization to provide first response capabilities in the event of a spill within U.S. waters. These plans must be reviewed and approved by the vessel's flag administration, and would be regularly checked by USCG Marine Inspection personnel. The FSRU, as well as LNG carriers calling on the offshore berthing platform, would maintain SOPEPs. The FSRU would also maintain a Certificate of Financial Responsibility in accordance with the Oil Pollution Act of 1990.

2.7.1.2 Fire and Hazard Detection and Control Systems

The FSRU would be fitted with a variety of fire prevention, detection, and extinguishment tools. The vessel would meet the requirements for an LNG carrier in firefighting respects as set forth in the International Convention for the Safety of Life at Sea (SOLAS) (IMO, 1974). The equipment and systems installed would be those approved for the vessel's classification society and strategically placed for rapid deployment and use and regularly inspected for operational readiness. Aguirre LLC would maintain the systems and equipment in accordance with a planned maintenance system that would be documented and open to records inspection in the vessel's Safety Management System.

The FSRU and offshore berthing platform personnel would receive marine and LNG-specific fire-fighting instruction from internationally accredited firefighting schools. The personnel would use a variety of tools, agents, and techniques to prevent, detect, and extinguish fire, and to mitigate damage as required, while protecting the environment external to the vessel.

Marine Firefighting and Salvage requirements under 33 CFR 155 regulate vessels carrying oil. The offshore berthing platform would follow regulations pertinent to firefighting and emergency response for LNG facilities, 33 CFR 127. Aguirre LLC would develop a Project-specific Emergency Response Plan (ERP) for approval by FERC prior to any site construction. Aguirre LLC would consult with the USCG and other Commonwealth and local agencies, as needed, during preparation of the ERP. The ERP would address marine firefighting and response at the offshore berthing platform. The Emergency Procedures Manual would address marine firefighting response, as well as oil spill response as it relates to bunkers, minor spills resulting from hydraulic lines, or other auxiliary equipment at the facility.

The firefighting medium would be seawater. As this represents an essentially infinite water source, no backup system would be needed. The offshore berthing platform would house some oil spill response equipment, including but not limited to, empty drums, buckets, absorbent sheets, plastic drums, and protective gloves.

2.7.1.3 Emergency Shutdown System

An extensive manually and/or automatically activated ESD system and automatically activated Automatic Shut Down (ASD) system would deactivate LNG regasification and natural gas transfer in the event of any malfunction. The primary difference between the two systems is that the ESD system is intended to work to quickly stop cargo transfer during an emergency condition and cause primary isolation or ESD valves to automatically close, terminating the transfer of cargo. The ASD system is designed to prevent mechanical damages to equipment and further problems by eliminating the potential for a hazardous condition to exist. At any time during gas transfer operations that an ASD or ESD occurs, the Vessel Operator’s Person in Charge (PIC) would confirm the shutdown to the Offshore Berthing Facility Operator. Following an ASD or ESD function, the Vessel Operator must demonstrate to the PIC that the cause of the shutdown has been rectified, and must receive permission from the PIC to resume gas discharge operations

The ESD system can be initiated manually by operating personnel from several ESD stations around the FSRU. Manual ESD switches would be located in four locations aboard the vessel that control ESD valves on the FSRU and on the offshore berthing platform. The Vessel Operator would control the valves connecting the FSRU and natural gas pipeline system. Detection equipment aboard the FSRU would include state-of-the-art gas, fire, and smoke detection systems that continually monitor the atmosphere of the FSRU.

In addition to the manual operation described above, the ESD would be activated when any automated permissive control sensors indicate a non-standard situation, including (but not limited to) detection of hydrocarbon gas vapor at 60 percent lower explosive limit, or detection of fire.

2.7.2 Pipeline Facilities

The DOT's Pipeline and Hazardous Materials Safety Administration (PHMSA) "Minimum Federal Safety Standards" for natural gas pipelines as contained in 49 CFR 192 prescribe the minimum standards for operating and maintaining pipeline facilities, including the requirement to establish a written plan governing these activities. Under 49 CFR 192.615, each pipeline operator must also establish an Emergency Plan that provides written procedures to minimize hazards from a gas pipeline emergency. Key elements of the Emergency Plan would include procedures for:

- receiving, identifying, and classifying notices of events that require immediate response by the operator;
- establishing and maintaining communications with appropriate fire, police, and public officials;
- prompt and effective response to a notice of each type of emergency, including:
  - gas detected inside or near a building;
  - fire located near or directly involving a pipeline facility;
  - explosion occurring near or directly involving a pipeline facility; or
  - natural disaster;
- making personnel, equipment, tools, and materials available at the scene of an emergency;
- protecting people first and then property, and making safe any actual or potential hazards to life or property;
- ESD and pressure reduction in any section of the system necessary to minimize hazards to life or property;
- notifying appropriate fire, police, and other public officials of gas pipeline emergencies and coordinating with them both planned responses and actual responses during an emergency; and
- safely restoring any service outage.

Each operator must train appropriate operating personnel to ensure that they are knowledgeable of the emergency procedures and verify that the training is effective. Following any emergency, the operator must review employee activities to determine whether the procedures were effectively followed. Each operator must establish and maintain liaison with appropriate fire, police, and public officials to identify the resources and responsibilities of each organization that may respond to a gas pipeline emergency and to coordinate mutual assistance in responding to emergencies. The operator must also establish a continuing education program to enable customers, the public, government officials, and those engaged in excavation activities to recognize a gas pipeline emergency and report it to appropriate public officials.

An Emergency Plan as required by 49 CFR 192 for the subsea pipeline component would be incorporated into Aguirre LLC's ERP.

2.8 FUTURE PLANS AND ABANDONMENT

Aguirre LLC has not identified any plans for the future expansion or abandonment of the Project facilities. We received several comments related to the volumes of LNG that would be delivered to the LNG terminal being in excess of what the Aguirre Plant can consume. Aguirre LLC contends that extra volume of LNG is necessary to maintain sufficient fuel storage for the Aguirre Plant. Aguirre LLC also stated that Excelerate's EBRVs, one of which would be used for the FSRU, must be adequately sized to be useful in various different projects and that the ability to lower the send-out rate to 50 MMscf/d would allow the Aguirre Plant to receive only the amount of natural gas it is capable of using. Both Aguirre LLC and PREPA assert that the sole purpose of the Project is to supply natural gas to the Aguirre Plant.

The EPA also asserted its concern over the additional capacity on the FSRU and the possibility for transportation of the gas to other facilities in Puerto Rico. On November 5, 2013, the EPA requested further information on the additional capacity in response to PREPA's PSD Non-Applicability Analysis application to EPA. Following PREPA's response to the EPA's concerns, the EPA issued its finding on May 6, 2014, that the Aguirre Power Plant and the proposed Project would not be subject to PSD requirements provided that certain permit conditions would be included in the EQB construction permits for both the Aguirre Plant and the Project. These conditions regarding the available capacity on the FSRU included, but are not limited to the following:

- PREPA shall own and shall have all the necessary rights to utilize the 4.1 miles (6.6 km) of pipeline and the Offshore GasPort facility;
- the contract agreements between PREPA and Excelerate Energy shall give PREPA exclusive rights to 100 percent of the LNG at the Offshore GasPort; and
- any proposed change to transfer the natural gas from the Offshore GasPort to another entity other than the PREPA Aguirre Plant shall be presented to EPA for review to determine whether the single source determination is still valid.

These conditions in the EPA's finding thereby prohibit the use of the additional gas capacity at any other facility other than the Aguirre Plant without additional permitting and review.

If the Project facilities are proposed to be expanded to provide natural gas service to other facilities, appropriate federal, state, and local regulations would need to be complied with by Aguirre LLC. Similarly, if the Project facilities are abandoned in the future, Aguirre LLC would need to comply with the appropriate federal, state, and local regulations in effect at that time (including the FERC's abandonment regulations).

3.0 ALTERNATIVES

In accordance with NEPA and Commission policy, we evaluated alternatives to the Aguirre Offshore GasPort Project to determine whether they would be reasonable and have significant environmental advantages compared to the proposed action. NEPA requires that federal agencies evaluate reasonable alternatives to a proposed major federal action. According to the CEQ, "reasonable alternatives include those that are practical or feasible from the technical and economic standpoint and using common sense, rather than simply desirable from the standpoint of the applicant" (CEQ, 1981). Further, the FERC has established several key criteria to evaluate potential alternatives identified for a given project. Each alternative is thus evaluated in consideration of whether it would:

- be technically and economically feasible and practical;
- offer significant environmental advantage over the proposed project; and
- meet the proposed project objectives.

With respect to the first criterion, it is important to recognize that not all conceivable alternatives are technically feasible and practical. For example, some alternatives may not be possible to implement due to technological difficulties or logistics. In conducting an alternatives analysis, it is important to recognize the environmental advantages and disadvantages of the proposed action in order to focus the analysis on reasonable alternatives that may reduce impacts and offer a significant environmental advantage.

Specific to the Aguirre Offshore GasPort Project, the purpose of our alternatives evaluation was to determine whether there are reasonable alternatives that would result in less environmental impact than the Project as proposed while still meeting the Project's objectives. As described in section 1.1, Aguirre LLC indicated the following Project objectives:

- diversify the energy sources at the Aguirre Plant, thereby reducing the use of fuel oils, as outlined in PREPA's Corporate Strategic Plan 2011–2015;

- allow the Aguirre Plant to meet the requirements of the EPA's MATS rule;

- reduce fuel oil barge traffic in Jobos Bay, thereby reducing the potential for fuel spills, as well as potential encounters with certain endangered species and recreational boat traffic; and

- contribute to price stabilization.

The range of alternatives to the proposed action that are addressed in this section include the No-Action Alternative, System Alternatives, Terminal Site Alternatives, Pipeline Route Alternatives, and Pipeline Route Variations.

As part of the No-Action Alternative, we considered the effects and actions that might result if the proposed Project were not constructed. We identified system alternatives to evaluate the ability of existing LNG import terminals and pipeline systems to meet Aguirre LLC's objectives. We also evaluated alternative locations for the offshore terminal and the offshore pipeline.

Aguirre LLC participated in our pre-filing process for the Project (see section 1.3), as well as provided additional information on potential alternatives, following the submittal of its application, in response to concerns from federal and state agencies regarding the proposed pipeline route. This process emphasized identification of potential stakeholder issues, as well as the identification and evaluation of alternatives that could avoid or minimize impacts. We analyzed each alternative based on public comments; guidance received from federal, state, and local regulatory agencies; and our own independent investigations. Using the evaluation criteria discussed above and subsequent environmental comparisons, each alternative was considered to the point where it was clear that the alternative was either not reasonable, would result in substantially greater environmental impacts that could not be readily mitigated, offered no potential environmental advantages over the proposed Project, or could not meet the Project's objectives. Alternatives that resulted in less than or similar levels of environmental impact were reviewed in greater detail. The following sections discuss and analyze each of the alternatives evaluated and explain why they were eliminated from further consideration.

3.1 NO-ACTION ALTERNATIVE

The action triggering this environmental review was Aguirre LLC's application to the FERC. If the No-Action Alternative is selected by the Commission denying the proposal, the proposed facilities would not be constructed and the short- and long-term environmental impacts would not occur. In addition, if the No-Action Alternative were selected, the stated objectives of Aguirre LLC's proposal would not be met.

The No-Action Alternative would eliminate this new long-term natural gas supply source for Puerto Rico causing the Aguirre Plant to continue to burn fuel oil. The Project objectives of diversifying the plant's fuel sources and meeting the requirements of the EPA's MATS rule would also not be achieved. The continued use of fuel oil as a resource could prolong the community's exposure to emissions from the operation of the plant and operate in violation of the EPA mandate. In addition, the lack of a new fuel source for the plant would require the continued weekly delivery of fuel oil by barges, thus maintaining the risk of a potential spill during the fuel oil transfer from the barge to the onshore tank.

Aguirre LLC states that the construction of the terminal and pipeline is necessary to satisfy the EPA's MATS rule requirements to reduce emissions (e.g., replace the fuel source). Puerto Rico continues to have a need for electrical power that is provided by the Aguirre Plant. With the limitation of increased use of fuel oil, natural gas is a reasonable alternative for Puerto Rico to consider when reviewing options to improve the Aguirre Plant's emissions. Several pipelines have been proposed to bring alternative sources to the Aguirre Plant but due to Puerto Rico's sensitive environmental resources and other factors, the proposals have failed.

If the Commission denies this authorization, the environmental impacts identified in this draft EIS for the Project would not occur, but the additional supply of natural gas to meet the demand would not be available, and the diversity of fuel supply for the Aguirre Plant would not be introduced. The use of alternative fuels as opposed to natural gas could result in continued exposure to air pollutant emissions from diesel fuel.

We believe it is important to consider alternative energy sources as part of the alternative selection process. As noted above, implementing the No-Action Alternative could force PREPA to seek other forms of energy. Traditional energy alternatives to natural gas include coal and hydroelectric. Renewable energy resources such as solar, ocean energy, biomass, wind, landfill gas, and municipal solid waste represent new, advanced energy alternatives. Conceivably, each of these energy alternatives could support the generation of electric power at the Aguirre Plant.

Because the renewable energy sector is demonstrating its capacity to deliver cost reductions; the sector is expanding rapidly. Costs have been decreasing around renewable energies and a portfolio of renewable energy technologies is considered to be cost-competitive (International Energy Agency, 2014). As reported by the U.S. Energy Information Administration (EIA), renewable consumption will grow by about 0.7 percent in 2014 (for electricity and heat generation use). In the EIA (2014) short-term energy outlook it found by "2015, renewables consumption for electric power and heat generation is projected to increase by a rate of 5.8 percent from 2014, as a 5.0 percent increase in hydropower is combined with a 6.2 percent increase in non-hydropower renewables." However, economic barriers that would prevent further expansion and costs would need to be reduced further to promote growth over the next decade (International Energy Agency, 2014).

In the EIA's short-term energy outlook report, solar electricity generation is expected to continue to grow; however, it is estimated it will only represent 0.4 percent of the total U.S. generation by 2015. While solar electricity generation is often generated for customer-sited distributed installations, the utility-scale solar capacity grew by 96 percent in 2013 (EIA, 2014). In fact, AES Ilumina operates a 24-MW photovoltaic power plant in Guayama, about 4.5 miles (7.2 km) east of the Aguirre Plant, and is the first utility-scale solar energy project in Puerto Rico. Electricity generated at the facility is sold to PREPA under a 20-year power purchase agreement. Salinas Solar Park is a 16-MW photovoltaic power plant in Salinas, about 2.5 miles (4.0 km) north of the Aguirre Plant, and is currently under construction. These two solar-powered power plants can provide a certain amount of electricity to the area; however, these plants are not capable of providing the same capacity as the Aguirre Plant. The EIA report, predicts utility-scale solar capacity projects will continue to increase through 2015.

The International Energy Agency (2012) reported that coal exports are increasing, and in the United States several new coal export projects were recently proposed, suggesting that in many international markets coal will remain competitive with natural gas in spite of coal's greater air emissions. The EPA (2013) states that compared to the average air emissions from coal-fired generation, natural gas power plants produces half as much carbon dioxide (CO_2), less than a third as much nitrogen oxides, and one percent as much sulfur oxides. As a result, if the No-Action Alternative is selected, PREPA could opt for the use of coal; however, due to the MATS rule standards, PREPA would have to implement significant air emissions control equipment at the Aguirre Plant which would make coal as a fuel source less attractive.

Hydropower is currently the largest source of renewable electric power generation worldwide, and the International Energy Agency expects this trend to continue through 2030. However, as with nuclear power generation, there are high costs associated with developing substantial hydropower projects and long time periods between project conception and the production of electric power. There are no hydropower projects currently proposed for Puerto Rico.

Ocean energy is a largely unexplored renewable resource. Technologies to capture ocean energy are in their infancy, and environmental and engineering considerations are being studied to better understand the implications of placement of power generating facilities in the ocean.

Entrepreneurs and scientists are exploring the emerging use of algae for biofuels and other renewable energy applications, and are working to accelerate the development of applications to use algal biomass. International Energy Agency (2012) projected that electric power generation from biomass technology would increase four-fold through 2035, but that time frame is well beyond the planned startup of the proposed Project.

Further generation of electrical power by wind would require construction of new wind turbines and additional electric transmission lines. Wind power facilities have increased in recent years in Puerto Rico; however, such facilities cannot be used for constant and reliable energy production because of the variability in winds, and other power generation facilities are commonly in place as backup facilities.

With regard to these renewable sources of energy, natural gas is often considered a "bridge fuel;" a fuel that bridges the time between the dominant use of fossil fuels today and the greater use of renewable energy sources in the future. Natural gas is cleaner burning than other fossil fuels and can also reliably serve as a backup fuel to renewable energy facilities, which often provide power intermittently.

There is currently considerable momentum behind advancing renewable energy technologies and moving toward more diversified energy sources. These advanced technologies, either individually or in combination, will likely be important in addressing future energy demands. Presumably, as renewable energy technologies continue to advance, they will offset an increasing amount of fossil fuels to meet growing energy demands.

Although it is speculative and beyond the scope of this analysis to predict what action might be taken by policymakers or end users in response to the No-Action Alternative, it is possible that without the proposed Project, the energy needs may be met by alternative energy sources, likely resulting in impacts on the environment. Alternative energy forms, such as coal, could be used to meet increased demands for energy; however, natural gas is a much cleaner-burning fuel. These other fossil fuels emit greater amounts of particulate matter, sulfur dioxide (SO_2), carbon monoxide (CO), CO_2, hydrocarbons, and non-criteria pollutants. Renewable energies, such as solar, hydroelectric, and wind are not always reliable or available in sufficient quantities to support most market requirements and would not necessarily be an appropriate substitute for natural gas. Therefore, we conclude that the No-Action Alternative would not meet the Project objectives, and we are not recommending it.

3.2 SYSTEM ALTERNATIVES

We reviewed system alternatives to evaluate the ability of existing, modified, or proposed facilities to meet the stated objectives of the Project. The purpose of identifying and evaluating system alternatives was to determine whether potential environmental impacts associated with the construction and operation of the Project could be avoided or reduced. By definition, implementation of a system alternative would make it unnecessary to construct all or part of the proposed Project, although modifications or additions to the system alternative may be required to increase capacity or provide receipt and delivery capability consistent with that of the proposed Project. Such modifications or additions may result in environmental impacts less than, comparable to, or greater than those associated with construction and operation of the Aguirre Offshore GasPort Project.

3.2.1 Existing EcoEléctrica LNG Facility and New Pipeline

In order for us to recommend a system alternative, the alternative must be technically and economically feasible. In addition, it must offer a significant environmental advantage over the Project. We reviewed a system alternative that included the expansion of the only LNG import terminal in Puerto Rico, the EcoEléctrica LNG (EcoEléctrica) facility in Peñuelas, and the construction of a new pipeline to the Aguirre Plant (see figure 3.2.1-1). EcoEléctrica is a FERC-regulated facility that began commercial operations in March 2000. Since its construction, it has operated 94 percent of the time, receiving ships from Trinidad and Tobago. EcoEléctrica can store approximately 1,000,000 barrels of LNG or a 40-day power supply to its current customers.

For the EcoEléctrica facility to be a viable system alternative to the proposed Project, the facility would have to construct new LNG storage capacity and regasification facilities as well as a new pipeline (discussed below) to connect the EcoEléctrica facility to the Aguirre Plant. We estimate that an additional 30 acres (31 cuerdas) would be required to be added to the facility to accommodate the expansion of fuel storage and regasification. As shown in figure 3.2.1-2, the expansion of the existing facility by 30 acres (31 cuerdas) would be difficult without encroaching upon existing communities. If EcoEléctrica were to obtain the additional land, the onshore facility would result in additional industrial development in a previously undisturbed area.

Figure 3.2.1-1
EcoEléctrica LNG Facility Location and New Pipeline Alternatives
Aguirre Offshore GasPort Project

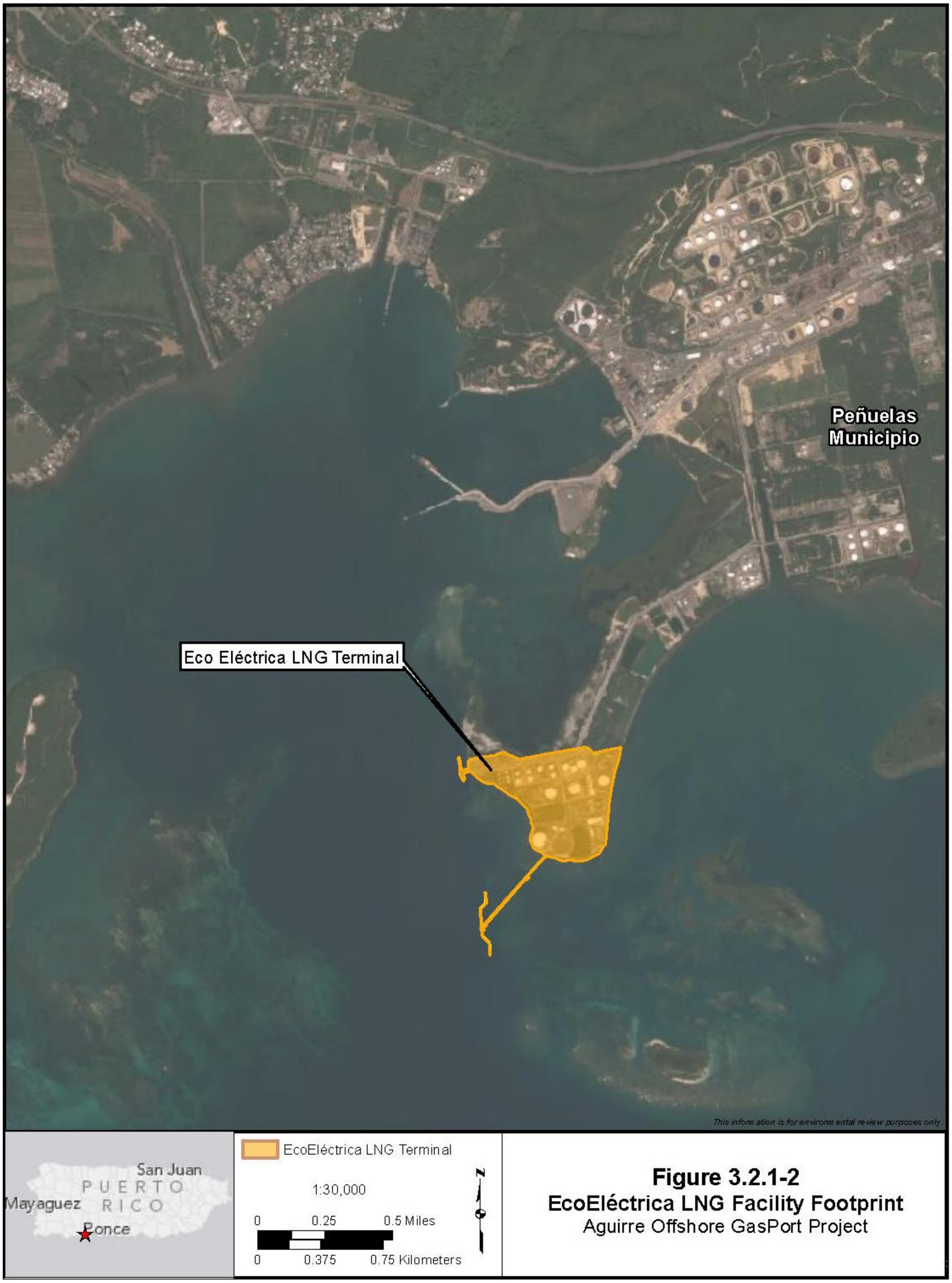


Figure 3.2.1-2
EcoEléctrica LNG Facility Footprint
Aguirre Offshore GasPort Project

Two previously planned pipeline projects in Puerto Rico were developed to assist in the diversification of fuels sources for Puerto Rico. The first project, Gasoducto del Sur ("Southern Gas Pipeline"), PREPA proposed in 2008. This project, a 42-mile-long (67.6 km), 20-inch-diameter (51 cm) pipeline was designed to transport natural gas from the EcoEléctrica facility in Peñuelas to the Aguirre Plant. Construction of Gasoducto del Sur began in 2008; however, only 10 miles (16 km) were constructed prior to it being cancelled in 2009 due to significant public opposition. The project route crossed the highly populated southern coastal areas, as well as unique hydrographic basins and sensitive areas.

The second project, the Via Verde Project ("Green Way Project"), proposed by PREPA was to construct a natural gas pipeline from EcoEléctrica to the north. The Via Verde Pipeline was approximately 92 miles (148 km) long and extended northerly from EcoEléctrica to deliver natural gas to PREPA's Cambalache Power Station in Arecibo, Puerto Rico, continue easterly along the north coast of the island, and terminate at the Central San Juan Power Plant in San Juan, Puerto Rico. This project would supply natural gas to northern Puerto Rico, enabling a reduction of emissions at the northern power plants, which could help Puerto Rico meet its overall emissions goals. However, it would not meet Aguirre LLC's objective of fuel conversion for the Aguirre Plant.

As the proposed Project does not require construction of onshore LNG storage facilities and additional gasification facilities, the expansion at the EcoEléctrica facility would likely result in greater onshore environmental impacts than the proposed Project. In addition, attempting to revive the failed Gasoducto del Sur (or start the permitting process over for a similar pipeline) is not a reasonable system alternative and was not considered further. The Via Verde Project would also not meet the objectives of the proposed Project and was not evaluated further. For the reasons discussed above, we concluded that the expansion of the existing EcoEléctrica facility (and associated pipeline) was not considered to be an environmentally preferable or feasible alternative to the proposed Project and was removed from further consideration.

3.3 FACILITY SITING ALTERNATIVES

We evaluated the area in the vicinity of the existing Aguirre Plant for alternative sites to the proposed offshore facility. Each alternative site was evaluated in consideration of whether it would be technically and economically feasible and practical; offer significant environmental advantage over the proposed Project; and meet the proposed Project objectives. An alternative facility site would need to be in close proximity to the existing plant to allow the Project to obtain its objective of fuel conversion at this plant. Our evaluation of alternative sites considered two land based sites and two dockside sites. The LNG Terminal Site Alternatives considered are illustrated on figure 3.3-1 and summarized by type in table 3.3-1. Note that a dockside facility would require Aguirre LLC to moor a FSRU vessel that connects to a shore-mounted high-pressure gas unloading arm. The FSRU vessel would function similar to a land-based LNG receiving terminal; however its construction costs would be lower because of the use of an existing FSRU for LNG storage and regasification.

3.3.1 Las Mareas Bay

Las Mareas Bay is approximately 6.0 miles (9.7 km) east of the Aguirre Plant with access to the area off Puerto Rico Highway 3. Two industrial facilities are located on the north shore of Las Mareas Bay: the Chevron-Philips chemical facility and the AES Puerto Rico, L.P. (AES) 454-MW coal-fired power generation facility. The Chevron-Philips facility was sold in 2008 with the intent to dismantle and salvage the assets. An existing pier associated with the Chevron-Philips facility remains and extends into Las Mareas Bay. The AES facility was the first coal-fired power plant in Puerto Rico. The facility operates two circulating fluidized bed boilers with a combined maximum heat input rate of 4,922 million British thermal units per hour (MMBtu/hour).

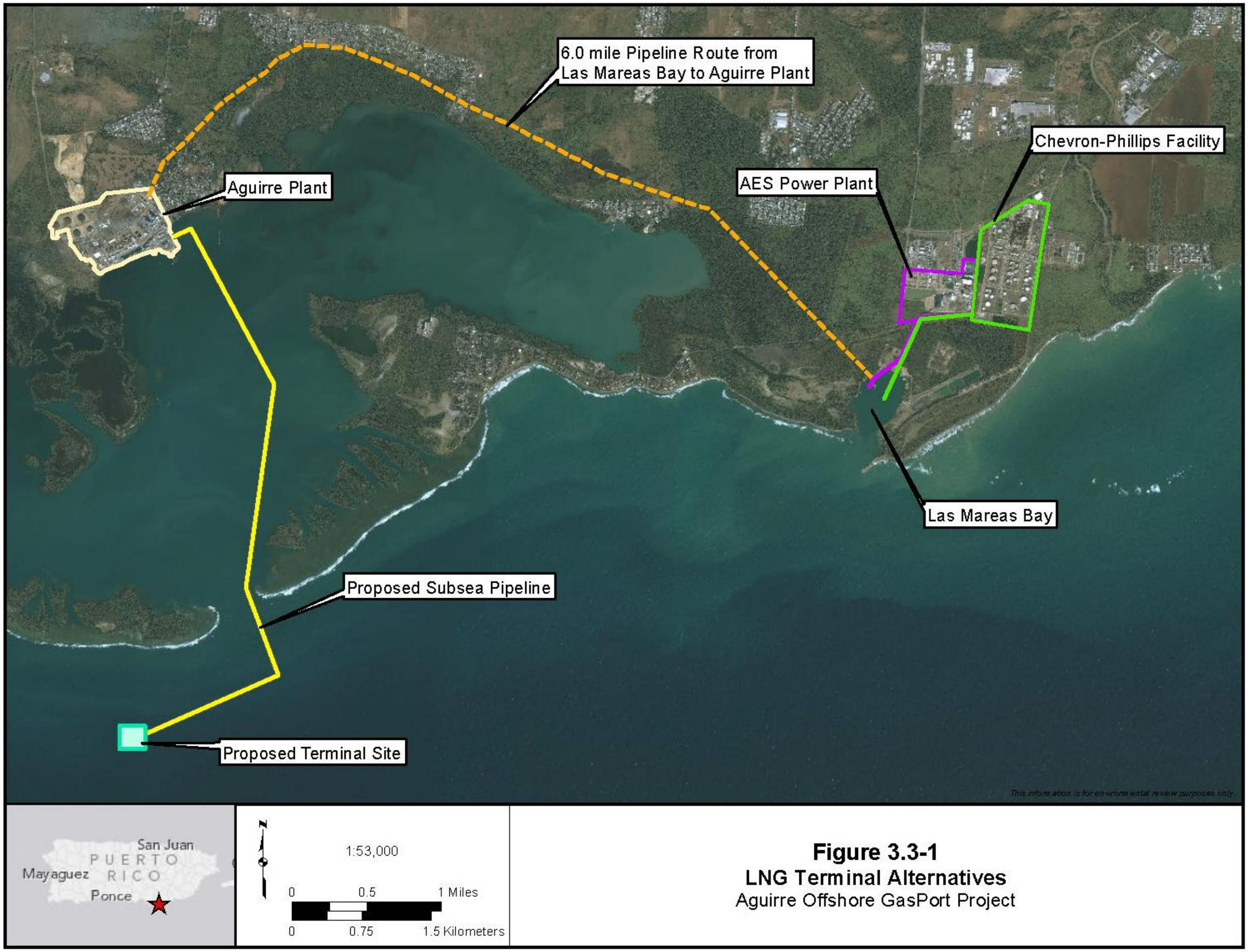


Figure 3.3-1
LNG Terminal Alternatives
Aguirre Offshore GasPort Project

TABLE 3.3-1

Comparison of Onshore and Dockside LNG Terminal Locations for the Aguirre Offshore Gas Port Project

Location	Distance to Aguirre Plant	Advantages	Disadvantages
Onshore			
Las Mareas Bay	6.0 miles (9.7 km)	• Industrial area with existing infrastructure, including a pier into Las Mareas Bay. However the pier would require reinforcement and enlargement to accommodate LNG carriers.	• Portions of facility may require construction in wetlands. • Dredging of an access channel would be required. • Requires construction of 6.0 miles (9.7 km) onshore pipeline.
Aguirre Plant	Adjacent	• Requires minimal pipeline to reach the plant.	• Dredging of existing barge channel would be required. • Potential sedimentation impacts on surrounding mangrove islands. • Requires acquisition or condemning of lands to construct facility. • Close proximity to the Aguirre community.
Dockside			
Las Mareas Bay	6.0 miles (9.7 km)	• Industrial area with existing infrastructure, including a pier into Las Mareas Bay. However, the pier would require reinforcement and enlargement to accommodate LNG carriers.	• Dredging of an access channel would be required. • Requires construction of 6.0 miles (9.7 km) onshore pipeline.
Aguirre Plant	Adjacent	• Requires minimal pipeline to reach the plant.	• Dredging within Jobos Bay for turning basin would be required. • A dockside facility located directly at the Aguirre Plant site would also have similar public safety concerns as a land-based terminal at the site.

This industrial area has sufficient land to allow for the development of an onshore LNG facility. Based on a review of aerial photography, we determined that additional development at the existing Chevron-Philips facility would be required to construct an onshore or dockside terminal. The area near the AES facility has sufficient land to allow development. Either site would create disturbance in areas that mainly consist of previously developed upland and palustrine emergent wetlands located along the coastal area.

To complete the onshore or dockside facility, the Las Mareas Bay entrance would need to be expanded to allow for tug-assisted mooring as required for LNG at the existing pier. The existing 700-foot-long (213 m) pier was designed for receipt of coal ships. The pier would need to be reinforced and enlarged to allow for the docking of an LNG carrier, which would be approximately 500 or 720 feet (152 or 220 m) in length. The modifications to the pier would likely require significant work within Las Mareas Bay. In addition to the in-water work of enlarging the pier, dredging would be required in the existing barge channel for additional depth to accommodate an LNG carrier delivering at the pier. A typical LNG carrier transporting approximately 170,000 m^3 requires a minimum water depth of 45 feet (14 m) when fully loaded. Finally, an alternative site located near Las Mareas Bay would require 6.0 miles (9.7 km) of an onshore pipeline to reach the Aguirre Plant. We conclude that the associated environmental impacts with this alternative would be greater than the proposed Project. For these reasons, we conclude that a new land-based or dockside LNG facility within Las Mareas Bay would not present any significant environmental advantage compared to the proposed Project.

3.3.2 Aguirre Plant

We reviewed the Aguirre Plant as an alternative location for both a land-based terminal facility and a dockside terminal facility. Similar to the Las Mareas Bay on shore site, the land based terminal would require the construction of storage tanks, regasification equipment, and other infrastructure to support the facility. Based purely on land requirements, an efficiently designed LNG regasification plant with two tanks and a throughput capacity of 500 MMscf/d can be sited on as little as 30 acres (31 cuerdas) of land. For example, the EcoEléctrica facility with a similar throughput and storage capacity plus a separate power plant and desalination plant is sited on about 36 acres (37 cuerdas). In reviewing the area around the Aguirre Plant, 30 contiguous acres (31 cuerdas) are not available that would avoid population centers. In addition, the land-based terminal would require deepwater access and a turning basin. The lack of available land, the need to create deepwater access with turning basin, and the proximity to a population center makes a land-based terminal less environmentally preferable than the Proposed Action. Therefore, we do not recommend it.

We also reviewed the dockside terminal alternative for the Aguirre Plant. A dockside terminal facility would require deepwater access and a turning basin large enough for both the FSRU and the LNG carrier as well as modification at the plant to build a pier for the FSRU. The existing pier at the facility can not accommodate an FSRU as well as the LNG carrier. The land disturbance for a dockside facility is less than a land-based alternative as the regasification facilities, and the LNG storage tanks are onboard the FSRU. However, a dockside LNG facility has similar safety concerns for the Aguirre community as a land-based terminal alternative. A dockside facility would create short-term impacts on water quality, vegetation (seagrasses), and threatened and endangered species when in-water construction activites would occur.

The dockside LNG terminal would be preferable to a land-based terminal due to limited onshore construction requirements; however, due to its proximity to the Aguirre community, and the extensive amount of in-water work (dredging and pier construction) that would be required, we consider that the environmental impacts would be equal or greater than the proposed Project. Therefore, we conclude that a land based or dockside facility at the Aguirre Plant offers no significant environmental advantage over the Proposed Action. As such, we are not recommending this alternative.

3.4 OFFSHORE TERMINAL SITE ALTERNATIVES

To serve as a viable offshore terminal site alternative to the proposed site, offshore terminal sites were further evaluated based on the following criteria:

- reasonably close to the Aguirre Plant (to minimize the required pipeline length);
- located in sufficient water depths to accommodate the offshore terminal design;
- avoids sensitive marine resources;
- avoids population centers that could potentially create increased impacts on recreational users, safety concerns, and visual impacts; and
- has a stable seafloor with favorable wind and wave data.

In considering the impact of each terminal from a safety concern, we reviewed the LOR Analysis of the proposed site (appendix A, Section 1) conducted by the USCG. This May 2014 document recommends that the proposed terminal site implement a 500-yard (457 m) safety zone. The safety zone would prohibit any vessel traffic from entering or transiting this area without permission from the COTP. The safety zone was determined by considering a worst-case impact from an LNG spill and considered factors including maritime commerce, regional impact, and cultural and economic impact. It determined that the recommended safety zone at the proposed terminal site would minimally affect local recreational and fishing vessels that may have traditionally transited this area. The USCG noted in its LOR Analysis that the siting of the terminal site near the islands could be a critical issue for the fishing community if the safety zone extended beyond the 500 yards (457 m). Additionally, it noted that the Project in the "midst of the Cays threatens to severely hamper the ecotourism and recreational activities" (page 18, LOR Analysis).

For purposes of this analysis, we used the same safety zone recommendation to compare the alternative offshore terminal sites as well as considered the impact on fishing, recreational activities, and ecotourism. If another site is determined to be preferred and is recommended by the FERC staff, the USCG would need to conduct a review of the site and make its determination on suitability and safety considerations.

We evaluated four alternative offshore terminal sites with pipelines to the terminal based on Aguirre LLC's field review of each site and corresponding pipeline. The sites identified as possible alternative site locations are located offshore of Cayos Caribes (Sites 1 and 2), Cayos de Barca (Site 3), and Cayos de Pájaros (Site 4). Table 3.4-1 provides information about the proposed offshore terminal site as well as each alternative site by criteria. The proposed offshore terminal site and the alternative sites are shown in figure 3.4-1.

TABLE 3.4-1

Comparison of Proposed Offshore Terminal Site Alternatives for the Aguirre Offshore Gas Port Project

Offshore Terminal	Length of Pipeline to Aguirre Plant (miles [km])	Water Depth at Terminal Site (feet [m])	Marine Resources Present	Distance to Closest Population Centers	Seafloor Condition
Proposed Site	4.1 (6.6)	60 (18)	Designated as critical habitat for Elkhorn and Staghorn coral; patch reef, macroalgae and seagrass present	3 miles (5 km) southwest of Punta Pozuelo; 3.3 miles (5.3 km) south of Aguirre community.	Favorable
Site 1	3.7 (6.0)	60 (18)	Designated as critical habitat for Elkhorn and Staghorn coral; unknown benthic cover	2 miles (3 km) southwest of Punta Pozuelo; 3.2 miles (5.2 km) southeast from Aguirre community	Unfavorable
Site 2	4.1 (6.6)	55 (17)	Designated as critical habitat for Elkhorn and Staghorn coral; unknown benthic cover	1.1 miles (1.8 km) southwest of Punta Pozuelo; 2.7 miles (4.4 km) southeast from Aguirre community	Favorable
Site 3	4.8 (7.7)	60 (18)	Designated as critical habitat for Elkhorn and Staghorn coral; softbottom and macroalgae present	3.5 miles (5.6 km) southwest of Punta Pozuelo; 3.2 miles (5.2 km) south from Aguirre community	Not determined
Site 4	4.7 (7.6)	55 (17)	Designated as critical habitat for Elkhorn and Staghorn coral; softbottom and macroalgae present	1.7 miles (2.7 km) south of Las Mareas, Salinas; 3.1 miles (5 km) southeast of Salinas	Not determined

Source: NMFS, 2008; Tetra Tech, 2012; Tetra Tech, 2014a, 2014d

Proposed Site

The proposed site is located about 3,900 feet (1.2 km) southwest and directly offshore of the eastern tip of Cayos de Barca. From the proposed site, the pipeline would proceed northeast for about 0.9 mile (1.5 km), then turn northward through the Boca del Infierno pass for about 0.6 mile (1.0 km). Once through the Boca del Infierno pass, the pipeline would head northward through Jobos Bay for about 1.3 miles (2.1 km), then turn northwesterly for 1.2 miles (2.0 km), then turn west for 0.1 mile (0.2 km) where it would enter the Aguirre Plant from the east.

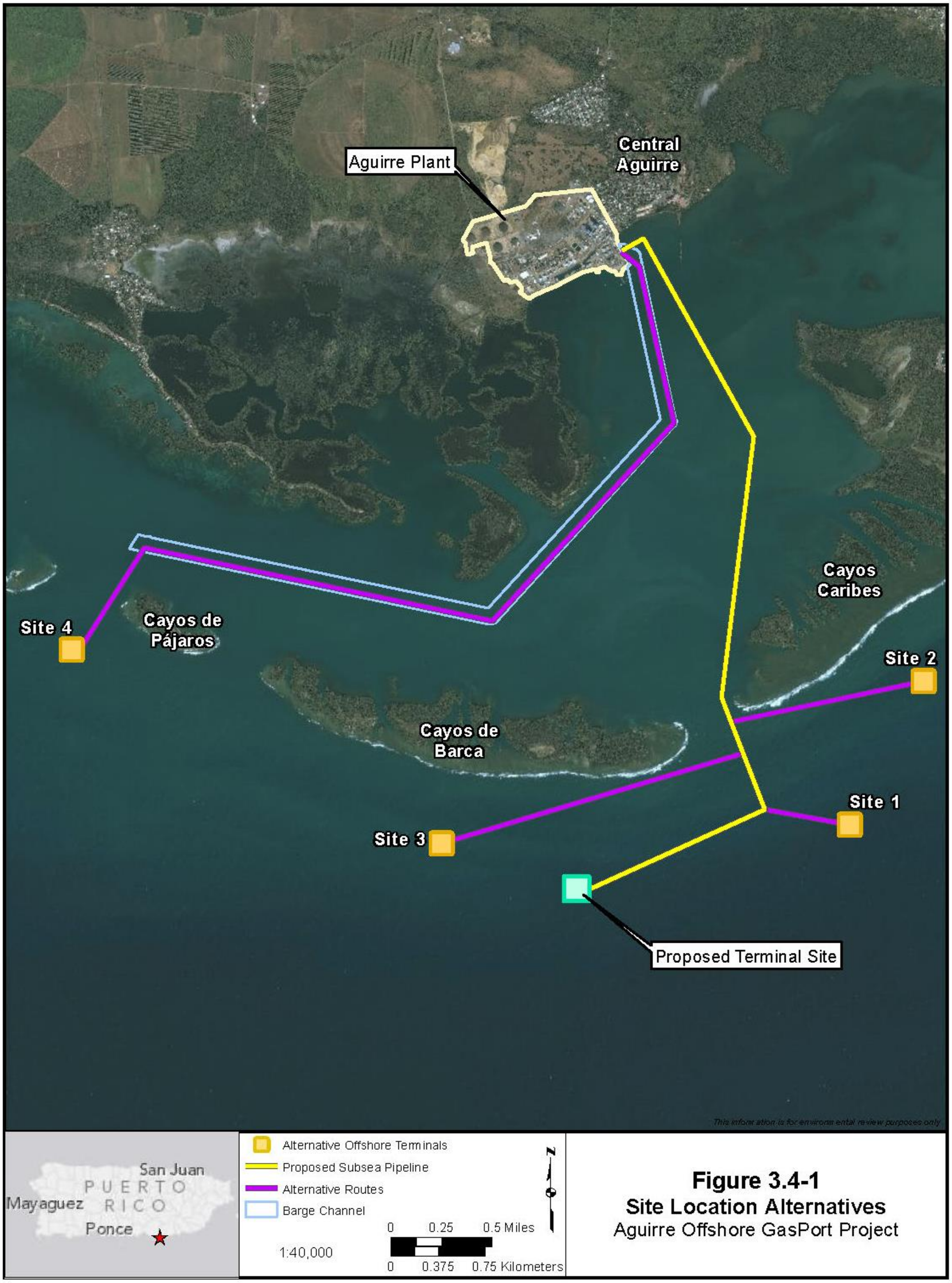


Figure 3.4-1
Site Location Alternatives
Aguirre Offshore GasPort Project

As presented and discussed in further detail in section 4.0 of this draft EIS, the proposed terminal site would encompass about 75.5 acres (77.7 cuerdas), of which 22.3 acres (23.0 cuerdas) would be permanently impacted. Construction activities would temporarily disturb 71.4 acres (73.5 cuerdas) of submerged aquatic vegetation (SAV) (e.g., seagrasses, macroalgae) and 4.1 acres (4.2 cuerdas) of coral reef habitat. Of these SAV and coral reef impacts, permanent habitat losses impact 22.1 and 1.1 acres (22.8 and 1.1 cuerdas), respectively. Coral reef habitat surveys for the alternative terminal sites were not conducted.

This site is located the greatest distance from the string of islands that separates the Jobos Bay and the Caribbean Sea. Due to its distance from population's centers as well as from the islands, it would have fewer impacts on recreational users of the area compared to the alternatives sites. In addition, it is the site located the furthest from population centers thus mitigating concerns over the safety zone imposed on the facility.

Site 1

Site 1 is located about 4,600 feet (1.4 km) southeast of the western tip of Cayos Caribes, offshore from the Boca del Infierno pass. From Site 1, the pipeline would proceed northwest for about 0.5 mile (0.8 km), then turn northward through the Boca del Infierno pass for about 0.6 mile (1.0 km). Once through the Boca del Infierno pass, the pipeline would follow the proposed route for the remaining 2.6 miles (4.2 km). The pipeline required for this site would be shorter than the proposed route but would cross the same coral reef habitat and other sensitive resources.

Site 1 is reasonably close to the Aguirre Plant and it is located in water depths that would accommodate the terminal operations. It is closer to a population center (Punta Pozuelo) than the proposed site and could create a visual impact on the community. In addition, this site is in an area that was noted to have a geologic anomaly during the geotechnical work completed by Aguirre LLC. For these reasons, we conclude that Site 1 is not be a reasonable alternative and does not provide a significant environmental advantage compared to the proposed site. Therefore, Site 1 was not evaluated further.

Site 2

Site 2 is located about 3,300 feet (1.0 km) southeast of the western tip of Cayos Caribes, offshore from the Boca del Infierno pass. From Site 2, the pipeline would proceed west for about 0.9 mile (1.5 km), then turn northward through the Boca del Infierno pass for about 0.6 mile (1 km). Once through the Boca del Infierno pass the pipeline would follow the proposed route for the remaining 2.6 miles (4.2 km). The pipeline length would be about the same length as the proposed route and it would cross the same coral reef habitat and other sensitive resources as the proposed pipeline.

This site is reasonably close to the Aguirre Plant and is in shallower water than the proposed site but still within the acceptable range for a LNG offshore terminal. Site 2 is closer to Punta Pozuelo than the proposed site and could create a visual impact on the community. There is less potential for a visual impact on the Central Aguirre community as Cayos Caribes lies between Site 2 and the community and the island would act as a visual barrier. Assuming the USCG would recommend a 500 yard (457 m) safety zone for Site 2 (see figure 3.4-2), there is greater potential for impact on recreational users as it is nearer to the shoreline of the islands, where more recreational users are present. These recreational users would be restricted from entering the safety zone without prior authorization from the COTP.

The environmental impacts associated with Site 2 would be greater than the proposed site due to the site's proximity to population centers, visual impacts, and recreational impacts. For these reasons, we conclude that Site 2 is not a reasonable alternative and does not provide a significant environmental advantage compared to the proposed site. Therefore, Site 2 was not evaluated further.

Figure 3.4-2
U.S. Coast Guard
Recommended Safety Zone
Aguirre Offshore GasPort Project

Site 3

Site 3 is located about 5,700 feet (1.7 km) southwest and directly offshore of the eastern area of Cayos de Barca. From Site 3, the pipeline would proceed east for about 1.6 miles (2.6 km) then turn north through the Boca del Infierno pass for about 0.6 mile (1.0 km). Once through the Boca del Infierno pass, the pipeline would follow the proposed route for the remaining 2.6 miles (4.2 km). The pipeline required for this site would cross the same coral reef habitat and other sensitive resources as the proposed route but would be longer and thus result in additional seafloor disturbance.

This site, similar to the proposed site, is reasonably close to the Aguirre Plant and is in a water depth that would accommodate the offshore terminal. The terminal site would be approximately 0.1 mile (0.2 km) directly closer to Central Aguirre and approximately 0.5 mile (0.8 km) further from Punta Pozuelo. The visual impact of this site would be similar to the proposed site as both sites are south of Cayos de Barca.

Assuming the USCG would also recommend a 500 yard (457 m) safety zone around Alternative Site 3 (see figure 3.4-2), there would be a greater impact on recreational boating and fishing resources as it is about 675 yards (617 m) south of the Cayos de Barca and about 300 yards (274 m) closer to the island than the proposed site. This nearshore location is less favorable as a high volume of recreational boating and fishing activity takes place here, and the site creates potential safety concerns due to its proximity to popular activities.

The environmental impacts associated with Site 3 would be comparable to the proposed site; however, there could be greater recreational impacts and safety concerns to individuals or groups utilizing the resources of Cayos de Barca. While Site 3 does not present any significant environmental advantages as compared to the proposed site, it is further evaluated in section 3.5 because the site presents additional pipeline routing options.

Site 4

Site 4 is located about 2,000 feet (0.6 km) southwest of Cayos de Pájaros. From Site 4, the pipeline would proceed northeast for about 0.6 mile (1.0 km) to the existing barge channel where it would proceed about 1.8 miles (2.9 km) east within the basin of Jobos Bay. The pipeline would then proceed northeast for about 1.3 miles (2.1 km) within the basin of Jobos Bay and turn north at about MP 3.7 northwest for 1.0 mile (1.6 km) to the Aguirre Plant property where it would interconnect with existing Aguirre Plant piping.

This site, similar to the proposed site, is reasonably close to the Aguire Plant and is in a water depth that would accommodate the offshore terminal. Due to its closer proximity to the communities and the mainland shoreline, Site 4 experiences greater use by recreational boating and fishing users. DNER staff monitoring land use in the area noted that Cayo Morrillo (an island 1.13 nautical miles to the west of Cayos de Pájaros) is intensively used by recreational boaters year round (Lilyestrom, 2014). Cayos de Pájaros is used for “spill-over” boats when Cayo Morrillo is overcrowded. As shown on figure 4.7.4-1, Cayos de Pájaros includes recreational areas for swimming, hiking, diving, and contains a public boat ramp. The DNER reports that the area is used by divers collecting the West Indian topshell for recreational and commercial use (Lilyestrom, 2014). The West Indian topshell is collected as a food source, fishing bait, and a unique black and white striped shell. The proximity of Site 4 to this community recreational resource makes it less environmentally preferable than the proposed site. This terminal site alternative would also increase the visual impacts to the region, as this site is approximately 1.5 miles (2.4 km) closer to the mainland than the proposed site.

Assuming that the USCG would recommend a 500 yard (457 m) safety zone for Site 4 (see figure 3.4-2), there would be greater impacts on recreational boating and fishing activities as the area between the two islands (Cayo Morrillo and Cayos de Pájaros) would be restricted and marine traffic would be required to traverse to the north of the island or further to the south to avoid the safety zone.

Site 4 would result in greater impacts on the recreational boating and fishing activities in the area, as well as create a greater visual impact than the proposed site. However, due to concerns about pipeline construction through the Boca del Infierno pass (which this alternative would avoid), Site 4, similar to Site 3, is further evaluated in section 3.5.

3.5 MAJOR PIPELINE ROUTE ALTERNATIVES

We received comments during scoping, as well as during our environmental review, from community members, Comité Diálogo Ambiental, NMFS, EPA, FWS, and DNER concerning impacts from the proposed pipeline route on federally threatened and endangered coral species, coral reef habitat, seagrass within Jobos Bay, and the Antillean manatee. During preliminary project planning, Aguirre LLC investigated several construction methods for the pipeline in Jobos Bay including trenching, HDD, and direct lay on the seafloor. Early in the pre-filing process, Aguirre LLC established its proposed construction method to be direct lay in an attempt to minimize impacts on sensitive resources in the Boca del Infierno pass and Jobos Bay. The EPA and NMFS suggested that the barge channel, currently used for oil barges to the Aguirre Plant[1], should be evaluated as an alternative location for the pipeline on the assumption that construction and operation impacts would be fewer because the barge channel area is previously disturbed. Following recommendations from the EPA, NMFS, and Puerto Rico regulatory agencies, Aguirre LLC completed additional review of Alternative Site 4 and several alternative pipeline routes. Aguirre LLC provided information on alternatives in its original application (April 2013), in a subsequent data response (June 2013), and in supplemental information filings provided in January, February, and March 2014. These additional filings provided specific information on potential construction methods for the pipeline route and environmental impacts from the construction of the alternative routes.

Due to the complexity of the Project that includes selection of an LNG terminal location and a connecting pipeline route, we chose to review a combination of alternative terminal sites (previously discussed in section 3.4) and pipeline routes. We used the core alternative criteria (technically and economically feasible and practical; offer significant environmental advantage over the proposed Project; and meet the proposed Project objectives) as well as proximity to the Aguirre Plant (to minimize the required pipeline length) to evaluate each site/pipeline alternative. Other objectives we used in analyzing each alternative was avoiding sensitive marine resources as well as areas of commercial and recreational value; avoiding population centers; and avoiding significant visual impacts on the existing viewscape.

The Project's objectives are to diversify the fuel supply to the Aguirre Plant while meeting the EPA MATS rule. Each of the terminal and pipeline route alternatives considered in this section would meet the Project's objectives. Terminal Sites 3, 4, and the Proposed Site along with variations of a subsea pipeline route were developed for further review as shown on figure 3.5-1. All five alternative pipeline routes avoid the Boca del Inferno pass crossed by the proposed pipeline route.

[1] There are no federally regulated shipping lanes in the vicinity of terminal site; traffic along the coast is mainly recreational and smaller sized fishing boats. There is a privately maintained navigational channel used by PREPA to deliver fuel oil to the Aguirre Plant.

Figure 3.5-1
Site Location Alternatives
Aguirre Offshore GasPort Project

Pipeline Installation Methods

An important factor in reviewing the pipeline route alternatives is the construction method to be used to install the pipeline. Traditionally, a subsea pipeline can be installed using the HDD construction method (water-to-water drill or water-to-land drill), trenching and backfill, or direct lay. The HDD construction method is commonly used to avoid sensitive resources, contaminated sediments, or areas where construction vessels may be hazardous. Directional drilling minimizes impacts on resources, but the process is not suitable to all areas. Aguirre LLC has not proposed the use of the HDD construction method; however, we are recommending in section 4.5.2.4 that Aguirre LLC assess the possibility of using an HDD to minimize impacts along the proposed route through the Boca del Inferno pass.

The HDD construction method has been in use since the 1970s as a means to install pipelines across rivers and at shore approaches to eliminate pipeline exposure from erosion and scour and to eliminate impacts on water quality from construction activities within the waterbody. This method allows for trenchless construction across an area by pre-drilling a hole well below the depth of a conventional pipeline lay and then pulling the pipeline through the pre-drilled borehole. Pipelines up to 60 inches (1.5 m) in diameter have been successfully installed using this method. The length of pipeline that can be installed by the HDD construction method depends upon soil conditions and pipe diameters and is limited by available technology and equipment sizes. A directional drilling rig would be set up and a small-diameter pilot hole would be drilled along a prescribed profile. Once the pilot hole is completed, it would be enlarged using reaming tools to provide access for the pipe. The reaming tools would be attached to the drill string at the exit point of the pilot hole and then rotated and drawn back to the drilling rig, thus progressively enlarging the pilot hole with each pass. During this process, drilling fluid consisting primarily of bentonite clay and water would be continuously pumped into the hole to remove cuttings and maintain the integrity of the hole. Once the hole has been sufficiently enlarged, the prefabricated segment of pipe would be attached behind the reaming tool on the exit side of the crossing and pulled back through the drill hole to the drill rig, completing the crossing.

At this time, the feasibility of an HDD through the Boca del Infierno pass is unknown and is contingent upon the geotechnical studies that Aguirre LLC would conduct pursuant to our recommendation in section 4.5.2.4. If the geotechnical studies show that the HDD construction method is feasible for the proposed route, it is likely that an HDD could be successful through the cays along any of the alternative routes, thereby balancing the associated impacts on coral reef habitat for all of the routes. Therefore, our analysis assumes a direct lay through the cays for the proposed route and each of the alternative routes for comparison.

Offshore pipeline trenching (to lower the pipeline) and backfill (to cover the pipeline) can be accomplished using plowing, jetting, or conventional bucket dredge construction methods. Plowing involves laying the pipeline on the bottom and then dragging a plow along the seafloor using the pipeline to guide the plow. The plow simultaneously casts the bottom sediment to the sides of the trench and lowers the pipeline into the trench. After the pipeline is placed in the trench, the plow is reversed and dragged along the trench, refilling the trench with the material cast out of the trench during plowing. In general, the advantage of plowing is that it creates less sediment resuspension (plume) than jetting or dredging. The disadvantage includes the large size of the plow and plow vessel, which creates a sizable area of disturbance from the anchorage requirements and water depth needed to successfully pull a plow. In addition, plowing requires a minimum water depth of 23 feet (7 m). In water depths of less than 23 feet (7 m), the plow would only be partially submerged and the increased weight creates a large increase in the pull force required. Most large barges with suitable equipment to pull a plow are unable to operate in waters less than 23 feet (7 m) deep.

Jetting involves using a hydraulic jet of ocean water to liquidize the sediments out of the trench, and then lowering the pipeline into the trench. The advantage of jetting is the ability to operate in shallower water depths than a plow. Jetting can also create a deeper trench by using multiple passes of the jetting sled, provided bottom sediments are suitable. Disadvantages of jetting include increased sediment plumes and potential trench slumping. Trench slumping would require additional jetting activities, resulting in further sedimentation and increasing risk of secondary impacts on SAV, corals, and marine wildlife. A jet plume can be suspended for a long period and can be transported over longer distances than the sediment plume from a plow or dredge operation. Small jet sleds can operate in shallow water depths; however, it requires a greater in-water construction duration as the jet sled speed is reduced (Bai and Bai, 2005; Ocean Engineering Systems, Undated).

Dredging involves removing material from the bottom to construct a trench for the pipeline, laying the pipeline in the trench, and then returning the dredged material to cover the pipeline or allowing natural currents to refill the trench. The advantage of dredging is its ability to remove a large volume of material, and ability to work in shallow water. The disadvantages include sedimentation and water quality impacts, and a longer in-water construction period.

The direct lay construction method fabricates the pipeline segments on pipe lay barges and lowers the pipeline to the seafloor using floats or other equipment to lay the pipeline. The direct lay method does not bury the pipeline. The advantage of direct lay is that the area of disturbance for construction of the pipeline is minimal when compared to other construction methods. The disadvantage of direct lay is the pipeline has a greater risk of being damaged from human or natural incidents that occur. To reduce this risk, Aguirre LLC proposes to coat the 18-inch-diameter (46 cm) pipe with 3 inches (8 cm) of concrete for an outside diameter of 24 inches (61 cm).

To review the alternatives, we considered plowing, jetting, dredging, and direct lay as potential construction methods for pipeline installation. Due to the size of operational vessels, plowing of the proposed pipeline route or any alternative routes would impact a large area of seafloor. In addition, there are areas along the route where the route depth is less than 23 feet (7 m) deep which could require dredging to attain the necessary depth to move the plow equipment through the area. Jetting would also require large equipment to pull the jet sled and impact a large area of seafloor; more critically, the jet sled would create sediment plumes with each successive pass of the jet sled, dispersing benthic materials over a large area. Both of these construction methods do not offer any environmental advantage over dredging or direct lay. Therefore, we reviewed the proposed route and alternative routes using the dredging and direct lay construction methods for pipe installation.

Potential Impacts Associated with Terminal Sites and Pipeline Routes

We developed our alternative terminal locations and pipeline routes based on the information provided by Aguirre LLC and recommendations from the COE, EPA, FWS, and DNER. We considered the following alternative terminal and subsea pipeline routes:

1. proposed site and proposed subsea pipeline route;

2. proposed site and subsea pipeline route alternative 1 runs to the northwest past Cayos de Pájaros, turning north between Cayos de Pájaros and Cayo Morrillo, and then turning northeast using the existing disturbed barge channel route to access the Aguirre Plant;

3. proposed site and pipeline route alternative 2 runs to the northwest past Cayos de Barca, turning north between the two cays (Cayos de Pájaros and Cayos de Barca), and then turning northeast using the existing disturbed barge channel route to access the Aguirre Plant;

4. Terminal Site 4 and pipeline route alternative 3 to the northeast turning to enter the existing disturbed barge channel route to access the Aguirre Plant;

5. Terminal Site 4 and pipeline route alternative 4 to the southeast past Cayos de Pájaros, turning north between the two cays (Cayos de Pajaros and Cayos de Barca), and then turning northeast using the existing disturbed barge channel route to access the Aguirre Plant; and

6. Terminal Site 3 and the pipeline route alternative 5 northwest past Cayos de Barca, turning north between the two cays (Cayos de Pájaros and Cayos de Barca), and then turning northeast using the existing disturbed barge channel route to access the Aguirre Plant.

Typically, the depth of burial of a pipeline is set by COE or DOT regulations and is dependent upon usage (e.g., fairway, federal channel) and water depth. In research on the barge channel, we (along with the COE and EPA) have determined that it is not a federally regulated barge channel. It is maintained by PREPA to allow for barge traffic to reach its facility. On June 23, 2014, PHMSA determined that the pipeline would be an interstate pipeline facility regulated by PHMSA under 49 CFR 192. Aguirre LLC has stated it intends to file a variance request for depth of burial. Therefore, for purposes of this alternative analysis and to calculate the area of disturbance, we conservatively applied the DOT regulations for pipeline depth for the alternative subsea pipeline routes that would traverse the existing barge channel (alternatives 1 through 5). The DOT regulations state a subsea pipeline will have a minimum of 3 feet (1 m) of cover. To achieve 3 feet (1 m) of cover, we assumed a trench depth of 5 feet (1.5 m) and a top of trench width of 40 feet (12 m) based on 3:1 side-slopes. The 40-foot (12 m) trench width represents the limits of the temporary construction impacts. Permanent impacts on the seafloor would consist of the 20-foot-wide (6 m) permanent right-of-way that Aguirre LLC would maintain easement for pipeline maintenance. Indirect impacts associated with sediment suspension, water quality impacts, and appropriate mitigation measures to minimize these impacts (silt curtains, use of the environmental bucket, etc.) would be further evaluated if any of the routes were found to be environmentally preferable. If PHMSA should determine that the pipeline for safety reasons would require a greater depth of cover than the 3-foot estimate used in this analysis, impacts on the environment could be greater.

Our analysis also assumed that the direct lay method along the proposed pipeline route or outside the barge channel would require a 20-foot-wide (6 m) construction area on the seafloor (6-foot-wide [2 m] corridor for permanent impacts and 14-foot-wide [4 m] for temporary impacts). In addition, we utilized the additional temporary workspace (ATWS) identified by Aguirre LLC for calculating the temporary construction impacts.

Table 3.5-1 summarizes the construction acreage impacts for the alternative terminal sites and associated pipeline routes. Each alternative's critical impact on environmental resources is summarized in table 3.5-2.

TABLE 3.5-1

Terminal and Pipeline Route Alternatives for the Aguirre Offshore GasPort Project

Selection Criteria	Alternatives: Proposed Terminal Site Proposed Pipeline	Proposed Terminal Site Pipeline Route 1	Proposed Terminal Site Pipeline Route 2	Terminal Site 4 Pipeline Route 3 [a]	Terminal Site 4 Pipeline Route 4 [a]	Terminal Site 3 Pipeline Route 5 [a]
Pipeline Length (miles [km])	4.1 (6.6)	7.4 (11.9)	6.1 (9.8)	4.6 (7.4)	4.9 (7.9)	5.4 (8.7)
Pipeline Construction Method (miles [km])						
Subsea Lay	4.1 (6.6)	3.4 (5.5)	2.8 (4.5)	0.6 (1.0)	1.6 (2.6)	2.1 (3.4)
Trenching	0.0	4.0 (6.4)	3.3 (5.3)	4.0 (6.4)	3.3 (5.3)	3.3 (5.3)
Area of Disturbance (acres [cuerdas])						
Terminal	75.5 (77.7)	75.5 (77.7)	75.5 (77.7)	75.5 (77.7)	75.5 (77.7)	75.5 (77.7)
Pipe Lay Direct [b]	9.9 (10.2)	8.2 (8.4)	6.8 (7.0)	1.5 (1.5)	3.9 (4.0)	5.1 (5.3)
Pipe Lay Trenching [c]	0.0	19.4 (20.0)	16.0 (16.5)	19.4 (20.0)	16.0 (16.5)	16.0 (16.5)
ATWS [d]	31.5 (32.4)	20.1 (20.7)	28.4 (29.2)	20.1 (20.7)	23.1 (23.8)	28.4 (29.2)
TOTAL	**116.9 (120.3)**	**123.2 (126.8)**	**126.7 (130.4)**	**116.5 (119.9)**	**118.5 (122.0)**	**125.0 (128.7)**

[a] Survey was not completed in all areas near Site 3 or Site 4; the assumed ATWS locations, and presence of coral reef and SAV were estimated based on surveyed area.

[b] Assumes a 20-foot-wide (6 m) area of disturbance for subsea pipeline installation, including temporary and permanent impacts.

[c] Assumes a 40-foot-wide (12 m) area of disturbance (based on top of trench width) for trenching pipeline installation, including temporary and permanent impacts.

[d] ATWS refers to the temporary workspace around the points of inflection and near the offshore approach to the Aguirre Plant.

Proposed Terminal Site and Proposed Route

The proposed terminal site would be located in at least 60 feet (18 m) of water approximately 3 miles (4.8 km) directly south of the southern coast of Puerto Rico. To deliver natural gas to the Aguirre Plant, a 4.1-mile (6.6 km) pipeline would be laid from the offshore terminal to interconnect with the plant’s piping. Aguirre LLC proposes to construct the pipeline on the seabed using a direct lay method. This installation method would result in the pipeline being laid directly on the sea floor, unburied or only partially buried by natural bottom sediments, depending on the sediment type. This installation method would result in less area of sea floor impact and associated water quality impact during construction as no disturbance of the area to bury the pipeline would be conducted. The proposed method would use crane barges, pipe lay barges, temporary piles and winches to pull the pipe into location. Construction details are provided in section 2.3 of this draft EIS. Further analysis of the proposed terminal site and route are provided in section 4.0 of this draft EIS.

Proposed Terminal Site and Alternative Pipeline Route 1

This alternative pipeline route is about 7.4 miles (11.9 km) in length, beginning at the proposed terminal (MP 0.0) and extending approximately 3.4 miles (5.5 km) offshore in a northwest direction before turning northeast between Cayo Morrillo and Cayos de Pájaros. The route then follows the existing barge channel across the basin of Jobos Bay to the Aguirre Plant property where the pipeline would interconnect with the power plant. Construction procedures for installation of the pipeline in open water outside Jobos Bay (between about MPs 0.0 and 3.4) would be the same as for the proposed route. The remaining 4.0 miles (6.4 km) would be within the barge channel, where trenching and burial of the pipeline would be required.

TABLE 3.5-2

Environmental Resources Affected From Proposed and Alternative Options for the Aguirre Offshore Gas Port Project

	Alternatives					
Selection Criteria	Proposed Terminal and Proposed Pipeline	Proposed Terminal and Pipeline Route 1	Proposed Terminal and Pipeline Route 2	Terminal Site 4 and Pipeline Route 3	Terminal Site 4 and Pipeline Route 4	Terminal Site 3 and Pipeline Route 5
Geology and Soils	Subsea lay would minimize soil disturbance.	Trenching would disturb greater quantities of soils.	Trenching would disturb greater quantities of soils.	Trenching would disturb greater quantities of soils.	Trenching would disturb greater quantities of soils.	Trenching would disturb greater quantities of soils.
Water Quality	Construction method for pipeline would suspend minimal quantities of sediment creating very short-term water plume.	Sediment suspension during dredging; unknown if sediments in channel are toxic. Suspended sediments may settle on SAV and mangroves.	Sediment suspension during dredging; unknown if sediments in channel are toxic. Suspended sediments may settle on SAV and mangroves.	Sediment suspension during dredging; unknown if sediments in channel are toxic. Suspended sediments may settle on SAV and mangroves.	Sediment suspension during dredging; unknown if sediments in channel are toxic. Suspended sediments may settle on SAV and mangroves.	Sediment suspension during dredging; unknown if sediments in channel are toxic. Suspended sediments may settle on SAV and mangroves.
Temporary Hardbottom and/or Coral Reef Habitat Impacts (acres [cuerdas])						
Terminal	4.1 (4.2)	4.1 (4.2)	4.1 (4.2)	0.0	0.0	0.0
Pipeline	1.1 (1.1)	2.4 (2.5)	1.1 (1.1)	1.5 (1.5)	0.7 (0.7)	1.1 (1.1))
ATWS	0.0	6.4 (6.6)	10.9 (11.3)	6.4 (6.6)	10.9 (11.2)	10.9 (11.2)
Permanent Coral Reef Impacts (acres [cuerdas])						
Terminal	0.2 (0.2)	0.2 (0.2)	0.2 (0.2)	0.0	0.0	0.0
Pipeline	0.3 (0.3)	0.5 (0.5)	0.3 (0.3)	0.2 (0.2)	0.2 (0.2)	0.3 (0.3)
Temporary SAV Impacts (acres [cuerdas])						
Terminal	71.4 (73.5)	71.4 (73.5)	71.4 (73.5)	3.3 (3.4)	3.3 (3.4)	23.7 (24.4)
Pipeline	5.3 (5.5)	1.7 (1.8)	1.3 (1.3)	0.7 (0.7)	0.3 (0.3)	0.3 (0.3)
ATWS	20.5 (21.1)	0.0	0.0	0.0	0.0	0.0
Permanent SAV Impacts (acres [cuerdas])						
Terminal	22.1 (22.8)	22.1 (22.8)	22.1 (22.8)	0.0	0.0	2.6 (2.7)
Pipeline	1.6 (1.7)	0.3 (0.3)	0.2 (0.2)	0.2 (0.2)	0.1 (0.1)	0.1 (0.1)
Visual Resources	Long-term impact would be minimal due to distance offshore.	Long-term impact would be minimal due to distance offshore.	Long-term impact would be minimal due to distance offshore.	Long-term impact would be greater as terminal would be located closer to shore and thus more visible to the area users and community.	Long-term impact would be greater as terminal would be located closer to shore and thus more visible to the area users and community.	Long-term impact would be greater as terminal would be located closer to shore and thus more visible to the area users and community.
Recreational Resources	Terminal and pipeline route have a low frequency of use due to their distance from shore.	Terminal has fewer users due to distance from shore. Pipeline located near shore would create greater impacts.	Terminal has fewer users due to distance from shore. Pipeline located near shore would create greater impacts.	Terminal and pipeline experience heavy use. Terminal safety zone would have a greater impacts on offshore area.	Terminal and pipeline experience heavy use. Terminal safety zone would have a greater impacts on offshore area.	Terminal and pipeline experience heavy use. Terminal safety zone would have a greater impacts on offshore area.

The route alternative crosses areas of SAV, consolidated reef, and unconsolidated reef[2]. As shown in figure 3.5-2, the longest SAV area crossed is directly adjacent and a continuation of the resources located at the terminal site. The consolidated reefs are located northwest of the Cayos de Barca and represents formations that support a diverse assemblage of reef inhabitants. The unconsolidated reef habitat near the barge channel where the route alternative turns to the northeast would require disturbance for the direct lay of pipe as well as the commencement of the dredging for the pipeline trench. In addition, ATWS would be required to complete the pipeline turn and to set up for construction.

Based on Project-specific surveys completed, construction of the pipeline along this alternative route would impact about 8.8 acres (9.1 cuerdas) of coral reef habitat, including 4.5 acres (4.6 cuerdas) of consolidated reef and 4.3 acres (4.5 cuerdas) of unconsolidated reef. This is about 7.7 acres (8.0 cuerdas) more than the mostly consolidated coral reef habitat that would be impacted by the proposed route. Seven federally listed or proposed species of coral were documented in the reef habitat crossed by the alternative route, while nine species were observed along the proposed route.

The alternative route would impact approximately 1.7 acres (1.8 cuerdas) of macroalgae and no seagrass, which is far less than the 25.8 acres (26.6 cuerdas) of SAV that would be impacted by the proposed route. Even still, we believe that the proposed route's impacts on SAV would not be significant because these impacts represent only a fraction of the existing SAV present in Jobos Bay. In addition, natural regrowth would mitigate most of the construction-related impacts, and Aguirre LLC has agreed to prepare a seagrass mitigation and monitoring plan, which would further minimize impacts (see section 4.5.2.4). This mitigation plan will be developed in compliance with the COE's mitigation requirements for the Project and reviewed by the COE, NMFS, FWS, DNER, and appropriate agencies.

Alternative Pipeline Route 1 would result in 47.7 acres (49.1 cuerdas) of disturbance, which is about 15 percent more than the proposed route (41.4 acres [42.6 cuerdas]). Over half of this alternative pipeline route is within the barge channel, which would require dredging, resulting in a greater suspension of sediments and thus impacting water quality in the short term. In addition, the route alternative is 3.3 miles (5.3 km) longer than the proposed route. A key criterion in route selection is the reasonably shortest possible route.

Impacts on visual resources for this alternative would be the same as the proposed terminal and pipeline route. This pipeline route alternative passes near and between Cayo Morrillo and Cayos de Pájaros, potentially impacting the recreational uses and commercial uses mentioned previously in the description of Alternative Site 4. Therefore, this alternative route's impacts on recreational and commercial uses would be greater than that of the proposed route.

Due to the coral reef habitat impacts, water quality impacts, recreational and commercial impacts, and longer pipeline length, there are no environmental advantages to this route alternative. For these reasons, we conclude that Alternative Pipeline Route 1 does not provide any significant environmental advantage over the proposed pipeline route.

[2] The consolidated reef habitat is characterized by well-developed low relief consolidated hardbottom formations supporting a rich and diverse assemblage of reef inhabitants. The unconsolidated reef is characterized by well integrated, low relief discontinuous hardbottom (rubble and rock out croppings), supporting a variety of sessile and motile organisms. Coverage and species richness observed during the benthic surveys were generally higher within the consolidated reef when compared to the unconsolidated reef. Stony coral cover was estimated to be 5 to 50 percent within the consolidated reef and less than 5 percent in the unconsolidated.

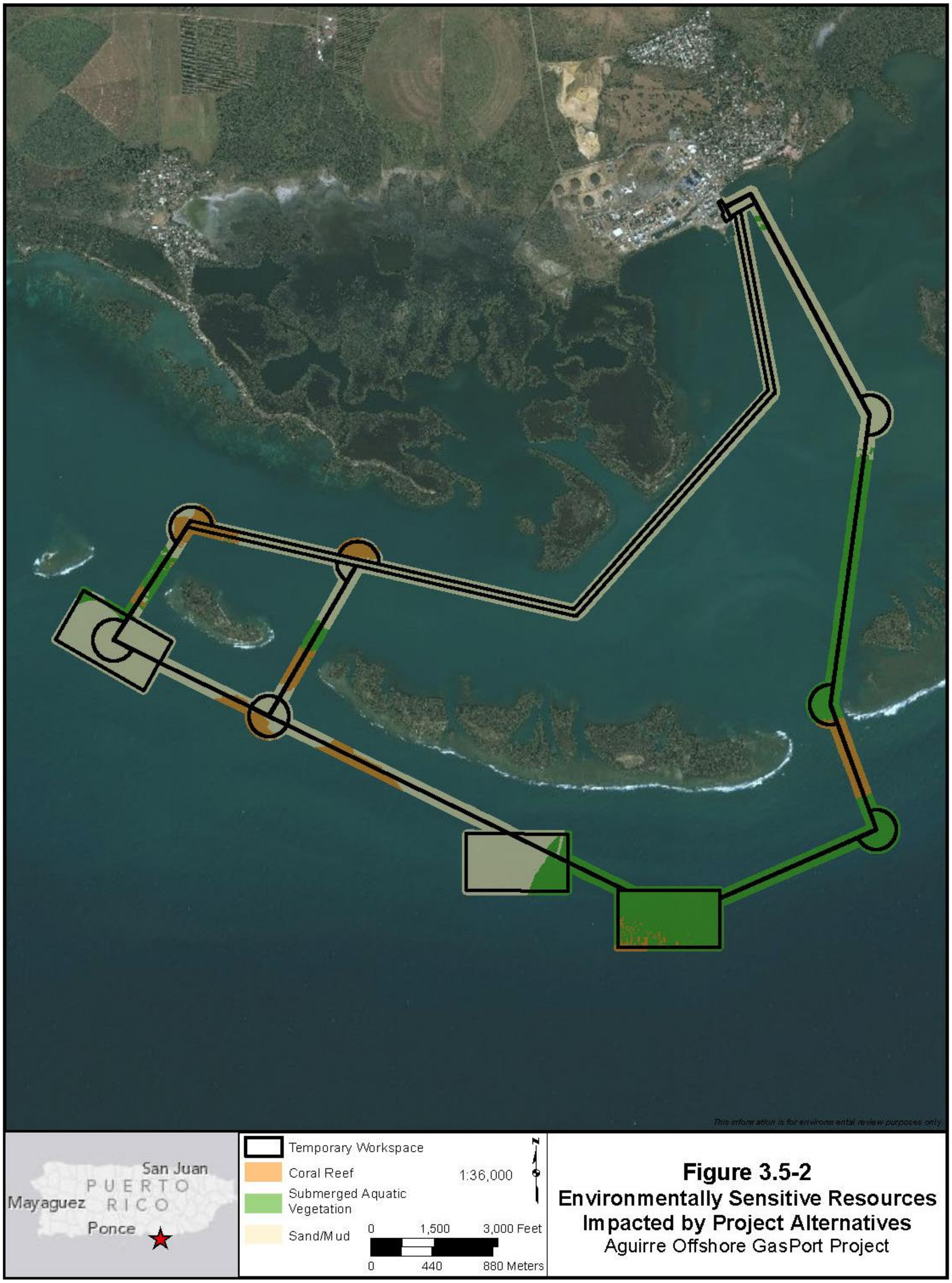


Figure 3.5-2
Environmentally Sensitive Resources Impacted by Project Alternatives
Aguirre Offshore GasPort Project

Proposed Terminal Site and Alternative Pipeline Route 2

This alternative pipeline route is about 6.1 miles (9.8 km) in length, beginning at the proposed terminal (MP 0) and extending approximately 2.8 miles (4.5 km) offshore in a northwest direction before turning northeast between Cayos de Barca and Cayos de Pájaros. The route then follows the existing barge channel across the basin of Jobos Bay to the Aguirre Plant property where the pipeline would interconnect with the power plant. Construction procedures for installation of the pipeline in open water outside Jobos Bay (between about MPs 0.0 and 2.8) would be the same as for the proposed route (e.g., direct lay). The remaining 3.3 miles (5.3 km) would be within the barge channel, where trenching and burial of the pipeline would be required.

Similar to the previous route alternative, this route alternative crosses areas of SAV, consolidated reef, and unconsolidated reef. As shown in figure 3.5-2, the longest SAV area crossed is directly adjacent and a continuation of the resources found at the terminal site. This alternative route crosses coral reef habitat in both the direct lay area as well as the trenching area. The pipeline would require ATWS in a coral rich environment to enable the pipeline to make the turn to the northeast and approach the barge channel. Construction of the pipeline in the barge channel would impact the water quality in the short term as sediment would be suspended during the construction period.

Based on Project-specific surveys completed, construction of the pipeline along this alternative route would impact approximately 12.0 acres (12.4 cuerdas) of coral reef habitat, including 5.9 acres (6.1 cuerdas) of consolidated reef and 6.1 acres (6.3 cuerdas) of unconsolidated reef. This is approximately 10.9 acres (11.2 cuerdas) more than the mostly consolidated coral reef habitat that would be impacted by the proposed route. Eight federally listed or proposed species of coral were documented in the reef habitat crossed by this alternative route, while nine species were observed along the proposed route.

Construction of the alternative route would impact approximately 1.1 acres (1.1 cuerdas) of macroalgae and 0.2 acre (0.2 cuerda) of seagrass, which is far less than the 25.8 acres (26.6 cuerdas) of SAV that would be impacted by the proposed route. Even still, we believe that the proposed route's impacts on SAV would not be significant because these impacts represent only a fraction of the existing SAV present in Jobos Bay. In addition, natural regrowth would mitigate most of the construction-related impacts, and Aguirre LLC has agreed to prepare a seagrass mitigation and monitoring plan, which would further minimize impacts (see section 4.5.2.4). This mitigation plan will be developed in compliance with the COE's Mitigation Rule and reviewed by the COE, NMFS, FWS, and appropriate agencies.

Impacts on visual resources for this alternative would be the same as the proposed terminal and pipeline route. This pipeline route alternative passes near and between Cayos de Pájaros and Cayos de Barca. As noted previously in the description of Site 3, a high volume of recreational boating and fishing activity takes place near Cayos de Barca. Therefore, greater recreational impacts could occur from this alternative pipeline route in comparison to the proposed route.

Alternative Pipeline Route 2 would result in 51.2 acres (52.7 cuerdas) of disturbance, which is about 24 percent more than the proposed route (41.4 acres [42.6 cuerdas]), with impacts on sensitive habitats, including federally protected coral species. In addition, this route alternative is two miles (3.2 km) longer than the proposed route. Therefore, for the reasons cited above, we conclude that Alternative Pipeline Route 2 does not offer any significant environmental advantage over the proposed pipeline route.

Terminal Site 4 and Alternative Pipeline Route 3

Terminal Site 4 with Alternative Pipeline Route 3 assumes that Aguirre LLC constructs its offshore terminal at Site 4 using similar construction techniques as for the proposed site. As previously noted, Site 4 does not present any environmental advantage over the proposed site. However, due to concerns regarding the proposed pipeline route, Site 4 with Alternative Pipeline Route 3 could be a reasonable alternative.

From Site 4, the route alternative is about 4.6 miles (7.4 km) in length, beginning outside of Jobos Bay (MP 0) and extending approximately 0.6 mile (1 km) offshore northeast between Cayo Morrillo and Cayos de Pájaros. The route turns east to follow the existing barge channel across the basin of Jobos Bay to the Aguirre Plant property where it would interconnect with power plant piping (see figure 3.5-1). As currently conceived, 4.0 miles (6.4 km) of this alternative route is directly within the barge channel.

From Site 4 to the barge channel, the pipeline would be installed using the direct lay method. Once the pipeline is in the barge channel, the pipeline would be installed using trench and backfill construction techniques to a turning basin at the Aguirre Plant where it would connect with onshore piping.

Based on Project-specific surveys completed, construction of the pipeline along this alternative route would impact approximately 7.9 acres (8.1 cuerdas) of coral reef habitat, including 3.6 acres (3.7 cuerdas) of consolidated reef and 4.3 acres (4.4 cuerdas) of unconsolidated reef. This is approximately 6.8 acres (7.0 cuerdas) more than the mostly consolidated coral reef habitat that would be impacted by the proposed route. Four federally listed or proposed species of coral were documented in the reef habitat crossed by the alternative route, while nine protected species were observed along the proposed route.

The alternative route would impact approximately 0.7 acre (0.7 cuerda) of macroalgae and no seagrass, which is far less than the 25.8 acres (26.6 cuerdas) of SAV that would be impacted by the proposed route. Even still, we believe that the proposed route's impacts on SAV would not be significant because these impacts represent only a fraction of the existing SAV present in Jobos Bay. In addition, natural regrowth would mitigate most of the construction-related impacts, and Aguirre LLC has agreed to prepare a seagrass mitigation and monitoring plan, which would further minimize impacts (see section 4.5.2.4). This mitigation plan will be developed in compliance with the COE's Mitigation Rule and reviewed by the COE, NMFS, FWS, and appropriate agencies.

Alternative Pipeline Route 3 would result in 41.0 acres (42.2 cuerdas) of disturbance, which is slightly less than the proposed route (41.4 acres [42.6 cuerdas]). However, the area crossed by this route alternative would disturb more overall area of coral reef habitat than the proposed route.

In addition to the coral reef impact, Alternative Pipeline Route 3 passes between Cayo Morrillo and Cayos de Pájaros, potentially impacting the recreational uses and commercial uses in this area. As mentioned previously in the description of Terminal Site 4, the area around these cays is used intensively for recreational and commercial uses. Siting the offshore terminal at this location would restrict these uses, and marine traffic would be required to traverse to the north of the cay or further to the south to avoid the USCG safety zone. This terminal site alternative would also increase the visual impacts on the region, as this site is approximately 1.5 miles (2.4 km) closer to the mainland than the proposed site.

For the reasons presented above, we conclude that Terminal Site 4 with Alternative Pipeline Route 3 does not present any significant environmental advantages compared to the proposed Project.

Terminal Site 4 and Alternative Pipeline Route 4

Terminal Site 4 with Alternative Pipeline Route 4 assumes that Aguirre LLC constructs its offshore terminal at Site 4 using similar construction techniques as for the proposed site. From Site 4, the route alternative proceeds to the southeast offshore of Cayos de Pájaros and turns northeast between Cayos de Pájaros and Cayos de Barca for a total of 1.6 miles (2.6 km). The route then turns east to follow the existing barge channel across the basin of Jobos Bay to the Aguirre Plant property for about 3.3 miles (5.3 km), where the pipeline would interconnect with power plant piping (see figure 3.5-1). As currently conceived, this alternative would require about 4.9 miles (7.9 km) of pipeline.

From the terminal to the barge channel, the pipeline would be installed using the direct lay method between Cayos de Pájaros and Cayos de Barca. Once the pipeline is in the barge channel, the pipeline would be installed using trench and backfill construction techniques for approximately 3.3 miles (5.3 km) to a turning basin at the Aguirre Plant where it would connect with onshore piping.

Based on Project-specific surveys completed, construction of the pipeline along this alternative route would impact approximately 11.6 acres (12.0 cuerdas) of coral reef habitat, including 5.5 acres (5.7 cuerdas) of consolidated reef and 6.1 acres (6.3 cuerdas) of unconsolidated reef. This is approximately 10.5 acres (10.8 cuerdas) more than the mostly consolidated coral reef habitat that would be impacted by the proposed route. Eight federally listed or proposed species of coral were documented in the reef habitat crossed by the alternative route, while nine protected species were observed along the proposed route. The alternative route would impact approximately 0.1 acre (0.1 cuerda) of macroalgae and 0.2 acre (0.2 cuerda) of seagrass, which is far less than the 25.8 acres (26.6 cuerdas) of SAV that would be impacted by the proposed route.

Alternative Pipeline Route 4 is almost 1 mile (1.6 km) longer than the proposed route; however the acreage of disturbance along Route 4 is only slightly higher than the proposed route. Alternative Pipeline Route 4 would result in 43.0 acres (44.3 cuerdas) of disturbance compared to 41.4 acres [42.6 cuerdas] of the proposed route.

In addition to the coral reef impact, Alternative Pipeline Route 4 passes near and between Cayos de Pájaros and Cayos de Barca, potentially impacting the recreational uses and commercial uses mentioned previously in the description of Alternative Site 4. Adding to these impacts, installing the terminal at Site 4 would further restrict recreational and commercial uses in the area to avoid the USCG safety zone. Finally, this terminal site alternative would introduce compratively greater visual impacts to the region compared to the proposed site, as detailed earlier in the description of Alternative Site 4.

For the reasons presented above, we conclude that Terminal Site 4 with Alternative Pipeline Route 4 does not present any significant environmental advantages compared to the proposed Project.

Terminal Site 3 and Alternative Pipeline Route 5

Terminal Site 3 with Alternative Pipeline Route 5 assumes that Aguirre LLC constructs its offshore terminal at Site 3 using similar construction techniques as for the proposed site. From Site 3, the route alternative proceeds to the northwest offshore of Cayos de Barca and turns northeast between Cayos de Pájaros and Cayos de Barca for a total of 2.1 miles (3.4 km). The route then turns east to follow the existing barge channel across the basin of Jobos Bay to the Aguirre Plant property for about 3.3 miles (5.3 km), where the pipeline would interconnect with power plant piping (see figure 3.5-1). As currently conceived, this alternative would require about 5.4 miles (8.7 km) of pipeline.

From the terminal to the barge channel, the pipeline would be installed using the direct lay method between Cayos de Pájaros and Cayos de Barca. Once the pipeline is in the barge channel, the pipeline would be installed using trench and backfill construction techniques for approximately 3.3 miles (5.3 km) to a turning basin at the Aguirre Plant where it would connect with onshore piping.

Based on Project-specific surveys completed, construction of the pipeline along this alternative route would impact approximately 12.0 acres (12.4 cuerdas) of coral reef habitat. This is approximately 10.9 acres (11.2 cuerdas) more than the mostly consolidated coral reef habitat that would be impacted by the proposed route. Eight federally listed or proposed species of coral were documented in the reef habitat crossed by the alternative route, while nine protected species were observed along the proposed route. The alternative route would impact approximately 0.3 acre (0.3 cuerda) of SAV, which is less than the 25.8 acres (26.6 cuerdas) of SAV that would be impacted by the proposed route.

Similarly, Alternative Pipeline Route 5 is over 1 mile (1.6 km) longer than the proposed route. A key criterion in route selection is the reasonably shortest route possible. This Alternative Route would result in 49.5 acres (51.0 cuerdas) of disturbance, which is about 20 percent more than the proposed route (41.4 acres [42.6 cuerdas]).

In addition to the coral reef impact, Alternative Pipeline Route 5 passes near and between Cayos de Pájaros and Cayos de Barca, potentially impacting the recreational uses and commercial uses discussed previously. Adding to these impacts, installing the terminal at Site 3 would further restrict recreational and commercial uses in the area to avoid the USCG safety zone. Finally, this terminal site alternative would introduce compratively greater visual impacts to the region compared to the proposed site, as detailed earlier in the description of Alternative Site 3.

For the reasons presented above, we conclude that Terminal Site 3 with Alternative Pipeline Route 5 does not present significant environmental advantages compared to the proposed Project.

We reviewed the potential terminal sites and route alternatives for delivering natural gas to meet the Project objective. Each alternative resulted in impacts on environmental resources. Our analysis determined that the proposed route with appropriate mitigation measures would be environmentally preferable compared to each alternative. No one single alternative considered was better than the proposed site and route combination. In addition, none of the alternative site/route combinations would offer any significant environmental advantage over the proposed terminal and pipeline route, even considering a successful HDD of any of the alternative routes because of the other negative or problematic impacts associated with these alternatives. Therefore, we eliminated these alternatives from further consideration.

3.6 PIPELINE ROUTE VARIATIONS FROM THE PROPOSED TERMINAL SITE

Route variations differ from route alternatives in that they are typically shorter in length and do not deviate as far from the propose route as route alternatives, and they are identified to resolve or reduce construction impacts on localized, specific resources such as cultural resource sites, wetlands, recreational lands, residences, landowner requests, and terrain conditions. Because route variation are identified in response to local concerns, they are often the result of landowner comments and may not always clearly display an environmental advantage other than reducing or avoiding impacts on specific features. We have considered a variety of factors in evaluating route variations for the proposed Project, including length, land requirements, resources crossed, and potential for reducing or minimizing resource impacts.

We reviewed three pipeline route variations from the proposed terminal site to the Aguirre Plant. Each of the three route variations was reviewed to determine if a route that was shorter or crossed fewer sensitive resources could be identified. For each route variation, we considered the pipeline length, number of bends in the pipeline, disturbance of SAV (e.g., seagrasses, macroalgae) and coral reef habitat, and direct landfall to the Aguirre Plant. Table 3.6-1 compares the proposed route to the three pipeline route variations (see also figure 3.6-1).

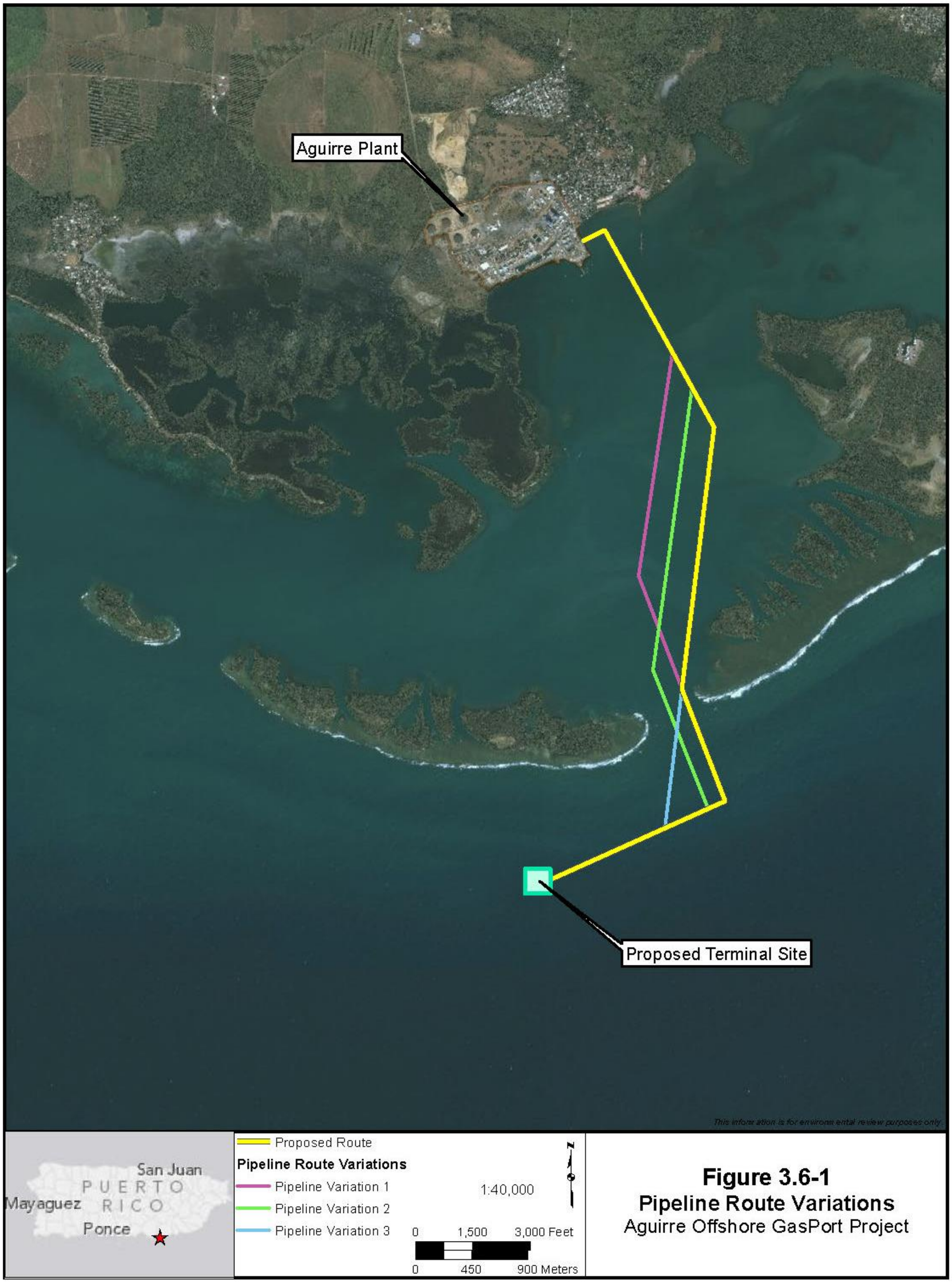


Figure 3.6-1
Pipeline Route Variations
Aguirre Offshore GasPort Project

TABLE 3.6-1

Pipeline Route Variations from the Proposed Terminal Site for the Aguirre Offshore Gas Port Project

Route from Proposed Terminal	Offshore Pipeline Length (miles [km])	Sensitive Habitat Crossed [a]	Commentary
Proposed Route	4.2 (6.8)	0.73 mile (1.2 km) of SAV 0.37 mile (0.6 km) of coral reef habitat	
Route Variation 1	4.2 (6.8)	0.96 mile (1.5 km) of SAV 0.43 mile (0.7 km) of coral reef habitat	Similar impacts to proposed route; no advantage to constructing route variation 1.
Route Variation 2	4.2 (6.8)	0.93 mile (1.5 km) of SAV 0.39 mile (0.6 km) of coral reef habitat	Crosses additional areas of coral reef habitat; no advantage to constructing route variation 2.
Route Variation 3	3.9 (6.3)	0.76 mile (1.2 km) of SAV 0.36 mile (0.6 km) of coral reef habitat	Shorter route than proposed; one less bend in the pipe; but based on habitat crossed, no environmental advantage to constructing route variation 3.

[a] Based on Whitall et al., 2011.

Following review of the pipeline route variations from the proposed terminal, no one variation provided any greater protection to the environment compared to the proposed route. The proposed route does impact coral reef habitat as well as SAV; however, Aguirre LLC has proposed mitigation that would minimize these impacts (see section 4.5). Therefore, we conclude that none of the route variations identified would provide significant environmental advantages over the proposed Project route and were not evaluated further.

3.7 LNG VAPORIZATION ALTERNATIVES

There are three available heating methods used to vaporize the LNG: burning part of the vaporized LNG, using the surrounding seawater to warm the LNG, or using the surrounding air to warm the LNG. Any of these warming media can be used directly to warm LNG or can warm an intermediate fluid that then warms the LNG. Burning part of the LNG and no use of ambient seawater is generally referred to as a closed-loop system. Using the surrounding seawater in a once-through system to warm the LNG is generally referred to as an open-loop system. Using ambient air to warm LNG is referred to generally as ambient air vaporization. There are several commercially tested vaporization systems currently used as heat exchangers to vaporize LNG: submerged combustion vaporizers, shell-and tube vaporizers, open rack vaporizers, and ambient air vaporization equipment with or without backup heating systems (usually submerged combustion vaporizers). Vaporization systems can be configured in numerous ways to use one or more of the available heat sources to vaporize LNG.

Aguirre LLC has proposed to operate the FSRU in closed-loop mode. In the closed-loop mode, steam from the FSRU propulsion steam boilers is used to heat fresh water circulated through the shell-and-tube vaporizers to regasify the LNG. There is no seawater intake or discharge used specifically for the regasification process in the closed-loop mode. The closed-loop mode is preferred by federal and state regulatory agencies due to reduced entrainment impacts. No further review of alternative gasification systems was conducted.

4.0 ENVIRONMENTAL ANALYSIS

4.1 GEOLOGIC RESOURCES

4.1.1 Physiographic and Geologic Setting

Puerto Rico is at the eastern end of the Greater Antilles island chain that runs from Cuba to the Virgin Islands along the northern margin of the Caribbean Sea (see figure 4.1.1-1). This 3,514 square mile (mi^2) (9,101 square kilometer [km^2]) island consists of mainly mountainous terrain with lowland areas along the coasts. An east-west trending mountain chain called the Cordillera Central divides the island and has peaks up to approximately 4,200 feet (1,280 m) in elevation. The major geologic units on the island consist of Jurassic to Eocene volcanic, volcaniclastic, and plutonic rocks, which are overlain by younger Oligocene to recent-aged carbonates and other sedimentary rocks.

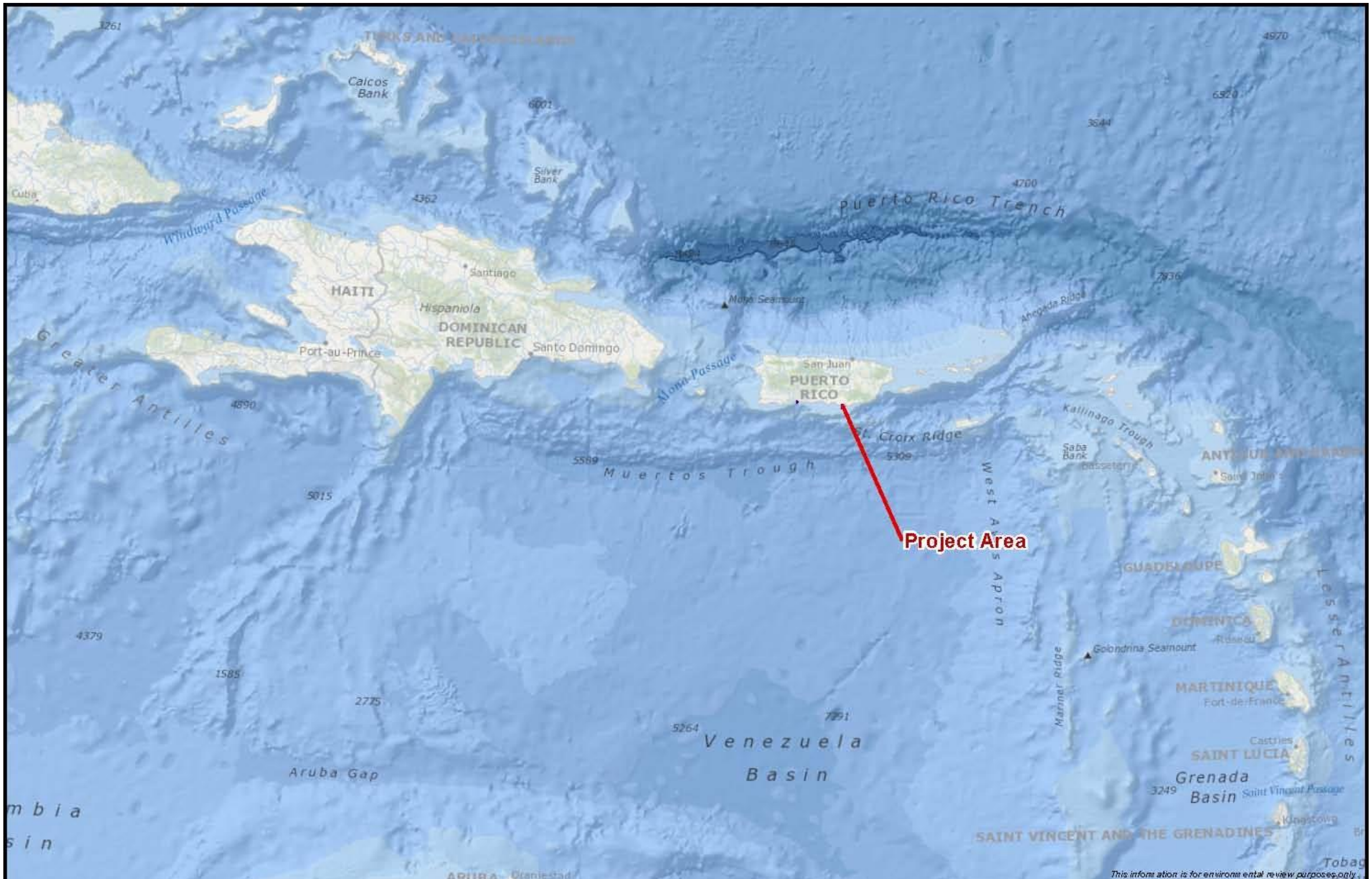
Coastal plains formed by erosion of the Cordillera Central make up much of the island's coastal zone. The central south coast of Puerto Rico consists of a series of Pleistocene age fan deltas formed by erosion, transport, and deposition of terrigenous sediment from rivers flowing from the mountains into a series of seaward-sloping, fan-shaped deposits. The fan deltas in the region of Jobos Bay were formed by flow of the Rio Seco and the Rio Salinas over bedrock of Cretaceous to early Paleogene age (Renken et al., 2002). Most of the land surface of these south coast fan deposits is less than 164 feet (60 m) above sea level and slopes gently seaward (Renken et al., 2002). The coastal fringes of these fan deltas are typically made up of beach deposits, mangrove swamps, marsh, or scrub flats where protected by offshore fringing reefs.

The nearshore bathymetry along the southern coast of Puerto Rico is dominated by an extensive insular shelf that extends outwards more than 9 miles (14.5 km) in some areas. The shelf provides for shallow nearshore waters that abruptly increase to over 1,500 feet (457 m) deep, seaward of the shelf break (NOAA, 2013a). The Project facilities would be well within the insular shelf with water depths ranging from approximately 60 feet (8 m) near the proposed offshore terminal site to 8 feet (2.5 m) near landfall at the Aguirre Plant. Water depths along the majority of the subsea pipeline range from 10 to 25 feet (3 to 8 m).

4.1.2 Mineral Resources

The predominant mineral resources in Puerto Rico include portland cement, crushed stone, lime, salt, and common clay. In 2009, Puerto Rico's nonfuel raw mineral production was valued at $72 million, which is $26 million less than the 2008 value (U.S. Geological Survey [USGS], 2009a). Based on a review of USGS topographic maps, recent aerial photography, and available USGS databases, no active mining operations are within 0.5 mile (0.8 km) of the onshore portion of the Project (USGS, 2005a; USGS, 2005b).

As a result of past and current construction activities, onshore sources of sand and gravel in Puerto Rico are limited. Based on reconnaissance geologic mapping conducted by the USGS, three offshore sand and gravel deposits were identified on the insular shelf of Puerto Rico. The closest deposit is located off the northwest corner of the Island of Vieques, approximately 40 miles (64 km) east of the Project area (Rodriguez, 2003).



1:6,765,768

0 100 200 Miles

0 2,900 5,800 Kilometers

N

Figure 4.1.1-1

Location of Puerto Rico in the Greater Antilles Island Chain

Aguirre Offshore GasPort Project

4.1.3 Geologic and Other Natural Hazards

Geologic hazards are natural, physical conditions or events that can result in damage to land and structures or injury to people. The geologic hazards examined for the Project include seismicity, fault offsets, liquefaction, tsunamis, volcanic eruptions, and karst terrain. Other natural hazards examined include hurricane winds and waves. Aguirre LLC has investigated the potential hazards in the Project area and has proposed associated design features and mitigation measures (discussed below) that would be implemented to minimize or avoid impacts.

4.1.3.1 Seismicity

Puerto Rico is located along the northern edge of the Caribbean tectonic plate, which encompasses much of Central America and the Greater and Lesser Antilles. The Caribbean plate is sandwiched between the North and South American plates to the north, south, and east, and the Cocos and Nazca plates to the west. The Caribbean plate moves eastward relative to the North and South American plates (Jansma et al., 2000) which results in faulting, earthquakes, and volcanoes along the plate margins. Plate interactions affecting Puerto Rico occur in an approximately 155-mile-wide (250 km) region of deformation between the Puerto Rico Trench to the north of the island and the Muertos Trough to the south (see figure 4.1.1-1). Puerto Rico and the Virgin Islands are situated on a shallow submarine bank within this wide deformational zone (Mueller et al., 2010). The Project area falls within what is known as the Great Southern Puerto Rico Fault Zone (GSPRFZ), a region of multiple, nearly parallel, faults trending northwest to southeast across the island. These fault zones are now considered largely quiescent, although they seem to be associated with very small earthquakes, and may represent inherited zones of weakness (McCann, 1985). Although the GSPRFZ is not considered a significant seismic source, other seismic sources in the region are present and therefore the Project is considered to be in an area of moderately high seismicity.

We received a comment from Captain Jimmy Vazquez-Aran that cited a study performed by the USGS in conjunction with the University of Mayaguez. This study, which could not be located, reportedly identified seismic activity 12 miles northeast of the Project between 1986 and 2008. This comment also described how magnitude earthquakes in the 2.3 to 3.0 range would cause strong ground shaking. However, it is not common for magnitude 3 earthquakes to cause strong ground shaking. One of the standards for ground shaking is the Modified Mercalli Scale which shows that Richter magnitudes in the range of 2 to 3 are felt by few people (Michigan Tech, 2007).

The island of Puerto Rico has a long history of damaging earthquakes. At least 12 major earthquakes of magnitude 7.0 or greater have occurred in the Caribbean near Puerto Rico, the U.S. Virgin Islands, and the island of Hispaniola in the past 500 years (Woods Hole Oceanographic Institution, 2005). The closest significant earthquake to the Project area occurred in 1999 approximately 6 miles (10 km) east of the proposed offshore berthing platform. This event had a magnitude of 4.0 and a Modified Mercalli Intensity of VI (USGS, 2009b). An event such as this in the Project area would be felt but would result in little or no damage.

Golder Associates, Inc. (Golder) performed a site-specific probabilistic seismic hazard analysis (PSHA) for the offshore marine terminal site (Golder, 2013a). Golder identified 11 potential seismic sources within about 190 miles of the proposed site. The sources are based on Golder’s review of the available published data, and reports and maps that describe the tectonics, seismicity, and seismic hazards for the site and surrounding region. Golder’s review incorporated the offshore geophysical survey study by C&C Technologies, Inc. (C&C) and included additional literature research. Of the 11 seismic sources, two are subduction zone sources, eight are offshore and onshore crustal faults, and one is a background area source.

The potential ground motions at the site are dominated by those sources with largest magnitudes and/or at the closest distances, particularly those with high rates of coseismic slip (i.e., the shortest recurrence intervals for the maximum magnitude events). As shown in figure 4.1.3-1, the dominant seismic sources in the Project area are:

- North American-Caribbean Interface and Interslab Seismic Zone Sources (part of the Puerto Rico Trench Fault Zone)
- Offshore Crustal Faults:
  - Investigator Faults,
  - Muertos Trough Fault Zone,
  - Anegada Passage Fault Zone,
  - Mona Passage Fault Zone,
  - Bowin Fault,
  - Septentrional Fault; and
- Onshore Crustal Faults:
  - Great Northern Puerto Rico Fault Zone,
  - Cerro Goden Fault,
  - South Lajas Fault; and
- Crustal Area Source associated with unidentified or buried faults in the upper crust beneath Puerto Rico

It should be noted that Golder did not explicitly include the GSPRFZ in the seismic source model because trenching studies indicated there was poor evidence of Quaternary surface fault rupture.

The Golder PSHA analysis indicates that primary contribution of the various seismic sources to the probabilistically determined ground motion depends on the on the level of shaking and spectral acceleration (SA) period of interest. The largest contribution for the peak ground acceleration (PGA) and 0.2s spectral acceleration hazard levels of shaking (SA less than 10 percent of gravity) are intraslab events. These accelerations have return periods of less than 100 years. For the intermediate levels of shakings (SA from 10 to 25 percent of gravity) the largest contribution for the PGA and 0.2s spectral acceleration is the Crustal Area Source. These accelerations have return periods from approximately 100 years to 2,500 years. For the highest level of earthquake shaking (SA greater than 25 percent of gravity) the largest contribution for the PGA and 0.2s spectral acceleration hazard is from the Investigator Faults. The Los Muertos Trough and Investigator Faults contribute the largest proportions to the seismic hazard for long period spectral accelerations greater than about 10 percent of gravity.

A geotechnical investigation of the offshore terminal site completed by Golder during the pre-feasibility design identified areas of loose soils that could be subjected to liquefaction during an intense seismic event. Based on these subsurface investigations, the offshore site sediment profile was classified as being Site Class F. American Society of Civil Engineers (ASCE) 7-05 indicates that spectral values for Site Class F should not be taken less than 80 percent of those determined for the same location assuming site coefficients for soil Site Class E.

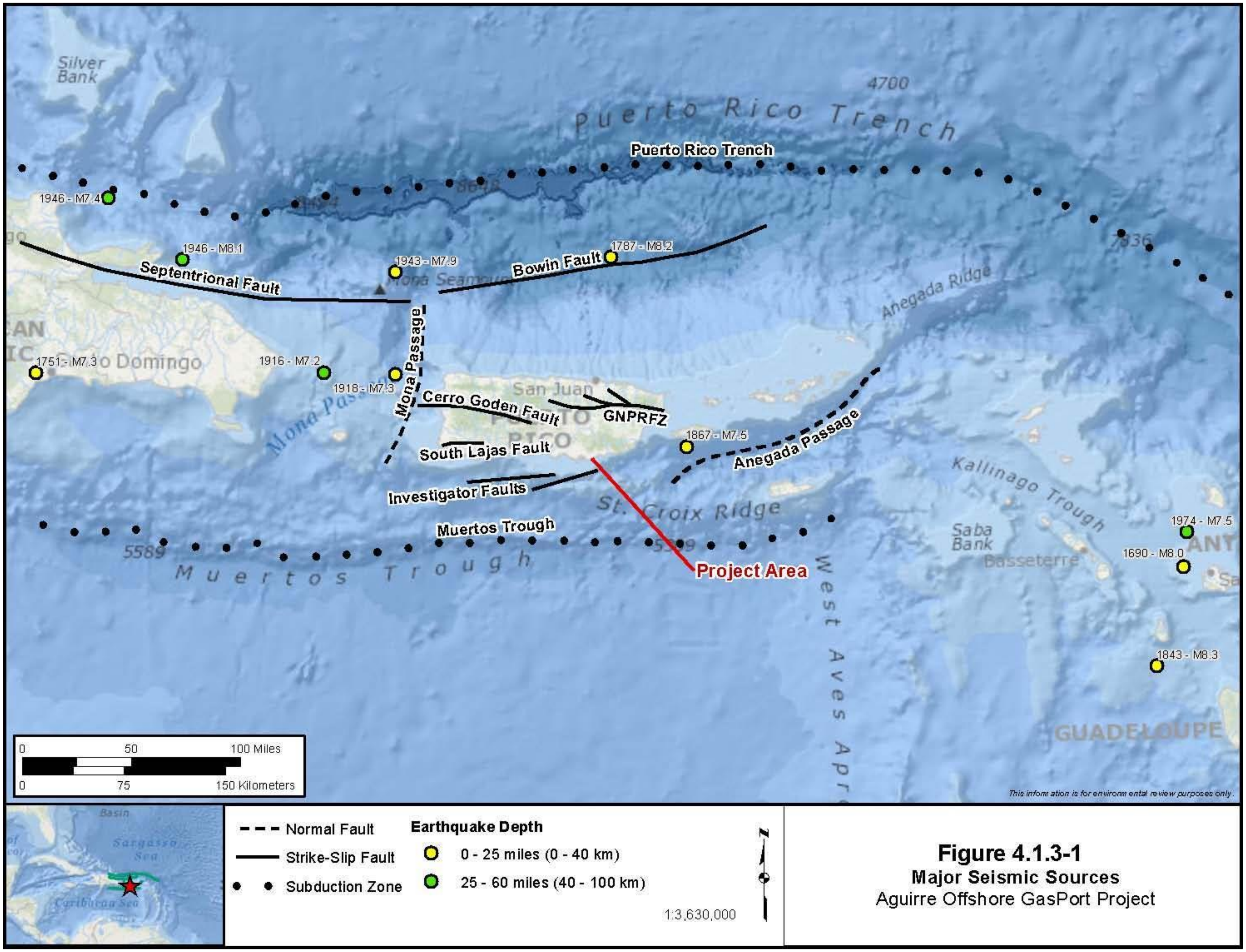


Figure 4.1.3-1
Major Seismic Sources
Aguirre Offshore GasPort Project

We received a comment from Captain Jimmy Vazquez-Aran expressing concern over a 3-D survey of the southern offshore trench conducted by NOAA that reportedly found frequent landslides off of the wall of the trench. Earthquakes could thus trigger instability of a subsurface soil layer resulting in landslides off of the trench wall. Aguirre LLC is considering both earthquake ground motions and the potential liquefaction of subsurface layers in the Project design. Aguirre LLC is designing the Offshore GasPort structures assuming that liquefiable soil layers provide no support to the offshore foundation system when subjected to earthquake design forces.

The results of the Golder PSHA at the seafloor based on Site Class E are summarized in table 4.1.3-1. The predicted ground motions are consistent with a site with a moderately high seismic hazard.

TABLE 4.1.3-1

Probabilistic Seismic Hazard Analysis Results at Seafloor at Offshore Terminal Site for the Aguirre Offshore GasPort Project

Probability/Return Period	Peak Ground Acceleration (percent of gravity)	Spectral Acceleration at 0.2 Second (percent of gravity)	Spectral Acceleration at 1 Second (percent of gravity)
2 percent in 50 years/2,475 years	35.5	88.7	31.5

Source: Golder and Associates, Inc., 2013a

Golder (2013a) also investigated the potential for fault offset for the proposed Aguirre LLC facilities. As part of that investigation, a geophysical survey was conducted by C&C at the offshore marine terminal location and along the pipeline route (C&C, 2012). The geophysical data collected by C&C showed no evidence of recent fault offset activity, although one offset in the seafloor below the surface seabed layers potential fault was observed to intersect the pipeline route. Golder also studied reports prepared by others (Rodriquez, 2007) and found that no evidence of terrestrial, late Quaternary (Holocene) faulting has been documented along the onshore south coast of Puerto Rico. Evidence of late Quaternary faulting has been reported at three offshore locations, the closest to the area being east of Jobos Bay, which would appear to correspond to strands of the GSPRFZ (Esmeralda and Rio Jueyes faults) continuing their northwest to southeast trend seaward (Mann, 2005). However, this particular seafloor faulting apparently pinches out landward in a scissor-like manner and does not displace terrestrial fan-delta deposits. Golder concluded that the overall likelihood of active faults being present along the pipeline route and marine terminal site areas is low based on available geophysical literature and site-specific geophysical data.

We received a comment from Captain Jimmy Vazquez-Aran expressing concern over studies identifying recent deformation of the seafloor along the proposed subsea pipeline route. The geophysical investigation performed by C & C dated July 17, 2013 identified two offsets below the seafloor only one of which intersected the pipeline route; however, there was no visual expression observed in the surface seabed layers or any signs of active fault deformation. Aguirre LLC indicated that in any event, the undersea pipeline had the capacity to accommodate a fault offset if it was to occur. Furthermore, the natural gas pipeline would be shut down in the event of a significant earthquake. However, as noted below in the next section, we are recommending an additional analysis be conducted to further assess the liquefaction potential of the pipeline.

4.1.3.2 Liquefaction

Liquefaction is a phenomenon often associated with seismic activity in which saturated, non-cohesive sediments temporarily lose their strength and liquefy (i.e., behave like viscous liquid) when subjected to forces such as intense and prolonged ground shaking. Based on a literature review, no studies of historic liquefaction and liquefaction risk proximate to the Project area were identified. Golder also performed an evaluation of potential for and magnitude of earthquake induced liquefaction (Golder, 2013b). Golder indicated that there is the potential for liquefaction to depths approaching 40 feet (12 m) below the seafloor and therefore recommended that liquefaction be assumed in the design of offshore marine terminal structures. Golder also noted that a more comprehensive analysis was needed to further assess the liquefaction potential of the pipeline. The current pipeline design seems reasonable; however, we agree with this recommendation because the slope angles can have an impact on the pipeline liquefaction potential and they have not been completely evaluated. Therefore, **we recommend that:**

- **Prior to construction, Aguirre LLC should file for review and written approval by the Director of OEP, additional studies on the pipeline route seafloor slope angles and the liquefaction potential along the alignment and provide mitigation measures as needed.**

4.1.3.3 Tsunamis

A tsunami is a set of ocean waves caused by any large, abrupt disturbance of the seafloor. Tsunamis proximate to Puerto Rico are mainly associated with earthquakes. Historic earthquakes around Puerto Rico have occurred north, east, and west of the island, affecting the coasts facing the locations of the earthquakes. The volcanic activity along the Lesser Antilles (see section 4.1.3.4) may also result in tsunamis in the region but would not likely impact the Project area.

Tsunami flood mapping created by the University of Puerto Rico (2011) shows that portions of the Aguirre Plant would likely be inundated if a tsunami occurred. However, the flooding is only estimated to extend approximately 200 feet (61 m) onshore in that area and would not impact the majority of the plant facilities (see figure 4.1.3-2).

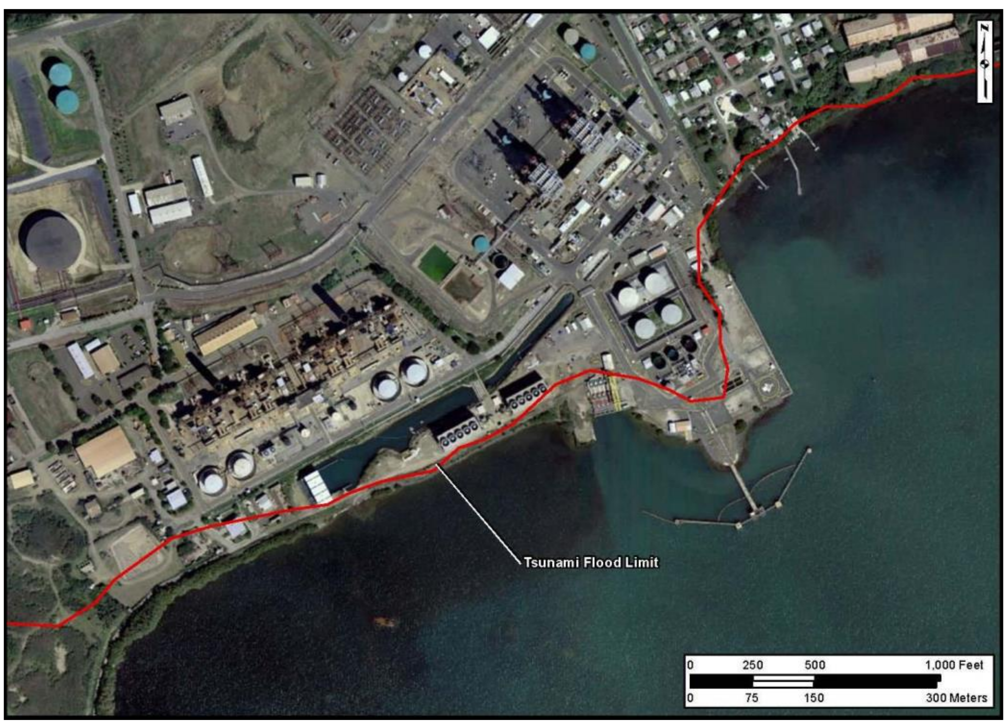


Figure 4.1.3-2 Tsunami Flood Limit

Aguirre LLC investigated the tsunami hazard associated with the marine terminal and onshore facilities. The chance of a tsunami run-up, which is the vertical height above sea level, exceeding 6.6 feet (2 m) within the region is quite unlikely. Aguirre LLC also concluded that for the offshore marine terminal structures the hurricane design waves would be much higher than maximum expected tsunami waves (C&C, 2012). We agree.

4.1.3.4 Volcanic Eruptions

Based on available information, no volcanic activity has occurred in Puerto Rico in the last 10,000 years (USGS, 2013). However, the Lesser Antilles located to the east of Puerto Rico have experienced numerous volcanic events in the last 12,000 years (Boudon et al., 2007). In particular, the Soufriere Hills and Kick'em Jenny volcanos, located approximately 200 miles (322 km) east and 500 miles (805 km) southeast of the Project area, respectively, have experienced volcanic activity in recent history and may be prone to future events. Based on the distance between the Project area and these volcanos, and others along the Lesser Antilles, the likelihood of volcanic activity impacting the Project is very low.

4.1.3.5 Karst Terrain

Karst terrain is characterized by distinctive landforms such as sinkholes, caves, and caverns created from the dissolution of soluble rocks, principally limestone and dolomite. Approximately 20 percent of Puerto Rico, primarily along the north coast, is covered by karst terrain formed on limestone formations (Giusti, 1978). However, karst development on the limestone belt of the south coast has been very limited. The limited development may be due to the aridity of the south coast in comparison to the north coast and/or the presence of caliche on the south coast (Rodríguez-Martinez, 2007). Caliche is a residue created by the evaporation of water saturated with calcium bicarbonate that forms a surficial crust that can be several feet thick, which limits the penetration of water into the soil. Based on the limited development of karst features along the southern coast, the likelihood of the Project facilities crossing any karst terrain is low.

4.1.4 Mitigation Design Features

Aguirre LLC indicated that the design of offshore marine terminal structures would account for both seismic ground motion and liquefaction effects. The offshore marine terminal structures would be designed for the site-specific Design Earthquake ground motions of ASCE 7-05 which have a PGA of 24 percent of gravity. In addition, Aguirre LLC has developed contingency plans to shut down the terminal, and to move the vessels immediately following a significant earthquake/fault offsets that could possibly rupture the gas pipeline. Aguirre has also considered tsunami and hurricane effects on the offshore marine terminal. The predicted tsunami wave run-up heights at the terminal are significantly less than those predicted for both a 100- and 500-year return period hurricane storm surge; so the storm surge wave height would govern the design. Also in the event of a threatening hurricane or tsunami, the moored ship(s) would depart and head for deeper water prior to the waves reaching the terminal.

The offshore marine terminal structures would be designed as steel jacketed or tri/quad pile structures that are anchored with steel piles to firm ground below the seafloor liquefiable sediments. The piles would not rely on the potential liquefiable sediments to provide vertical support. Laterally the effects of liquefaction would be considered in the jacket and pile design in combination with lateral seismic forces. The effects of liquefaction on the offshore pipeline have been considered; however, we are recommending in section 4.1.3.2 that Aguirre LLC conduct additional studies to accommodate potential liquefaction induced settlements and lateral spreading.

Aguirre LLC would design the offshore marine terminal structures to withstand wind and wave loadings. The offshore structures would be designed for a wind speed of 68.2 miles per hour (mph) (3-second gust) (109 kilometers per hour [km/hr]) before the vessels disengage and leave the terminal; and designed for approximately 150 mph (241 km/hr) (sustained) and 179 mph (288 km/hr) (3-second gust) after the vessels have departed. Based on preliminary studies performed for Aguirre LLC by Forristall Ocean Engineering Inc. (Forristall), the current estimate of the 500-year wave crest height at the marine terminal site is 46.7 feet (14.2 m) above Lowest Astronomical Tide (Forristall, 2013). The underside of the offshore terminal upper deck height is 41.7 feet (12.7 m) above Lowest Astronomical Tide. Because the upper deck would be subject to full wave crest impact effects, the offshore terminal structures would be designed to withstand the impact forces from wave loadings based on a hurricane with a 500-year return period. In addition and as mentioned above, Aguirre has committed to updating the wave studies prior to commencing with detailed design on the offshore terminal structures. Therefore, **we recommend that:**

- **<u>Prior to construction</u>, Aguirre LLC should file with the Secretary the updated offshore wave analyses as indicated in Aguirre LLC's December 5, 2013 response to the FERC's November 15, 2013 Environmental Information Request (questions 6 and 7). This analysis should be stamped and sealed by the professional engineer-of-record.**

Aguirre LLC would establish a tsunami warning system to ensure that the moored vessels and Offshore GasPort operators can initiate a safe shutdown of the facility to minimize damage that may occur in the event of a tsunami in the region. In the event of a tsunami, the vessels would be released from their moorings to prevent damage caused by the vessels from being pushed into marine terminal structures by waves.

The design of the offshore platform is currently at the Front End Engineering Design (FEED) level of completion. Aguirre LLC has proposed a feasible design and it has committed to conducting a significant amount of detailed design work for the Project if it is authorized by the Commission. Information regarding the development of the final design, as detailed below, would need to be reviewed by FERC staff in order to ensure that the final design addresses the requirements identified in the FEED. Therefore, **we are recommending that:**

- **<u>Prior to construction</u>, Aguirre LLC should file the following information, stamped and sealed by the professional engineer-of-record, with the Secretary:**

  a. marine terminal structures (including prefabricated and field constructed structures) and pile foundation design drawings and calculations. The marine terminal structures and pile foundation designs should incorporate criteria revisions agreed to by Aguirre LLC in its responses to FERC staff's June 17 and November 15, 2013 Environment Information Request;

  b. seismic specifications used in conjunction with the procuring equipment; and

  c. quality control procedures that would be used for design and construction.

Because we recognize the Project area is located in an area of high seismicity, our regulations in 18 CFR 380.12(h)(5)[1] recommends that a special inspector be contracted by Aguirre LLC to observe the work performed to assure the quality and performance of the seismic resisting systems. Therefore, **we recommend that:**

- **Aguirre LLC should employ a special inspector <u>during construction</u>. The special inspector should be responsible for:**

  a. observing the construction of Aguirre Offshore Gasport to be certain it conforms to the design drawings and specifications;

  b. furnishing inspection reports to the engineer or architect of record, and other designated persons. The inspection reports should be summarized in <u>monthly</u> status reports and filed with the Secretary. All discrepancies should be brought to the immediate attention of the contractor for correction, then if uncorrected, to the engineer or architect of record; and

  c. submitting a final signed report stating whether the work requiring special inspection was, to the best of his/her knowledge, in conformance with approved plans and specifications and the applicable workmanship provisions. A copy of the report should be filed with the Secretary.

4.1.5 Paleontological Resources

Paleontological resources are the fossilized remains of prehistoric plants and animals, as well as the impressions left in rock or other materials as indirect evidence of the forms and activities of such organisms. The geologic units underlying the Project area are composed primarily of Quaternary age-unconsolidated deposits that are continuously reworked by tide and wave action. Based on the presence of these recent deposits and the limited disturbance of deeper sediment that would occur as a result of the Project, the possibility of encountering paleontological resources of significance is low.

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[1] NBSIR84-2833 "Data Requirements for the Seismic Review of LNG Facilities."

4.2 SOILS AND SEDIMENTS

4.2.1 Soils

Impact on soils within the Project area would be limited to the 1.5 acres (1.5 cuerdas) required for the onshore temporary staging and support area. This area is within the existing Aguirre Plant property and has been disturbed by past industrial activities. The majority of the Aguirre Plant property, including the Project area, is mapped as Pozo Blanco clay loam, 5 to 12 percent slopes, eroded (Soil Survey Staff, 2013). The Pozo Blanco series consists of very deep, well drained soils that formed in sediments weathered from limestone and calcareous volcanic rocks. These soils are not designated as hydric or considered prime farmland. The main limiting factor for these soils is their susceptibility to erosion by water (Soil Survey Staff, 2013).

4.2.2 Sediments

Sediment eroded from the land surface within the Jobos Bay watershed is delivered to the bay by surface runoff occurring during rain events. Much of this terrigenous sediment is deposited within the bay and makes up a fraction of the mud and sand on the bay seafloor. The most widespread sediment type is a sandy mud which consists of coarse shell debris mixed with fine grained terrigenous and carbonate mud.

Aguirre LLC conducted geotechnical investigations along the proposed pipeline route and in the area of the proposed offshore terminal to characterize subsurface conditions in the Project area. These investigations included 4 shallow (2 to 4 feet [0.6 to 1.2 m]) vibracore samples along the pipeline route and 6 deep (80 to 177 feet [24 to 54 m]) borings outside of Jobos Bay. In addition, side scan sonar, a subbottom profiler, and a shallow seismic boomer system were utilized to interpret the geophysical conditions in the Project area. Figure 4.2.2-1 shows the boring/vibracore locations and interpreted bottom conditions in the Project area.

Sediments in the two shallow borings along the pipeline route that were closest to landfall consisted mostly of very soft, very dark greenish gray silty clay with very fine sand and shell fragments. The vibracore taken further out into Jobos Bay consisted of very dark greenish gray, silty fine sand with shell fragments. The vibracore taken at the mouth of the Bay contained only coarse shell fragments; therefore, detailed sediment analysis was not possible (C&C, 2012).

The deep borings collected outside of Jobos Bay identified three major subsurface units. The upper unit was interpreted to be recent marine deposits and was up to 40 feet (12 m) thick, consisting of very loose to dense sand and very soft, silt, clay, and peat. This unit was underlain by relict reef deposits that were 29 feet (9 m) to more than 46 feet (14 m) thick, consisting of medium to dense sand, dense to very dense gravel, and relict coral reef fragments. The deepest unit was interpreted to be alternating older terrigenous and marine deposits and consisted of loose to very dense sand and gravel and firm to hard silty clay. This unit extended to the bottom of all of the boring except one unit (BH-13), which terminated in the overlying unit (Golder, 2013a).

Figure 4.2.2-1
Vibracore and Boring Locations in the Project Area
Aguirre Offshore GasPort Project

4.2.2.1 Sediment Contamination

In 2008, NOAA collected samples from 44 locations throughout Jobos Bay to quantify the level of chemical contaminants in the sediments within the bay (Whitall, et al., 2011). Thirteen of these locations were within approximately 1 mile (1.6 km) of the Project area. Samples were analyzed for polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyl congeners (PCBs), organochlorine pesticides (e.g., dichlorodiphenyltrichloroethane [DDT]), butyltins, and metals. Table 4.2.2-1 summarizes the results of these analyses and lists the effects range low (ERL) and effects range median (ERM) threshold values for each contaminant, as established under NOAA National Status and Trends sediment quality guidelines. Concentrations below the ERL are not considered to pose a risk to benthic communities, and concentrations above the ERM are expected to have some degree of negative effect (Long and Morgan, 1990; Long et al., 1996).

TABLE 4.2.2-1

Summary of Analytical Data for Sediment Samples from Jobos Bay (May 2008) for the Aguirre Offshore GasPort Project

			All 44 Sample Locations			13 Locations Within 1 Mile of Project Area		
Contaminant	ERL (mg/kg)	ERM (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)	Mean (mg/kg)
Total PAHs	4.0	44.8	0.004	14.3	1.1	0.06	3.41	0.66
Total PCBs	0.02	0.18	0.002	0.02	0.004	0.002	0.02	0.005
Total DDT	0.002	0.046	ND	0.003	0.001	ND	0.003	0.001
Tributyltin	NA	NA	ND	0.01	0.001	ND	0.002	0.0
Silver	1.0	3.7	0.05	0.22	0.12	0.05	0.14	0.09
Aluminum	NA	NA	629.0	73,700.0	39,138.0	28300.0	68200.0	45453.3
Arsenic	8.2	70.0	1.8	28.1	12.6	6.9	28.1	14.1
Cadmium	1.2	9.6	ND	0.17	0.008	ND	0.17	0.02
Chromium	81.0	370.0	ND	29.8	18.2	9.4	29.4	20.1
Copper	34.0	270.0	1.4	73.7	33.8	13.1	69.0	34.8
Iron	NA	NA	1,060.0	50,500.0	26,570.0	16600.0	48100.0	29826.7
Mercury	0.15	0.71	0.001	0.14	0.04	0.008	0.10	0.04
Manganese	NA	NA	33.1	1,130.0	510.6	329.0	765.0	590.5
Nickel	20.9	51.6	ND	31.0	11.0	4.4	26.6	11.9
Lead	46.7	NA	0.23	16.7	7.2	2.8	14.0	7.5
Antimony	NA	NA	ND	0.59	0.22	ND	0.56	0.28
Selenium	NA	NA	ND	1.6	0.33	0.11	1.6	0.36
Tin	NA	NA	ND	2.7	1.1	0.57	2.1	1.3
Zinc	150.0	410.0	1.6	117.0	54.2	25.7	117.0	58.8

Source: Whitall et al., 2011
Notes: NA = sediment quality guideline not available; ND= constituent below detection limits; mg/kg = milligram per kilogram

As shown in table 4.2.2-1 none of the samples contained concentrations of contaminants that exceeded the corresponding ERM. However, the ERL was exceeded in at least one sample location for five contaminants (total PAHs, total DDT, arsenic, copper, and nickel). The ERL for total PAHs was exceeded in one sample location, which was approximately 2 miles (3.2 km) east of the Project area. The ERL for total DDT was exceeded in four sample locations, two of which were within 1 mile (1.6 km) of the Project area. The ERL for arsenic was exceeded in 31 of the 44 total sample locations, 12 of which were within 1 mile (1.6 km) of the Project area. The ERL for copper was exceeded in 9 sample locations, 5 of which were within 1 mile (1.6 km) of the Project area. The ERL for nickel was exceeded in 3 sample locations, 3 of which were within 1 mile (1.6 km) of the Project area.

Whitall et al. (2011) observed that the contaminant concentrations observed in Jobos Bay were comparable to other areas of Puerto Rico and were generally below established sediment quality threshold guidelines, suggesting that impacts on resident biota are unlikely. The study recognizes that, whereas PAHs, PCBs, and DDT are derived from anthropogenic sources, the comparability of metal constituent concentrations to those in other coastal areas of Puerto Rico indicates that likely sources in Jobos Bay may include natural bedrock weathering, detrital inputs from tributaries, and atmospheric deposition, more than direct input from locally based industrial sources.

4.2.3 General Impact and Mitigation

4.2.3.1 Soils

Onshore construction and operation activities would be limited to previously disturbed, industrial areas and would not represent new impacts on soils resources. To minimize or avoid impacts associated with the onshore portion of the Project, Aguirre LLC would implement measures outlined in the FERC Plan and Procedures, which includes measures to control erosion and sedimentation (e.g., installation of silt fence) during construction and to ensure proper restoration of disturbed areas following construction.

4.2.3.2 Sediment Resuspension and Transport

Construction activities, including the installation of the temporary piles and permanent structures at the offshore berthing platform, would result in the resuspension of seafloor sediment into the water column. As discussed above, the sediments in the vicinity of the offshore berthing platform consist of mostly sand, which would descend rapidly and deposit on the seafloor near the base of the piling or at the site of the source of disturbance. Currents in this area can exceed 3.3 feet per second (ft/sec) (1.0 m/s) during storms but typically flow westward in the range of 0.2 to 0.3 ft/sec (0.06 to 0.09 m/s). Sand particles descend through the water column rapidly so that suspended particles would reach the bottom within seconds. During this time the suspended sediment may travel up to a few meters under typical water current speeds. Aguirre LLC estimates that the transport of sediments resuspended during construction of the offshore berthing platform would be limited to within 100 feet (30 m) of the pile foundation footprint. To ensure that the impacts associated with the resuspension, transport, and redeposition of sediments disturbed during construction activities are addressed, **we recommend that:**

- **<u>Prior to the end of the draft EIS comment period</u>, Aguirre LLC should conduct sediment transport modeling to support its determination that the redeposition of sediments disturbed during the construction activities at the offshore berthing platform would be limited to within 100 feet (30 m) of the pile foundation footprint. The modeling should include an analysis of mitigation measures (e.g., silt curtains) that could be implemented to minimize sediment transport. The results of sediment transport modeling should be filed with the Secretary.**

The amount of sediment resuspension and transport pipeline installation would vary with the length and severity of disturbance, grain size composition, and resettling rates. Based on historical data (NOAA, 2013b), standard currents along the south shore of Puerto Rico, near the City of Ponce, are primarily tidally induced with a maximum ambient speed of about 1.6 ft/sec (4.9 m/s) near the seafloor; however, storm induced currents occasionally exceed 3.0 ft/sec (0.9 m/s) at the same depth. These values can be considered representative of those that could be found in the oceanic waters of the Project area, beyond Jobos Bay. The current speed of 1.6 ft/sec (0.5 m/s) corresponds to a bed stress of 0.00009 psi (0.62 Pascals [Pa]) and a shear velocity of 0.1 ft/sec (0.03 m/s), using a quadratic resistance coefficient of 0.0025.

In Jobos Bay, surface currents average 0.3 ft/sec (0.1 m/s) and range from 0 to 0.9 ft/sec (0 to 0.3 m/s) (Field et al., 2003; Zitello et al., 2008). Currents closer to the seafloor have been measured at speeds up to 0.3 ft/sec (0.1 m/s) in water less than 33 deep (10 m). The maximum current speed of 0.9 ft/sec (0.3 m/s) corresponds to a bed stress of 0.00002 psi (0.14 Pa) and a shear velocity of 0.04 ft/sec (0.01 m/s).

Critical stresses for mobilization of cohesive mixtures of clay, silt, fine sand, and organic matter similar to those in Jobos Bay are approximately 0.00004 to 0.00007 psi (0.28 to 0.48 Pa); the critical stress to mobilize fine to medium 250-micron sand grains is approximately 0.00004 psi (0.28 Pa), whereas coarser sand (1000 microns) has a critical stress of approximately 0.00006 psi (0.41 Pa). On this basis, current speeds in Jobos Bay, which correspond to a bed stress of up to 0.00002 psi (0.14 Pa), would be insufficient to cause widespread sediment mobilization; however, this does not account for the latent ability to transport sediments mobilized by construction activities. Vertical settling rates for suspended substrates vary by particle size, from approximately 16 feet per day (5 m per day) for clay and very fine silt to approximately 16,400 feet per day (5,000 m per day) for coarse sand.

As discussed above, the sediments of Jobos Bay are dominated by fine sand, silt, and clay, particularly closer to shore. Aguirre LLC estimates that direct impacts during pipeline construction would be confined to a 6-foot-wide (1.8 m) corridor centered on the pipeline, where sediment in a 2-foot-wide (0.6 m) footprint under the pipeline would be displaced 2 feet (0.6 m) on either side (see figure 4.2.3-1). Aguirre LLC also estimates that sediment resuspension and redeposition would occur within a 7-foot-wide (2.1 m) buffer zone on either side of the 6-foot-wide (1.8 m) corridor centered on the pipeline.

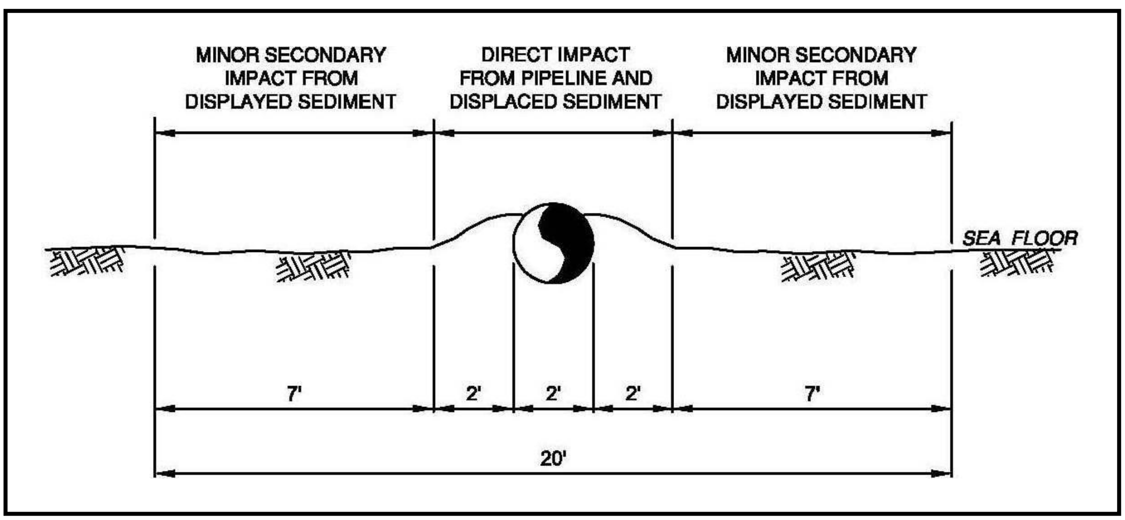

Figure 4.2.3-1 Cross-Section of Potential Direct and Indirect Pipeline Impacts

Aguirre LLC cites "best professional judgment" and the results of a pipeline burial analysis as the calculative basis for the sediment displacement width of 2 feet (0.6 m) and the sediment dispersion limit of 9 feet (2.7 m) either side of the pipeline. However, these estimates do not take into account the spatial variability in sediment type or vegetative cover along the pipeline route. To ensure that the impacts associated with the resuspension, transport, and redeposition of sediments disturbed during construction activities are addressed, **we recommend that:**

- **<u>Prior to the end of the draft EIS comment period</u>, Aguirre LLC should conduct sediment transport modeling to support its determination that the redeposition of sediments disturbed during pipeline construction would be limited to within 10 feet (3 m) of the pipeline centerline. The modeling should include an analysis of**

mitigation measures (e.g., silt curtains) that could be implemented to minimize sediment transport. The sediment transport modeling of this analysis should be filed with the Secretary.

During operation of the offshore berthing platform, scouring-induced substrate loss around piles could potentially compromise foundation stability and structural integrity. American Petroleum Institute (API) guidelines (2011) recommend including scour allowances [2] for both global (regional) and localized scour around sleeves/piles and developing those allowances based on site-specific data (metocean and sediment transport studies). However, the guidelines also include a general recommendation of at least 1.5 times the sleeve (jacket) or pile diameter for localized scour. Aguirre LLC is proposing to use a scour allowance of two times the pile diameter (5 feet [1.5 m]) to protect against localized scour. This equates to a scour allowance of 10 feet (3 m). Additionally, steel piles would be coated with a scour-resistant material.

The pipeline burial analysis conducted by Aguirre LLC estimated that the pipeline would penetrate the fine sediments within the inner part of Jobos Bay about 7 to 12 inches (18 to 30 cm) but would penetrate less than 1 inch (2.5 cm) in the course sediments and hardground along the remainder of the route (Geoscience Earth and Marine Services, Inc., 2012). Depending upon local current direction and velocity, sediment resuspension from pipeline installation and subsequent scouring may occur through tide reversal. However, little net transport of either suspended or bed load material would be anticipated, due to settling at slack tide and alternating bi-directional transport with successive flood and ebb flows. As such, material resuspended through installation or scouring would tend to remain in the construction area and no significant impact from sediment scouring has been identified. Coating the pipeline with concrete would provide an additional layer of protection from external mechanical sources and scouring problems. Based on the footprint of the proposed pipeline and offshore berthing platform piles, we conclude that the Project would not have a significant impact on sediments in the area. If a portion of the pipeline is constructed using the HDD technique (see section 4.5.2.4), sediment resuspension would occur at the HDD entry and exit points; however, these effects would be short-term during construction.

4.2.3.3 Sediment Contamination

As discussed in section 4.2.2.1, low concentrations of contaminants were reported in sediment samples taken proximate to the Project area. Exceedance of the ERL was noted for total PAHs, total DDT, arsenic, copper, and nickel. However, exceedance of the ERL is not considered a definitive basis for negative effects but only as an inferential consideration for potential effects when considered in the context of background concentrations.

Based on the results of the 2008 NOAA study, construction activities in Jobos Bay are not expected to cause widespread or significant impacts associated with the introduction of contaminants into the water column through resuspension of surficial sediments. The existing benthic infaunal community is inevitably exposed to existing contaminants in the surficial sediments and the temporary resuspension of this material is not expected to exacerbate this exposure. Most of the detected contaminants were below the ERL screening value, indicating the absence of an associated significant risk to marine life. Therefore, we conclude that the resuspension of these contaminants during construction would not represent a significant impact on sensitive resources in the area.

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[2] "Scour allowance" is a depth below the seafloor that is disregarded during pile design. Theoretically, it is the depth of benthic substrate that is potentially subject to scouring and, under the worst-case design scenario, assumed to be absent. In other words, pile length (for vertical support) and jacket bracing (for lateral support) would be designed to reflect conditions where this depth of material has been lost through scouring and cannot provide potential foundation support. This design procedure does not minimize scour; rather it mitigates against scour effects.

4.3 WATER RESOURCES

4.3.1 Offshore Surface Water Resources

4.3.1.1 Physical Oceanography

As discussed in section 2.1, Aguirre LLC would construct the Project offshore of Salinas, along the southern shore of mainland Puerto Rico. The proposed facilities would be in the open oceanic waters of the Caribbean Sea and the coastal waters of Jobos Bay, both of which are considered marine waters based on salinity. Aguirre LLC would construct the Offshore GasPort approximately 3 miles (4.8 km) from the Aguirre Plant and about 0.6 mile (1 km) beyond Cayos de Barca, a cay that separates Jobos Bay from the open sea. The proposed subsea pipeline location extends approximately 4.1 miles (6.6 km) from the proposed offshore berthing platform site, through the Boca del Infierno inlet between of Cayos de Barca and Cayos Caribes, and across the basin of Jobos Bay to the Aguirre Plant (see figure 2.1-1).

Along the southern coast of Puerto Rico, bathymetry is characterized by an extensive insular shelf that provides for shallow nearshore waters and extends outwards more than 9 miles (14.5 km) in some areas. Beyond the shelf break, the water depth abruptly increases to over 1,500 feet (460 m) (NOAA, 2013a). Based on NOAA bathymetry mapping (NOAA, 2003), water depths at the proposed Offshore GasPort range from 60 to 65 feet (18 to 20 m) at mean low water[3]. The open oceanic waters beyond Jobos Bay are categorized as Marine, Subtidal, Unconsolidated Bottom by NWI mapping (FWS, 1983).

Jobos Bay is on the south-central coast of mainland Puerto Rico between the municipalities of Salinas and Guayama. According to Whitall et al. (2011), Jobos Bay is the second largest estuary in Puerto Rico, covering an estimated 6,177 acres (6,361 cuerdas), and is classified as a coastal plain estuary. The islands are characterized by extensive mangrove stands on the bay side and coral reef structures on the ocean side. Jobos Bay provides a natural harbor protected from offshore wind and waves by the barrier islands to the west and a peninsula (Punta Pozuelo) to the east. Portions of the bay have been classified as one of the 28 National Estuarine Research Reserves designated by NOAA. The Jobos Bay National Estuarine Research Reserve (JBNERR) encompasses approximately 3,300 acres (3,398 cuerdas) of coastal ecosystems, a portion of which would be crossed by the proposed subsea pipeline (see section 4.7.2).

Based on NOAA bathymetry mapping, water depths vary by location but are generally shallow and range between 10 and 20 feet (3 to 6 m) below mean low water (NOAA, 2003). The channels between the barrier islands are generally less than 4 feet (1.2 m) deep, except at Boca del Infierno pass (about 13 feet [4 m] deep), between Cayos de Barca and Cayo Morrillo (about 26 feet [8 m] deep), and between Cayo Morillo and Cayos de Pájoros (over 26 feet [8 m] deep).

The main ship navigation channel in Jobos Bay is 150 feet (46 m) wide by 27 feet (8 m) deep and is maintained only as required, with the last maintenance occurring in the late 1990s or early 2000s (DNER, 2010). From the existing pier in the vicinity of the Aguirre Plant, the channel runs south, southwest, and west-southwest for about 4.5 miles (7.2 km), following the shoreline of the Mar Negro sector of the JBNERR. This sector is a mangrove-wetlands forest complex on the mainland southwest of the Aguirre Plant. The proposed subsea pipeline would be east of the navigation channel.

Jobos Bay features diverse marine habitats, including mangroves, mud flats, salt marshes, sea grasses, and coral reefs. Bottom substrates are represented by coral outcrops and depositional substrates

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[3] Mean low water is defined as the average of all the low water heights observed over the National Tidal Datum Epoch. For stations with shorter series, simultaneous observational comparisons are made with a control tide station to derive the equivalent datum of the National Tidal Datum Epoch (NOAA, 2013c).

that can vary from hard bottom materials to soft muds (Whitall, et al., 2011). The open waters of Jobos Bay are categorized as Estuarine, Subtidal, Unconsolidated Bottom by NWI mapping (FWS, 1983).

Winds

The northeastern Caribbean, including Puerto Rico, lies on the northerly fringe of the Trade Wind belt, which is associated with easterly winds (Field, et al., 2003). The strongest winds occur in the winter, with a slight decrease in strength during the summer. Wind speeds proximate to the Project area are moderate, ranging from 13 to 27 mph (21 to 44 km/hr) (see figure 4.3.1-1).

Short-term increases in wind speed can occur when tropical systems become imbedded in the east to west flow and pass across Puerto Rico. Based on the hindcast metocean data analysis performed for the Project (Forristall, 2013), extreme wind speeds of over 67 mph (108 km/hr) are common during the passages of these systems, with the associated direction dependent on the specific storm track. Between 1978 and 2008, 15 hurricanes crossed Puerto Rico, including Hurricane Georges in 1998 and Hurricane Jose in 1999, both of which impacted the Project area directly (Field et al., 2003). The bay itself is shielded from the full effects of hurricane winds by the Puerto Rican mainland and the encompassing barrier islands.

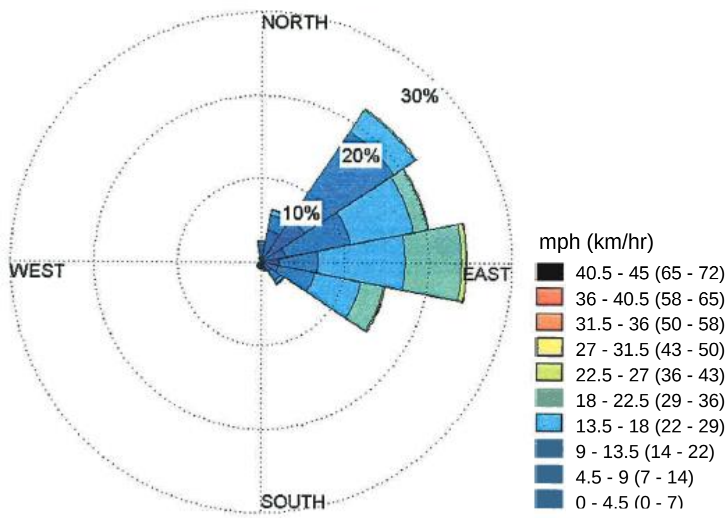


Figure 4.3.1-1 Yearly Average Wind Speed and Direction Proximate to the Project Area
Source: Forristall, 2013

Waves

Waves along the southern coast of Puerto Rico are generally produced by the prevailing easterly trade winds and influenced by topography and the behavior of the wind as it hits the barrier islands encompassing Jobos Bay. As offshore waves approach the Puerto Rican coastline from the east, they make contact with the seafloor, and then refract and turn towards shore, forming a westward longshore current (Field et al., 2003).

Waves produced by the trade winds typically range between 3 and 5 feet (1 to 1.5 m) in height in the open sea, with more placid conditions found within Jobos Bay (Field et al., 2003). Morelock and Williams (2008) describes Jobos Bay as a calm water area with low wave energy and current flow, characteristics that are attributable to the physical separation from the open ocean provided by the encompassing barrier islands; however, the channels between the islands provide for exchange of water with the open sea. Strong waves can develop in the narrower channels, where wave energy is concentrated by bed topography. In the Boca del Infierno channel, which would be crossed by the subsea pipeline, wave height is limited to less than 2 feet (0.6 m) because of the sill depth.

Short-term increases in wave height can occur from the passage of tropical systems (tropical storms and hurricanes) in the offshore areas encompassing the proposed terminal site. Table 4.3.1-1 summarizes the predicted extreme values of significant wave heights and associated return periods (an estimate of how often the given conditions would occur) in these areas during the passage of a tropical system.

TABLE 4.3.1-1

Extreme Values of Significant Wave Height in Tropical Storms

Return Period (years)	Wave Height (feet [m])
5	14.8 (4.5)
10	18.4 (5.6)
50	26.1 (8.0)
100	29.3 (8.9)

Source: Forristall, 2013

Currents and Tides

Surface currents within the bay and the tide channel range between 0.1 and 0.6 mph (0.3 and 1.0 km/hr) and in a generally west to east direction, with an average value of approximately 0.2 mph (0.3 km/hr) observed throughout the year (Field et al., 2003). The current speeds are higher within the surge channels. Generalized current patterns within Jobos Bay are depicted in figure 4.3.1-2. The mean residence time for a water mass in Jobos Bay is about 5.5 days, with an average daily displacement of 39.9 million cubic yards (30.5 million m^3) (Field et al., 2003).

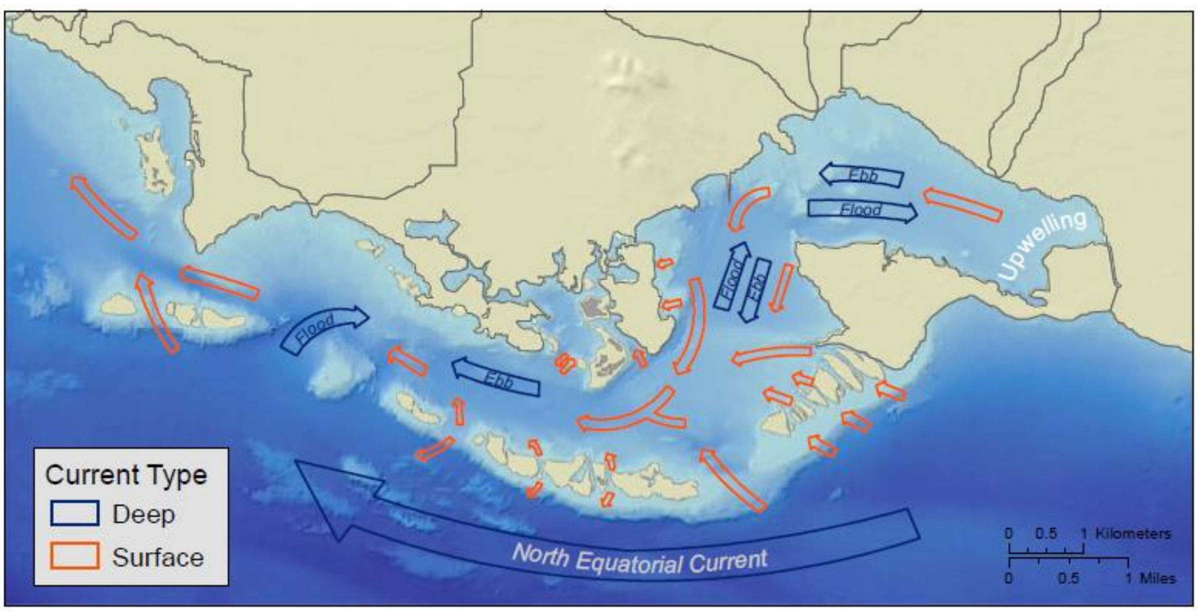


Figure 4.3.1-2 Generalized Current Patterns Within Jobos Bay
Source: Zitello et al., 2008

Physico-Chemical Water Properties

Temperature and Salinity

Caribbean Sea

Sea surface temperatures collected as part of the hindcast metocean data analysis performed for the Project showed little variability, with the warmest values of approximately 85.3 °F (29.6 ºC) occurring in summer and the coolest values of approximately 79.3 °F (26.3 ºC) occurring in winter (Forristall, 2013). Typical salinity in the area ranges from 34.0 parts per thousand (ppt) in the spring to 36.3 ppt in the fall (Center for Energy and Environment Research, 1981).

The University of Puerto Rico, on behalf of Aguirre LLC, measured temperature and salinity at various depths along four ichthyoplankton survey transects, positioned between 0.5 and 2 miles (0.8 and 3.2 km) east of the proposed platform site (University of Puerto Rico, 2012). The results of this investigation showed no depth gradient for salinity or temperature.

Jobos Bay

The National Estuarine Research Reserve System runs a System-Wide Monitoring Program that measures water quality parameters such as temperature, salinity, depth, turbidity, pH, dissolved oxygen, nutrient levels, and chlorophyll fluorescence at each of the reserves (NOAA, 2004). There are four active water quality monitoring stations within the JBNERR; of these, two stations are near the Project area and two are in the Mar Negro coastal mangroves (about 1.5 and 2.8 miles [2.4 and 4.5 km] west of PI no. 4). Station 20 is located on the landward side of the Cayos Caribes, about 0.5 mile (0.8 km) southeast of PI no. 4, and has been in operation since 2002. Station 19 is located about 0.5 mile (0.8 km) southwest of the Aguirre Plant where the subsea pipeline makes landfall, and has also been collecting data since 2002.

According to data from this program, Jobos Bay maintains relatively stable temperature and salinity levels. Average summer high temperatures reach 85.1 °F (29.5 °C) and winter lows average 81.3 °F (27.4 °C). Salinity has no discernable seasonal or annual fluctuations; the data collected at Stations 19 and 20 show an average of 35.2 ppt (NOAA, 2004). Figure 4.3.1-3 identifies the location of Station 19 and 20 and provides a summary of the temperature and salinity data collected since 2002.

Other Parameters

The University of Puerto Rico also collected surface water data for pH, conductivity, and dissolved oxygen during the ichthyoplankton field survey. Table 4.3.1-2 summarizes the result of the water quality data collected.

TABLE 4.3.1-2

Water Quality Data Collected in Vicinity of Proposed Offshore GasPort Site (May 2012) [a]

Water Quality Parameter	Minimum	Maximum	Mean
Temperature (ºF [ºC])	82.0 (27.8)	82.2 (27.9)	82.0 (27.8)
pH	8.0	8.1	8.1
Salinity (ppt)	35.4	35.4	35.4
Conductivity (µS/cm)	47,590	49,120	47,956
Dissolved Oxygen (mg/L)	5.3	8.7	7.5
Dissolved Oxygen (percent saturation)	78.1	120	108

Source: University of Puerto Rico, 2012

[a] Measurements taken at water depths of up to 3 feet (1 m).

Notes: µS/cm = micro-siemens per centimeter; mg/L = milligrams per liter

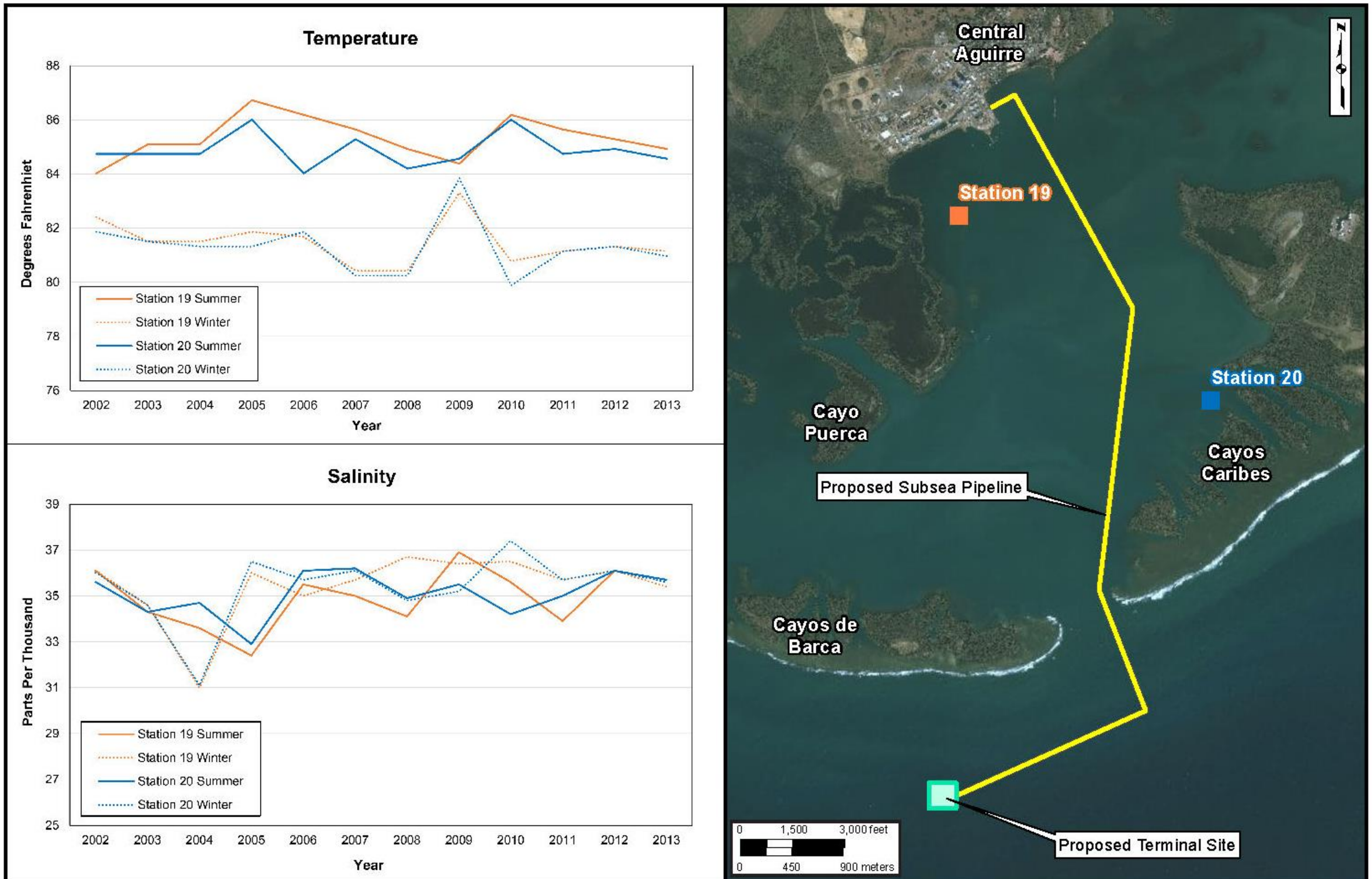


Figure 4.3.1-3
JBNERR Water Quality Monitoring Stations
Aguirre Offshore GasPort Project

Turbidity is a measure of water clarity and the amount of light blocked by material suspended in the water, whereas total suspended solids is a measure of material weight per water volume. Suspended materials include sediment (clay, silt, and sand particles), algae, plankton, microbes, and other substances, typically ranging in the size range from 0.004 millimeters (mm) (clay) to 1.0 mm (sand). Turbidity can increase water temperature because suspended particles absorb more heat than clear water; this in turn decreases dissolved oxygen, which can cause biological stress (EPA, 2012). Water clarity/transparency, which provides a default measure of turbidity, can be measured with a Secchi disk[4]. Jobos Bay and its adjacent nearshore waters are relatively shallow and Secchi transparency ranges from 3 to 13 feet (1 to 4 m). These low readings are attributable to the presence of relatively high levels of suspended sediment and plankton (Morelock and Williams, 2008).

4.3.1.2 Water Uses and Quality

Current Uses

Major water uses in Jobos Bay and surrounding areas include fishing, recreational uses (e.g., tourism, swimming/beaches, boating, scuba diving), and scientific research (see section 4.7). The bay waters are also used for industrial purposes, including the supply of cooling water for local industry (e.g., the Aguirre Plant) and treated/process water discharges (EQB, 2010a).

Designated Uses and Regulatory Classification

The Puerto Rico Water Quality Standards Regulation (PRWQSR), as amended, establishes the designated uses to be maintained and protected for all waters in the archipelago of Puerto Rico, with the most recent version in March 2010 (EQB, 2010b). The designated uses include: 1) protection and propagation of fish, shellfish, and wildlife; 2) direct and indirect contact recreation; and 3) raw source of drinking water. The PRWQSR also identifies the water quality standards that have been adopted to protect each of the designated uses (EQB, 2012).

The waters in the Project area are classified as Class SB and SC. Class SB waters include coastal and estuarine waters extending from the tidal zone (mean sea level) up to 0.31 mile (0.5 km) seaward that are not classified as Class SA (waters of high quality and/or exceptional ecological or recreational values) or Class SC. The Class SC designation applies to waters that lie beyond Class SB waters, between 0.31 and 10.4 miles (0.5 and 16.7 km) seaward (EQB, 2012). Based upon these geographic boundaries, the subsea pipeline would cross both Class SB and Class SC waters in Jobos Bay, whereas the Offshore GasPort and the section of the pipeline in the Caribbean Sea would be wholly in Class SC waters.

Class SB waters are designated for primary and secondary contact recreation and for propagation and preservation of desirable species, including threatened and endangered species. The Class SC waters in the Project area are designated for primary contact recreation between 0.31 to 3.0 miles (0.5 and 4.8 km) seaward, for secondary contact recreation between 3.0 and 10.4 miles (4.8 and 16.7 km) seaward, and for the propagation and preservation of desirable species, including threatened and endangered species, across the whole area.

Water Quality Standards and Evaluation

Based on the PRWQSR standards, no heat can be added to any waters of Puerto Rico that would cause the temperature of any site to exceed 90 ºF (32 ºC), except by natural causes (EQB, 2010b). With

[4] A Secchi disk is a black and white disk, approximately 12 inches (30 centimeters) in diameter, which is lowered by hand into the water to the depth at which it vanishes from sight.

respect to dissolved oxygen, Class SB waters cannot contain less than 5 milligrams per liter (mg/L) and Class SC waters shall not contain less than 4 mg/L, except when this value is depressed due to natural causes. The turbidity standard for Class SB and Class SC waters requires that turbidity not exceed 10 nephelometric turbidity units, except by natural causes.

For the purposes of biennial water quality evaluations under Sections 305(b) and 303(d) of the CWA, Jobos Bay and the adjacent offshore waters are in the South Region Coastal Shoreline sector of the Puerto Rico Coastal Segmentation Unit (PRSC34) (EQB, 2010a). The most recent approved EQB 305(b) and 303(d) integrated report (EQB, 2010a) lists the waters of PRSC34 as Category 5 (non-attainment) for primary contact recreation and aquatic life standards at select stations, and Category 1 (full attainment) for secondary contact uses (recreational swimming, fishing, and boating).

For a waterbody to be designated as Category 5, at least one water quality standard has not been attained (impaired or non-supporting of designated uses). Non-attainment within PRSC34 for primary contact is caused by elevated fecal coliforms and *Enterococcus* counts. Non-attainment for the aquatic life use is caused by pH imbalances, low dissolved oxygen levels, and elevated turbidity. Sources of pollution in PRSC34 include major industrial point sources, agricultural runoff, urban runoff, wastewater systems, and upstream impoundments (EQB, 2010a).

4.3.1.3 General Impacts and Mitigation

Offshore Berthing Platform

Construction of the offshore berthing platform would involve the placement and driving of deep-seated pilings into the seafloor to provide a foundation for the dock and mooring structures. Aguirre LLC would drive 13 pile structures into the seafloor, including 9 main piles with tubular steel jackets and 4 unjacketed tri/quad piles (see section 2.3.1). These activities would cause the displacement of sediments on the seafloor and the resuspension of sediments into the water column. The placement of the steel jackets on the seafloor and subsequent pile installation would cause most of the sediment disturbance. The insertion of the piles into the seafloor would directly displace a corresponding volume of substrate and the vibrations caused by a vibratory or impact hammer could dislodge and cause resuspension of surrounding material.

The amount of resuspended material generated by jacket and pile installation, and its distribution through time and space, would depend primarily on the duration and vibratory strength of the pile-driving, the depth below the seafloor to which the piles would be driven, and grain size. The placement of mooring anchors and chains to secure the berthing platform would also cause some sediment resuspension. Based on the sea depth (60 to 65 feet [18 to 20 m]) relative to the draught of the construction vessels (typically less than 25 feet [8 m]) that would be operating at the site of the offshore berthing platform, we would not expect the construction vessels to cause significant sediment disturbance through anchoring, propeller wash, or water uptake/discharge operations.

Turbidity levels in the areas adjacent to construction activities would likely exceed PRWQSR standards. However, these impacts would be temporary and localized, and the course sediments would quickly fall out of suspension and revert to previous turbidity levels after construction is complete. Further, given the unconfined extent of the oceanic environment in which the construction activities would occur, the topographic and structural uniformity of the seafloor in the area, and the lack of any evident sources of contamination, the temporary resuspension of sediment and associated elevated turbidity would not constitute or cause significant water quality impacts.

Subsea Pipeline

As discussed in section 2.3.3, Aguirre LLC proposes to lay its 4.1-mile-long (6.6 km) subsea pipeline directly on the seafloor. If a portion of the pipeline is constructed using the HDD technique (see section 4.5.2.4), sedimentation would occur at the HDD entry and exit points: these effects would be temporary and would subside following construction. Sediment disturbed during pipeline placement would be resuspended in the water column and transported by currents. Other construction activities, such as augering and pile-driving would also introduce sediment into the water column.

The effects of the pipeline construction activities on turbidity levels would vary with the length and severity of disturbance, grain size composition, and resettling rates. Based on rapid settling rates, we conclude construction activities in the areas with coarse sediments (outer Jobos Bay to the Offshore GasPort) would have only minor impacts on water quality associated with short-term, localized turbidity increases. Construction along the remainder of the pipeline route would likely result in more widespread turbidity due to the prolonged resettling rates of the finer sediments found in that portion of the bay. In both cases, the temporary, sequential nature of pipeline installation activities would limit the temporal and spatial extent of sediment resuspension and turbidity. As such, overall water quality impacts would be relatively short-term and minor.

Construction-Related Water Withdrawals and Discharges

Offshore Berthing Platform

Construction of the offshore berthing platform would involve the use of multiple support vessels, including material transport barges, tugs, crew/supply vessels, a dive support vessel, and a crane barge. Larger vessels may require the uptake of sea water for ballast and all vessels would require the uptake and discharge of sea water for engine cooling. These uptakes and discharges would be localized, temporary, and intermittent and we conclude they would not have any significant impacts on ambient water quality.

Subsea Pipeline

Under DOT regulations (49 CFR 192), Aguirre LLC is required to verify the integrity of the piping associated with the Project facilities before placing them into service by conducting hydrostatic testing. This testing involves filling the pipeline with water, pressurizing it, and then checking for pressure losses due to pipeline leakage. Aguirre LLC would pump seawater for testing into the pipeline using portable, high volume pumps on the offshore lay barge. The intake rate would be between 14,900 and 22,500 gallons per hour (56 to 85 m^3 per hour [m^3/hr]). The water intake would be about 6 feet below the surface and would be fitted with a 100-micron screen to prevent intake of organisms. Hydrostatic testing would require about 240,000 gallons of water (909 m^3) to fill the pipeline and complete one full hydrostatic test. Aguirre LLC does not anticipate the need for more than one full test, although some water replenishment may be required if isolated connections or flanges need depressurizing and retightening. No consumptive losses, temperature changes, or biocide treatment of the test water is anticipated.

Following the completion of the hydrostatic testing, the pipeline would be emptied, pigged, and purged with nitrogen or air to prepare for the receipt of natural gas. Aguirre LLC would filter all test water through a 100-micron filter system before discharging it at the shoreline approach of the pipeline in Jobos Bay. The discharge would be directed through a pipe secured about 6 feet (1.8 m) below the bay's water surface to minimize surface disturbance. To reduce discharge velocity and minimize sediment resuspension at the point of discharge, Aguirre LLC would attach a diffuser head to the discharge pipe during dewatering operations. Given the subsurface discharge and use of a diffuser, use of a 100-micron filter during withdrawal and discharge, and no change in water volume or temperature, we do not expect water quality impacts associated with test water uptake or discharge. In addition, Aguirre LLC would obtain all required permits and authorizations to conduct hydrostatic testing.

In addition to hydrostatic testing, construction of the subsea pipeline would involve the use of multiple marine support vessels including a lay barge, tug, pipe boat, dive vessel, crew boat, and various smaller vessels. During construction, certain vessels may require the uptake and discharge of sea water for engine cooling. These uptakes and discharges would be localized, temporary, and intermittent and are not expected to have any significant impacts on ambient water quality.

Operation-Related Water Withdrawals

Of the Project's four principal facility components (i.e., FSRU, LNG carriers, offshore berthing platform, and subsea pipeline), only the FSRU and LNG carriers would have operation-related water withdrawals. The offshore berthing platform would not be equipped with its own withdrawal systems; instead, it would be serviced via the FSRU systems. Water withdrawal profiles, impacts, and mitigation for the FSRU and LNG carriers are described below.

Floating Storage and Regasification Unit

Routine operations would require seawater use, whether the FSRU was in standby mode or vaporization mode. These operations would involve maintenance of the vessel's main and auxiliary cooling systems, regulation of ballast water, provision of a safety water curtain during LNG transfer and regasification, maintenance of a desalination system to provide freshwater for hoteling and sanitary purposes, and maintenance of a marine growth preventative system (MGPS). Non-routine uses for seawater include maintenance of the water deluge and fire main systems, which would run off dedicated pumps with an approximate flow capacity of 232,000 to 238,000 gallons per hour (880 to 900 m^3/hr).

The normal water use of the FSRU would total approximately 56 million gallons per day (mgd) (211,800 m^3 per day [m^3/day]) of seawater, including 53 mgd (200,600 m^3/day) to support machinery cooling through operation of the main condenser and auxiliary seawater cooling systems, 0.6 mgd (2,270 m^3/day) to generate the vessel's water safety curtain, 2 mgd (7,200 m^3/day) for ballast water, and 0.2 mgd (600 m^3/day) for the MGPS. All of the water used for these purposes would be discharged back into the surrounding ocean. Approximately 0.3 mgd (1,135 m^3/day) would be used in the FSRU's freshwater generation system, of which 0.03 mgd (115 m^3/day) would be consumed. Table 4.3.1-3 summarizes the anticipated standard intake (and discharge) volume requirements.

TABLE 4.3.1-3

Summary of Standard FSRU Water Use Intakes and Discharges [a]

Facilities	FSRU Seawater Intake (mgd [m^3/day])	FSRU Seawater Discharge (mgd [m^3/day])
Main Condenser Cooling System	47.0 (177,900)	47.0 (177,900)
Auxiliary Seawater Cooling System	6.0 (22,700)	6.0 (22,700)
Safety Water Curtain	0.6 (2,270)	0.6 (2,270)
Ballast Water	1.9 (7,200)	1.9 (7,200) [b]
Freshwater Generator	0.3 (1,135)	0.27 (1,020)
Marine Growth Preventative System	0.16(600)	0.16 (600)
Total:	**55.96 (211,800)**	**55.93 (211,685)**

[a] Based on standard continuous operation of an Excelerate Energy FSRU in closed loop regasification.
[b] Discharge based upon loading rate and buoyancy compensation needs for the FSRU.

All water used to support FSRU operations would be drawn through four sea chests on the sides of the vessel: starboard high, starboard low, port high, and port low. Each sea chest would draw water through a series of grids. For the high sea chests, approximately 22.8 feet (7 m) below the ocean surface, there would be four grids on the starboard side and eight on the port side; for the low sea chests, approximately 37.4 feet (11.4 m) below the ocean surface, there would be six grids on the starboard side and eight on the port side.

Each sea chest grid would have metal gratings with 0.87-inch-diameter (2.2 cm) slots between the grating bars. The high sea chests would have an open area of 8.2 square feet (0.8 square meters [m^2]) per grid and a total open area of 98.4 square feet (9.1 m^2). The low sea chests would have an opening of 6.9 square feet (0.6 m^2) per grid and a total open area of 96.6 square feet (9.0 m^2). The total open area for all four sea chests would be 195 square feet (18.1 m^2). Seawater would be drawn horizontally through the high sea chests and vertically through the low sea chests. Under normal water use capacity, the calculated through-screen velocity of water entering the sea chests would be approximately 0.45 ft/sec (0.14 m/s), which is just below the upper velocity threshold of 0.5 ft/sec (0.15 m/s) recommended as best available technology to minimize impingement of aquatic organisms (EPA, 2001). Potential impacts of the FSRU water uptake on marine organisms are discussed in more detail in sections 4.5 and 4.6.

The FSRU would circulate water drawn through the sea chests through the five main vessel operating systems (Main Condenser Cooling, Auxiliary Seawater Cooling, Water Curtain, Freshwater Generator, and Hoteling and Sanitary Treatment) and discharge at various outfall locations along the FSRU deck and hull. In addition, the MGPS would withdraw a small volume of seawater for the application of a self-generated sodium hypochlorite solution (approximately 0.5 parts per million [ppm]) into the sea chests to control biofouling. Consumptive volume from the freshwater generator would be used for sanitary system supply, boiler make-up water, and potable supply. Water in excess of that needed for operations would be discharged as part of the freshwater generator effluent.

The FSRU's seawater uptake would represent a negligible volume of water relative to the surrounding ocean. For reference, the 56 mgd (211,800 m^3/day) total withdrawal volume represents the water contained in an approximately 195 cubic feet (5.5 m^3) section of the Caribbean Sea in the vicinity of the Offshore GasPort.

LNG Carriers

While unloading LNG at the Offshore GasPort, visiting LNG carriers would take in seawater as ballast to maintain stability. Each LNG carrier would take ballast water up through the vessel's sea chests over an estimated 25 to 72 hours. No ballast water would be intentionally discharged from LNG carriers while at the Offshore GasPort. Ballast water is typically only discharged during loading operations at an LNG export terminal or in mid-ocean ballast water exchanges during transit. Ballast water may be chlorinated to eliminate biofouling of machinery cooling systems, water intake pumps, and piping.

LNG carriers unloading LNG would also need cooling water for the engines that generate electrical power for the offloading pumps and other onboard systems. Ships' engines are powered up while at dock; therefore, LNG carriers would need cooling water during the entire time they are moored (estimated at 41 to 88 hours).

LNG carriers calling at the Offshore GasPort could range in size from 33 to 57 million gallons (125,000 to 217,000 m^3) and be powered either by diesel engine or steam-turbine engine. The majority of smaller class vessels are steam turbine driven (CH_2M Hill, 2008), which use more cooling water than diesel engines.

Aguirre LLC's quantitative estimates for LNG carrier water use were derived from three sources; the Jordan Cove final EIS (FERC, 2009), the Broadwater LNG final EIS (FERC, 2008), and information provided by Oregon LNG in its application to the FERC (CH_2M Hill, 2008). Estimated cooling water intake rates ranged from a low of 0.3 million gallons per hour (mgh) (1,250 m^3/hr) based on diesel engine vessels using supplemental power from onshore facilities to a high of 2.6 mgh (9,800 m^3/hr). Similarly, the three sources indicate significant variation in ballast water intake rates from 0.7 to 1.0 mgh (2,600 to 3,900 m^3/hr). Table 4.3.1-4 summarizes the potential ranges of cooling ballast water and intake rates, volumes, and durations for the LNG carriers. Aguirre LLC indicated that, based on the type and size of the LNG carriers in the current fleet, the higher estimates in each case are most likely to be representative of the Project.

TABLE 4.3.1-4

Estimates of LNG Carrier Water Use and Intake Rates at the Offshore GasPort

Range	Time to Offload (hours)	Total time at AOGP (hours)	Ballast Intake Rate (mgh [m^3/hr]) [a, b]	Ballast Volume (million gallons [m^3])	Cooling Intake Rate (mgh [m^3/hr])	Cooling Volume (million gallons [m^3])	Total Intake Volume (million gallons [m^3])
Low	25	41	0.7 (2,600)	17.2 (65,100)	0.3 (1,250)	13.5 (51,100)	30.7 (116,200)
High	72	88	1.0 (3,900)	74.2 (280,900)	2.6 (9,800)	227.8 (862,300)	302.0 (1,143,200)

[a] All ballast intake occurs during offloading.
[b] Low value from FERC, 2009; high value from FERC, 2008.

LNG carriers would require about 17.2 to 74.2 million gallons (65,100 to 280,900 m^3) of water for ballast while offloading at the Offshore GasPort. Total cooling water intake volume would range from about 13.5 to 227.8 million gallons (51,100 to 862,300 m^3) during LNG delivery. Therefore, the combined water intake for ballast and cooling water for each LNG delivery would range from about 31 to 302 million gallons (116,200 to 1,143,200 m^3).

Seawater uptake by visiting LNG carriers would represent a negligible volume of water relative to the surrounding sea. For reference, the maximum 302 million gallons (1,143,200 m^3) required for ballast and cooling water represents the water contained in an approximately 340 cubic feet (9.6 m^3) of the Caribbean Sea in the vicinity of the Offshore GasPort.

Operation-Related Water Discharges

Of the Project's four principal facility components (i.e., FSRU, LNG carriers, offshore berthing platform, and subsea pipeline), only the FSRU and LNG carriers would have operation-related water discharge systems. The offshore berthing platform would be serviced via the FSRU systems. The heated water from the FSRU's engine cooling systems would represent the main water discharge during operation. LNG carrier discharges would be of similar volume to the FSRU discharges but with a smaller temperature rise relative to ambient sea temperature.

Water discharges have the potential to impact ambient water quality and biotic communities where discharge parameters fail to meet recognized standards and thresholds, generally embodied in regulations and permit conditions. Temperature standards are of particular significance here, based on the magnitude of the predicted cooling water discharges from the FSRU and LNG carriers. Residual chlorine standards are also relevant because several of the discharges would be treated with sodium hypochlorite as a biocide. Elevated temperature and chlorine levels can have sub-lethal or lethal effects on marine biota, depending on the magnitude and duration of the increase. Similar effects can occur if other contaminants, such as oil, grease, and metal particulates, are present in discharge water.

Floating Storage and Regasification Unit

During routine operations, the FSRU would operate with six permitted outfalls (001 through 006) and separate ballast outlets. Discharge sources for each of the outfalls (which correspond to functional use and/or derivation of discharged water, not necessarily actual discharge locations) are summarized in the following sections.

Outfall 001 – Main Condenser Cooling Water Discharge

The FSRU would utilize the steam from on-board boilers to drive the main turbine and turbo generators that provide power for the vessel's propulsion system, electric generation system, and auxiliaries. During vessel passage, which would occur when the FSRU first sails to the berthing platform and at intermittent times thereafter, seawater would be used to cool and condense exhaust steam in the vessel's main condenser, allowing heat dissipation. The same main condenser cooling system would operate during LNG transfer and regasification operations at the berthing platform.

The FSRU's main condenser cooling system would require the intake and discharge of approximately 47 mgd (177,900 m^3/day) of seawater during periods of normal capacity water use associated with LNG transfer and regasification. Intake water would circulate through the cooling system prior to discharge through a 55-inch-diameter (1.4 m) pipe (Outfall 001) on the side of vessel, 17.4 to 24.3 feet (5.3 to 7.4 m) below the ocean surface.

The JETLAG/VISIJET (JETLAG) Model (Lee and Cheung, 1990: Lee and Chu, 2003; Choi and Lee, 2007) was used to predict and analyze the spatiotemporal characteristics of the thermal plume associated with the discharge from the Main Condenser Cooling System. Parameters that were factored into the modeling include water discharge rate (momentum) and volume, thermal dissipation characteristics, and outlet port dimensions.

An elevation in water temperature of 21.6 ºF (12.0 ºC) above ambient (85.3 ºF [29.6 ºC]) was used to model the proposed mixing zone[5] for Outfall 001. This temperature increase was based on operating records for the Northeast Gateway Energy Bridge Project (EPA, 2007). Aguirre LLC assumed that this temperature differential (delta–t) would be representative of that associated with cooling water discharge from the Project's FSRU. Applying a delta-t of 21.6º F (12.0 ºC), the maximum discharge temperature at Outfall 001 was estimated at 106.9 ºF (41.6 ºC). This maximum temperature was compared against a thermal compliance value of 90º F (32 ºC), which is the EQB's ambient threshold that cannot be exceeded by the addition of higher temperature water other than through natural causes or by establishment of a permitted mixing zone (EQB, 2010b). The mixing zone was calculated to be a 135-foot (41 m) radius[6] from the outlet port based on EPA guidelines (EPA, 1991).

The result of the JETLAG modeling for the "no current" and "minimal current" scenarios (0.3 ft/sec [0.1 m/s]) are summarized in table 4.3.1-5. Under the "no current" scenarios, attainment of the 90 ºF (32 ºC) temperature criterion was calculated at a maximum horizontal distance of 33.7 feet (10.3 m)[7] from the discharge port and at a maximum depth of 22.8 feet (6.9 m). When modeled with a minimal current, the temperature criterion was attained at a maximum horizontal distance of 25.4 feet

5 A mixing zone is an allocated impact zone where water quality criteria can be exceeded as long as acutely toxic conditions are prevented (EPA, 1991).

6 Calculated based on 50 times the discharge length scale (2.7 feet [0.82 m]), which is the square root of the cross-sectional area of the discharge outlet (EPA, 1991).

7 All linear measurements for thermal plumes in this section are based on distance from the outlet port.

(7.8 m) and a maximum vertical depth of 23.4 feet (7.1 m). Therefore, the net increase in thermal loading is expected to have only a localized effect on water quality, well within the boundary of the 135 foot (41 m) mixing zone. The plume is predicted to dissipate beneath the FSRU's hull and not reach the seafloor.

TABLE 4.3.1-5

Temperature Criterion Attainment Profile for FSRU Outfall 001 Thermal Plume Based on JETLAG Model

Case	Discharge Depth (feet [m])	Ambient Velocity (ft/sec [m/s])	Temperature Criterion (ºF [ºC])	Horizontal Distance for Criterion Attainment (feet [m])	Water Depth for Criterion Attainment (feet [m])	Plume Contact with Seafloor
1	17.4 (5.3)	0	90 (32)	33.7 (10.3)	15.9 (4.8)	No
2	20.8 (6.4)	0	90 (32)	33.7 (10.3)	19.3 (5.9)	No
3	24.3 (7.4)	0	90 (32)	33.7 (10.3)	22.8 (6.9)	No
4	17.4 (5.3)	0.3 (0.1)	90 (32)	25.4 (7.8)	16.6 (5.0)	No
5	20.8 (6.4)	0.3 (0.1)	90 (32)	25.4 (7.8)	20.0 (6.1)	No
6	24.3 (7.4)	0.3 (0.1)	90 (32)	25.4 (7.8)	23.4 (7.1)	No

Under the NPDES, a permitted mixing zone would be inherently protective of area-wide water quality and thermal discharges from Outfall 001 (and Outfall 002) as they would have to comply with applicable regulatory requirements. Operation of the FSRU would be authorized by the EPA (the NPDES authority in Puerto Rico) only if the modeled mixing zone meets these requirements.

To prevent macrofouling of the FSRU's raw water intake systems, the FSRU would inject chlorine in the form of a sodium hypochlorite solution (approximately 0.5 ppm) into the sea chests to act as a biocide. The electrolytic generation system on board the FSRU would produce a continuous supply of sodium hypochlorite. The chlorine would disperse naturally within the water intake systems. The EQB water quality standard for residual chlorine in Class SC waters is currently under revision to limit concentrations to 0.011 ppm. The EQB will regulate residual chlorine in the water quality certificate based on the water quality standard in effect at the time of issuance of the water quality certificate. The EPA's recommended water quality criteria for residual chlorine are 0.013 ppm for continuous maximum concentration and 0.007 ppm for continuous chronic concentration in marine waters (EPA, 1986). These criteria are published pursuant to Section 304(a) of the CWA and provide guidance for states and tribes to use in adopting water quality standards. The in-pipe residual chlorine levels would range from 0.1 to 0.15 ppm, which exceeds both the current EQB and EPA standards. This residual chlorine concentration is not expected to significantly affect water quality due to the low concentration of sodium hypochlorite that may be present in the discharge and the relatively localized zone of initial dilution. All operational discharges would be subject to the requirements of the NPDES permit for the Project.

Outfall 002 – Auxiliary Cooling Water Discharge

Aguirre LLC used the JETLAG model to determine the thermal discharge plume associated with the auxiliary cooling water discharge from Outfall 002. Based on a similar FSRU currently in operation, a delta-t of 11.0 ºF (6.5 °C) above ambient temperature was assumed. As such, at an ambient temperature of 85.3 ºF (29.6 °C), the calculated maximum discharge temperature at Outfall 002 is 96.3 ºF (35.7 °C). The mixing zone was modeled to be a 47.5-foot (14.5 m) radius[8] from the outfall based on EPA guidelines (EPA, 1991).

8 Calculated based on 50 times the discharge length scale (0.95 feet [0.29 m]), which is the square root of the cross-sectional area of the discharge outlet (EPA, 1991).

The result of the JETLAG modeling for the "no current" and "minimal current" scenarios (0.3 ft/sec [0.1 m/s]) are summarized in table 4.3.1-6. Under the "no current" scenarios, attainment of the 90 ºF (32 ºC) temperature criterion was calculated at a maximum horizontal distance of 5.0 feet (1.5 m) and a maximum depth of 27.3 feet (8.4 m). With a minimal current of 0.3 ft/sec (0.1 m/s), attainment of the 90 ºF (32 °C) criterion was predicted within a maximum horizontal distance of 4.1 feet (1.3 m) and a maximum depth of 27.3 feet (8.4 m). Therefore, the net increase in thermal loading is expected to have only a localized effect on water quality, well within the boundary of the 47.5 foot (14.5 m) mixing zone. The plume is predicted to dissipate beneath the FSRU's hull and not reach the seafloor. Plume parameters developed under the "no current" and "minimal current" scenarios are summarized in table 4.3.1-6.

TABLE 4.3.1-6

Temperature Criterion Attainment Profile for FSRU Outfall 002 Thermal Plume Based on the JETLAG Model

Case	Discharge Depth (feet [m])	Ambient Velocity (ft/sec [m/s])	Temperature Criterion (ºF [°C])	Horizontal Distance for Criterion Attainment (feet [m])	Water Depth for Criterion Attainment (feet [m])	Plume Contact with Seafloor
1	20.4 (6.3)	0	90 (32)	5.0 (1.5)	20.4 (6.3)	No
2	23.9 (7.4)	0	90 (32)	5.0 (1.5)	23.9 (7.4)	No
3	27.3 (8.4)	0	90 (32)	5.0 (1.5)	27.3 (8.4)	No
4	20.4 (6.3)	0.3 (0.1)	90 (32)	4.1 (1.3)	20.4 (6.3)	No
5	23.9 (7.4)	0.3 (0.1)	90 (32)	4.1 (1.3)	23.9 (7.4)	No
6	27.3 (8.4)	0.3 (0.1)	90 (32)	4.1 (1.3)	27.3 (8.4)	No

Outfall 003 A (Port) and B (Starboard) – Water Curtain

For safety purposes it is common practice for most LNG vessels to maintain a constant flow of water, referred to as a "water curtain," over the deck and hull of the vessel during LNG transfer or regasification. In the event of a LNG leak during these operations, the presence of the water curtain helps protect the metal hull from any potential cracking or stress. The LNG vessel would use seawater withdrawn through the high and low starboard and port sea chests, pumped onto the deck of the FSRU at a flow rate of approximately 0.6 mgd (2,270 m^3/day), and then discharged over the port and starboard sides of the vessel as runoff. As discussed above, water within the FSRU's internal piping system would be subject to treatment with sodium hypochlorite for biofouling control. We anticipate that these levels would diminish shortly after discharge and would not significantly affect water quality. We do not anticipate these discharges would result in any change in ambient temperature. All operational discharges would be subject to the requirements of the NPDES permit for the Project.

Outfall 004 A (Port) and B (Starboard) – Freshwater Generator

The seawater supply for the freshwater generator would enter the FSRU through the high and low starboard and port sea chests. Approximately 0.3 mgd (1,135 m^3/day) of seawater would be withdrawn and piped to the freshwater generator, which would produce approximately 0.03 mgd (115 m^3/day) of freshwater. The FSRU would discharge the remaining 0.27 mgd (1,020 m^3/day) as brine water, which would exhibit slightly higher salinity content than the surrounding surface waters due to the concentrating effects of freshwater removal.

Consumptive uses of the generated freshwater would include on-board potable supplies for drinking water and sanitary purposes, feed water for the main and auxiliary boilers, and make-up water. Any surplus freshwater would be stored on the vessel or discharged.

The freshwater generator and piping would be treated with sodium hypochlorite. Some residual chlorine may be present in the 0.27 mgd (1,020 m^3/day) of seawater that would pass through the freshwater generator without desalinization prior to discharge through the Outfall 004 discharge points on the starboard and port sides. Given the very low discharge volume relative to the oceanic receiving waters, the high brine concentration and possible residual chlorine are not expected to result in noticeable water quality impacts. All operational discharges would be subject to the requirements of the NPDES permit for the Project.

Outfall 005 – Ballast Water Systems

The FSRU would discharge ballast water in response to ongoing FSRU operations and vessel stability needs during the LNG loading and regasification processes. Ballast discharge volumes could reach 1.9 mgd (7,200 m^3/day) but would vary according to operational status and sea conditions. An MGPS would be developed to minimize the potential for macrofouling of the onboard ballast system. Intermittent biocide treatment of the ballast tanks would involve the injection of chlorine, derived from the vessel's electrolytic sodium hypochlorite generation system. We anticipate that these levels would diminish shortly after discharge and would not significantly affect water quality. Given that the ballast water for the FSRU would be withdrawn and discharged at the same Offshore Gasport location, there would be no possibility of invasive species being introduced through the release of ballast water originating from another location.

The FSRU would undergo dry-dock maintenance about every 5 years. During scheduled dry-dock periods, PREPA may require Aguirre LLC to use a similar FSRU to meet contractual send-out rates. The commissioning of the new and/or returning FSRU would likely require the discharge of ballast water from an offsite location. Due to the infrequency of these discharges and the fact that Aguirre LLC must comply with USCG's ballast water discharge requirements, we do not anticipate any significant impacts on water quality. All operational discharges would be subject to the requirements of the NPDES permit for the Project.

Outfall 006 Stormwater

Under normal operation conditions, dust and dirt are expected to accumulate on the decks and other exposed services of the FSRU. In addition, minor leaks of grease and other lubricants from on-board equipment could occur. When raining, these materials could become entrained in sheet-flow runoff from the decks, resulting in intermittent releases to the surrounding waters of the Caribbean Sea. To minimize impacts associated with stormwater discharges, Aguirre LLC would implement measures outlined its Stormwater Pollution Prevention Plan, including the deployment of equipment drip vats and oil absorbent material around collection drains. We conclude that implementation of these measures would minimize the likelihood of stormwater impacts on the Caribbean Sea. All operational discharges would be subject to the requirements of the NPDES permit for the Project.

Hoteling and Sanitary Treatment System

Operation of the FSRU would generate galley, hotel services, and sanitary wastes. Water contributing to these wastes would be freshwater generated by the FSRU's on-board desalination system. Assuming 10 percent of the freshwater is used for sanitary system support, the FSRU would generate approximately 0.03 mgd (115 m^3/day) of black and gray wastewater from the restroom, hoteling, and galley services.

The FSRU would treat and manage wastewater on a daily basis in compliance with regulations set forth by the 1978 Protocol of the 1973/78 International Convention for the Prevention of Pollution from Ships (MARPOL, Annex IV). Under MARPOL, the FSRU would be required to have an approved on-board system to treat and disinfect sewage before offshore discharge or would need to store and periodically off-load sewage to a service vessel for transportation to a land-based treatment facility. Aguirre LLC has indicated that all black and gray wastewater would be treated by an on-board septic system then pumped to a service vessel and taken onshore for eventual disposal. This would preclude any water quality impacts associated with offshore discharge.

Bilgewater and Blowdown Water Management

The bilge is the lowest compartment of a ship's hull, below the waterline, where the two sides meet at the keel. Deck water from precipitation, heavy waves, and other sources that does not drain directly over the sides of the ship would drain down through the ship's interior into the bilge. The collected water must be pumped out periodically to maintain the ship's full stability and operational capacity. Bilge water contains materials that are washed off the drained surfaces. These materials, some of which may be derived from leaks and spills, can include oil, grease, detergents, solvents, and particulate matter (e.g., metallic particles [including rust] and dirt).

Bottom blowdown refers to the periodic removal of accumulated particulates, sludge, and other impurities from the bottom of a ship's boilers to facilitate safe operation and efficiency. These impurities, which include rust and other metallic particles, pH adjustment compounds, and anti-scaling agents, can become concentrated during continuing evaporation of steam. Without blowdown, this concentration can compromise the boiler's steam generation capacity and structural integrity.

USCG regulations (33 CFR 151.10) require ships to comply with specific conditions for marine bilge discharges when operating within 12 nautical miles (22 km) of the nearest land. These conditions relate to the oil content and origin of the bilge water and the use of monitoring, alarm, and oil-water separation equipment. Oily water that fails to meet specified treatment standards must be containerized and stored for off-vessel removal and treatment at an onshore certified treatment facility. In consideration of these conditions, Aguirre LLC has indicated that bilge water collected from the FSRU bilge sump pumps, together with comingled bottom blowdown water from the main and auxiliary boilers would be pumped off the FSRU for onshore disposal at a Puerto Rico government approved facility. As part of this process, residual oil and grease would be concentrated and containerized. The absence of any offshore discharge would preclude ambient water quality impacts.

<u>LNG Carriers</u>

The condenser cooling water system would be the dominant discharge associated with the LNG carriers while moored at the offshore berthing platform. Aguirre LLC used the same JETLAG modeling system for the thermal plume characteristics of the LNG discharge as was used for the FSRU. Intake and discharge parameters were identical to those selected for the FSRU, except for a slightly higher maximum volume intake rate and a maximum delta-t of 5.4 ºF (2.8 °C), which is based on off-loading characteristics from the Jordan Cove LNG Project (FERC, 2009).

The results of the JETLAG modeling for the LNG carrier discharges under the "no current" and "minimal current" scenarios are summarized in table 4.3.1-7. The modeling showed a confined plume with EQB's temperature criterion (90 ºF [32 °C]) attained at 2.7 feet (0.8 m) in the horizontal plain and up to 26.7 feet (8.1 m) in the vertical plain; under the minimal current scenario (0.3 ft/sec [0.1 m/s]), the temperature criterion was attained at 1.3 feet (0.4 m) in the horizontal plain and at up to 25.4 feet (7.7 m) in the vertical plain. Therefore, the temperature criterion is met close to the discharge outlet under both current scenarios. However, the elevated flow rate is projected to impact the seafloor across all discharge depths and under both current scenarios, with consequent implications for sediment resuspension.

TABLE 4.3.1-7

Temperature Criterion Attainment Profile for LNG Carrier Thermal Plume Based on the JETLAG Model

Case	Discharge Depth (feet [m])	Ambient Velocity (ft/sec [m/s])	Temperature Criterion (ºF [°C])	Horizontal Distance for Criterion Attainment (feet [m])	Water Depth for Criterion Attainment [a] (feet [m])	Plume Contact with Seafloor
1	17.2 (5.2)	0	90 (32)	2.7 (0.8)	19.8 (6.0)	Plume periphery
2	20.6 (6.3)	0	90 (32)	2.7 (0.8)	23.4 (7.1)	Plume periphery
3	24.0 (7.3)	0	90 (32)	2.7 (0.8)	26.7 (8.1)	Plume periphery
4	17.2 (5.2)	0.3 (0.1)	90 (32)	1.3 (0.4)	18.5 (5.6)	Plume periphery
5	20.6 (6.3)	0.3 (0.1)	90 (32)	1.3 (0.4)	22.1 (6.7)	Plume periphery
6	24.0 (7.3)	0.3 (0.1)	90 (32)	1.3 (0.4)	25.4 (7.7)	Plume periphery

[a] Depth is projected attainment of temperature criterion, plume momentum would impact bottom.

Cooling water discharges from LNG carriers would have to comply with applicable water quality criteria. Anti-fouling agents similar to those discussed for the FSRU above would be used by the visiting LNG carriers. We anticipate that these levels would diminish shortly after discharge and would not significantly affect water quality. Given compliance with EQB’s temperature criterion of 90 ºF (32 °C) is reached close to the point of discharge, we do not anticipate that elevated temperature levels would constitute a significant water quality impact. Whereas thermal plume modeling suggests that sediment resuspension could be a recurring phenomenon, with each visiting ship (approximately one every 8 days) discharging cooling water for the duration of its stay (up to approximately 88 hours), the effects would be localized and relatively minor.

As discussed above, the LNG carriers would take on ballast water to maintain stability and operational readiness as their cargo is off-loaded. However, ballast water discharges are not anticipated during the off-loading process. Similarly, LNG carriers would not conduct routine blowdowns while at berth.

4.3.2 Onshore Surface Water Resources

4.3.2.1 Regional Characteristics

The Jobos Bay watershed, which is defined as the entire land area draining directly to Jobos Bay, covers 53 mi^2 (137 km^2) and is bordered by two perennial stream networks: Rio Nigua to the west and Rio Guamani to the east. The watershed’s northern boundary begins in the foothills of the Central Interior Mountain Range and the southern boundary extends for about 28 miles (45 km) along the mainland coastline of the bay (Zitello et al., 2008).

Freshwater surface discharges to Jobos Bay from the adjoining watershed are limited to one major perennial river (Rio Seco, 2.3 miles [3.7 km] east of the Aguirre Plant), several small intermittent streams, and diffuse overland runoff. Due to the dry climate, the streams exhibit intermittent flow throughout the year without any seasonal emphasis. Year-round flow is also limited where the streams meet highly porous fan delta deposits and water infiltrates downwards, contributing significantly to groundwater recharge in the underlying aquifer (Quiñones-Aponte et al., 1997).

4.3.2.2 Water Quality

Zitello et al. (2008) indicates that in addition to run-off from high intensity developed areas and agricultural fields, additional sources of waterborne constituent inputs from the Central Aguirre subwatershed could include the Central Aguirre Golf Club, located 0.3 mile (0.5 km) from the Jobos Bay shoreline, along with a municipal landfill and dredge spoils from the Aguirre Navigation Channel, located 0.9 mile (1.5 km) from the shoreline.

4.3.2.3 General Impacts and Mitigation

None of the rivers or streams flowing into Jobos Bay are in the Project's construction footprint or would otherwise be directly impacted by construction or operation of the proposed facilities. Construction activities at the pipeline landfall, which would be within the fenceline of the Aguirre Plant, would likely involve the disturbance of soils in the vicinity of the shoreline. Soil disturbance and stormwater runoff have the potential to result in offshore sedimentation. Aguirre LLC would implement mitigation measures outlined in the FERC Plan and Procedures and the NPDES construction stormwater discharge permit and Stormwater Pollution Prevention Plan developed for the Project to avoid or minimize water quality impacts on shore and in the bay. These measures include maintaining erosion and sedimentation controls (e.g., silt fence) throughout construction, establishing refueling restrictions and spill control measures, and restoring disturbed areas when construction is complete.

4.3.3 Groundwater Resources

4.3.3.1 Regional Characteristics

Puerto Rico is underlain by an aquifer complex composed of limestone, alluvium, and volcanic rocks. The South Coastal Plain aquifer, which underlies the Jobos Bay watershed, extends east to west from Patillas to Ponce, and north to south from the bedrock hills near the watershed's northern boundary to the southern coastline of the bay. According to Quiñones-Aponte et al. (1997), the aquifer consists of a principal groundwater flow zone of fan delta and alluvial deposits, sandwiched between a deep zone of weathered bedrock and an upper zone of sand and gravel. Towards the coast, an increasing amount of fine-grained material in the upper zone impedes groundwater flow from the north and results in two discrete groundwater units: a shallow unit approximately 10 to 76 feet (3 to 23 m) thick and a deep unit below. The shallow unit is believed to supply the mangrove complex at the watershed's coastal margins, whereas the deep unit may provide freshwater to the offshore mangrove islands on the southern perimeter of Jobos Bay (Whitall et al., 2011).

The South Coastal Plain aquifer provides about one-half of the public water and agricultural irrigation supply of the south coast; the remainder is drawn from surface water sources.

4.3.3.2 Water Quality and Public Use

Groundwater resources intended for use as drinking water supply sources, agricultural uses including irrigation, and flow into coastal, surface, and estuarine waters and wetlands as defined in the regulation are protected under the PRWQSR (EQB, 2010b). The PRWQSR states that groundwater pH, color, turbidity, total dissolved solids, taste or odor substances, and dissolved gases (composition, combination, and concentration) shall not be altered except by natural causes; fecal coliform colonies shall not be present under specified sampling protocols; and surfactants (as methylene blue active substances) shall not be present.

The mainland surrounding Jobos Bay encompasses two public supply water aggregation service areas (USGS, 2008). These supply areas, designated as Areas 38 and 41, approximately bisect the drainage area and comprise the municipalities of Salinas to the west (Area 38) and Guayama to the east (Area 41). Public water supply is sourced from surface water and groundwater in both areas.

Those water supply wells closest to the Project area were identified by Aguirre LLC through consultation with EPA Region 2 and EQB staff. No wells are within 3 miles (4.8 km) of the proposed Offshore GasPort. The closest well to the Project footprint is approximately 1.2 miles (1.9 km) north of the proposed pipeline landfall at the Aguirre Plant. The locations of the water supply wells are summarized in table 4.3.3-1.

TABLE 4.3.3-1

Water Supply Wells in the Vicinity of the Aguirre Offshore GasPort Project

Public Supply Reference	Name of Well Or Well Cluster	No. of Well Locations	Distance and Direction from Project (miles [km])	Municipality or Private Well
PR0004765	Cimarrona	1	3.3 (5.3), east	Guayama
PR0004775	Puente Jobos	2	4.0 and 5.0 (6.4 and 8.1), east	Puente Jobos
PR0004845	Guayama Urbano	2	3.1 and 4.1 (5.0 and 6.6),east	-
PR0004915	Coqui	3	1.4, 1.5 and 1.8 (2.3, 2.4 and 2.9), west	Salinas
PR0563015	Corporacion Azucarera Aguirre	1	1.2 (1.9), west	Private
PR0563065	AEE Aguirre Termoelec.	1	2.5 (4.0), west	Private

Sources: Espanol, 2012; Gould, 2012

4.3.3.3 General Impacts and Mitigation

The proposed Project facilities are at least 1 mile from the closest known water well, and no direct intrusion into groundwater bearing strata, either through offshore pile placement or pipe laying is anticipated. Onshore facilities are restricted to the short section of overland pipeline between the Aguirre Plant and the Jobos Bay shoreline, which would be installed aboveground, precluding the need for trenching and physical connection with any shallow groundwater table that might exist. The Project would not affect municipal or private water supplies. However, spills or leaks of hazardous materials (e.g., fuel, lubricants) from construction or operation equipment could result in adverse impacts on groundwater. Construction contractors and port operations personnel would be required to comply with all laws and regulations related to handling of fuels and lubricants, including 40 CFR 110, and vessel-to-vessel transfers, including 33 CFR 155. Aguirre LLC has committed to preparing a site-specific spill prevention and control plan to minimize the potential for inadvertent release and to establish protocol for the containment, remediation, and reporting of accidental releases. Because Aguirre LLC has not yet provided its spill plan, **we recommend that:**

- **Prior to construction, Aguirre LLC file a site-specific spill prevention and control plan for the construction and operation phases of the onshore and offshore portion of the Project with the Secretary for review and written approval by the Director of OEP.**

4.4 VEGETATION RESOURCES

4.4.1 Terrestrial Vegetation Resources

The proposed temporary staging and support area, where the subsea pipeline would reach landfall, is entirely within the existing Aguirre Plant, which consists of previously disturbed industrial land with little or no vegetation coverage.

4.4.2 Marine Vegetation Resources

4.4.2.1 Mangroves

Mangroves are estuarine, intertidal, emergent scrub-shrub wetlands that are usually found along shorelines in the intertidal zone between open water and upland habitat (NMFS, 2011c). Mangroves serve as sediment traps, causing the accumulation of sediments, production of organic matter, and prevention of erosion. They are a vital component in the estuarine food chain, providing habitat for a large variety or organisms, which serve as a base to the food chain. Mangroves provide essential ecosystem services for Jobos Bay, including habitat for a variety of marine organisms (Whitall, et al., 2011).

Mangrove cays, including Cayos de Barca and Cayos Caribes, are on the southern and western edges of Jobos Bay and cover approximately 25 percent of the entire bay. Four species of mangroves are found within Jobos Bay: red mangrove, black mangrove, white mangrove, and buttonwood mangrove. The majority of the shoreline in the bay is dominated by red mangrove, which grows in silty soils in tidally flooded areas and is the most water-tolerant of the four mangrove species.

The closest mangrove island to the proposed Project facilities is approximately 600 feet (183 m) east of MP 2.0 of the subsea pipeline.

4.4.2.2 Seagrass and Macroalgae

Submerged aquatic vegetation (SAV) is the most common benthic cover type in Jobos Bay. Seagrass is the dominant cover in approximately 30 percent (3,000 acres [3,089 cuerdas]) of the bay; macroalgae (seaweed) is the dominant cover in an additional 20 percent (2,000 acres [2,049 cuerdas]) (Whitall et al., 2011). Seagrasses provide food and shelter to commercial and recreational fishery species as well as invertebrates and birds. Seagrasses also reduce wave and current action and improve water clarity and quality. Seagrass beds are more prevalent near the shore, where they cover some 70 percent of Jobos Bay's shallows (Field et. al., 2003). The seagrass flora in Jobos Bay is relatively diverse and includes turtle grass, manatee grass, shoal grass, paddle grass, and Florida Keys seagrass. The distribution pattern for these species is controlled by salinity, light, and air exposure. Generally, shoal grass inhabits the shallowest areas, turtle and manatee grass occupy the intermediate areas, and paddle grass, widgeon grass, and Florida Keys seagrass grow in the deepest areas. While seagrass cover is most common on sandy or muddy substrate, macroalgae grow in both soft sediments and on hardbottom. Both seagrass and macroalgae are distributed throughout Jobos Bay, providing habitat for commercially and recreationally important fish and invertebrates.

Aguirre LLC conducted multiple surveys of the Project area, including towed-diver video transects and sample quadrats, to characterize the benthic conditions along the proposed subsea pipeline route and within the offshore terminal site. The results of these surveys showed that seagrass was the most abundant benthic cover along the pipeline route (see figure 4.4.2-1). Within inshore regions of the Project area, turtle grass had the highest areal extent, followed by macroalgae, paddle grass, manatee grass, and shoal grass. Turtle grass dominated areas immediately shoreward of the cays, before giving way to a mix of manatee grass, shoal grass, and paddle grass toward the center of Jobos Bay.

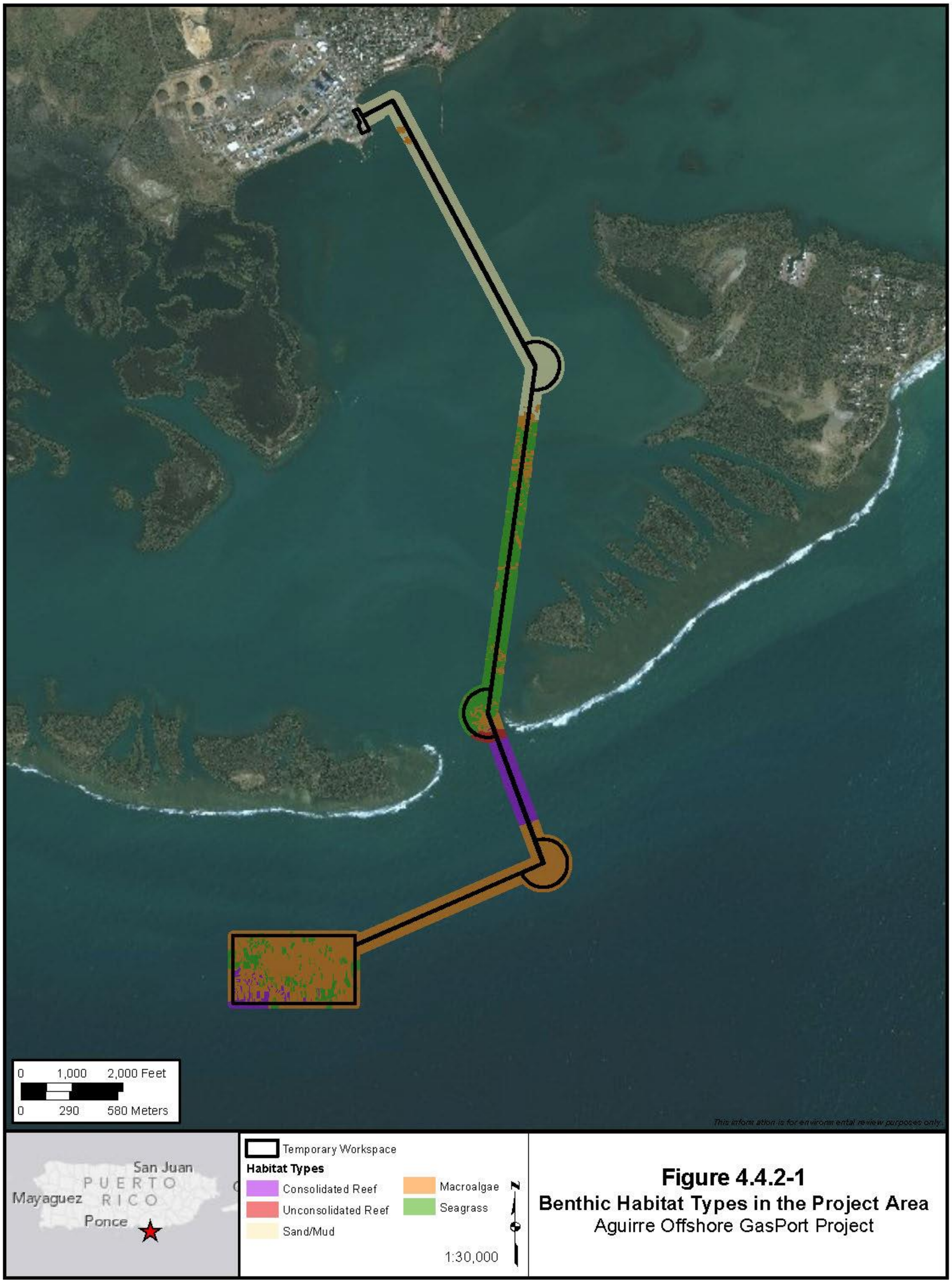


Figure 4.4.2-1
Benthic Habitat Types in the Project Area
Aguirre Offshore GasPort Project

Seagrass was not observed on the southernmost leg of the pipeline route (MPs 0.0 to 1.5). Macroalgae within the Project area had a discontinuous distribution and was intermixed with seagrass in some areas, while occurring as monospecific assemblages in other areas. The most common macroalgae taxon, out of the 39 genera documented, was *Halimeda* spp.

Survey efforts within the offshore terminal location revealed three broad-scale benthic communities: macroalgae, seagrass, and patch reef. Macroalgae was the dominant biotic cover and accounted for more than half of the survey area. The seagrass found within in the survey area consisted of large mono-specific Florida Keys grass stands with smaller patches of paddle grass intermixed.

4.4.3 General Impacts and Mitigation

Based on the sparse vegetation within the proposed onshore temporary workspace area, no significant impacts on terrestrial vegetation resulting from construction or operation of the Project are anticipated.

Although no mangroves would be directly impacted by the proposed Project activities, spills or leaks of hazardous materials (e.g., fuel, lubricants) from equipment working in Jobos Bay and offshore areas could result in adverse impacts on nearby mangroves. As described in section 4.3.3.3, construction contractors and port operations personnel would be required to comply with all laws and regulations related to handling of fuels and lubricants, and Aguirre LLC would prepare a site-specific spill prevention and control plan for construction and operation to minimize the potential for inadvertent release. We are recommending in section 4.3.3.3 that Aguirre LLC file this plan for review and approval prior to construction. Inadvertent hydrocarbon spills in open water areas and associated impacts to the marine environment are discussed in more detail in section 4.5.2.4. Based on the location of the mangroves relative to the Project area we expect impacts on these resources, if any, to be short term and minor.

Construction activities such as vessel anchoring, pipe laying, and pile driving would result in direct impacts on approximately 19.8 acres (20.4 cuerdas) of seagrass and 77.4 acres (79.7 cuerdas) of macroalgal habitat (see table 4.4.3-1). The operation of the offshore terminal would result in permanent impacts on approximately 2.9 acres (3.0 cuerdas) of seagrass and 19.2 acres (19.8 cuerdas) of macroalgal habitat. For the pipeline, as Aguirre LLC proposes to lay it directly on the seafloor, Aguirre LLC estimates that the area of permanent habitat conversion would be restricted to a 6-foot-wide (2 m) right-of-way centered over the pipeline. These impacts may be even less if Aguirre LLC can determine that a HDD under Boca del Infierno pass is feasible (see our recommendation in section 4.5.2.4). Based on direct lay, direct, permanent impacts on seagrass and algal communities within this corridor would be 0.7 and 0.9 acre (0.7 and 0.9 cuerda), respectively.

TABLE 4.4.3-1

Benthic Habitat Types Within the Aguirre Offshore GasPort Project Area

	Seagrass		Macroalgae		Coral Reef		Sand/Mud	
Project Component	Const.	Oper.	Const.	Oper.	Const.	Oper.	Const.	Oper.
Offshore Terminal (acres [cuerdas])	12.0 (12.4)	2.9 (3.0)	59.4 (61.2)	19.2 (19.8)	4.1 (4.2)	0.2 (0.2)	0.0	0.0
Subsea Pipeline (acres [cuerdas])	7.8 (8.0)	0.7 (0.7)	18.0 (18.5)	0.9 (0.9)	1.1 (1.1)	0.3 (0.3)	14.5 (14.9)	1.1 (1.1)
TOTAL(acres [cuerdas])	**19.8 (20.4)**	**3.6 (3.7)**	**77.4 (79.7)**	**20.1 (20.7)**	**5.2 (5.3)**	**0.5 (0.5)**	**14.5 (14.9)**	**1.1 (1.1)**

Note: Const. = temporary impacts during construction (includes operational impacts), Oper. = permanent impacts during operation

Aguirre LLC has agreed to prepare a seagrass mitigation and monitoring plan in consultation with respective agencies to offset short-term and/or permanent impacts on seagrass communities. The plan would include seagrass planting and post-construction monitoring to determine Project effects and/or mitigation success. After construction, Aguirre LLC would perform seagrass mitigation in areas where the impact has occurred. In areas of impact where planting would not be feasible, Aguirre LLC would identify alternative mitigation sites where existing seagrass beds of similar species are thriving. Planting at these sites will increase the chance of mitigation success, as adequate water quality, substrate, depth, and light penetration area ideal for seagrass growth in these areas. To ensure that impacts on seagrass are minimized and/or properly mitigated, **we recommend that:**

- **<u>Prior to the end of the draft EIS comment period</u>, Aguirre LLC should consult with NMFS, FWS, DNER, and other appropriate agencies in developing the seagrass mitigation and monitoring plan. This mitigation plan should be developed in compliance with the COE's mitigation requirements for the Project. Aguirre LLC should file a draft of this plan along with agency comments on the draft with the Secretary.**

Based on our analysis, Aguirre LLC's proposed mitigation measures, and our recommendation, we conclude that the Project would not result in significant impacts on seagrass.

4.5 WILDLIFE RESOURCES

Wildlife species inhabiting the Project area are characteristic of the habitats that occur in the vicinity of the Project. Threatened and endangered wildlife species are discussed in section 4.6. Our BA for species that are federally listed under the ESA, as amended, is included as appendix D.

4.5.1 Terrestrial Wildlife Resources

The onshore facilities for the Project would be entirely within the existing Aguirre Plant property. The industrial infrastructure development within the Aguirre Plant has significantly reduced the available upland habitat for wildlife species. Additionally, while other areas surrounding Jobos Bay are considered areas of conservation priority for wildlife species by the Natural Heritage Program, the industrial complex surrounding the Aguirre Plant is excluded from this designation (DNER, 2005). Due to the lack of suitable vegetated habitat and the ongoing industry activities at the site, only urban-acclimated species are likely to inhabit the proposed Project area. Urban acclimated species occurring within the vicinity of the Project area include Brook's house gecko, Giant toad, house mouse, black rat, and feral cats and dogs (Ventosa-Febles et al., 2005). Because of the lack of suitable wildlife habitat within the upland area of the Project, bird species within the Project vicinity would likely utilize surrounding estuarine and marine habitats (see section 4.5.3.2) or be acclimated to disturbance.

General Impacts on Terrestrial Wildlife Resources

The urban acclimated species within the Aguirre Plant would likely leave the Project area during construction. Noise associated with construction could also disrupt breeding of wildlife in the vicinity of the Project. No additional lighting is proposed at the Aguirre Plant; therefore, wildlife impacts associated with lighting are not anticipated. Animals displaced by construction activities may relocate into similar or higher quality habitats nearby. Additionally, some smaller, less mobile wildlife, such as small mammals, burrowing species, amphibians, and reptiles, could be crushed by construction equipment. However, these effects would cease after construction and any wildlife previously utilizing the Project area would return to the existing industrial area. Because wildlife in the Project area are already acclimated to industrial conditions, we conclude that no significant impacts on wildlife within the upland areas would occur during the construction or operation of the Project.

4.5.2 Marine Benthic Resources

4.5.2.1 Coral Reef

Although coral reefs comprise only about 4 percent (512 acres [527 cuerdas]) of the total benthic habitat in Jobos Bay (Zitello et al., 2008), they are some of the most productive habitats in the area and provide important habitat for fish and invertebrates of commercial, recreational, and ecological value. Corals are often divided into two main types: stony, hard, or "reef-building" corals (Scleractinia) and soft corals or gorgonians (Alcyonacea). Coral cover in inshore areas is relatively low. Most of Jobos Bay's coral reefs are linear in formation, running along cays encircling the central bay. García-Sais et al. (2003) assessed two of these cays, Cayos Caribes and Cayos de Barca, and documented significant amounts (20 to 21 percent) of coral cover. The most common stony corals in Jobos Bay are mustard hill coral, followed by massive starlet coral, great star coral, and boulder star coral. Soft corals exhibit similar coverage patterns as hard corals. Of these, encrusting soft corals are most common in Jobos Bay, followed by sea plumes/rods/whips, and sea fans. Whitall et al. (2011) observed 24 coral species in Jobos Bay, with species richness ranging from 0 to 13 species present at individual sample sites.

Aguirre LLC conducted multiple surveys of the Project area, including towed-diver video transects and sample quadrats, to characterize the benthic conditions along the proposed subsea pipeline route and within the offshore terminal site. These surveys documented three zones in the Project area: a backreef zone, consisting mainly of dead coral rubble; a gorgonian (Alcyonacea) zone, consisting mainly of soft corals; and a forereef zone, defined mainly by stony corals (see figure 4.5.2-1). The rubble fragments in the backreef zone were mixed with coarse-grained sand substrate. The substrate within the gorgonian zone and forereef zone was low to moderately rugose consolidated reef. Additionally, in the forereef zone, spur and groove coral formations with sand chutes were observed. Biotic cover in the forereef and gorgonian zone was approximately 85 percent, with turf algae as highest mean percent coverage at 22 percent, and followed by 22 percent macroalgae, 18 percent stony coral, 12 percent soft coral, 7 percent sponge, and 4 percent other algae and biota. During the 2012 survey work, 30 species of stony corals were documented, with starlet coral, symmetrical brain coral, and great star coral accounting for the highest cover. Sixteen species of soft coral were documented, with slimy sea plume accounting for the highest cover. All nine of the coral species that are ESA-listed or proposed for listing were observed in the Project area (see section 4.6.1.5). Based on the survey results, Aguirre LLC estimates that there are likely 40,115 total coral colonies within the 20-foot-wide (6 m) pipeline corridor.

Substrates within the offshore terminal location are mainly sand and mud, and lack the hard surfaces necessary for the attachment of reef-building corals. However, survey work identified 4.1 acres of patch reef and showed that the coral cover consisted of 11 different species, including two ESA-listed species (see section 4.6.1.5). The most abundant species were rose coral and tube coral. All the corals sampled were small, but well developed. The largest coral sampled was a colony of rose coral that was 1.5 by 3.5 inches (4 by 9 cm), which is typically as large as this species gets in deep, sand flat habitats.

Caribbean coral reefs are under a number of threats, and those of Jobos Bay are no exception. Corals in the area have been subjected to mass mortality due to black band disease, white band disease, coral bleaching, overfishing, and tropical cyclones (Whitall et al., 2011). Additional physical damage has been incurred by anchor and propeller impacts, trampling during snorkeling activities, and water contamination by garbage and engine fuels (García-Saís et al., 2008). Gardner et al. (2003) found that live coral cover in the Caribbean has declined by 80 percent over the last three decades. In addition to these regional stresses, local stresses to Jobos Bay corals include thermal discharges from the existing Aguirre power plant, sewage inputs, agricultural runoff, sedimentation, and mangrove deforestation.

4.5.2.2 Other Invertebrates

Although seagrasses, macroalgae, and coral reefs represent the most typical benthic cover types, other benthic organisms inhabit Jobos Bay which do not fall as neatly into discrete groups or form as continuous cover as the above mentioned cover types. These include sessile invertebrates such as sponges, zoanthids, tunicates, hydroids, and mobile invertebrates such as queen conch, fighting conch, milk conch, spiny lobster, and long-spine sea urchins. The benthic surveys conducted by Aguirre LLC documented 12 queen conch, generally associated with turtle grass between MPs 1.5 to 3.0 of the pipeline route, and many fighting conch, mostly concentrated in the vegetated-mud transition near MP 3.0. Surveys also noted eight milk conch in the forereef and Boca del Infierno pass area, and many long-spine sea urchins in the interface between the backreef rubble and gorgonian zone. Spiny lobsters were rare, with only four specimens observed in the reef and one individual in the offshore patch reef.

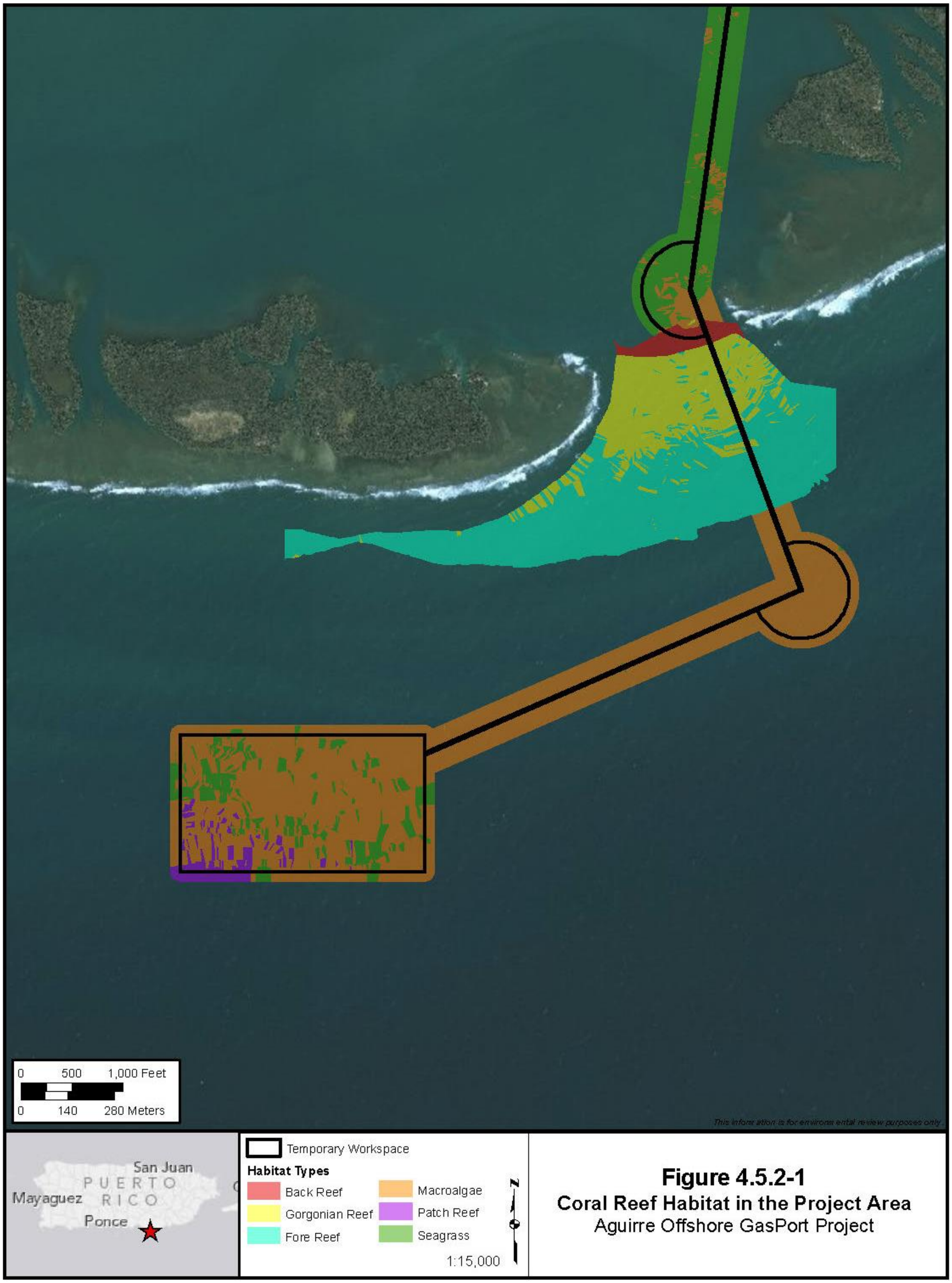


Figure 4.5.2-1
Coral Reef Habitat in the Project Area
Aguirre Offshore GasPort Project

The highest occurrence of sponges was documented on the forereef and gorgonian zones, where sponge cover was 7 percent and a total of 47 taxa were observed. Zoanthids and tunicates were relatively abundant in this area as well, each with 0.5 percent cover. Sessile invertebrates, including hydroids, fire corals, and anemones, were also found in relatively high number within the back reef. The patch reefs in the offshore terminal are biologically well developed, with an abundance of stony corals, gorgonians, sponges, and macroalgae. The reef also supports a variety of motile benthic organisms including fish, crustaceans, gastropods, and echinoderms.

4.5.2.3 Other Algae

While macroalgae are common in Jobos Bay, calcareous red algae, also known as crustose coralline algae, are present as well, albeit in fewer numbers. Some species form attachments on hard substrate, and others form unconsolidated, often warty balls that settle in beds. These are known as rhodoliths, and provide habitat for diverse benthic communities. Crustose coralline algae were most frequently observed in the backreef zone. Turf algae were observed in particularly high cover (22 percent) on the forereef and gorgonian zones, although they are present in many areas of Jobos Bay. Turf algae were among the more common cover types in the offshore terminal area, at 0.5 percent. Very low amounts of crustose coralline algae were observed in the offshore terminal area.

4.5.2.4 General Impact and Mitigation

Construction of the proposed Project would result in short-term, minor adverse impacts on benthic resources from hydrostatic testing, sediment resuspension, and shading; and short-term, moderate adverse impacts from inadvertent hydrocarbon spills and habitat alteration/loss. The subsea pipeline, as currently proposed, would be constructed using a “push pipe lay” technique that results in the pipeline being laid directly on the seafloor, unburied or only partially buried by natural bottom sediments depending on the sediment type. By not burying the pipe, there are fewer acres of sea floor disturbed during construction as well as less sediment disturbance and associated water quality impacts. Operation of the Project would result in permanent, minor adverse impacts on benthic resources from shading, scour, and thermal plume discharge from the FSRU and LNG vessels; and permanent, moderate adverse impacts from habitat alteration/loss (e.g., pipeline barrier) and inadvertent hydrocarbon spills.

Aguirre LLC provided thermodynamic calculations related to the heat transfer from the subsea pipeline to the surrounding seawater during operation. The calculations demonstrated that water flowing past the pipeline would increase slightly but would return to ambient seawater temperature within 1 inch (2.5 cm) of the surface of the concrete coating. Based on our review of the provided calculations, we agree with Aguirre LLC’s determination. We also reviewed the heat transfer for the vertical section of pipeline (riser) from the seafloor to offshore berthing platform, which we assumed would not be coated in concrete. Our calculations showed that the temperature of the water flowing past the riser would also return to ambient temperatures within 1 inch (2.5 cm) of the riser. Even under the most conservative assumptions, water would return to ambient temperatures within several inches or less, with the majority of the temperature change occurring within a 1 to 2 inches (2.5 to 5 cm) of the pipeline. Therefore, thermal stress associated with the pipeline is not discussed in the remainder of this document.

Hydrostatic Testing

Hydrostatic testing involves filling pipelines with water, performing pressure tests in accordance with applicable regulations, and discharging the test water following completion of the test. Aguirre LLC would withdraw the water used for testing from Jobos Bay or the Caribbean Sea, depending on the section of pipeline being tested. The intake rate would be between 14,900 and 22,500 gallons per hour (56 to 85 m^3/hr). The water intake would be about 6 feet below the surface and would be fitted with a 100-

micron mesh screen to minimize the entrainment of fish and other organisms. NMFS raised concerns regarding entrainment of fish during this process. To ensure that the entrainment of fish and other organisms is minimized or avoided, **we recommend that:**

- **<u>Prior to construction</u>, Aguirre LLC should consult with NMFS regarding the type of screen (e.g., wedge-wire) that should be used for hydrostatic test water withdrawals during the construction of the Project. The results of this consultation should be filed with the Secretary for review and written approval by the Director of OEP.**

Hydrostatic testing would require about 240,000 gallons of water (909 m^3) to fill the pipeline and complete one full hydrostatic test. Under normal circumstances, only one test event would be required, but there is a possibility that retesting of the pipeline could be required. Following completion of a testing event, Aguirre LLC would discharge the untreated seawater to Jobos Bay at the shore approach. The water would be discharged at least 6 feet (2 m) below the water surface through a pipe fitted with a diffuser head to reduce discharge velocity and minimize impacts on the bottom sediment.

Benthic cover at the shore approach is almost exclusively macroalgae (estimated at 14 percent cover), growing in silty or muddy substrate. Thus, impacts would likely be minor and limited to local mortality in the immediate discharge area. Macroalgae would likely recolonize areas affected by the discharge in a matter of weeks to months. Resuspended sediment would reduce light availability for macroalgae and seagrasses in a more widespread area beyond the immediate discharge area; however, this impact would be temporary (generally limited to a one or two time event) and localized to the discharge location.

Sediment Resuspension

An increase in turbidity due to sediment resuspension from installation of the proposed moorings and pipeline has the potential to cause short-term minor adverse effects on benthic resources. Impacts associated with sediment resuspension also include reduced filtering efficiencies in certain invertebrates, potentially impacting their growth and survival, and decreased foraging efficiency of visual predators. Coral reefs may be particularly sensitive to sediment impacts, which include smothering, burial, and shading of the coral polyps. Benthic substrates beneath the proposed terminal site are predominately coarse sands, which would settle quickly and not be subject to prolonged transport. Placement of the pipeline could result in the resuspension of finer sediments, but the increased turbidity is expected to be minor and in the immediate vicinity of the proposed pipeline.

Overall, turbidity increases during construction would be temporary in duration and localized in scope, so the impact on benthic resources is expected to be minor and short-term. However, the pipeline could also result in persistent siltation and turbidity from scour and sediment deposition around the pipeline, reducing light penetration and lowering photosynthesis rates and primary productivity in the area. Thus, impacts may vary depending on the degree to which the pipeline self-buries. Water discharges from the LNG carriers could also cause sediment resuspension at the offshore berthing platform during operation. Turbidity increases associated with scour around the pipeline and the LNG carrier discharges would be localized in scope, so the impact on benthic resources is expected to be permanent but minor.

Inadvertent Hydrocarbon Spills

Minor releases of hydrocarbons (e.g., LNG, fuel, and lubricants) during construction could result in short-term, minor to moderate adverse impacts on benthic resources. Spills could originate from accidental spills from construction barges or support boats, loss of fuel during fuel transfers, or accidents resulting from collisions. The impacts of hydrocarbons are 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.

As described in section 4.3.3.3, construction contractors and port operations personnel would be required to comply with all laws and regulations related to handling of fuels and lubricants, and Aguirre LLC would prepare a site-specific spill prevention and control plan for construction and operation to minimize the potential for inadvertent release. We are recommending in section 4.3.3.3 that Aguirre LLC file this plan for review and approval prior to construction.

Habitat Alteration/Loss

Construction activities such as vessel anchoring, platform construction, and pipeline laying would result in direct impacts on approximately 19.8 acres (20.4 cuerdas) of seagrass, 77.4 acres (79.7 cuerdas) of macroalgae, and 5.2 acres (5.3 cuerdas) of coral reef habitat. Generally, seagrasses can recover from damage to leaves but not from damage to roots. Coral growth rates have been observed to range from 2 to 5 percent per year (Osborne et al., 2011); thus, recovery of damaged or destroyed coral assemblages may be on the order of decades. A large majority of the corals that would be impacted by the Project are between MPs 1.0 to 1.6 (within the back, fore, and gorgonian reef areas). To ensure that impacts on coral reef habitat are minimized or avoided to the extent practicable, **we recommend that:**

- **<u>Prior to the end of the draft EIS comment period</u>, Aguirre LLC should assess the potential use of a water-to-water HDD between approximate MPs 1.0 to 1.6 to avoid direct impacts on coral reef habitat. The assessment should discuss the feasibility of an HDD based on the substrate that would be crossed, estimate the area of seafloor disturbance that would be required, estimate the impacts on coral reef habitat and SAV, estimate the volume of sediment that would be displaced at the HDD entry and exit locations, and include a schedule for any necessary geotechnical studies, should be filed with the Secretary.**

The operation of the offshore pipeline would result in permanent impacts on approximately 0.7 acre (0.7 cuerda) of seagrass, 0.9 acre (0.9 cuerda) of macroalgal habitat, 0.3 acre (0.3 cuerda) of coral reef habitat, based on the permanent habitat conversion being limited to a 6-foot-wide (2 m) right-of-way centered over the pipeline. These impacts would include loss of habitat in the 2-foot (0.6 m) pipeline footprint, and reduced growth due to shading in areas adjacent to the pipeline. Therefore, impacts on benthic resources are expected to be permanent and moderate. These impacts would be further reduced if the HDD method is found to be feasible.

Resuspension and mixing of fine sediments with underlying coarse sediments may alter substrate composition and adversely affect the habitat of benthic organisms which rely on soft sand and mud habitats. Overall, the impact of this habitat modification is expected to be short-term and minor.

The habitat beneath the offshore berthing platform would be permanently altered by shading and the thermal plume discharge, which are discussed more below. These permanent impacts include approximately 2.9 acres (3.0 cuerdas) of seagrass and soft bottom benthic communities as well as 0.2 acre (0.2 cuerda) of patch reef with live corals. We conclude the impact of the proposed terminal location on benthic habitat would be permanent and moderate because there would be a permanent change in the benthic community in this location.

Because we do not anticipate that the pipeline would completely self-bury, localized habitat conversion would occur, and the pipeline would present a barrier to migration for conch, urchins, sea cucumber, and other mobily impaired benthic organisms. This permanent barrier could present a permanent, moderate impact for these species; however, these species are generally able to traverse voids or hills along the substrate within Jobos Bay where the topography is not completely flat. Spiny lobsters are capable of swimming, and thus would likely be less affected by the presence of the proposed pipeline. Utilizing the HDD construction method HDD construction method under Boca del Infierno pass, if determined to be feasible, would also help minimize impacts as it would create access across the pipeline for about 0.6 mile (1.0 km).

Aguirre LLC has agreed to prepare a seagrass mitigation and monitoring plan in consultation with respective agencies to offset short-term and/or permanent impacts on seagrass communities. In section 4.4.3 above, we are recommending that Aguirre LLC submit drafts of this plan prior to the end of the draft EIS comment period.

Aguirre LLC has also agreed to prepare a coral reef restoration and/or mitigation plan in coordination with NMFS and the FWS to offset impacts from construction and operation of the Project. The plan would include one or more of the following: monitoring of the reef community prior to, during, and after construction; installation and monitoring of an artificial reef; coral cache and relocation to adjacent natural and/or artificial reef; development of a reef awareness/outreach program; and funding to support existing and ongoing reef community programs. In conjunction with seagrass and coral mitigation requirements, environmental regulatory agencies are likely to require a management plan that involves an educational program for construction personnel and work practices occurring near sensitive resources. Standard protection measures may be required which include the use of an integrated global positioning system to track vessel movement during construction activities. To ensure that impacts on coral reef are minimized and/or properly mitigated, **we recommend that:**

- **<u>Prior to the end of the draft EIS comment period,</u> Aguirre LLC should consult with NMFS, FWS, DNER, and other appropriate agencies in developing the coral reef restoration and/or mitigation plan. This mitigation plan should be developed in compliance with the COE's mitigation requirements for the Project. Aguirre LLC should file a draft of this plan along with agency comments on the draft with the Secretary.**

Shading

During construction, barges would be utilized in the Project area, resulting in potential shading impacts on SAV and corals. The barges would be approximately 250 feet (76 m) long by 75 feet (23 m) wide, resulting in a shaded area of approximately 0.4 acre (0.4 cuerda) per barge. To minimize potential shading impacts, Aguirre LLC would limit barge operations to near MPs 1.0 and 3.0, where coral reef habitat is not present and SAV abundance is low. Barges would remain in a single location for no more than 6 days. Seagrasses have particularly high light requirements, and may begin to experience physiological impacts after several days of shading. Potential shading impacts on corals could result during pipeline placement. Permanent shading could result from suspension of the pipe over natural depressions in the seafloor.

There is also the potential for shading of corals and SAV during construction and operation of the proposed offshore berthing platform from the platform structure itself. Based on the benthic characterization study conducted by Aguirre LLC, bottom cover in the vicinity of the proposed terminal location consists of approximately 16 percent seagrass, 79 percent macroalgae, and 5 percent stony coral. Aguirre LLC proposes to relocate viable stony corals prior to construction to minimize shading impacts.

We conclude that the impacts of shading would be minor during construction due to the short-term nature of the construction activities and the lower cover of corals and SAV in the areas of potential shading.

The operation of the proposed offshore berthing platform would result in the permanent shading of the area beneath the FSRU structure. This would represent permanent impacts on seagrass and coral reef habitat. We are recommending above that Aguirre LLC develop mitigation plans to minimize or avoid these impacts.

Thermal Plume Discharge – Offshore Berth

Operation of the proposed FSRU would result in heated cooling water discharges from the Main Condenser Cooling System and the Auxiliary Seawater Cooling Service. Thermal plume discharges would also result from the LNG carriers when offloading LNG at the terminal. Based on previous projects, the thermal discharges from the FSRU are assumed to be approximately 21.6 °F (12.0 ºC) above ambient temperature, and the discharges from the LNG carriers are assumed to be approximately 5.4 °F (2.8 °C) above ambient. Assuming an ambient temperature of 85.3 °F (29.6 °C), this translates to a discharge temperature of about 106.9 °F (41.6 °C) from the FSRU and about 90 °F (32 °C) from the LNG carriers.

Thermal plume modeling conducted by Aguirre LLC predicts that the discharges from the FSRU and LNG carries would meet Puerto Rico's maximum temperature criterion of 90 °F (32 °C) at a maximum horizontal distance of 23.4 feet (7.1 m) and 25.4 feet (7.7 m), respectively, under minimal current conditions (see section 4.3.1.3). The modeling predicted the plume from the FSRU discharges would dissipate beneath the hull and would not reach the seafloor. However, the discharge form the LNG carriers is predicted to reach the seafloor. Water temperature at this plume-substrate interface is anticipated to be approximately 86 °F (30 °C), just below Puerto Rico's maximum temperature criterion. Over time, the discharge plume would displace finer sediment materials (less than 1 mm) away from the site and the concentration of coarser materials would increase at the seabed surface. This transition to coarser sands would permanently alter the composition of the benthic community at the proposed terminal site, favoring burrowing, infaunal species that construct enforced burrows, rather than species using unconsolidated excavated burrows. However, the thermal plume would be restricted to a relatively localized area, so the impact on benthic resources is anticipated to be permanent but minor.

Scour

Over time, hydrodynamic forces along the proposed pipeline and platform piles would result in some level of scouring, which would permanently alter the composition of the benthic community. However, this scouring would be limited to areas directly adjacent to the pipeline and piles. Therefore, the impact of scour on the benthic community is anticipated to be permanent but minor.

4.5.3 Marine Wildlife Resources

Marine wildlife species, such as marine mammals, sea turtles, fish, and marine invertebrates inhabit the Project area. Fisheries within the Project area are discussed in section 4.5.5 and invertebrates are discussed in section 4.5.2. Threatened and endangered species are not specifically discussed in this section; however, many of the impacts would be the same as those described below. Threatened and endangered species are discussed in section 4.6.

4.5.3.1 Marine Mammals

The MMPA established, with limited exceptions, a moratorium on the "taking" of marine mammals in waters or on lands under U.S. jurisdiction. The act further regulates, with certain exceptions, the "take" of marine mammals on the high seas by persons, vessels, or other conveyances subject to the jurisdiction of the United States.

The range of distribution extends within the coastal and offshore waters of southern Puerto Rico for 8 species of whales and 12 species of dolphins protected under the MMPA (NMFS, 2013b). A list of these species is provided in table 4.5.3-1.

Only two marine mammal species were documented within the Project area during surveys conducted by Aguirre LLC: the Antillean manatee and the bottlenose dolphin. The Antillean manatee is a federally listed species and is discussed in detail in section 4.6.1.1. The bottlenose dolphin is discussed below.

Whales

Whales are long-lived marine mammals that inhabit the world's oceans. Many species migrate extremely long distances to take advantage of seasonal food resources or calm wintering grounds for rearing young. They can be divided into two main groups: toothed whales and baleen whales. Feeding morphology and prey are the major differences between these groups. Whales commonly use warm tropical waters during winter months when the polar seas are cold, ice covered, and food-poor.

TABLE 4.5.3-1

Non-ESA-Listed Marine Mammals Potentially Occurring in the Aguirre Offshore GasPort Project Area

Mammal	Portion of Project Area where Mammal May Occur [a]	Mammal	Portion of Project Area where Mammal May Occur [a]
Dolphins		**Whales**	
Atlantic spotted dolphin	Jobos Bay and Offshore	Blainville's beaked whale	Offshore
Bottlenose dolphin	Jobos Bay and Offshore	Bryde's whale	Offshore
Clymene dolphin	Offshore	Cuvier's beaked whale	Offshore
Frasier's dolphin	Offshore	Dwarf sperm whale	Offshore
Melon-headed whale	Offshore	Gervais' beaked whale	Offshore
Orca	Offshore	Minke whale	Offshore
Pantropical spotted dolphin	Offshore	Pygmy sperm whale	Offshore
Pygmy killer whale	Offshore		
Risso's dolphin	Offshore		
Rough-toothed dolphin	Offshore		
Short-finned pilot whale	Jobos Bay and Offshore		
Spinner dolphin	Offshore		
Striped dolphin	Offshore		

Source: NMFS, 2013b

[a] Offshore refers to the area south of Jobos Bay (beyond the barrier islands).

The three beaked whale species (Blainville's, Cuvier's, and Gervais) may occur in the Caribbean region and are found in deep offshore waters of the continental shelf and slope where they utilize deep diving to hunt for prey. These species of beaked whales feed on squid, octopus, fish, and crustaceans. The Blainville's and Cuvier's beaked whales' range of distribution extends worldwide while the Gervais beaked whale is limited to the central and north Atlantic. The Blainville's and Cuvier's whales commonly associate with steep underwater geologic structures. As of 1986, there have been eight documented sightings of Cuvier's beaked whales off Puerto Rico and the Virgin Islands (Mignucci-Giannoni, 1998). Mignucci-Giannoni's studies concluded that although Blainville's and Gervais beaked whales have not been recorded off Puerto Rico or the Virgin Islands since 1989, they may be present in the area. It is very unlikely these beaked whale species are present in the Project area due to the common depth range of this species. However, these species may be encountered along LNG carrier transit routes.

Bryde's whales are baleen whales found in tropical and subtropical temperate waters near the continental shelf. Smaller species may prefer to reside in coastal zones (NMFS, 2013b). Bryde's whales feed on plankton, crustaceans, and schooling fish. Bryde's whales are known to be present in the southeastern Caribbean; however, in studies conducted by Mignucci-Giannoni (1998), there were no documented sightings of Bryde's whales off Puerto Rico. It is very unlikely Bryde's whales are present in the Project area due to the common depth range of this species. However, Bryde's whales may be encountered along LNG carrier transit routes.

Dwarf sperm whales and pygmy sperm whales are similar in appearance and share a similar geographic range. Both species are distributed worldwide in tropical to temperate waters. Dwarf sperm whales inhabit the continental shelf edge and slope while pygmy sperm whales are usually found seaward of this area. Both species feed on squid, octopus, crabs, shrimp, and fish. The dwarf sperm whale is generally considered more of a coastal species than the pygmy sperm whale (NMFS, 2013b). Five pygmy sperm whale strandings were documented within Puerto Rico and the Virgin Islands between 1976 and 1989. While the dwarf sperm whale has not been documented within this area during this timeframe, it may be present (Mignucci-Giannoni, 1998). Both species are generally considered rare as there is limited information available (NMFS, 2013b). It is very unlikely dwarf and pygmy sperm whales are present in the Project area due to the common depth range of these species. However, these species may be encountered along LNG carrier transit routes.

Minke whales are baleen whales that prefer temperate to colder northern waters, but are also found in tropical and subtropical areas and can be found in both coastal and oceanic waters. Minke whales feed on crustaceans, plankton, and schooling fish (NMFS, 2013b). Minke whales have been observed in Puerto Rican waters on three occasions documented in 1965, 1973, and 1976 (Mignucci-Giannoni, 1998). It is possible, yet unlikely that minke whales are present in the Project area and LNG carrier transit routes due to their preferred geographic range.

Dolphins

Atlantic spotted dolphins are found within warm tropical to temperate waters of the Atlantic Ocean. Their diet consists of small fish, squid, octopus, and benthic invertebrates. Eighty-five percent of Atlantic spotted dolphin sightings in Puerto Rico or the Virgin Islands have been within the shelf in areas of low seafloor relief (Mignucci-Giannoni, 1998). Although Atlantic spotted dolphins have not been documented within the Project area, their presence is possible due to their occasional association with bottlenose dolphins (NMFS, 2013b), which are present in the Project area. Additionally, Atlantic spotted dolphins may be encountered along LNG carrier transit routes.

Bottlenose dolphins are found in tropical and temperate waters worldwide. Coastal populations commonly migrate into bays and estuaries while offshore populations reside along the continental shelf. The coastal populations feed on fish and benthic invertebrates. Bottlenose dolphins were documented during surveys conducted by Aguirre LLC within the Project area. Additionally, they may be encountered along LNG carrier transit routes.

Clymene dolphins inhabit tropical, subtropical, and warm temperate waters in the Atlantic Ocean. This species is generally found in oceanic waters ranging from 820 feet to 16,400 feet in depth and feeds on small deep sea fish and squid (NMFS, 2013b). Clymene dolphins have been observed in some areas of the Caribbean, but not in Puerto Rico as of 1989 (Mignucci-Giannoni, 1998). It is very unlikely Clymene dolphins are present in the Project area due to the common depth range of this species. However, clymene dolphins may be encountered along LNG carrier transit routes.

Fraser's dolphins prefer warm tropical to temperate oceanic waters, usually deeper than 3,000 feet (914 m). They feed on deep sea species of fish, shrimp, squid, and octopus (NMFS, 2013b). Frasier's dolphins have been observed in other areas of the Caribbean, but as of 1989, not in Puerto Rico (Mignucci-Giannoni, 1998). It is very unlikely Fraser's dolphins are present in the Project area due to the common depth range of this species. However, Fraser's dolphins may be encountered along LNG carrier transit routes.

Melon-headed whales are members of the dolphin group that are found in deep tropical waters worldwide. Melon-headed dolphins have been observed in other areas of the Caribbean, but as of 1989, not in Puerto Rico (Mignucci-Giannoni, 1998). It is very unlikely melon-headed dolphins are present in the Project area due to the common depth range of this species. However, melon-headed dolphins may be encountered along LNG carrier transit routes.

Orcas are found in all parts of the world's oceans and have the most wide geographic distribution of all marine mammals. They are most commonly found in water depths of 200 to 260 feet (20 to 60 m) (Burnett, 2009). Their diet varies depending on the specific population or location, but can include fish, other marine mammals, and sharks (NMFS, 2013b). Thirteen sightings of orcas were reported off of Puerto Rico and the Virgin Islands between 1979 and 1989; however, the closest sighting to the Project area was off Cabo Rojo on the southwest coast of Puerto Rico (Mignucci-Giannoni, 1998). It is very unlikely orcas are present in the Project area due to the common depth range of this species. However, orcas may be encountered along LNG carrier transit routes.

Pantropical spotted dolphins inhabit tropical and subtropical waters worldwide, in water depths ranging between 300 and 1,000 feet (91 and 305 m) during the day. Pantropical spotted dolphins have been observed in other areas of the Caribbean, but as of 1989, not in Puerto Rico (Mignucci-Giannoni, 1998). It is very unlikely pantropical spotted dolphins are present in the Project area due to the common depth range of this species. However, pan tropical spotted dolphins may be encountered along LNG carrier transit routes.

Risso's dolphins are found in tropical to temperate waters worldwide in water depths deeper than 3,300 feet (1,006 m) seaward of the continental shelf and slope. Risso's dolphins have not been observed off the coast of Puerto Rico but have been observed in the Caribbean in areas of very deep water east of Puerto Rico (Mignucci-Giannoni, 1998). It is very unlikely Risso's dolphins are present in the Project area due to the common depth range of this species. However, Risso's dolphins may be encountered along LNG carrier transit routes.

Rough toothed dolphins reside in tropical and warmer temperate waters worldwide and prefer deep water where their food source is abundant. Mignucci-Giannoni (1998) reports nine sightings in the Caribbean off of Puerto Rico and the Virgin Islands. The closest sighting to the Project area was within the continental shelf off of Fajardo, Puerto Rico, approximately 50 miles (80 km) northeast of the Project area (Mignucci-Giannoni, 1998). It is very unlikely rough toothed dolphins are present in the Project area due to the common depth range of this species. However, rough toothed dolphins may be encountered along LNG carrier transit routes.

Pygmy killer whales are members of the dolphin family found in tropical and subtropical deep waters worldwide. Pygmy killer whales have been observed in other areas of the Caribbean, but as of 1989, not in Puerto Rico (Mignucci-Giannoni, 1998). It is unlikely Pygmy killer whales are present in the Project area due to their preference for deep waters. However, pygmy killer whales may be encountered along LNG carrier transit routes.

Short-finned pilot whales are members of the dolphin group found worldwide in tropical and subtropical areas. Short-finned pilot whales typically prefer deeper waters to feed but are also found in shallower coastal water. Although their primary food source consists of squid, they may also feed on octopus and fish (NMFS, 2013b). Short-finned pilot whales have been documented near the Project area in offshore waters south of Salinas, Puerto Rico (Mignucci-Giannoni, 1998). Short-finned pilot whales may occur in the Project area and along LNG carrier transit routes.

Spinner dolphins reside in tropical and subtropical waters worldwide. They are found in deep ocean waters where their prey is concentrated. The closest sighting to the Project area was within the continental shelf off of Fajardo, Puerto Rico, approximately 50 miles (80 km) northeast of the Project area (Mignucci-Giannoni, 1998). It is unlikely spinner dolphins are present in the Project area due to their preference for deeper waters. However, spinner dolphins may be encountered along LNG carrier transit routes.

Striped dolphins are found in tropical to warm temperate waters worldwide. They mainly reside in deep oceanic waters seaward of the continental shelf. Striped dolphin sightings have been reported along the southern coast of the Caribbean Sea, but not in Puerto Rico or nearby islands (Mignucci-Giannoni, 1998). It is unlikely striped dolphins are present in the Project area due to their preference for deeper waters. However, striped dolphins may be encountered along LNG carrier transit routes.

4.5.3.2 Birds

Puerto Rico supports a rich and diverse range of bird species due to its variety of habitats and protected reserves. Threatened and endangered species are discussed further in section 4.6 of this EIS. Migratory birds are protected under the MBTA and Executive Order 13186. The executive order was enacted, in part, to ensure that environmental analyses of federal actions evaluate the impacts of actions and agency plans on migratory birds. It also states that emphasis should be placed on species of concern, priority habitats, and key risk factors, and it prohibits the take of any migratory bird without authorization from the FWS. The destruction or disturbance of a migratory bird nest that results in the loss of eggs or young is also a violation of the MBTA. The Project area, particularly the JBNERR, provides habitat for various migratory bird species that winter in the area.

Birds of Conservation Concern are a subset of birds protected under the MBTA and include all species, subspecies, and populations of migratory nongame birds that are likely to become candidates for listing under the ESA without additional conservation actions (FWS, 2008). The Project is within the Caribbean Islands Birds of Conservation Concern Region. Birds of Conservation Concern and other migratory birds potentially occurring in this region are listed in table 4.5.3-2.

TABLE 4.5.3-2

Migratory Bird Species Potentially Occurring in the Aguirre Offshore GasPort Project Area

	Habitat Type				
Common Name	Seagrass and Macroalgae [a]	Mangrove	Mud Flat	Coral Reef [a]	Offshore
American oystercatcher [a]	X		X		
Audubon's shearwater [a]				X	X
Bananaquit		X			
Black-necked stilt	X		X		
Black-whispered vireo		X			
Brown booby [b]				X	X
Common sandpiper	X		X		
Flamingo [b]			X		
Glossy ibis	X		X		
Great blue heron	X	X	X		
Great egret	X	X	X		
Greater yellowlegs	X		X		
Least sandpiper	X		X		
Magnificent Frigatebird [b]				X	X
Masked booby [b]				X	X
Northern mockingbird		X			
Peregrine falcon		X	X		
Red-footed booby [b]				X	X
Red-tailed hawk		X			
Red knot [b]	X		X		
Royal tern				X	
Ruddy turnstone	X		X		
Sandwich tern				X	
Semipalmated plover	X		X		
Semipalmated sandpiper [b]	X		X		
Short-billed dowicher	X		X		
Snowy egret	X	X	X		
Snowy plover [b]	X		X		
Stilt sandpiper	X		X		
Turkey vulture		X			
White-crowned pigeon [b]		X			
Wilson's plover [b]	X		X		
Yellow warbler		X			

[a] Species may occupy this habitat type where located in shallow water (i.e., during low tides).
[b] Bird of Conservation Concern for Caribbean Islands.
Sources: Field et al., 2003; FWS, 2008

4.5.3.3 General Impact and Mitigation

Construction of the Project would result in short-term, minor to moderate adverse impacts on marine wildlife species. The most common effects would likely be the general avoidance or isolation from preferred habitat due to construction activities. Noise impacts on marine mammals as a result of the construction may also cause moderate adverse impacts. Operation of the Project would result in permanent, minor adverse impacts on marine wildlife species from increased vessel traffic and vessel strikes, habitat alteration/loss, thermal plume discharge, anti-fouling agents, inadvertent hydrocarbon spills, noise, and lighting. Much of the impact discussion included below would also apply to marine wildlife species protected under the ESA that are described in detail in section 4.6 and in the BA (appendix D).

Increased Vessel Traffic and Vessel Strikes

Vessel traffic during construction would consist of approximately six to eight construction and support vessels working within and/or traveling to and from the construction sites. Impacts due to increased vessel traffic include increased ship noise and increased likelihood of vessel strikes. Although possible, ship strike impacts on whales are unlikely during construction because vessels approaching or operating in nearshore waters generally transit at much slower speeds than in open water, and whales are less likely to occur in nearshore waters.

Whales and dolphins could be vulnerable to vessel strikes during Project operation of the proposed Project. LNG carriers are assumed to make 46 deliveries per year (one every 8 days) with a 3-day stay per calling event. Vulnerability to collision with an LNG carrier, or the associated assist tugs, would be greatest while these animals feed, swim, and rest near the surface of the water. In areas of intense ship traffic, whales and dolphins can experience propeller or collision injuries; however, most of these injuries are caused by small, fast moving vessels. LNG carriers operating within the U.S. Exclusive Economic Zone (EEZ) are generally slower and generate more noise than typical large vessels and would be more readily avoided by mammals. Additionally, LNG ships push a considerable bow wave when underway on the open ocean because of their design and large displacement tonnage. This wave pushes water, flotsam, and other small objects (such as dolphins) away from the vessel.

To minimize the potential for vessel strikes, vessel operators and crews would receive training in protected species identification and would keep watch for marine mammals and sea turtles. The DNER has expressed interest in participating in the development and execution of this training. Additionally, certified marine mammal observers would be assigned to construction vessels during all construction phases of the Project. Aguirre LLC stated that vessels would maintain a distance of at least 100 yards (91 m) from whales and at least 50 yards (46 m) from small cetaceans and manatees. Vessels would reduce their speed to 10 knots or less and a minimum distance of 100 yards (91 m) when mother/calf pairs, groups, or large assemblages are present in the area (safety permitting). With these measures in place, the impact of vessel traffic and vessel strikes on marine mammals is anticipated to be short-term and negligible during construction, and permanent but minor during Project operation.

Noise

The noise levels reported in this section may appear higher than those commonly noted for construction because the reference value for underwater sound pressure is 1 microPascal, whereas in-air sound uses a reference of 20 microPascals. The discrepancy relates to differences in the acoustic impedance, density, and compressibility of air and water. For example, the threshold of hearing for humans is 0 dB in the air, but 60 dB in water. Similarly, direct tissue damage to humans can occur at 160 dB in the air, but rises to 222 dB in water (Tetra Tech, Inc. [Tetra Tech], 2013c).

Noise from general construction and pile driving activities would be generated at the offshore berthing platform, as well as from general construction of the pipeline. Background noise levels were measured by Aguirre LLC during the hydroacoustic survey and found to be around 120 dB at the offshore berthing platform site and closer to 140 dB within Jobos Bay.

Within Jobos Bay, Aguirre LLC would install the temporary piles used during construction with vibratory drivers (rather than impact hammers) to keep the sound and vibrations low. The estimated sound levels are 177 dB for construction and support vessels and 195 dB for vibratory pile driving. Nine structural jackets and four tri/quad pile structures would be installed at the offshore berthing platform.

Unlike the temporary piles for pipeline construction, impact hammering may be required to install some of these structures. The noise impacts due to hammer pile driving were not provided; therefore, **we recommend that:**

- **<u>Prior to the end of the draft EIS comment period</u>, Aguirre LLC should conduct acoustic modeling to determine the underwater noise impacts associated with hammer pile driving at the offshore berthing platform and other areas where it may be used. Aguirre LLC should also consult with the FWS, NMFS, and DNER to identify mitigation measures that it would implement to reduce noise levels associated with vibratory and hammer pile driving to 180 dB. The results of the modeling and proposed mitigation measures should be filed with the Secretary.**

NMFS defines two levels of harassment due to noise levels under the MMPA: Level A (180 dB) and Level B (160 dB intermittent, 120 dB continuous). These harassment levels are defined as:

- Level A – harassment that has the potential to injure a marine mammal; and
- Level B – harassment that has the potential to disturb a marine mammal by causing disruption of behavioral patterns, such as migration, breathing, nursing, breeding, feeding, or sheltering.

The modeling of noise attenuation completed by Aguirre LLC indicates that vibratory pile driving would exceed the 180 dB threshold within 33 feet of the source of the sound and exceed the 160 dB threshold within 213 to 738 feet (65 to 225 m) (depending on the location of the pile). The 120 dB harassment level would not be applicable for pile driving activities because it is not continuous noise.

The modeling also indicates that the estimated noise associated with the construction and support vessels would not exceed the Level A harassment threshold, but would exceed Level B harassment levels within 33 feet (10 m) of the source for the 160-dB limit, within 2.1 to 2.2 miles (3.4 to 3.5 km) for the 120-dB limit in the offshore terminal area, and within 0.4 to 1.4 miles (0.5 to 2.3 km) for the 120-dB limit within Jobos Bay.

Noise from incoming vessels and the offshore berthing platform operations would be generated within the immediate vicinity of the shipping route and platform location. Background noise levels were measured by Aguirre LLC during the hydroacoustic survey and found to be about 120 dB at the offshore berthing platform site. The modeled sound levels from LNG carriers are expected to be 160 to 170 dB on their transit in and out of the berthing location. Thrusters could be utilized upon the approach and berthing; this is anticipated to be of short duration (less than 30 minutes) and would raise the ambient noise levels to 183 dB. The modeling of noise attenuation completed by Aguirre LLC indicates that transiting LNG carrier noise would exceed the 120-dB limit within 1.0 to 1.1 miles (1.6 to 1.8 km) of the source of the sound, depending on the transiting direction of the LNG carrier. If thrusters are used, the sound generated is predicted to exceed the 160-dB limit within 164 feet (50 m) of the source. The 120-dB harassment level would not be applicable for thrusters because it is not continuous noise.

To minimize noise impacts on marine wildlife species during construction, Aguirre LLC would employ qualified onsite marine mammal observers to monitor a 0.3-mile (0.5 km) safety exclusion zone for marine mammals and sea turtles before and during pile driving activities. If a marine mammal or sea turtle is observed within the exclusion zone, pile driving activities would be suspended until the animal moves out of the area. With these measures in place, we conclude noise impacts on dolphins and whales in the offshore environment would be minor. These animals are highly mobile and would avoid areas of noise that cause them discomfort or potential harm. Dolphins may be deterred from entering Jobos Bay due to construction activities; however, this is expected to be a short-term minor impact because there are other feeding areas available along the southern coast of Puerto Rico. Noise impacts on marine mammals during operation of the Project are expected to be permanent but minor. These animals are highly mobile and could avoid areas of noise that would cause them discomfort or harm; however, we recognize use of some habitats could be lost due to noise impacts.

Bird species in or adjacent to the Project area may experience short-term moderate impacts as they may be temporarily displaced from areas with elevated noise levels. Noise impacts on birds during operation of the Project are expected to be permanent but minor. These animals are highly mobile and could avoid areas of noise that would cause them discomfort or harm. To ensure that construction-related and operational noise impacts on birds are minimized or avoided, **we recommend that:**

- **<u>Prior to construction</u>, Aguirre LLC should provide an assessment of potential noise impacts on resting and nesting birds during construction (e.g., pile driving, vessels, and possible HDD) and operation of the Project and identify mitigation measures that Aguirre LLC would implement to minimize or avoid these impacts. This information should be filed with the Secretary.**

Inadvertent Hydrocarbon Spills

General impact and mitigation information regarding inadvertent hydrocarbon spills are described in section 4.5.2.4. Minor releases of hydrocarbons during construction could result in short-term, minor to moderate adverse impacts on marine wildlife species. Accidental releases of hydrocarbons resulting from operation of the Project are expected to have short-term and minor to moderate impacts on marine wildlife resources.

Habitat Alteration/Loss

Overall habitat modification impact information and acreages for benthic resources (e.g., seagrasses, corals, and macroalgae) used by marine wildlife are discussed in section 4.5.2.4. Marine mammals and birds in the offshore portion of the Project area would likely move away from areas of disturbance to other similar, adjacent habitats. Within Jobos Bay, destruction of seagrasses, macroalgae, and coral reef would result in a loss of feeding habitat for various migratory bird and dolphin species. These construction impacts are expected to take place within a 20-foot-wide (6.1 m) corridor along the pipeline, where sediment displacement, resuspension, transport, and redeposition would impact benthic resources. Aguirre LLC has agreed to develop coral reef and seagrass mitigation plans to compensate for impacts on these habitat types. In sections 4.4.3 and 4.5.2.4 above, we are recommending that Aguirre LLC submit drafts of these plans within 30 days of the draft EIS publication date. In addition, if use of the HDD is shown to be feasible, impacts on benthic habitat would be reduced. With mitigation measures in place, overall habitat impacts during construction are expected to be short-term and minor for most marine wildlife species.

Direct impacts on seagrass, coral reef, and macroalgae during operation of the pipeline could result in a permanent, minor loss of feeding habitat for several migratory bird and dolphin species. These operational impacts are expected to occur within a 6-foot-wide (1.8 m) corridor along the pipeline, which includes the 2-foot-diameter (0.6 m) of the pipeline and 2 feet (0.6 m) on both sides of the line where the footprint of the pipe, sediment displacement, and/or shading would disrupt the productivity of benthic resources. The impacts of seagrass and macroalgal habitat loss on marine wildlife species resulting from operation of the offshore berthing platform are anticipated to be negligible. The presence of the permanent structure in the offshore could be a beneficial effect for migratory birds, as it may provide roosting habitat as they travel and feed over the coastal waters.

Shading

General impacts from shading on benthic resources (e.g., corals and SAV) utilized by marine mammals are discussed in section 4.5.2.4. A temporary reduction in seagrass productivity due to shading could result in loss of feeding habitat for several migratory bird and dolphin species. Aguirre LLC has agreed to develop seagrass mitigation plans to compensate for impacts on these habitat types. In sections 4.4.3 and 4.5.2.4 above, we are recommending that Aguirre LLC submit drafts of these plans within 30 days of the draft EIS publication date. With mitigation measures in place, impacts on these species are expected to be permanent but minor.

Thermal Plume Discharge – Offshore Berthing Platform

General impacts and mitigation information regarding thermal plume discharge from the offshore berthing platform are discussed in section 4.5.2.4. Impacts on marine wildlife species are expected to be minor, as marine mammals are mobile and would move out of the zone of heated water.

Anti-fouling Agents

Aguirre LLC proposes to utilize biocides in the form of sodium hypochlorite to prevent fouling of water intake systems and ballast tanks. This is standard practice in the shipping industry to prevent the growth of marine organisms. To treat the water intake system, sodium hypochlorite would be injected at the sea chests and allowed to disperse within the system. The target dose level of free residual chlorine within the water systems would be 0.1 to 0.15 ppm (0.1 to 0.15 mg/L). Following the treatment, residual sodium hypochlorite would be discharged as part of the cooling effluent. This residual chlorine concentration is not expected to significantly affect water quality, due to the low concentration of sodium hypochlorite; however, marine mammal species in the immediate vicinity of the outfall may be exposed to harmful concentrations of sodium hypochlorite. All operational discharges would be subject to the requirements of the NPDES permit for the Project.

Lighting

The Project would necessitate the installation of temporary lighting to facilitate construction activities during evening hours as well as for safety requirements. Operation of the terminal would necessitate the installation of permanent lighting to meet operational safety and security requirements. To minimize lighting effects during operation, the Offshore GasPort would limit the number and wattage of operational lights to the minimum possible for safe operations. Light bulbs would be tinted or filtered, well shielded, and directed downwards toward the facilities so as to minimize illumination of surrounding waters.

The response of marine organisms to artificial lights can vary depending on a number of factors such as the species, life stage, and the intensity of the light. Small organisms are often attracted to lights, which in turn attracts larger predators to feed on the biological aggregations. Lights could cause artificially induced biological aggregations. Generally, impacts on marine wildlife species would be minor as these species may change their feeding habits based on these aggregations. To ensure that impacts associated with nighttime lighting during operation of the Project are minimized, **we recommend that:**

- **<u>Prior to construction,</u> Aguirre LLC should develop a lighting plan that identifies specific measures that would be implemented to minimize or avoid impacts associated with the Project's operational nighttime lighting on avian species, fish species, marine mammals, and individuals on the shoreline. This plan should be filed with the Secretary for review and written approval by the Director of the OEP.**

4.5.4 Plankton

Plankton are small free-floating or weakly swimming organisms that are suspended in the water column. They have limited powers of locomotion and tend to drift with the prevailing water movements. Plankton communities are influenced by a variety of factors including food availability, grazing rates of predators, and coastal processes such as currents, tides, and storm events. Some plankton undergo vertical, diurnal migrations and are concentrated in deeper waters during the day and in shallower waters at night. The cumulative result of all of these variables leads to spatial and temporal patchiness. The plankton community also varies between the estuarine environment of Jobos Bay and the marine waters surrounding the proposed offshore berthing platform site. In Jobos Bay, mangrove reefs restrict the flow of offshore water into the bay. This structure suggests a limited influence of planktonic marine species and a dominance of estuarine species within the bay, as opposed to a marine species-dominated community outside of the bay.

Plankton communities are made up of phytoplankton and zooplankton. Phytoplankton are tiny plants and microscopic algae that utilize available sunlight and nutrients to derive their energy. Zooplankton are small animals such as single-celled protozoans and the egg, larval, or adult forms of marine fish and invertebrates that feed on phytoplankton and other particulate matter. Zooplankton are further classified as either holoplankton or meroplankton. Holoplankton (e.g., copepods) spend their entire life as plankton, while meroplankton spend only a portion of their life cycles as plankton. Meroplankton includes both the egg and larval stages of invertebrates and fish (e.g., ichthyoplankton).

4.5.4.1 Phytoplankton

In the Project area, the phytoplankton community is dominated by diatoms and dinoflagellates (Field et al., 2003). In Jobos Bay, chlorophyll *a* concentrations have been observed to be significantly lower in the open water areas of the bay versus within the mangrove areas (Whitall et al., 2011). Concentrations were also significantly higher during the wet season, June to November (Whitall et al., 2011). This pattern is commonly found in estuaries and coastal locations around Puerto Rico (Gilbes et al., 1996; Otero and Carbery, 2005), as rainfall plays a large role in stormwater discharges from land and nutrient availability. In offshore and coastal waters, phytoplankton are vertically stratified and can be found in the waters where sunlight penetrates, which varies based on a number of factors including suspended particulate matter. Within Jobos Bay, a significant vertical stratification of phytoplankton is unlikely due to the shallow depths.

4.5.4.2 Zooplankton

Limited information is available about the holoplanktonic zooplankton community in the Project area. In similar ecosystems, this community is comprised mainly of copepods (Ríos-Jara, 2005). The meroplanktonic zooplankton is comprised of larval stages of fish, decapods, mollusks, and polychaetes (Ríos-Jara, 2005).

While data on the zooplankton community in the immediate vicinity of the Project area are limited, the 2003–2004 316 Demonstration Study by PREPA conducted within Jobos Bay found the dominant zooplankton species to be calanoid copepods (Washington Engineers PSC, 2005). This is similar to the holoplankton taxonomic assemblage dominated by the calanoid copepod, *Acartia tonsa*, found during baseline zooplankton surveys in Jobos Bay from 1972 to 1973. Other permanent components of the year-round resident zooplankton community in Jobos Bay, according to the 2003-2004 Demonstration Study, included chaetognath worms, larvaceans, sergestoid shrimps, and cyclopoid copepods. There was also a year-round prevalence of invertebrate larvae in the meroplankton, including such species groups as caridean shrimps, brachyuran and anomuran crabs, cirripeds (barnacles), polycheates, and gastropods (Washington Engineers PSC, 2005). This study, as well as previous reports for Jobos Bay and other coastal sites around Puerto Rico, demonstrated a seasonal pattern in total meroplankton abundances related to the dry season (e.g., significantly lower abundances between November to February [Washington Engineers PSC, 2005]). Echinoderm larvae in Puerto Rican estuaries have been shown to occur in highest numbers at the shelf break, versus either nearshore or further offshore (Williams and García-Sais, 2010). Conversely, the phyllosoma (larval) stage of spiny lobsters shows a trend of higher densities closer to shore (Sabater and García-Sais, 1998).

Overall, the combined zooplankton community is extremely diverse in form, function, and preferred habitat (García-Sais et al., 2008). The remainder of this discussion is focused on the egg and larval stages of fish (i.e., ichthyoplankton) and corals. Because of their regional importance, spiny lobsters (family Palinura) are included with the discussion of ichthyoplankton.

Ichthyoplankton

For the purposes of this assessment, the discussion of ichthyoplankton includes the early life stages of both finfish and spiny lobsters (family Palinura), including the egg and the larval stages up to the point where the individuals are large enough to swim against the currents. Coral larvae are discussed in the following section.

Survival for early life stages of finfish and shellfish is highly unpredictable and variable. Despite producing a large number of offspring, survival during these early stages has implications for the population on the whole (Houde, 1987). Factors important to survival during the early life stages include temperature, size, stage duration, food availability, and predation, with starvation and predation considered as the leading causes of larval mortality (Bailey and Houde, 1989).

The presence, abundance, and species composition of ichthyoplankton are influenced by a number of parameters, including spawning patterns, migrations, water currents, water temperature, salinity gradients, and larval behavior. Spawning in this region occurs year round as indicated by the presence of larval fish found throughout the year (Ramírez and García-Sias, 1997). Transport also plays a role in species composition of the plankton community. The currents near the proposed terminal site generally move east to west along the barrier cays and may bring different species into the region from other spawning locations to the east (Esteves-Amador, 2005). Tidal transport can also move estuarine species into the immediate offshore waters. A study off La Parguera in southwest Puerto Rico found an ichthyoplankton community with taxa representing both reef fish and oceanic species at the shelf-edge, with reef fish dominating numerically (Ramírez and García-Sias, 1997, Ramírez-Mella and García-Sais, 2003). Closer to shore the total larval abundance was higher, though fewer oceanic taxa were represented. The major families caught were Clupeiformes (pelagic spawning), Gobiidae (demersal spawning), and Myctophidae (oceanic taxa) (Ramírez-Mella and García-Sais, 2003). A similar dominance of nearshore species was observed in the Guayanilla and Tallaboa Bay region where stations were sampled inshore and offshore of coastal islands and at the 33-foot bathymetric contour (García et al., 1995).

The PREPA 2003–2004 316 Demonstration Study within Jobos Bay reported a bimonthly pattern of fish egg abundance, which suggests continuous reproduction of fishes that spawn planktonic eggs (Washington Engineers PSC, 2005). There was a relatively high abundance of fish eggs entrained possibly due to the in-situ production of resident shoreline fishes and the alongshore transport from nearby reef and seagrass habitat sources. The estuarine shoreline fishes that spawn round planktonic eggs within Jobos Bay include those in the families Sparidae (porgies), Sciaenidae (drums and croakers), Haemulidae (grunts), Carangidae (jacks), Callionymidae (dragonets) and Gerreidae (mojarras). During the 2003-2004 Demonstration Study, larval fish abundance in Jobos Bay was strongly represented by demersal fish types, such as Gobiidae, Tripterygiidae, and Callionymidae, which are families of fish that reproduce continuously in shallow habitats of the bay. Clupeiformes, which are pelagic spawners, were also numerically dominant in all sampling dates, thus indicating that they also reproduce continuously in Jobos Bay (Washington Engineers PSC, 2005). While the PREPA study was done within Jobos Bay, it provides insight to which species are found inshore of the Project area and could potentially be transported offshore via planktonic or pelagic ichthyoplankton stages.

A preliminary assessment of vertical variation on the ichthyoplankton community off La Parguera (Ramírez-Mella and García-Sais, 2004) indicated that oceanic species commonly increased in abundance below the surface waters (sampled at 0 to 66 feet [0 to 20 m] deep), including the Myctophidae (lanternfishes), Gonostomatidae (bristlemouths), and Photichthyidae (lighthouse fishes); whereas the Clupeiformes (herring-like), Pomacentridae (damselfishes and clownfishes), Haemulidae (grunts), and Holocentridae (squirrelfishes) families were found in higher abundance. The Gobiidae (gobies) and Scaridae (parrotfishes) families, though reef fish, were also found in higher numbers deeper in the water column, and Lutjanidae (snappers) was commonly found in the midwater. This suggests that if the intake locations for the Project are located between 23 and 36 feet (7 to 11 m) as proposed, there would be a considerable overlap in space with where many larval fish and shellfish are found. Additionally, abundances in different depth zones change throughout the day as larvae come to the surface to feed at night and return to deeper depths during the day to avoid predation.

Tetra Tech, on behalf of Aguirre LLC, conducted ichthyoplankton net sampling offshore of Boca del Infierno pass, near Guayama, approximately 1 mile (1.6 km) outside of the JBNERR along the southern shore of Puerto Rico. The sampling was performed during one-day sampling events over four seasons between May 2012 and November 2013 (Tetra Tech, 2013a; 2013e; 2013g; and 2014e). A list of the ichthyoplankton larvae collected during these events is provided in table 4.5.4-1.

The total fish larvae densities ranged from an average of 29 to 158 larvae per 26,400 gallons (100 m^3) during the winter, spring, summer, and fall sampling (Tetra Tech, 2013a, 2013e, 2013g, and 2014e). This estimate is lower than the mean abundance of fish larvae (418 individuals per 26,400 gallons [100 m^3]) collected during day samples over a course of a year at the Aguirre Intake Station (Washington Engineers PSC, 2005) and the 180 fish larvae per 26,400 gallons (100 m^3) reported prior to the operation of the APPC (Youngbluth, 1974). The fish larvae sampled, as described by Tetra Tech (2014b), were identified to the lowest practical taxa (typically family).

Relatively high abundances of fish eggs were collected during the winter, spring, and summer sampling at the proposed terminal site (Tetra Tech, 2014b). This could be a result of long-shore transport of eggs from coastal reefs and pelagic waters in and around Boca del Infierno pass and from adjacent seagrass habitat serving as spawning habitat for many fish species. The fish egg densities were particularly high during the summer sampling event, potentially as a result of the lunar spawning activities of serranids, sciaenids, and other common fish species in Puerto Rican waters (Sale, 1993). The average egg densities were 169, 401, 1,475, and 96 eggs per 26,400 gallons (100 m^3) during the winter, spring, summer, and fall samplings, respectively (Tetra Tech 2013a, 2013e, 2013g, and 2014e). The density of eggs (1.475 per 26,400 gallons [100 m^3]) collected in summer was comparable with the mean abundance of eggs collected near the APPC at 2,252 eggs per 26,400 gallons (100 m^3) during day samplings and 1,711 larvae per 26,400 gallons (100 m^3) during night samplings (PREPA, 2005). For this study (Tetra Tech, 2014b), eggs were not differentiated based on shape and thus were not identified to a specific taxa.

TABLE 4.5.4-1

Species of Ichthyoplankton Collected by Aguirre LLC at the Proposed FSRU Location for the Aguirre Offshore GasPort Project Area

Family	Common Name	Family	Common Name
Antennariidae	Frogfishes	Mugiliformes	Mugilidae
Apogonidae	Cardinalfishes	Myctophidae	Myctophids
Atherinidae	Silversides	Nemichthyidae	Snipe eels
Aulostomidae	Trumpetfishes	Ophichthidae	Snake eels
Balistidae	Triggerfishes	Ophidiidae	Cusk-eels
Berycidae	Redfishes / Alfonsinos	Opistognathidae	Jawfishes
Bleniidae	Blennies	Ostraciidae	Trunkfishes
Bothidae	Left-eye Flounders	Pleuronectiformes	Flounders
Bythitidae	Brotulas	Pomacanthidae	Angelfishes
Callionymidae	Dragonets	Pomacentridae	Damselfishes
Carangidae	Jacks	Scaridae	Parrotfishes
Clupeidae / Engraulidae	Sardines / Anchovies	Sciaenidae	Drums / Croakers
Coryphaenidae	Dolphinfishes	Scombridae	Tunas / Mackerels
Eleotridae	Sleepers	Scorpaenidae	Scorpionfishes
Ephippidae	Spadefishes	Serranidae	Sea Basses / Groupers
Exocoetidae	Flying fishes	Sparidae	Porgies
Gerreidae	Mojarras	Sphyraenidae	Barracudas
Gobiesocidae	Clingfishes	Syngnathidae	Pipefishes
Gobiidae	Gobies	Synodontidae	Lizardfishes
Haemulidae	Grunts	Tetraodontidae	Porcupinefishes
Hemiramphidae	Half-beaks	Tripterygiidae	Triplefin Blennies
Labridae	Wrasses	Unknown Beloniformid	--
Lutjanidae	Snappers	Unknown fish larvae	--
Microdesmidae	Wormfishes	Fish egg	--
Monacanthidae	Filefishes		

Source: Tetra Tech, 2013a; 2013e; 2013g; and 2014e

Table 4.5.4-2 lists the mean densities of several key taxa of concern, based on the results of the Aguirre LLC's seasonal sampling events. These key taxa are assessed in the entrainment analysis described in section 4.5.4.3 and appendix E.

Coral Larvae

Different species of coral utilize a variety of reproductive techniques. In the Caribbean, many of the reef-building corals either engage in brooding or broadcast spawning. In brooding species, fertilization occurs within maternal polyps containing egg cells, and the larvae remain there until an advanced stage of development. At this point the free-swimming larvae are released and typically settle onto hard substrate near the mother colony. In broadcast spawning species, eggs and sperm are released into the water column in large numbers. The buoyant eggs and sperm float toward the water surface and join to form larvae that spend days to weeks in the water column before developing into a free-swimming stage. After reaching this stage, the larvae migrate downward in the water column, settle to the bottom, and attach to hard substrate.

Many of the coral species in the Project area engage in mass spawning, a synchronized event where many species release their eggs and sperm at the same time. This event typically occurs 3 to 8 days after the full moon following the warmest month (typically, August, September, or October). Table 4.5.4-3 summarizes the method and timing of reproduction, as well as the timing of larval development, for the coral species in the Project area that are ESA-listed or species proposed for ESA listing.

TABLE 4.5.4-2

Densities (no. of individuals) of Representative Taxa of Concern Chosen for Entrainment Calculations in the Project Area

Taxa (Eggs and/or Larvae)	Common Name	Mean Winter Density		Mean Spring Density		Mean Summer Density		Mean Fall Density	
		no./100 m^3	no./MG	no./100 m^3	no./MG	no./100 m^3	no./MG	no./100 m^3	no./MG
Lutjanidae	Snappers	1	47	2	65	1	49	0	-
Serranidae	Groupers and Sea basses	0.4	16	0.2	6	0	-	0.4	15
Carangidae	Jacks	0	-	1	31	0.1	6	0	
Haemulidae	Grunts	4	167	5	191	1	49	2	68
Palinura	Spiny lobsters	3	110	0.2	9	1	45	1	36
Total fish eggs	--	169	6,413	401	15,173	1,475	55,845	96	3,651
Unidentified and other fish larvae	--	45	1,708	80	3,040	155	5,872	27	1,006
Other invertebrate larvae	--	1,151	43,573	1,481	56,068	1,629	61,661	1,847	69,907

MG = million gallons (1 MG = 3,785 m^3)

TABLE 4.5.4-3

Timing and Method of Reproduction for ESA Proposed and Listed Corals

Species [a]	Reproductive Method	Timing of Reproduction [b]	Time to Free-Swimming Larval Stage
Acropora cervicornis (T/PE)	Broadcast Spawning	3 days after August full moon, between approx. 7:00 to 10:30 PM	5 to 7 days
Acropora palmata (T/PE)	Broadcast Spawning	3 to 4 days after August full moon, approx. 9:00 PM	5 to 7 days
Agaricia lamarcki (PT)	Brooding	Small numbers released all night during September/October	Released as free-swimming larvae
Dendrogyra cylindrus (PE)	Broadcast Spawning	Not well known; possibly 3 to 4 days after August full moon, approx. 9:00 PM	Unknown
Dichocoenia stokesii (PT)	Broadcast Spawning	Near September/October full moon	Unknown
Montastraea annularis (PE)	Broadcast Spawning	6 to 7 days after September/October full moon; approx. 10:00 PM	3 to 8 days
Montastraea faveolata (PE)	Broadcast Spawning	6 to 7 days after September/October full moon; approx. 10:00 PM	3 to 8 days
Montastraea franksi (PE)	Broadcast Spawning	6 to 7 days after September/October full moon; approx. 10:00 PM	3 to 8 days
Mycetophyllia ferox (PE)	Brooding	February/March	Released as free-swimming larvae

Sources: Caribbean Marine Biological Institute, 2012; NMFS, 2012; Brainard et al. 2011; Baird et al., 2009; Riddle, 2008

[a] T = Threatened, PE= Proposed for Endangered Status, PT = Proposed for Threatened Status

[b] Peak spawning times are listed, but there can be substantial variability. For example, Adams (2006) notes massive coral spawning in Puerto Rico can occur anywhere between 7 to 15 days after the full moon.

In order to provide site-specific data on coral larvae densities in the vicinity of the proposed FSRU during periods of regular spawning activity, a sampling event was undertaken by Aguirre LLC between August 20 and 28, 2013 (Tetra Tech, 2014c). This period was chosen to coincide with the August 2013 spawning event predicted to take place after the monthly full moon. While the proposed FSRU would be over a benthic habitat that consists primarily of coarse sand with isolated corals occurring at low densities, the concentrated area of coral reefs found at Boca del Infierno pass (approximately 1 mile to the east) must be considered when determining potential impacts from the Project (NMFS, 2012; Tetra Tech, 2012).

The subsurface plankton tow Aguirre LLC used collected free-swimming larvae of many cnidarians including anemones, coral, and octocoral (most of which are 0.01 to 0.03 inches [300 to 700 micrometers] in size and collected with nets 0.01 inches [300 micrometers] mesh or smaller) (Tetra Tech, 2014c). While it is possible to distinguish anemone larvae from coral and octocoral under a microscope, it is difficult to distinguish between coral and octocoral and even more difficult to distinguish between coral families, genera, and species based on morphological features of the larvae. Most coral species are indistinguishable from one another until they settle to the bottom. Genetic analyses, which were not performed in this sampling, could be used to determine which species are present. However, in addition to not distinguishing between the ESA-listed corals (table 4.5.4-2) in the area, it was not possible to determine their density for a number of reasons, including: (a) a high diversity of hard and soft coral in the water column at the sampling depths (23 to 26 feet [7 to 8 m]; i.e., depth of the FSRU intakes) during the period of August and September (e.g., ESA species are not the only ones present), and (b) larvae are found in patchy, heterogeneous aggregations and undergo daily vertical migrations (Oliver and Willis, 1987; Richmond, 1997; Jones et al., 2010) increasing the difficulty in collecting them in tows (Tetra Tech, 2014c). Therefore, a gross density estimate of total coral larvae (i.e., total number per 26,400 gallons [100 m^3]) was derived and compared with representative larvae densities from previous studies.

During a nine-day period just before and following the full moon in August 2013, pre-spawn and post-spawn sampling using bongo nets with single diurnal and nocturnal tows was conducted along a single transect passing through the proposed moorage point for the FSRU (Tetra Tech, 2014c). Tows were conducted every second day during the sampling period. No coral larvae were detected during either the diurnal or nocturnal surveys on the first 3 days of sampling (August 22, 24, or 26). However, local anecdotal information indicated coral slicks were apparent along the southwestern Puerto Rican shore on August 24. Coral larvae were first detected on August 28 with an estimated 456 larvae collected in the nocturnal tow. However, no further sampling was conducted after this tow so it is not possible to track densities after that point. Therefore, the range of density resulting from this one day of the sampling period was 0.085 coral larvae per 264 gallons (1 m^3) during the day and 5.31 larvae per 264 gallons (1 m^3) during the night. The range of coral larvae density (0 to 531 larvae per 26,400 gallons [100 m^3]) observed in Tetra Tech (2014c) is below that found in studies over natal reef conglomerate for other reef ecosystems (e.g., Pacific Ocean), where densities ranged from 10,000 to 1,000,000 per 26,400 gallons (100 m^3) (Hodgson, 1985; Oliver et al., 1992). However, the estimated high density of 531 larvae per 26,400 gallons (100 m^3) is more consistent with those observed in non-reef aggregate water or perimeter areas and where drift densities are remotely transported from a natal reef assemblage (Hodgson, 1985).

4.5.4.3 General Impact and Mitigation

Construction of the Project would result in short-term, minor adverse impacts on plankton from hydrostatic testing and sediment resuspension, and short-term, moderate adverse impacts from potential inadvertent spills of hydrocarbon materials. Operation of the Project would result in permanent, minor adverse impacts on a localized area for plankton from anti-fouling agents, thermal plume discharge, and lighting, permanent, minor impacts on the plankton community due to loss of individuals entrained in sea water intakes; and short-term, moderate adverse impacts from potential inadvertent spills of hydrocarbon materials, as described further below.

Hydrostatic Testing

Hydrostatic testing procedures, general impacts, and mitigation measures are described in section 4.5.2.4. Seawater intakes would entrain or impinge some eggs and larvae against the intake screen. The mortality rate of all entrained organisms is assumed to be 100 percent. Although hydrostatic testing would result in a loss of plankton from the ecosystem, the impact is expected to be minor due to the relatively small volume of water affected and the short-term nature of these testing events.

Sediment Resuspension

General impact and mitigation information regarding sediment resuspension is discussed in section 4.5.2.4. An increase in turbidity due to sediment resuspension from installation of the proposed moorings and pipeline has the potential to adversely affect plankton. In particular, demersal eggs or larvae could be smothered as resuspended sediments settle back to the bottom. Turbidity-related impacts can include reductions in growth and feeding rates, the clogging of respiratory structures, and/or death. Overall, turbidity increases during construction would be temporary in duration and localized in scope, so the impact on plankton is expected to be minor and short-term. However, the pipeline could also result in persistent siltation and turbidity from scour and sediment deposition around the pipeline. Water discharges from the LNG carriers could also cause sediment resuspension at the offshore berthing platform during operation. Turbidity increases associated with scour around the pipeline and the LNG carrier discharges would be localized in scope, so the impact on plankton is expected to be permanent but minor.

Inadvertent Hydrocarbon Spills

General impact and mitigation information regarding inadvertent hydrocarbon spills are described in section 4.5.2.4. Minor releases of hydrocarbons during construction could result in short-term, minor to moderate adverse impacts on plankton. Accidental releases of hydrocarbons resulting from operation of the Project are expected to have short-term and minor to moderate impacts on plankton, but population-level effects from the loss of a cohort of plankton could be permanent. However, given the vessels use of spill response procedures, we conclude that hydrocarbon spill impacts are unlikely.

Anti-fouling Agents

General impact and mitigation information regarding anti-fouling agents are described in section 4.5.2.4. Phytoplankton and ichthyoplankton have been shown to be sensitive to low levels of chlorine (Gentile et al., 1976). Plankton in the immediate vicinity of the outfall may potentially be exposed to harmful concentrations of sodium hypochlorite, but these effects would be very limited due to the small zone of potential exposure. All operational discharges would be subject to the requirements of the NPDES permit for the Project.

Lighting

Lighting procedures, general impacts, and mitigation information are described in section 4.5.3.3. The response of plankton to artificial lights can be quite variable depending on a number of factors such as the type of organism, species, and the intensity of the light. For example, artificial lighting may decrease the daily vertical migration of zooplankton that come to the surface to feed on phytoplankton under the cover of darkness. The effect of operational lighting on plankton is expected to be permanent but minor, due to the highly localized nature of the impact. We are recommending in section 4.5.3.3 that Aguirre LLC develop a lighting plan that identifies specific measures that would be implemented to minimize or avoid impacts associated with nighttime lighting.

Thermal Plume Discharge

General impacts and mitigation information regarding thermal plume discharge from the offshore berthing platform are discussed in section 4.5.2.4. Plankton species that undergo vertical migrations are typically exposed to a wide range of water temperatures and show an increased level of thermal tolerance (Myers et al., 1986). However, some plankton species (including planktonic fish and invertebrates) could be killed by a sudden increase in temperature. Plankton that are not able to move away from the zone of increased temperature are likely to be affected by thermal stress, and may be killed. However, the impacts of the thermal plume on plankton would be localized to a relatively small area and would represent a minor impact on the overall plankton community in the region.

Seawater Intake

The two main sources of potential entrainment for plankton from the proposed Project are the water use at the FSRU intakes and at the LNG carriers while at berth at the Offshore GasPort. Ichthyoplankton (including shellfish) and coral larvae are the two main types of plankton that would have the highest potential for impact; thus, an entrainment analysis was performed for these two groups. It is assumed that all pelagic eggs and larvae in the intake water would be entrained and suffer mortality.

The entrainment estimates were calculated based on the anticipated water uses for the proposed FSRU and LNG carriers. As discussed in section 4.3.1.3, there is a range in the potential daily operating intake volumes for the LNG carriers (based on values derived from past projects). Given the type and size of the LNG carriers in the current fleet, the higher end of that range is most likely to be representative of the Project. Thus, for the purposes of the analysis, the maximum LNG carrier intake volume of 81.6 mgd (308,900 m^3) was used to estimate entrainment. We assumed that there would be 50 deliveries per year and each delivery would take 88 hours.

<u>Ichthyoplankton</u>

Aguirre LLC conducted an evaluation to estimate the annual entrainment impact in terms of equivalent adult losses for the Project using the four seasonal sampling events collected to date (Tetra Tech, 2014b). However, Aguirre LLC’s study was inadequate because it did not include age-specific mortality or survival rates necessary to accurately convert raw entrainment and impingement numbers into age-1 equivalents. Thus, we conducted a separate equivalent loss analysis to estimate potential entrainment impacts on fish and spiny lobster eggs and larvae associated with seawater intakes during GasPort operations. Note that entrainment impacts were calculated for the operational phase of the Project only, as data on water use during construction were not provided. The full analysis is provided in appendix E and is summarized briefly below.

The entrainment calculations were performed in part by following the NOAA/USCG jointly developed methodology for ichthyoplankton entrainment, as described in the ichthyoplankton assessment model appended to the Gulf Landing Final Environmental Impact Statement (USCG and U.S. Maritime Administration, 2005 and subsequent revisions/clarifications). Not all of the steps described in this guidance were applicable for this Project due to lack of extensive seasonal ichthyoplankton sampling.

A selection of specific species and taxa of concern were analyzed to serve as indicators of the potential entrainment impacts of the Project. The species/taxa analyzed for the ichthyoplankton entrainment assessment were chosen due to their adequate life history information and their ecological and economic importance. The density information, based on the towed ichthyoplankton net sampling as described in Tetra Tech (2014b), is only down to the family level. Thus, specific species within each of the key taxa were selected and used as proxies for the life history inputs necessary to derive age-one equivalents and growth and production foregone for lost individuals. Table 4.5.4-4 lists the taxa of concern chosen for the entrainment analysis and their respective proxy species for life history inputs. For the entrainment calculations of fish eggs and unidentified and other fish larvae, two proxy species were used for life history inputs in order to derive a range of growth and production foregone for lost individuals. Because the "other invertebrate larvae" category is comprised of a wide range of taxa, no one proxy species could be chosen for life history inputs; thus, only raw entrainment numbers were calculated for this group.

TABLE 4.5.4-4

Representative Taxa of Concern Chosen for Entrainment Calculations at the Project Location

Taxa (Eggs and/or Larvae)	Common Name	Proxy Species for Life History Inputs	Rationale for Consideration
Lutjanidae	Snappers	Silk snapper	Target reef fish in the commercial fishery
Serranidae	Groupers and Sea basses	Nassau grouper	Important continental shelf taxa
Carangidae	Jacks	Blue runner	High recreational landings as listed in the Shallow Water Reef Fish Fishery Management Plan (FMP)[a]
Haemulidae	Grunts	Tomtate grunt	High recreational landings as listed in the Shallow Water Reef Fish FMP
Palinura	Spiny lobsters	Caribbean spiny lobster	Important continental shelf taxa
Fish Eggs	--	Engraulidae (bay anchovy) and Haemulidae (tomtate grunt)	Both abundant species in sampling events, thus prevalent in the area
Unidentified and All Other Fish Larvae	--	Engraulidae (bay anchovy) and Haemulidae (tomtate grunt)	Majority of fish larvae collected during seasonal sampling [b]
All Other Invertebrate Larvae	Decapods, Mollusks and Cephlapods	-	Majority of invertebrate larvae collected during seasonal sampling

Sources:
[a] Caribbean Fishery Management Council, 1985
[b] Tetra Tech, 2013a; 2013e; 2013g; and 2014e

Tables 4.5.4-5 and 4.5.4-6 present the results of the entrainment analysis for the FSRU and LNG carriers, respectively. These tables include the raw number individuals entrained, the number of age-1 equivalents lost, and losses of age 1+ age classes per year and over the life of the Project, which was assumed to be 40 years.

TABLE 4.5.4-5

Annual Population Impacts Under FSRU Continuous Operations

			No. Individuals Lost (millions)		No. Age-1 Equivalents Lost		Losses of Age 1+ Age Classes (pounds [kilograms])	
Taxa	Common Name	Stage	Annually	Project Life [a]	Annually	Project Life [a]	Annually	Project Life [a]
Lutjanidae	Snappers	Larvae	0.8	32.9	0.13	5.4	0.28 (0.13)	11.2 (5.1)
Serranidae	Groupers	Larvae	0.2	7.6	0.01	0.2	0.03 (0.01)	1.0 (0.5)
Carangidae	Jacks	Larvae	0.2	7.4	0.04	1.5	0.08 (0.04)	3.2 (1.4)
Haemulidae	Grunts	Larvae	2.4	96.6	0.03	1.3	0.22 (0.10)	9.0 (4.1)
Palinura	Spiny lobster	Larvae	1.0	40.7	0.04	1.5	0.06 (0.03)	2.5 (1.4)
All other fish taxa as Engraulidae	Anchovies	Larvae	59.5	2,379.7	0.46	18.5	0.22 (0.10)	9.0 (4.1)
All other fish taxa as Haemulidae	Grunts	Larvae	59.5	2,379.7	0.78	31.3	5.52 (2.50)	220.8 (101.1)
Fish eggs as Engraulidae	Anchovies	Eggs	333.8	13,353.6	2.60	104.0	28.56 (12.96)	1,142.5 (518.2)
Fish eggs as Haemulidae	Grunts	Eggs	333.8	13,353.6	4.39	175.7	30.97 (14.05)	1,238.8 (561.9)

[a] The Project life was assumed to be 40 years.

TABLE 4.5.4-6

Annual Population Impacts Associated with LNG Carrier Deliveries

			No. Individuals Lost (millions)		No. Age-1 Equivalents Lost		Losses of Age 1+ Age Classes (pounds [kilograms])	
Taxa	Common Name	Stage	Annually	Project Life [a]	Annually	Project Life [a]	Annually	Project Life [a]
Lutjanidae	Snappers	Larvae	0.6	24.2	0.10	3.9	0.21 (0.09)	8.3 (3.7)
Serranidae	Groupers	Larvae	0.1	5.6	0.00	0.2	0.02 (0.01)	0.7 (0.3)
Carangidae	Jacks	Larvae	0.1	5.4	0.03	1.1	0.06 (0.03)	2.3 (1.1)
Haemulidae	Grunts	Larvae	1.8	71.0	0.02	0.9	0.16 (0.07)	6.6 (3.0)
Palinura	Spiny lobster	Larvae	0.7	30.0	538.62	1.1	0.05 (0.02)	1.8 (0.8)
All other fish taxa as Engraulidae	Anchovies	Larvae	43.5	1,739.3	0.34	13.5	0.16 (0.07)	6.6 (3.0)
All other fish taxa as Haemulidae	Grunts	Larvae	43.5	1,739.3	0.57	22.9	4.03 (1.83)	161.3 (73.2)
Fish eggs as Engraulidae	Anchovies	Eggs	243.4	9,737.3	1.90	75.9	20.83 (9.45)	833.1 (377)
Fish eggs as Haemulidae	Grunts	Eggs	243.4	9,737.3	3.20	128.1	22.58 (10.24)	903.3 (409.7)

[a] The Project life was assumed to be 40 years.

Based on the results of the ichthyoplankton entrainment analysis, annual losses of age 1+ fish and invertebrates are relatively low. However, these entrainment estimates need to be used with the caveat that they are only based on four one-day seasonal sampling events to derive fish and invertebrate plankton densities. Based on the information available, operation of the Project would result in a permanent, minor impact on fish and shellfish populations in the region due to entrainment. The loss of planktonic fish and shellfish due to entrainment would also result in a reduction in food availability for fish and invertebrates species that prey on these items. This impact is expected to be permanent but minor.

Coral Larvae

The seven broadcast-spawning species found in the Project area that are ESA-listed or proposed for listing (see table 4.5.4-3) would be at risk of being exposed to entrainment over a period of approximately 10 days in August and potentially one week in September/October, depending on the summer water temperature. Larvae at the depth of the FSRU intakes at 23 and 36 feet (7 and 11 m) below the water surface would be at the highest risk of entrainment. Coral gametes could be exposed to entrainment as they are spawned near the bottom, then rise to the surface and return through the water column to settle. There is also the possibility of entrainment as larvae are carried through the water column again due to waves and currents. The larvae of the two proposed ESA-listed species that brood (table 4.5.4-3) would potentially be exposed to entrainment impacts after they are released. However, brooded larvae are not buoyant and typically disperse only a short distance from their parent colony, thus their risk of entrainment would be relatively low.

Potential entrainment of coral larvae from the FSRU and calling LNG carriers was estimated based on the minimum (daytime) and maximum (nighttime) density of coral larvae observed in the Tetra Tech (2014c) study. The entrainment estimates of maximum daily entrainment apply only to planktonic coral densities present in the water column following the spawning activity, and should be considered a rough estimate as they are based on a single day of sampling in which larvae were present. In order to determine the number of coral larvae entrained annually, two factors need to be taken into account: 1) two major coral spawning events (August and September-October) have been identified for the southern shore of Puerto Rico; and 2) the duration of larval stage before settlement can range from 2 to 10 days (Baird, 2001). Therefore, the following equation can be used to estimate annual entrainment of coral larvae:

Number of Coral Larvae Entrained Annually (n) = $\Sigma(\text{Larvae}_{day}*0.5\text{day} + \text{Larvae}_{night}*0.5\text{ day})$ *(daily volume withdrawn m^3)*(duration of larval stage)

Where:

- Larvae_{day} = Density of larvae during daytime sampling event from Tetra Tech (2014c): 0.085 larvae/m^3);
- Larvae_{night} = Density of larvae during nighttime sampling event from Tetra Tech (2014c): 5.31 larvae/m^3);
- Daily Volume Withdrawn = Daily water withdrawal by the FSRU or LNG carriers (m^3);
- Duration of Larval Stage = Estimated exposure duration for the coral larvae stage prior to settlement, 10 days (Baird, 2001) for two distinct spawning events.

This estimate assumes larvae would only be present at the depth of the intake 23 to 36 feet (7 to 11 m) during spawning events, which is a conservative assumption. Table 4.5.4-7 summarizes the annual converted entrainment for coral larvae for the FSRU and LNG carriers.

TABLE 4.5.4-7

Qualitative Annual Entrainment Estimate of Coral Larvae by Offshore GasPort FSRU and LNG Carriers for the Aguirre Offshore GasPort Project Area

Operating Scenario	Daytime Coral Larvae Density (no./m^3) [a]	Nighttime Coral Larvae Density (no./m^3) [a]	Duration of Larval Susceptibility to Entrainment (days)	Maximum Daily Entrainment Estimate (no. of individuals)	Annual Entrainment Estimate (no. of individuals)
FSRU	0.085	5.31	20 [b]	571,417	11,428,336
LNG Carriers	0.085	5.31	12.7 [c]	833,231	10,582,031

[a] Source: Tetra Tech (2014c); total coral larvae collected on one sampling event – 28 August 2013
[b] Assumes two major spawning events per year with 10-day larval duration during each event.
[c] Assuming 50 deliveries per year that are evenly spaced, one delivery would occur every 7.3 days. Therefore, a maximum of 1.7 deliveries (3.67 days in duration each) could occur during each of the two 10-day spawning events.

Equivalent adult analyses used in estimating entrainment impacts for fish cannot be used for coral larvae due to the lack of known population level parameters, the short temporal period for the pelagic stage, and the complex development of coral larvae from pelagic to sessile organisms. As a result, these annual entrainment estimates in table 4.5.4-7 could be considered conservative because they do not account for natural mortality of the larvae. However, these entrainment estimates need to be used with the important caveat that they are based on one day of sampling within a nine day sampling event in August 2013, which may not represent typical post-spawning larval densities.

During spawning periods, there is potential for entrainment of coral larvae with the highest risk occurring near the depth of the intake of the FSRU. Entrainment of coral larvae would likely result in a permanent, moderate impact on coral populations in the region.

4.5.5 Fisheries Resources

The Jobos Bay estuary and the offshore waters of the Caribbean Sea provide valuable habitat for a variety of tropical fish species. Common fish species found within Jobos Bay include anchovies, barracuda, jacks, tarpon, wrasses, damselfish, grunts, snappers, surgeonfishes, and parrotfish.

Tropical fish species are present both in the Jobos Bay estuary and in the Caribbean Sea. Estuaries are protected nearshore areas such as bays, sounds, inlets, and river mouths, influenced by both ocean and freshwater. Because of tidal cycles and freshwater runoff, salinity varies within estuaries and results in great diversity, offering freshwater, brackish, and marine habitats within close proximity. Estuaries tend to be shallow, protected, nutrient rich, and are biologically productive, providing important habitat for marine organisms.

4.5.5.1 Fisheries of Special Concern

Fisheries resources of special concern occurring within the Project area include:

- federally designated EFH for corals, queen conch, spiny lobster, reef fish, and highly migratory species;
- species listed as federally threatened, endangered, proposed, or candidate under the ESA and their designated or proposed critical habitat;
- species listed as species of concern by NMFS; and
- fisheries protected under NMFS annual catch limit regulations.

EFH within the Project area is discussed in section 4.5.5.2, and ESA-listed species and their critical habitats are discussed in section 4.6. Fishery species protected under annual catch limit regulations are discussed in section 4.5.5.3. NMFS species of concern are discussed below.

Species of concern are defined as those species with insufficient information to require listing under the ESA; however, NMFS has concerns regarding status and threats of the species. These species are not protected under the ESA; however, the designated status is in place to draw attention and conservation actions to the species. One species of concern, the dusky shark, has the potential to occur in the Project area.

The dusky shark is listed as a species of concern in the western Atlantic by NMFS, although its range includes all waters surrounding Puerto Rico. This species is a highly migratory coastal shark that is found in inshore surf zones and offshore water. Reasons for decline include illegal commercial and recreational shark fisheries and by-catch. The dusky shark matures late in life, grows slowly, and only reproduces every 3 years, making it very susceptible to overfishing (NMFS, 2010c). The Project would not contribute to commercial or recreational fishing within the Project area, as discussed in section 4.5.5.3. Therefore, Project impacts on the dusky shark would be similar to those actions described below for EFH species and would not be significant.

4.5.5.2 Essential Fish Habitat

The MSA (Public Law 94-265 as amended through October 11, 1996) was established, along with other goals, to promote the protection of EFH in the review of projects conducted under federal permits, licenses, or other authorities that affect or have the potential to affect such habitat. EFH is defined in the MSA as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.

Federal agencies that authorize, fund, or undertake activities that may adversely impact 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 in order 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, the 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 will 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.

We are consolidating EFH consultations for the Project with the EIS process. As such, the EFH Assessment is included as appendix F of this EIS.

Identification of Essential Fish Habitat

EFH potentially affected by the Project was identified through review of NMFS and Caribbean Fishery Management Council (CFMC) regulations. The CFMC manages the Fishery Management Plans (FMP) for several species in the Project area including queen conch, spiny lobster, corals, and reef fish. Highly migratory species are managed by NMFS, and specific geographic boundaries are defined as EFH for each individual species (NMFS, 2009). According to the 1998 EFH Generic Amendment to the FMPs of the U.S. Caribbean, EFH for these species is identified as "all waters and substrates (mud, sand, shell, rock, and associated biological communities), including coral habitats (coral reefs, coral hardbottoms, and octocoral reefs), sub-tidal vegetation (seagrasses and algae) and adjacent intertidal vegetation (wetlands and mangroves). Therefore, EFH includes virtually all marine waters and substrates (mud, shell, rock, coral reefs, and associated biological communities) from the shoreline to the seaward limit of the EEZ" (CFMC, 1998).

<u>Queen Conch</u>

The queen conch EFH is designated within all marine waters and substrates for post-egg and larval life stages within the Project area. Queen conch within the EEZ are managed by the CFMC under the FMP for the queen conch resources of Puerto Rico and the U.S. Virgin Islands (CFMC, 1996). The queen conch is an ESA-listed candidate species and is discussed in detail in section 4.6.1.5. Annual catch limit regulations for the queen conch are discussed in section 4.5.5.3.

<u>Spiny Lobster</u>

The spiny lobster EFH is designated within all marine waters and substrates for post-egg and larval life stages within the Project area. Two species are included in the EFH designation: the spiny lobster and the slippery lobster. Spiny lobster within the EEZ are managed by the CFMC under the FMP for the spiny lobster fishery of Puerto Rico and the U.S. Virgin Islands (CFMC, 1981). The spiny lobster and its annual catch limit regulations are discussed in section 4.5.5.3.

<u>Reef Fish</u>

The reef fish EFH is designated within all marine waters and substrates for post-egg and larval life stages within the Project area. Six groups of reef fish with a total of 43 species are included in the EFH designation. The six groups include triggerfish, jacks, wrasses, snappers, tilefish, and groupers. Reef fish within the EEZ are managed by the CFMC under the FMP for shallow water reef fish fishery of Puerto Rico and the U.S. Virgin Islands (CFMC, 1985). Reef fish and their annual catch limit regulations are discussed in section 4.5.5.3.

Coral

The coral EFH is designated within all marine waters and substrates for post-egg and larval life stages within the Project area. Corals within the EEZ are managed by the CFMC under the FMP for corals and reef associated plants and invertebrates of Puerto Rico and the U.S. Virgin Islands (CFMC, 1994). Coral reefs are discussed in section 4.5.2.1, and ESA-listed coral species are discussed in section 4.6.

Highly Migratory Species

The EFH for highly migratory species in the Project area has been designated for individual species due to their highly variable life histories. Four highly migratory species have designated EFH within the Project area: lemon shark, sailfish, longbill spearfish, and tiger shark. Highly migratory species are managed by the NMFS Highly Migratory Species Management Division (NMFS, 2009).

4.5.5.3 Commercial and Recreational Fisheries

Jobos Bay and the Caribbean Sea support a number of valuable commercial and recreational fisheries. Commercial fishing in Puerto Rico is generally small scale and limited to coastal areas. Recreational fishing occurs within Jobos Bay and in offshore waters. Common commercial and recreational fish species in the Project area include whalebone anchovies, herring, jacks, conch, octopus, lobster, and parrotfish (DNER, 2010). Over the last few decades, local fisheries have suffered from overfishing from legal and illegal fishing practices and habitat loss. Information on recreational and commercial fishing in the Project area is included in section 4.7.

Finfish landings make up a majority of the commercial fisheries in Puerto Rico, although invertebrate landings have increased over time as a result of declining finfish landings (NMFS, 2011a). Commercial fishing is done by using a variety of fishing gear, including hand lines, fish traps, wooden cage traps, gill nets, trammel nets, horizontal and vertical longlines, trolling, harpoons, snares, gaffs, and hand gathering. Recreational fishing for various estuarine species listed above is done by hand-line or rod and reel fishing. Pelagic species such as dolphin fish, wahoo, billfish, and tuna are fished by boat trolling. Skin-diving fishing is also utilized for recreational fishing in deep waters or shelf edge reefs.

Several fisheries are regulated under annual catch limits developed by NMFS and the CFMC to prevent overfishing resulting from commercial and recreational fishing practices in the federal waters of the U.S. Caribbean. These regulated fisheries include reef fish, spiny lobster, queen conch, and corals and reef associated plants and invertebrates (NMFS, 2011a).

Spiny Lobster Fishery

The spiny lobster occurs throughout the Caribbean Sea and the western Atlantic Ocean and Gulf of Mexico in the southern United States and northern South America. Caribbean spiny lobsters occupy several habitat types throughout their life cycle. Adult lobsters utilize offshore environments, living in social groups and utilizing rock outcrops, reef holes, or artificially created structures as closed den habitat. Larvae are released near reef edges or coastal shelves and spend 6 to 10 months in a series of planktonic larval stages which distribute them throughout the Caribbean. Young lobsters often inhabit clusters of red algae, seagrass beds, sponges, or submerged mangrove roots which provide refuge and food sources. Juvenile and sub-adult lobsters utilize coral reefs, caves, and sponges for habitat. Caribbean spiny lobsters will migrate in single-file lines to deeper water to avoid stressful environments such as cold and turbid water (NMFS, 2005).

On average, the spiny lobster represents approximately half of all invertebrate commercial landings within the Caribbean. The spiny lobster fishery comprised approximately nine percent of the total commercial landings in Salinas and Guayana municipalities between 1993 and 2003. Historically, spiny lobsters were primarily caught using fish or lobster pots and traps; however, in recent years commercial fishermen have utilized diving as a primary method to capturing these species. Commercial landings for the spiny lobster have shown a general decreasing trend.

Caribbean spiny lobsters utilize a variety of habitat types that are present throughout the Project area including coral reef, algal and seagrass beds, mangroves, and offshore habitat. No Caribbean spiny lobsters were documented within Jobos Bay during benthic surveys conducted in June 2009 (Whitall et al., 2011). Aguirre LLC performed additional benthic surveys within the Project area in May 2012, during which, two sub-adult individuals were documented within coral reef habitat.

Queen Conch Fishery

The queen conch is an ESA-listed candidate species; therefore, its characteristics and distribution throughout the Project area and associated impacts and mitigation are discussed in sections 4.6.1.5 and 4.6.2, respectively. This species matures late in life, grows slowly, and reproduces in groups in shallow water, making it very susceptible to overfishing. Queen conch are primarily harvested by hand, both commercially and recreationally. Commercial and recreational fishermen are limited to harvesting a limited amount of conch per day and within seasonal timeframes of November 1 to July 31 within territorial waters of Puerto Rico. The CFMC coordinated the Queen Conch Working Group (previously known as the International Queen Conch Initiative) which consists of a group of Caribbean region countries that have common interests in promoting a universal strategy for the management of queen conch resources in the Caribbean (CFMC, 2012).

Reef Fish Fishery

The reef fish FMP is comprised of over 137 reef fish species, of which 55 are associated with the aquarium trade. The reef fish category consists of a variety of different species including snapper, sea bass, grouper, parrotfish, grunts, goatfish, porgies, squirrelfish, tilefish, jacks, surgeonfish, triggerfish, filefish, boxfish, wrasses, and angelfish (CFMC, 1985). The recreational landings for reef fish in Puerto Rico are included in table 4.5.5-1.

Corals and Reef Associated Plants and Invertebrates Fishery

Over 100 species of coral and over 60 species of plants and invertebrates are included in the FMP for corals and reef associated plants. Coral reef characteristics and distribution throughout the Project area are discussed in section 4.5.2.1. Similar information regarding ESA-listed coral species is included in section 4.6.1.5. Seagrasses, hydrocorals, anthozoans, gorgonian corals, hard corals, and black corals are currently prohibited from being extracted in the territorial waters of Puerto Rico unless permitted for scientific research, education, or unless restoration is completed. Live rock, snapping shrimp, emerald crab, olive snail, cushion sea star or West Indies starfish, banded shrimp, golden shrimp, yellow arrow crab, and anemone shrimp are all targeted commercially for aquarium trade (CFMC, 1994).

TABLE 4.5.5-1

Recreational Reef Fish Landings for Puerto Rico in 2011

Species group [a]	Total Reported Catch [b]	Annual Catch Limit [b]	Percent of Annual Catch Limit
Angelfish	167	4,492	3.7
Aquarium trade	1,405	8,155	17.2
Boxfish	2,477	4,616	53.7
Goliath Grouper	0	0	n/a
Goatfish	277	362	76.5
Grouper	14,830	77,213	19.2
Grunts	2,113	5,028	42.0
Jacks	3,1982	51,001	62.3
Nassau Grouper	221	0	n/a
Parrotfish	10,391	15,263	68.1
Porgies	1,787	2,577	69.3
Snapper Unit 1	39,230	95,526	41.1
Snapper Unit 2	0	34,810	0
Snapper Unit 3	27,896	83,158	33.5
Snapper Unit 4	9,745	28,509	34.2
Squirrelfish	754	3,891	19.4
Triggerfish & Filefish	1,970	21,929	9.0
Wrasses	5,539	5,050	109.7

a Snapper Unit 1 includes silk, black, blackfin, vermilion, and wenchman; Snapper Unit 2 includes queen and cardinal; Snapper Unit 3 includes gray, lane, mutton, dog, schoolmaster, and mahogany; Snapper Unit 4 includes yellowtail.

b Pounds of whole fish.

Source: NMFS, 2014

4.5.5.4 General Impacts and Mitigation

Construction of the proposed Project would result in direct and indirect impacts on fisheries. Direct impacts include entrainment of fish larvae, loss or alteration of habitat, and direct mortality of species resulting from construction activities. Indirect impacts as a result of turbidity, noise, water quality, and lighting would also occur. Operation of the Project would result in permanent, minor adverse impacts on fishery resources from increased vessel traffic and entrainment, shading, anti-fouling agents, thermal plume discharge, noise, and lighting; permanent moderate adverse impacts from habitat alteration/loss associated with the pipeline; and short-term, moderate adverse impacts from potential inadvertent spills of hydrocarbon materials. Much of the impact discussion included below applies to fish protected under the ESA, which are described in detail in section 4.6, and to EFH designated under the MSA, which is discussed further in section 4.5.5.2. In addition, marine mammals and sea turtles occurring along the waterway for LNG marine traffic are protected under the ESA and/or the MMPA and are described in sections 4.6.1.1 and 4.5.3.1.

In-Water Construction Activities

Fishery resources could be impacted by in-water construction activities such as pile driving and placement of the subsea pipeline. Direct impacts of in-water construction activities on fishery resources would include the displacement of fishery species within the affected area and direct mortality of some individuals. Most fish species are highly mobile and would leave the vicinity of the Project area during construction activities. However, construction activities could cause mortality of less mobile species, including the queen conch if encountered during construction.

Hydrostatic Testing

Hydrostatic testing procedures, general impacts, and mitigation measures are described in section 4.5.2.4. The intake of water would impact fishery resources in the Project area through entrainment and impingement of larvae. The impact of entrainment and impingement of fish larvae is addressed in section 4.5.4.3. The discharge would be directed through a pipe secured about 6 feet (1.8 m) below the bay's water surface to minimize surface disturbance. To reduce discharge velocity and minimize sediment resuspension at the point of discharge, Aguirre LLC would attach a diffuser head to the discharge pipe during dewatering operations. We conclude impacts of the discharge on fishery resources would be short-term and minor.

Sediment Resuspension

General impact and mitigation information regarding sediment resuspension is discussed in section 4.5.2.4. An increase in turbidity due to sediment resuspension from installation of the proposed moorings and pipeline has the potential to affect fishery resources. Increased turbidity can adversely affect fish eggs and juvenile fish survival, benthic community diversity and health, foraging success, and suitability of spawning habitat. Increased turbidity can also reduce in-water visibility that can affect the ability of sight-feeders to locate prey. In sufficient quantities, increased turbidity levels can affect oxygen exchange over the gills in fishery species, resulting in weakened individuals or mortality. Additionally, sediments in the water column can be deposited on nearby substrates, which could bury aquatic macroinvertebrates (an important food source for many species of fish). Overall, turbidity increases would be temporary in duration and localized in scope; therefore, we anticipate the impact on fishery resources to be short-term and minor. However, the pipeline could also result in persistent siltation and turbidity from scour and sediment deposition around the pipeline. Water discharges from the LNG carriers could also cause sediment resuspension at the offshore berthing platform during operation. Turbidity increases associated with scour around the pipeline and the LNG carrier discharges would be localized in scope, so the impact on fishery resources is expected to be permanent but minor.

Inadvertent Hydrocarbon Spills

General impact and mitigation information regarding inadvertent hydrocarbon spills are described in section 4.5.2.4. Minor releases of hydrocarbons during construction could result in short-term, minor to moderate adverse impacts on fishery resources. Because the construction vessels, the FSRU, and LNG carriers would abide by its respective spill plans, we conclude accidental spills during operation would have negligible impacts on fish species.

Habitat Alteration/Loss

Overall habitat modification impact information and acreages for benthic resources used by fishery resources (seagrasses, corals, and macroalgae) are discussed in section 4.5.2.4. The impact of temporary habitat modification/loss on fishery resources varies. Fish in the offshore portion of the Project area would likely move away from areas of disturbance to other similar, adjacent habitats. Within Jobos Bay, destruction of seagrasses, macroalgae, and coral reef would be a loss of habitat for fishery species. Aguirre LLC has agreed to develop coral reef and seagrass mitigation plans to compensate for impacts on these habitat types. In sections 4.4.3 and 4.5.2.4 above, we are recommending that Aguirre LLC file drafts of these plans. With mitigation measures in place, overall habitat impacts during construction are expected to be short-term and minor for most fishery species.

Seagrasses and macroalgal habitat loss as a result of the offshore berthing platform operation are anticipated to be minor. The presence of the permanent structure in the offshore could be a beneficial effect for some fish species, as it may provide artificial reef habitat in the offshore coastal waters.

The inshore habitat of Jobos Bay would be altered by the presence of the pipeline which could act as a physical deterrent that bisects the bay. Many fishery species are highly mobile and would not be impacted directly by the presence of the pipeline. However, queen conch are less mobile and could be directly impacted. Impacts regarding the presence of the pipeline on queen conch are discussed in section 4.6.2.2.

Noise

General impacts and mitigation information, as well as current noise levels and modeling results in the Project area are discussed in section 4.5.3.3. Unfortunately, relatively little is known about the effects from exposure to underwater sound on most aquatic organisms, particularly fish (Popper and Hastings, 2009). Even in cases where data are available, most experts recommend extreme caution in attempting to extrapolate between species (Popper and Hastings, 2009). Fish species with swim bladders seem more susceptible to noise/pressure impacts. However, these fish species are highly mobile and would be able to avoid areas of noise that would cause them discomfort or harm. Construction impacts could create large volumes of noise/pressures (particularly during the installation of the piles). However, these impacts would be temporary and we are recommending in section 4.5.3.3 that Aguirre LLC provide minimization measures to limit noise impacts associated with pile driving. Impacts on fishery resources in the offshore environment from the FSRU and LNG vessels are expected to be permanent but minor given the existing noise conditions in the Project area.

Lighting

Lighting procedures, general impacts, and mitigation information are described in section 4.5.3.3. The response of fishery species to artificial lights can be quite variable depending on a number of factors such as the species, life stage, and the intensity of the light. Small organisms are often attracted to lights, which in turn attract larger predators to feed on the biological aggregations. Lights could cause artificially induced biological aggregations. Generally, impacts on fishery resources would be minor as these species may change their feeding habits based on these aggregations. Overall, with mitigation measures in place, the effect of construction lighting on fishery species is expected to be permanent but minor due to the highly localized nature of the impact. We are recommending in section 4.5.3.3 that Aguirre LLC develop a lighting plan that identifies specific measures that would be implemented to minimize or avoid impacts associated with nighttime lighting.

Shading

General impacts from shading on benthic resources (e.g., corals and SAV) utilized by fishery species are discussed in section 4.5.2.4. Impacts of this habitat loss on fishery species may impact preditor/prey interactions; however, we conclude these impacts would be permanent but minor.

Thermal Plume Discharge – Offshore Berthing Platform

General impacts and mitigation information regarding thermal plume discharge from the offshore berthing platform are discussed in section 4.5.2.4. Impacts on fishery resources are expected to be permanent but minor, as mobile organisms would be able to move out of the zone of heated water.

Brine Water Discharge – Offshore Berthing Platform

Operation of the offshore berthing platform would result in approximately 0.27 mgd (1,022 m^3/day) of brine water discharge from the desalination reverse osmosis unit. The salinity levels of brine discharges from the offshore berthing platform are estimated to be 64 to 70 ppt (64 to 70 mg/L), which is roughly double that of the supplied feed water. Changes in water salinity can influence aquatic organisms including fishery species in various ways including species development, reproduction, and population density (Danoun, 2007). Water salinity changes can additionally influence larval stages of fishery species. Impacts on ichthyoplankton are discussed in section 4.5.4.3. We expect the brine water plume to dissipate quickly due to local currents and vertical mixing near the offshore berthing platform. Prior to dispersion, mobile organisms would move out of the zone of increased salinity water. Permanent but minor impacts on fishery resources are expected from brine water discharges.

Anti-fouling Agents

General impact and mitigation information regarding anti-fouling agents are described in section 4.5.2.4. The effect of residual chlorine on aquatic life in estuarine ecosystems has been studied extensively; however, little research has been conducted on its effects on tropical reef fish communities. Continuous residual chlorine concentrations that produced 100 percent mortality in fathead minnows was between 0.16 and 0.21 ppm (0.16 and 0.21 mg/L), with threshold concentrations between 0.04 and 0.05 ppm (0.04 and 0.05 mg/L) (Zillich, 1972). Although not documented for tropical fish and invertebrate species, behavioral avoidance of chlorinated discharges has been documented by fish and larger inverterbrates such as white perch, grass shrimp, and blue crab (Brungs, 1976). This behavior, if present in fish species within the Project area, would reduce overall exposure to any residual chorine present in the discharge. The behavior would also reduce the fishery species use of any habitat in proximity of the discharge plume. Residual chlorine has been shown to cause mortality to larval fish when routinely exposed in concentrations greater than 0.1 ppm (0.1 mg/L). Our discussion of impacts on fish larvae is included in section 4.5.4.3.

Fishery species in the immediate vicinity of the outfall may be exposed to harmful concentrations of sodium hypochlorite, but these effects are anticipated to be negligible due the small zone of potential exposure and the ability of these species to move away from contaminated waters. All operational discharges would be subject to the requirements of the NPDES permit for the Project.

Seawater Intake

Operational uses of seawater have the potential to adversely affect fish populations via entrainment of larval stages (see section 4.5.4.3). The intake of water is anticipated to have negligible impact on juvenile and adult fish in the Project area, as they are all large enough to avoid entrainment and mobile enough to avoid the intake area.

Introduction of Exotic Species

LNG carriers in transit to and from the offshore berthing platform could import exotic species on their hulls and exterior equipment. The FSRU would undergo dry-dock maintenance about every 5 years. During scheduled dry-dock periods, PREPA may require Aguirre LLC to use a similar FSRU to meet contractual send-out rates. Therefore the new and/or returning FSRU could also import exotic species on its hull and exterior equipment. Operators of commercial vessels have a significant economic interest in maintaining underwater body hull platings in a clean condition. Fouling of bottom platings would result in increased fuel costs for voyages and could also reduce the vessel's maximum transit speed. To prevent fouling and the associated economic costs, operators aggressively and conscientiously apply hull plating preservation and maintenance programs.

LNG carriers would not discharge ballast water while unloading LNG at the offshore berthing platform. However, the commissioning of the new and/or returning FSRU associated with the dry-dock maintenance would likely require the discharge of ballast water from an offsite location. The USCG has developed responses to exotic/invasive organisms associated with foreign vessels. The USCG Office of Operating and Environmental Standards developed *Mandatory Practices for All Vessels with Ballast Tanks on All Waters of the United States*. The mandatory practices include requirements to rinse anchors and anchor chains during retrieval to remove organisms and sediments at their place of origin and remove fouling organisms from hull, piping, and tanks on a regular basis and dispose of any removed substances in accordance with local, state, and federal regulations.

Based on above descriptions of hull plating surface treatments, the mandatory practices required by the USCG, the lack of ballast water being discharged by the LNG carriers, and the infrequency of the ballast water discharges from the new and/or returning FSRUs, operation of the Project would not likely introduce exotic or invasive species into the Project area.

The lionfish is an invasive species found in the U.S. south Atlantic and Caribbean Sea including Puerto Rico. Lionfish are predatory in nature and have very few known natural predators. Lionfish are known to greatly reduce fish populations in reefs where they become established. Operation of the Project is not expected to impact the already established lionfish populations in or surrounding the Project area.

4.6 THREATENED AND ENDANGERED SPECIES

Federal agencies are required by Section 7 of the ESA (19 USC § 1536(c)), as amended, to ensure that any actions authorized, funded, or carried out by the agency do not jeopardize the continued existence of a federally listed endangered or threatened species, or result in the destruction or adverse modification of the designated critical habitat of a federally listed species. The action agencies are required to consult with the FWS and/or NMFS to determine whether federally listed endangered or threatened species or designated critical habitat are found in the vicinity of a proposed project, and to determine the action's 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 federal agency must prepare a BA for those species that may be affected. The action agency must submit its BA to the FWS and/or NMFS and, if it is determined that the action would likely adversely affect a listed species, the federal agency must submit a request for formal consultation to comply with Section 7 of the ESA. 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.

We reviewed the information submitted by Aguirre, performed our own research, and consulted directly with the agencies regarding federally listed species in the Project area. Our analysis of the potential for Project-related impacts on these species and their designated critical habitats is discussed below and in appendix D to this EIS. As required by Section 7 of the ESA, we are requesting that the FWS and NMFS consider appendix D, along with information in this EIS and survey reports prepared by Aguirre LLC (submitted separately) as our BA for the Project and are requesting formal consultation. To ensure that impacts on ESA-listed species are addressed, **we recommend that:**

- **Aguirre LLC not begin construction of the Project until:**
    - **we receive comments from the FWS and NMFS regarding the proposed action;**
    - **we complete formal consultation with the FWS and NMFS, if required; and**
    - **Aguirre LLC has received written notification from the Director of OEP that construction or use of mitigation may begin.**

In addition to the ESA, the Commonwealth of Puerto Rico conserves species under the Regulation to Govern the Threatened and Endangered Species (Regulation No. 6766), and protects all corals under Law 147 of July 15, 1999. Most species that are listed by Puerto Rico as either threatened or endangered are also listed as federally threatened or endangered. For purposes of this discussion, special status species of plants and animals include species known to occur in the coastal habitats of Puerto Rico found in or near the Project area that are listed by the federal government or Puerto Rico as endangered, threatened, or are proposed/candidates for listing. Other special status species such as those protected by the MBTA and the MMPA are discussed in section 4.5.3.

Special status species potentially occurring in the Project area are summarized in table 4.6-1 and discussed in section 4.6.1. Potential impacts on special status species and their designated critical habitat are discussed in section 4.6.2.

Additional threatened and endangered species found in the region are listed in table 4.6-2. Due to the distance of their primary habitat from the Project area, the Project is expected to have *no effect* on these species. Thus, they are not discussed further in this section. Our determination of effects for the remaining species is summarized in section 4.6.3.

TABLE 4.6-1

Threatened and Endangered Species Potentially Occurring in the Aguirre Offshore GasPort Project Area

Common Name	Scientific Name	Federal Status	Puerto Rico Status	Areas Crossed by the Project Where Species May Occur [a]
Marine Mammals				
Antillean Manatee	*Trichechus manatus manatus*	E	E	Jobos Bay, Offshore
Blue whale	*Balaenoptera musculus*	E	NL	Offshore
Fin whale	*Balaenoptera physalus*	E	E	Offshore
Humpback whale	*Megaptera novaenglia*	E	V	Offshore
Sei whale	*Balaenoptera borealis*	E	E	Offshore
Sperm whale	*Physeter macrocephalus*	E	E	Offshore
Reptiles				
Green sea turtle	*Chelonia mydas*	T, CH	E	Jobos Bay and Offshore
Hawksbill sea turtle	*Eretmochelys imbricate*	E, CH	E	Jobos Bay and Offshore
Leatherback sea turtle	*Dermochelys coriacea*	E, CH	E	Jobos Bay and Offshore
Loggerhead sea turtle	*Caretta caretta*	T	NL	Jobos Bay and Offshore
Puerto Rican Boa	*Epicrates inornatus*	E	V	Uplands
Birds				
Brown Pelican	*Pelecanus occidentalis*	DL	E	Jobos Bay and Offshore
Piping plover	*Charadrius melodus*	T	CE	Jobos Bay
Puerto Rican broad-winged hawk	*Buteo platypterus brunnescens*	E	CE	Uplands
Puerto Rican nightjar	*Caprimulgus noctitherus*	E	E	Uplands
Puerto Rican plain pigeon	*Columba inornata wetmorei*	E	E	Uplands
Puerto Rican sharp-shinned hawk	*Accipiter striatus venator*	E	CE	Uplands
Snowy plover	*Charadrius alexandrinus*	NL [b]	CE	Jobos Bay
Yellow-shouldered blackbird	*Agelaius xanthomus*	E	E	Uplands
Rufa Red Knot	*Calidris canutus rufa*	PE	NL	Jobos Bay and Offshore
Amphibians				
Golden Coqui	*Eleutherodactylus jasper*	T, CH	CE	Uplands
Fishes				
Dwarf seahorse	*Hippocampus zosterae*	PE	V [c]	Jobos Bay
Goliath grouper	*Epinephelus itajara*	NL	CE	Jobos Bay and Offshore
Great hammerhead shark	*Sphyrna mokarran*	C	NL	Jobos Bay and Offshore
Nassau grouper	*Epinephelus striatus*	C	E	Jobos Bay and Offshore
Scalloped hammerhead shark	*Sphyrna lewini*	PT	NL	Jobos Bay and Offshore
Invertebrates				
Boulder star coral	*Montastraea annularis*	PE	NL	Jobos Bay and Offshore
Elkhorn coral	*Acropora palmata*	T/PE, CH	NL	Jobos Bay and Offshore
Elliptical star coral	*Dichocoenia stokesii*	PT	NL	Jobos Bay and Offshore
Lamarck's sheet coral	*Agaricia lamarcki*	PT	NL	Jobos Bay and Offshore
Mountainous star coral	*Montastraea faveolata*	PE	NL	Jobos Bay and Offshore
Pillar coral	*Dendrogyra cylindrus*	PE	NL	Jobos Bay and Offshore
Queen conch	*Strombus gigas*	C	NL	Jobos Bay and Offshore

TABLE 4.6-1(cont'd)

Threatened and Endangered Species Potentially Occurring in the Project Area for the Aguirre Offshore GasPort Project Area

Common Name	Scientific Name	Federal Status	Puerto Rico Status	Areas Crossed by the Project Where Species May Occur [a]
Rough cactus coral	*Mycetophyllia ferox*	PE	NL	Jobos Bay and Offshore
Staghorn coral	*Acropora cervicornis*	T/PE, CH	NL	Jobos Bay and Offshore
Star coral	*Montastraea franksi*	PE	NL	Jobos Bay and Offshore
Plants				
Erubia	*Solanum drymophilum*	E	E	Uplands
Cobana Negra	*Stahlia monosperma*	T	V	Uplands
Palo de ramon	*Banara vanderbiltii*	E	CE	Uplands

Sources: NMFS, FWS, Puerto Rico Department of Natural and Environmental Resources.

[a] Offshore refers to the area south of Jobos Bay (beyond the barrier islands).

[b] Only western U.S. population listed as threatened.

[c] Puerto Rico lists all seahorses as vulnerable.

Note: E = Endangered, T = Threatened, PE= Proposed for Endangered Status, PT = Proposed for Threatened Status, CH = Critical Habitat, C = Candidate, DL = Delisted, CE = Critically Endangered, V = Vulnerable, NL = Not Listed

TABLE 4.6-2

Justification for Determinations of No Effect on Federally Listed Species for the Aguirre Offshore GasPort Project Area

Species Name	Habitat Description and Project Assessment
Reptiles	
Puerto Rican boa	Species occurs in moist and wet forest, woodland and shrub land mangrove, mature dry forest, and dry forest near waterbodies. No potential habitat is present in the Project Area.
Birds	
Puerto Rican broad-winged hawk	Species occurs in subtropical wet forests and subtropical rain forests habitat types. May occur as a transient in the vicinity of the Project, but is not expected to utilize the Project area for foraging, nesting, or breeding.
Puerto Rican nightjar	Species occurs in forested areas in southern Puerto Rico. The Puerto Rican nightjar was documented approximately 3 miles northeast of the Project area, where the closest suitable habitat is located. However, there is no suitable habitat in the Project area.
Puerto Rican plain pigeon	Habitat generalist; nest, forage, and roost in trees near roads, breed in mature forests near water bodies. No potential habitat is present in the Project Area.
Puerto Rican sharp-shinned hawk	Species occurs in subtropical wet forests habitat types. May occur as a transient in the vicinity of the Project, but is not expected to utilize the Project area for foraging, nesting, or breeding.
Amphibians	
Golden Coqui	Species occurs in forested mountains over 2,300 feet in elevation. No potential habitat is present in the Project Area.
Plants	
Erubia	Habitat includes evergreen forests on volcanic soils at elevations above 1,000 feet. Population limited to Tetas de Cayey in the Sierra de Cayey in Central Puerto Rico. No potential habitat is present in the Project Area.
Cobana Negra	Species habitat includes uplands near brackish and seasonally flooded mangrove wetlands, mainly in northeast and southwest Puerto Rico. No potential habitat is present in the Project Area.
Palo de ramon	Species habitat includes northwest limestone hills and central mountains of Puerto Rico in elevations above 300 feet. No potential habitat is present in the Project Area.

Sources: FWS, 2010 and 2011a

4.6.1 Description of Potentially Affected Species

4.6.1.1 Marine Mammals

Antillean Manatee

The manatee is an herbivorous marine mammal most commonly found in coastal estuaries and rivers. There are three species worldwide, but only the West Indian manatee (*Trichechus manatus*) can be found in U.S. waters. The West Indian manatee is divided into two subspecies: the Antillean manatee (*Trichechus manatus manatus*) and the Florida manatee (*Trichechus manatus latirostris*). The West Indian manatee and its subspecies are listed as endangered under the ESA and depleted under the MMPA Act of 1972. Global protection of the Antillean manatee is provided by the International Union for Conservation of Nature, which lists it as endangered (Self-Sullivan and Mignucci-Giannoni, 2008).

The Florida manatee is restricted to the coast of Florida during the winter months then travels north along the Atlantic coast (highest abundance in Georgia; as far north as Rhode Island) and west along the Gulf coast states (to Texas) from March to November, (Deutsch et al., 2008). The Florida manatee is not expected to occur in the Project area.

Antillean manatees inhabit coastal areas of eastern Mexico and Central America, northern and eastern South America, and in the Greater Antilles (FWS, 2009c). The Antillean manatee population in Puerto Rico has been recorded in protected areas such as cays, bays, and shallow seagrass beds east of San Juan, and along the east, south, and southwest coasts where freshwater sources are available. However, Antillean manatees are most abundant and consistently found along the southern and eastern coasts, specifically in the Jobos Bay area and Roosevelt Roads Naval Station, Ceiba, which is approximately 45 miles (72 km) northeast of the Project area (FWS, 2009c; Field et al., 2003).

In 2008, the International Union for Conservation of Nature estimated the Antillean manatee subspecies population to be approximately 4,100 individuals. This population is projected to decline by 20 percent over the next 40 years (Deutsch et al., 2008). The decline is predicted to occur as a result of non-effective conservation actions from current and projected anthropogenic threats (Self-Sullivan and Mignucci-Giannoni, 2008). In 2009, the population in Puerto Rico was determined to be either stable or slightly increasing (FWS, 2009c). Jobos Bay has been documented as having the second largest Antillean manatee population in Puerto Rico (Field et al., 2003). The FWS estimates that the Antillean manatee population in Puerto Rico consists of 142 individuals (FWS, 2013a).

Manatee preferred habitat consists of protected shallow waters, some fresh water sources, and seagrass beds. They are known to congregate near warm water outflows associated with anthropogenic sources. Manatees feed on seagrasses and occasionally on other marine plants including green algae, mangroves, and water hyacinth (FWS, 2007b). Manatees tagged around Puerto Rico showed both resident and transient patterns; some individuals were documented to move very little within the estuary in which they were tagged, while others traveled among estuaries along the southern coast (FWS, 2007b). Breeding and calving occurs throughout the year and individuals live to 50 or 60 years of age (FWS, 1986).

Three Antillean manatees were observed over seagrass beds near Boca del Infierno pass during Aguirre LLC’s marine mammal surveys in April/May 2012 (Tetra Tech, 2013d). One Antillean manatee was observed offshore of Boca del Infierno pass during Aguirre LLC’s coral mapping in November 2013 (Tetra Tech, 2014d).

Whales

Whales are long-lived marine mammals that inhabit the world's oceans. Many species migrate extremely long distances to take advantage of seasonal food resources or calm wintering grounds for rearing young. They can be divided into two main groups: toothed whales and baleen whales. Feeding morphology and prey are the major differences between these groups. Commonly, whales are found to utilize warm tropical waters during winter months when the polar seas are cold, ice covered, and food-poor, though some species will stay in these regions year-round.

The sperm whale (*Physeter macrocephalus*) is a toothed whale that inhabits the deeper waters of the world's oceans throughout the year. They feed primarily on squid and other deep sea creatures. Migrations are not as distinct as other species and thought to primarily follow food resources (NMFS, 2010b). The Atlantic population is considered a separate stock from the Pacific and Indian Ocean stocks. Additionally, the Gulf of Mexico stock has been petitioned for separate listing as a Distinct Population Segment under the ESA due to isolation in the northern Gulf of Mexico and the unique threats in that area such as oil and gas development and habitat degradation (WildEarth Guardians, 2011). Due to the complex bathymetry around Puerto Rico and the Caribbean Sea, sperm whales could utilize the offshore Project area as feeding grounds.

The humpback whale (*Megaptera novaeangliae*) is a baleen whale that is distributed throughout the world's oceans. They generally spend winter months in lower temperate and tropical waters then migrate northward and southward in summer months to feed in areas of high productivity (i.e., high latitudes). Within the Caribbean and western Atlantic, humpbacks are commonly found south of the Bahamas and along the Dominican Republic, with some activity on the western side of Puerto Rico and down the Lesser Antilles (NMFS, 1991). Calving occurs primarily during the winter months, and the only breeding ground in U.S. waters is in Puerto Rico (NMFS, 1991).

Other baleen whales, including the fin whale (*Balaenoptera physalus*), sei whale (*Balaenoptera borealis*), and blue whale (*Balaenoptera musculus*), are listed by NMFS as occurring within the southeast region (generally, the Gulf of Mexico and U.S. territories in the Caribbean). These whales are not commonly found around Puerto Rico, but could utilize the area during migrations or other movements. Feeding is not expected in or around Puerto Rico as these species usually feed on zooplankton and small fish aggregations during summer months in the north Atlantic (NMFS, 1998, 2010a, 2011b). Calving and breeding grounds have not been identified for these species in Puerto Rico.

No whales were observed during the marine mammal surveys conducted by Aguirre LLC for the Project (Tetra Tech, 2013d). However, the surveys only occurred in late April through early May, which is a limited window for observing these wide-ranging and highly mobile animals.

4.6.1.2 Sea Turtles

Sea turtles are found throughout the tropical and subtropical seas of the world. All species are listed as threatened or endangered under the ESA. Trade of sea turtles is restricted by the Convention on International Trade in Endangered Species; however, not all countries have ceased to harvest these species. The major threats to sea turtle populations are overharvesting, fisheries by-catch, disease, pollution, and coastal development of nesting beaches. Four sea turtle species could occur in the water proximate to the Project area: the green (*Chelonia mydas*), the hawksbill (*Eretmochelys imbricate*), the leatherback (*Dermochelys coriacea*), and the loggerhead (*Caretta caretta*).

Sea turtles are highly migratory and will transit significant distances between foraging and nesting locations. Natal site fidelity is a major influence for all species, and breeding-associated migration occurs every 1 to 4 years depending on the species (Lutz et al., 2003). Many tagged individuals follow circumglobal routes between nesting and foraging locations, which can be hundreds to thousands of miles apart (Luschi et al., 2003).

Sea turtles utilize sandy beaches to lay their eggs. The age at which sea turtles reach sexual maturity varies considerably between and within species, ranging from as few as several years to as long as two decades (Milton and Shigenaka, 2003). They breed at sea, and the females return to their natal beaches to lay eggs in the sand. Females typically nest 1 to 10 times during the nesting season, again depending upon the species, with clutch sizes of 80 to 150 eggs. About 2 months after being laid, eggs hatch, and the hatchlings immediately enter the sea. Once at sea the males rarely, if ever, return to land.

Developmentally, the green, hawksbill, and loggerhead sea turtles follow a pattern of oceanic juvenile stages followed by utilization of the neritic zone (i.e., coastal waters overlying the continental shelf) in later development stages (Bolten, 2003). Conversely, the leatherback shows the strongest pattern of pelagic habitat usage throughout its life. This pattern affects where these turtles feed and what species they forage on (Bjorndal, 1997; Bolten, 2003).

Five green sea turtles were sighted in the Project area during the marine mammal and sea turtle survey completed by Aguirre LLC (Tetra Tech, 2013d). The remaining species were not observed; however, the surveys only occurred in late April through early May, which is a limited window for observing these wide-ranging and highly mobile animals. Two loggerhead sea turtle were observed offshore of Boca del Infierno pass during Aguirre LLC’s coral mapping in November 2013 (Tetra Tech, 2014d).

Hawksbill Sea Turtle

The hawksbill sea turtle is widely distributed throughout the tropical waters of the world’s oceans. They have been shown to migrate significant distances between foraging and nesting sites (Plotkin, 2003). Hawksbills are commonly found in the waters around Puerto Rico and associated islands and nest on a number of beaches (NMFS and FWS, 2007b) both in Puerto Rico and throughout the Caribbean with the most important nesting sites found on the Yucatan Peninsula (NMFS and FWS, 1993). In Puerto Rico, hawksbills are known to nest on the beaches of Humacao, Isla Culebra, Isla Caja de Muertos, and Islas Mona and Monita (NMFS and FWS, 2007b). The Isla Mona and Isla Monita habitats, which are located over 100 miles west of the Project area, have been designated as critical habitat for the hawksbill sea turtle since 1998 (63 Federal Register [FR] 46693). Isla Caja de Muertos is approximately 20 miles (32 km) west of the Project area, while Humacao is approximately 30 miles (48 km) east, suggesting turtles could utilize the Project area frequently. Young hawksbills are found foraging in association with *Sargassum* mats, and after leaving the pelagic stage they commonly forage over coral reefs and hard bottom substrate. They can also be found over seagrass and in bays fringed with mangroves (Bjorndal, 1997). In the Caribbean, sponges are the primary, and in many cases the exclusive, food source (Bjorndal, 1997).

Leatherback Sea Turtle

The leatherback sea turtle is the largest and most pelagic of the sea turtles. This species occurs globally, and ranges farther north and south than the other species, likely due to their ability to maintain warmer body temperatures (NMFS and FWS, 2007c). The largest breeding populations are found on the Pacific coast of Mexico. In the Caribbean, French Guiana supports the largest population followed by a number of other countries, while the U.S. Caribbean supports relatively few nesting colonies (NMFS and FWS, 1992). However, the number of leatherback nests has been increasing over the past 30 years, with at least 469 nests recorded each year from 2000 to 2005 in Puerto Rico. Important nesting areas in Puerto Rico are Fajardo and Isla Culebra, located approximately 40 to 60 miles (64 to 97 km) to the northeast of the Project, respectively. The nesting sites at Cuelbra have been in steady decline since 2004, with only five females nesting on the island in 2012. Evidence suggests that this is not representative of a loss of breeding population but rather a shift in nesting site preference, which is still being studied (NMFS and FWS, 2013). Although considered omnivorous (feeding on sea urchins, crustaceans, fish, and floating seaweed), leatherbacks feed principally on soft foods such as cnidarians (medusae, siphonophores) and tunicates (salps, pyrosomas) (Bjorndal, 1997; NMFS and FWS, 1992). Leatherbacks may also forage nocturnally at depth on siphonophores and salps in the deep scattering layer (NMFS and FWS, 1992).

Green Sea Turtle

The green sea turtle is found throughout the world's oceans where temperatures remain above 68 °F (20 °C). There are three breeding populations; the global population is considered threatened while the two other breeding populations (Florida and Pacific Mexico) are considered endangered (NMFS and FWS, 2007a). While there are no major green sea turtle nesting sites in Puerto Rico or the surrounding islands, the coastal waters are likely common foraging grounds for both the global and Florida-breeding populations (Lutz et al., 2003). Critical habitat for the green sea turtle is located on Culebra Island, Puerto Rico, which is over 60 miles (97 km) northeast of the Project area. Green sea turtles can exhibit high site fidelity with respect to both nesting and feeding, which can lead to common migratory routes (Luschi et al., 2003). However, some individuality and variation has been documented. As one of the more coastal species of sea turtle, green turtles forage primarily on benthic organisms. Food sources include seagrasses and algae as well as animal food items including mollusks, crustaceans, bryozoans, sponges, jellyfish, polychaetes, echinoderms, fish, and fish eggs (Bjorndal, 1997; NMFS and FWS, 1991). In the Caribbean, the primary seagrass food source is turtle grass (Bjorndal, 1997), which is one of the dominant seagrass species in Jobos Bay.

Loggerhead Sea Turtle

The loggerhead sea turtle is most commonly found over the continental shelves around the world and may be present in the Project area. Loggerheads can migrate significant distances between foraging areas, breeding areas, and nesting locations (Plotkin, 2003). Loggerheads nest around the Gulf of Mexico basin, including Cuba, and the southeastern coast of the mainland United States (NMFS and FWS, 2008). Nesting is no longer observed along the rest of the Greater Antilles, including Puerto Rico (NMFS and FWS, 2007d). Loggerhead sea turtles are omnivorous, feeding on a variety of benthic prey such as shellfish, crabs, barnacles, oysters, jellyfish, squid, and sea urchins; and occasionally on fish, algae, and seaweed (Lutz and Musick, 1997; NMFS and FWS, 2008). As with green sea turtles, loggerheads move from pelagic foraging preferences to more benthic-associated feeding at a certain age (Bjorndal, 1997). They are known to forage over hard and soft benthic substrate. During their pelagic stage, they are often found associated with macroalgae mats.

4.6.1.3 Birds

Piping Plover and Snowy Plover

Plovers are migratory shore birds, usually wintering in warmer climates and migrating north during the summer months to breed. During the winter these birds forage on coastal beaches, mudflats, and tidal flats for benthic epifaunal and infaunal prey. Puerto Rico lists both the piping plover (*Charadrius melodus*) and snowy plover (*Charadrius alexandrinus*) as critically endangered; however, neither of these birds is listed under the ESA for the subspecies that occur in Puerto Rico (76 FR 55638-55641), though they are protected under the MBTA. The FWS designates the coastal zones of Puerto Rico as habitat for the piping plovers, which could include use by the threatened subspecies. However, the majority of the population of this species primarily winters only as far south as Florida and other Gulf of Mexico states; their abundance in Puerto Rico and other surveyed Caribbean islands is low (FWS, 2009a). The southeastern subspecies of the snowy plover (*C. a. tenuirostris)* includes the Gulf of Mexico and Caribbean population and accounts for around 1,500 individuals, of which 27 pairs reside and breed in Puerto Rico (Morrison et al., 2006). In Puerto Rico, nesting begins in January on sandy beaches and the breeding season can last from March to mid-summer.

Brown Pelican

The brown pelican (*Pelecanus occidentalis*) was delisted from the ESA in 2009 (74 FR 59444-59472); however, Puerto Rico lists this bird as endangered. Brown pelicans reside in colonies year-round in Puerto Rico and nest irregularly from late fall through June, but some undertake migrations north to breed. They feed by diving into the water; their diet consists of primarily fish but occasionally other marine organisms. This species roosts after diving to dry plumage and to conserve energy (FWS, 2007a); manmade habitats such as piers, docks, and buoys are commonly utilized for this purpose. Pelicans nest in vegetated areas such as trees, shrubs, and mangroves. The breeding population in Puerto Rico has been estimated to be constant at 150 to 250 breeding pairs over a series of surveys (FWS, 2009b). Brown pelicans are commonly seen in the JBNERR, and likely reside and feed in the waters within the bay and the coastal ocean surrounding it.

Yellow-Shouldered Black Bird

The yellow-shouldered black bird (*Agelaius xanthomus*) is endemic to Puerto Rico and utilizes mudflats and saltflats, black mangrove forests, and offshore red mangrove cays for nesting habitat. Nests are usually built in clusters low in mangrove trees or in large deciduous trees near mangroves. Their breeding season is commonly April to August but varies to some degree as it coincides with the rainy season (FWS, 2011b); it can occur as early as February and as late as November. Although the yellow-shouldered black bird is non-migratory, portions of the population move inland from coastal areas during the non-breeding season to feed (FWS, 2011b). This species feeds predominantly on insects, seeds, and nectar, but has been documented consuming cattle ration, dog food, fruit, cooked rice, and granulated sugar within bird feeders and around domestic animals. Yellow-shouldered black birds have been observed within the JBNERR where mangrove forests and cays may provide adequate nesting habitat (Field et al., 2003). Critical habitat for this species is designated in Puerto Rico; however, the closest critical habitat is over 40 miles (64 km) west of the Project area (42 FR 47842). Although yellow-shouldered black birds prefer to nest in black mangrove forests, they have been documented utilizing urban areas for nesting. In 2000, several yellow-shouldered black bird nests were observed at the PREPA facilities in Aguirre and Guayama (FWS, 2011b). Therefore, it is possible that this species could be found within the onshore portion of the Project area.

Rufa Red Knot

The rufa red knot (*Calidris canutus rufa*) is a medium-sized shorebird, typically with a wingspan of 20 inches (51 cm) and a body length of 9 inches (23 cm) (FWS, 2013b). Each year, the rufa red knot migrates thousands of miles between its Canadian Arctic breeding grounds and wintering areas in South America (Harrington, 2001). Some individuals are known to migrate over 18,000 miles (29,000 km) each year (FWS, 2013b). Populations generally fly in large flocks northward through the contiguous United States from March to early June, and return southward July through August. These migrating knots can complete nonstop flights of 1,500 miles (2,400 km) and more, converging together on important stopover sites such as the Delaware Bay (FWS, 2013b). Relatively few birds are known to utilize Puerto Rico as wintering grounds, as a majority of the population spends the boreal winter about 5,000 miles (8,000 km) south in a small area of Tierra del Fuego, Argentina (Niles et al., 2008). Increased commercial harvest of horseshoe crabs, the reduction in horseshoe crab populations, and the consequent reduction in red knot food resources (horseshoe crab eggs) during stopovers have led to a worsening body condition during spring migration and is a major threat to the health of the species (Harrington, 2001). Horseshoe crab populations have stabilized over recent years, but the red knot is still under threat from a loss of quality wintering habitats due to human encroachment and the threat of climate change on its breeding grounds in the Arctic (Niles et al., 2008).

4.6.1.4 Fishes

Goliath Grouper

The goliath grouper (*Epinephelus itajara*) is the largest of the Atlantic groupers, growing up to about 8 feet (2.4 m) in length and weighing up to about 700 lbs (317 kilograms [kg]). Harvesting this species is prohibited in Puerto Rico territorial waters and the EEZ. Their larvae are pelagic, and juveniles are commonly found in mangroves and seagrass beds. Adults tend to prefer areas of high relief, presumably for shelter and protection, and they can be found on manmade structures in addition to rock crevices and overhangs (NMFS, 2006). Adults are sedentary and prefer shallower habitats up to about 164 feet (50 m) deep. They feed on a variety of prey items, including crustaceans such as spiny lobster, and opportunistically on other passing prey. Goliath groupers are dispersal spawners; the timing of spawning is regional and thought to peak in July and August in the Caribbean (NMFS, 2006). They may form spawning aggregations, but this is not well documented. Mangroves make up some of the barrier islands that form Jobos Bay in addition to extensive mangrove forest of the JBNERR. As a result, it is likely that this species could be found within the Project area.

Nassau Grouper

The Nassau grouper (*Epinephelus striatus*) is a reef fish that is a candidate species for listing under the ESA. Nassau groupers are found throughout the West Indies, Bahamas, and southern Gulf of Mexico. They grow to about 4 feet (1.2 m) in length and can weigh up to 44 lbs (20 kg) (Jory and Iversen, 1989). They prefer habitat that is high in relief, such as coral reefs and rocky bottoms. Nassau groupers can be found from shallow waters to waters more than 295 feet (90 m) in depth. Depth preferences appear to be associated with size, with larger animals tending to occupy deeper habitats (Jory and Iversen, 1989). Nassau groupers are protogynous hermaphrodites and can change from females to males when they reach a size between about 1 to 2.6 feet (0.3 to 0.8 m) in length (Jory and Iversen, 1989). They spawn in the winter, and form large spawning aggregations during full moons. Eggs and larvae are planktonic and can be dispersed on coastal currents. The juveniles utilize seagrass beds during development prior to maturity.

In Puerto Rico, the species is protected and harvest is prohibited. There are few reports of spawning aggregations around the island (Aguilar-Perera et al., 2006). Groupers are carnivorous, feeding on crustaceans and other small fish. Their diet may be ontogenetic, consisting of primarily crustaceans when they are smaller and found in seagrass beds, but switching to primarily fish prey as they mature and move to coral reef habitats (Eggleston et al., 1998). This species was not observed during the benthic habitat survey conducted by Aguirre LLC but has the potential to occur in the Project area.

Sharks

The scalloped hammerhead shark is proposed for threatened status under the ESA. The great hammerhead shark is currently a candidate for listing. Both species have the potential to occur in the Project area. An additional shark species found in the region, the dusky shark, is listed as a Species of Concern by NMFS. This species is discussed in section 4.5.5.1.

The major threat to great hammerhead and scalloped hammerhead sharks is overfishing, mainly in the shark fin trade but also as a result of by-catch in other fisheries. Both species can be found throughout the tropical and warmer temperate oceans of the world. In tagging studies, scalloped hammerhead sharks have been shown to congregate in core areas and have site fidelity, but time spent away from original tagging locations varies widely (Miller et al., 2013). The great hammerhead sharks are more solitary and are generally found over continental shelves, island terraces, and in passes and lagoons of coral atolls in water depths ranging from 3 to over 262 feet (1 to over 80 m) (Shark Research Institute, 2005). The diet of both species consists of a variety of prey species, ranging from fish and crustaceans to gelatinous organisms. The western Atlantic population of the scalloped hammerhead shark has been shown to grow more slowly than other population segments (Miller et al., 2013). After hammerhead individuals mature to a certain size, they are capable of reproduction and give birth to live pups approximately once every 2 years. Great hammerheads, unlike most other shark species, have been observed to mate in waters near the surface (Shark Research Institute, 2005; Florida Museum of Natural History, Undated). Great hammerheads were witnessed in the Bahamas to have risen from a depth of 70 feet (21 m), spiraling slowly around each other and copulating at the surface (Shark Research Institute, 2005).

Seahorses

The dwarf seahorse (*Hippocampus zosterae*) is a reef fish that is proposed for endangered status under the ESA. This species was petitioned for listing recently due to loss of habitat, commercial collection, and endangerment due to the 2010 BP Deepwater Horizon oil spill in the Gulf of Mexico (Center for Biological Diversity, 2011). This species occurs along the Atlantic coast of Florida and throughout the Gulf of Mexico and the Caribbean, inhabiting shallow seagrass beds in these warm water areas. They feed on crustacean prey both pelagic and benthic. This small species, the smallest seahorse in U.S. waters, lives about 1 year and reaches sexual maturity at about 3 months of age (Foster and Vincent, 2004). They form monogamous pairs and breed throughout the majority of the year, from February through November, as frequently as twice per month (Foster and Vincent, 2004). As with all seahorses, young are born alive after incubating in the male's pouch. Dwarf seahorses were not observed during the benthic habitat survey conducted by Aguirre LLC but have the potential to occur in the Project area. Other species of seahorses that may be present in the Project area include *H. erectus* and *H. reidi* (Foster and Vincent, 2004), which are both listed as vulnerable in Puerto Rico.

4.6.1.5 Invertebrates

Corals

Coral reefs are structurally and biologically complex ecosystems. The physical structure of reefs is provided primarily by scleractinian (stony) corals. These species grow in clear coastal waters and provide many services to the other species residing among them. In addition to providing structural habitat, they also produce energy via photosynthesis, recycle nutrients, deposit calcium carbonate, and produce sand (Brainard et al., 2011).

Most corals are clonal species, which means they can grow by adding additional polyps. Other than growth, a colony can expand through fragmentation where detached pieces can reattach to nearby substrate and continue growing (Acropora Biological Review Team [Acropora BRT], 2005). Additionally, corals can also reproduce sexually, most commonly by broadcast spawning or brooding. Both growth mechanisms are important to survival as asexual reproduction allows for quick growth but may leave the colony susceptible to disease and other impacts due to the lack of genetic diversity. Additional discussion of coral sexual reproduction and coral larvae in the Project area can be found in section 4.5.4.2.

Corals can feed both autotrophically (i.e., by synthesizing their own food) and heterotrophically (i.e., by feeding on other organisms). During daylight hours, coral colonies are provided with carbon through the photosynthetic process employed by symbiotic algae that live within the corals. Additionally, corals feed directly on zooplankton filtered from the water column, which provide additional nutrients not acquired through photosynthesis (Brainard et al., 2011).

Coral reefs are sensitive to environmental changes. While able to withstand some fluctuation, the survival of individual species and the reef ecosystem on the whole is affected by a number of variables. Temperature is an important variable to the survival of coral. Increases in temperature can lead to bleaching events. An increase in temperature as little as 2 to 4 °F (1.1 to 2.2 °C) can put a population at risk (Acropora BRT 2005), and an increase in 5 to 7 °F (2.8 to 3.9 °C) can cause thermal stress leading to death (Brainard et al., 2011). This is most important during warmer summer months and during El Nino-Southern Oscillation periods when temperatures are already elevated. However, human use can also raise water temperature in localized patches. Other effects of direct human use, such as anchoring, can cause major destruction (García-Sais et al., 2008).

Physical effects to coral are well documented in the general Project region. Hurricanes can cause high-energy seas that affect the shallowest reefs and can also penetrate to deeper reefs (García-Sais et al., 2008). Other effects from storms, such as increased stormwater runoff from land can have additional implications. Stormwater runoff can increase the sediment load in the waters over the reefs, reducing light availability (García-Sais et al., 2008). *Acropora* species are particularly susceptible to loss of light and have been shown to be one of the most sensitive reef species (Acropora BRT, 2005).

Historically, elkhorn (*Acropora palmata*) and staghorn (*A. cervicornis*) corals were found throughout the shallow waters of the Caribbean sea, the southern Gulf of Mexico, and the central western Atlantic (Acropora BRT, 2005). However, in the early 1980s a major decline occurred, reducing populations to less than 97 percent of historic population levels. Since this decline, there has been little appreciable recovery, and additional loss of established colonies was recorded throughout the late 1990s. Acropora BRT (2005) assessed the status of these species and concluded there was no immediate threat of extinction but that there could be in the coming future; thus, these species were proposed for threatened status under the ESA in May 2005 (70 FR 24359). Approved a year later (71 FR 26852), they remained at the threatened level until they were proposed for the elevated listing of endangered in December 2012 (77 FR 73219). At that time critical habitat was designated (73 FR 72210), which includes all waters less than 98 feet (30 m) deep around Puerto Rico and associated islands. This critical habitat extends from the coast approximately 2.8 miles (4.8 km) offshore of Barca Cay, which is approximately 2.2 miles (3.5 km) south of the Project area. Elkhorn and staghorn coral critical habitat can be seen in figure 4.6.1-1 as the pink shaded areas surrounding Puerto Rico and the U.S. Virgin Islands.

Additional stony coral species proposed for endangered status in December 2012 are boulder star coral (*Montastraea annularis*), mountainous star coral (*M. faveolata*), star coral (*M. franksi*), pillar coral (*Dendrogyra cylindrus*), and rough cactus coral (*Mycetophyllia ferox*). Additional coral species proposed for threatened status are Lamarck's sheet coral (*Agaricia lamarcki*) and elliptical star coral (*Dichocoenia stokesii*). All of these threatened and proposed species were found within the proposed Project area during the benthic surveys conducted by Aguirre LLC.

Staghorn coral is common in waters up to 66 feet (20 m) deep with colonies forming less dense structures in deeper habitat (Acropora BRT 2005). Elkhorn coral is common in waters up to 50 feet (15 m) deep, but is most frequently found in waters less than 16 feet (5 m) deep. At these depths, colonies can be exposed at low tides and are particularly susceptible to increased energy during storm events (Acropora BRT, 2005). *Acropora* spp. are at risk for extinction due to susceptibility to shading and lowered water quality conditions, in addition to disease and the major population declines already suffered. A study done by Rogers (1983) showed that single applications of 0.1 ounces per cubic inch (200 milligrams per cubic centimeter) of sediment to colonies caused coral tissue death as the sediments accumulated on the branches of the species. This study suggests that shading from the moored FSRU and offshore terminal may adversely affect any *Acropora* spp. in the shaded area, resulting in reduced colony viability, or mortality. LNG carriers are expected to be moored at the terminal for approximately 183 days each year (50 deliveries per year at 88 hours each). Therefore shading from the LNG carries could also adversely affect *Acropora* spp.

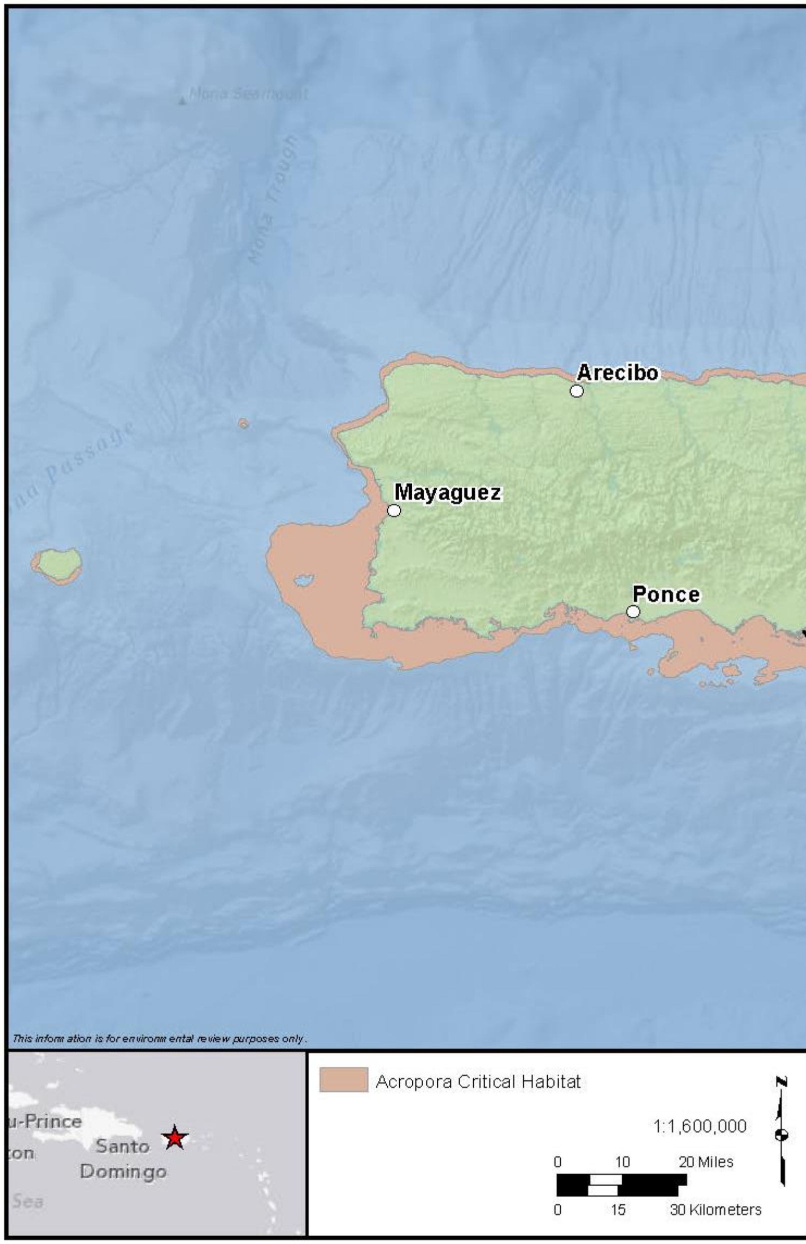


Figure 4.6.1-1
Elkhorn and Staghorn Coral Critical Habitat
Aguirre Offshore GasPort Project

Montastraea annularis (boulder star coral) is divided into three sibling species (i.e., boulder star coral, *M. faveolata* (mountainous star coral), and *M. franksi* (star coral) in the western Atlantic and Caribbean due to differences in morphology, depth range, ecology, and behavior; however, this is a recent species division with some caveats (Brainard et al., 2011). Mountainous star coral is the most genetically distinct out of the three species. It grows in heads or sheets that may be smooth or have keels or bumps. Boulder star coral grows in columns that exhibit rapid and regular upward growth; the live colonies usually lack ridges or bumps. Star coral is distinguished by large, unevenly arrayed polyps that give the colony its characteristic irregular surface (Brainard et al., 2011). Historically, these coral species were abundant in many reefs; however, the population dropped significantly in the 1990s and 2000s. The potential for recovery is low due to slow growth and low recruitment. These species are hermaphroditic broadcast spawners, and post-settlement growth rates are slow.

Dendrogyra cylindrus (pillar coral) is a columnar coral that is rare but easily identified during surveys (Brainard et al., 2011). Juveniles are infrequently identified during surveys, and asexual reproduction is thought to be the major mode of population growth. Pillar coral is at risk due to low population density (which may be part of the reason sexual reproduction is rare), low population size, and disease (Brainard et al., 2011).

Mycetophyllia ferox (rough cactus coral) is an encrusting coral and is rare in Puerto Rico. It is hermaphroditic and reproduces by brooding (Brainard et al., 2011). Rough cactus coral is at risk due to rarity and disease.

Agaricia lamarcki (Lamarck's sheet coral) is an encrusting coral common at greater depths and can also occasionally be found in areas with less light than other corals (Brainard et al., 2011). The species has a thick skeleton and can be susceptible to breakage. Little is known about the reproduction of this species, but recruitment has been found to be very low (Brainard et al., 2011). Lamarck's sheet coral is at risk for extinction due to general degradation of conditions in the Caribbean and the susceptibility of this species to disease. However, it is found at greater depths than other species, where disturbances are less frequent (Brainard et al., 2011).

Dichocoenia stokesii (elliptical star coral) is spherical in structure and more common in shallower reefs. Colonies are gonochoric (i.e., male or female, rather than hermaphroditic) and spawning occurs twice per year. Juveniles are commonly found in nutrient poor waters, and the species has been shown to do well in these conditions (Brainard et al., 2011). Elliptical star coral is at risk due to population-level impacts from disease. However, some tolerance may occur due to the variety of habitats this species can inhabit (Brainard et al., 2011).

Queen Conch

The queen conch (*Strombus gigas*) is a candidate species for listing under the ESA. This herbivorous benthic marine invertebrate is found throughout the Caribbean, Gulf of Mexico, and the southeastern coast of the U.S. mainland. Queen conch are long-lived individuals, estimated to reach up to 30 years of age. They lay benthic eggs that hatch into larvae that are planktonic for 2 to 5 weeks before settling to shallow waters where they remain for up to 4 years (Stoner, 2003).

Queen conch have been shown to have several movement patterns. The first is a shift to deeper water as individuals' age. The second is a seasonal migration between foraging grounds on hard substrate and seagrass or algae beds and reproductive sites that are usually on sandy substrate (Glazer and Kidney, 2004). In the Caribbean, where reproduction primarily occurs in the summer, conch are found on sandy substrates either dormant or in a reproductive state (Stoner and Sandt, 1992). The remainder of the year they are found foraging on algae and other plant matter.

The queen conch fishery is important in the Caribbean and fishing is allowed within Puerto Rican waters. Queen conch were observed in the seagrass habitats along the pipeline route and at the offshore terminal location during the benthic habitat surveys conducted by Aguirre LLC.

4.6.2 General Impact and Mitigation

Construction of the Aguirre Offshore GasPort Project would result in short-term, minor to moderate adverse impacts on threatened and endangered species. Aside from general avoidance or isolation from preferred habitat due to construction activities, the most notable effects would likely be to protected coral species as a result of direct impact of pipe lay and associated habitat alteration. Noise impacts on manatees, sea turtles, birds, seahorses, and sharks as a result of construction may also cause moderate adverse impacts. Construction and operation of the Project would result in permanent, minor adverse impacts on protected species from increased vessel traffic, shading, anti-fouling agents, thermal plume discharge, noise, and lighting; permanent, moderate adverse impacts from habitat alteration/loss associated with the pipeline; and short-term, moderate to minor adverse impacts from sedimentation and potential inadvertent spills of hydrocarbon materials.

Increased Vessel Traffic and Vessel Strikes

General impacts and mitigation measures regarding increased vessel traffic and vessel strikes are discussed in section 4.5.3.3. Manatees within Jobos Bay have the highest potential for impact as they are known to forage within the Project area, and vessel strikes in shallow water are a major source of mortality. Foraging may be disrupted by the physical presence of vessels and equipment. Operation of the Project would result in a 90 percent decrease in barge traffic within Jobos Bay, decreasing the current risk of vessel strikes on protected species within the bay.

Based on the mitigation measures proposed by Aguirre LLC (e.g., certified marine mammal observers and reduced vessel speeds), the impact of vessel traffic and vessel strikes during construction is anticipated to be short-term and negligible for whales and sea turtles, and short-term and minor for manatees. The impact of vessel traffic and vessel strikes during operation is anticipated to be permanent but minor for whales, manatees, and sea turtles.

Hydrostatic Testing

Hydrostatic testing procedures, general impacts, and mitigation measures are described in section 4.5.2.4. The intake of water is anticipated to have negligible impact on juvenile and adult protected species in the Project area, as they are all large enough to avoid entrainment and mobile enough to avoid the intake area. The impact of entrainment and impingement of larvae is addressed in section 4.5.4.3. The discharge would be directed through a pipe secured about 6 feet (2 m) below the bay’s water surface to minimize surface disturbance. To reduce discharge velocity and minimize sediment resuspension at the point of discharge, a diffuser head would be attached to the discharge pipe during dewatering operations. Disturbance of the benthic cover and sediment resuspension proximate to the discharge location are expected to have short-term and minor impacts on protected species.

Sediment Resuspension

General impact and mitigation information regarding sediment resuspension is discussed in section 4.5.2.4. An increase in turbidity due to sediment resuspension from installation of the proposed moorings and pipeline has the potential to adversely affect protected species. In particular, coral species could be smothered as resuspended sediments settle back to the bottom. Additionally, increased sedimentation could impact seagrasses which serve as foraging habitat for protected sea turtles, mammals, fish, and invertebrate species. Turbidity-related impacts can include reduced light availability, reductions in growth and feeding rates, the clogging of respiratory structures, and/or death. While all species of coral may be impacted from sedimentation, the two ESA-listed coral species, elkhorn and staghorn coral, are particularly susceptible to smothering which could result in localized impacts at moderate levels. Other species, including reef fish, are mobile and therefore able to avoid areas of temporarily high-suspended sediments. Overall, turbidity increases would be temporary in duration and localized in scope, so the impact on protected species is expected to be short-term and minor, except for coral species where the impact could be moderate. However, the pipeline could also result in persistent siltation and turbidity from scour and sediment deposition around the pipeline, reducing light penetration and lowering photosynthesis rates and primary productivity in the area. Water discharges from the LNG carriers could also cause sediment resuspension at the offshore berthing platform during operation. Turbidity increases associated with scour around the pipeline and the LNG carrier discharges would be localized in scope, so the impact on protected species is expected to be permanent but minor.

Noise

General impacts and mitigation information, as well as current noise levels and modeling results in the Project area are discussed in section 4.5.3.3. With the proposed and our recommended mitigation measures in place, impacts on whales and sea turtles in the offshore environment are expected to be minor. These animals are highly mobile and would be able to avoid areas of noise that would cause them discomfort or harm. Sea turtles may be deterred from entering Jobos Bay due to construction activities; however, this is expected to be a short-term minor impact. Manatees within Jobos Bay may experience short-term moderate impacts because they may not be able to escape the elevated noise levels within the bay. Protected bird species in or adjacent to the Project area may experience short-term moderate impacts as they may be temporarily displaced from areas with elevated noise levels. Snowy plover, yellow-shouldered blackbird, and/or rufa red knot nesting seasons may be impacted during the months of March to August if construction activities take place then. Brown pelicans nest irregularly in the area, usually beginning in late fall and extending through June during which noise may cause them to abandon their nests. We are recommending in section 4.5.3.3 that Aguirre LLC provide additional information related to noise impacts on birds and associated mitigation measures that it would implement.

Impacts on protected marine mammals, sea turtles, and fish in the offshore environment resulting from operation of the Project are expected to be permanent but minor. These animals are highly mobile and would be able to avoid areas of noise that would cause them discomfort or harm.

Inadvertent Hydrocarbon Spills

General impact and mitigation information regarding inadvertent hydrocarbon spills are described in section 4.5.2.4. Minor releases of hydrocarbons during construction could result in short-term, minor to moderate adverse impacts on protected species. Accidental releases of hydrocarbons resulting from operation of the Project area expected to have short-term and minor to moderate impacts on protected species. As described in section 4.3.3.3, construction contractors and port operations personnel would be required to comply with all laws and regulations related to handling of fuels and lubricants, and Aguirre LLC would prepare a site-specific spill prevention and control plan for construction and operation to minimize the potential for inadvertent release. We are recommending in section 4.3.3.3 that Aguirre LLC provide this plan for review and approval prior to construction. With these measures, we conclude that impacts on ESA proposed and listed species would be minimized to the extent practicable.

Habitat Alteration/Loss

Overall habitat modification impact information and acreages for benthic resources used by protected species (seagrasses, corals, and macroalgae) are discussed in section 4.5.2.4. The impact of temporary habitat modification/loss on protected species varies. Birds in the onshore portion of the Project area as well as marine mammals, sea turtles, birds, and fish in the offshore portion of the Project area would likely move away from areas of disturbance to other similar, adjacent habitats. Within Jobos

Bay, destruction of approximately 7.7 acres (7.9 cuerdas) of seagrasses and 3.7 acres (3.8 cuerdas) of macroalgae would be a loss of foraging habitat for manatees, sea turtles, seahorses, queen conch, and fish. Aguirre LLC has agreed to develop coral reef and seagrass mitigation plans to compensate for impacts on these habitat types. In sections 4.4.3 and 4.5.2.4 above, we are recommending that Aguirre LLC submit drafts of these plans within 30 days of the draft EIS publication date. Given the limited scope of the Project area and Aguirre LLC's mitigation measures, we conclude habitat impacts during construction would be short-term and minor for most protected fish, bird, marine mammal, and sea turtle species.

Construction could result in short-term moderate impacts for the dwarf seahorse and other seahorse species, and permanent, moderate impacts for protected corals. Seahorses have the potential to occur in seagrass habitats in Jobos Bay; destruction of seagrass could result in direct mortality to seahorses, as it is unlikely that they would be able to escape. Impacts on protected coral species could occur from disturbance to the water column and seafloor resulting in increased sedimentation that could impact colonies near construction activities. Additionally, coral species within the pipeline alignment could be impacted during pipeline placement which would result in physical damage to or destruction of the colony. Coral growth rates have been observed to range from 2 to 5 percent per year (Osborne et al., 2011), thus, recovery may be on the order of years to decades. Seagrass and coral reef mitigation is discussed in sections 4.4.3 and 4.5.2.4, respectively.

The loss of seagrass and coral reef habitat could result in a permanent impact on protected manatees, sea turtles, seahorses, queen conch, and fish. NMFS has expressed its grave concern regarding the pipeline's potential impacts on coral reef habitat. The direct lay of the pipeline segment within Boca del Infierno pass, as proposed, could lead to a lengthy and complex consultation process. We are recommending in section 4.5.2.4 that Aguirre LLC conduct a feasibility analysis of constructing using the HDD construction method under Boca del Infierno pass with the intent to alleviate NMFS' concerns and substantially reduce impacts on coral reef habitat. If Aguirre LLC finds that the HDD construction method is feasible, implementation of this construction technique as a method of avoidance or minimization of impacts would likely expedite formal consultation with NMFS.

We are also recommended in section 4.5.2.4 that Aguirre LLC submit draft coral reef and seagrass mitigation plans. With these mitigation measures in place, we conclude the loss of coral and seagrass habitat as a result of the offshore berthing platform and pipeline operation would be minimized to the extent practicable. The presence of the permanent structure in the offshore could be a beneficial effect for brown pelicans, as it may provide roosting habitat as they travel and feed over the coastal waters.

The inshore habitat of Jobos Bay would be altered by the presence of the pipeline which could act as a physical deterrent that bisects the bay. Laboratory experiments indicate that queen conch are capable of gliding vertically and therefore may be able to climb over a structure like the pipeline (Hesse, 1980). However, DNER staff noted that an existing water pipeline between Isla Culebra and Isla Vieques has proven to be a serious barrier to queen conch movements (Lilyestrom, 2014). Therefore, the pipeline would likely present a barrier to migration for queen conch, representing a permanent, moderate impact for the species. We are recommending in section 4.5.2.4 that Aguirre LLC assess the potential for the use of a HDD to avoid impacts on coral reef habitat; if such an HDD is feasible, this would also reduce the length of exposed pipe and potential impacts on queen conch.

Shading

General impacts from shading on benthic resources (e.g., corals and SAV) utilized by protected species are discussed in section 4.5.2.4. Two federally protected coral species (elliptical star coral and pillar coral) were identified in the offshore berthing area during the benthic survey. Impacts on these species and other coral species in the patch reef, all of which are protected under Puerto Rico law, are expected. In addition, a temporary reduction in seagrass productivity due to shading could result in loss of habitat for manatees, sea turtles, dwarf seahorse, fish, and queen conch. We are recommending in sections 4.4.3 and 4.5.2.4 that Aguirre LLC submit draft seagrass and coral reef mitigation plans within 30 days of the draft EIS publication date to reduce impacts related to the construction and operation of the Project.

Thermal Plume Discharge – Offshore Berthing Platform

General impacts and mitigation information regarding thermal plume discharge from the offshore berthing platform are discussed in section 4.5.2.4. The thermal plumes from operation discharges may have a minor impact on protected coral species within the offshore berthing area. Impacts on other protected species are expected to be minor, as mobile organisms would be able to move out of the zone of heated water.

Seawater Intake

Operational uses of seawater have the potential to adversely affect populations of queen conch, Nassau grouper, goliath grouper, and protected corals via entrainment of larval stages. Entrainment impacts are discussed in section 4.5.4.3.

Anti-fouling Agents

Protected species in the immediate vicinity of the outfall may potentially be exposed to harmful concentrations of sodium hypochlorite. General impact and mitigation information regarding anti-fouling agents are described in section 4.5.2.4.

Scour

General impacts and mitigation regarding scour are discussed in section 4.5.2.4. Scouring along the pipeline could contribute to a loss of habitat for protected corals, fish, queen conch, seahorses, sea turtles, and manatee utilizing Jobos Bay. Overall, the impact of scour on the protected species is anticipated to be permanent but minor.

Lighting

Lighting procedures, general impacts, and mitigation information are described in section 4.5.3.3. Generally, impacts on protected species would be minor as these species may change their feeding habits based on artificially induced biological aggregations. However, for species that use moonlight to time spawning events the impact could be more noticeable. There is evidence of queen conch, Nassau grouper, and many coral species using the full moon to time spawning events. If species are not successful in synchronizing spawning events, there is the possibility for reduced fecundity and genetic recombination, and the ultimate degradation of genetic diversity.

The additional artificial light could also cause disorientation for sea turtles in the area which use cues from the moon to direct movements. However, sea turtles are the most vulnerable to the effect as hatchlings. Because there are no known nesting beaches in the vicinity of the Project area, this effect is unlikely to cause appreciable impact.

Overall, with mitigation measures in place, the effect of operational lighting on protected species is expected to be permanent but minor due to the highly localized nature of the impact. We are recommending in section 4.5.3.3 that Aguirre LLC develop a lighting plan that identifies specific measures that it would implement to minimize impacts associated with nighttime lighting.

4.6.3 Determination of Effects under the Endangered Species Act

Table 4.6.3-1 summarizes our effects determinations for the Project under Section 7 of the ESA. These determinations were based on the species' characteristics, habitat requirements, proposed construction and operation procedures, Aguirre LLC's proposed mitigation methods, and our recommendations. Additional information is provided in the BA, which is included as appendix D.

TABLE 4.6.3-1

Determination of Effects for Federally Listed, Proposed, and Candidate Species

Common Name	Scientific Name	Federal Status [a]	Determination [b]
Marine Mammals			
Antillean Manatee	*Trichechus manatus manatus*	E	LAA
Blue whale	*Balaenoptera musculus*	E	NLAA
Fin whale	*Balaenoptera physalus*	E	NLAA
Humpback whale	*Megaptera novaenglia*	E	NLAA
Sei whale	*Balaenoptera borealis*	E	NLAA
Sperm whale	*Physeter macrocephalus*	E	NLAA
Reptiles			
Green sea turtle	*Chelonia mydas*	T, CH	NLAA, NLAM
Hawksbill sea turtle	*Eretmochelys imbricata*	E, CH	NLAA, NLAM
Leatherback sea turtle	*Dermochelys coriacea*	E, CH	NLAA, NLAM
Loggerhead sea turtle	*Caretta caretta*	T	NLAA
Birds			
Piping plover	*Charadrius melodus*	T	NLAA
Yellow-shouldered blackbird	*Agelaius xanthomus*	E	NLAA
Rufa Red Knot	*Calidris canutus rufa*	PE	NLAA
Fishes			
Dwarf seahorse	*Hippocampus zosterae*	PE	NLAA
Great hammerhead shark	*Sphyrna mokarran*	PT	NLAA
Nassau grouper	*Epinephelus striatus*	C	NCTFL
Scalloped hammerhead shark	*Sphyrna lewini*	C	NCFTL
Invertebrates			
Queen conch	*Strombus gigas*	C	NCTFL
Boulder star coral	*Montastraea annularis*	PE	LAA
Elkhorn coral	*Acropora palmata*	T/PE, CH	LAA, LAM
Elliptical star coral	*Dichocoenia stokesii*	PT	LAA
Lamarck's sheet coral	*Agaricia lamarcki*	PT	LAA
Mountainous star coral	*Montastraea faveolata*	PE	LAA
Pillar coral	*Dendrogyra cylindrus*	PE	LAA
Rough cactus coral	*Mycetophyllia ferox*	PE	LAA
Staghorn coral	*Acropora cervicornis*	T/PE, CH	LAA, LAM
Star coral	*Montastraea franksi*	PE	LAA

[a] E = Endangered, T = Threatened, PE= Proposed for Endangered Status, PT = Proposed for Threatened Status, CH = Critical Habitat, C = Candidate

[b] LAA = Likely to Adversely Affect, NLAA = Not Likely to Adversely Affect, NLAM= Not Likely to Adversely Modify, NCTFL= Would Not Cause a Trend toward Federal Listing, LAM= Likely to Adversely Modify

4.7 LAND USE, RECREATION, AND VISUAL RESOURCES

This section discusses the current uses of the areas proximate to the Project and describes the potential impacts of the Project on land use, recreation, commercial fishing, visual resources, and associated issues. Impacts on commercial fishing are also evaluated in our socioeconomics discussion (see section 4.8.3). For the purposes of this draft EIS, land use is defined by the way in which humans use the air, land, or water.

4.7.1 Land Use

The FSRU and the offshore berthing platform would be located approximately 1 mile south of Jobos Bay in waters of the Municipality of Salinas. The subsea pipeline would pass between Cayos de Barca and Cayos de Caribes and in waters of the Municipality of Salinas and the Municipality of Guayama. The pipeline would connect onshore directly within PREPA's existing Aguirre Plant located in the community of Central Aguirre, Municipality of Salinas. Onshore facilities would include a meter station, pressure reducing equipment, a pig launcher/receiver, a construction office, and an onshore construction staging area. The onshore facilities would be entirely within the property of the Aguirre Plant. Table 4.7.1-1 summarizes the anticipated impacts associated with construction and operation (temporary and permanent) of the Project. The USCG is proposing to establish a radius of 500 yards (457 m) centered on the offshore terminal site.

TABLE 4.7.1-1

Summary of Proposed Construction and Operation Impacts Associated with the Aguirre Offshore GasPort Project

Project Component	Temporary Impacts During Construction (acres [cuerdas])		Permanent Impacts During Operation (acres [cuerdas])
	Water Surface	Seafloor [a]/Upland	
Offshore Berthing Platform	75.5 (77.7)	75.5 (77.7)	22.3 (23.0)
Subsea Interconnecting Pipeline	49.7 (51.2)	9.9 (10.2)	3.0 (3.1)
Lay Barge Construction Areas	31.5 (32.4)	31.5 (32.4)	0.0
Temporary Staging and Support Area [c]	0.0	1.5 (0.6)	0.0
USCG Safety Zone	0.0	0.0	162.3 (167.1)
TOTAL	**156.7 (161.3)**	**118.4 (121.9)**	**187.6 (193.2)**

[a] Includes direct impacts on the seafloor from mechanical activities (e.g., pile and pipeline installation) and associated sedimentation. The proposed construction methods for the subsea interconnecting pipeline do not include use of mooring anchors or cables; therefore no temporary workspace would be required for the sweep of mooring anchor chains or cables. Estimates of the offshore berthing platform construction includes mooring and anchor chain acreages.

[c] Located within the existing Aguirre Plant property.

Jobos Bay and the surrounding areas are used for a variety of marine activities, including recreational boating, recreational and commercial fishing, scientific research, and other recreational activities such as snorkeling and wildlife viewing. Jobos Bay and the open sea south of the bay are also used by various shipping vessels, including the barges that currently deliver fuel oil to the Aguirre Plant. Other shipping activity in the region includes:

- The AES Corporation Total Energy coal fired power plant, located approximately 4 miles (6 km) east of the Project area. Receives coal and limestone deliveries approximately once each week. Exports manufactured aggregate (e.g., fly ash) from the facility approximately five times a week.

- The Port of Ponce, located approximately 26 miles (42 km) west of the Project area. Large industrial port with a variety of vessel traffic.

- EcoElectrica, located approximately 35 miles (56 km) west of the Project area. The only existing LNG import facility in Puerto Rico; receives an average of two LNG carriers per month.

As shown in table 4.7.1-2, the majority of the vessel traffic within and around the bay is associated with commercial and recreational fishing.

TABLE 4.7.1-2

Estimated Weekly Vessel Traffic Within and Near Jobos Bay for the Aguirre Offshore GasPort Project

Vessel Type	Interior to Jobos Bay	South of Jobos Bay
Recreational Fishing Vessels	50 to 75	75 to100
Commercial Fishing Vessels	35 to 45	40 to 50
Diving Vessels	1 to 5	Not Available
Fuel Oil Barges or Ocean-going Vessels	3 to 4	8 to 10
Vessels to AES Coal	0	1
LNG Vessels to the EcoElectrica LNG Facility	0	1 to 2

Source: Tetra Tech, 2013f

4.7.2 Jobos Bay National Estuarine Research Reserve

The JBNERR was designated in 1981 and includes parts of Jobos Bay and the surrounding barrier islands (cays). The National Estuarine Reserve System was created by the CZMA to provide a network of protected areas established to promote informed management of the Nation's estuaries and coastal habitats. The JBNERR is the only estuarine reserve in Puerto Rico and the greater Caribbean, and is one of two reserves representing the West Indian Biogeographic Region. Located on the southern coast of Puerto Rico, the JBNERR encompasses approximately 3,300 acres (3,398 cuerdas) of coastal ecosystems. The habitats within the reserve boundaries include mangrove forests, salt flats, coastal strand, beach dunes, seagrass beds, algae beds, and coral reefs. These coastal resources are surrounded by the local communities of Las Mareas, Coqui, and Aguirre in the Municipality of Salinas and the communities of Puerto de Jobos, Pozuelo, and Puente de Jobos in the Municipality of Guayama (DNER, 2010).

The JBNERR is managed by the DNER and is partially funded by NMFS. The DNER maintains a management plan for the JBNERR, which is updated every 5 years. The current management plan is valid until 2015, and identifies the management plan goals as: ensure a stable environment for research; address coastal management issues; enhance public awareness and understanding of estuarine areas; promote federal, state, public, and private research use; and gather and make available information necessary for improved understanding and management of estuarine areas (DNER, 2010).

To promote multiple uses within the JBNERR, the JBNERR is divided into three separate management sector classifications: preservation, conservation, and limited use (see figure 4.7.2-1). The preservation sector is the core area of the JBNERR, and activities within this sector are limited to research and monitoring activities. The conservation sector covers areas that require protection against inappropriate or excessive use; the types of activities within this sector are limited to low impact activities such as hook and line fishing, anchoring on mooring buoys, and permitted collection of dead coral. Activities not permitted in the conservation sector include net fishing, extraction of corals or related fish species, and anchoring without mooring buoys. The limited use sector is a buffer area around the conservation and preservation sectors, and is primarily designated for public access. Activities within the limited use sector are those that will not threaten or significantly disturb the natural ecosystem. As shown in figure 4.7.2-1, the subsea pipeline would cross portions of the conservation sector. An HDD under Boca del Infierno pass would result in a smaller portion of the conservation sector affected by the pipeline. The preservation and limited use sectors would not be crossed by any part of the Project.

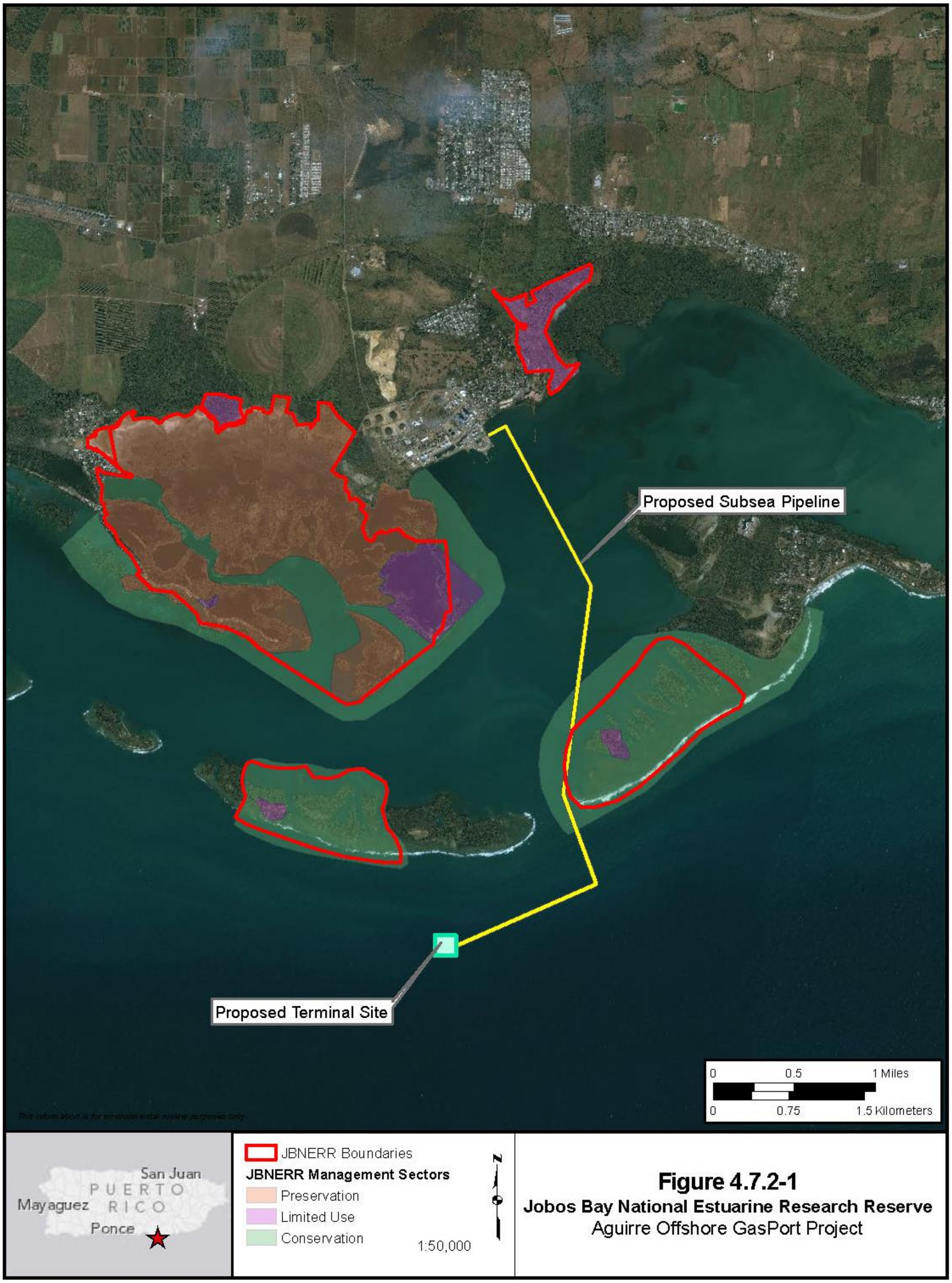


Figure 4.7.2-1
Jobos Bay National Estuarine Research Reserve
Aguirre Offshore GasPort Project

Scientific Research

According to the DNER Research Coordinator at the JBNERR, there are eight ongoing research projects, three monitoring programs, and one proposed research and monitoring project within the JBNERR (Dieppa, 2013). The ongoing and proposed research and monitoring projects are listed below.

The ongoing research includes:

- Effects of Nutrient Pollution on Mangrove Functioning (Odum School of Ecology, University of Georgia);
- Ecological and Biogeochemical Responses to Experimental Nutrient Enrichment in Coastal Fringe and Basin Mangrove Systems (University of Rhode Island);
- Passive Harbor Acoustic Monitoring in Puerto Rico (University of Puerto Rico, Mayaguez);
- A Comparison of the Arthropod Fauna among Mangrove and Dry Forests, and Agricultural Fields in the Jobos Bay Area, Puerto Rico (University of Turabo);
- Short-term Impact of Black Mangrove Restoration on Avian Biodiversity and Breeding Ecology Along the Northern Boundary of JBNERR (Michigan State University);
- Interhabitat Connectivity of Wintering New England Songbirds on the South Coast of Puerto Rico: Development of an Emerging Paradigm in the Face of Global Warming (University of Turabo);
- Habitat Use by Yellow Warblers and Interactions Between Migratory and Residential Individuals (University of Turabo); and
- The Influence of Habitat Composition and Food Availability on Migratory and Resident Bird Abundance and Diversity in a Subtropical Dry Forest in Southeastern Puerto Rico (University of Turabo).

The monitoring programs include:

- System-wide Monitoring Program for Water Quality in Four Stations Within Jobos Bay and Meteorological Monitoring, conducted by the JBNERR;
- Aquifer Water Level Monitoring in Several Wells, conducted by the JBNERR, Agricultural Research Service; and
- Accounting for Agricultural Best Management Practices by Monitoring Agricultural Runoff in the Estuary During Heavy Rain Events, conducted by the JBNERR in collaboration with the U.S. Department of Agriculture, Agricultural Research Service.

The proposed research and monitoring includes:

- JBNERR Sentinel Site Program, to establish a series of monitoring stations and transects to study the effects of climate change/sea level changes on SAV and mangrove communities.

4.7.3 Coastal Zone Management Program

Puerto Rico's CZMP is authorized by the CZMA and is administered at the federal level by the Coastal Programs Division of NOAA's Office of Ocean and Coastal Resource Management. The consistency provisions of the CZMA require federal agency actions to be consistent with each state's federally approved CZMP. Puerto Rico approved its CZMP in 1978 as a part of its Land Use Plan. The CZMP is administered by the DNER, and developments within the coastal zone require a review by the PRPB in order to ensure consistency under the federal CZMA. The goals of the CZMP are to develop guidance for public and private development on the coastal zone; conduct active management of coastal resources; and foster scientific research, education, and public participation as a means of promoting sustainable develop of Puerto Rico's coastal zone and coastal resources. States (including the Commonwealth of Puerto Rico) with federally approved CZMPs have the responsibility of reviewing federal agency actions and activities to ensure that they are consistent with the goals and policies of the state's program. Applicants for federal permits in coastal areas must provide the federal agency with a consistency certification from the state, showing that a proposed project is consistent with the state's CZMP.

The coastal zone in Puerto Rico generally extends 0.6 mile (1.0 km) inland but extends further inland in some areas to include key ecosystems along the coast (DNER, 2008). The coastal zone is divided into eight Coastal Sectors based on socioeconomic, ecological, geological, and topographic characteristics. The Aguirre Offshore GasPort Project is within the South Coastal Management Sector, which extends from the Rio Grande in Patillas to the Rio Tallaboa in Peñuelas (DNER, 2008). Within this coastal zone sector, the JBNERR is designated as a Special Planning Area (SPA).

SPAs are defined as "important coastal resource areas subject to serious present or potential use conflicts, and, therefore, require detailed planning" (DNER, 2010). SPAs emphasize a consensus-based approach among all federal, commonwealth, and local entities on future development policy. The Project, including the offshore berthing platform, FSRU, and subsea pipeline, would be located within the designated Jobos Bay SPA. Since the Jobos Bay SPA extends from Guamani River in Guayama to Playa de Salinas and inland to Highway PR-53, which is all part of Puerto Rico's Coastal Zone, a considerable number of governmental agencies are participants in the SPA task force, including the COE, EPA, FWS, EQB, PRPB, Puerto Rico Land Authority, and DNER, among others. The participants in the SPA process create consensus derived planning agreements that are legitimized through a legally binding Memorandum of Understanding (DNER, 2010).

Aguirre LLC stated that it plans to complete a coastal zone consistency evaluation with the PRPB to determine the Project's consistency with the CZMP policies. The COE requires a concurrence certification with CZMP from the PRPB prior to issuing a permit. To ensure that Aguirre LLC receives its determination of consistency with the CZMP, **we recommend that:**

- **Aguirre LLC should not begin construction of the project until it files with the Director of the OEP a copy of the determination of consistency with the CZMP issued by the PRPB.**

4.7.4 Recreational Activities

Puerto Rico offers many types of coastal recreational opportunities for the public. Marine and onshore recreation activities are available year-round in and around Jobos Bay. Coastal recreation activities include recreational boating, recreational fishing, wildlife viewing, kayaking, diving, golf, and swimming/sunbathing at beaches. The facilities that are available within or near the municipalities of the Salinas and Guayama are summarized in table 4.7.4-1 and illustrated on figure 4.7.4-1.

TABLE 4.7.4-1

Recreational Facilities and Activities in the Vicinity of the Aguirre Offshore GasPort Project

Facility	Approximate Number of Visitors (per month)	Activities	Public Access
JBNERR and Visitor's Center	140	Recreational uses allowed vary between the preservation, conservation, and limited use sectors. The JBNERR Visitor's Center is a public facility that has a small library, historical photos, and an interactive exhibition.	The visitor center is open on weekdays. The most frequent visitors are student groups and community groups.
Central Aguirre Golf Club	280	The course has nine holes and, built in 1928, is the oldest golf course in Puerto Rico. The golf course is managed by the municipality.	There is a fee to play at the public course. It is open every day except Monday.
Punta Pozuelo Beach	160	This beach has gazebos and is a popular sunbathing and kite surfing location.	Access and parking available.
Kayak Trail	20	A kayak trail with 11 interpretive signs will be restored in Mar Negro with land access through the Las Mareas community. The kayak tours have been coordinated by the Sierra Club. At present, the DNER has denied permits for kayaking.	Rental kayaks are available from the community organization.
La Paseadora	600	Tour company that offers snorkeling tours, a trip around Jobos Bay, and a trip to Cayo Ratones (also known as Cayo Matías) for a beach day.	Trips are offered on weekends and holidays.
Guayama Kite Crew School and Tropical Kiteboarding	7	Kite surfing classes from Punta Pozuelo Beach. The kite surfers use the area off of Pozuelo Beach, Cayos Caribes, Cayos de Barca, and Boca del Infierno pass.	A fee is required for classes.
Aqua Adventure	50	Aqua Adventure has facilities in Guanica, San Juan, and Salinas and offers SCUBA, snorkeling, and sightseeing cruises.	Offers a number of options for a fee.
Guayama Nautical Club	Not applicable	Private marina in Pozuelo on Jobos Bay. The Nautical Club has a total capacity for 200 boats [a] with space for vessels both on the water (up to 45 vessels) and in dry dock [b].	Private.
Salinas Marina	Not applicable	Marina accommodates recreational vessels and offers a public boat ramp. Accommodates 103 vessels. [b] Boat ramp serves 6 to 10 boats per day on weekends [c]	Public boat ramp.

[a] Source: Pales, 2012
[b] Source: Puerto Rico Encyclopedia, 2010
[c] Source: Ortiz et al., 2012

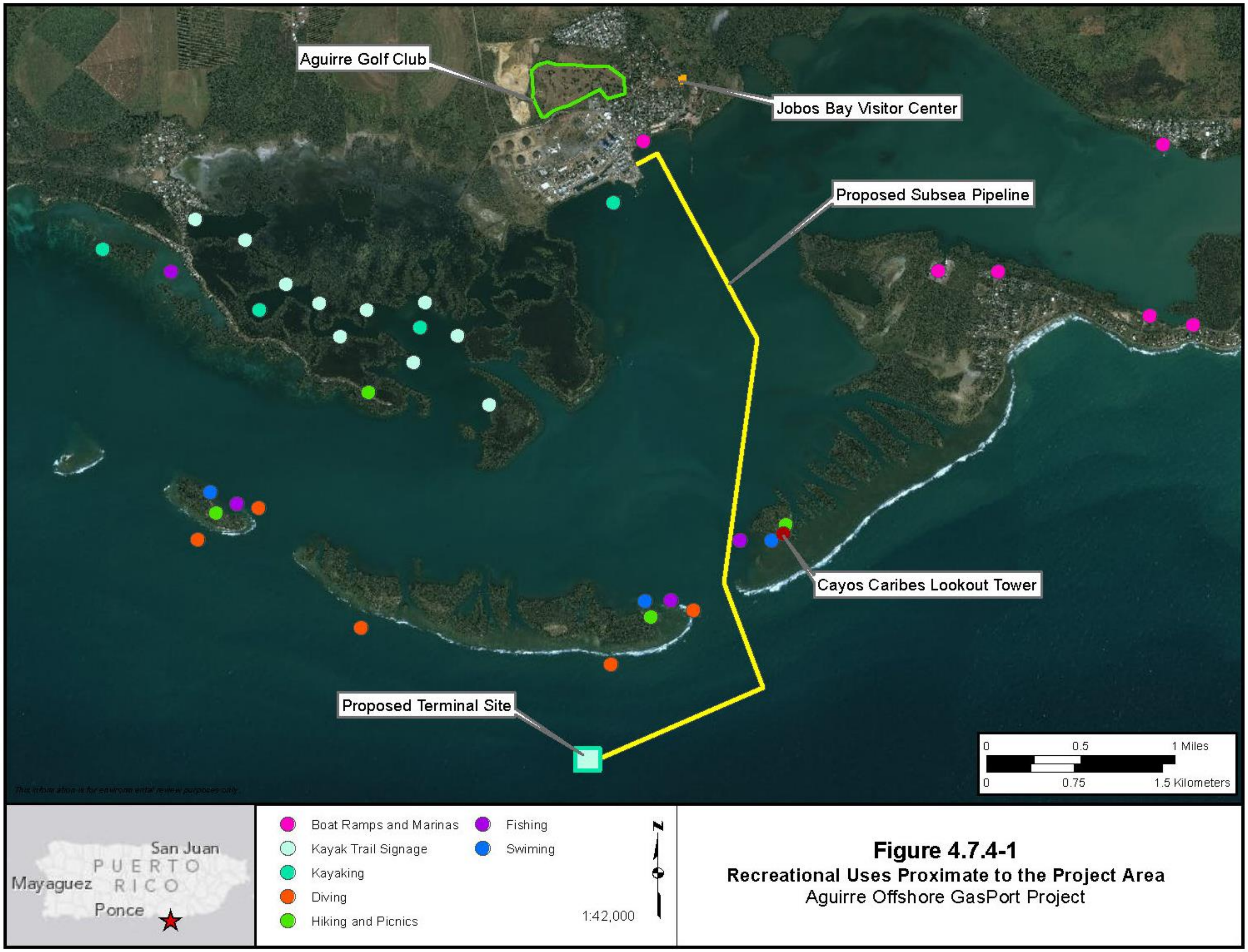


Figure 4.7.4-1
Recreational Uses Proximate to the Project Area
Aguirre Offshore GasPort Project

Recreational Boating

Recreational boating within Jobos Bay and the Project area occurs year-round and includes power boats, kayaks, canoes, and other watercraft. The use of jet skis or similar personal watercraft are prohibited in all areas of the JBNERR (DNER, 2010). Anchoring and mooring in areas around the barrier islands and within Jobos Bay are limited to 3 hours. The DNER plans to designate docking and mooring facilities for public use of Jobos Bay in a manner that will not threaten or significantly disturb the natural ecosystem.

A number of boating facilities are located near Jobos Bay, including but not limited to public and private marinas, public docks and boat launches, fishing clubs, and water taxis. The largest boating facilities in the area are the Salinas Marina and the Guayama Nautical Club. The Salinas Marina is west of the Project area (see figure 4.7.4-1) and has capacity to accommodate 103 vessels (Puerto Rico Encyclopedia, 2010). The Guayama Nautical Club is east of the Project area (see figure 4.7.4-1) and has capacity to accommodate 200 vessels including slips and dry storage (Puerto Rico Encyclopedia, 2010). In addition to these private marinas, public boat ramps are available in Playita de Salinas, Puerto de Jobos, and three locations in Pozuelo in Guayama (see figure 4.7.4-1). Private boat ramps are also located at a number of residences near the Project area. The public and private boats that enter water from the boat ramps near Jobos Bay east of the Project area likely cross over the proposed pipeline route in order to exit or enter Jobos Bay.

A kayak trail is located within part of the preservation, limited use, and conservation sectors of the JBNERR. The DNER plans to re-route and restore the existing kayak trail for security and public safety reasons, although no date for the trail restoration has been set (DNER, 2010). The newly formed Las Mareas Community non-governmental organization plans to provide kayak rentals and to assist with the restoration of the kayak trail. The kayak trail has not received a permit for operation from the DNER as of June 2014.

Recreational Fishing

Approximately 120,000 residents and between 20,000 and 40,000 non-residents participate in marine recreational fishing each year within Puerto Rico. A variety of fishing methods are used, including hand-line fishing, standard rod and reel, fly fishing, kayak fishing, boat trolling, and skin diving (Sea Grant Puerto Rico, 2012). Recreational anglers target a variety of species, including but not limited to species groups such as barracudas, cartilaginous fishes (e.g., sharks and rays), dolphins, drums, eels, flounders, grunts, herrings, jacks, mullets, porgies, puffers, sea basses, snappers, triggerfish, tunas and mackerals, and wrasses. Fisheries in the Project area are discussed in section 4.5.5.3. The Guayama Nautical Club hosts two sport fishing tournaments each year: The Dorado (mahi mahi) tournament in March and the Wahoo tournament in November. The tournaments typically have between 50 and 100 participating vessels (Pales, 2012).

Fishing of any kind is illegal within the preservation sector of the JBNERR; however, hook and line fishing is allowed within the conservation and limited use sectors (DNER, 2010). Catch and release fishing and releasing small or immature individuals is encouraged by the DNER. Illegal fishing with nets and pots within the JBNERR is occasionally encountered by JBNERR staff (DNER, 2010).

Other Marine-Dependent Activities

Coastal areas of the Municipalities of Salinas and Guayama are used year-round for swimming, scuba diving, snorkeling, and other watersports such as kayaking and kite surfing. Swimming beaches are located at Punta Pozuelo public beach and other private swimming areas near both Cayos de Barca and Cayos Caribes (see figure 4.7.4-1). Punta Pozuelo beach is regularly used for swimming and is also used by the Guayama Kite Crew School and Tropical Kiteboarding. Kite surfing activities take place from Cayos de Barca to an area east of Punta Pozuelo beach (Guayama KiteBoarding School, 2013). In May 2012 and 2013, the Puerto Rico Kite Surfing Federation sponsored a kite surfing tournament at Punta Pozuelo, which is anticipated to occur annually.

Scuba diving and snorkeling trips occur around the coral reefs near Jobos Bay. Linear reefs are present along the seaward and inland sides of Cayos de Barca and Cayos Caribes, which are typical of Caribbean reefs (Field et al., 2003). Aqua Adventures, which operates from Salinas, offers scuba and snorkeling trips at Caja de Muertos Island (located approximately 18 miles [29 km] west of the Project area) and planned to offer scuba and snorkeling trips along the reefs within Jobos Bay starting in summer 2013. However, as of June 2014, Aqua Adventures and other commercial scuba and snorkeling outfitters have not offered regular scuba or snorkeling trips within Jobos Bay.

In addition to swimming and scuba, visitors at the JBNERR commonly participate in wildlife viewing; however, it is unknown how many of the approximately 140 monthly visitors come specifically to see wildlife. Near the Project area, Cayos Caribes has a marked walking trail, observation tower, and a small pier that are often used for wildlife viewing.

4.7.5 Commercial Fishing

Commercial fisheries in Puerto Rico are generally small-scale and are predominately operated-owned with low capital investment. Currently, there are approximately 800 to 1,000 licensed commercial fishers, island wide. Commercial fishing in Guayama and Salinas is comprised of multi-gear fishing for a variety of species in both inshore and offshore (see figure 4.7.5-1). The location (i.e., inshore or offshore) of fishing activities and the target species are dependent on the season and the weather. Many commercial fishers in Guayama and Salinas use homemade boats with outboard motors, called yolas, which typically range between 10 and 25 feet (3 to 8 m) in length (Garcia-Quijano, 2009).

The DNER Fisheries Research Laboratory recognizes a total of 88 fishing centers in 42 coastal municipalities around Puerto Rico, including the islands of Vieques and Culebra (DNER, 2007). Six of these centers are within 5 miles (3 km) of the Project area including the Playa, Playita, Las Mareas, and Aguirre fishing villages in Salinas and Puerto de Jobos, and Pozuelo fishing villages in Guayama (see figure 4.7.5-1). Recreational and subsistence fishing also occur in these areas.

According to an interview with Miguel Ortiz, President of the Pozuelo Fisherman Village, fishermen are scattered around Jobos Bay; however, the Pozuelo Fisherman Village is the only certified commercial fishing cooperative in the bay (Ortiz et al., 2012). The Pozuelo Fisherman Village is comprised of 19 individuals who fish near the barrier islands using hand lines, troll lines, long lines, and rod and lines. These fisherman fish near the barrier islands for a variety of species, including grouper, snapper, mojarras, grunts, croakers, white mullet, dolphin fish, and wahoo, depending on the weather and the season.

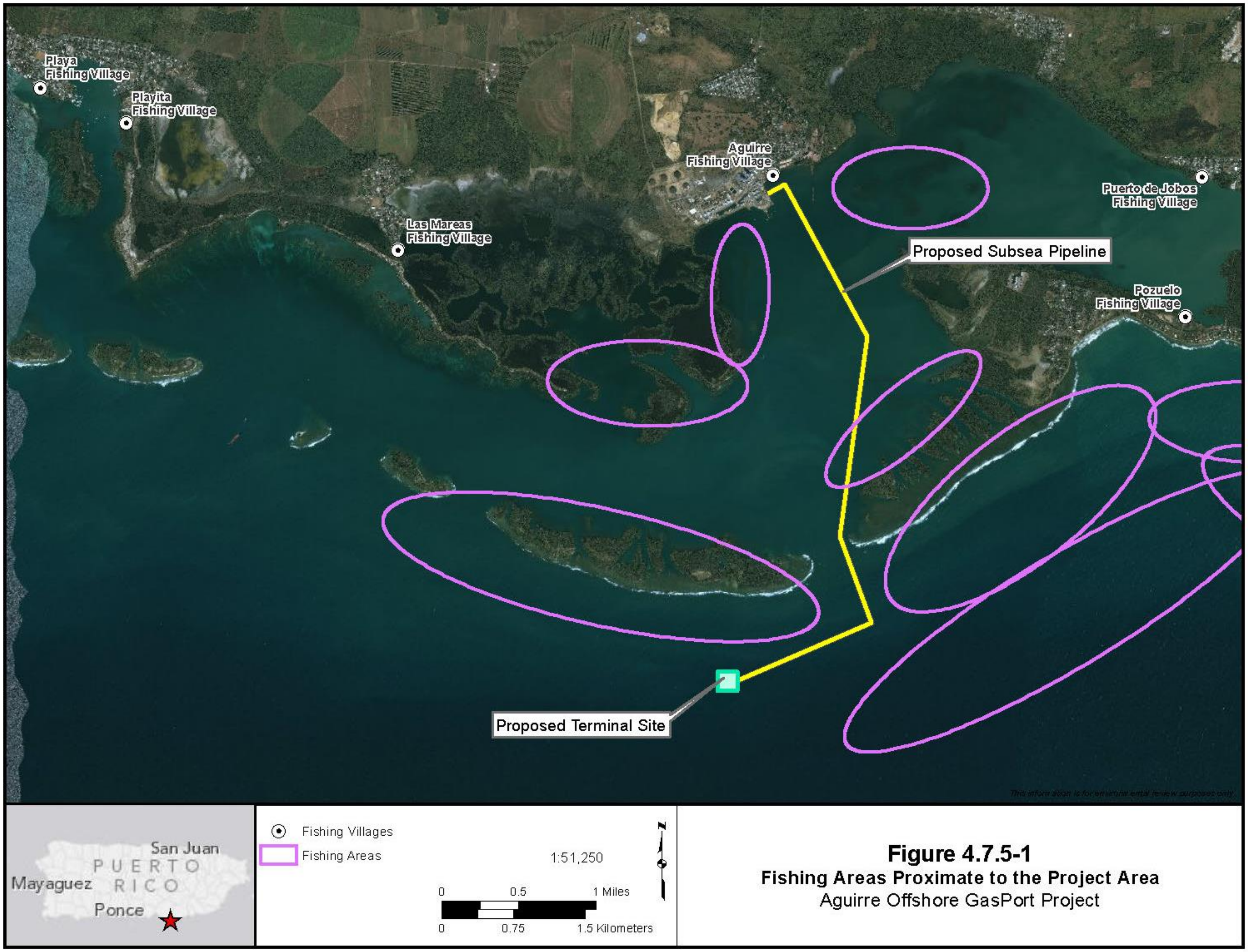


Figure 4.7.5-1
Fishing Areas Proximate to the Project Area
Aguirre Offshore GasPort Project

4.7.6 Visual Resources

The Project would be located approximately 1 mile outside of Jobos Bay and approximately 3 miles from the mainland shore. The Project area has ocean to the south and is framed by multiple cay islands and mainland Puerto Rico to the north. The mainland landscape is comprised of mixed-use seaside communities, agricultural lands, and open land. Various private beaches, public boat ramps, the JBNERR, and other recreational areas are found along the shoreline where residents and tourists come to recreate and enjoy views of Jobos Bay and the ocean. Marinas and commercial areas, including the Aguirre Plant, are also present. The landscape along the immediate coastline consists of cay islands and mainland areas with mangrove forests and beaches, while the area surrounding Jobos Bay is part of the coastal plain subtropical dry forest with scrub-shrub and forested habitats (DNER, 2010). Topography varies from broad flat beaches along the immediate coast and increases in elevation heading inland. Views from coastal communities show the barrier islands and relatively unobstructed views of the ocean and the horizon.

4.7.7 General Impact and Mitigation

Construction of the Project facilities would require the use of a variety of vessels including lay barges, dive support vessels, support tugs, crew boats, pipe transport barges, and pipe haul barge tugs. The presence of these vessels would represent an increase in the current levels of large vessel traffic in the bay, which is typically limited to small recreation and commercial fishing vessels. The barges that deliver fuel oil to the Aguirre Plant utilize the dredged ship navigation channel to the west of the Project and would not likely be impacted by construction activities. Aguirre LLC would coordinate with the fuel oil delivery vessel operators to provide uninterrupted access to the Aguirre Plant. The remaining shipping vessel traffic discussed above would be located outside of Jobos Bay and would not likely be impacted by the construction of the offshore berthing platform due to the open sea available to the south.

Pipeline construction would disturb approximately 22.3 acres (23.0 cuerdas) of the JBNERR conservation sector, of which 2.2 acres (2.3 cuerdas) would be retained as permanent easement on the sea floor. If an HDD under Boca del Infierno pass was found to be feasible (see recommendation in section 4.5.2.4), the required construction workspace in the conservation sector would be larger. However, the HDD construction method would reduce the amount of pipeline laying on the seafloor and would thereby reduce the permanent footprint in the conservation sector. Based on the limited impacts in this area and a review of the management plan for the Reserve (DNER, 2010), we do not anticipate any significant impacts on the use or management of the JBNERR, regardless of whether the pipeline in this area is constructed by direct lay or HDD. In sections 4.4.3 and 4.5.2.4, we are recommending that Aguirre LLC submit seagrass and coral mitigation plans within 30 days of the draft EIS publication date to prevent impacts on these natural resources.

Construction activities could interfere with recreational boating and fishing in the area due to increased vessel traffic in and around Jobos Bay. Construction activities could also interfere with some commercial fishing sites and vessels in transit to fishing sites due to exclusion from active construction sites. However, consultations with commercial fishermen in Salinas and Guayama provided by Aguirre LLC state that commercial fishing does not occur in most of the Project area (Ortiz, et al., 2012). Fishing may also be affected by impacts on fish species proximate to the Project area due to the various in-water activities associated with construction (see section 4.5.5.4). Based on the limited footprint of the proposed construction activities, it is anticipated that commercial and recreational vessel operators would have the ability to safely navigate and avoid construction activities.

The Comité Diálogo Ambiental (“Environmental Dialog Committee”) commented that subsistence fishing does occur in the Project area. As mentioned previously, construction activities would limit subsistence fishing near the construction areas and vessels in transit to fishing sites due to exclusion from active construction sites. However, there are other known fishing areas outside of the Project area that would not have limited access during construction. Given the limited scope of the Project and the relatively small construction and operational footprint of the pipeline in and around Jobos Bay, we anticipate that the effects to subsistence fishermen from project activities would be minor and short-term.

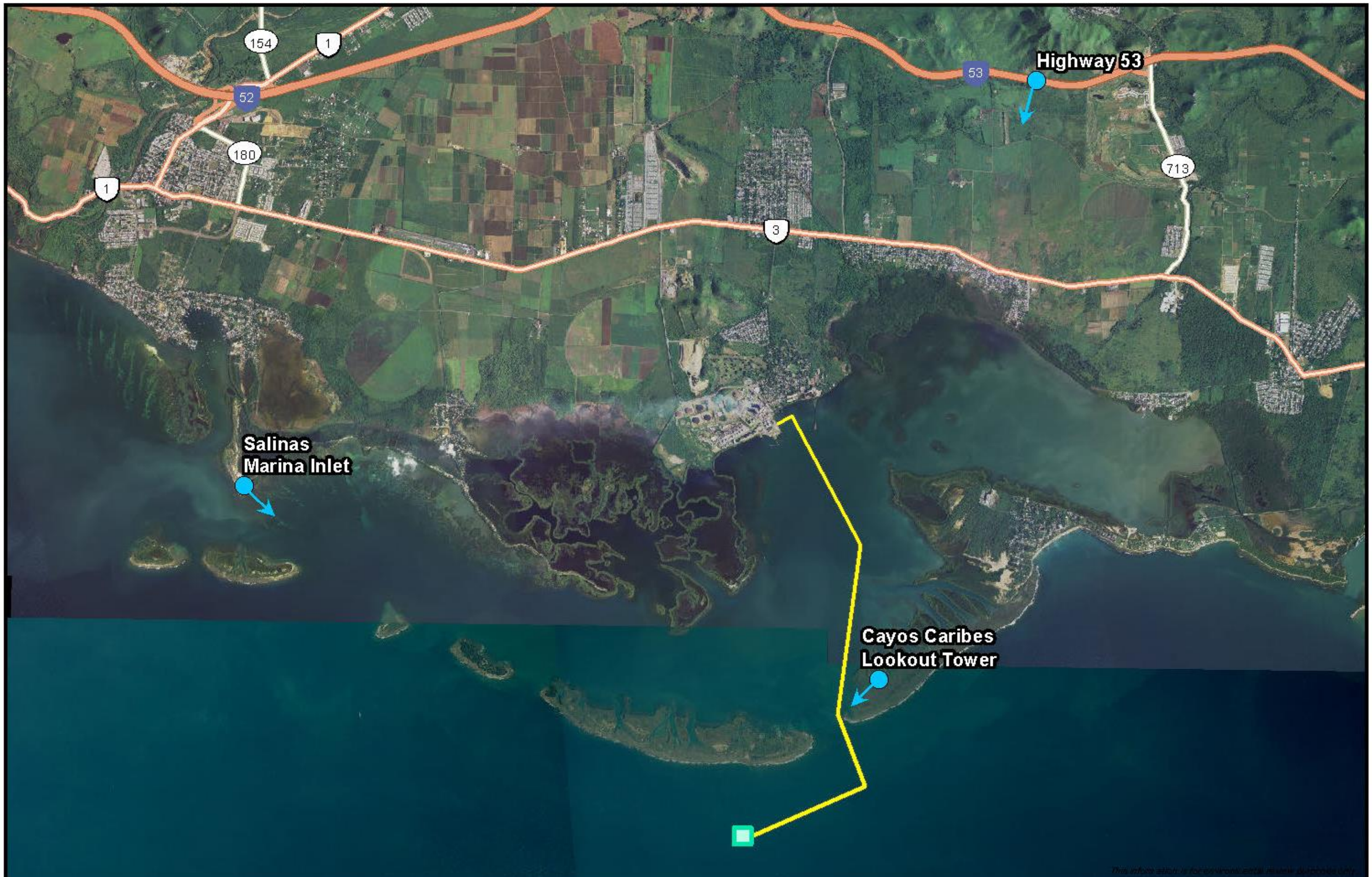
Operation of the Project would have direct impacts on the boating, fishing, and other marine uses in the Jobos Bay area as well as around the FSRU and LNG carriers. The USCG LOR Analysis (appendix B, section 1) advises posting the subsea pipeline area on NOAA navigational charts to inform mariners of the submerged pipeline and noting it as a risk for anchoring as well as a risk with vessels with a deep draft. In addition, the USCG LOR Analysis recommends placement of a safety zone of 500 yards (457 m) around the platform and a moving 100-yard (92 m) safety zone for LNG carriers while on approach and departure to the offshore terminal. The safety zone is discussed in more detail in section 4.11. Recreational and commercial vessels would not be able to enter the safety zone without permission from the COTP. Although this safety zone would essentially preclude boating, fishing, and other marine uses within 500 yards (457 m) of the Offshore GasPort Terminal and 100 yards (92 m) of a moving LNG carrier, we do not anticipate significant impacts on recreational, commercial, or subsistence uses in the larger area surrounding Jobos Bay. Similarly, the impacts on coastal recreation, such as hiking or sunbathing and other onshore activities, are anticipated to be minimal.

Aguirre LLC conducted a visual assessment from three locations proximate to the Project area including Highway 53 in Guayama (6 miles [10 km] northeast), the Salinas Marina Inlet (4.5 miles [7.2 km] northwest), and a lookout tower on Cayoes Caribes (1.5 mile [2.4 km] northeast; see figure 4.7.7-1). Figures 4.7.7-2 through 4.7.7-4 show the existing and simulated views of the Project area from these locations as provided by Aguirre LLC.

As shown in figures 4.7.7-2 and 4.7.7-4, the FSRU is apparent from the upland highway viewpoint and it dominates the view from the Cayos Caribe lookout tower. The presence of the FSRU would visually affect wildlife viewing from the Cayos Caribe lookout tower and other places within the JBNERR that have views of the ocean. As shown in figure 4.7.7-4, the red FSRU contrasts the blue and green landscape that surrounds the Project area. The FSRU is less apparent from the Marina de Salinas, as the barrier islands partially obstruct the line of sight. Views of Jobos Bay and the ocean south of Jobos Bay include daily recreational and commercial fishing boats, and occasionally include LNG vessels or other ocean-going barges.

Visual impacts on the Project area from fuel oil barges would decrease after construction of the Project. Currently, 8 to 10 fuel oil or oceangoing barges pass south of Jobos Bay each week, and 3 to 4 fuel oil barges enter Jobos Bay each week. During operation of the Project, the frequency of fuel oil barge traffic within Jobos Bay is anticipated to decrease to one barge per week. The reduction in fuel oil barges would allow users of the Jobos Bay area to view a more natural environment.

The FSRU and offshore berthing platform would be lit 24 hours per day by security lighting, navigation lights, and Federal Aviation Administration warning lights. The waters surrounding the Offshore GasPort are unlit due to the lack of permanent structures in the water and on uninhabited Cayos Barca and Cayos Caribe. Therefore, the nighttime lighting contrast between the Project and the background would be high. To date, Aguirre LLC has not provided any simulations of the nighttime lighting in the Project area. We are recommending in section 4.5.3.3 that Aguirre LLC develop a lighting plan that identifies specific measures that would be implemented to minimize or avoid impacts associated with nighttime lighting.



Visual Assessment Points
Proposed Subsea Pipeline
Proposed Terminal Site

1:66,500

0 0.5 1 Miles

0 0.75 1.5 Kilometer

Figure 4.7.7-1
Visual Assessment Points
Aguirre Offshore GasPort Project

Figure 4.7.7-2
Visual Assessment from Highway 53
Aguirre Offshore GasPort Project

Figure 4.7.7-3
Visual Assessment from Salinas Marina Inlet
Aguirre Offshore GasPort Project

Figure 4.7.7-4
Visual Assessment from Cayos Caribes Lookout Tower
Aguirre Offshore GasPort Project

4.8 SOCIOECONOMICS

This section describes the socioeconomic resources that could be affected by the construction and operation of the proposed Project. We also present our analysis of commercial fishing, marine recreation and tourism, onshore socioeconomic conditions, and environmental justice.

The Project area considered in this draft EIS for socioeconomic resources (referenced as "socioeconomic region") includes the municipalities and towns and ports along the shoreline of Guayama and Salinas, which are the two municipalities located to the east and west of the Project area. The community of Central Aguirre is within the municipality of Salinas, and is included in the economic statistics for Salinas when community-specific data were not available.

4.8.1 Existing Socioeconomic Conditions

4.8.1.1 Population and Housing

The population within the Project's socioeconomic region accounts for approximately 2 percent of Puerto Rico's population. The latest population estimates from the U.S. Census Bureau show that the populations of the municipalities of Salinas and Guayama have declined by less than 1 percent since the 2010 Census (U.S. Census Bureau, 2012). The census data also show that the socioeconomic region is largely comprised of a Puerto Rican population, with Central Aguirre having the largest non-Puerto Rican population of 2.1 percent. Central Aguirre has the highest population density, which is likely due to the land area only including the Aguirre population center and not the rural areas that surround Central Aguirre, while the populations of Salinas and Guayama include both urban and rural areas. Table 4.8.1-1 summarizes the population data and housing occupancy and vacancy numbers for each municipality and the community of Aguirre.

TABLE 4.8.1-1

Summary of Population and Housing Conditions in Aguirre, Salinas, and Guayama

Category	Unit	Central Aguirre	Salinas	Guayama
Land Area	Square mile (km^2)	0.5 (1.3)	69.7 (180.5)	65.0 (168.3)
Total Population	Persons	1,263	31,019	45,250
Population Density	Persons per square mile (km^2)	2,526 (972)	445 (172)	696 (269)
Occupied Housing Units	Number	429	11,400	16,244
Vacant Housing Unit	Number	142	2,980	3,467
Rental Vacancy Rate	Percent	0.0	3.6	7.1

Sources: U.S. Census Bureau, 2010a and 2012

4.8.1.2 Employment and Unemployment

The employment rate within the Project's socioeconomic region varies within Central Aguirre, Salinas, and Guayama. Central Aguirre has a higher unemployment rate than Salinas and Guayama, as well as having the lowest mean household income (U.S. Census Bureau, 2010a). Jobs within Central Aguirre are mainly in production, transportation, and material moving, which employs approximately 39.3 percent of the employed civilian workforce. This sector only employs 18.1 and 14.1 percent of the workforce in Salinas and Guayama, respectively. The service sector employs the highest percent of the employed workforce in Salinas, and the management, business, science, and arts sector employs the highest percent of the employed workforce in Guayama. Table 4.8.1-2 summarizes the employment data for each municipality and the community of Aguirre.

TABLE 4.8.1-2

Summary of Employment Statistics in Aguirre, Salinas, and Guayama

	Unit	Central Aguirre	Salinas	Guayama
Civilian Labor Force Unemployment Rates	Percent	35.5	23.1	21.4
Mean Household Income	Dollars	21,725	20,650	25,202
Per capita personal income	Dollars	7,594	7,517	9,020
Employment Data				
Management, business, science, and arts	Persons	28	1,786	3,443
Service	Persons	65	2,009	2,413
Sales and office	Persons	7	1,343	3,538
Natural resources, construction, and maintenance	Persons	16	1,323	1,373
Production, transportation, and material moving	Persons	129	1,193	1,468

Sources: U.S. Census Bureau, 2010a and 2012

According to Aguirre LLC, construction of the Project is anticipated to require approximately 350 workers over a 12-month construction period. Aguirre LLC did not provide an exact estimate of local workers that would be hired for construction; however, Aguirre LLC has stated it intends to hire at least 10 percent of the construction workforce locally (approximately 35 workers). Aguirre LLC has not specified if workers used during the construction of the Project would be from Central Aguirre, Salinas, or Guayama, as hiring would be dependent on the availability and capability of the local workforce.

Aguirre LLC also anticipates that approximately 13 to 15 skilled personnel would be required for the operation of the Project. These positions would include a terminal manager, assistant manager, jetty operators, and security personnel. The hiring of local workers to fill these positions is dependent on the availability of specialized workers. In addition, Aguirre LLC plans to use escort and barge tugs to support operations that are currently located in Puerto Rico, although no estimates of workers to operate the tugs were provided.

Income

As shown in table 4.8.1-2, the mean household income and the per capita personal income are lower in Salinas than in Aguirre and Guayama, while Guayama had the highest mean household and per capita income levels (U.S. Census Bureau, 2012). Aguirre LLC did not provide income estimates for local workers to be hired during construction of the Project, although based upon average incomes for construction occupations within the Project area, approximately 35 local workers would receive an estimated income between $12,650 and $17,500 based on median incomes during construction (U.S. Census Bureau, 2010b). Operation of the Project is anticipated to generate annual mean income that ranges from $87,000 for the terminal manager to $24,000 for administrative assistants. Maintenance, security, and jetty operator positions are anticipated to generate annual mean income of $34,000, $31,000, and $37,000, respectively. Based on the 2010 census data, management occupations in Salinas and Guayama had a median annual income of $32,022 and $26,794, respectively. Protective service occupations in Salinas and Guayama had median annual incomes of $24,167 and $22,611, respectively (U.S. Census Bureau, 2012). Therefore, the mean annual incomes for the operational positions required for Project are anticipated to be higher than the median incomes for similar positions in the Project area (see figure 4.8.1-1).

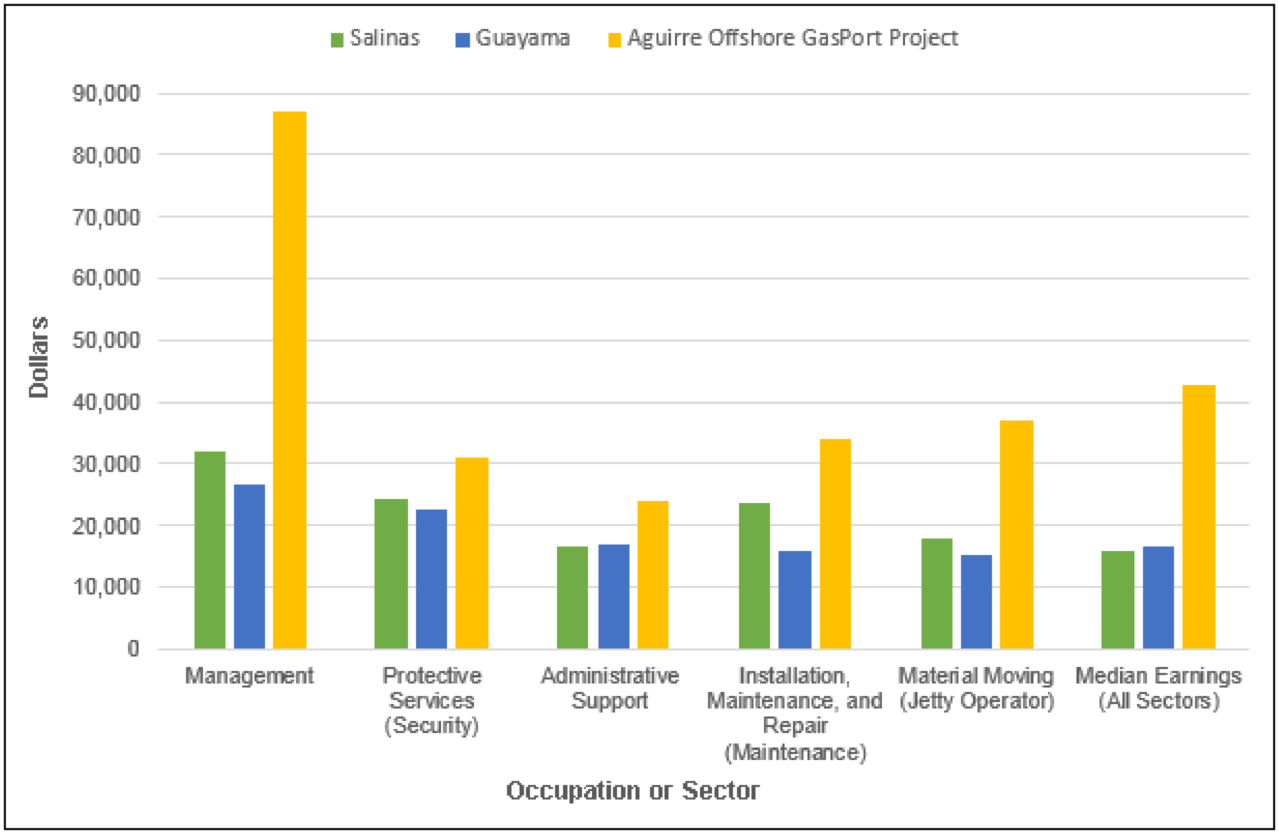


Figure 4.8.1-1 Median Income Within the Project Area by Occupation/Economic Sector
Source: U.S. Census Bureau, 2012

Taxes

Income tax rates within Puerto Rico vary based on the source of income (i.e., income from Puerto Rico or U.S. mainland). Puerto Ricans, unless they are federal employees or earn income that was generated on the mainland of the United States, are not required to pay federal income taxes (Internal Revenue Service, 2013). As such, Aguirre LLC estimates that the Commonwealth of Puerto Rico would be paid approximately $580,000 of annual income tax revenue during operation of the Project. Aguirre LLC did not provide an estimate of annual tax revenue during construction; however, the estimated average median income for construction workers in the area ranges between $12,650 and $17,500, which would be taxed at the Puerto Rico income tax rate which varies between 7 and 33 percent, depending on total annual income.

4.8.2 Environmental Justice

This section presents the demographic data to identify potential environmental justice impacts associated with the Project. An area is considered to have a disproportionately high percentage of low-income or minority residents under either of two conditions:

1. if the percentage of low-income or minority populations within that area is substantially greater than the county or state low-income or minority percentage, or

2. the percentage of persons in low-income or minority populations within the area is greater than 50 percent.

In accordance with Executive Order 12898 on Environmental Justice, all public documents, notices, and meetings were made readily available to the public throughout the Project area during our review of the Project. The mailing list for the Project has been continuously updated during the EIS process. The public has been notified of all official proceedings regarding the Project with the issuance of the NOI, and the scoping meetings were held in the Project area. Section 1.4 of this EIS further describes the public participation and notification processes.

Within Puerto Rico, approximately 99 percent of the population is Hispanic or Latino, and approximately 95.4 percent of the Hispanics or Latinos report to be Puerto Rican (U.S. Census Bureau, 2010b). The socioeconomic region has a Puerto Rican percentage of the population that is higher than the island-wide average. However, the socioeconomic region (specifically, Central Aguirre) has substantially lower mean household and per capita income, and substantially higher percentages of families below the poverty line. Unemployment within Central Aguirre is more than double that of the average in Puerto Rico. In addition, all other poverty data in Central Aguirre and Salinas were substantially higher than in Puerto Rico as a whole. Poverty indicators in Guayama are similar to those of Puerto Rico as a whole; however, the unemployment rate is substantially higher and mean household income is substantially lower in Guayama than overall in Puerto Rico. Table 4.8.2-1 summarizes the income and poverty data for the socioeconomic region and Puerto Rico as a whole.

TABLE 4.8.2-1

Poverty Statistics for Aguirre, Salinas, Guayama, and Puerto Rico

Category	Unit	Central Aguirre	Salinas	Guayama	Puerto Rico
Mean household income	Dollars	21,725	20,650	25,202	30,270
Per capita personal income	Dollars	7,594	7,517	9,020	10,850
Civilian labor force unemployment rates	Percent	35.5	23.1	21.4	17.8
People below the poverty line	Percent	51.0	59.5	47.5	45.1
Families below the poverty line	Percent	45.3	55.4	44.2	41.2
Families below the poverty line with related children under 5 years old	Percent	40.6	62.8	63.9	50.5
Families with female householder, no husband present, below the poverty line	Percent	81.7 [a]	65.1 [b]	59.4 [c]	58.1 [d]

Sources: U.S. Census Bureau, 2010a and 2012

[a] In Central Aguirre, 23.8 percent of households have a female householder with no husband present.

[b] In Salinas, 23.4 percent of households have a female householder with no husband present.

[c] In Guayama, 24.4 percent of households have a female householder with no husband present.

[d] In Puerto Rico overall, 22.6 percent of households have a female householder with no husband present.

4.8.3 Commercial Fisheries

Commercial fishing in Puerto Rico has been in decline since the middle of the 1980s, and declines in total catch have continued in recent years. Between 2007 and 2010 commercial fishing declined in Puerto Rico due to a number of factors, including overfishing, fewer active commercial fishermen, the economic recession, higher gas prices, and implementation of stricter fishing regulations by the DNER. Total reported landings within Puerto Rico declined from approximately 1.24 million pounds (562,500 kg) in 2007 to approximately 1.11 million pounds (499,000 kg) in 2010 (Matos-Caraballo et al., 2011). Information regarding the total landings located specifically within the municipalities of Guayama and Salinas was not readily available.

According to Puerto Rico Law 278 of November 29, 1998, which is known as Puerto Rico's Fishing Law, a full-time commercial fisher is a person that receives 50 percent or more of his/her income from fishing activity, while a part-time commercial fisher receives between 49 and 20 percent of his/her income from fishing activity. In accordance with the Puerto Rico Fishing Law, full-time and part-time fishermen must submit their income to the Internal Revenue Service in order to receive a commercial fisher license. However, many fishermen do not obtain a commercial fishing license because they do not want to file income taxes or complete monthly sales tax reports for their fishing income (Matos-Caraballo and Agar, 2011). Table 4.8.3-1 summarizes the number of commercial fishermen in Puerto Rico by percentage of income from fishing activity based on information obtained from both licensed and unlicensed commercial fishermen, as collected by NMFS and the Commercial Fisheries Statistics Program of the DNER (Matos-Caraballo et al., 2011). As shown in table 4.8.3-1, approximately 88 percent of active commercial fishermen on the southern coast could be considered full time.

TABLE 4.8.3-1

Number of Commercial Fishermen by Percentage of Income Generated by Fishing Activity Within Puerto Rico

Location	Number of Fishermen	Percentage of Income from Fishing			
		100-75	74-50	49-20	Less than 20
North Coast	162	45	48	43	26
East Coast	155	91	17	26	45
South Coast	233	139	65	16	15
West Coast	318	230	62	18	15
TOTAL	**868**	**505**	**192**	**103**	**101**

Source: Matos-Caraballo and Agar, 2011

As of 2008, an estimated 868 commercial fishermen were active in Puerto Rico, including 51 fishermen in the Guayama and Salinas area (see table 4.8.3-2). This total was down approximately 295 fishermen from 2002 (Matos-Caraballo and Agar, 2011). The total number of commercial fishermen within the Project area since 2008 is not available. There are six fishing villages managed by the Puerto Rico Department of Agriculture within 5 miles of the Project area (see section 4.7.5).

TABLE 4.8.3-2

Number of Commercial Fishermen Within Guayama and Salinas

Municipality	Full Time [a]	Part Time [b]	Average Age (years)
Guayama	11	4	39
Salinas	25	11	55

Source: Matos-Caraballo and Agar, 2011

[a] Full time is defined as a person who earns 50 percent or more of his/her income from fishing activities.

[b] Part time is defined as a person who earns between 49 and 20 percent of his/her income from fishing activities.

4.8.4 Tourism and Coastal Recreation

Tourism plays a significant role in the Puerto Rican economy. In 2005, Puerto Rico drew approximately 3,686,000 visitors, which contributed approximately $3.2 billion to the Commonwealth's economy (NationMaster, 2013). In addition to contributing to Puerto Rico's economy, tourism supports thousands of jobs. In May 2013, Puerto Rico had approximately 75,500 jobs in leisure and hospitality (Bureau of Labor Statistics, 2013a). In 2012, leisure and hospitality workers in Salinas and Guayama had average annual salaries of $11,266 and $11,490, respectively (Bureau of Labor Statistics, 2013b). Leisure and hospitality labor statistics specifically for Central Aguirre are not available.

Coastal recreation in Salinas and Guayama includes boating, fishing, wildlife viewing, kayaking, diving, golf, and swimming/sunbathing at beaches (see section 4.7.4). Estimates of recreational fishing harvests were prepared by the DNER Marine Recreational Fisheries Statistics Program in collaboration with NMFS from 2000 to 2013. Starting in 2014, they are being prepared solely by NMFS. According to NMFS, the total recreational fishing harvest in Puerto Rico has been generally declining from 2002 to 2012 (see table 4.8.4-1), in part due to emigration effects, increasing popularity of catch and release, and also ongoing overharvest of the resource. Approximately 120,000 residents and between 20,000 and 40,000 non-residents participate in marine recreational fishing each year in Puerto Rico. These anglers contributed over $72,400,000 into the local economy in 2011 in direct purchases alone (Lovell et al., 2011).

TABLE 4.8.4-1

Total Harvest of Recreational Fisheries for Puerto Rico (2002 to 2012)

Year	Total Harvest (number of fish)	Total Harvest (pounds) [kilograms]
2002	1,266,495	2,454,351 (1,113,275)
2003	1,527,092	3,767,579 (1,708,945)
2004	870,977	2,149,865 (975,162)
2005	923,948	1,973,897 (895,345)
2006	664,881	2,402,422 (1,089,720)
2007	1,067,644	2,375,686 (1,077,593)
2008	1,341,256	1,911,312 (866,957)
2009	663,593	1,166,187 (528,974)
2010	392,623	784,068 (355,647)
2011	387,306	891,662 (404,451)
2012	477,678	1,245,676 (565,029)

Source: NMFS, 2013a

4.8.5 General Impact and Mitigation

The construction and operation of the Project would have minor impacts on the existing socioeconomic conditions within the Project area. Potential impacts on populations could arise due to incoming workers associated with the Project. However, these impacts would be localized and temporary and would be limited to the influx of non-local workers and their family members.

The construction and operation of the Project is not anticipated to have an effect on rental and occupancy rates. Construction workers would be housed onboard the construction barges, and post-construction population levels in the Project area are expected to remain consistent with pre-construction levels, as the number of workers required to operate the facility would require only a minimal number of local employees. As the Project construction and operational activities would occur mainly offshore, the Project is not anticipated to have a noticeable effect on local infrastructure such as schools, fire and police departments, and medical facilities. Temporary and permanent hires would increase tax revenue in the area and may lower unemployment rates within the local communities proximate to the Project site.

We conclude that implementation of the Project would not result in any disproportionately high and adverse human health or environmental effects on minority or low-income communities. Rather, the Project would result in improved air quality by converting the fuel for the Aguirre Plant to natural gas. The surrounding communities to the Aguirre Plant currently experience emissions from the fuel oil burned at the plant. Therefore, the conversion to natural gas would benefit this low-income community.

Construction activities would have the potential to interfere with some commercial fishing sites and vessels in transit to fishing sites due to safety zone exclusions from active construction sites. However, consultations with commercial fishermen in Salinas and Guayama provided by Aguirre LLC state that commercial fishing does not occur in most of the Project area (Ortiz, et al., 2012). Construction activities could also interfere with recreational boating and fishing in the area due to increased vessel traffic in and around Jobos Bay. Based on the limited footprint of the proposed construction activities, it is anticipated that commercial and recreational vessel operators would have the ability to safely navigate and avoid construction activities.

In addition to the potential impacts on commercial and recreational fishing and boating, construction and operation of the Project may affect subsistence fishermen in the area. The Comité Diálogo Ambiental commented that subsistence fishing does occur within the Project area. As mentioned previously, construction activities would limit subsistence fishing near the construction areas and vessels in transit to fishing sites due to exclusion from active construction sites. However, given that there are alternative fishing areas that could be accessed during construction and the relatively small construction and operational footprint of the pipeline in and around Jobos Bay, we anticipate that these effects would be minor and short-term.

Operation of the Project would have direct minor impacts on the boating, fishing, and other marine uses in the Jobos Bay area as well around the FSRU and LNG carriers. The USCG LOR Analysis (appendix B, section 1) describes and recommends measures that would include posting the subsea pipeline area on NOAA navigational charts informing mariners of the submerged pipeline and noting it as a risk for anchoring as well as a risk with vessels with a deep draft. In addition, the USCG LOR Analysis recommends a safety zone of 500 yards (457 m) around the platform and a moving 100-yards (92 m) safety zone for all LNG carriers entering the surrounding areas of Jobos Bay while on approach and departure to the offshore terminal. The safety zone is discussed in more detail in section 4.11. Recreational and commercial vessels would not be able to enter the safety zone without permission from the COTP. This safety zone would essentially preclude boating, fishing, and other marine uses in the area. Boating, fishing, and other marine uses would experience direct but minor impacts due to the operations of the Project.

4.9 CULTURAL RESOURCES

Cultural resources include all buildings, sites, districts, structures, features, objects, or landscapes that have been created by or associated with humans and are considered to have historical or cultural value (National Park Service, 1998). Section 106 of the NHPA, as amended (16 USC 470-470t), requires federal agencies to take into account the effects of their undertakings (including authorizations under Section 3 of the NGA) on cultural resources listed or eligible for listing in the NHPA and to afford the ACHP the opportunity to comment on the undertaking. In Puerto Rico, the Institute of Puerto Rican Culture serves as the State Historic Preservation Office (SHPO). Aguirre LLC, as a non-federal party, is assisting the FERC in meeting its obligations under Section 106 by preparing the necessary information, analyses, and recommendations as authorized by 36 CFR 800.2(a)(3). As a part of the Federal Consistency evaluation, the PRPB will consult the Puerto Rico Culture Institute and request its comments and endorsement according to its responsibilities in the administration of enforceable CZMP policies.

The Area of Potential Effects for the onshore portion of the Project would occur within the existing fenced Aguirre Plant property. The Project proposes to disturb a small upland portion (approximately 1.5 acres [1.5 cuerdas]) of the industrial site during the construction of the onshore receiving facility and utilization of the temporary construction staging and support area. The offshore construction would include the construction right-of-way and temporary workspace for the 4.1-mile-long (6.7 km) subsea pipeline and the construction area for the offshore berthing platform. The marine survey for the Project encompassed these areas.

Aguirre LLC conducted archival research and marine surveys of the proposed Project area to identify cultural resources including locations for potential prehistoric and historic archaeological sites.

4.9.1 Archival Research

A database review was conducted at the SHPO and Institute of Puerto Rican Culture to identify previously recorded archaeological and architectural resources eligible for listing or listed in the NRHP within both the terrestrial and marine portions of the Project area. The archival research for the terrestrial portion of the Project included a one-mile (1.6 km) radius of the existing fenced Aguirre Plant property. No sites were identified within the APE. The NRHP-listed Central Aguirre Historic District is located outside of the Project area but within the viewshed of the Project.

Archival research for the underwater portion of the Project included a database review at the SHPO and Institute of Puerto Rican Culture to identify previously recorded submerged resources eligible for listing or listed in the NRHP. The database review indicated that no submerged cultural resources investigations have been conducted within the study area. Nor have any submerged resources been previously documented. Additional sources were reviewed to identify possible wrecks or obstructions within the study area, including NOAA’s National Ocean Service, Automated Wreck and Obstruction Information System and Office of Coast Survey Historical Map and Chart Collection, as well as data gathered through oral interviews. The survey indicated that no previously identified historic shipwrecks would be impacted by the Project.

4.9.2 Cultural Resources Investigations

4.9.2.1 Terrestrial Investigation

Background research documented that the 1.5 acre (1.5 cuerdas) area within the Aguirre Plant property has been disturbed as a result of past construction activities and modern shoreline filling. Aguirre LLC did not conduct an archeological survey because of the low potential for intact cultural deposits. In a letter dated August 15, 2012, the SHPO concurred that no archaeological survey is necessary. We concur as well.

The Central Aguirre Historic District is approximately 500 feet (152 m) northeast of the Project area. The Central Aguirre Historic District, constructed by the Central Aguirre Sugar Company between 1899 and 1964, represents the only surviving example of an autonomous planned community in Puerto Rico. At the time this historic district was listed in the NRHP, the Aguirre Power Plant was identified as an element affecting the visual setting of the district (National Park Service, 2002). Aguirre LLC believes that the Project has little potential to further impact the visual setting of the historic district. In an email dated February 7, 2013, the SHPO commented that the Central Aguirre Historic District does not appear to be affected by this undertaking. We concur.

4.9.2.2 Marine Investigation

The marine APE includes about 155 acres (160 cuerdas) of submerged land that could be affected by the construction and operation of the subsea pipeline and the offshore berthing platform. Aguirre conducted an archeological survey of the Project area through remote sensing using a combination of magnetometer, sidescan sonar, single and multi-beam echo sounders, and sub-bottom profiler technologies.

The water depths in the Project area range from 0 feet/meters at the pipeline landfall to a maximum of 70 feet (21 m) near the receiving facility. Because the shoreline at 7,000 years before present was 32 feet (10 m) lower than modern levels, prehistoric archaeological sites could be present above that depth contour. Therefore, the seafloor was mapped to identify those areas, as well as to ensure the towed systems would not damage the seafloor. Only the pipeline corridor within Jobos Bay falls above the 32 feet (10 m) contour. That area was analyzed for landforms or features that could contain prehistoric archaeological sites. Two areas that may represent sediment beds older than 7,000 years before present were identified; however, the data did not indicate that any features indicative of a site were present.

The magnetometer survey transects were closely spaced to facilitate the detection of early historic exploration and colonization vessels since their signatures tend to be small. In an initial survey, 57 magnetic anomalies were identified in the survey area and of these, 10 anomalies were recommended for further evaluation to determine their eligibility for listing in the NRHP. An addendum survey was performed for a route change, and an additional anomaly was identified for further evaluation. In a letter dated October 3, 2012, the SHPO concurred with the recommendations and strategy for evaluative testing of the anomalies.

Aguirre LLC completed the evaluative testing in March 2013, prepared a report of findings in April 2013, and submitted a copy to the SHPO for review in June 2013. The archaeological assessment of these 11 anomalies determined that they are modern marine debris and therefore are not recommended eligible for listing in the NRHP. We are currently waiting on SHPO comments on the evaluation report.

4.9.3 Unanticipated Discoveries

Aguirre LLC prepared a plan to be used in the event any unanticipated terrestrial or submerged historic properties or human remains are encountered during construction. The plan provides for the notification of the SHPO in the event of any discovery. The SHPO provided comments and requested changes to the plan on October 3, 2012. Aguirre LLC revised the plan in June 2013 to address the SHPO's comments (see appendix G). We approve the plan.

4.9.4 Cultural Resources Consultations

Aguirre LLC consulted with the SHPO between July 2012 and February 2013 concerning the definition of the APE, evaluation of NRHP eligibility, assessment of Project effects, and cultural groups that have designated Traditional Cultural Properties that could be affected by the Project. No Indian tribes with historic ties to the Project area were identified. Additionally, no known Traditional Cultural Properties are within the Project area.

4.9.5 General Impact and Mitigation

Because we have not received SHPO comments on the evaluative testing, compliance with Section 106 of the NHPA has not been completed for the proposed Project. To ensure that the FERC's responsibilities under the NHPA and its implementing regulations are met, **we recommend that:**

- **Aguirre LLC not begin construction of facilities or use of staging areas <u>until</u>:**

  a. Aguirre LLC files with the Secretary the SHPO's comments on the evaluative testing report;

  b. the ACHP is provided an opportunity to comment on the undertaking if historic properties would be adversely affected; and

  c. the FERC staff reviews and the Director of OEP approves all cultural resources survey reports and plans, and notifies Aguirre LLC in writing that construction may proceed.

  All material filed with the Secretary containing location, character, and ownership information about cultural resources must have the cover and any relevant pages therein clearly labeled in bold lettering: "CONTAINS PRIVILEGED INFORMATION – DO NOT RELEASE."

4.10 AIR QUALITY AND NOISE

4.10.1 Air Quality

This section describes the potential air quality effects associated with the Aguirre Offshore GasPort Project. In addition, existing laws and regulations relevant to air quality are described.

Air quality impacts would also result from the conversion of the Aguirre Plant from fuel oil to natural gas. We discuss the Aguirre Plant emissions and the cumulative air quality impacts of the Project and the Aguirre Plant in section 4.12.2.2.

4.10.1.1 Existing Ambient Air Quality

The CAA, as amended in 1997 and 1990, and codified at 40 CFR 50-99, was enacted by Congress to protect the health and welfare of the public from the adverse effects of air pollution. The CAA directed the EPA to establish National Ambient Air Quality Standards (NAAQS) for certain criteria air pollutants. The EPA has promulgated NAAQS for seven air pollutants, including nitrogen dioxide (NO_2), SO_2, particulate matter (2.5 micrometers or less [$PM_{2.5}$] and 10 micrometers or less [PM_{10}]), CO, ozone, and lead.

In December 2009, EPA updated the definition of air pollution to include six greenhouse gases (GHG) after determining that GHGs in the atmosphere can endanger public health and welfare. The GHGs include CO_2, methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. GHGs can be ranked by their global warming potential (GWP), which is a relative measure of a GHG's ability to absorb solar radiation and its residence time in the atmosphere in comparison to that of CO_2. Thus, CO_2 has a GWP of 1. In comparison, CH_4 has a GWP of 25, and N_2O has a GWP of 298.[9]

The NAAQS include both "primary" and "secondary" standards. The primary standards are intended to protect human health; the secondary standards are intended to protect public welfare from any known or anticipated adverse effects associated with the presence of air pollutants, such as damage to vegetation. The more stringent of the primary or secondary standards are applicable to the evaluation of a proposed project. The NAAQS for various durations of exposure are summarized in table 4.10.1-1. Some states have developed more stringent state ambient air quality standards; Puerto Rico does not have such standards and defers to the NAAQS. The EQB will be responsible for review and issuance of permits for Project stationary sources including location approval, construction and operating permit, and Title V permit, as applicable. EPA Region 2, headquartered in New York City, is responsible for PSD permits and is the review authority of the Title V permit, if applicable. As outlined below, PSD permit requirements are not expected to apply to the Project. The EQB permit will evaluate and incorporate all laws and regulations that ensure the protection of the NAAQS and compliance with all air quality regulations.

In addition to the NAAQS, there are many other federal regulations promulgated by the EPA that could potentially be applicable to the Project. These regulations are described in the following subsections.

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9 On November 29, 2013, the EPA revised GWPs for GHGs to reflect more accurate GWPs from the Intergovernmental Panel for Climate Change Fourth Assessment Report to better characterize the climate impacts of individual GHGs and to ensure continued consistency with other U.S. climate programs, including the Inventory U.S. Greenhouse Gas Emissions and Sinks. More information is available in Volume 78 of the Federal Register, Issue 230.

Air Quality Control Regions (AQCR) were established by the EPA and local agencies in accordance with Section 107 of the CAA, as a means to implement the CAA and comply with the NAAQS through State Implementation Plans. The AQCRs are intra- 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. Each AQCR, or portion thereof, is designated as attainment (areas in compliance with the NAAQS), unclassifiable, maintenance, or nonattainment (areas not in compliance with the NAAQS). Areas where the ambient air pollutant concentration is determined to be below the applicable ambient air quality standard are designated attainment. Areas where no data are available are designated unclassifiable and are treated as attainment areas for the purpose of stationary source air permitting. Areas where the ambient air concentration is greater than the applicable ambient air quality standard are designated nonattainment. Areas that have been designated nonattainment but have since demonstrated compliance with the ambient air quality standard(s) are designated maintenance for that pollutant.

TABLE 4.10.1-1

National Ambient Air Quality Standards

Pollutant	Averaging Period	Primary Standard	Secondary Standard
SO_2	Annual [a,k]	0.03 ppm (80 μg/m^3)	--
	24-Hour [b,k]	0.14 ppm (365 μg/m^3)	--
	3-Hour [b]	--	0.5 ppm (1300 μg/m^3)
	1-Hour [i,j]	75 ppb (196 μg/m^3)	--
PM_{10}	24-Hour [d]	150 μg/m^3	150 μg/m^3
$PM_{2.5}$	Annual [e]	12.0 μg/m^3	15 μg/m^3
	24-Hour [f]	35 μg/m^3	35 μg/m^3
CO	8- Hour [b]	9 ppm (10,000 μg/m^3)	--
	1- Hour [b]	35 ppm (40,000 μg/m^3)	--
Ozone	8- Hour (2008 Standard) [g]	0.075 ppm (150 μg/m^3)	0.075 ppm (150 μg/m^3)
	8-Hour (1997 Standard) [g,h]	0.08 ppm (157 μg/m^3)	0.08 ppm (157 μg/m^3)
NO_2	Annual [a]	53 ppb (100 μg/m^3)	53 ppb (100 μg/m^3)
	1-Hour [c]	100 ppb (188 μg/m^3)	--
Lead	Rolling 3-month [a]	0.15 μg/m^3	0.15 μg/m^3

[a] Not to be exceeded.
[b] Not to be exceeded more than once per year.
[c] Compliance based on 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area.
[d] Not to be exceeded more than once per year on average over 3 years.
[e] Compliance based on 3-year average of weighted annual mean $PM_{2.5}$ concentrations at community-oriented monitors.
[f] Compliance based on 3-year average of 98th percentile of 24-hour concentrations at each population-oriented monitor within an area.
[g] Compliance based on 3-year average of fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area.
[h] The 1997 8-hour ozone standard and associated implementation rules remain in place as the transition to the 2008 standard occurs.
[i] Compliance based on 3-hear average of 99th percentile of the daily maximum 1-hour average at each monitor within an area.
[j] The 1-hour SO_2 standard was effective as of August 23, 2010.
[k] The 24-hour and annual average primary standards for SO_2 have been revoked but remain in effect until 1 year after attainment designations are made for the 1-hour and 3-hour standards.

Notes: ppm = parts per million by volume; ppb = parts per billion by volume; μg/m^3 = micrograms per cubic meter.

The attainment status designations appear in 40 CFR 81. The area in the vicinity of the Project has been designated as “unclassifiable” or better than national standards for all criteria pollutants. Table 4.10.1-2 lists the attainment status for each designated area in the vicinity of the Project. The EPA

AirData Interactive Map tool (EPA, 2014a) was used to locate existing monitoring data near the Project site, and the most recent 3 years of data available are presented in table 4.10.1-3.

TABLE 4.10.1-2

Attainment Status for the Aguirre Offshore GasPort Project Area

Pollutant	Designated Area	Designation
SO_2	Puerto Rico AQCR	Attainment
CO	Commonwealth-wide	Unclassifiable/Attainment
Ozone (8-hour standard)	Commonwealth-wide	Unclassifiable/Attainment
NO_2 (1971 annual standard)	Puerto Rico AQCR	Unclassifiable/Attainment
NO_2 (2010 1-hour standard)	Salinas County	Unclassifiable/Attainment
PM_{10}	Rest of Commonwealth	Unclassifiable/Attainment
$PM_{2.5}$ (Annual NAAQS)	Salinas County	Unclassifiable/Attainment with respect to 15 μg/m^3 standard (EPA expects to designate with respect to the 12 μg/m^3 standard by December 2014)
$PM_{2.5}$ (24-hour NAAQS)	Salinas County	Unclassifiable/Attainment
Lead (2008 NAAQS)	Rest of Commonwealth	Unclassifiable/Attainment

TABLE 4.10.1-3

Ambient Air Quality Concentrations for Areas Near the Aguirre Offshore GasPort Project

Pollutant	Averaging Period	Rank	2011	2010	2009	Units	Monitor(s) [a]
CO	1-Hour	2nd high	16.3	2.9	9.4	ppm	A
	8-Hour	2nd high	4.3	2.4	2.8	ppm	A
NO_2	Annual	Mean	N/A	N/A	N/A	ppb	B
	1-hour	2nd high	N/A	N/A	N/A	ppb	B
Ozone	8-hour	4th high	0.037	0.035	0.043	ppm	C
$PM_{2.5}$	24-hour	98th percentile	13.7	24.2	16.6	μg/m^3	D
	Annual	Mean	5.4	8.0	5.3	μg/m^3	D
PM_{10}	24-hour	2nd high	55	120	58	μg/m^3	D
SO_2	1-hour	2nd high	20	13	25	ppb	E
	3-hour	2nd high	0.0143	0.0126	0.0146	ppm	E
	24-hour	2nd high	0.0127	0.0109	0.0035	ppm	E
	Annual	Mean	0.0030	0.0042	0.0041	ppm	E
Lead	Quarterly	Maximum	N/A	N/A	N/A	μg/m^3	A

[a] Monitor Key:
A = Baldorioty de Castro Av, San Juan, San Juan County (monitor no. 72-127-0003)
B = Road No. 3, Salinas, Salinas County (monitor no. 72-123-0001)
C = Rd. 183, Juncos County (monitor no. 72-077-0001)
D = Barrio Jobos, Intersection of Highways 3 & 707, Guayama County (monitor no. 72-057-0008)
E = Rd. 2 Final Las Mareas, Salinas County (monitor no. 72-123-0002)

Notes: μg/m^3 = micrograms per cubic meter; ppm = parts per million; ppb = parts per billion; N/A = data not available

The data presented in table 4.10.1-3 demonstrate continued compliance with all NAAQS. In some instances the ambient air quality concentrations differ from those used to represent "background" or "design" air quality values for use with air quality modeling results, in accordance with EPA-recommended modeling procedures, to evaluate projected Project impacts relative to the NAAQS.

4.10.1.2 Regional Climatology

The climate of Puerto Rico is classified as tropical. The Aguirre region of Puerto Rico has an average annual high of 87.9 °F (31.1 °C) and an average annual low of 70.9 °F (21.6 °C), additionally on average the Aguirre area receives 39.7 inches (100.9 cm) of rain (National Weather Service, 2013). Monthly mean wind speeds for the South of Puerto Rico (years 1862 to 1973) peak during December-January at 14 mph (23 km/h) and are weakest in October at 11 mph (18 km/h) (NOAA, 2008). The island of Puerto Rico is subject to potential storms during the Atlantic hurricane season, which lasts from June through November each year. A storm with tropical-storm-strength winds passes over the island roughly once every 5 years, and a hurricane- strength storm crosses the island roughly once per decade (Andrews, 2007).

4.10.1.3 Air Quality Regulations

Federal

The CAA comprises the basic federal statute and regulation governing air pollution. The provisions of the CAA that are potentially relevant to the proposed Project include the following:

- New Source Review;
- Prevention of Significant Deterioration;
- Title V operating permit;
- Compliance Assurance Monitoring;
- New Source Performance Standards (NSPS);
- Federal Standards for Designated Facilities and Pollutants;
- National Emission Standards for Hazardous Air Pollutants (NESHAP);
- Greenhouse Gas Reporting;
- Chemical Accident Prevention and Provisions; and
- General Conformity.

<u>New Source Review</u>

Proposed new or modified air pollutant emissions sources must undergo a New Source Review (NSR) permitting process prior to construction or operation. Through the NSR permitting process, local, state, and federal regulatory agencies review and approve project construction plans, regulated pollutant increases or changes, emissions controls, and various other details. The agencies then issue construction permits that include specific requirements for emissions control equipment and operating limits. Once construction is complete, the sources are issued operating permits that specify detailed operating conditions, emissions limits, fees, reporting and recordkeeping requirements, and various other operating parameters that must be met throughout the life of the permit. The three basic categories of NSR permitting are PSD, Nonattainment NSR, and Minor Source NSR. The applicability of each NSR permitting process depends on the attainment status of a project location, and whether the project source(s) exceed specific emissions thresholds established in local, state, and federal regulations. The EPA evaluates all stationary source emissions of criteria pollutants during development of the preconstruction permit to determine whether a project is subject to major or minor NSR requirements. The proposed Aguirre Offshore GasPort Project is located in an attainment area for all criteria pollutants; therefore, Nonattainment NSR does not apply to the Project.

Prevention of Significant Deterioration

PSD regulations are intended to preserve the existing air quality in attainment areas where pollutant levels are below the NAAQS. In addition to requiring an extensive review of environmental impacts, viable emissions-control technologies, and related impacts, PSD regulations impose specific limits on the amount of pollutants that major new or modified stationary sources might contribute to existing air quality levels.

The EPA uses a three-part test to determine the scope of a stationary source. Under 40 CFR 52.21(b)(5) and (6), a single stationary source includes all of the pollutant emitting activities that:

1. belong to the same industrial grouping;
2. are located on one or more contiguous or adjacent properties; and
3. are under the control of the same person (or persons under common control).

The Aguirre Plant is an existing "major source" of criteria air pollutants. Pre-construction permitting review of a physical change to (or change in the method of operation of) an existing major stationary source is required under the federal PSD program if the change meets the criteria for a "major modification." If the change results in an increase and a net increase in the annual emission rate of any of the pollutants regulated under the PSD program greater than their respective significant emissions rates, then the change is considered "major" and PSD review requirements are triggered. Aguirre LLC is proposing to install new units at the Offshore GasPort that would introduce emissions increases. A detailed discussion of PSD permitting requirements and the Aguirre Plant and Offshore GasPort is in section 4.12.2.2.

PREPA filed a PSD Non-Applicability Application with the EPA; the EQB has also been provided a courtesy copy for its evaluation. In its application, PREPA asserts that the proposed Project should be considered part of the Aguirre Plant because the Offshore GasPort would be constructed to store and supply natural gas to the Aguirre Plant. Estimated emission reductions at the Aguirre Plant along with federally enforceable permit conditions for all Project equipment have been proposed at an emissions level that would render a PSD review inapplicable. The EPA issued its finding on May 6, 2014 that the Aguirre Power Plant and the proposed Project would not be subject to PSD requirements, provided that certain permit conditions are included in the EQB construction permits for both the Aguirre Power Complex and the Project.

Title V Operating Permit

Operating permits are legally enforceable documents that permitting authorities issue to air pollution sources after the source has begun to operate. The operating permit is designed to improve compliance by clarifying what facilities (sources) must do to control air pollution. Under the EPA's delegation, the EQB is the permitting authority for the Title V operating permit program in Puerto Rico. The proposed Project is subject to Title V operating permit requirements (including the Title V portion of the EPA's Greenhouse Gas Tailoring Rule) and because the Offshore GasPort and the Aguirre Plant would be permitted as one stationary source, the modification to the Aguirre Plant's current Title V operating permit is considered a "significant modification." The Aguirre Plant is currently operating under the CAA Title V Operating Permit PFE-TV-4911-63-0796-0005.

On November 5, 2013, the EPA issued a letter noting that the Offshore GasPort would be capable of unloading 183 billion standard cubic feet of natural gas per year; however, potential emissions were calculated based on an annual unloading amount of 159 billion standard cubic feet per year. On May 6, 2014, the EPA asserted that a permit condition be included in the EQB construction permit for the Project that would limit the unloading amount of LNG to 159 billion standard cubic feet per year, to which PREPA agreed. PREPA will submit a modification to its existing Title V permit to include the conditions in the RCAP Part 203 Permit to Construct when it is issued.

Compliance Assurance Monitoring

As mentioned above, the FSRU would be subject to a Title V Operating Permit, each FSRU boiler would have uncontrolled nitrogen oxides (NO_x) emissions in excess of the major source threshold (100 tons per year [tpy]) (91 metric tons per year [mtpy]), and each FSRU boiler would be using add-on control equipment to comply with a NO_x emissions limit. Therefore, the boilers would be subject to the Compliance Assurance Monitoring requirements of 40 CFR 64 unless the Title V permit specifies a continuous compliance method.

New Source Performance Standards

The EPA has established NSPS at 40 CFR 60 that regulate air pollutant emissions from certain categories of stationary sources. In addition to the General rules in Subpart A, equipment within the Project would be subject to certain other subparts as identified below. Based on past precedent, emission sources onboard the LNG carriers delivering cargo are exempt from applicability under NSPS because they are not stationary sources. The NSPS requirements are therefore only applicable to emission sources on the FSRU and the terminal platform.

Subparts Ce, Ec, CCCC, DDDD EEEE, and FFFF – Standards of Performance for Incinerators

Subparts Ce, Ec, CCCC, DDDD, EEEE, and FFFF can apply to small stationary source incinerators, with the applicability of each depending upon the age of the incinerator and the type of material being incinerated. The FSRU and visiting LNG carriers can be equipped with shipboard incinerators, typically relatively small (e.g., 10 tons per day capacity). LNG carrier incinerators are not "stationary sources" and are therefore exempt from these requirements. The incinerator on the FSRU would not be utilized while the FSRU is at the Offshore Gasport, and therefore these subparts do not apply to the Project. Permit conditions will ensure compliance with this subpart.

Subpart Db – Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units

Subpart Db applies to steam generating units constructed, reconstructed, or modified after June 19, 1984 with a heat input capacity of greater than 100 MMBtu/hour. A "steam generating unit" is defined in this Subpart as a device that combusts any fuel and produces steam or heats water or heats any transfer medium. The boilers on visiting LNG carriers are not "stationary" and are not subject to this rule. The main boilers and auxiliary boiler on the FSRU would have a heat input capacity of at least 100 MMBtu/hour; however, when each boiler was constructed, it met the definition of a "temporary boiler" ("...designed to, and...capable of being carried or moved from one location to another..."), which is not subject to Subpart Db (per 40 CFR 60.40b(m)). Since NSPS applies to stationary sources at the time of construction, reconstruction, or modification, and anchoring or docking the marine vessel that the boilers are installed on does not constitute an act of construction, reconstruction, or modification, the NSPS in Subpart Db do not apply to the boilers on the FSRU.

Subpart Dc – Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units

Subpart Dc (40 CFR 60.41c) applies to stationary source boilers constructed, reconstructed, or modified after June 9, 1989 with a heat input capacity of between 10 and 100 MMBtu/hour. The inert gas generator onboard the LNG carriers has a heat input capacity within this range but does not heat water or a heat transfer medium and therefore does not meet the definition of "steam generating unit."

Subpart Kb, Standards of Performance for Volatile Organic Liquid Storage Vessels

Subpart Kb applies to storage vessels constructed, reconstructed, or modified after July 23, 1984 with a capacity greater than or equal to 19,813 gallons (75 m^3) that are used to store a volatile organic liquid, which is any organic liquid which can emit VOCs (as defined in 40 CFR 51.100) into the atmosphere. The FSRU and LNG carriers would include tanks of various sizes for storage of LNG, fuel oil, lubricants, and waste oil. However, storage vessels permanently attached to mobile vehicles, including ships, are exempt from Subpart Kb under 40 CFR 60.110b(d)(3). The terminal platform would include several small storage tanks for fuel oil, lubricants, and waste oil, each with a capacity far less than 19,813 gallons (75 m^3). As the Project would not include any volatile organic liquid storage tanks having a capacity greater than 75 m^3 that meet the applicability outlined in 40 CFR 60.110b, Subpart Kb is not applicable to the Project.

Subpart IIII – Stationary Compression Ignition Internal Combustion Engines

Subpart IIII applies to owners and operators of stationary compression ignition internal combustion engines that commence construction after July 11, 2005 where the stationary compression ignition internal combustion engines are manufactured after April 1, 2006 and are not fire pump engines, or manufactured as a certified NFPA fire pump engine after July 1, 2006. The two diesel platform gensets and two diesel fire pumps would be subject to Subpart IIII and compliance would be assured by purchasing engines that are certified by the manufacturers to meet the corresponding emissions standards, per 40 CFR 60.4211(c). The duel-fuel diesel electric (DFDE) and other small engines (e.g., emergency generator, lifeboat engines, etc.) onboard the FSRU and visiting LNG carriers are not stationary internal combustion engines. Subpart IIII defines a "stationary combustion engine" as excluding nonroad engines. A nonroad engine, as defined in 40 CFR 1068.30 section (1)(i), specifically includes engines that are used in or on a piece of equipment that is self-propelled. There is an exclusion in section (2)(iii) of the definition of "nonroad engine" that applies to engines remaining at a single location for more than 12 consecutive months, but that exclusion only applies to engines meeting section (1)(iii) of the definition – i.e., those that are "portable or transportable, meaning designed to be and capable of being carried or moved from one location to another" – and not the engines on self-propelled equipment described in section (1)(i) of the definition.

Subpart IIII only applies to owners and operators of stationary engines that "commence construction" (or were modified or reconstructed) after July 11, 2005, and defines "commence construction" as the date the engine was ordered [40 CFR 60.4200(a)]. In this case, construction was never commenced on a stationary engine on the date that the engine was ordered (through the current time); the engine was and still is a nonroad engine. Anchoring or docking the marine vessel that the engines are installed on does not constitute an act of ordering the engine (commencing construction), modification, or reconstruction, and therefore, Subpart IIII would not apply to the engines on the FSRU. Because this situation is relatively unique, it was discussed with EPA Region 2 by conference call on November 19, 2012; EPA Region 2 agreed with this interpretation (Kennedy, 2012).

Subpart JJJJ – Stationary Spark Ignition Internal Combustion Engines

Subpart JJJJ applies to owners and operators of stationary spark ignition internal combustion engines that are ordered after June 12, 2006 where the stationary spark ignition internal combustion engines are manufactured after a specified date (for engines smaller than 500 horsepower (hp) such as those proposed here, the date is July 1, 2008). The two spark ignition internal combustion engines platform gensets would be subject to Subpart JJJJ and would meet the corresponding emissions limits (1.0 grams per horsepower-hour [g/hp-hr] NO_x, 2.0 g/hp-hr CO, 0.7 g/hp-hr volatile organic compounds [VOC]). The DFDE and other spark ignition engines on the FSRU are not stationary engines since they are classified as nonroad engines, as described in the prior subsection on Subpart IIII. Thus, the FSRU engines are not subject to Subpart JJJJ, as verified by EPA in Excelerate Energy's April 11, 2013 letter (Riva, 2013).

Subpart OOOO – Crude Oil and Natural Gas Production, Transmission and Distribution

Subpart OOOO rule regulates emissions of VOCs and SO_2 from facilities constructed or modified after August 23, 2011. The rule addresses emissions limits and work practice standards for completions of hydraulically fractured gas wells, pneumatic devices, compressors, and tanks.

The Offshore GasPort does not include any oil wells or gas wells and does not sweeten or otherwise process (e.g., dehydrate, fractionate, etc.) the gas, and therefore does not have any "process units" and is not an "affected facility" under §60.5365(a)-(d) or (f)-(h) of Subpart OOOO.

Although under Subpart OOOO the storage vessels on the FSRU meet the regulatory applicability definition of "storage vessel," the applicable requirements for storage vessels only apply to storage vessels at well sites with VOC emissions greater than 6 tons (5.4 metric tons) per year [§60.5395(a)]. Since there are no well sites at this facility (and LNG has negligible VOC emissions), these requirements do not apply.

Federal Standards for Designated Facilities and Pollutants

Subparts HHH, III, and JJJ of 40 CFR 62 include requirements that can potentially apply to incinerators, with the applicability of each depending upon the age of the incinerator and what exactly is being incinerated. The FSRU and visiting LNG carriers can be equipped with shipboard incinerators, which typically are relatively small (e.g., 10 tons per day [9 metric tons per day] capacity). LNG carrier incinerators are not "stationary sources" and are therefore exempt from these requirements. The incinerator on the FSRU would not be utilized while the FSRU is at the Offshore GasPort. Therefore, Subparts HHH, III, and JJJ do not apply to the Offshore GasPort.

National Emission Standards for Hazardous Air Pollutants

The NESHAP, codified in 40 CFR Parts 61 and 63, regulate hazardous air pollutant (HAP) emissions. Part 61 was promulgated prior to the 1990 CAA Amendments and regulates only eight types of hazardous substances (asbestos, benzene, beryllium, coke oven emissions, inorganic arsenic, mercury, radionuclides, and vinyl chloride). The proposed Project is not in one of the source categories regulated by Part 61; therefore, the requirements of Part 61 are not applicable.

The 1990 CAA Amendments established a list of 189 HAPs, resulting in the promulgation of Part 63. Part 63, also known as the Maximum Achievable Control Technology standards, regulates HAP emissions from both major sources of HAP emissions and non-major (area) sources of HAP emissions within specific source categories. Part 63 defines a major source of HAP as any "stationary source or group of stationary sources located within a contiguous area and under common control" that has the potential to emit 10 tpy (9 mtpy) of any single HAP or 25 tpy (23 mtpy) of HAPs in aggregate. For the same reasons identified in the discussion of PSD applicability above, the Offshore GasPort is being considered as "within a contiguous area and under common control" with the Aguirre Plant. The latter alone is a major source of HAPs and this fact does not change as a result of implementing the Offshore

GasPort Project; therefore, the combination of the Offshore GasPort and Aguirre Plant is also a major source of HAP.

Subpart Y – National Emission Standards for Marine Tank Vessel Loading Operations

Subpart Y (40 CFR 63.561) establishes requirements for existing major sources of HAPs and for new marine vessel loading operations at major HAP sources and area (non-major) sources of HAP. Subpart Y defines marine vessel loading operations as "any operation under which a commodity is bulk loaded onto a marine tank vessel from a terminal, which may include the loading of multiple marine tank vessels during one loading operation." However, this subpart does not apply to marine tank vessel loading operations at loading berths that only transfer liquids containing organic HAP as impurities. As defined in this subpart, "impurity" means HAP substances that are present in a commodity or that are produced in a process coincidentally with the primary product or commodity and that are 0.5 percent total HAP by weight or less. Also, the impurity does not serve a useful purpose in the production or use of the primary product or commodity and is not isolate. The HAP compounds present in LNG are only impurities and, therefore, Subpart Y does not apply to the Project.

Subpart EEE – Hazardous Waste Incineration

Subpart EEE can apply to the incineration of "hazardous waste." The definition of "hazardous waste" is complex but specifically excludes household waste, including any material (i.e. garbage, trash, and sanitary wastes in septic tanks) derived from households (including crew quarters) [40 CFR 261.4(b)(1)]. The FSRU and visiting LNG carriers can be equipped with shipboard incinerators, typically relatively small (e.g., 10 tons per day [9 metric tons per day] capacity). The FSRU's incinerator would not be operated at the Offshore GasPort, and visiting LNG carriers would be required to not incinerate anything at the Offshore GasPort other than "household waste" as described above. Therefore, Subpart EEE does not apply to the Project.

Subpart ZZZZ – NESHAP for Stationary Reciprocating Internal Combustion Engines

Subpart ZZZZ applies to stationary reciprocating internal combustion engines. The platform engines would be "new" (commencing construction on or after June 12, 2006) and because the gensets are all 500 hp or smaller, there are no additional requirements under Subpart ZZZZ (i.e., compliance with the Subpart IIII NSPS is all that Subpart ZZZZ requires for these engines). The platform fire pump engines may be larger than 500 hp in which case they would be subject to the applicable requirements under Subpart ZZZZ and meet the requirements for "emergency stationary reciprocating internal combustion engines" (no more than 100 hours/year of non-emergency operation, no more than 50 of which can be for operations other than maintenance checks and readiness testing). For the engines on the FSRU, as with NSPS Subpart IIII, this subpart defines a "stationary reciprocating internal combustion engine" as excluding nonroad engines (as defined in 40 CFR 1068.30). For the same reasons identified in NSPS Subpart IIII, the FSRU engines are considered nonroad engines and should not be subject to Subpart ZZZZ. Because this situation is relatively unique, confirmation of this interpretation was requested of EPA Region 2 and EPA confirmed this interpretation by letter dated April 11, 2013 (Riva, 2013).

Subpart DDDDD – NESHAP for Industrial, Commercial, and Institutional Boilers and Process Heaters

Subpart DDDDD can apply to industrial, commercial, and institutional boilers that are located at a major source of HAPs. The LNG carrier boilers meet the definition of "temporary boilers" in 40 CFR

63.7575 and are therefore exempt per section 63.7491(j). As identified in the Subpart DDDDD revisions[10], the definition of "temporary boiler" excludes boilers that (1) are attached to a foundation; (2) that remain at a location within the facility and performs the same or similar function for more than 12 consecutive months (any temporary boiler that replaces a temporary boiler at a location and performs the same or similar function would be included in calculating the consecutive time period), unless the regulatory agency approves an extension (which may be granted by the regulating agency upon petition by the owner or operator of a unit specifying the basis for such a request); (3) that are located at a seasonal facility and operate during the full annual operating period of the seasonal facility, remain at the facility for at least 2 years, and operate at that facility for at least 3 months each year; or (4) are moved from one location to another within the facility but continue to perform the same or similar function and serve the same electricity, steam, and/or hot water system in an attempt to circumvent the residence time requirements of the definition. Therefore, Aguirre LLC is assuming that the FSRU boilers do not meet the definition of "temporary boilers" and would be subject to Subpart DDDDD. EPA Region 2 concurred with this interpretation as well (Kennedy, 2012).

As the FSRU boilers would have been constructed prior to June 4, 2010, they would be subject to the Table 2 standards applicable to "existing" boilers (per 40 CFR 63.7490). Because oil would be required to light boiler burners for more than 48 hours per year, the boilers are in the "Unit designed to burn liquid" subcategory. Because the Project is in Puerto Rico, each boiler is the subcategory of "Unit designed to burn liquid fuel that is a non-continental unit." During normal operation (when boil-off gas is being fired, with or without oil used for burner lighting), the boilers would meet all applicable limits. If gas supply is curtailed and the FSRU needs to operate on oil only, AP-42 emission factors indicate that emissions of hydrogen chloride could potentially exceed the applicable limits. If a situation of gas curtailment were projected to arise, Aguirre LLC would commit to analyzing the oil for chlorine content before using it in the boilers.

The inert gas generator on FSRU does not meet the definition of "boiler" or "process heater" in section 63.7575 (i.e., its purpose is not to recovery thermal energy or transfer heat) and therefore is not subject to Subpart DDDDD.

Subpart JJJJJJ – NESHAP for Industrial, Commercial, and Institutional Boilers Area Sources

Subpart JJJJJJ applies to new or existing boilers located at an area source of HAPs. The definition of an area source for this regulation means any source of HAPs that is not a major source. Because the Aguirre Plant is a major source of HAPs, Subpart JJJJJJ is not applicable.

Greenhouse Gas Reporting

On November 8, 2010, the EPA signed a rule that finalizes reporting requirements for the petroleum and natural gas industry under 40 CFR 98. Subpart W of 40 CFR 98 requires petroleum and natural gas facilities that have actual GHG emissions of 25,000 metric tons or more of carbon dioxide equivalent (CO_2e) per year to report annual emissions of specified GHGs from various processes within the facility and conduct associated monitoring. LNG storage and LNG import and export equipment are considered part of the source category regulated by Subpart W. Therefore, if actual emissions from the Aguirre Plant or the Offshore GasPort exceed the 27,500 ton (25,000-metric ton) threshold, it would be required to comply with all applicable requirements of the rule.

[10] See volume 78 of the Federal Register, page 7192 (January 31, 2013).

Chemical Accident Prevention Provisions

LNG facilities are subject to DOT safety regulations (e.g., 49 CFR 193 and 33 CFR 127). Section 112(r) of the CAA and associated EPA regulations (40 CFR 68) apply to owners or operators of stationary sources producing, processing, handling, or storing toxic or flammable substances. However, the EPA's General Counsel has clarified that Section 112(r) and the associated regulations do not apply to LNG facilities to the extent that these facilities transport such substances, or store them incident to transportation (Klee, A. 2003). Aside from LNG, which would be stored incident to transportation, the Project would not be storing hazardous or flammable substances in excess of any thresholds identified in 40 CFR 68, and therefore those regulations do not apply. Aqueous urea would be used for the selective catalytic reduction (SCR) systems, rather than ammonia, and would be stored in tanks onboard the FSRU. 40 CFR 68 does not apply to the storage of aqueous urea, because it is not a listed substance under Section 112(r). However, for these tanks, the 112(r)(1) general duty clause does apply:

> The owners and operators of stationary sources producing, processing, handling or storing [hazardous] substances have a general duty in the same manner and to the same extent as section 654, title 29 of the United States Code, to identify hazards which may result from [accidental] releases using appropriate hazard assessment techniques, to design and maintain a safe facility taking such steps as are necessary to prevent releases, and to minimize the consequences of accidental releases which do occur.

Aguirre LLC would take steps necessary to meet the general duty provisions above at the Offshore GasPort.

General Conformity

General conformity regulations in 40 CFR 93, Subpart B can only apply to areas designated as "nonattainment" or "maintenance" areas with respect to the NAAQS. Table 4.10.1-2 lists the attainment designations for the Project area. None of the areas in the vicinity of the Project are designated as "nonattainment" with respect to any pollutant. No areas are "maintenance" areas for any pollutant either. Therefore, the general conformity regulations do not apply.

International MARPOL Annex VI

The IMO created MARPOL in 1973, and has subsequently promulgated Annex VI, Regulations for the Prevention of Air Pollution from Ships, which was adopted in 1997 and which became effective in 2005. MARPOL Annex VI applies to all ships and regulates emissions of NO_x and sulfur oxides. Regulation 13 of Annex VI establishes NO_x limits for marine diesel engines. The DFDE on the FSRU is subject to the Tier I NO_x limit for marine diesel engines constructed between the dates of January 1, 2000 and January 1, 2011. The emission limit is based on the rated engine speed (n), and is calculated using the formula $45*n_{-0.2}$ grams per kilowatt hour (g/kWh), when *n* is 130 or more but less than 2,000 revolutions per minute. The DFDE has a rated speed of 720 revolutions per minute, resulting in a Tier I NO_x limit of 12.1 g/kWh. The FSRU DFDE can currently comply with this limit.

Regulation 14 of Annex VI establishes limits on the sulfur content of any fuel used onboard ships. Fuel sulfur content is limited to 3.5 percent by weight on or after January 1, 2012, and 0.5 percent by weight on or after January 1, 2020. Regulation 14 also establishes certain Emission Control Areas (ECA) that have lower sulfur content limits. Currently, established ECAs have a sulfur in fuel limit of 1 percent by weight except for vessels with approved exhaust gas cleaning systems or any other technological method to meet a sulfur oxides limit equivalent to the sulfur in fuel limit. Vessels operating in ECAs must use fuel with a sulfur content less than or equal to 0.1 percent beginning January 1, 2015.

A Caribbean ECA was designated in July of 2011, which includes the coastal waters within 50 nautical miles of the coast of Puerto Rico. Sulfur in fuel limits in this new ECA became effective on January 1, 2014. Therefore, in 2014, vessels in the Project area would need to limit sulfur in fuel to 1 percent (unless they have an approved exhaust cleaning system) and on January 1, 2015, would need to limit sulfur in fuel to 0.1 percent (unless they have an approved exhaust cleaning system). These provisions have the potential to affect the LNG carriers delivering cargo to the Offshore GasPort and potentially the FSRU. Importantly, this amendment for ECAs has an exemption for ships built on or before August 1, 2011 that are powered by propulsion boilers that were not originally designed for continued operation on marine distillate fuel or natural gas. Vessels in the EBRV fleet fall into this category. For these vessels, the 0.1 percent sulfur requirements may not be applied prior to January 1, 2020.

Regulation 16 of Annex VI establishes international requirements for shipboard incineration, including prohibitions on incinerating certain types of materials and continuous outlet temperature monitoring while the incinerator is operating. Both the FSRU and LNG carriers would adhere to the applicable requirements of this regulation.

Puerto Rico/Local

The EQB is the permitting authority for air emissions from the Project not subject to PSD. The EQB has promulgated air quality requirements in their Regulations for the Control of Atmospheric Pollution. Below is a description of the potentially applicable local air quality requirements.

Rule 201 Location Approval

All new major stationary sources, or major modifications of existing sources, must obtain a location approval from the EQB prior to construction. In order to obtain a location approval, it must be demonstrated that the location is “propitious” with respect to existing air quality, locate climate and meteorology, existing land use, and effects on nearby ecological sensitive areas. Proposed emissions must not violate any applicable NAAQS for pollutants in attainment of the standards, or exceed significant impact levels for any non-attainment pollutants. Proposed emissions must be limited by means of Best Available Control Technology for attainment pollutants, and by means of Lowest Achievable Emission Rate technology for any non-attainment pollutants.

Rule 202 Air Quality Impact Analysis

When required by the EQB, an air quality impact analysis shall be performed, demonstrating that the proposed emissions, in conjunction with all other applicable emission increases or reductions, would not significantly cause or contribute to air pollution in violation of any NAAQS. See Section 4.10.1.5 of this analysis for a discussion of predicted air quality impacts.

Rule 203 Permit to Construct

All new sources or modifications of existing sources shall apply for and receive a Rule 203 Permit to construct prior to beginning construction. As part of the federal permitting process, the PREPA would provide the information required under Rule 203 for construction permit applications, including a certification by a professional engineer licensed in Puerto Rico that the technical information is true and complete. The Project would comply with Rule 203 and obtain a Permit to Construct.

Rule 204 Permit to Operate

Rule 204 requires sources to obtain an operating permit prior to commencing operation. However, sources that are required to obtain a permit under the federal Title V Operating Permit program are exempt from the requirements of this rule. PREPA will submit to the EPA a modification to its existing Title V permit to include the Project.

Rule 206 Exemptions

Rule 206 lists a number of activities that are exempt from the requirement to obtain a construction permit under Rule 203 or an operating permit under Rule 204. A variety of exempt activities such as air conditioning, ventilation systems, kitchen equipment, and cleaning equipment would be present on the FSRU, terminal platform, and LNG carriers.

Rule 403 Visible Emissions

Stationary sources are limited to visible emissions of no more than 20 percent opacity, except that visible emissions up to 60 percent opacity are permitted for up to 4 minutes in any consecutive 30-minute interval. Compliance shall be determined using the test methods in Rule 106, which incorporates the methods of 40 CFR 60 by reference, and requires the submittal of a test protocol to EQB for approval. Visible emissions from maritime vessels are limited to 20 percent opacity, while anchored or moored at any port, pier, dock, harbor, or bay in the Commonwealth of Puerto Rico, except that visible emissions up to 60 percent opacity are permitted for up to 4 minutes in any consecutive 30-minute interval. Compliance shall be determined using EPA Reference Methods 9 or 9A.

Rule 404 Fugitive Emissions

No person shall cause or permit any materials to be handled, transported, or stored in a building, its appurtenances, or a road to be used, constructed, altered, repaired, or demolished, without taking reasonable precautions to prevent particulate matter from becoming airborne. The Project is expected to comply with Rule 404 and would take the appropriate measures to control and prevent particulate matter gains access to the atmosphere.

Rule 405 Incineration

Rule 405 requires non-hazardous solid waste incinerators to complete performance tests, comply with an emissions limit, and submit training certificates to EQB. The FSRU would be equipped with a small incinerator for disposal of various wastes, but this would not be operated at the Offshore GasPort. While most LNG carriers would also be equipped with a shipboard incinerator, it is understood that shipboard incinerators are not subject to Rule 405. This would be confirmed with EQB; if they are subject to Rule 405, Aguirre LLC may require that LNG carriers either not operate their shipboard incinerators while at the Offshore GasPort, or else comply with all applicable requirements of Rule 405.

Rule 406 Fuel Burning Equipment

Rule 406 limits emissions of particulate matter from any type of fuel burning equipment to 0.30 pound per MMBtu. All Project emissions sources would comply with this limit.

Rule 410 Maximum Sulfur Content in Fuels

For any fuel burning equipment constructed after the effective date of this rule, a fuel sulfur content of 2.5 percent by weight shall not be exceeded, provided that this would not result in the violation of any NAAQS. For any fuel burning equipment with a heat input capacity greater than 8 MMBtu/hour, the owner or operator must request a sulfur percent assignment from the EQB. All Project emissions sources would comply with this limit and if exceeds the limit would request a sulfur percent assignment from the EQB.

Rule 412 Sulfur Dioxide Emissions

No person shall cause or allow the emission of sulfur compounds into the air, expressed as SO_2, with a concentration greater than 1,000 ppm (1,000 mg/L) by volume, and standard conditions and corrected to 21 percent O_2. All Project emissions sources would comply with this limit.

Rule 417 Storage of Volatile Organic Compounds

VOC storage tanks larger than 151,412 liters (40,000 gallons) must either be pressurized, be equipped with a floating roof, or be equipped with a vapor recovery and disposal system. Storage tanks are exempt from these requirements if used to store a liquid with a true vapor pressure of less than 0.75 psi absolute. The FSRU, terminal platform, and LNG carriers would have various storage tanks for diesel oil, heavy fuel oil (HFO), and lubricating oils. All of these substances have vapor pressures less than 0.75 psi absolute and are, therefore, exempt from this rule.

Rule 420 Objectionable Odor

As enforceable by the State under Rule 420, no person shall cause or permit emission to the atmosphere of matter which produces an "objectionable" odor that can be perceived on an area other than that designated for industrial purposes. The Offshore GasPort is not expected to emit to the atmosphere matter which produces an "objectionable" odor that can be perceived on an area other than that designated for industrial purposes (note: the minimum distance to a human receptor is 1.7 miles [2.7 km]). If odors are detectable beyond the property perimeter, and complaints are received, Aguirre LLC would investigate and take measures to minimize and/or eliminate odors as necessary.

Title V Operating Permits

Rules 601 through 605 describe the requirements for applying for and issuing Title V operating permits for new major stationary sources. The Aguirre Plant is currently operating under the CAA Title V Operating Permit PFE-TV-4911-63-0796-0005. PREPA will submit a modification to this Title V permit to the EPA to include the Project.

4.10.1.4 Construction Emissions Impact and Mitigation

Construction of the Project is anticipated to take approximately 12 months. Only a small portion of the construction emissions occur on land because the facility would consist primarily of subsea and offshore structures. Estimated construction emissions by Project component are described below.

Subsea Interconnecting Pipeline and Offshore Terminal

Pipeline construction would involve various vessels with specialized construction capabilities, as well as other vessels to support construction activities. These vessels would include a crew/supply boat, spud barge, lay barge, assist tugs, survey vessel, pipe transport barge, and pipe transport tug. Construction of the pipeline would take place over a period of approximately 4 months, and is estimated to include 113 days of operation for a number of marine vessels supporting construction. Completion of the pipeline includes several other tasks, such as dive support, conducting hydrostatic testing of the pipeline, and performing an as-built survey.

For the offshore berthing platform, Aguirre LLC would pursue the use of prefabricated modular designs, made up of elements fabricated under plant conditions rather than on site. Use of prefabricated elements reduces the need for onsite complex formwork operations over water. Advantages include a reduced construction schedule and smaller crews and associated marine support. Minimized labor time on-site in the marine environment reduces the temporary air pollutant emissions associated with construction activities. Construction of the offshore platform would take place over a period of approximately 11 months, and is estimated to include 200 days of operation for a derrick barge and an assist tug. Table 4.10.1-4 lists calculated pollutant emission totals for construction of the subsea pipeline and offshore platform. It is assumed that all marine engines would be in compliance with applicable marine emission standards. However, for the purpose of estimating emissions, factors from EPA's AP-42 compilation were used for criteria pollutants, and default emission factors from 40 CFR 98 were used for GHGs.

TABLE 4.10.1-4

Subsea Pipeline and Offshore Platform Construction Emissions (tons [metric tons]) for the Aguirre Offshore GasPort Project

Source	NO_x	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2	HAP	CO_2e
Crew/Supply Boat	4.4 (4.0)	1.2 (1.1)	0.11 (0.09)	0.14 (0.13)	0.14 (0.13)	0.14 (0.13)	0.007 (0.006)	224 (203)
Spud Barge	2.7 (2.4)	0.6 (0.5)	0.21 (0.19)	0.19 (0.17)	0.19 (0.17)	0.06 (0.05)	0.004 (0.003)	99 (90)
Lay Barge	42.7 (38.7)	10.6 (9.6)	1.84 (1.67)	1.88 (1.71)	1.88 (1.71)	1.26 (1.14)	0.067 (0.061)	1,987 (1,803)
Assist Tug no. 1	8.4 (7.6)	2.2 (2.0)	0.21 (1.67)	0.26 (0.24)	0.26 (0.24)	0.27 (0.25)	0.013 (0.012)	428 (388)
Pipe Transport Tug	8.4 (7.6)	2.2 (2.0)	0.21 (1.67)	0.26 (0.24)	0.26 (0.24)	0.27 (0.25)	0.013 (0.012)	428 (388)
Hydrostatic Testing	0.6 (0.5)	0.1 (0.1)	0.05 (0.05)	0.04 (0.04)	0.04 (0.04)	0.01 (0.01)	0.001 (0.001)	21 (19)
Derrick Barge	50.1 (45.4)	10.8 (9.8)	4.0 (3.6)	3.5 (3.2)	3.5 (3.2)	1.2 (1.1)	0.08 (0.07)	1,857 (1,685)
Assist Tub no. 2	152.5 (138.3)	40.5 (36.7)	3.9 (3.5)	4.8 (4.4)	4.8 (4.4)	4.9 (4.4)	0.23 (0.21)	7,796 (7,072)
Total	**269.6 (244.5)**	**68.2 (61.8)**	**10.5 (9.5)**	**11.1 (10.1)**	**11.1 (10.1)**	**8.1 (7.3)**	**0.4 (0.4)**	**12,841 (11,649)**

FSRU

Aguirre LLC would use a vessel from Excelerate Energy's existing fleet as the FSRU for the Project; therefore, no new construction emissions would result from the FSRU component of the Project.

Onshore Connection

The construction office and onshore contractor staging areas would be located on industrial land within the Aguirre Plant property. Aguirre LLC anticipates utilizing an existing pier, also within the Aguirre Plant property, with direct access to the Jobos Bay barge channel.

During offshore construction, the onshore staging area would be used for 15 weeks. Aguirre LLC estimates two delivery trips per week for a heavy diesel truck, and five trips per week for a light duty gasoline pickup truck. Table 4.10.1-5 shows the estimated vehicle miles traveled based on an estimated 25 miles (40 km) per trip.

TABLE 4.10.1-5

On-Road Vehicle Use for the Onshore Staging Area for the Aguirre Offshore GasPort Project

Vehicle	Number of Vehicles	Number of Weeks	Estimated Activity		
			Trips per Week	Miles per Trip (km)	Vehicle Miles Traveled (km)
Light-duty Gasoline Truck	1	15	5	25 (40)	1,875 (3,018)
Heavy-duty Diesel Truck	1	15	2	25 (40)	750 (1,207)

Table 4.10.1-6 shows estimated emissions for on-road vehicles and fugitive dust associated with activities in the onshore staging area. Emissions for on-road vehicles have been calculated using emission factors from MOBILE 6.2 and the Climate Registry. Fugitive dust emissions have been estimated assuming one acre of disturbed land, with a duration of 4 months each for construction and staging activities. Water spray and other dust suppression measures would be used to reduce dust emissions.

TABLE 4.10.1-6

On-Road Vehicle and Fugitive Dust Emissions (tons [metric tons]) for the Aguirre Offshore GasPort Project

Source	CO	NO_x	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2e
On-Road Vehicle Engines	0.02 (0.02)	3E-03 (3E-03)	3E-05 (3E-05)	1E-03 (1E-03)	6E-05 (6E-05)	6E-05 (6E-05)	2.29 (2.08)
Fugitive Dust					0.25 (0.23)	0.03 (0.03)	
Totals	0.02 (0.02)	3E-03 (3E-03)	3E-05 (3E-05)	1E-03 (1E-03)	0.25 (0.23)	0.03 (0.03)	2.29 (2.08)

Based on the analysis above and Aguirre LLC's proposed mitigation measures, we conclude that construction of the Project would not result in a significant impact on local or regional air quality.

4.10.1.5 Operational Emissions Impact and Mitigation

The operational air emission sources associated with the Project would include equipment on the FSRU, the terminal platform, and the LNG carriers. The assumptions used to determine annual total emissions are presented below.

FSRU

The FSRU is equipped with two main boilers, one auxiliary boiler, and one DFDE. The two main boilers, each rated at 224 MMBtu/hour, are capable of firing any combination of boil-off gas, HFO, or both fuels simultaneously. The boilers are also capable of burning a small quantity of distillate oil, for the sole purpose of starting a cold boiler. HFO would be burned during boiler startups. In the event of a cold startup, the boilers must be lit with a lighter grade of marine distillate oil until sufficient steam is available to heat HFO to the required temperature for pumping and atomization in the burners. However, the startup emission calculations assumed HFO as the only fuel throughout the startup. The main boilers would burn boil-off gas as the only fuel during routine operation, except for periodic burner lightings when both boil-off gas and HFO would be burned for a brief time, estimated as equivalent to one 30-minute period per boiler per day. The Project would also require the capability for a limited amount of HFO-firing, equivalent to 744 hours per year per boiler (which includes 48 hours of cold startup per year per boiler at approximately 33 percent load, and 696 hours per year per boiler at approximately 10 percent load, to maintain hoteling power during maintenance and periods when no LNG cargo is available). During operation on boil-off gas, the main boilers would use SCR to control NO_x emissions.

For the main boilers, the worst-case combination of operating scenarios was selected for each pollutant. For NO_x, PM_{10}, $PM_{2.5}$, SO_2, and N_2O, the worst-case annual emissions result from 7,833 hours of operation on boil-off gas with SCR at 100 percent load; 696 hours of operation on HFO at approximately 10 percent load; 48 hours of cold startups firing HFO only, at an average load of 33 percent; and 183 hours of burner lightings. For CO, VOC, HAP, ammonia, CO_2, CH_4, and CO_2e, worst-case annual emissions are based on 8,577 hours of operation on boil-off gas only, with SCR, at 100 percent load; and 183 hours of burner lightings. The emissions conservatively include all emissions from the boilers, regardless of the extent to which boiler power was used to unload LNG vs. hoteling (i.e., the latter have not been excluded). For the auxiliary boiler, 8,760 hours of operation on boil-off gas with SCR at 100 percent load are assumed.

The auxiliary boiler, rated at up to 157 MMBtu/hour, would burn regasified LNG as its only fuel. SCR would be used to control NO_x emissions at all times, except during startup and shutdown periods. During periods when insufficient LNG cargo is available to provide fuel, the auxiliary boiler would not operate.

The DFDE, rated at 4,020 kilowatts (kW), is capable of burning either marine distillate oil or regasified LNG with a small amount of marine distillate oil (approximately 1 percent of total heat input) used as pilot fuel. The DFDE would have a limited number of operating hours: approximately 365 hours per year on regasified LNG to provide electrical power for starting the high pressure send out pump, and up to 864 hours per year on either marine distillate oil or regasified LNG to provide electrical power while one or more steam turbine generators is undergoing maintenance.

The miscellaneous small engines on the FSRU include a rescue boat engine rated at 144 hp, a lifeboat with two engines rated at 29 hp each, and an emergency generator rated at 620 kW. All of these engines burn distillate oil with an assumed sulfur content of 15 ppm by weight, and during routine GasPort operations would only run for 30 minutes of testing per week. The FSRU is also equipped with a small shipboard incinerator, but this would not be used at the Offshore GasPort. To the extent that sources are associated with hoteling and other vessel functions not associated with LNG transfer, storage, or gasification—as is the case for the incinerator, emergency generator engines, and lifeboat engines—they are not considered part of the permitted stationary source under the PSD program (per EPA Region 2). However, potential emissions from the emergency generator and lifeboat engines are estimated in this analysis for disclosure purposes.

Platform Equipment

The terminal platform would be equipped with four electric generators with reciprocating engines, each rated at approximately 238 to 350 kW. Two engines would burn natural gas exclusively, and two would burn diesel oil exclusively. The engines would turn generators to provide electric power for various activities on the platform, including lighting, switches and controls, fire pumps, and other uses. The two natural gas-fired engines would be running at 100 percent load for 8,760 hours. In addition, one of the two diesel oil-fired generators would operate at 100 percent load for the duration of LNG carrier mooring, cargo transfer, and LNG carrier unmooring operations, or 2,300 hours per year. The maximum load required by platform equipment is approximately 662 kW, so only a maximum of three of the engines are expected to operate at any given time and total facility emissions are based on this. The platform would include several storage tanks for fuel oil and lubricants, which would be insignificant sources of emissions.

In addition, there would be two diesel-fired fire pump engines, each rated at approximately 525 hp. Potential emissions from the platform fire pump engines are based on 500 hours per year of operation each, at 100 percent load. However, during routine operation the fire pump engines would only run for 30 minutes of testing per week.

The vent stack located on the platform mooring dolphins would safely vent regasified LNG from various GasPort components in the event of an emergency upset condition, resulting in emissions of CH_4 and VOC. However, during normal operation all residual LNG vapors that need to be cleared from piping or other components would be recaptured and vented back into the FSRU and/or LNG carrier cargo tanks. The only non-emergency use of the vent stack would be for a once-yearly purge of the platform equipment to allow for maintenance, resulting in a very small amount of emissions. These emissions are based on the total volume of gas contained in the piping, as determined by Excelerate Energy, along with typical values for the density, CH_4 content, and VOC content of regasified LNG. (No short-term emission rate exists for this intermittent activity; see table 4.10-10 for annual estimated emissions from non-emergency venting.)

LNG Carrier Unloading

The Project would be capable of accepting LNG deliveries from any of several hundred LNG carriers operating in the worldwide fleet, ranging in cargo capacity from 125,000 to 217,000 m^3. These vessels are powered predominantly by steam boilers or by DFDE engines, with a variety of models and ratings. Potential emissions from LNG carriers are calculated based on the following assumptions.

- An average year-round natural gas send out rate of 500 MMscf/day from the FSRU, which corresponds to approximately 50 cargo deliveries from a "typical" LNG carrier with 39 million gallons (151,000 m^3) of cargo capacity. Each delivery from a "typical" LNG carrier is assumed to take approximately 30 hours.

- Two different types of LNG carrier propulsion systems were considered: steam turbine boilers fired with oil and boil-off gas; and medium-speed DFDE vessels which have the capability of firing either dual fuel (99 percent boil-off gas, 1 percent oil) or oil.

- For each pollutant, g/kWh emission factors were developed for each type of propulsion system, based on the following three fuel use scenarios: steam turbine firing 1/3 residual oil and 2/3 boil-off gas; steam turbine firing 100 percent boil-off gas; and DFDE firing 100 percent distillate oil. The worst-case emission rate for each pollutant was then selected to determine short-term and annual emissions.

- LNG would be unloaded at a rate of 1.3 million gallons per hour (5,000 m^3/hr), at an estimated power demand of 1,560 kW. The hoteling load is assumed to be 1,900 kW for steam-driven LNG carriers, and 3,000 kW for DFDE-driven LNG carriers.

Based on discussions with EPA Region 2, only the portion of LNG carrier emissions that are directly related to cargo transfer are to be included as part of the Project's emissions under the PSD program. LNG carrier hoteling emissions are estimated here for disclosure purposes.

Support Vessel

A single dedicated support vessel, approximately 150 feet (46 m) in length, would transfer supplies and personnel to and from the terminal platform. The support vessel is also assumed to have two diesel generators rated at 40 kW each, and two diesel fire pump engines rated at 873 hp each. The two small diesel generators would operate 24 hours per day, and the two fire pump engines would operate for 30 minutes of testing per week. The support vessel main engines would operate for six hours per day to transfers cargo and personnel to and from shore. While emissions from the support vessel are not included as part of the facility's emission total for PSD permitting, they are estimated here for disclosure purposes.

Support Tugs

Four tugboats, each with a rated output of 5,520 hp, would each spend a total of four hours in transit at 60 percent engine load, and four hours in mooring and unmooring activities at 69 percent engine load, for each LNG carrier that arrives at the GasPort. While emissions from the support tugs are not included as part of the facility's emissions totals for PSD permitting, they are estimated here for disclosure purposes.

Table 4.10.1-7 presents annual potential emissions for the Project.

Project Best Management Practices

In response to federal and local requirements, BMPs have been included in Project design or proposed by Aguirre LLC to reduce environmental impacts. Potential impacts of air emissions from Project operations would be reduced by incorporation of operating restrictions and use of emission reduction technologies on the FSRU to limit pollutant emissions. Project design for the offshore engines and boilers include only combusting natural gas as fuel, the use of low-NO_x combusters for the engines to achieve controlled NO_x levels at 10 ppm (10 mg/L), and SCR technology for the boilers to achieve controlled NO_x and ammonia slip levels at 15 ppm and 10 ppm (15 and 10 mg/L) respectively. These measures employ proven technology and would reduce the potential impacts of the Project on air quality.

Air Quality Impact Assessment

Offshore and Coastal Dispersion Model Analysis

The Offshore and Coastal Dispersion (OCD) model was used to assess the air quality concentrations for all criteria pollutants from the proposed Offshore GasPort Project for comparison with the NAAQS. This analysis evaluates the Offshore Gasport's stationary emission sources as well as the transitory emission sources including the tug boats and other support vessels moving within the safety zone, and the LNG carriers moving to and from the Offshore GasPort and under hoteling conditions within the safety zone. The OCD model is the model recommended by EPA for sources located over water and it uses meteorological data from both over-land and over-water weather stations.

Meteorological Data for OCD

The OCD model uses hourly over-land and over-water meteorological data to simulate the plume transport and dispersion for shoreline conditions. Data from land-based monitoring stations and water-based buoy monitoring stations representative of site conditions were input to the OCD model.

Ozone Limiting Method NO_2 Calculations

EPA guidance on 1-hour NO_2 dispersion modeling (*Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard, March 1, 2011*) describes a three-tiered screening approach for modeling 1-hr NO_2 Concentrations. Preliminary modeling indicated that the 1-hour NO_2 concentrations from all of the Offshore GasPort Project sources, using either the Tier 1 or Tier 2 approach, would result in unrealistically high predicted concentrations. Both Tier 1 and Tier 2 can predict overly conservative (high) NO_2 concentrations, in that actual atmospheric conversion processes are not adequately taken into account. Therefore, Tier 3, known as Ozone Limiting Method, was utilized to provide more realistic (but still conservative) estimates of the maximum 1-hour NO_2 concentrations.

TABLE 4.10.1-7

Annual Potential Emissions (tpy [mtpy]) for the Aguirre Offshore GasPort Project

Source	NO_x	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2	CO_2e
Boiler 1 boil-off gas (8,760 hrs)	17.8 (16.1)	21.7 (19.7)	1.0 (0.9)	7.3 (6.6)	7.3 (6.6)	0.6 (0.5)	114,642 (104,001)
Boiler 2 boil-off gas (8,760 hrs)	17.8 (16.1)	21.7 (19.7)	1.0 (0.9)	7.3 (6.6)	7.3 (6.6)	0.6 (0.5)	114,642 (104,001)
Boiler 1 HFO (696 hrs)	1.6 (1.5)	0.1 (0.1)	0.02 (0.02)	0.4 (0.4)	0.3 (0.3)	4.5 (4.1)	1,375 (1,247)
Boiler 2 HFO (696 hrs)	1.6 (1.5)	0.1 (0.1)	0.02 (0.02)	0.4 (0.4)	0.3 (0.3)	4.5 (4.1)	1,375 (1,247)
Boiler 1 Cold start-up HFO (48 hrs)	0.9 (0.8)	0.01 (0.01)	0.003 (0.003)	0.09 (0.08)	0.07 (0.06)	0.09 (0.08)	282 (256)
Boiler 2 Cold start-up HFO (48 hrs)	0.9 (0.8)	0.01 (0.01)	0.003 (0.003)	0.09 (0.08)	0.07 (0.06)	0.09 (0.08)	282 (256)
Boiler 1 Burner lighting (183 hrs)	0.4 (0.4)	0.45 (0.41)	0.02 (0.02)	0.25 (0.23)	0.22 (0.20)	1.2 (1.1)	2,767 (2,510)
Boiler 2 Burner lighting (183 hrs)	0.4 (0.4)	0.45 (0.41)	0.02 (0.02)	0.25 (0.23)	0.22 (0.20)	1.2 (1.1)	2,767 (2,510)
Boiler 1 (Worst case annual total)	18.8 (17.1)	21.7 (19.7)	1.0 (0.9)	7.3 (6.6)	7.1 (6.4)	7.1 (6.4)	115,021 (104,345)
Boiler 1 (Worst case annual total)	18.8 (17.1)	21.7 (19.7)	1.0 (0.9)	7.3 (6.6)	7.1 (6.4)	7.1 (6.4)	115,021 (104,345)
Aux Boiler (worst case)	12.7 (11.5)	30.9 (28.0)	3.8 (3.4)	5.2 (4.7)	5.2 (4.7)	0.4 (0.4)	81,566 (73,995)
Diesel Generator (worst case)	17.2 (15.6)	18.0 (16.3)	4.4 (4.0)	0.5 (0.5)	0.5 (0.5)	0.5 (0.5)	2,339 (2,176)
Platform Engine 1 (NG)	4.5 (4.1)	9.1 (8.3)	3.2 (2.9)	0.15 (0.13)	0.15 (0.13)	0.012 (0.012)	2,338 (2,121)
Platform Engine 2 (NG)	4.5 (4.1)	9.1 (8.3)	3.2 (2.9)	0.15 (0.13)	0.15 (0.13)	0.012 (0.012)	2,338 (2,121)
Platform Engine 3 (distillate oil)	0.2 (0.2)	0.2 (0.2)	0.06 (0.05)	0.01 (0.01)	0.01 (0.01)	0.004 (0.004)	547 (496)
Platform Engine 4 (distillate oil)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Platform Fire Pump 1	0.7 (0.6)	0.2 (0.2)	0.1 (0.1)	0.02 (0.02)	0.02 (0.02)	0.001 (0.001)	148 (134)
Platform Fire Pump 2	0.7 (0.6)	0.2 (0.2)	0.1 (0.1)	0.02 (0.02)	0.02 (0.02)	0.001 (0.001)	148 (134)
Fugitive Methane	N/A	N/A	N/A	N/A	N/A	N/A	220 (200)
Venting Emission	N/A	N/A	0.003 (0.003)	N/A	N/A	N/A	1 (0.9)
LNG Carrier Unloading (worst case)	31.2 (28.3)	11.8 (10.7)	2.0 (1.8)	0.5 (0.5)	0.4 (0.4)	5.8 (5.3)	2,139 (1,940)
LNG Carrier Hoteling, including safety zone movements and idling at berth (worst case)	60.0 (54.4)	22.7 (20.6)	3.9 (3.5)	0.94 (0.85)	0.84 (0.76)	7.0 (6.4)	5,297 (4,805)
Support Vessel	72.5 (65.8)	19.3 (17.3)	1.9 (1.7)	2.3 (2.1)	2.3 (2.1)	0.04 (0.04)	3,706 (3,362)
LNG Carrier Tugs (X4)	63.8 (57.9)	16.9 (15.3)	1.6 (1.5)	2.0 (1.8)	2.0 (1.8)	2.1 (1.9)	3,262 (2,959)
FSRU Misc. Engines	0.5 (0.5)	0.08 (0.07)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.0001 (0.0001)	15 (14)
Facility Totals	**354.4 (321.5)**	**200.0 (181)**	**26.1 (23.7)**	**27.1 (24.6)**	**26.5 (24.0)**	**35.7 (32.4)**	**334,579 (303,525)**

Offshore GasPort Emission Source Parameters

The OCD dispersion model impact analysis evaluated the Offshore GasPort's stationary emission sources (FSRU sources, platform sources, and LNG carrier unloading) as well as the LNG carriers hoteling emissions and the transitory emission sources operating within the safety zone (tug boats, other support vessels, and the LNG carriers moving to and from the GasPort platform within the safety zone). The emission sources parameters used for the OCD dispersion modeling analysis are presented in table 4.10.1-8.

OCD Model Results

The OCD-predicted impact concentrations for the Offshore GasPort are presented in table 4.10.1-9. Since a single year (2011) of meteorological data was used from the nearby Jobos Bay Reserve (JOXP4) meteorological monitoring station, maximum predicted impact concentrations (rather than second highest or 98 percentile concentrations) were conservatively used in the NAAQS compliance assessment. Total modeled concentrations plus ambient background concentrations are less than all corresponding NAAQS. Therefore, the operation of the Offshore Gasport is not expected to cause or contribute to a violation of any of the NAAQS and would not have a significant impact on air quality.

Based on the analysis above and the proposed mitigation measures, we conclude that operation of the Project would not result in significant impacts on air quality.

GHG Emission Impacts

For assessment of the Project's GHG impact and potential significance, emissions were compared to data from the EPA Greenhouse Gas Reporting Program, which received GHG emission reports from about 8,000 facilities in 2011, covering all 50 states plus the District of Columbia, Guam, Puerto Rico, and the U.S. Virgin Islands (EPA, 2013). Twenty-eight of these reporting facilities were in Puerto Rico, and included most of the island's major power plants as well as a number of landfills (which are major emitters of CH_4, a potent GHG) and several other industrial facilities. The total GHG emissions reported in 2011 from these 28 Puerto Rico facilities was 18,540,844 tons (16,819,970 metric tons) of GHG mass, or 55,577,807 tons (50,419,338 metric tons) when converted to CO_2e. The future annual potential emissions from the GasPort component of the Project are equal to 0.6 percent of Puerto Rico's reported GHG emissions for 2011; therefore, the relative impact and potential significance of the Project's potential GHG emissions is very small in comparison to other existing emission sources.

Fugitive CH_4 emissions from leaking valves, pump seals, connectors, and flanges on both the FSRU and the terminal platform are based on facility component counts, and assume that one percent of components are leaking. The EQB may require a Leak Detection and Repair Program for these fugitive CH_4 emissions. Emission rates for leaking components are based on emission factors in 40 CFR 98 Subpart W for LNG import and export equipment.

TABLE 4.10.1-8

OCD Model Emissions and Exhaust Parameters for Offshore GasPort Modeled Sources

Source Description	NO_x (lb/h [g/s])	CO (lb/h [g/s])	PM_{10} / $PM_{2.5}$ (lb/h [g/s])	SO_2 (lb/h [g/s])	Stack Height (ft [m])	Stack Temp (F[K])	Stack Diameter (ft [m])	Exit Velocity (ft/s [m/s])	Stack Angle (Deg)	Grd-level Elev (ft [m])
Boiler 1 [a]	4.9 (0.62)	5.0 (0.63)	1.7 (0.21)	3.1 (0.39)	122.7 (37.4)	352 (451)	4.6 (1.4)	69.6 (21.2)	45	0.0
Boiler 2 [a]	4.9 (0.62)	5.0 (0.63)	1.7 (0.21)	3.1 (0.39)	122.7 (37.4)	352 (451)	4.6 (1.4)	69.6 (21.2)	45	0.0
Auxiliary Boiler [b]	2.9 (0.37)	7.1 (0.89)	1.2 (0.15)	0.1 (0.012)	122.7 (37.4)	392 (473)	4.6 (1.4)	68.2 (20.8)	45	0.0
DFDE Generator [c]	11.5 (1.45)	29.3 (3.69)	0.2 (0.03)	0.2 (0.03)	122.7 (37.4)	626 (603)	2.3 (0.7)	93.8 (28.6)	45	0.0
Platform Engine Gas 1 [d]	1.0 (0.13)	2.1 (0.26)	0.0 (0.0043)	0.0 (0.00034)	20.0 (6.1)	892 (751)	0.7 (0.2)	122.0 (37.2)	0	52.5 (16.0)
Platform Engine Gas 2 [d]	1.0 (0.13)	2.1 (0.26)	0.0 (0.0043)	0.0 (0.00034)	20.0 (6.1)	892 (751)	0.7 (0.2)	122.0 (37.2)	0	52.5 (16.0)
Platform Engine Oil 1 [d]	0.2 (0.026)	0.2 (0.0198)	0.0 (0.0013)	0.0 (0.00047)	20.0 (6.1)	899 (755)	0.7 (0.2)	91.2 (27.8)	0	52.5 (16.0)
LNG Carrier Steam Turbine Unloading + Hoteling [e]	N/A	N/A	N/A	17.1 (2.16)	122.7 (37.4)	320 (433)	4.6 (1.4)	15.1 (4.6)	45	0.0
LNG Carrier Steam Turbine Safety Zone + Idling [f]	N/A	N/A	N/A	1.3 (0.16)	122.7 (37.4)	311 (428)	4.6 (1.4)	8.2 (2.5)	45	0.0
LNG Carrier Medium-speed Dual-fuel Diesel (MSD) Unloading + Hoteling [g]	121.7 (15.33)	46.0 (5.8)	1.9 (0.24)	N/A	122.7 (37.4)	682 (634)	4.6 (1.4)	35.1 (10.7)	45	0.0
LNG Carrier MSD Safety Zone + Idling [h]	11.0 (1.38)	4.1 (0.52)	0.2 (0.02)	N/A	122.7 (37.4)	682 (634)	4.6 (1.4)	23.0 (7.0)	45	0.0
Support Vessel + Tugs (20% of total mass emissions) [i]	6.2 (0.78)	1.7 (0.21)	0.2 (0.025)	0.1 (0.012)	19.7 (6.0)	590 (583)	0.7 (0.2)	65.6 (20.0)	45	0.0
Support Vessel + Tugs (40% of total mass emissions) [i]	12.5 (1.57)	3.3 (0.42)	0.4 (0.049)	0.2 (0.024)	19.7 (6.0)	590 (583)	0.7 (0.2)	65.6 (20.0)	45	0.0
Support Vessel + Tugs (40% of total mass emissions) [i]	12.5 (1.57)	3.3 (0.42)	0.4 (0.049)	0.2 (0.024)	19.7 (6.0)	590 (583)	0.7 (0.2)	65.6 (20.0)	45	0.0

[a] Boilers 1 and 2 emissions are average annualized emission rates based on 7,833 hours on boil-off gas, 696 hours on HFO, 183 hours of burner lightings, and 48 hours of start-up.

[b] Auxiliary boiler emissions are average annualized emission rates based on 8,724 hours on boil-off gas and 36 hours of start-up.

[c] DFDE generator emissions are based on maximum hourly emissions under normal dual fuel operation.

[d] Platform engine emissions are based on maximum hourly emissions.

[e] LNG Carrier steam turbine unloading and hoteling emissions are based on maximum hourly emissions of the steam turbine propulsion LNG carriers at berth (higher than MSD emissions for SO_2).

[f] LNG Carrier steam turbine safety zone and idling emissions are based on annual average emissions for operation of the steam turbine propulsion LNG carriers within the safety zone (higher than MSD emissions for SO_2).

[g] LNG Carrier MSD unloading and hoteling emissions are based on maximum hourly emissions of the medium speed diesel propulsion LNG carriers at berth (higher than steam turbine emissions for NO_x, CO, and particulate matter).

[h] LNG Carrier MSD safety zone and idling emissions are based on annual average emissions for operation of the medium speed diesel propulsion LNG carriers within the safety zone (higher than steam turbine emissions for NO_x, CO, and particulate matter).

[i] Support Vessel and Four Tug emissions assume three locations along the platform, one location for the support vessel, and two locations with two co-located tugs each.

Notes: g/s = grams per second; m = meter; K =Kelvin; m/s= meters per second; Deg= degree

TABLE 4.10.1-9

Cumulative OCD Model Results for All Aguirre GasPort Project Sources Combined with Ambient Background for Comparison with NAAQS

Pollutant	Averaging Period	Maximum Predicted OCD concentration [μg/m³]	Ambient Background (μg/m³)	Total Concentration (μg/m³)	NAAQS (μg/m³)
CO	1-hour	147.8	18,370	18,517.8	40,000
CO	8-hour	96.4	4,846	4,942.4	10,000
NO_2	1-hour	128.9	56.4	185.3	188
NO_2	Annual	16.3	27.5	43.8	100
$PM_{2.5}$	24-hour	5.0	18.2	23.2	35
$PM_{2.5}$	Annual	3.8	6.2	10.0	12
PM_{10}	24-hour	5.0	77.5	82.5	150
SO_2	1-hour	42.6	50.7	93.3	196
SO_2	3-hour	36.6	38.3	74.9	1300
SO_2	24-hour	17.5	33.3	50.8	365
SO_2	Annual	3.0	11.0	14.0	80

4.10.2 Noise

This section describes the potential noise effects associated the Aguirre Offshore GasPort Project. Noise is expected to be generated during both construction and operation of the Project. The potential effects of both in-air and underwater sound are considered. Refer to Section 4.5.3.3 for a discussion on the hydro acoustic (underwater) impacts of the Project. The following sections discuss in-air sound, existing conditions and regulations, and how noise generated from the construction and operation of the Project may contribute to the acoustic environment and means to mitigate these impacts on NSAs where necessary.

4.10.2.1 Principles of 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. Decibels are the units of measurement used to quantify the intensity of noise. To account for the human ear's sensitivity to low level noises the decibel values are corrected to weighted values known as decibels on the A-weighted scale (dBA). Table 4.10.2-1 shows the relative dBA noise levels of common sounds measured in the environment and industry.

The equivalent sound level (L_{eq}) is the preferred single value figure to describe sound levels that vary over time, it is defined as the sound pressure level of a noise fluctuating over a period of time, expressed as the amount of average energy. The 24-hour average A-weighted equivalent sound level of the measured daytime L_{eq} and nighttime L_{eq} is known as the day-night noise level (L_{dn}). For the L_{dn}, 10 dB are added to the sound levels occurring during the nighttime hours of 10PM to 7AM to account for the increased sensitivity of people to nighttime noise and the typically quieter ambient conditions during this time period.

TABLE 4.10.2-1

Sound Pressure Levels (LP) and Relative Loudness

Noise Source or Activity	Sound Level (dBA)	Subjective Impression	Relative Loudness (perception of different sound levels)
Jet aircraft takeoff from carrier (50 feet)	140	Threshold of pain	64 times as loud
50-hp siren (100 feet)	130		32 times as loud
Loud rock concert near stage / Jet takeoff (200 feet)	120	Uncomfortably loud	16 times as loud
Float plane takeoff (100 feet)	110		8 times as loud
Jet takeoff (2,000 feet)	100	Very loud	4 times as loud
Heavy truck or motorcycle (25 feet)	90		2 times as loud
Garbage disposal / Food blender (2 feet) / Pneumatic drill (50 feet)	80	Loud	Reference loudness
Vacuum cleaner (10 feet)	70	Moderate	1/2 as loud
Passenger car at 65 mph (25 feet)	65		
Large store air-conditioning unit (20 feet)	60		1/4 as loud
Light auto traffic (100 feet)	50	Quiet	1/8 as loud
Quiet rural residential area with no activity	45		
Bedroom or quiet living room / Bird calls	40	Faint	1/16 as loud
Typical wilderness area	35		
Quiet library, soft whisper (15 feet)	30	Very quiet	1/32 as loud
Wilderness with no wind or animal activity	25	Extremely quiet	
High quality recording studio	20		1/64 as loud
Acoustic test chamber	10	Just audible	
	0	Threshold of hearing	

Source: Barnes and Laymon, 1977 and EPA, 1971.

[a] Noise sources or activities with no information in the subjective impression column have been included to demonstrate the doubling effect between 10 dBA intervals.

4.10.2.2 Regulatory Requirements

Regulations or ordinances were identified that would be applicable to the Project under the FERC and the EQB. The following noise limits are understood to apply to all normal operations at the Aguirre GasPort and are further described in the following subsections.

Federal

The Health and Welfare with an Adequate Margin of Safety (EPA, 1974) publication evaluates the effects of environmental noise with respect to health and safety. The document provides information for state and local governments to use in developing their own ambient noise standards. The EPA has 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 (18 CFR 157.206(b)(5)) for new compression and associated pipeline facilities, and it is used here to evaluate the potential noise affects from operation of the Offshore GasPort. An L_{dn} of 55 dBA is equivalent to a continuous noise level of 48.6 dBA for facilities that operate at a constant level of noise.

Regulations (18 CFR 380.12(k)) require that the noise attributable to any new installation (i.e., new compressor stations and associated pipeline facilities or other FERC-jurisdictional facilities) at any preexisting NSA, unless such NSAs are established after facility construction, be quantified. NSAs include schools, hospitals, and residences. Other federal regulations that pertain to noise beyond the immediate work environment include the Noise Emission Standards for Construction Equipment in 40 CFR 204 and Noise Emission Standard for Transportation Equipment in 40 CFR 205.

State and Local

In accordance with the Public Environmental Policy Act (Act Number 416 of September 22, 2004), the EQB has enacted regulations with the primary purpose of establishing standards to minimize damage to the environment and to establish checkpoints for activities that produce pollution. In 2001, the Legislature of Puerto Rico approved the Noise Prohibition Act as a regulation to eliminate noise pollution harmful to the health or welfare of the residents of the Commonwealth of Puerto Rico and establish clear aquatic noise level criteria. This act identifies the EQB as the main local agency for the enforcement of noise regulations on the island. The EQB Regulation 3418 for the Control of Noise Pollution (Reglamento para el Control de la Contaminación por Ruidos de la Junta de Calidad Ambiental, versión enmendada 2011) contains established standards and requirements for the control, reduction, or elimination of noise that might be harmful to health and disrupt public welfare. The EQB noise regulation prescribes noise emission limits for different receptor zones, noise emissions levels from motor vehicles, and procedures relating to noise level measurements. The EQB noise level limits applicable to the Project are summarized in table 4.10.2-2.

TABLE 4.10.2-2

Puerto Rico Environmental Quality Board Noise Emission Limits (dBA)

	Receiving Land Use Type							
	Zone I Residential		Zone II Commercial		Zone III Industrial		Zone IV Tranquility	
Emitting Source	Day	Night	Day	Night	Day	Night	Day	Night
Zone I	60	50	65	55	70	60	55	50
Zone II	65	50	70	60	75	65	55	50
Zone III	65	50	70	65	75	75	55	50
Zone IV	65	50	70	65	75	75	55	50

For the purposes of this acoustic assessment, all NSAs (with the exception of NSA 6, which is unclassified) were assumed to be located within receiving land use type Zone I which corresponds to residential. This assumption results in a conservative assessment approach as the noise emission limits for receptors in Zone I are the most stringent limits as prescribed by the EQB for NSAs located within the study area, with a nighttime limit of 50 dBA. There are no Zone IV receiving land use types classified as areas of tranquility identified within the acoustic study area. As the Project may operate at any time during the day or night, the more stringent nighttime permissible sound level becomes the controlling limit for the future operational condition.

According to EQB regulation, adjustments to the regulatory noise limits are allowable depending on the levels of existing background noise. Allowable adjustments to the EQB noise regulation are defined as follows:

- if existing (ambient) sound levels are less than the EQB noise level limits by more than 10 dBA, then no adjustment to the limits are made;
- if the difference between the EQB noise level limits and the existing (ambient) sound levels is between 6 and 10 dBA, then 1 dBA is added to the noise levels limits;
- if the difference between the EQB noise level limits and the existing (ambient) sound levels is between 3 and 6 dBA, then 2 dBA are added to the noise levels limits; and

- if the difference between the EQB noise level limits and the existing (ambient) sound levels is between 0 and 6 dBA, then 3 dBA are added to the noise levels limits.

The EQB also provides guidance on noise generated during construction activities. The regulation restricts the use and operation of construction equipment or the performing of demolition work that generates noise exceeding the applicable limits as prescribed in table 4.10.2-4, except in an emergency situation or if a waiver is obtained from the EQB for special circumstances.

4.10.2.3 Existing Ambient Noise Conditions

A baseline sound survey was completed to document the existing ambient in-air sound levels in proximity to select NSAs within the Project area. An inventory of receptors within a radius of about 5 miles (8 km) of the proposed Offshore GasPort was completed prior to the baseline survey. A field reconnaissance and ambient noise survey was conducted over a four-day period from April 23 to April 26, 2012. Meteorological conditions during the measurement program were conducive to accurate data collection with an average temperature of 80 °F (27 °C), relative humidity of 81 percent, and low wind speeds of less than 8 mph (13 km/hr) predominantly from the eastward direction.

The measurement locations were selected to be representative of NSAs nearest to the Project in the principal onshore geographical directions. NSAs can include areas and buildings such as schools, hospitals, parks, and residences. Six NSAs were identified with two to the north, one northwest, two northeast and one east of the GasPort site at ranges varying 1.7 to 4.6 miles (2.7 to 7.4 km). The locations of the baseline sound monitoring stations and distances to the proposed Project are shown in Figure 4.10.2-1. Below is a brief description of each NSA:

- **NSA 1:** Las Mareas is a residential waterfront neighborhood within the Town of Salinas.
- **NSA 2:** Mondesoria 1 is a residential waterfront neighborhood located adjacent to the Aguirre Power Plant and also within the Town of Salinas.
- **NSA 3:** This is a residential tri-community of San Philippe, Chunchin, and Mosquito and spans both the Towns of Salinas and Guayama.
- **NSA 4:** This monitoring location in the community of Pozuelo at a restaurant “Villa Pesquera,” which has a boat launch and parking area on-site for water vessels.
- **NSA 5:** This monitoring location is in a residential waterfront neighborhood of Pozuelo within the Town of Guayama.
- **NSA 6:** This monitoring location is situated on Isle de Education, also known as “Cayos Caribes.”

Figure 4.10.2-1
Baseline Sound Survey Locations
Aguirre Offshore GasPort Project

Table 4.10.2-3 summarizes the results of the baseline sound survey. Where present, extraneous sound energy generated by seasonal frogs and/or insects was extracted, resulting in a more conservative assessment of baseline sound levels.

TABLE 4.10.2-3

Summary of Daytime and Nighttime Baseline Sound Measurement Results

Monitoring Location				Sound Level Metrics (dBA)		
NSA	Location/Community	Distance to the Offshore Terminal Site (miles [km])	Time Period	L_{eq}	L_{10}	L_{dn}
1	Las Mareas	3.6 (5.8)	Day	44	46	47
			Night [a]	40	43	
2	Mondesoria	3.3 (5.3)	Day	64	65	70
			Night	64	65	
3	San Philippe, Chunchin, Mosquito	4.6 (7.4)	Day	56	59	56
			Night	45	47	
4	Pozuelo	3.8 (6.1)	Day	48	52	53
			Night [a]	46	47	
5	Guayama	3.4 (5.5)	Day	46	51	49
			Night [a]	41	45	
6	Isle de Education	1.7 (2.7)	Day	55	56	N/A [b]
			Night [b]	N/A [b]	N/A [b]	

[a] Extraneous sound from frogs and/or insects extracted from nighttime measurement data.
[b] Nighttime observations were not conducted at NSA 6 due to the lack of access by boat during the nighttime hours (Tetra Tech, 2013b).

The results of the baseline sound survey show that sound levels vary depending in part on location and exposure to existing sound sources. The measured L_{dn} noise levels ranged from 47 dBA (at NSA 1) to 70 dBA (at NSA 2). NSA 2 is adjacent to the existing Aguirre Power Plant; therefore, the higher measured sound levels during daytime and nighttime are expected due to the prominent noise-generating equipment at that location. The results of the baseline sound survey at the other NSAs show similar L_{eq} and L_{dn} sound levels, indicating a relative acoustic homogeneity across the Project area, with NSAs exposed to both similar sources and overall background sound levels.

4.10.2.4 Construction Noise Impact and Mitigation

Potential impacts from the Project may result in short-term noise effects during construction of the Offshore GasPort and longer-term effects due to operation of the Project. In-air acoustic modeling was conducted for the Project in order to assess the potential noise impacts associated with construction and operation.

Construction of the Aguirre Offshore GasPort can be divided into three major components that feature different types of construction equipment and techniques. Although some phases would overlap, the three primary construction phases include: (1) marine infrastructure, including berth facilities; (2) topside mechanical and electrical facilities; and (3) the subsea interconnecting pipeline. Construction is anticipated to take approximately 12 months with the Project placed in service in 2016.

Aguirre LLC proposes to install the interconnecting pipeline on the seabed using a push-pull technique. This installation method would result in the pipeline being laid directly on the seafloor, unburied or only partially buried by natural bottom sediments depending on the sediment type. This would involve the use of a lay barge, temporary piles, and winches to pull from the point of insertion to the end of each tangent. The installation of pipelines and the platform would require a number of different types of vessels including heavy lift vessels, pipeline installation vessels, barges, tugs, and support vessels. Tugs and work boats would be used to maneuver barges. In general, vessels with high-powered engines that use thrusters tend to generate higher levels of sound than vessels without these types of propulsion systems. There would be no thruster-enabled vessels in use within Jobos Bay during Project construction. Thruster enabled vessels may be required during terminal construction but have not been considered in the acoustic analysis, due to the comparatively larger distance between the proposed terminal facilities site and the nearest NSA.

Piles to secure the pipe lay barge would be driven with vibratory pile driving equipment for all piles within Jobos Bay. In addition, piles would be required to fix the berthing facilities at the offshore terminal to the seabed. The use of impact hammers may be necessary for installation of the terminal facilities but have not been formally addressed in this submittal, pending further review of the geological information for confirmation. Vibratory pile installation and removal of the temporary piles is estimated to produce sound levels of 78 dBA at a distance of approximately 400 feet (122 m). The subsea pipeline would be installed in five segments, with segment end points defined by PIs along the pipeline. Each segment would be fabricated on shallow water pipe lay barges that would be secured to the bottom with temporary piles. Temporary piles would also be used to anchor pulleys that would be used for pushing/pulling pipe segments into place using cable and winch mounted on the lay barge. The model simulation assumes a total of five construction positions located at the PIs. If an HDD were found to be feasible, the HDD equipment would generate additional noise during construction. The primary sound generated during HDD activities are from the diesel engines that power the drilling equipment. If the pipeline under the Boca del Infierno pass was constructed by HDD, Aguirre LLC would be required to demonstrate that the noise impacts on the nearest NSAs attributable to the HDD operations would not exceed an L_{dn} of 55 dBA.

The modeling conservatively assumed that all sources would be operating simultaneously and at or near full load conditions, and that they would be all the same distance from a given NSA (i.e., all co-located within approximately 1 mile [1.6 km]). However, during actual construction, some of the intermittent sources (tug, work boat, and barge equipped mechanical equipment) would not operate concurrently and would be somewhat more dispersed within a given area. Estimated noise levels during offshore construction and vibratory pile driving are in table 4.10.2-4.

TABLE 4.10.2-4

Noise Levels During Offshore Construction and Vibratory Pile Driving Based on Worst Case Position

NSA	Location/Community	Existing Ambient L_{dn} Noise Levels (dBA)	Construction Activities (dBA)	Vibratory Pile Driving (dBA)	FERC Criteria (dBA)	EQB Noise Emission Daytime Limits (dBA)
1	Las Mareas	47	30	42		65/50
2	Mondesoria	70	66	71		68/53 [a]
3	San Philippe, Chunchin, Mosquito	56	37	44	55	65/50
4	Pozuelo	53	33	43		65/50
5	Guayama	49	38	46		65/50
6	Isle de Education	N/A	50	59		65/50 [b]

[a] If the difference between the EQB noise level limits and the existing (ambient) sound levels is between 0 and 6 dBA, then 3 dBA are added to the noise level limits.
[b] The island does not fall within any given EQB classification as it is presently undeveloped but is used for recreational purposes; therefore, EQB limits for residential receptors has been used for this assessment.

The acoustic modeling results indicate that noise levels would vary at NSA locations as the activities move nearer or farther from the shoreline. The noise modeling results indicate that pipeline construction within Jobos Bay, specifically sound levels generated by vibratory pile driving may not be in compliance with the nighttime the EQB noise limits at representative NSAs in Mondesoria (NSA 2) and the Isle de Education (NSA 6) when this activity occurs close to the shoreline. Aguirre LLC would consult with the EQB to develop the appropriate mitigation measures should actual sound levels measured during construction activities exceed the nighttime EQB noise limits. These mitigation measures could include establishing appropriate work hours and development of a Construction Noise Abatement Plan where Aguirre LLC would monitor onshore sound levels in the vicinity of active pipeline construction. If sound levels at residential areas onshore do not meet EQB criteria for an extended time, noise mitigation measures would be adjusted appropriately.

Although construction of the Project would exceed our criteria of an L_{dn} of 55 dBA, the noise impacts on the NSAs would be short-term and temporary. Based on the noise analysis above and Aguirre LLC's commitment to consult with the EQB on appropriate noise mitigation measures during construction, we conclude that adjacent NSAs would not be significantly affected by construction-related noise.

4.10.2.5 Operational Noise Impact and Mitigation

Figure 4.10.2-2 presents the prototype EBRV *Excelsior* and areas of principal sound emission. In order to evaluate sound levels generated from operation during regasification and transit, sound data were previously collected during extensive field studies conducted of the prototype EBRV in the Gulf of Mexico. In-air sound measurements were collected from an observation vessel in the vicinity of the *Excelsior* EBRV. Measurements were also collected during *Excelsior* EBRV on station and operating in the open-loop regasification and send out mode. The FSRU for the Project would be subject to International Maritime Organization standards for noise emissions.

Figure 4.10.2-2: Prototype EBRV Excelsior and Areas of Principal Sound Emission

The main sound sources of an EBRV acting as an FSRU at berth are the generator exhausts including main and auxiliary boilers and generators; mechanical ventilation for the engine room;

regasification devices; and LNG discharge equipment. Sound levels were quantified for typical EBRV mechanical sounds including aft of the gas discharge and offloading/regasification operations through the turret connection located forward and through the control arm extending from the ship. During normal operating conditions, process pipework, gas metering and the gas analyzer system would be the potential noise sources. During periods of pressure equalization, gas control valves, and the gas heater system would also be active. Pressurization and/or depressurization of a vessel are aided by pressure equalization devices which typically include valves and controls. The result of the pressure equalization process can be noise.

The platform would also include switchgear, transformers, and motor control centers as needed to distribute power throughout the facility. The electrical equipment would be housed in a climate controlled switch room. There are no landside components that are directly associated with the Project that would generate noise during normal operations.

Acoustic modeling was completed for operational conditions when: (1) the FSRU is moored but no regasification is being conducted (i.e., standby); and (2) the FSRU is conducting regasification and discharge offloading and an LNG carrier is present conducting LNG transfer. Under Scenario 1 (vessel standby), it is expected that only the main boiler would be operating at 40 percent load to generate electrical power onboard the vessel. Under Scenario 2, it was assumed that both main and auxiliary boilers would be operating under maximum load to provide full power to regasification mechanical and process equipment.

The acoustic modeling analysis focuses on normal operations and not atypical emergency or upset conditions; however, special attention was paid to periods of pressure equalization. The contribution of the pressure equalization to noise levels at any NSA would be limited to a maximum of 48 dBA, which allows for a small design tolerance and maintaining conformance with the most stringent 50 dBA nighttime limit imposed by the EQB regulations. Pressure equalization activities would be expected to occur once or twice per year, with pressure equalization venting and support equipment in operation for approximately 30 to 60 minutes on average per event.

Predicted noise level results from major equipment proposed for the Offshore GasPort and applicable permissible noise limits are summarized in table 4.10.2-5.

As shown in table 4.10.2-5, the calculated Project-related noise contributions would range from 14 to 37 dBA L_{dn} at the representative NSAs. Table 4.10.2-5 also demonstrates that operational noise levels would be the highest under Scenario 2; however, all noise levels during operation of the Offshore GasPort would be below our criteria of 55 dBA L_{dn} at the nearest NSAs as well as EQB's more stringent nighttime permissible noise level. However, to ensure that the Project operates in compliance with our guidelines, specifically under Scenario 2, **we recommend that:**

- **Aguirre LLC file a noise survey with the Secretary <u>no later than 60 days</u> after placing the Aguirre Offshore GasPort Project in service. If a full load condition noise survey is not possible, Aguirre LLC should provide an interim survey at the maximum possible load and provide the full load survey <u>within 6 months</u>. If the noise attributable to operation of the Offshore GasPort under interim or full load conditions exceeds an L_{dn} of 55 dBA at any nearby NSAs, Aguirre LLC should file a report on what changes are needed and should install additional noise controls to meet the level <u>within 1 year</u> of the in-service date. Aguirre LLC should confirm compliance with the above requirement by filing a second noise survey <u>no later than 60 days</u> after it installs the additional noise controls.**

Based on the results of the noise analysis and our recommendation, we conclude that operation of the Project would have no significant impact on the noise environment in the Project area.

TABLE 4.10.2-5

Calculated Operational Noise from the Aguirre Offshore GasPort Project

NSA	Location	Existing L_{dn} (dBA)	FERC Perm. Noise Limit (dBA)	EQB Permissible Noise Level		Calculated Operational Sound Level (dBA)		Calculated L_{dn} of Proposed Noise Sources (dBA)		Estimated Incremental Increase of Cumulative Sound Levels (dBA)	
				Day (dBA)	Night (dBA)	Scen. 1 [a]	Scen. 2 [b]	Scen. 1 [a]	Scen. 2 [b]	Scen. 1 [a]	Scen. 2 [b]
1	Las Mareas	47		65	50	12	15	20	24	<1	<1
2	Mondesoria	70		65	50	15	18	24	27	<1	<1
3	San Philippe, Chunchin, Mosquito	56	55	65	50	5	9	14	18	<1	<1
4	Pozuelo	53		65	50	11	14	19	23	<1	<1
5	Guayama	49		65	50	12	16	21	24	<1	<1
6	Isle de Education	N/A [c]		N/A [d]	N/A [d]	25	28	34	37	N/A [c]	N/A [c]

[a] FSRU Standby Mode.
[b] LNG Transfer and Regasification.
[c] Nighttime observations were not conducted at NSA 6 due to the lack of access by boat during the nighttime hours (Tetra Tech, 2013b).
[d] The island does not fall within any given EQB classification as it is presently undeveloped but is used for recreational purposes.

4.11 RELIABILITY AND SAFETY

The transportation of natural gas involves some incremental risk to the public due to the potential for an accidental release of natural gas. The greatest hazard is a fire or explosion following a major pipeline rupture or LNG carrier spill. However, it is also important to recognize that there are stringent requirements for the design, construction, operation, and maintenance of marine terminals and that there would be extensive safety systems in place to detect and control potential hazards associated with the proposed Project.

4.11.1 Regulatory Agencies

Two federal agencies share regulatory authority over the siting, design, construction, and operation of LNG import terminals located offshore: the USCG and the FERC. The USCG regulates the safety of an LNG facility's marine transfer area and LNG marine traffic, and regulates security plans for the entire LNG facility and LNG marine traffic. Those standards are codified in 33 CFR 105 and 127. In addition, the LNG vessels and the FSRU would be subject to 46 CFR 154, which are the safety standards for self-propelled vessels carrying bulk liquefied gases. Under the Natural Gas Act and delegated authority from the U.S. Department of Energy (DOE), the FERC authorizes the siting and construction of LNG import and export facilities.

In February 2004, the USCG and FERC entered into an Interagency Agreement to ensure greater coordination among these two agencies in addressing the full range of safety and security issues at LNG terminals, including terminal facilities and tanker operations, and maximizing the exchange of information related to the safety and security aspects of the LNG facilities and related marine operations. Under the Interagency Agreement, the 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 USCG participates as a cooperating agency. Both agencies have some oversight and responsibility for inspection and compliance during the facility's operation.

FERC and USCG staff are evaluating the proposed facility on multiple design standards, including appropriate portions of the NFPA's Standard 59A (NFPA 59A), an industry consensus safety standard for the design and operation of on-shore LNG facilities. In conjunction with this, the USCG would also determine the suitability of the Project Waterway for LNG marine traffic by issuing a Letter of Recommendation (see section 4.11.5.4).

As part of the review required for a FERC authorization, we must ensure that the Offshore GasPort would be able to operate safely and securely. The design information that must be filed in the application to the Commission is specified by 18 CFR § 380.12 (m) and (o). The level of detail necessary for this submittal requires the Project sponsor to perform substantial front-end engineering of the proposed facilities. The design information is required to be site-specific and developed to the extent that further detailed design would not result in changes to the siting considerations, basis of design, operating conditions, major equipment selections, equipment design conditions, or safety system designs which we considered during our review process.

The following sections contain the conclusions of our reliability and safety analysis and incorporate comments of the USCG as a cooperating agency. In accordance with 33 CFR 127, the USCG has provided FERC with a LOR regarding the suitability of the waterway for LNG carrier traffic.

4.11.2 Hazards

The principal hazards associated with the storage and vaporization of LNG result from loss of containment, vapor dispersion characteristics, flammability, and the ability to produce damaging overpressures. A loss of the containment provided by the LNG cargo tanks or process piping would result in the formation of flammable vapor near the release location, as well as near LNG that pooled. Releases occurring in the presence of an ignition source would most likely result in a fire located at the vapor source. A spill without ignition would form a vapor cloud that would travel with the prevailing wind until it either dispersed below the flammable limits or encountered an ignition source. In some instances, ignition of a vapor cloud may produce damaging overpressures. These hazards are described in more detail below.

Loss of Containment

A loss of the containment is the initial event that results in all other potential hazards. The initial loss of containment can result in an LNG and/or gaseous release with the formation of vapor at the release location, as well as from any liquid that pooled. LNG released may present low or high temperature hazards, and may result in the formation of flammable vapors. The extent of the hazard will depend on the storage and process conditions and the volumes released.

LNG would be stored in cargo tanks on the FSRU at atmospheric pressure and at a cryogenic temperature of approximately –260 °F. Loss of containment of LNG could lead to the release of both liquid and vapor on the FSRU or into the water surrounding the FSRU. Exposure to either cold liquid or vapor could cause freeze burns and, depending on the length of exposure, more serious injury or death. However, spills would be limited to the area adjacent to the Offshore GasPort and the cold state of these releases would be greatly limited due to the continuous mixing with the warmer air and surrounding water. The cold temperatures from the release would not present a hazard to the public, which would not have access to areas up to 500 yards from the offshore terminal as discussed in the LOR section (see 4.11.5.4).

LNG is a cryogenic liquid that would quickly cool any materials contacted by the liquid on release, causing extreme thermal stress in materials not specifically designed for such conditions. These thermal stresses could subsequently subject the material to brittleness, fracture, or other loss of tensile strength. These temperatures, however, would be accounted for in the design of the LNG cargo tanks and process equipment on the FSRU as well as the process piping on the Offshore GasPort. This would not be substantially different from the hazards associated with the storage and transportation of liquid oxygen (–296 ºF) or several other cryogenic liquids that have been routinely produced and transported in the United States.

A rapid phase transition (RPT) can occur when a cryogenic liquid is spilled onto water and changes from liquid to gas, virtually instantaneously. Unlike an explosion that releases energy and combustion products from a chemical reaction, an RPT is the result of heat transferred to the liquid inducing a change to the vapor state. RPTs have been observed during LNG test spills onto water. In some test cases, the overpressures generated were strong enough to damage test equipment in the immediate vicinity of the LNG release point. The sizes of the overpressure events have been generally small and are not expected to cause significant damage. The average overpressures recorded at the source of the RPTs during the Coyote tests have ranged from 0.2 to 11 psi.[11] These events are typically limited

[11] The Lawrence Livermore National Laboratory conducted seven tests (the Coyote series) on vapor cloud dispersion, vapor cloud ignition, and RPTs at the Naval Weapons Center in China Lake, California in 1981.

to the area within the spill and are not expected to cause damage outside of the area engulfed by the LNG pool. However, a RPT may affect the rate of pool spreading and the rate of vaporization rate for a spill on water.

Vapor Dispersion

In the event of a loss of containment, LNG would vaporize when released from any storage or process facilities. Depending on the size of the release, LNG may form a liquid pool and vaporize. Additional vaporization would result from exposure to ambient heat sources, such as water or the platform. When released from a containment vessel or transfer system, LNG will generally produce 620 to 630 standard cubic feet of natural gas for each cubic foot of liquid.

If the loss of containment does not result in immediate ignition of the natural gas vapors, the vapor cloud would travel with the prevailing wind until it either encountered an ignition source or dispersed below its flammable limits. An LNG release would form a denser-than-air vapor cloud that would sink to the ground due to the cold temperature of the vapor. As the LNG vapor cloud disperses downwind and mixes with the warm surrounding air, the LNG vapor cloud may become buoyant. As a result, estimating the dispersion of the vapor cloud is an important step in addressing potential hazards and will be discussed in section 4.11.4.

Methane, the primary component of LNG, is classified as a simple asphyxiate and may pose extreme health hazards, including death, if inhaled in significant quantities within a limited time. Very cold CH_4 vapors may also cause freeze burns. However, the locations of concentrations where cold temperatures and oxygen-deprivation effects could occur are greatly limited due to the continuous mixing with the warmer air surrounding the spill site. Exposure injuries from contact with releases of CH_4 normally represent negligible risks to the public.

Vapor Cloud Ignition

Flammability of the LNG vapor cloud would be dependent on the concentration of the vapor when mixed with the surrounding air. In general, higher concentrations within the vapor cloud would exist near the spill, and lower concentrations would exist near the edge of the cloud as it disperses downwind. Mixtures occurring between the lower flammability limit (LFL) and the upper flammability limit (UFL) can be ignited. Concentrations above the UFL or below the LFL would not ignite.

The LFL and UFL for CH_4 are approximately 5 and 15 percent by volume in air, respectively. If the flammable portion of a vapor cloud encounters an ignition source, a flame would propagate through the flammable portions of the cloud. In most circumstances, the flame would be driven by the heat it generates. This process is known as a deflagration. An LNG vapor cloud deflagration in an uncongested and unconfined area travels at slower speeds and does not produce significant pressure waves. However, exposure to this LNG vapor cloud fire can cause severe burns and death, and can ignite combustible materials within the cloud. Confined and congested CH_4 vapor clouds may produce higher flame speeds and overpressures, and are discussed later in this section under "Overpressures."

A deflagration may propagate back to the spill site if the vapor concentration along this path is sufficiently high to support the combustion process. When the flame reaches vapor concentrations above the UFL, the deflagration could transition to a fireball and result in a pool or jet fire back at the source. A fireball would occur near the source of the release and would be of a relatively short duration compared to an ensuing jet or pool fire.

The extent of the affected area and the severity of the impacts on objects either within an ignited cloud or in the vicinity of a pool fire would primarily be dependent on the quantity and duration of the initial release, the surrounding terrain, and the environmental conditions present during the dispersion of the cloud. Radiant heat and dispersion modeling are discussed in section 4.11.4.

Overpressures

If the deflagration in a flammable vapor cloud accelerates to a sufficiently high rate of speed, pressure waves would be generated. As a deflagration accelerates to super-sonic speeds, larger pressure shock waves are produced, and a shock wave is created. This shock wave, rather than the heat, would begin to drive the flame, resulting in a detonation. Deflagrations or detonations are often characterized more generally as explosions when the rapid movement of the flame and pressure waves associated with them cause additional damage. The amount of damage an explosion causes is dependent on the amount the pressure wave is above atmospheric pressure (i.e. an overpressure) and its duration (i.e., pulse). For example, a 1-psi overpressure is often cited as a safety limit in regulations and is associated with glass shattering and traveling with velocities high enough to lacerate skin. Flame speeds and overpressures are primarily dependent on the reactivity of the fuel, the ignition strength and location, the degree of congestion and confinement of the area occupied by the vapor cloud, and the flame travel distance.

The potential for unconfined LNG vapor cloud detonations was investigated by the USCG in the late 1970s at the Naval Weapons Center in China Lake, California. Using CH_4, the primary component of natural gas, several experiments were conducted to determine whether unconfined LNG vapor clouds would detonate. Unconfined CH_4 vapor clouds ignited with low-energy ignition sources (13.5 joules), produced flame speeds ranging from 12 to 20 mph. These flame speeds are much lower than the flame speeds associated with a deflagration with damaging overpressures or a detonation.

To examine the potential for detonation of an unconfined natural gas cloud containing heavier hydrocarbons that are more reactive, such as ethane and propane, the USCG conducted further tests on ambient-temperature fuel mixtures of methane-ethane and methane-propane. The tests indicated that the addition of heavier hydrocarbons influenced the tendency of an unconfined natural gas vapor cloud to detonate. Natural gas with greater amounts of heavier hydrocarbons would be more sensitive to detonation.

Although it has been possible to produce damaging overpressures and detonations of unconfined LNG vapor clouds, the LNG proposed for importation to the Project would have lower ethane and propane concentrations than those that resulted in damaging overpressures and detonations. The substantial amount of initiating explosives needed to create the shock initiation during the limited range of vapor-air concentrations also renders the possibility of detonation of these vapors at an LNG plant as unrealistic. As discussed in the “Vapor Dispersion” and “Vapor Cloud Ignition” sections above, the primary hazards to the public from an LNG spill that disperses to an unconfined area would be from dispersion of the flammable vapors or from radiant heat generated by a pool fire.

Ignition of a confined LNG vapor cloud could result in higher overpressures. In order to prevent such an occurrence, measures are taken to mitigate the vapor dispersion and ignition into confined areas, such as buildings. Discussion of these hazards and potential mitigation are in section 4.11.3.

4.11.3 Technical Review of the Preliminary Engineering Design

Operation of the proposed Offshore GasPort poses a potential hazard that could affect the public safety if strict design and operational measures to control potential accidents are not applied. The primary concerns are those events that could lead to an LNG spill of sufficient magnitude to create an off-site hazard as discussed in section 4.11.2. However, it is important to recognize the stringent requirements in place for the design, construction, operation, and maintenance of the facility, as well, as the extensive safety systems proposed to detect and control potential hazards.

In general, we consider an acceptable design to include multiple protection systems or safeguards to reduce the risk of a potentially hazardous scenario from developing into an event that could impact the off-site public. These layers of protection should be independent of one another so that each could perform its function regardless of the action or failure of any other protection layer or initiating event. Such design features and safeguards typically include:

- a facility design that prevents hazardous events through the use of suitable materials of construction; operating and design 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 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;

- equipment protection systems, such as pressure relief valves, proper equipment and building spacing, appropriate electrical area classification, spill control, and structural fire protection, to prevent escalation to a more severe event;

- emergency response, including hazard detection and control equipment, firewater systems, on-site fire-fighting personnel and equipment, and coordination with local first responders to mitigate the consequences of a release and prevent it from escalating to an event; and

- site security measures for controlling access to the facility, including security inspections and patrols; response procedures to any breach of security and liaison with local law enforcement officials.

We find that the inclusion of such protection systems or safeguards in a facility design would minimize the potential for an initiating event to develop into an incident that could impact the safety of the public. In addition, proper siting of the facility with regard to potential consequences can be further used to minimize impacts to public safety. The siting requirements for the Project are discussed in section 4.11.4.

As self-propelled vessels carrying LNG as a bulk cargo, both the FSRU and the visiting LNG carriers would be under the jurisdiction of the USCG, rather than FERC (see Non-Jurisdictional Facilities in section 1.4). These vessels would be subject to 46 CFR 154 which require foreign-flagged vessels to receive a Certificate of Compliance (COC) from the USCG prior to calling on a United States port. Issuance of a COC is contingent upon USCG review and inspection to ensure that the vessel meets U.S. requirements for the following:

- hull structure;
- cargo tank and containment systems;
- piping systems;
- pump and compressors;

- electrical equipment;
- instrumentation; and
- hazard detection and firefighting systems.

The FSRU to be stationed at the Offshore GasPort would be from Excelerate Energy's existing fleet of eight ships. Several of Excelerate Energy's vessels have already been in operation in the United States as LNG import terminals as Deepwater Ports subject to regulation by the U.S. Maritime Administration and the USCG. The design, construction, and operation of the FSRU and LNG carriers, which are not subject to FERC jurisdiction and have already been reviewed and accepted by the USCG, were not included in our engineering review.

As part of its application, Aguirre LLC provided a FEED for the Offshore GasPort. In developing the FEED, Aguirre LLC conducted a Hazard Identification and Operability Study (HAZID/HAZOP) to identify potential risk scenarios. The HAZID/HAZOP studies address hazards of the process, engineering and administrative controls, and provides a qualitative evaluation of a range of possible safety, health, and environmental effects which may result from the design or operation of the facility. Recommendations to prevent or minimize these hazards are generated from the results of the HAZID/HAZOP reviews. These studies help establish the required safety control levels and identify whether additional process and safety instrumentation, mitigation, and/or administrative controls would be needed. In addition, a HAZOP review of the completed design would be performed by Aguirre LLC's design development team during the detailed design phase.

As part of our review of the Project, we analyzed the information filed by Aguirre LLC to determine the extent that layers of protection or safeguards were included. Our review focused on the engineering design and safety concepts of the various protection layers, as well as the projected operational reliability of the proposed facilities. The design would use materials of construction suited to the pressure and temperature conditions of the process design. Piping would be designed in accordance with American Society of Mechanical Engineers (ASME) B31.3. Pressure vessels would be designed in accordance with ASME Section VIII and NFPA 59A.

The facility would also be designed to withstand the effects of hurricane force winds. The FSRU would leave the Offshore GasPort before the wind speed reaches 68.2 mph (109 km/hr). The design wind velocity for hurricanes on the platforms, superstructures, and equipment after the FSRU departs the Offshore GasPort would be 150 mph (241 km/hr) (sustained) and 179 mph (288 km/hr) (3-second gust). The current estimate of the 500 year wave crest height at the marine terminal site is 44.8 feet (13.7 m) above mean sea level. We also examined the seismic and structural design of the facility and provided recommendations to mitigate issues identified as detailed in sections 4.1.3 and 4.1.4.

Aguirre LLC would install process control valves and instrumentation to safely operate and monitor the facility. 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. Aguirre LLC would develop facility operations procedures after completion of the final design; this timing is fully consistent with accepted industry practice. We are recommending that Aguirre LLC provide the operating and maintenance procedures as they are developed, as listed later in this section. In addition, we are recommending measures such as labeling of instrumentation and valves (i.e., car-seals and/or locked valves) to address human error and improve facility safety. An alarm management program would also be in place to ensure effectiveness of the alarms.

Safety valves and instrumentation would be installed to monitor, alarm, shutdown, and isolate equipment and piping during process upsets or emergency conditions. Safety instrumented systems would comply with International Society for Automation Standard 84.01. As listed below, we are also including recommendations on the design, installation, and commissioning of instrumentation and emergency shutdown equipment to ensure appropriate cause and effect alarm or shutdown logic and enhanced representation of the emergency shutdown valves in the facility control system. This would ensure that the design includes sufficient safeguards to react to process upsets and hazardous conditions.

Safety relief valves and vent stacks would be installed to protect the process equipment and piping. The safety relief valves would be designed to handle process upsets and thermal expansion within piping, per NFPA 59A and would be designed based on API 520 and 521. As listed below, we are including recommendations to ensure the pressure relief valves would be sufficiently sized for major process equipment and vessels.

In the event of a release, LNG and process facilities would be provided with a spill system designed to direct a spill to a low point and into the sea. A continuous deck wash would be operating on the Offshore GasPort during LNG transfer operations to direct any LNG spills down and avoid LNG contact with the substructure.

Aguirre LLC performed a preliminary fire protection evaluation to ensure that adequate hazard detection, hazard control, and firewater coverage would be installed to detect and address any upset conditions. Structural fire protection, proposed to prevent failure of structural supports of equipment and pipe racks, would comply with NFPA 59A. Aguirre LLC would also install hazard detection systems to detect, alarm, and alert personnel in the area and control room to initiate an emergency shutdown and/or initiate appropriate procedures and would meet NFPA 72. Hazard control devices would be installed to extinguish or control incipient fires and releases, and would meet NFPA 59A, 10, and 12. Aguirre LLC would provide automatic firewater systems and monitors for use during an emergency to cool the surface of piping and equipment exposed to heat from a fire, mitigate potential cryogenic contact with the hull side of the ship, and prevent migration of a vapor cloud into the utility area or the control room. These firewater systems would meet NFPA 59A, 15, 20, and 24 requirements. We are recommending that Aguirre LLC provide more information on the design, installation, and commissioning of hazard detection, hazard control, and firewater systems as Aguirre LLC would further develop this information during the final design phase. We would review this information to confirm that the final design, installation, and capabilities of the hazard detection and control equipment would be consistent with the equipment proposed in the application.

Aguirre LLC would also have emergency procedures in accordance with 33 CFR 127. The emergency procedures would provide for protection of personnel and the public as well as the prevention of property damage that may occur as a result of incidents at the facility. Aguirre LLC would also be required to develop an ERP in accordance with Energy Policy Act of 2005, as discussed further in section 4.11.6.

As part of the FEED, Aguirre LLC has proposed to continuously man the Offshore GasPort. In order to minimize the risk of an intentional event, Aguirre LLC would provide lighting, camera systems, and intrusion detection to deter, monitor, and detect intruders onto the facility. These systems would be supported by backup power supplies. Aguirre LLC would be required to develop a Facility Security Plan (FSP) in accordance with the USCG’s regulations found in 33 CFR 105, Subpart D. These regulations require all terminal owners and operators to submit a Facility Security Assessment and a FSP to the USCG for review and approval. Some of the responsibilities of the applicant include, but are not limited to:

- designating an Facility Security Officer with a general knowledge of current security threats and patterns, risk assessment methodology, and the responsibility for implementing the Facility Security Assessment and FSP and performing an annual audit for the life of the Project;

- conducting a Facility Security Assessment to identify site vulnerabilities, possible security threats and consequences of an attack, and facility protective measures;
- developing a FSP based on the Facility Security Assessment, with procedures for:
  - responding to transportation security incidents;
  - notification and coordination with local, state, and federal authorities;
  - prevention of unauthorized access; measures and equipment to prevent or deter dangerous substances and devices;
  - training; and
  - evacuation;
- implementing scalable security measures to provide increasing levels of security at increasing maritime security levels for facility access control, restricted areas, cargo handling, vessel stores and bunkers, and monitoring;
- ensuring the Transportation Worker Identification Credential program is properly implemented; and
- reporting all breaches of security and security incidents to the National Response Center.

Under 33 CFR 105 Aguirre LLC would need to submit a FSP to the USCG for review and approval before commencement of operations. The FSP would specify measures that have the capability to continuously monitor the facility's security through a combination of lighting, security guards, waterborne patrols, automatic intrusion-detection devices, or surveillance equipment.

We conclude the use of these protection layers would minimize the potential for an initiating event to develop into an incident that could impact the safety of the off-site public. As a result of our technical review of the information provided by Aguirre LLC in its application, we did identify a number of concerns in an information data request letter issued on October 9, 2013. Aguirre LLC provided written responses to the information data request on October 29, 2013. Below, we have included recommendations based on our review of the proposed design filed in the application and the information filed in response to our information request.

The FEED and specifications submitted for the proposed facilities to date are preliminary, but would serve as the basis for any detailed design to follow. If authorization is granted by the Commission, the next phase of the Project would include development of the final design, including final selection of equipment manufacturers, process conditions, and resolution of some safety-related issues. It is unlikely that the detailed design information to be developed would result in changes to the basis of design, operating conditions, major equipment selections, equipment design conditions, or safety system designs which were presented as part of Aguirre LLC's FEED.

Prior to finalizing the design as "Issued for Construction," a more detailed and thorough HAZOP would be performed by Aguirre LLC. These studies would further refine the required safety control levels and identify whether additional process and safety instrumentation, mitigation, and/or administrative controls would be needed. Aguirre LLC would evaluate these changes to ensure that the safety, health, and environmental risks arising from these changes are addressed and controlled. Resolutions of the recommendations generated by the HAZOP review would be monitored by the FERC staff. We have included a recommendation that Aguirre LLC should file a hazard and operability study on the completed final design.

Information regarding the development of the final design, as detailed below, would need to be reviewed by FERC staff before equipment construction at the site would be authorized. To ensure the final design would be consistent with the safety and operability characteristics identified in the FEED, **we recommend that the following measures should apply to Aguirre LLC's Offshore GasPort. Information pertaining to these specific recommendations should be filed for review and written approval by the Director of OEP either: prior to any construction; prior to construction of final design; prior to commissioning; prior to introduction of hazardous fluids; or prior to commencement of service, as indicated by each specific condition. Specific engineering, vulnerability, or detailed design information meeting the criteria specified in Order No. 683 (Docket No. RM06-24-000), including security information, should be submitted as critical energy infrastructure information (CEII) pursuant to 18 CFR 388.112. See Critical Energy Infrastructure Information, Order No. 683, 71 FR 58,273 (October 3, 2006), FERC Stats. & Regs. 31,228 (2006). 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 should be filed a minimum of 30 days before approval to proceed is requested.**

- **Prior to any construction, Aguirre LLC should file the quality assurance and quality control procedures for construction activities.**

- **Prior to any construction, Aguirre LLC should file a plot plan (area layout drawings) of the final design showing all major equipment, structures, buildings, and spill control systems.**

- **Prior to any construction, a technical review of facility design should be filed that:**

  a. identifies all combustion/ventilation air intake equipment and the distances to any possible hydrocarbon release (LNG, flammable refrigerants, flammable liquids, and flammable gases); and

  b. demonstrates that these areas are adequately covered by hazard detection devices and indicate how these devices would isolate or shutdown any combustion equipment whose continued operation could add to or sustain an emergency.

- **The final design should include change logs that list and explain any changes made from the FEED provided in Aguirre LLC'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.**

- **The final design should provide up-to-date P&IDs, which include the following information:**

  a. **equipment tag number, name, size, duty, capacity, and design conditions;**

  b. **equipment insulation type and thickness;**

  c. **valve high pressure side and internal and external vent locations;**

  d. **piping with line number, piping class specification, size, and insulation type and thickness;**

  e. **piping specification breaks and insulation limits;**

  f. **all control and manual valves numbered;**

  g. **relief valves with set points; and**

  h. **drawing revision number and date.**

- **The final design should provide an up-to-date complete equipment list, process and mechanical data sheets, and specifications.**

- **The final design should provide 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.**

- **The final design should provide complete plan drawings and a list of the fixed and wheeled dry-chemical, hand-held fire extinguishers, and other hazard control equipment. Drawings should clearly show the location by tag number of all fixed, wheeled, and hand-held extinguishers. 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.**

- **The final design should provide facility plans and drawings that show the location of the firewater system. Drawings should clearly show: firewater piping and the location, and area covered by, each monitor, hydrant, deluge system, water-mist system, and sprinkler. The drawings should also include piping and instrumentation diagrams of the firewater system.**

- **The final design should include an updated fire protection evaluation of the proposed facilities carried out in accordance with the requirements of NFPA 59A 2013, chapter 12.2. A copy of the evaluation, a list of recommendations and supporting justifications, and actions taken on the recommendations should be filed.**

- **The final design should specify that for hazardous fluids, the piping and piping nipples 2 inches or less are to be no less than Schedule 160.**

- **The <u>final design</u> should provide electrical area classification drawings.**

- **The <u>final design</u> should include a hazard and operability review of the completed design prior to issuing the P&IDs for construction. A copy of the review, a list of recommendations, and actions taken on the recommendations, should be filed.**

- **The <u>final design</u> should include the cause-and-effect matrices for the process instrumentation, fire and gas detection system, and emergency shutdown system. The cause-and-effect matrices should include alarms and shutdown functions, details of the voting and shutdown logic, and set points.**

- **The <u>final design</u> should include 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.**

- **The <u>final design</u> should include 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 cleanout, dry-out, purging, and tightness testing.**

- **The <u>final design</u> should include the sizing basis and capacity for the final design of the vent stack and pressure relief valves for major process equipment and vessels.**

- **The <u>final design</u> should provide the procedures for pressure/leak tests which address the requirements of ASME VIII and ASME B31.3.**

- **The <u>final design</u> flow rate of each firewater pump should be based on the required firewater demand.**

- **The <u>final design</u> should specify how the nitrogen purge piping to the vent stack would be used to extinguish an ignited vent.**

- **<u>Prior to commissioning</u>, Aguirre LLC should file plans and detailed procedures for: testing the integrity of onsite mechanical installation; functional tests; introduction of hazardous fluids; operational tests; and placing the equipment into service.**

- **<u>Prior to commissioning</u>, Aguirre LLC should provide 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. Aguirre LLC 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.**

- **<u>Prior to commissioning</u>, Aguirre LLC should provide tag numbers on equipment and flow direction on piping.**

- **<u>Prior to commissioning</u>, Aguirre LLC should tag all instrumentation and valves in the field, including drain valves, vent valves, main valves, and car-sealed or locked valves.**

- **<u>Prior to commissioning</u>, Aguirre LLC should file the operation and maintenance procedures and manuals.**

- **<u>Prior to commissioning</u>, Aguirre LLC should maintain a detailed training log to demonstrate that operating staff has completed the required training.**

- **<u>Prior to introduction of hazardous fluids</u>, Aguirre LLC should complete 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>, Aguirre LLC should complete all pertinent tests (Factory Acceptance Tests, Site Acceptance Tests, Site Integration Tests) associated with the Distributed Control System and the Safety Instrumented System that demonstrates full functionality and operability of the system.**

- **<u>Prior to commencement of service</u>, progress on the construction of the proposed systems should be reported in <u>monthly</u> reports filed with the Secretary. Details should include a summary of activities, problems encountered, contractor non-conformance/deficiency logs, remedial actions taken, and current Project schedule. Problems of significant magnitude should be reported to the FERC <u>within 24 hours</u>.**

- **<u>Prior to commencement of service</u>, Aguirre LLC should provide a plan for:**

  i. training frequency for operators;

  j. testing frequency of facility components; and

  k. record keeping for each training, equipment test, inspection or survey, and maintenance activity.

In addition, **we recommend that the following measures should apply <u>throughout the life of the facility</u>:**

- **Aguirre LLC should ensure that the FSRU moored at the Offshore GasPort would be in compliance with 46 CFR 154 and should remain classed <u>throughout the life of the facility</u>.**

- **The facility should be subject to regular FERC staff technical reviews and site inspections on at least an <u>annual basis</u> or at other intervals as determined by the Director of OEP. Prior to each FERC staff technical review and site inspection, Aguirre LLC 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 piping and instrumentation diagrams 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.

- **Semi-annual operational reports should be filed with the Secretary to identify changes in facility design and operating conditions, abnormal operating experiences, activities (including ship arrivals, quantity and composition of imported LNG, vaporized quantities, boil-off/flash gas, etc.), facility modifications, including future plans and progress thereof. Abnormalities on the Offshore GasPort should include, but not be limited to: hazardous conditions in associated cryogenic piping, significant equipment or instrumentation malfunctions or failures, non-scheduled maintenance or repair (and reasons therefore), hazardous fluids releases, fires involving hazardous fluids and/or from other sources. In addition, include unloading/loading/shipping problems, potential hazardous conditions from the FSRU or LNG carriers. Adverse weather conditions and the effect on the facility also should be reported. Reports should 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)" also should be included in the semi-annual operational reports. Such information would provide FERC staff with early notice of anticipated future construction/maintenance projects at the LNG facility.**

- **Significant non-scheduled events, including safety-related incidents (e.g., LNG or natural gas releases, fires, explosions, mechanical failures, unusual over pressurization, and major injuries) and security-related incidents should be reported to FERC staff. In the event an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification should be made immediately, without unduly interfering with any necessary or appropriate emergency repair, alarm, or other emergency procedure. In all instances, notification should be made to FERC staff within 24 hours. This notification practice should be incorporated into the LNG facility's emergency plan. Examples of reportable hazardous fluids related incidents include:**

  l. **fire;**

  m. **explosion;**

  n. **estimated property damage of $50,000 or more;**

  o. **death or personal injury necessitating in-patient hospitalization;**

  p. **release of hazardous fluids for five minutes or more;**

  q. **unintended movement or abnormal loading by environmental causes, such as an earthquake, or flood, that impairs the serviceability, structural integrity, or reliability of an LNG facility that contains, controls, or processes hazardous fluids;**

  r. **any crack or other material defect that impairs the structural integrity or reliability of an LNG facility that contains, controls, or processes hazardous fluids;**

s. 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;

t. a leak in an LNG facility that contains or processes hazardous fluids that constitutes an emergency;

u. 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;

v. safety-related incidents to hazardous fluids vessels occurring at or en route to and from the LNG facility; or

w. 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, 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.

In addition to the final design review, we would conduct inspections prior to operation and would review additional materials, including quality assurance and quality control plans, non-conformance reports, and commissioning plans to ensure that the installed design is consistent with the safety and operability characteristics of the FEED. We would also conduct inspections during operation at intervals determined by the Director of OEP to ensure that the facility would be operated and maintained in accordance with the filed design throughout the life of the facility. Based on our analysis and recommendations presented above, we conclude that the FEED for the Offshore GasPort presented by Aguirre LLC would include acceptable layers of protection or safeguards which would reduce the risk of a potentially hazardous scenario from developing into an event that could impact the off-site public.

4.11.4 Siting Analysis

Our siting analysis to address the thermal radiation and vapor dispersion zones for the proposed Project have been calculated based on the recommended practices outlined by the Sandia National Laboratories (Sandia) and described in the report entitled, *Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill Over Water* (2004 Sandia Report). For this Project, Aguirre LLC selected the following release scenarios as inputs in the hazard modeling:

- a release from a failure of the loading arm connection that transfers LNG from the Offshore GasPort into the FSRU for 10 minutes; and
- jetting releases from process piping onboard the FSRU for 10 minutes.

Pool Formation

Due to the marine nature of the proposed Project, the analysis lacks any defined impoundment areas and the potential LNG pool size from LNG releases would be controlled by the balancing of the LNG release onto the water surface versus the amount of LNG that would be vaporized from the pool. Methods defined by the 2004 Sandia Report for determining pool sizes for LNG spilled on water were used for each LNG release scenario. Utilizing this methodology, Aguirre LLC calculated pool diameters for the release scenarios listed above. Aguirre selected a spill rate of 11,000 m^3/hr (approximately 48,000 gallons per minute) from a failure of the LNG loading arms for 10 minutes. This release would result in a 119 m (390 feet) pool diameter.

For process releases onboard the FSRU, Aguirre LLC selected releases on the LNG feed piping from the FSRU cargo tanks, the high pressure LNG feed piping to the vaporizers, and the gas export line. The LNG feed from the FSRU cargo tanks resulted in an LNG pool diameter of 2.8 m (9 feet) from a 5.08 cm (2-inch) hole on the process piping and an LNG pool diameter of 76 m (249 feet) from a full rupture on the process piping. Releases from the high pressure LNG feed to the vaporizers and the gas export line would not result in pooled LNG as the LNG release would flash and gas export line release would not result in a liquid release.

Thermal Modeling

If a large quantity of LNG is spilled in the presence of an ignition source, the resulting LNG pool fire could cause high levels of thermal radiation. Thermal radiation levels typically used for exposure analyses include (1) a low level that can be tolerated by humans long enough to allow them to move to safety without significant burn injuries (about 1,600 British thermal units per square foot per hour [BTU/ft^2-hr], or 5 kW per square meter [kW/m^2]); and (2) a high level that can cause significant injury and damage to property (about 10,000 BTU/ft^2-hr, or 32 kW/m^2). These levels were designated in the LOR Analysis as Hazard Zones 2 and 1, respectively (see section 4.11.5.4). The thermal exclusion distance calculations are based on site-specific atmospheric conditions: ambient temperature of 80 °F, a relative humidity of 77 percent, and a 15-mph wind speed. Using the LNGFIRE3 computer program model developed by the Gas Research Institute, Aguirre LLC calculated thermal radiation distances for 1,600- to 10,000-BTU/ft^2-hr (approximately 5- to 32-kW/m^2) incident flux levels from a pool resulting in a failure of the loading arm. Table 4.11.4-1 presents the results from this hazard scenario at various thermal radiation levels. Due to the location of the proposed Project, these thermal radiation distances for each zone would extend only over water and would be within Zone 1.

TABLE 4.11.4-1

Thermal Radiation Distances for the Aguirre Offshore GasPort Project

		Thermal Radiation Levels		
Scenario	Pool Size	10,000 BTU/ft²-hr (32 kW/m²)	4,000 BTU/ft²-hr (12.5 kW/m²)	1,600 BTU/ft²-hr (5 kW/m²)
Loading Arm Failure	119 m (390 feet)	234 m (768 feet)	297 m (974 feet)	385 m (1,263 feet)

Vapor Dispersion Modeling

Flammable vapor dispersion calculations were based on an ambient temperature of 70 ºF, 50 percent relative humidity, a 4.4-m/s (9.8 mph) wind speed, atmospheric stability Class D, and a surface roughness of 0.01 m. Aguirre LLC utilized DEGADIS to calculate the flammable vapor clouds from the loading arm failure scenario. The modeling results show an unignited vapor cloud extending 2,805 m (9,203 feet) to half the lower flammability limit (½ LFL) and would be within Zone 3. These distances would extend over the barrier reef and mangrove complex of Cayos Caribe, Cayos de Barca, and Cayo Puerca, which are located to the north of the proposed facility.

Aguirre LLC utilized PHAST to model the largest unignited vapor cloud from a release onboard the FSRU. The largest unignited vapor cloud would originate from a full bore release from the gas export line. The resulting flammable vapor cloud would extend to 1,405 m (4,610 feet) to the ½ LFL and would be within Zone 3. This vapor cloud would also extend over portions of the barrier reef and mangrove complex of Cayos de Barca. As this would be a non-cryogenic release, the vapor cloud would be buoyant and would quickly lift off into the air.

4.11.5 FSRU and LNG Carriers

Since 1959, ships have transported LNG without a major release of cargo or a major accident involving an LNG vessel. 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 more than 2,600 individual LNG ship arrivals at terminals in the United States. For the past 44 years, LNG shipping operations have been safely conducted in U.S. ports and waterways.

4.11.5.1 Design and Operating Requirements

The FSRU and the LNG carriers used to import and export LNG to and from the United States are constructed and operated in accordance with the IMO's *Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk*, the SOLAS, and 46 CFR 154, which contains the U.S. safety standards for vessels carrying liquefied natural gas in bulk.

As required by the IMO's conventions and design standards, hold spaces and insulation areas on the FSRU and LNG carrier are equipped with gas detection and low temperature alarms. These devices monitor for leaks of LNG into the insulation between primary and secondary LNG cargo tank barriers. In addition, hazard detection systems also monitor the hull structure adjacent to the cargo tank, compressor rooms, motor rooms, cargo control rooms, enclosed spaces in the cargo area, specific ventilation hoods and gas ducts, and air locks.

In 1993, amendments to the IMO's *Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk* required all vessels to have monitoring equipment with an alarm facility which is activated by detection of over-pressure or under-pressure conditions within a cargo tank. In addition, cargo tanks are heavily instrumented, with gas detection equipment in the hold and inter-barrier spaces, temperature sensors, and pressure gauges. The FSRU and LNG carriers are equipped with a firewater system with the ability to supply at least two jets of water to any part of the deck in the cargo area and parts of the cargo containment and tank covers above-deck. A water spray system is also available for cooling, fire prevention, and crew protection in specific areas. In addition, certain areas of the FSRU and LNG carriers are fitted with dry chemical powder-type extinguishing systems and CO_2 smothering systems for fighting fires. Fire protection also includes the following systems:

- a water spray (deluge) system that covers the accommodation house control room and all main cargo valves;
- a traditional firewater system that provides water to fire monitors on deck and to fire stations found throughout the vessel;
- a dry chemical fire extinguishing system for hydrocarbon fires; and
- a CO_2 system for protecting machinery including the ballast pump room, emergency generators, and compressors.

All LNG vessels entering U.S. waters are required to possess a valid IMO Certificate of Fitness and either a USCG Certificate of Inspection (for U.S. flag vessels) or a USCG COC (for foreign flag vessels). These documents certify that the vessel 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 FSRU would also be required to possess a COC issued by the USCG.

Furthermore, the FSRU is classed including the ship's hull, machinery, equipment (including regasification equipment) under the survey of Bureau Veritas classification society. The classification society reviewed the FSRU's equipment and system drawings against the rules of the classification society for compliance. Certain critical equipment was inspected during the manufacturing process. The classification society surveyors also verified material certificates, traceability of materials, welding processes, destructive tests, and non-destructive tests.

The FSRU calling at the Offshore GasPort and the LNG carriers that would deliver LNG to the facility comply with various U.S. and international security requirements. The IMO adopted the *International Ship and Port Facility Security Code (ISPS Code)* in 2003. The ISPS 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 vessels, as well as other cargo vessels 500 gross tons and larger, 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 Maritime Transportation Security Act was enacted by the U.S. Congress and aligned domestic regulations with the maritime security standards of the ISPS Code and SOLAS. The resulting USCG regulations, contained in 33 CFR 104, require vessels to conduct vulnerability assessments and develop corresponding security plans. All LNG carriers servicing the facility comply with the Maritime Transportation Security Act requirements and associated regulations while in U.S. waters. The FSRU calling at the Offshore GasPort also complies with SOLAS and the ISPS Code.

4.11.6 Hazards Resulting from Accidents

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 vessels, 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 vessel fleet, are described below:

- **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 vessel 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 vessel 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 vessel'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 USCG, the Khannur was allowed to discharge its LNG cargo.

- **Mostefa Ben Boulaid** had an 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 vessel 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 vessel, 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 vessel 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 vessel to a safe anchorage for repairs. The Catalunya Spirit was repaired and taken to port to discharge its cargo.

- **Suez Matthew** grounded on the reef off Cayo Maria Langa, near Guayanilla, Puerto Rico on December 19, 2009. The ship was refloated and no damage was found to the hull.

- **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, fatalities, or injuries were reported.

Although the history of LNG shipping has been free of major incidents, and no incidents have resulted in significant quantities of cargo being released, the possibility of an LNG spill from a vessel over the duration of the proposed Project must be considered. If an LNG spill were to occur, the primary hazard to the public would be from radiant heat from a pool fire. If an LNG release were to occur without ignition, an ignitable gas cloud could form and also present a hazard. Historically, the events most likely to cause a significant release of LNG were a vessel casualty such as:

- a grounding sufficiently severe to puncture an LNG cargo tank;
- a vessel colliding with an LNG vessel in transit;
- an LNG vessel alliding[12] with the terminal or a structure in the waterway; or
- a vessel alliding with an LNG vessel while moored at the terminal.

To result in a spill of LNG, any of the above events would need to occur with sufficient impact to breach an LNG vessel's double hull and cargo tanks. All LNG vessels used to deliver LNG to the proposed Project as well as the FSRU would have double-hull construction, with the inner and outer hulls separated by about 10 feet. Furthermore, the cargo tanks are normally separated from the inner hull by a layer of insulation approximately 1-foot thick.

As a result, many grounding incidents severe enough to cause a cargo spill on a single-bottom oil tanker would be unable to penetrate both inner and outer hulls of an LNG vessel. Previous incidents with LNG vessels have primarily involved grounding, and none of these have resulted in the breach of the

[12] "Allision" is the action of dashing against or striking upon a stationary object (for example, the running of one ship upon another ship that is docked) – distinguished from "collision," which is used to refer to two moving ships striking one another.

double hull and subsequent release of LNG cargo. The likelihood of an LNG vessel sustaining cargo tank damage in a collision would depend on several factors:

- the displacement and construction of both the struck and striking vessels;
- the velocity of the striking vessel and its angle of impact with the struck vessel; and
- the location of the point of impact.

In December 2004, the DOE released a study on the potential for an LNG vessel breach. At the request of the DOE, Sandia conducted the research and wrote the 2004 Sandia Report. The 2004 Sandia Report included an LNG cargo tank breach analysis using modern finite element modeling and explosive shock physics modeling to estimate a range of breach sizes for both credible accidental and intentional LNG spill events. Accidental breaching evaluations were based on finite element modeling of collisions of double-hulled oil tankers similar in size and design to LNG ships. The analysis of accidental events found that groundings, collisions with small vessels, and low-speed (less than 7 knots) collisions with large vessels striking at 90 degrees could cause minor vessel damage but would not result in a cargo spill. This is due to the protection provided by the double-hull structure, the insulation layer, and the primary cargo tank of an LNG vessel (i.e., LNG carriers and FSRUs). High-speed (12 knots) collisions with large vessels striking at 90 degrees were found to potentially cause cargo tank breach areas of from 0.5 to 1.5 m^2.

The possibility of an LNG release due to an accident, such as a collision or grounding, is considered minimal. In addition, current operational procedures in use by the USCG, such as managing ship traffic, coordinating ship speeds, and active ship control in inner and outer harbors, would also further reduce the potential of LNG spill from accidental causes.

4.11.7 Hazards Resulting from Intentional Acts

The 2004 Sandia Report also analyzed credible intentional breaches on LNG carriers up to 145,000 m^3 in capacity using modern finite element modeling and explosive shock physics modeling. The events considered for credible intentional acts were based on intelligence and historical data ranging from sabotage and hijacking to other types of physical attacks. Physical attacks included those documented to have occurred to several types of international shipping vessels, including attacks with small missiles and rockets, and attacks with bulk explosives.

For intentional scenarios, the size of the cargo tank hole depends on the location of the ship and source of threat. Intentional breach areas were estimated to range from 2 to 12 m^2. In most cases, an intentional breaching scenario would not result in a nominal hole area of more than 5 to 7 m^2, which is a more appropriate range to use in calculating potential hazards from spills. These hole sizes are equivalent to circular hole diameters of 2.5 and 3 m.

The 2004 Sandia Report evaluated cascading damage due to brittle fracture from exposure to cryogenic liquid or fire-induced damage to foam insulation. While possible under certain conditions, the cascading damage was found to not likely involve more than two or three cargo tanks. Cascading events were expected to increase the fire duration but not to significantly increase the overall fire hazard.

The 2004 Sandia Report also included guidance on risk management for intentional spills, based on the findings that the most significant impacts to public safety and property exist within approximately 500 m (1,640 feet) of a spill due to thermal hazards from a fire, with lower public health and safety impacts beyond 1,600 m (approximately 1 mile). Large un-ignited LNG vapor releases were found to be unlikely, but could extend from nominally 2,500 m (8,200 feet) to a conservative maximum distance of 3,500 m (2.2 miles) for an intentional spill.

In 2008, the DOE released another study prepared by Sandia, entitled *Breach and Safety Analysis of Spills Over Water from Large Liquefied Natural Gas Carriers, May 2008* (2008 Sandia Report). The 2008 Sandia Report assessed the scale of possible hazards for newer LNG vessels with capacities up to 265,000 m^3. Using the same methodology as the 2004 Sandia Report, the 2008 Sandia Report concluded thermal hazard distances would be only 7 to 8 percent greater than those from vessels carrying 145,000 m^3 of LNG, due primarily to the slightly greater height of LNG above the waterline. The 2008 Sandia Report also noted the general design of the larger vessels was similar to the previously analyzed ship designs and, for near-shore facilities; the calculated breach size for intentional scenarios would remain the same. Overall, the 2008 Sandia Report maintained the same impact zones as with the smaller vessels that were analyzed in the 2004 Sandia Report.

In February 2007, the U.S. Government Accountability Office (GAO) published a report assessing several studies, including the 2004 Sandia Report, which had been conducted on the consequences of an LNG spill resulting from a terrorist attack on an LNG vessel (GAO, 2007). The GAO's panel of experts agreed that the most likely public safety impact of an LNG spill would be the radiant heat from a pool fire and suggested that further study was needed to eliminate uncertainties in the assumptions used in modeling large LNG spills on water. After the GAO report, Congress requested the DOE to further address these research needs. In May 2012, a report entitled *Liquefied Natural Gas Safety Research Report to Congress* was released and is summarized below.

DOE contracted Sandia to conduct a series of large-scale LNG fire and cryogenic damage tests to investigate the larger classes of LNG carriers with capacities up to 260,000 m^3, representative of the largest LNG vessels in operation. Sandia conducted the largest LNG pool fire tests done to date and performed advanced computational modeling and ship simulations between 2008 and 2011. As in the earlier studies, Sandia worked with marine safety, law enforcement, and intelligence agencies to assess threats and credible intentional acts. Scenarios included attacks with shoulder-fired weapons, explosives, and attacks by aircraft and other boats. Sandia identified several ranges of possible hull breaches ranging from 0.005 m^2 (Very Small) to 15 m^2 (Very Large). Based on the collected pool fire test data and the ship simulations, Sandia concluded that thermal hazard distances to the public from a large LNG pool fire was smaller, by at least 2 to 7 percent, than the results listed in the 2004 and 2008 Sandia Reports.

In order to more robustly analyze the potential for cascading failure of LNG carrier cargo tanks, Sandia use detailed vessel structural and thermal damage models to simulate the effects to an LNG carrier from a spill. For the large breaches considered, Sandia predicts that as much as 40 percent of the LNG released from the cargo tank would remain within the ship's structure. Due to both the cold temperature of the LNG and the heat from a pool fire, the LNG carrier's structural steel would be degraded. The effects could be significant enough to cause the ship to be disabled, severely damaged, and at risk of sinking.

Although LNG ship design and construction practices render simultaneous, multiple tank failures as extremely unlikely, Sandia concluded that sequential multi-tank spills may be possible. If sequential failures were to occur, they would not increase the size of the area impacted by the pool fire but could increase the duration of the fire hazards. Based on this research, Sandia concluded that use of a nominal one-tank spill, with a maximum of a three-tank spill, as was recommended in the 2004 Sandia report, is still appropriate for estimating hazard distances. Due to the similar design features between LNG carries and the FSRU (i.e., double hull construction with approximately 10-feet separation, insulation between the inner hull and the cargo tanks, etc.), Sandia's conclusion would also apply to the FSRU. Aguirre LLC utilized the Sandia recommended breach for a near-shore facility of 5 m^2 hole on the FSRU and calculated an LNG pool diameter of 270 m (886 feet). This pool size compares to the 290 m (951 feet) pool size calculated in the 2008 Sandia Report. Therefore the Hazard Zones described in section 4.11.5.4 would apply to both the LNG carriers and the FSRU.

4.11.7.1 Regulatory Requirements for LNG Carrier Operations

The USCG 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 191); the Ports and Waterways Safety Act of 1972, as amended (33 USC 1221, et seq.); and the Maritime Transportation Security Act of 2002 (46 USC 701). The USCG is responsible for matters related to navigation safety, 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 USCG also has authority for LNG FSPreview, approval, and compliance verification as provided in 33 CFR 105.

The USCG regulations in 33 CFR 127 apply to the marine transfer area of waterfront facilities between the LNG vessel and the first manifold or valve located inside the containment. 33 CFR 127 regulates the design, construction, equipment, operations, inspections, maintenance, testing, personnel training, firefighting, and security 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, Aguirre LLC would be required to submit two copies of its Operations and Emergency Manuals to the USCG COTP for examination at least 30 days prior to the first LNG transfer..

Both the USCG regulations under 33 CFR 127 and FERC regulations under 18 CFR § 157.21, require an applicant who intends to build an LNG import facility to submit a Letter of Intent (LOI) to the USCG at the same time the pre-filing process is initiated with the Commission. Consequently, Aguirre LLC initially notified the USCG that it proposed to construct an LNG receiving terminal located outside of Jobos Bay near Central Aguirre along the south coast of Puerto Rico and submitted an LOI to the COTP, Sector San Juan, on December 20, 2011.

As required by its regulations (33 CFR § 127.009), the USCG 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 vessel'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 vessels en route to the facility, within 25 km (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 vessels from the channel and the width of the channel.

In addition to the LOI, 33 CFR 127 and FERC regulations require each LNG project applicant to submit a WSA to the cognizant COTP no later than the start of the FERC pre-filing process. Until a facility begins operation, applicants must annually review their WSAs and submit a report to the COTP as to whether changes are required. The WSA must include the following information:

- port characterization;
- risk assessment for maritime safety and security;
- risk management strategies; and
- resource needs for maritime safety, security, and response.

On June 14, 2005, the USCG published a Navigation and Vessel Inspection Circular (NVIC) – *Guidance on Assessing the Suitability of a Waterway for Liquefied Natural Gas (LNG) Marine Traffic* (NVIC 05-05). The purpose of NVIC 05-05 was to provide the USCG 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. Since 2005, the USCG updated this guidance twice, publishing NVIC 05-08 and NVIC 01-11. The current guidance from the USCG is contained in NVIC 01-11.

Waterway Suitability Assessment

As described in 33 CFR 127 and in NVIC 01-11, the applicant develops the WSA in two phases. The first phase is the submittal of the Preliminary WSA, which begins the USCG's review process to determine the suitability of the waterway for LNG marine traffic. The second phase is the submittal of the Follow-On WSA. This document is reviewed and validated by the USCG and forms the basis for the agency's LOR to the FERC.

The Preliminary WSA provides an outline which characterizes the port community and the proposed facility and transit routes. It provides an overview of the expected major impacts LNG operations may have on the port, but does not contain detailed studies or conclusions. This document is used to start the USCG's scoping process for evaluating the suitability of the waterway for LNG marine traffic. Aguirre LLC submitted the Preliminary WSA with its LOI to the USCG on December 20, 2011.

A Follow-On WSA is required to provide a detailed and accurate characterization of the LNG facility, the LNG tanker route, and the port area. The assessment is to identify appropriate risk mitigation measures for credible security threats and safety hazards. According to NVIC 01-11, the Follow-on WSA should provide 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. Aguirre LLC consulted with the USCG Resident Inspection Office, the Harbor Safety Committee and other port stakeholders in development of its Follow-On WSA. The Follow-On WSA was submitted to the USCG on January 10, 2014.

Hazard Zones

The Offshore GasPort would be located approximately 3 miles offshore and the LNG carriers would approach the Offshore GasPort via open water transits. There is no defined waterway that would be used by LNG carriers en route or departing from the Offshore GasPort, however the pilot boarding area would be in the open ocean located two nautical miles due South of the LNG offshore facility. The pilot boarding area is located in open waters and there would be no established population or shoreline areas along the LNG carrier route.

All three NVICs direct the use of the 2004 Sandia Report as the best available information on LNG spills. NVIC 05-08 and NVIC 01-11 also include use of the 2008 Sandia Report. Three concentric Zones of Concern, based on LNG carriers with a cargo carrying capacity up to 265,000 m^3, are used to assess the maritime safety and security risks of LNG marine traffic. Due to the similar designs of the LNG carriers and the FSRU (capacity of 150,900 m^3), these zones would also be applicable to the FSRU. The Zones of Concern are:

- Zone 1 – The area within 500 m (1,640 feet) of an LNG carrier where an LNG spill could pose a severe public safety and property hazard and could damage or significantly disrupt key assets located within that area. The outer perimeter of Zone 1 is approximately the distance to thermal hazards of 37.5 kW/m^2 (12,000 Btu/ft^2-hr) from a pool fire.

- Zone 2 – Is the area from 500 m (1,640 feet) to 1,600 m (5,250 feet) of an LNG carrier where an LNG spill would have less severe consequences for public safety, property, and key assets. 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.

- Zone 3 – The area from 1,600 m (5,250 feet) to 3,500 m (11,500 feet) from an LNG carrier where an LNG spill would have the least likelihood of severe consequences in the event that three cargo tanks are breached and a vapor cloud disperses with initial ignition at the source. The outer perimeter of Zone 3 should be considered the vapor cloud dispersion distance to the LFL 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.

For the proposed Project, the only location where the Zones of Concern encompass any land areas is directly to the north and northeast of the Offshore Terminal site. There would be no land areas within Zone 1. A small portion of uninhabited Cayos de Barca would be within Zone 2 directly to the north of the Offshore GasPort site. Zone 3 would encompass uninhabited areas of Cayos de Barca, Cayo Puerca, and portions of Punta Colchones to the north and Cayos Caribes to the northeast. There would be no inhabited areas within Zones 1, 2, or 3. This information was considered in the USCG's LOR Analysis.

Letter of Recommendation

Once the applicant submits a complete Follow-On WSA, the USCG reviews the document to determine if it presents a realistic and credible analysis of the public safety and security implications from LNG marine traffic in the port. Finally, the USCG issues a LOR. The USCG 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. On May 2, 2014, the COTP issued an LOR and an LOR Analysis which summarized the USCG's recommended risk mitigation measures, as well as the port community's capabilities.

Based on the review and validation of the information contained in the Follow-On WSA and the evaluation of the waterway in consultation with a variety of port stakeholders, the COTP has determined that the Bahía de Jobos transit route would be suitable for the type and frequency of marine traffic associated with this Project. The reasons supporting the COTP's determination are outlined in the LOR Analysis and include the following mitigation measures:

1. Inbound, loaded, or partially loaded LNG carriers should only transit the waterway during daylight hours, with daylight being interpreted, in practical terms, as being able to clearly see the horizon, shoreline and receiving berths clearly under conditions of natural light.

2. A minimum of two miles of clear visibility should be required for the movement of LNG carrier. In marginal weather conditions visibility can vary significantly along the route; the decision as to whether sufficient visibility exists, and is likely to continue to exist for the full transit, is a judgment call that would need to be made jointly between the attending pilot(s) in consultation with, and the concurrence of, the COTP.

3. Thirty knots should be the maximum sustained true wind speed, as measured on the LNG carrier, at which an inbound or outbound transit should be allowed to commence, and 25 knots gusting, during docking/undocking evolutions. As with visibility, significant variation in wind conditions can exist along the route, and the decision as to whether wind conditions permit a safe transit would be made by the attending pilot(s) in consultation with, and concurrence by, the COTP.

4. Aguirre LLC should plan and successfully conduct full mission bridge simulator training for those pilots providing services to LNG carriers. The training should take into account the full spectrum of vessel design and length, cargo carrying capacity, method of propulsion, steering and rudder configuration, thruster arrangements, and maneuvering characteristics for those carriers being considered for charter. In addition, expanded simulator training incorporating the number and design of tug boats having the minimum performance and operating criteria should be conducted.

5. Aguirre LLC should prepare and submit an Operations Manual, as required by 33 CFR § 127.305, and an Emergency Manual, as required by 33 CFR § 127.307, to the COTP for review and approval. The Operations and Emergency Manuals should be submitted at least 30 days before any transfer of LNG can take place. Comprehensive and coordinated response planning should consider:

    a. In-transit and dockside emergency procedures in the event of fire, mechanical malfunction, allision, grounding, and/or need of safe anchorage or refuge.

    b. The potential environmental impact of an LNG release and the identification and acquisition of joint resource needs to respond to the potential release.

    c. A contingency response plan specific to LNG and focusing on a layered response approach.

    d. Coordinated marine firefighting training and emergency response, with an emphasis on containing and extinguishing LNG fires.

    e. An incident management training and collaborative exercise program.

6. As per the enclosure (10) of NVIC 01-11, and prior to commencement of LNG operations, Aguirre LLC should provide the COTP with the following information pertaining to vessels that are reasonably anticipated to be servicing Aguirre LLC:

   a. intended LNG carriers nation of registry;

   b. the nationality or citizenship of the officers serving on board the intended LNG carriers; and

   c. the nationality or citizenship of the crew members serving on board the intended LNG carriers.

7. Until the facility goes into operation, Aguirre LLC should conduct an annual review of their WSA and provide the COTP with an update that accurately reflects all changes (actual and planned), to include changes of planned LNG carrier size or load frequency, port characterization modifications, facility-related design alternations, and conditions potentially affecting cumulative considerations. The annual review cycle should coincide with the anniversary date of the LOR.

8. Aguirre LLC should consider providing an education program directed at personnel residing or working near the proposed operation that outlines the steps Aguirre LLC operators and local emergency response organizations may take in the event of an emergency, and what the public can do to contribute to their own safety if an LNG release should occur.

9. Aguirre LLC should provide necessary data pertaining to the depth and keel clearance of the underwater pipeline. Most significantly at any area that the pipeline approaches the vicinity of the keys, entrance to Boca del Infierno pass or any other shoal areas. These areas are frequently used by local fishermen and recreational boaters. To mitigate the risk of an unintentionally grounding or anchoring, the pipeline should be mark and updated with NOAA so that is updated with the appropriate nautical charts. Areas where the keel clearance is less than 10 feet should also be properly marked to warn any vessel transiting in close proximity of the pipeline.

10. The USCG proposes to establish a moving 100 yards safety zone for all LNG carriers entering the surrounding areas of Bahía de Jobos while on approach and departure to the offshore terminal. Aguirre LLC would have a fixed 500 yards safety zone at all times. Once the LNG vessel is moored, the vessel would be part of the 500 yards safety zone regulation.

11. As described in the Follow-On WSA, marine firefighting capabilities are limited in this region. In order to improve firefighting capabilities able to respond to Aguirre LLC and LNG carriers, it is highly recommended to retrofit another commercial tug boat with FiFi 1 equipment, which would provide a third viable resource to combat at sea fire emergencies. As stated in Section 8.2.B. of the LOR Analysis, the COTP would require at least one tug in service to any LNG carriers, or the FSRU, to have FiFi 1 capability at all times. Additionally, the Commonwealth should assess the availability of marine firefighting resources in this region and develop a strategic plan in cooperation with Aguirre LLC that addresses all potential resource shortfalls.

The USCG's LOR is a recommendation on the current status of the waterway to the FERC, the lead agency responsible for siting the proposed LNG facility. Neither the USCG 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 or the Cost Sharing Plan (see section 4.11.6). However, if the Project is approved and if the appropriate resources are not in place, then neither agency would allow the Project to go into operation. As the USCG recommended that additional measures beyond those proposed by Aguirre LLC in the WSA would be needed to responsibly manage the maritime safety and security risks associated with LNG marine traffic, **we recommend that:**

- **Aguirre LLC should receive written authorization from the Director of OEP <u>prior to commencement of service</u> for the Project. Such authorization will only be granted following a determination by the USCG, under its authorities under the Ports and Waterways Safety Act, the Magnuson Act, the Maritime Transportation Security Act of 2002, and the Safety 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 Aguirre LLC or other appropriate parties.**

4.11.8 Emergency Response and Evacuation

While the release scenarios evaluated for the facility in sections 4.11.4 and 4.11.5 provide guidance on the extent of potential hazards, they should not be assumed to represent the evacuation zone for every potential incident. As with any other fuel or hazardous material, the actual severity of the incident would determine what area needs to be evacuated, if any, rather than a worst-case maximum zone. It is anticipated that the emergency evacuation plans would identify evacuation distances based upon increasing severity of events.

The USCG regulations in 33 CFR 127 establish requirements for the development and content of emergency response plans for waterfront LNG facilities. These plans, which are required to be developed prior to facility operation or LNG transfer from a ship, are to address the facility staff's response to onsite emergencies. For emergencies that may impact the public, the regulations contain requirements for notification, coordination, and cooperation with local officials, hospitals, fire departments, police departments, and other emergency response organizations. In addition, 15 USC 717b-1(e) stipulates that in any order authorizing an LNG terminal, the Commission shall require the LNG terminal operator to develop an ERP and Cost Sharing Plan in consultation with the USCG and state and local agencies. The NGA requires that this plan, intended to address security and safety needs at the LNG terminal and in proximity to vessels that serve the facility, be approved prior to the beginning of facility construction. Therefore, **we recommend that:**

- **<u>Prior to any construction</u>, Aguirre LLC should file with the Secretary for review and written approval by the Director of OEP an ERP (including evacuation) and coordinate procedures with the USCG; Commonwealth and local emergency planning groups; fire departments; Commonwealth law enforcement; and appropriate federal agencies. This plan should include at a minimum:**

  a. designated contacts with Commonwealth 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 vessel to activate sirens and other warning devices.**

Aguirre LLC should notify the FERC staff of all planning meetings in advance and should report progress on the development of its ERP <u>at 3-month intervals</u>.

On previous LNG import terminal proposals, a number of organizations and individuals have expressed concern that the local community would have to bear some of the cost of ensuring the security and emergency management of the LNG facility and the LNG vessels while in transit and unloading at the berth. In addition, Section 3A(e) of the NGA (as amended by the Energy Policy Act of 2005) specifies that the ERP shall include a Cost-Sharing Plan that contains a description of any direct cost reimbursements the applicants agree to provide to any Commonwealth and local agencies with responsibility for security and safety at the LNG terminal and in proximity to LNG vessels that serve the facility. Therefore, **we recommend that:**

- **<u>Prior to any construction,</u> the ERP should include a Cost-Sharing Plan identifying the mechanisms for funding all Project-specific security/emergency management costs that would be imposed on Commonwealth and local agencies. In addition to the funding of direct transit related security/emergency management costs, this comprehensive plan should include funding mechanisms for the capital costs associated with any necessary security/emergency management equipment and personnel base. The Cost-Sharing Plan should be filed with the Secretary for review and written approval by the Director of OEP.**

The cost-sharing plan must specify what the LNG terminal operator would provide to cover the cost of Commonwealth and local resources required to manage the security of the LNG terminal and LNG vessel, and Commonwealth 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, fire fighting 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 Commonwealth and local agency designated to receive resources.

4.11.9 Conclusions on Reliability and Safety

The principal hazards associated with the substances involved in the storage and vaporization of LNG result from cryogenic and flashing liquid releases; flammable vapor dispersion; vapor cloud ignition; and pool fires. As part of the NEPA review, Commission staff must assess whether the proposed Offshore GasPort would be able to operate safely and securely and minimize potential public safety impacts. Based on our technical review of the preliminary engineering designs, as well as our suggested mitigation measures, we conclude that sufficient layers of safeguards would be included in the facility designs to mitigate the potential for an incident that could impact the safety of the public. The FEED and specifications submitted for the proposed Offshore GasPort to date are preliminary, but would serve as the basis for any detailed design to follow. If authorization is granted by the Commission, the next phase of the Project would include development of the final design. We do not expect that the detailed design information to be developed would result in changes to the basis of design, operating conditions, major equipment selections, equipment design conditions, or safety system designs which were presented as part of Aguirre LLC's FEED. However, we are recommending that the final design be provided for further staff review to ensure it would be consistent with the safety and operability characteristics identified in the FEED. In addition, we are recommending that the facility, during construction and operation, be subject to regular FERC staff technical reviews and site inspections on at least an annual basis or at other intervals as determined by the Director of OEP. Siting of the facility with regard to potential consequences from these hazards is also required. The FERC authorizes the siting and construction of the proposed Project and the USCG has authority over the management of vessel traffic in and around the LNG facility (as stipulated in 33 CFR 127).

Since 1959, ships have transported LNG without a major release of cargo or a major accident involving an LNG vessel. For the past 50 years, LNG shipping operations have been safely conducted in U.S. ports and waterways. All LNG vessels entering U.S. waters are required to be certified by the USCG as designed and operating in accordance with both international standards and the U.S. regulations for bulk LNG carriers under 46 CFR 154. According to Aguirre LLC, the FSRU proposed for this Project has already been issued a COC.

All LNG vessels used to deliver LNG to the proposed Project as well as the FSRU would have double-hull construction, with the inner and outer hulls separated by about 10 feet. Furthermore, the cargo tanks are normally separated from the inner hull by a layer of insulation approximately 1-foot thick. As a result, the possibility of an LNG release due to an accident, such as a collision or grounding, is considered minimal. Threats and potential credible event scenarios for LNG marine transportation with marine safety, law enforcement, and intelligence agencies were also assessed. The evaluations considered a wide range of possible intentional events such as attacks with shoulder-fired weapons, explosives, and attacks by small to medium size boats and aircraft that could results in spill from the LNG carriers or FSRU. Security procedures could be used to reduce the potential of an LNG spill from intentional causes. Under 33 CFR 105 Aguirre LLC would submit a FSP to the USCG for review and approval before commencement of operations. The FSP would specify measures that have the capability to continuously monitor the facility's security through a combination of lighting, security guards, waterborne patrols, automatic intrusion-detection devices, or surveillance equipment.

If an LNG spill were to occur along the waterway, the primary hazard to the public would be from radiant heat from a pool fire. In order to assess the maritime safety and security risks of LNG marine traffic travelling to the proposed facility, hazard distances from both accidental and intentional events were estimated for the FSRU and LNG carriers with cargo capacities up to 265,000 m^3. Based on the results of this analysis, the USCG recommended that the waterway along the proposed carrier transit route would be suitable for the type and frequency of LNG marine traffic associated with this proposed Project. However, the USCG's conclusion is contingent upon implementation of the recommended measures, outlined in the LOR Analysis, to responsibly manage the maritime safety and security risks. If the Project is approved and the appropriate resources were not put into place, then neither the FERC nor the USCG would allow the Project to commence service.

4.11.10 Subsea Pipeline

4.11.10.1 Safety Standards

The DOT is mandated to provide pipeline safety under 49 USC Chapter 601. The PHMSA, Office of Pipeline Safety administers the national regulatory program to ensure the safe transportation of natural gas and other hazardous materials by pipeline. It develops regulations and other approaches to risk management that ensure safety in the design, construction, testing, operation, maintenance, and emergency response of pipeline facilities. Many of the regulations are written as performance standards that set a level of safety to be attained and allow the pipeline operator to use various technologies to achieve the required safety standard.

The DOT pipeline standards are published in 49 CFR 190–199. Part 192 specifically addresses natural gas pipeline safety issues. Under a *Memorandum on Natural Gas Transportation Facilities* dated January 15, 1993 between the DOT and the FERC, the DOT is recognized as having the exclusive authority to promulgate federal safety standards used in the transportation of natural gas. Section 157.14(a) (9) (vi) of the FERC's regulations requires that an applicant certify that it will design, install, inspect, test, construct, operate, replace, and maintain the facility for which a Certificate is requested in accordance with federal safety standards and plans for maintenance and inspection, or certify that it has been granted a waiver of the requirements of the safety standards by the DOT in accordance with Section 3(e) of the Natural Gas Pipeline Safety Act. The FERC accepts this certification and does not impose additional safety standards other than the DOT standards. If the Commission becomes aware of an existing or potential safety problem, there is a provision in the *Memorandum on Natural Gas Transportation Facilities* to promptly alert the DOT. The *Memorandum on Natural Gas Transportation Facilities* provides instructions for referring complaints and inquiries made by state and local governments and the general public involving safety matters related to pipelines under the Commission's jurisdiction.

The FERC also participates as a member of the DOT's Technical Pipeline Safety Standards Committee, which determines if proposed safety regulations are reasonable, feasible, and practicable.

Section 5(a) of the Natural Gas Pipeline Safety Act provides for a state agency to assume all aspects of the safety program for intrastate facilities by adopting and enforcing the federal standards, while section 5(b) permits a state agency that does not qualify under section 5(a) to perform certain inspection and monitoring functions. A state may also act as DOT's agent to inspect interstate facilities within its boundaries; however, the DOT is responsible for enforcement actions. Through certification by Office of Pipeline Safety, the Commonwealth inspects and enforces the pipeline safety regulations for intrastate gas pipeline operators in Puerto Rico. This work is performed by the Puerto Rico Public Service Commission.

The Pipeline Safety, Regulatory Certainty and Job Creation Act of 2011 (U.S. House of Representatives 2845) was passed by Congress and signed into law on January 3, 2012 by President Barack Obama. Among other things, this Act states that no later than 2 years after the date of enactment, after considering factors specified in the Act, the DOT Secretary, if appropriate, shall require by regulation the use of automatic or remote control shut-off valves, or equivalent technology, where economically, technically, and operationally feasible on transmission pipeline facilities constructed or entirely replaced after the date on which the Secretary issues the final rule containing such requirement. However, these regulations have not yet gone into effect and would apply to pipelines built in the future.

The Project's pipeline facilities would be designed, constructed, operated, and maintained in accordance with or to exceed the DOT Minimum Federal Safety Standards in 49 CFR 192. These regulations, which are intended to protect the public and to prevent natural gas facility accidents and failures, include specifications for material selection and qualification; minimum design requirements; and protection of pipelines from internal, external, and atmospheric corrosion.

The DOT defines area classifications, based on population density in the vicinity of a pipeline, and specifies more rigorous safety requirements for populated areas. Pipe wall thickness and pipeline design pressures, hydrostatic test pressures, MAOP, inspection and testing of welds, and frequency of pipeline patrols and leak surveys must conform to higher standards in more populated areas. The class location unit is an area that extends 220 yards (201 m) on either side of the centerline of any continuous 1.0-mile (1.6 km) length of pipeline. The four area classifications are defined below:

- <u>Class 1</u>: Location with 10 or fewer buildings intended for human occupancy;
- <u>Class 2</u>: Location with more than 10 but less than 46 buildings intended for human occupancy;
- <u>Class 3</u>: Location with 46 or more buildings intended for human occupancy or where the pipeline lies within 100 yards (91 m) of any building, or small well-defined outside area occupied by 20 or more people on at least 5 days a week for 10 weeks in any 12-month period; and
- <u>Class 4</u>: Location where buildings with four or more stories aboveground are prevalent.

In accordance with federal standards, class locations representing more populated areas require higher safety factors in pipeline design, testing, and operation.

The only location where the proposed subsea pipeline would be within 660 feet (201 m) of buildings intended for occupancy is at the northern end of the pipeline near the proposed landfall at Aguirre Plant. There are less than 10 residencies within the class location unit of the pipeline; therefore, the entire pipeline would be classified as Class 1.

If the Project is approved, the DOT regulations require that the pipeline be designed, at a minimum, to the appropriate class location standard. If a subsequent increase in population density adjacent to the right-of-way indicates a change in class location for the pipeline, Aguirre LLC would reduce the MAOP or replace the segment with pipe of sufficient grade and wall thickness, if required, to comply with the DOT code of regulations for the new class location.

The Pipeline Safety Improvement Act of 2002 requires operators to develop and follow a written integrity management program that contains all the elements described in 49 CFR 192.911 and addresses the risks on each transmission pipeline segment. Specifically, the law establishes an integrity management program that applies to all high consequence areas

The DOT published rules that define high consequence areas where a gas pipeline accident could do considerable harm to people and their property and requires an integrity management program to minimize the potential for an accident. This definition satisfies, in part, the Congressional mandate for the DOT to prescribe standards that establish criteria for identifying each gas pipeline facility in a high-density population area. No portion of Aguirre LLC's proposed pipeline facilities traverse zones classified as a high consequence area, alleviating the need for further consideration relative to 49 CFR 192.761(f).

49 CFR 192 prescribes the minimum standards for operating and maintaining pipeline facilities including the requirement to establish a written plan governing these activities. Under part 192.615, each pipeline operator must also establish an emergency plan that includes procedures to minimize the hazards in a natural gas pipeline emergency. Key elements of the plan include procedures for:

- receiving, identifying, and classifying emergency events, gas leakage, fires, explosions, and natural disasters;
- establishing and maintaining communications with local fire, police, and public officials and coordinating emergency response;
- initiating the emergency shutdown of system and safe restoration of service;
- making personnel, equipment, tools, and materials available at the scene of an emergency; and
- protecting people first and then property and making them safe from actual or potential hazards.

49 CFR 192 requires that each operator establish and maintain liaison with appropriate fire, police, and public officials to learn the resources and responsibilities of each organization that may respond to a natural gas pipeline emergency and to coordinate mutual assistance. The operator must also establish a continuing education program to enable customers, the public, government officials, and those engaged in excavation activities to recognize a gas pipeline emergency and report it to appropriate public officials.

An Emergency Plan as required by 49 CFR 192 for the pipeline component of the Project will be incorporated into the overall Emergency Response Plan for the Project (see section 4.11.2).

4.11.11 Pipeline Accident Data

The DOT requires all operators of natural gas transmission pipelines to notify the DOT of any significant incidents and to submit a report within 20 days. Significant incidents are defined as any leaks that:

- cause a death or personal injury requiring hospitalization; or
- involve property damage of more than $110,000. [13]

[13] As of December 2012, 110,000 dollars is approximately 50,000 in 1984 dollars (CPI, Bureau of Labor Statistics, ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt, January 16, 2013).

During the 20-year period from 1992 through 2011, a total of 1,197 significant incidents were reported on the more than 300,000 total miles (482,800 km) of natural gas transmission pipelines nationwide.

Additional insight into the nature of service incidents may be found by examining the primary factors that caused the failures. Table 4.11.8-1 provides a distribution of the causal factors as well as the number of each incident by cause. The dominant incident causes (corrosion; and pipeline material, weld, or equipment failure) comprise 47 percent of all significant incidents. The pipelines included in the data set in table 4.11.8-1 vary widely in terms of age, pipe diameter, and level of corrosion control. Each of these variables influences the incident frequency that may be expected for a specific segment of pipeline. The frequency of significant incidents, for example, is strongly dependent on pipeline age. Older pipelines have a higher frequency of corrosion incidents because corrosion is a time-dependent process.

The use of both an external protective coating and a cathodic protection system, required on all pipelines installed after July 1971, significantly reduces the corrosion rate compared to unprotected or partially protected pipe. [14]

TABLE 4.11.8-1

Natural Gas Transmission Pipeline Significant Incidents by Cause (1993 to 2012) [a]

Cause	Number of Incidents	Percentage [a]
Corrosion	286	23.6
Excavation [b]	203	16.8
Pipeline material, weld, or equipment failure	285	23.5
Natural force damage	144	11.9
Outside forces [c]	67	5.5
Incorrect operation	32	2.6
All other causes [d]	194	16.0
Total	**1,211**	–

Source: PHMSA, 2014.

[a] Due to rounding, column does not total 100 percent.
[b] Includes third-party damage.
[c] Fire, explosion, vehicle damage, previous damage, intentional damage.
[d] Miscellaneous causes or unknown causes.

Excavations, natural forces, and outside forces are the causes in 34 percent of significant pipeline incidents. Table 4.11.8-2 presents information on these incidents by cause. The incidents mostly result from the encroachment of mechanical equipment such as bulldozers and backhoes; earth movements due to soil settlement, washouts, or geologic hazards; and weather effects such as winds, storms, and thermal strains.

[14] Cathodic protection is a technique to reduce corrosion (rust) of the natural gas pipeline that includes the use of an induced current or a sacrificial anode (like zinc) that corrodes at faster rate to reduce corrosion.

TABLE 4.11.8-2

Outside Forces Incidents by Cause (1993 to 2012) [a]

Cause	Number of Incidents	Percent of all Incidents [b]
Third-party excavation damage	170	14.0
Operator excavation damage	25	2.0
Unspecified equipment damage/previous damage	4	0.3
Previous damage due to excavation	4	0.3
Heavy rain/floods	70	5.7
Earth movement	38	3.1
Lightning/temperature/high winds	21	1.6
Other/unspecified natural force	15	1.1
Vehicle (not engaged with excavation)	42	3.4
Fire/explosion	8	0.6
Previous mechanical damage	5	0.4
Intentional damage	1	0.0
Other/unspecified outside force	5	0.3
Maritime equipment or vessel adrift/ maritime activity	6	0.4
Total	**414**	**--**

[a] Excavation, outside forces, and natural force damage from table 4.11.8-1.
[b] Due to rounding, column does not equal 34.2 percent.

Older pipelines have a higher frequency of outside forces incidents partly because their location may be less well known and less well marked than newer lines. In addition, the older pipeline systems contain a disproportionate number of smaller diameter pipelines, which have a greater rate of outside forces incidents. Small diameter pipelines are more easily crushed or broken by mechanical equipment or earth movements.

4.11.11.1 Impact on Public Safety

Table 4.11.8-3 presents the average annual injuries and fatalities that occurred on natural gas transmission lines between 2008 and 2012. The data have been separated into employees and nonemployees, to better identify a fatality rate experienced by the general public. Fatalities among the public averaged two per year over the 20-year period from 1993-2012 (PHMSA, 2014).

The majority of fatalities from pipelines involve local distribution pipelines. These are natural gas pipelines that are not regulated by the FERC and that distribute natural gas to homes and businesses after transportation through interstate natural gas transmission pipelines. In general, these distribution lines are smaller diameter pipes, often made of plastic or cast iron rather than welded steel, and tend to be older pipelines that are more susceptible to damage. In addition, distribution systems do not have large rights-of-way and pipeline markers common to the FERC-regulated natural gas transmission pipelines.

TABLE 4.11.8-3

Annual Average Fatalities – Natural Gas Transmission Pipelines

	Injuries		Fatalities	
Year	Employees	Public	Employees	Public
2008	3	2	0	0
2009	4	7	0	0
2010 [a]	10	51	2	8
2011	1	0	0	0
2012	3	4	0	0

[a] All of the public injuries and fatalities in 2010 were due to the Pacific Gas and Electric pipeline rupture and fire in San Bruno, California on September 9, 2010.

The nationwide totals of accidental fatalities from various manmade and natural hazards are listed in table 4.11.8-4 to provide a relative measure of the industry-wide safety of natural gas transmission pipelines. Direct comparisons between the different accident categories listed in the table should be made cautiously because individual exposures to hazards are not uniform among all categories. The data nonetheless indicate a low risk of death due to incidents involving natural gas transmission pipelines compared to the other categories. For example, the fatality rate for incidents involving natural gas pipelines is more than 25 times lower than the rate from natural hazards such as lightning, tornados, floods, and earthquakes.

The available data show that natural gas transmission pipelines continue to be a safe, reliable means of energy transportation. From 1993 to 2012, there were an average of 61 significant incidents and two fatalities per year (PHMSA, 2014). The number of significant incidents over the more than 300,000 miles (482,800 km) of natural gas transmission lines indicates the risk is low for an incident at any given location. The operation of the Project would represent a slight increase in risk to the nearby public.

TABLE 4.11.8-4

Nationwide Accidental Deaths [a]

Type of Accident	Annual Number of Deaths
All accidents	117,809
Motor Vehicle	45,343
Poisoning	23,618
Falls	19,656
Injury at work	5,113
Drowning	3,582
Fire, smoke inhalation, burns	3,197
Floods [b]	93
Lightning [b]	57
Tornado [b]	57
Natural gas distribution lines [c]	14
Natural gas transmission pipelines [c]	2

[a] U.S. Census Bureau, 2010b.
[b] National Weather Service, 2012.
[c] PHMSA, 2014.

4.12 CUMULATIVE AND OTHER IMPACTS

Cumulative impacts may result from the incremental effects associated with an action when added to temporary or permanent impacts associated with past, present, and reasonably foreseeable future actions. The cumulative effects of multiple projects may be significant even if each individual action is not. The synergistic impacts from all actions could be significant if mitigative or other measures are not implemented.

The affected environment considered in the analysis of cumulative impacts associated with this Project includes the offshore berthing platform, the subsea pipeline, and onshore facilities. Onshore components of the Project include temporary construction work areas and permanent facilities needed for operation of the proposed Project that are non-jurisdictional (see section 1.4). Because the impacts of the onshore components are temporary and involve minimal land disturbance, the analysis of cumulative impacts associated with the Project focus primarily on offshore components.

The Comité Diálogo Ambiental filed comments expressing concerns that approval of the Project could lead to exacerbation of several sensitive and degraded resources in the vicinity of the Project. Impacts from the Project could cumulatively contribute to loss of marine habitat, decreased water quality, loss of traditional fishing activities, and degradation of air quality. The commenter also noted that these resources are already affected by several nearby operating facilities including municipal landfills, a coal burning power plant, and a scrap metal operation. Several abandoned facilities were noted as well and include a sugar mill with deteriorating buildings, a former petrochemical facility, and a former tire recycling operation. Further, nearby residential housing development is noted as contributing to the loss of groundwater quality and quantity and prime agricultural lands (Comité Diálogo Ambiental, 2013). As noted above, the focus of the cumulative impacts analysis is primarily on Project facilities located offshore. The cumulative impacts on the resources identified in the Comité Diálogo Ambiental letter are discussed below, where applicable.

4.12.1 Past, Present, and Reasonably Foreseeable Cumulative Actions

Actions considered in this analysis vary from the Project in duration and scale and those that have been, are in the process of, or are likely to be completed are evaluated. The actions considered are illustrated on figure 4.12.1-1 and discussed below.

Existing Facilities/Under Construction and Completed Activities

<u>AES Ilumina Solar Photovoltaic Power Plant</u>

AES Ilumina constructed a 24-MW photovoltaic power plant on a 138-acre (142 cuerdas) site in Guayama, approximately 4.5 miles (7.2 km) east of the Aguirre Plant. The project was completed in October 2012 and is the first utility scale solar energy project in Puerto Rico. Electricity generated at the facility is sold to PREPA under a 20-year power purchase agreement. Energy generated at the facility is capable of meeting the needs of 6,500 area households (AES Solar, 2011).

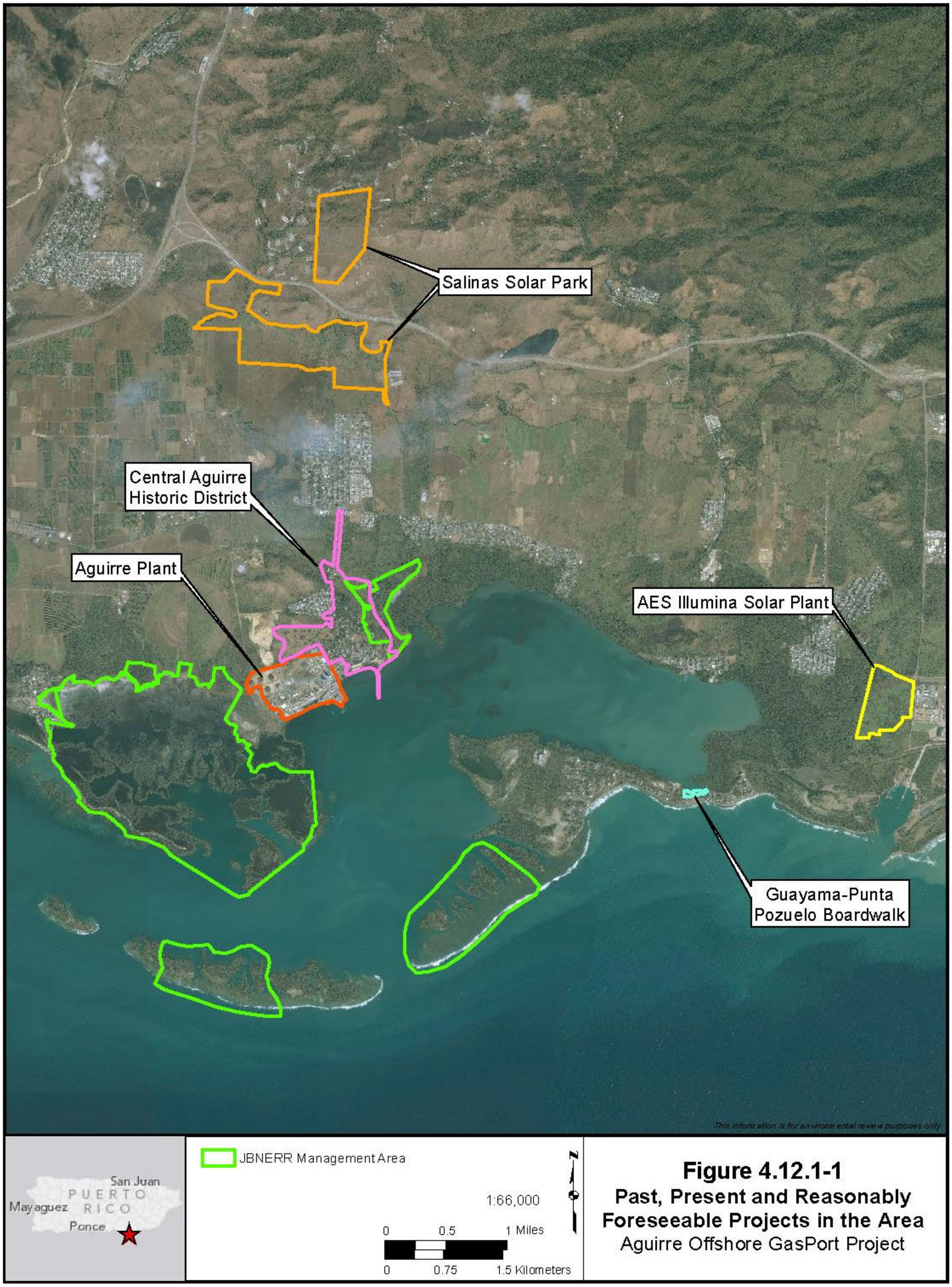

Figure 4.12.1-1
Past, Present and Reasonably Foreseeable Projects in the Area
Aguirre Offshore GasPort Project

Salinas Solar Park

Partner companies Sonnedix and Yarotek began construction in November 2012 of the first of two phases of the Salinas Solar Park, a 16-MW photovoltaic power plant on a 140-acre (144 cuerdas) site in Salinas, 2.5 miles (4.0 km) north of the Aguirre Plant. When fully operational, the Salinas Solar Park will provide services to approximately 2,500 households (Sonnedix, 2013).

Guayama-Punta Pozuelo Boardwalk

The municipality of Guayama is constructing a boardwalk along State Road PR-7710 in Barrio Punta Pozuelo, approximately 3 miles (4.8 km) southeast of the Aguirre Plant and 3.5 miles (5.6 km) northeast of the offshore berthing platform. The boardwalk project has a northerly view of Jobos Bay and includes park areas, gazebos, small areas for commercial use, facilities for kayak use, parking lots, and an observation point/monument site. Status of the project is not known, but based on recent aerial photography the project appears to be close to completion. Direct impact on Jobos Bay is limited to a small beach access point (Desarrollo Integral Del Sur, Inc., undated).

Proposed and Reasonably Foreseeable Projects

Aguirre Plant Fuel Conversion

As discussed in section 1.1, the purpose of the proposed Project is to provide LNG storage capacity and sustained deliverability of natural gas directly to the Aguirre Plant, which would facilitate PREPA's conversion of the Aguirre Plant from fuel oil only to dual-fuel generation facility, capable of burning diesel and natural gas for the combined cycle units and fuel oil and natural gas for the thermoelectric plant.

Master Plan for the Renovation of Aguirre

A master plan for the renovation of several existing historic structures throughout the area has been developed by the Polytechnic University of Puerto Rico. The conceptual plan has been reviewed and endorsed by the DNER and the Puerto Rico Tourism Company but has not advanced beyond the conceptual phase. Renovation projects would include redevelopment of urban areas and infrastructure including a small craft marina along the abandoned sugar mill pier. The primary objective of the master plan is to preserve the historic values of Aguirre and develop tourism attractions in the area (American Institute of Architects, 2011).

Management Plan for the JBNERR

The DNER has established a management plan for Jobos Bay that is revised every 5 years (DNER, 2010). The intent of the management plan is to preserve the natural resources of Jobos Bay while promoting its educational and recreational uses in a sustainable manner. The JBNERR has designated areas for education, outreach, passive recreation activities (i.e., picnicking, camping, bird watching, hiking, and recreational water uses), and limited public water access facilities. Many of the improvements in the management plan have been implemented with new projects underway as periodic revisions to the plan are approved. These improvements include upgraded dormitory, security, and office facilities; laboratory relocation and expansion; increased parking facilities; construction of maintenance and storage buildings; construction of a community volunteer office; and interpretive signs for the public.

4.12.2 Cumulative Impact Analysis by Resource Area

Potential impacts most likely to be cumulative with the Project's impacts are related to water resources, air quality, and noise. The Project could contribute to these cumulative impacts; however, our recommendations and Aguirre LLC's proposed mitigation measures would minimize adverse impacts as described in section 5.0. The section below also provides a qualitative analysis of the Project's contribution to climate change.

Because this analysis is focused on the offshore Project facilities, cumulative impacts with the onshore projects listed above on sensitive benthic habitat and marine wildlife are not anticipated. In fact, the operation of the proposed Project would reduce the fuel oil barge traffic in Jobos Bay, thereby reducing the potential for vessel strikes and other impacts on sensitive resources in the bay. Similarly, we do not anticipate any cumulative impacts on soils and geology because the Project's associated impacts would occur at the terminal site and any cumulative soils impacts would be minimized by distance of the Project to the projects listed above.

Due to the majority of the Project occurring offshore, we do not anticipate any cumulative impacts on wetlands or vegetated upland areas in the Project area. As the onshore component would entail the use of temporary construction workspaces and the only permanent onshore facilities would be within currently developed areas within the existing Aguirre Plant, we do not anticipate any impacts to wetlands or any permanent affects vegetated upland areas. As it is uncertain when, if ever, other proposed projects in the area would occur, the Project is not anticipated to have any cumulative impacts on wetlands or vegetated upland areas.

The Central Aguirre Historic District was the only identified cultural resource near the Project. This District is approximately 500 feet (152 m) northeast of the onshore portion of the Project area, and the Project facilities would be within the viewshed of the District. As the onshore facilities would be within the Aguirre Plant boundaries, they would not cause additional negative impacts to the District. In addition, at this time it is uncertain when, if ever, any of the other planned projects within the Project area and near the Central Aguirre Historic District would occur. Therefore, no cumulative impacts are anticipated to cultural resources from onshore Project facilities. The offshore portion of the Project is approximately 3.5 miles (5.6 km) southwest of the Central Aguirre Historic District, and the view is at least partially, if not fully, obstructed by barrier islands. Therefore, due to the distance from the Project area and the obstructed view, the offshore portion of the Project would not contribute to cumulative impacts on cultural resources.

Impacts associated with the Guayama-Punta Pozuelo Boardwalk project, renovation projects in Aguirre, and JBNERR Management Plan would represent beneficial improvements to the human and natural environment. Therefore, cumulative impacts on land use, recreation, visual resources, and socioeconomics are not anticipated.

4.12.2.1 Water Resources

The Aguirre Plant is the only current single point source discharge within Jobos Bay. The facility has obtained a NPDES permit from the EPA allowing discharge to the bay (Whitall, et al., 2011). Power station cooling water discharges through an approximately 0.8-mile-long (1.3 km) pipe to a point at the western edge of the bay just offshore of Punto Colchones. The proposed subsea pipeline would be about 0.6 mile (1.0 km) east of the cooling water discharge at its closest point. It is presumed that the Aguirre Plant water discharges are within the regulated limits established by the NPDES permit.

Operation of the FSRU and visiting LNG carriers at the offshore berthing platform would involve water discharges with thermal effects. The thermal plume from water discharged during operation would be limited to the immediate vicinity of the FSRU and LNG carriers (see section 4.3). The offshore berthing platform would be approximately 2.2 miles (3.5 km) from the Aguirre Plant cooling water discharge, located outside of Jobos Bay, and separated from the bay by barrier islands. Because any water temperature impact from operation of the Project would be limited to the vicinity of the offshore facilities outside of Jobos Bay and well removed from the existing power station discharge point, these discharges would not act cumulatively and their thermal plumes would equilibrate with ambient temperatures.

Construction of the Project would primarily affect water quality by causing temporary increases in turbidity from the installation of the offshore berthing platform and subsea pipeline. These impacts would dissipate quickly following construction. Water used for construction of the Project facilities would not contain any additives. During operations, water may be treated with biocides as necessary and in compliance with permits issued for that purpose.

Additional existing sources of water quality impacts within the Project area include sediment disturbance from barges and recreational vessels in shallow waters, the potential for spills from barges and recreational vessel using Jobos Bay, and non-point source runoff from the land surrounding Jobos Bay. The water quality impacts from barges, recreational vessels, and runoff historically has been minimal and infrequent. There are currently no known proposed or past projects that would directly affect water quality within Jobos Bay while occurring during the Project construction period. Therefore, water quality impacts of the proposed Project when considered cumulatively with other projects would not be significant.

4.12.2.2 Air Quality

The AES Ilumina and Salinas Solar Park facilities provide emissions-free energy to electric utility customers in the vicinity of the Project, presumably displacing demand for service from the Aguirre Plant. Although comparatively minor in scale, the operation of these solar facilities would reduce the amount of power output from the Aguirre Plant, potentially decreasing air emissions from the plant. Further, the purpose of the solar facilities is to reduce Puerto Rico’s dependence on oil and to further diversify energy sources for users on the island. Operation of these facilities would contribute to a beneficial impact on air quality.

Construction of the Guayama-Punta Pozuelo Boardwalk may be complete before construction of the Project commences. However, if construction of the Project, the Boardwalk, and the ongoing activities under the JBNERR Management Plan coincide, cumulative air quality impacts could be additive but would be minimal due to the limited, short-term nature of pipeline construction in Jobos Bay. Construction-related air quality impacts would subside once construction activities are complete. Further, construction the Project is expected to be near completion or complete before renovation projects in Aguirre commence and we do not anticipate any cumulative air quality impacts. We did not identify any permanent emission sources associated with the Guayama-Punta Pozuelo Boardwalk, the ongoing activities under the JBNERR Management Plan, or renovation projects in Aguirre, and we do not anticipate any significant cumulative air quality impacts as a result of the Project.

Cumulative impacts on air quality could be affected by the contribution of emissions from construction and operation of the Project when considered with other industrial operations nearby. The AES coal-fired power plant in Guayama emits NO_x, CO, VOCs, particulate matter, SO_2, sulfuric acid, various metals, and GHGs. Conversion of the Aguirre Plant from fuel oil to natural gas as its primary fuel would change the contribution of emissions from the plant, mostly in beneficial ways. As discussed in section 4.10.1, the existing Aguirre Plant is currently a PSD major source for every regulated NSR pollutant except VOC. The use of natural gas at the Aguirre Plant would result in substantial reductions in particulate matter, SO_2, NO_x, CO, and sulfuric acid mist.

Due to concerns about cumulative impacts, the EPA commented that the Project would consume only 39 percent of the total natural gas capacity that is unloaded into the FSRU, leaving much unused sendout capacity. The EPA inquired if the Offshore GasPort was seeking or would seek different natural gas markets to sell its unused capacity. Excelerate Energy responded, indicating that the Project is appropriately sized. The FSRU must maintain sufficient fuel storage for the Aguirre Plant, and the volume of LNG delivered to the FSRU must be greater than the volume of natural gas to be delivered to the Plant. The LNG to be supplied by the FSRU is fully committed to be used exclusively at the Plant. Further, the EPA asserted in its finding on the PSD Non-applicability analysis for the Aguirre Plant and the Project, that certain permit conditions concerning the FSRU's available capacity be included in the EQB air quality construction permits. Therefore, no excess LNG would be provided to other users or markets and there would be no emissions other than these estimated for the Aguirre Plant. Therefore, no excess LNG would be provided to other users or markets and there would be no emissions other than these estimated for the Plant.

Aguirre Plant Fuel Conversion

The Aguirre Plant consists of twelve oil-fired electric generation units as follows:

- steam power plant, consisting of two oil-fired steam boilers (AG 1 and 2) with a total generating capacity of 900 MW;
- combined cycle power plant (CC 1 and 2), consisting of eight oil-fired combustion turbines with two steam generators with a total generating capacity of 600 MW; and
- power block, consisting of two simple cycle oil-fired combustion turbines with a total generating capacity of 40 MW.

The two boilers are each rated at 4,180 MMBtu/hour and the combined cycle units are rated at 607.5 MMBtu/hour each. The two simple cycle power block combustion turbines are rated at 301.5 MMBtu/hour each. Total Aguirre Plant electrical output is rated at 1,540 MW. All Plant generating units are subject to conditions in (CAA) Title V Operating Permit No. PFE-TV-4911-63-0796-0005 issued on February 24, 2008. Only the steam boilers at the steam plant (AG 1 and 2) and the eight combustion turbines at the combined cycle power plant (CC 1 and 2) are proposed to be converted to use natural gas as part of the Aguirre Plant/Offshore GasPort Conversion Project.

Air Quality Regulations

Refer to section 4.10.1.2 for a description of the federal and local air quality regulations applicable to the Project.

Prevention of Significant Deterioration

PSD regulations are intended to preserve the existing air quality in attainment areas where pollutant levels are below the NAAQS. In addition to requiring an extensive review of environmental impacts, viable emissions-control technologies, and related impacts, PSD regulations impose specific limits on the amount of pollutants that major new or modified stationary sources might contribute to existing air quality levels.

PREPA has filed a PSD Non-Applicability Application with the EPA. A courtesy copy has been presented to the EQB to incorporate PSD conditions issued by EPA Region 2. In its application, PREPA asserts that the proposed Project be considered part of the Aguirre Plant because the Offshore GasPort would be constructed to store and supply natural gas to the Aguirre Plant. As mentioned previously, the EPA determined that the PSD requirements would not be applicable to the Aguirre Plant/Offshore GasPort. In essence, the cumulative operational air quality impacts associated with the Aguirre Plant and the proposed Project would be evaluated by the EQB and EPA in processing the applicable air quality permits.

For 28 specific source categories, the PSD major source threshold is 100 tpy (91 mtpy). Because fossil fuel boilers with a heat input capacity greater than 250 MMBtu/hour are one of the 28 listed source categories, the Aguirre Plant/Offshore GasPort is subject to the 100-tpy (91 mtpy) major source threshold. The existing Aguirre Plant is a major source of air pollutants, and is located in an area that is designated as "attaining" the NAAQS for all criteria pollutants.

Physical changes and/or changes in the method of operation trigger a review of past (baseline) and projected future actual or potential air pollutant emissions to determine if PSD review would apply. Conversion of the boilers and combined cycle units at the Plant to use natural gas would require the installation of new burners and controls in the boilers and turbines, construction of the Offshore GasPort, and new piping to transport the natural gas from the Offshore GasPort to the Plant. This would represent a physical change. Furthermore, use of natural gas would be a change in the method of operation of these units. Once the conversion project is completed, the boilers (AG 1 and 2) would have the capacity to generate electricity in various dual firing (No. 6 oil, Bunker C, and natural gas) scenarios. In the case of the combined cycle units, the gas turbines would have the capacity to generate electricity by firing either No. 2 fuel oil or natural gas.

PREPA plans to accept enforceable operational limits on the boilers and the combined cycle units at the Plant, thus rendering PSD review inapplicable. PREPA plans to limit future AG 1 and 2 operations to a 55 percent annual capacity factor and the combined cycle units to a 35 percent annual capacity factor.

For the Aguirre Plant/Offshore GasPort, PSD applicability was determined based on a proposed increase above actual emissions. In assessing PSD applicability, PREPA used the following procedure (AECOM, 2013):

- Calculate baseline actual emissions (40 CFR 52.21 (b)(48)) for the boilers and combined cycle combustion turbines based on the average rate in tpy that the units emitted during a consecutive 24-month period during the 5 years immediately preceding the date that construction is commenced. Note that a different 24-month period can be selected for each PSD-regulated pollutant.
- Calculate the future potential emissions for the boilers and the combined cycle combustion turbines based on the anticipated future power production by the units. Since the Project is also part of the Aguirre Plant/Offshore GasPort, the potential emissions from the Offshore GasPort are also accounted for in the applicability analysis.
- Calculate contemporaneous emission changes associated with minor source permits (there were no contemporaneous emission changes for the Project and none are expected by the end of the contemporaneous period).
- Subtract baseline actual emissions from future potential emissions (including potential emissions from the Offshore GasPort) to determine the "emissions change" due to the Project. If the difference is less than the PSD significant emission rate for each PSD pollutant, the Project is considered a "minor modification" and PSD review does not apply. If the difference is greater than the PSD significance threshold for at least one pollutant, the Project is considered a "major modification" and PSD review applies for that pollutant.

The emissions increases for each pollutant are presented in table 4.12.2-1 below. Therefore, based on these emissions data, the Aguirre Plant/Offshore GasPort would be considered a minor modification according to the PSD regulations because the change in emissions of all PSD-regulated pollutants (Step 1 of the applicability test) is below EPA's significant emission rates, as defined in 40 CFR 52.21(b)(23)(i) (AECOM, 2013).

TABLE 4.12.2-1

Net Emissions Changes and Significance for the Aguirre Plant and Aguirre Offshore Gasport Project

Pollutant	Baseline Actual Emission (tpy [mtpy])	Aguirre Boilers and CC Plant Future Potential Emissions (tpy [mtpy])	GasPort Potential Emissions (tpy [mtpy])	Emissions Increase (tpy [mtpy])	PSD "Significant" Threshold (tpy [mtpy])	PSD Applicability (Yes/No)
NO_x	7,514 (6,817)	6,610 (5,996)	110 (100)	-795 (-721)	40 (36)	No
CO	1,415 (1,284)	1,000 (907)	123 (112)	-293 (-266)	100 (91)	No
VOC	25 (23)	42 (38)	16 (15)	32 (29)	40 (36)	No
PM	1,205 (1,093)	899 (816)	21 (19)	-285 (-259)	25 (23)	No
PM_{10}	1,298 (1,178)	950 (862)	21 (19)	-327 (-297)	15 (14)	No
$PM_{2.5}$	876 (795)	680 (617)	21 (19)	-175 (-159)	10 (9)	No
SO_2	11,259 (10,214)	5,422 (4,919)	21 (19)	-5816 (-5276)	40 (36)	No
H_2SO_4	503 (456)	242 (220)	1 (1)	-260 (-236)	7 (6)	No
Lead	0.2 (0.2)	0.1 (0.1)	0	0	1 (1)	No
Fluoride	3 (3)	3 (3)	0	0	3 (3)	No
GHG (total mass)	4,117,379 (3,735,224)	3,838,316 (3,482,063)	321,266 (291,448)	42,204 (38,287)	N/A	N/A
GHG (CO_2e)	4,130,847 (3,747,442)	3,846,054 (3,489,082)	321,773 (291,908)	36,980 (33,548)	75,000 (68,039)	No

Through compliance with federal permitting requirements and federally enforceable emissions limits, emissions contributions in aggregate with other nearby emission sources would constitute a minor cumulative impact. When considered in the context of increased power demand and availability from all available sources, conversion of the Aguirre Plant resulting from the Project would limit the overall cumulative impact on local and regional air quality.

Air Quality Impact Assessment

Modeling Methodology

Aguirre LLC conducted a cumulative air quality dispersion model impact analysis with the OCD model to assess the air quality concentrations for all criteria pollutants. This analysis was conducted for the proposed Offshore GasPort and the onshore Aguirre Plant. The analysis includes evaluation of the Offshore GasPort stationary emission sources (FSRU sources, platform sources, and LNG carrier unloading) as well as the LNG carrier hoteling emissions and the transitory (mobile) emission sources operating within the safety zone (tug boats, other support vessels, and the LNG carriers moving to and from the Offshore GasPort platform within the safety zone). The OCD model is the model recommended by the EPA for sources located over water and it uses meteorological data from both over-land and over-water weather stations. The OCD model can also account for the overwater transport and dispersion and shoreline effects (i.e., development of the thermal internal boundary layer, sea breeze, and fumigation).

The Aguirre Plant sources considered consist of the two steam boilers and the eight combined cycle turbines while operating on natural gas provided from the GasPort. The Plant's two simple cycle turbines were not considered since they are not expected to operate while the Offshore GasPort is providing natural gas to the Plant. Tables 4.12.2-2 and 4.12.2-3 provide the emissions and stack/exhaust parameter data for the Offshore GasPort and Aguirre Plant sources, respectively. Building dimensions (height and maximum projected width) for the power plant structures associated with each stack were also input to the OCD model.

TABLE 4.12.2-2

Offshore and Coastal Dispersion Model Emissions and Exhaust Parameters for Offshore GasPort Modeled Sources for the Aguirre Offshore GasPort Project

Source Description	NO_x (lb/hr [g/s])	CO (lb/hr [g/s])	PM_{10} / $PM_{2.5}$ (lb/hr [g/s])	SO_2 (lb/hr [g/s])	Stack Height (ft [m])	Stack Temp (K)	Stack Diameter (ft [m])	Exit Velocity (ft/s [m/s])	Stack Angle (D_{eg})	Grd-level Elev (ft [m])
Boiler 1 [a]	4.3 (0.54)	5.0 (0.63)	1.7 (0.21)	1.6 (0.2)	122.7 (37.4)	352 (451)	4.6 (1.4)	69.6 (21.2)	45	0.0
Boiler 2 [a]	4.3 (0.54)	5.0 (0.63)	1.7 (0.21)	1.6 (0.2)	122.7 (37.4)	352 (451)	4.6 (1.4)	69.6 (21.2)	45	0.0
Auxiliary Boiler [b]	2.9 (0.37)	7.1 (0.89)	1.2 (0.15)	0.1 (0.012)	122.7 (37.4)	392 (473)	4.6 (1.4)	68.2 (20.8)	45	0.0
DFDE Generator [c]	11.5 (1.45)	29.3 (3.69)	0.2 (0.03)	0.2 (0.03)	122.7 (37.4)	626 (603)	2.3 (0.7)	93.8 (28.6)	45	0.0
Platform Engine Gas 1 [d]	1.0 (0.13)	2.1 (0.26)	0.0 (0.0043)	0.0 (0.00034)	20.0 (6.1)	892 (751)	0.7 (0.2)	122.0 (37.2)	0	52.5 (16.0)
Platform Engine Gas 2 [d]	1.0 (0.13)	2.1 (0.26)	0.0 (0.0043)	0.0 (0.00034)	20.0 (6.1)	892 (751)	0.7 (0.2)	122.0 (37.2)	0	52.5 (16.0)
Platform Engine Oil 1 [d]	0.2 (0.0264)	0.2 (0.0198)	0.0 (0.0013)	0.0 (0.00047)	20.0 (6.1)	899 (755)	0.7 (0.2)	91.2 (27.8)	0	52.5 (16.0)
LNG Carrier Steam Turbine Unloading + Hoteling [e]	N/A	N/A	N/A	17.1 (2.16)	122.7 (37.4)	320 (433)	4.6 (1.4)	15.1 (4.6)	45	0.0
LNG Carrier Steam Turbine Safety Zone + Idling [f]	N/A	N/A	N/A	1.3 (0.16)	122.7 (37.4)	311 (428)	4.6 (1.4)	8.2 (2.5)	45	0.0
LNG Carrier Medium-speed Dual-fuel Diesel (MSD) Unloading + Hoteling [g]	121.7 (15.33)	46.0 (5.8)	1.9 (0.24)	N/A	122.7 (37.4)	682 (634)	4.6 (1.4)	35.1 (10.7)	45	0.0
LNG Carrier MSD Safety Zone + Idling [h]	11.0 (1.38)	4.1 (0.52)	0.2 (0.02)	N/A	122.7 (37.4)	682 (634)	4.6 (1.4)	23.0 (7.0)	45	0.0
Support Vessel + Tugs (20 percent of total mass emissions) [i]	6.2 (0.78)	1.7 (0.21)	0.2 (0.025)	0.1 (0.012)	19.7 (6.0)	590 (583)	0.7 (0.2)	65.6 (20.0)	45	0.0
Support Vessel + Tugs (40 percent of total mass emissions) [i]	12.5 (1.57)	3.3 (0.42)	0.4 (0.049)	0.2 (0.024)	19.7 (6.0)	590 (583)	0.7 (0.2)	65.6 (20.0)	45	0.0
Support Vessel + Tugs (40 percent of total mass emissions) [i]	12.5 (1.57)	3.3 (0.42)	0.4 (0.049)	0.2 (0.024)	19.7 (6.0)	590 (583)	0.7 (0.2)	65.6 (20.0)	45	0.0

a Boilers 1 and 2 emissions are average annualized emission rates based on 7,833 hours on boil-off gas, 696 hours on HFO, 183 hours of burner lightings, and 48 hours of start-up.

b Auxiliary boiler emissions are average annualized emission rates based on 8,724 hours on boil-off gas and 36 hours of start-up.

c DFDE generator emissions are based on maximum hourly emissions under normal dual fuel operation.

d Platform engine emissions are based on maximum hourly emissions.

e LNG Carrier steam turbine unloading and hoteling emissions are based on maximum hourly emissions of the steam turbine propulsion LNG carriers at berth (higher than MSD emissions for SO_2).

f LNG Carrier steam turbine safety zone and idling emissions are based on annual average emissions for operation of the steam turbine propulsion LNG carriers within the safety zone (higher than MSD emissions for SO_2).

g LNG Carrier MSD unloading and hoteling emissions are based on maximum hourly emissions of the medium speed diesel propulsion LNG carriers at berth (higher than steam turbine emissions for NO_x, CO, and PM).

h LNG Carrier MSD safety zone and idling emissions are based on annual average emissions for operation of the medium speed diesel propulsion LNG carriers within the safety zone (higher than steam turbine emissions for NO_x, CO, and PM).

i Support Vessel and Four Tug emissions assume three locations along the platform, one location for the support vessel, and two locations with two co-located tugs each.

TABLE 4.12.2-3

Offshore and Coastal Dispersion Model Emissions and Exhaust Parameters for Aguirre Power Plant Modeled Sources [a] for the Aguirre Offshore GasPort Project

Source Description	NO_x (lb/hr [g/s])	CO (lb/hr [g/s])	PM_{10} / $PM_{2.5}$ (lb/hr [g/s])	SO_2 (lb/hr [g/s])	Stack Height (m)	Stack Temp (F [K])	Stack Diameter (ft [m])	Exit Velocity (ft/s [m/s])	Stack Angle (D_{eg})	Grd-level Elev (ft [m])
Steam Boiler 1 (per stack, total of 2 stacks)	610.6 (76.934)	80.8 (10.182)	24.7 (3.116)	1.5 (0.193)	249.3 (76.0)	300.7 (422.4)	14.00 (4.27)	86.52 (26.37)	0	33 (10)
Steam Boiler 2 (per stack, total of 2 stacks)	610.6 (76.934)	80.8 (10.182)	24.7 (3.116)	1.5 (0.193)	249.3 (76.0)	300.7 (422.4)	14.00 (4.27)	86.52 (26.37)	0	33 (10)
Combined Cycle Turbine 1 (per turbine, total of 4 turbines)	46.8 (5.902)	14.2 (1.795)	4.2 (0.529)	0.5 (0.0567)	58.1 (17.7)	424.1 (491.0)	15.65 (4.77)	60.43 (18.42)	0	23 (7)
Combined Cycle Turbine 2 (per turbine, total of 4 turbines)	46.8 (5.902)	14.2 (1.795)	4.2 (0.529)	0.5 (0.0567)	58.1 (17.7)	424.1 (491.0)	15.65 (4.77)	60.43 (18.42)	0	23 (7)

[a] Exhaust temperatures and velocity based on 2010 ICR testing. Emission rates based on gas fired operation. Oil fired NO_x emission rates as follows: Boiler: 73.471 g/s (per stack), CC Turbines: 47.87 g/s (per turbine).

The OCD model was used to predict maximum pollutant concentrations in ambient air from the Project emissions for comparison with the NAAQS. The OCD model was applied to the Offshore GasPort modeling using all the regulatory default options including use of: stack-tip downwash, buoyancy-induced dispersion, calms processing routines, upper-bound downwash concentrations for super-squat buildings, default wind speed profile exponents, vertical potential temperature gradients, and no use of gradual plume rise. As recommended by the EPA, the model was used with rural dispersion coefficients and included the effects of local terrain into the calculations. The grid extent encompasses an area of 12 miles (20 km) from the center point. Most of this receptor grid is over water and has ground elevation of 0 meters.

Meteorological Data for Offshore and Coastal Dispersion Modeling

The OCD model uses hourly over-land and over-water meteorological data to simulate the plume transport and dispersion for shoreline conditions. Data from land-based monitoring stations and water-based buoy monitoring stations representative of site conditions were input to the OCD model. Hourly surface meteorological data for the year 2011 were obtained for the nearby Jobos Bay Reserve (JOXP4), Puerto Rico meteorological monitoring station operated by JBNERR. This station is approximately 3.6 miles (5.8 km) from the Project site and is representative of the shoreline immediately adjacent to the Project. Missing data were filled with second and third level data sources from Mercedita Airport in Ponce (TJPS), and Magueyes Islands, (MGIP4), both of which are also located on the southern coastal area of Puerto Rico. The primary source of data for cloud cover data is Mercedita Airport (23.1 miles [37.2 km) from Project site) with missing data filled from Roosevelt Roads Naval Station (TJNR) in Ceiba and Luis Muñoz Marin International Airport (TJSJ) in San Juan. The surface data were processed with concurrent mixing height data from TJSJ to create the over-land meteorological file required by the OCD model.

Hourly over-water meteorological data concurrent with the 2011 over-land meteorological data were also used in the modeling analysis. The primary source for hourly over-water meteorological data was NOAA's National Data Buoy Center for Buoy Station 42085. This buoy is approximately 19.6 miles (31.5 km) west-southwest of the proposed Project location. Missing data were filled with second and third level data sources from Eastern Caribbean and Central Caribbean Buoy Stations 42059 and 42058, respectively. Concurrent mixing height data from the TJSJ station was also used for the over-water data set. Additional receptors were placed along the western edge of the neighborhood located just to the east of the Aguirre Plant, and along southern edge of the neighborhood north of the Plant. These additional receptors ensured that maximum impact concentrations were not overlooked at these sensitive areas.

Ozone Limiting Method NO_2 Calculations

The Ozone Limiting Method procedures were also used to calculate ground level 1-hour NO_2 concentrations. The 1-hour NO_2 modeling also takes credit for the emissions reductions associated with the Aguirre Plant sources firing oil since this existing operating scenario would not take place during operation of the Offshore GasPort. These Ozone Limiting Method calculations were conducted to provide more realistic (but still conservative) estimates of the maximum 1-hour NO_2 concentrations.

Offshore and Coastal Dispersion Model Results

Maximum cumulative OCD-predicted impact concentrations are presented in table 4.12.2-4, along with ambient background concentrations, and the totals are compared to the NAAQS. OCD-predicted concentrations are presented for both the standard statistical basis associated with each the pollutant NAAQS, as well as for the maximum highest first highest (H1H) values for conservatism.

As shown in table 4.12.2-4, the total cumulative impact concentrations including background are less than the NAAQS for all pollutants and averaging periods.

Based on the analysis above and the proposed mitigation measure, we conclude that operation of the Aguirre Plant/Offshore GasPort would not result in significant cumulative impacts on air quality. Further, the proposed Project would allow the Aguirre Plant to convert a portion of its fuel source from No. 6 and No. 2 fuel oil to natural gas, reducing the emissions at the Plant, thereby resulting in a cumulative improvement in the local and regional air quality.

TABLE 4.12.2-4

Offshore and Coastal Dispersion Model Results for All Aguirre GasPort Project Combined with Ambient Background for Comparison with National Ambient Air Quality Standards

Pollutant	Averaging Period	Rank [a]	Maximum Predicted OCD concentration (μg/m^3)	Ambient Background (μg/m^3)	Total Concentration (μg/m^3)	NAAQS (μg/m^3)
CO	1-Hour	H1H	150.5	18,370	18,520.5	40,000
CO	1-Hour	H2H	128.5	18,370	18,520.5	40,000
CO	8-Hour	H1H	96.9	4,846	4,942.9	10,000
CO	8-Hour	H2H	77.8	4,846	4,923.8	10,000
NO_2	1-Hour	H1H	128.9	56.4	185.3	188
NO_2	1-Hour	98% [b]	108.0	56.4	164.4	188
NO_2	Annual	H1H	35.3	27.5	62.8	100
$PM_{2.5}$	24-Hour	H1H	5.0	18.2	23.2	35
$PM_{2.5}$	24-Hour	98% [c]	3.8	18.2	22.0	35
$PM_{2.5}$	Annual	H1H	1.1	6.2	7.3	12
PM_{10}	24-Hour	H1H	5.0	77.5	82.5	150
PM_{10}	24-Hour	H2H	4.1	77.5	81.6	150
SO_2	1-Hour	H1H	142.9	50.7	193.6	196
SO_2	1-Hour	99% [d]	93.3	50.7	144.0	196
SO_2	3-Hour	H1H	81.9	38.3	120.2	1300
SO_2	3-Hour	H2H	71.6	38.3	109.9	1300
SO_2	24-Hour	H1H	32.2	33.3	65.5	365
SO_2	24-Hour	H2H	29.9	33.3	63.2	365
SO_2	Annual	H1H	8.3	11.0	19.3	80

[a] OCD-predicted concentrations are presented for both the typical statistical ranking associated with the pollutant NAAQS, as well as for the maximum highest first highest (H1H) values for conservatism, since 1 year of meteorological data was used in the modeling analysis.
[b] The ninety-eighth percentile (98%) 1-hour NO_2 concentration corresponds to highest eighth highest (H8H) predicted value.
[c] The ninety-eighth percentile (98%) 24-hour $PM_{2.5}$ concentration conservatively represented by highest fifth highest (H5H) concentration.
[d] The ninety-ninth percentile (99%) 1-hour SO_2 concentration corresponds to highest forth highest (H4H) predicted value.

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4.12.2.3 Climate Change

Climate is an observation of a given area's weather over a long period of time. Climate change is the term used to describe the change in climate over time and is generally attributed to human activity or natural variability (EPA, 2014b). The climate in Puerto Rico is generally categorized as tropical monsoon in the Köppen-Geiger Climate Classification System, which is characterized by a pronounced wet season and short dry season.

The Intergovernmental Panel on Climate Change (IPCC), which was established by the United Nations Environment Programme and the World Meteorological Organization in 1988, is the leading international body for the assessment of climate change. The United States is a member of the IPCC and participates in the IPCC working groups to develop reports on climate change. The U.S. Global Change Research Program (USGCRP) is a confederation of the research arms of 13 Federal departments and agencies, which carry out research and develop and maintain capabilities that support the U.S. response to global change.

Both the IPCC and USGCRP have concluded that, over the last half century, climate change is being driven primarily by human activities which release heat trapping GHGs (IPCC, 2013; USGCRP, 2014). In 2014, the USGCRP published the most recent National Climate Assessment for the United States, which assesses the science of climate change and its impacts across the country. The USGCRP's report notes the following observations of environmental impacts that may be attributed to climate change in the Southeast and Caribbean region of the United States:

- the Caribbean exhibits a trend since the 1950s, with increasing numbers of very warm days and nights, and with daytime maximum temperatures above 90 °F and nights above 75 °F;
- increasing temperatures and the associated increase in frequency, intensity, and duration of extreme heat events will affect public health, natural and built environments, energy, agriculture, and forestry;
- decreased water availability, exacerbated by population growth and land-use change, will continue to increase competition for water and affect the region's economy and unique ecosystems;
- sea level rise, attributable to climate change, poses widespread and continuing threats to both natural and built environmental and the regional economy; and
- daily and five-day rainfall intensities have increased.

There is no current methodology or policy guidance to determine how the Project's incremental contribution to GHGs would translate into physical effects on the global environment. However, the emissions would increase the atmospheric concentration of GHGs, in combination with past and future emissions from all other sources, and contribute incrementally to climate change that produces the impacts described above. The net annual increase in future potential GHG emissions for the combined Project is equal to 0.1 percent of Puerto Rico's reported GHG emissions for 2011 (see section 4.10.1.5). However, it cannot be determined whether or not the Project's contribution to cumulative impacts on climate change would be significant.

4.12.2.4 Noise

As discussed in section 4.10.2, noise would be generated during construction of the Project facilities and during the operation of the offshore berthing platform. Noise during construction would be short-term spanning approximately 1 year. Various phases of construction would include marine infrastructure components, offshore components, and installation of the subsea pipeline. Noise generated during construction activities would not be expected to contribute to cumulative effects given the temporary duration.

Operation of the Project facilities would contribute to background noise levels although given the location of the offshore berthing platform from the nearest NSA, the cumulative impact would be minimal; less than 1 dB during any phase of operation. The noise associated with LNG carriers under transit would be comparable to the existing oil barges in the area. Currently, the Aguirre Plant receives fuel oil by barge at a rate of three to four barge deliveries per week, and the Project, if approved, would reduce oil barge traffic to as much as 90 percent (or 15 to 20 deliveries per year). As proposed, LNG carriers would deliver LNG to the Offshore GasPort every 8 days (or 48 deliveries per year). Considering that operation of the Project would reduce the fuel oil barge traffic in Jobos Bay, the comparatively lower frequency of LNG carriers to fuel oil barges in the Project area, and LNG carrier traffic would be at a greater distance to NSAs, we conclude that there would be no significant cumulative noise impacts on NSAs during standard operations of the Project.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 SUMMARY OF THE STAFF'S ENVIRONMENTAL ANALYSIS

The conclusions and recommendations presented in this section are those of the FERC environmental staff. Our conclusions and recommendations were developed with input from the EPA, COE, USCG, PMO, EQB, PRPB, DNER, and PRDH as cooperating agencies. The federal cooperating agencies could adopt this EIS per 40 CFR 1506.3 if, after an independent review of the document, they conclude that their permitting requirements and/or regulatory responsibilities have been satisfied. These agencies would, however, present their own conclusions and recommendations in their respective and applicable decisions.

We determined that construction and operation of the Aguirre Offshore GasPort Project would result in limited adverse environmental impacts. These limited impacts would mostly occur during construction. This determination is based on a review of the information provided by Aguirre LLC and further developed from data requests; field investigations; scoping; literature research; alternatives analysis; and contacts with federal, state, and local agencies and individual members of the public. As part of our review, we developed specific mitigation measures that we believe would appropriately and reasonably reduce the environmental impacts resulting from construction and operation of the Project.

We find that environmental impacts would be reduced to less than significant levels if the proposed Project is constructed and operated in accordance with applicable laws and regulations, Aguirre LLC's proposed mitigation measures, and our additional mitigation measures. While we find the Project to be an environmentally acceptable action, the Project would adversely affect sensitive coral resources and other benthic resources. Aguirre LLC has committed to coral and seagrass mitigation and monitoring programs, with a goal of achieving a high level of environmental restoration following construction. We believe that Aguirre LLC could further reduce these impacts if the HDD construction method is determined to be feasible (see section 4.5.2.4). We are therefore recommending that our mitigation measures be attached as conditions to any authorization issued by the Commission. A summary of the anticipated Project impacts and our conclusions is provided, by resource area, below.

5.1.1 Geologic Resources

The construction and operation of the Project would have minimal impacts on the geologic resources of the area. However, some hazards such as seismic ground motion, liquefaction events, wind and wave loadings, and tsunamis could impact the Project during operation. The design of the facility is currently at the Front End Engineering Design (FEED) level of completion. Aguirre LLC has proposed a feasible design and it has committed to conducting a significant amount of detailed design work for the Project if it is authorized by the Commission. Information regarding the development of the final design would need to be reviewed by FERC staff in order to ensure that the final design addresses the requirements identified in the FEED. Therefore, we are recommending that Aguirre LLC file updated offshore wave analysis, marine terminal structure and pile foundation design and construction details, seismic specifications used in conjunction with the procuring equipment, quality control procedures that would be used for design and construction, and the identification of an inspector employed by Aguirre LLC to observe the construction of the Project and furnish inspection reports.

5.1.2 Soils and Sediments

Impact on soils within the Project area would be limited to the 1.5 acres (1.5 cuerdas) required for the onshore temporary staging and support area. This area is within the existing Aguirre Plant property and has been disturbed by past industrial activities. Aguirre LLC would implement measures outlined in the FERC Plan and Procedures to minimize or avoid impacts associated with the onshore portion of the Project and ensure proper restoration of disturbed areas following construction.

Construction activities, including the installation of the subsea pipeline, temporary piles, and permanent structures at the offshore berthing platform, would result in the resuspension of seafloor sediment into the water column. Relatively rapid settling rates for coarse sand found in the offshore terminal area, coupled with the local current speeds, suggest that resuspended sediments would not persist in the water column beyond the actual time of construction. However, the most widespread sediment type found along the pipeline route is a sandy mud that consists of coarse shell debris mixed with carbonate mud and fine-grained terrigenous mud. When suspended during construction, the fine silt particles that characterize this material would descend through the water column relatively slowly and could travel hundreds of yards (hundreds of meters) under mean current speeds due to the spatial and temporal asymmetry of the tidal currents. Although pipeline construction is scheduled over a continuous 4-month period, installation would be on a sequential, segment-by-segment basis, such that associated sediment resuspension and elevated turbidity would be localized at any given point in time; it would not occur simultaneously along the entire pipeline route nor for extended periods of time in any one area.

Utilization of the direct lay method would result in fewer impacts than conventional trenching. However, Aguirre LLC's estimated impacts do not take into account the spatial variability in sediment type or vegetative cover. To ensure that impacts associated with the resuspension, transport, and redeposition of sediments disturbed during construction activities are addressed, we are recommending in section 4.2.3.2 that Aguirre LLC conduct sediment transport modeling to support its determination that the redeposition of sediments disturbed during the construction activities would be limited to within 100 feet (30 m) of the pile foundations at the offshore berthing platform footprint and within 10 feet (3 m) of the pipeline centerline.

Construction activities in Jobos Bay are not expected to cause widespread or significant impacts associated with the introduction of contaminants into the water column through resuspension of surficial sediments. The existing benthic infaunal community is inevitably exposed to existing contaminants in the surficial sediments and the temporary resuspension of this material is not expected to exacerbate this exposure.

5.1.3 Water Resources

There are no groundwater or onshore surface water impacts anticipated with the construction and operation of the onshore portion of the Project. However, both temporary construction impacts and permanent operational impacts are anticipated for the offshore portion of the Project.

Construction of the offshore berthing platform would involve the placement and driving of deep-seated pilings into the seafloor to provide a foundation for the pier and mooring structures and the placement of mooring anchors and chains to secure the berthing platform. These activities would cause the displacement of sediments on the seafloor and the resuspension of sediments into the water column. Sediment disturbed during pipeline placement, augering, and pile driving would also be resuspended in the water column and transported by currents. The effects of the construction activities on turbidity levels would vary with the length and severity of disturbance, grain size composition, and resettling rates. Based on rapid settling rates, we conclude that construction activities in the areas with coarse sediments (outer Jobos Bay to the Offshore GasPort) would have only minor impacts on water quality, associated with short-term, localized turbidity increases. Construction along the remainder of the pipeline route would likely result in more widespread turbidity due to the prolonged resettling rates of the finer sediments found in that portion of the bay. In both cases, the temporary, sequential nature of pipeline installation activities would limit the temporal and spatial extent of sediment resuspension and turbidity. As such, overall water quality impacts would still be relatively short-term and minor.

Seawater for hydrostatic testing would be pumped into the pipeline using portable, high volume pumps on the offshore lay barge. The water would be withdrawn from 6 feet (1.8 m) below the surface at a rate of 1.5 to 3 ft/sec (0.5 to 0.9 m/sec). The intake pipe would be fitted with a 100-micron (0.1-mm) screen to prevent the accidental intake of organisms. About 240,000 gallons (909 m^3) of water would be required to complete one full hydrostatic test of the 4.1-mile-long pipeline. The test water would be discharged through a pipe secured about 6 feet (1.8 m) below the water surface to minimize surface disturbance. To reduce discharge velocity and prevent sediment resuspension at the point of discharge, a diffuser head would be attached to the discharge pipe during dewatering operations. No consumptive losses, temperature changes, or biocide treatment of the test water is anticipated.

Both the FSRU and LNG carriers would have operation-related cooling water withdrawals and discharges. The normal water use of the FSRU would total approximately 56 mgd (212,000 m^3/day) of seawater, including 53 mgd (200,600 m^3/day) to support machinery cooling through operation of the main condenser and auxiliary seawater cooling systems, 0.6 mgd (2,270 m^3/day) to generate the FSRU vessel's water safety curtain, 2 mgd (7,200 m^3/day) for ballast water, and 0.2 mgd (7,200 m^3/day) for the MGPS. All of the water used for these purposes would be discharged back into the surrounding ocean. LNG carriers would require about 17.2 to 74.2 million gallons (65,100 to 280,900 m^3) of water for ballast while offloading at the Offshore GasPort and a total cooling water intake volume would range from about 13.5 to 227.8 million gallons (51,100 to 862,300 m^3) during LNG delivery. Therefore, the combined water intake for ballast and cooling water for each LNG delivery would range from about 31 to 302 million gallons (116,200 to 1,143,200 m^3).

Seawater uptake by FSRUs and visiting LNG carriers would not cause any significant change in ambient water quality, given the negligible volume removed relative to the surrounding ocean. Water discharges have the potential to impact ambient water quality and biotic communities where discharge parameters fail to meet standards and thresholds, generally embodied in regulations and permit conditions. Temperature standards are of particular significance here, based on the magnitude of the predicted cooling water discharges from the FSRU and LNG carriers. Residual chlorine standards are also relevant because several of the discharges would be treated with sodium hypochlorite as a biocide prior to release. This residual chlorine concentration is not expected to significantly affect water quality, due to the low concentration of sodium hypochlorite; however, marine mammal species in the immediate vicinity of the outfall may be exposed to harmful concentrations of sodium hypochlorite. All operational discharges would be subject to the requirements of the NPDES permit for the Project. Elevated temperature and chlorine levels can have sub-lethal or lethal effects on marine biota, depending on the magnitude and duration of the increase. Similar effects can occur if other contaminants, such as oil, grease, and metal particulates, are present in discharge water.

Spills or leaks of hazardous materials (e.g., fuel, lubricants) from equipment working in the onshore areas could also result in adverse impacts on water resources. Construction contractors and port operations personnel would be required to comply with all laws and regulations. We are recommending that Aguirre LLC file a site-specific spill prevention and control plan for the construction and operation phases of the Project prior to construction.

5.1.4 Vegetation Resources

Based on the sparse vegetation within the proposed onshore temporary workspace area, no significant impacts on terrestrial vegetation resulting from construction or operation of the Project are anticipated.

Offshore construction activities such as vessel anchoring, pipe laying, and pile driving would result in direct impacts on approximately 19.8 acres (20.4 cuerdas) of seagrass and 77.4 acres (79.7 cuerdas) of macroalgal habitat. The operation of the offshore terminal would result in permanent impacts on approximately 2.9 acres (3.0 cuerdas) of seagrass and 19.2 acres (19.7 cuerdas) of macroalgal habitat. For the pipeline, the area of permanent habitat conversion would be restricted to a 6-foot-wide (1.8-m) right-of-way centered over the pipeline. Direct, permanent impacts on seagrass and algal communities within this corridor would be 0.7 and 0.9 acre (0.7 and 0.9 cuerda), respectively.

Aguirre LLC has agreed to prepare a seagrass mitigation and monitoring plan in consultation with respective agencies to offset short-term and/or permanent impacts on seagrass communities. The plan would include seagrass planting and post-construction monitoring to determine Project effects and/or mitigation success. After construction, Aguirre LLC would perform seagrass mitigation in areas where the impact has occurred. In areas of impact where planting would not be feasible, Aguirre LLC would identify alternative mitigation sites where existing seagrass beds of similar species are thriving. We are recommending in section 4.4.3 that this plan be filed prior to the end of the draft EIS comment period.

5.1.5 Wildlife Resources

Temporary impacts on marine wildlife habitats include 19.8 acres (20.4 cuerdas) of seagrass, 77.4 acres (79.7 cuerdas) of macroalgae, 5.2 acres (5.4 cuerdas) of reef, and 14.5 acres (14.9 cuerdas) of soft bottom habitat. Construction of the Project would result in short-term adverse impacts on a rich and diverse assemblage of wildlife species including manatees, sea turtles, reef fish, sharks, corals, and invertebrates found within these habitats. The most likely effects would be the general avoidance or isolation from preferred habitat due to construction activities. Marine mammals and sea turtles would also be exposed to an elevated risk of vessel strike during the construction period as the number of vessels present in the area would increase from current traffic levels. To minimize the entrainment of fish and other organisms during hydrostatic testing, we are recommending in section 4.5.2.4 that Aguirre LLC consult with NMFS regarding the type of screen (e.g., wedge wire) that would be used for water withdrawals during construction.

Permanent impacts on marine wildlife habitat include 3.7 acres (3.8 cuerdas) of seagrass, 20 acres (20.6 cuerdas) of macroalgae, 0.5 acre (0.5 cuerda) of reef, and 1.1 acres (1.1 cuerdas) of soft bottom habitat. Major direct impacts would result from mortality of coral colonies within the footprint of the pipeline across the reef. Major indirect impacts on species would result from shading of patch reef below the offshore terminal (including the permanent FSRU and temporary LNG carrier) and degradation of seagrass and macroalgae foraging habitats. The FSRU and LNG carriers stationed at the terminal would also locally impact wildlife resources with thermal plume and anti-fouling agent discharge, plankton entrainment, noise, and lighting.

Aguirre LLC intends to utilize several mitigative measures to minimize these impacts including the use of marine mammal observers to ensure vessel strike reduction, noise exclusion zones around vibratory pile driving activities, and seagrass restoration plans. Aguirre LLC has also proposed to prepare a coral reef restoration and/or mitigation plan in coordination with the NMFS and FWS to offset impacts from construction and operation of the Project on coral reef habitat. The plan would include one or more of the following: monitoring of the reef community prior to, during, and after construction; installation and monitoring of an artificial reef; coral cache and relocation to adjacent natural and/or artificial reef; development of a reef awareness/outreach program; and funding to support existing and ongoing reef community programs. In conjunction with seagrass and coral mitigation requirements, environmental regulatory agencies are likely to require a management plan that involves an educational program for construction personnel and work practices occurring near sensitive resources. Standard protection measures may be required which include the use of an integrated global positioning system to track vessel movement during construction activities. We are recommending in section 4.5.2.4 that the coral mitigation plan be filed prior to the end of the draft EIS comment period and that Aguirre LLC evaluate the use of a water-to-water HDD crossing to avoid coral reef habitat in the Boca del Infierno pass. We are also recommending that Aguirre LLC complete acoustic modeling associated with the proposed pile driving to determine if additional mitigation is warranted to reduce noise impacts on marine life during construction.

Several species of birds may be found in the Project area but are not expected to be impacted by the Project due to the nature of construction, the species behavioral characteristics, and preferred habitats. These birds are expected to avoid any impacts that may cause them discomfort or harm, such as noise, by leaving the area. To ensure that impacts on birds are minimized or avoided, we are recommending in section 4.5.3.3 that Aguirre LLC provide an assessment of potential noise impacts on resting and nesting birds during the construction and operation of the Project, and identify mitigation measures that could be implemented to minimize or avoid these impacts.

The Project would necessitate the installation of temporary lighting to facilitate construction activities during evening hours as well as for safety requirements. The FSRU and offshore berthing platform would be lit 24 hours per day by security lighting, navigation lights, and Federal Aviation Administration warning lights. To minimize lighting effects during operation, Aguirre LLC would implement certain measures, such as the limit the number and wattage of operational lights to the minimum possible for safe operations so as to minimize illumination of surrounding waters.

The waters surrounding the Offshore GasPort are unlit due to the lack of permanent structures in the water and on uninhabited Cayos de Barca and Cayos Caribes. The response of marine organisms to artificial lights can vary depending on a number of factors such as the species, life stage, and the intensity of the light. Therefore, the nighttime lighting contrast between the Project and the background would be high. To minimize operational impacts associated with nighttime lighting, we are recommending in section 4.5.3.3 that Aguirre LLC develop a lighting plan to minimize the impacts on people on the shore and on wildlife.

5.1.6 Threatened and Endangered Species

To comply with Section 7 of the ESA, we are consulting with the FWS and NMFS regarding the presence of federally listed or proposed species in the Project area. The DNER is also providing technical assistance and resource expertise regarding sensitive species. We have identified 23 federally listed threatened or endangered species and 10 species proposed for ESA listing occurring or potentially occurring in the Project area. Due to the distance of their primary habitat from the Project area, it was determined that the Project would have no effect on 9 of the listed or proposed species and may affect, but is not likely to adversely affect an additional 14 species based on behavioral characteristics, habitat requirements and the construction, operation and mitigative measures proposed by Aguirre LLC.

We have determined that the construction and or operation of the proposed Project is likely to adversely affect the Antillean manatee and nine species of listed or proposed corals. We have submitted a BA to the FWS and NMFS for these species as part of our formal Section 7 consultations. We have recommended in section 4.6 that Aguirre LLC not begin construction until our formal consultation is completed.

The impacts associated with the construction phase of the Project are expected to be temporary; long lasting effects on manatees are not expected. During construction, manatees would be at an elevated risk for vessel strikes and degradation of foraging habitats. With mitigation techniques such as the use of trained marine mammal observers and a 0.3-mile (0.5 km) zone of exclusion around vibratory pile driving activities, the risk of strikes and stress caused by excessive noise would be greatly reduced. We are recommending in sections 4.4.3 and 4.5.2.4 that Aguirre LLC file draft seagrass and coral reef mitigation and monitoring plans within prior to the end of the draft EIS comment period, allowing us to assess the potential of facilitating a recovery of impacted benthic resources. Impacted corals are expected to take longer to recover, thus, alternative pipeline construction methods, such as the use of an HDD under the reef, are being considered. With the proposed pipeline, permanent impacts on ESA listed corals are expected to result in direct mortality of colonies within the footprint of the pipeline.

5.1.7 Land Use, Recreation and Visual Resources

Jobos Bay and the surrounding areas are used for a variety of marine activities, including recreational boating, recreational and commercial fishing, scientific research, and other recreational activities such as snorkeling and wildlife viewing. Jobos Bay and the open sea south of the bay are also used by various shipping vessels, including the barges that currently deliver fuel oil to the Aguirre Plant. Construction of the Project would alter the land use, recreation, and visual resources of the area by temporarily increasing vessel traffic; therefore impacting recreational boating and fishing. Operation of the Project would permanently alter the existing visual resources as well as impact boating, fishing, and other marine uses near the offshore facility.

Construction activities would require the use of a variety of vessels including lay barges, dive support vessels, support tugs, crew boats, pipe transport barges, and pipe haul barge tugs. The presence of these vessels would represent a temporary increase in the current levels of large vessel traffic in the bay, which is typically limited to small recreation and commercial fishing vessels. The barges that deliver fuel oil to the Aguirre Plant utilize the dredged ship navigation channel to the west of the Project and would not likely be impacted by construction activities. Operation of the Project is not anticipated to affect marine use within Jobos Bay; however, the security zone established around the FSRU and LNG carriers would have a direct impact on boating, fishing, and other marine uses in the area.

Aguirre LLC stated that it plans to complete a coastal zone consistency evaluation with the PRPB to determine the Project's consistency with the CZMP policies. The COE requires a concurrence certification with CZMP from the PRPB prior to issuing a permit. To ensure that Aguirre LLC receives its determination of consistency with the CZMP, we are recommending in section 4.7.3 that: Aguirre LLC not begin construction of the project until it files with the Secretary a copy of the determination of consistency with the CZMP issued by the PRPB..

Aguirre LLC conducted a visual assessment from three locations proximate to the Project area including Highway 53 in Guayama, the Salinas Marina inlet, and a lookout tower on Cayos Caribe. The FSRU would be apparent from the upland highway viewpoint and it would dominate the view from the Cayos Caribes lookout tower. The presence of the FSRU would visually affect wildlife viewing from the Cayos Caribes lookout tower and other places within the JBNERR that have views of the ocean. The red FSRU contrasts with the blue water and green landscape surrounding the Project area. The FSRU is less apparent from the Marina de Salinas, as the barrier islands partially obstruct the line of sight. Visual impacts from fuel oil barges would decrease after construction of the Project resulting in a more natural setting for viewers of the Jobos Bay area.

5.1.8 Socioeconomics

The construction and operation of the Project may have minor impacts on the existing socioeconomic conditions within the Project area. Potential impacts on populations could arise due to incoming workers associated with the Project. However, these impacts would be localized and temporary and would be limited to the influx of non-local workers and their family members. Construction of the Project is anticipated to require approximately 350 workers over a 12-month construction period. Aguirre LLC has stated it intends to hire at least 10 percent (35 workers) of the construction workforce locally.

The construction and operation of the Project is not anticipated to have an effect on the rental and occupancy rates of the local communities. The implementation of the Project would not result in any disproportionately high and adverse human health or environmental impacts on minority or low-income communities. Rather, the Project would result in improved air quality for the local citizens as emissions from burning fuel oil at the Aguirre Plant would be reduced.

5.1.9 Cultural Resources

The APE for the onshore portion of the Project is within the existing fenced Aguirre Plant property. The Project proposes to disturb approximately 1.5 acres (1.5 cuerdas) of the industrial site during the construction for use as a temporary construction staging and support area. The offshore construction would include the construction right-of-way and temporary workspace for the 4.1-mile (6.7 km)-long subsea pipeline and the construction area for the offshore berthing platform. Aguirre LLC conducted archival research and marine surveys of these areas to identify cultural resources including locations for potential prehistoric and historic archaeological sites.

No sites were identified through archival research within the Project area. The NRHP-listed Central Aguirre Historic District is located outside of the Project area but within the viewshed of the Project. In an email dated February 7, 2013, the SHPO commented that the Central Aguirre Historic District does not appear to be affected by the proposed undertaking. We concur. Aguirre LLC did not conduct an archeological survey within the previously disturbed, terrestrial portion of the Project because of the low potential for intact cultural deposits. In a letter dated August 15, 2012, the SHPO concurred that no archaeological survey is necessary. We concur as well.

The marine APE includes about 155 acres (160 cuerdas) of submerged land that could be affected by the construction and operation of the subsea pipeline and the offshore berthing platform. Aguirre LLC completed evaluative testing in March 2013, prepared a report of findings in April 2013, and submitted a copy to the SHPO for review in June 2013. The archaeological assessment of 11 anomalies found during the surveys determined that they are modern marine debris and therefore are not recommended eligible for listing in the NRHP. We are currently waiting on SHPO comments on the evaluation report. To ensure that the FERC's responsibilities under the NHPA and its implementing regulations are met, we are recommending that Aguirre LLC does not begin construction until the SHPO's comments are filed, the ACHP is provided an opportunity to comment, the FERC staff reviews the reports and plans, and the Director of OEP has notified Aguirre LLC that construction may proceed.

5.1.10 Air Quality and Noise

Air quality impacts associated with construction of the Project include emissions from fossil-fueled construction equipment. Such air quality impacts would generally be temporary and localized, and are not expected to cause or contribute to a violation of the NAAQS. The operational air emission sources associated with the Project include equipment on the FSRU, the terminal platform, LNG carriers, and support vessels and tugs. In response to federal and local requirements, BMPs have been included in

Project design or proposed by Aguirre LLC to reduce air quality impacts. Potential impacts of operational air emissions would be reduced by incorporation of operating restrictions and use of emission reduction technologies on the FSRU to limit pollutant emissions. The overall effect of the Project would be an improvement in local and regional air quality as a result of the reduced emissions associated with a reduction in the burning of fuel oil at the Aguirre Plant.

Noise is expected to be generated during both construction and operation of the Project. Construction of the Offshore GasPort can be divided into three major components that feature different types of construction equipment and techniques. Although some phases would overlap, the three primary construction phases include the marine infrastructure including berth facilities, topside mechanical and electrical facilities, and the subsea interconnecting pipeline. Construction is anticipated to take approximately 12 months. Noise during construction would exceed the EQB's nighttime noise limits at NSAs. Aguirre LLC would consult with the EQB to develop the appropriate mitigation measures should actual sound levels measured during construction activities exceed the nighttime EQB noise limits. These mitigation measures could include, but not be limited to, establishing appropriate work hours and development of a Construction Noise Abatement Plan where Aguirre LLC would monitor onshore sound levels in the vicinity of active pipeline construction. If sound levels at residential areas onshore do not meet EQB criteria for an extended time, noise mitigation measures would be adjusted appropriately. The operational noise of the FSRU has been calculated to be below existing ambient sound levels at each of the NSAs. However, we are recommending that Aguirre LLC file a noise survey no later than 60 days after placing the facilities into service to ensure compliance with our criteria of 55 dBA L_{dn} at the nearest NSAs.

5.1.11 Reliability and Safety

The Project's pipeline facilities would be designed, constructed, operated, and maintained in accordance with or to exceed the DOT Minimum Federal Safety Standards in 49 CFR 192. These regulations, which are intended to protect the public and to prevent natural gas facility accidents and failures, include specifications for material selection and qualification; minimum design requirements; and protection of pipelines from internal, external, and atmospheric corrosion.

The USCG and the FERC share regulatory authority over the siting, design, construction, and operation of LNG import terminals located offshore. The FERC authorizes the siting and construction of LNG import and export facilities. The USCG regulates the safety of an LNG facility's marine transfer area and LNG marine traffic, and regulates security plans for the entire LNG facility and LNG marine traffic. Both agencies have some oversight and responsibility for inspection and compliance during the facility's operation.

Based on our technical review of the preliminary engineering designs, as well as our suggested mitigation measures, we conclude that sufficient layers of safeguards would be included in the facility designs to mitigate the potential for an incident that could impact the safety of the public. However, we are recommending that the final design be provided for further staff review and that the facility be subject to regular FERC staff technical reviews and site inspections on at least an annual basis.

All LNG vessels entering U.S. waters are required to be certified by the USCG as designed and operating in accordance with both international standards and the U.S. regulations for bulk LNG carriers. Current operational procedures in use by the USCG in U.S. ports, such as managing ship traffic, coordinating ship speeds, and active ship control in inner and outer harbors, would reduce the potential of LNG spill from accidental causes. The Offshore GasPort, FSRU, and LNG carriers would be subject to stringent requirements for security plan development and approval by the USCG and other applicable agencies, which would reduce the potential of an LNG spill from intentional causes.

The USCG determined that the waterway along the proposed LNG carrier transit route would be suitable for the type and frequency of LNG marine traffic associated with this proposed Project. However, the USCG's conclusion is contingent upon implementation of the recommended measures, outlined in the LOR Analysis, to responsibly manage the maritime safety and security risks. If the Project is approved and the appropriate resources were not put into place, then neither the FERC nor the USCG would allow the Project to commence service. By designing and operating the proposed Project in accordance with the applicable standards and the recommendations from us and the USCG, the Project would represent only a slight increase in risk to the nearby public.

5.1.12 Cumulative Impacts

Six past, present, and reasonably foreseeable actions have been identified within close proximity to the Project area. These actions include the construction of the AES Ilumina Solar Photovoltaic Power Plant, the Salinas Solar Park, and the Guayama-Punta Pozuelo Boardwalk, the renovation of the Aguirre Plant for natural gas capabilities, the development of a master plan for the renovation of Aguirre, and construction/renovation plans found in the JBNERR management plan.

Construction of the Project would primarily affect water quality by causing temporary increases in turbidity from the installation of the offshore berthing platform and subsea pipeline. These impacts would dissipate quickly following construction. Existing sources of water quality impacts within the Project area include sediment disturbance from barges and recreational vessels in shallow waters, the potential for spills from barges and recreational vessels using Jobos Bay, and non-point source runoff from the land surrounding Jobos Bay. There are currently no known proposed projects that would directly affect water quality within Jobos Bay and that would occur during the Project construction period. Therefore, water quality impacts of the Project when considered cumulatively with other projects would not be significant.

Based on the cumulative air quality analysis of the Project in section 4.12.2.2, the proposed mitigation measures, and the EPA's imposed permit conditions as part of the PSD Non-applicability determination, we conclude that operation of the Project would not result in significant cumulative impacts on air quality. Further, the Project would allow the Aguirre Plant to convert a portion of its fuel source from No. 6 and No. 2 fuel oil to natural gas, reducing the emissions at the Aguirre Plant, thereby resulting in a cumulative improvement in the local and regional air quality.

Noise generated during construction of the Project facilities would be short-term spanning approximately 1 year and is not expected to contribute to cumulative effects given the temporary duration.

Operation of the Project facilities would contribute to background noise levels although given the location of the offshore berthing platform from the nearest NSA, the cumulative impact would be minimal; less than 1 dB during any phase of operation. The noise associated with LNG carriers under transit would be comparable to the existing oil barges in the area. Considering that operation of the proposed Project would reduce the fuel oil barge traffic in Jobos Bay, the comparatively lower frequency of LNG carrier traffic to the existing fuel oil barge traffic in the Project area, and the larger distance of LNG carrier traffic to NSAs, we conclude that there would be no significant cumulative noise impacts on NSAs during standard operations of the Project.

5.1.13 Alternatives

As an alternative to the proposed action, we evaluated the No Action Alternative, system alternatives, facility siting alternatives, offshore terminal site alternatives, major pipeline route alternatives, and pipeline route variations. While the No Action Alternative would eliminate the short-and long-term environmental impacts identified in the EIS, the stated objectives of Aguirre LLC's proposal would not be met. We also evaluated the use of alternative energy sources and the potential effects of energy conservation, but determined that these sources and measures would not be a practicable alternative to the proposed Project.

One system alternative would be the expansion of the existing EcoEléctrica facility, which is approximately 35 miles (56 km) east of the Aguirre Plant. For the EcoEléctrica facility to be a viable system alternative to the proposed Project, the facility would have to construct new LNG storage capacity, regasification facilities, and a new pipeline to connect the EcoEléctrica facility to the Aguirre Plant. A pipeline connecting these facilities, the Gasoducto Del Sur, was proposed by PREPA and initial construction began in 2008, but by 2009 was cancelled due to significant public opposition. It is therefore unlikely and uneconomical to try to revive the failed pipeline. To accommodate the facilities required for this alternative, the EcoEléctrica facility would need to be expanded by 30 acres (31 cuerdas), which would be difficult without encroaching upon existing communities. If EcoEléctrica were to obtain the additional land, the onshore facility would result in additional industrial development in a previously undisturbed area. As the proposed Project does not require construction of onshore LNG storage or additional gasification facilities, the expansion at the EcoEléctrica facility would likely result in greater environmental impacts than the proposed Project. We conclude that the expansion of the existing EcoEléctrica facility is not considered to be environmentally preferable to the proposed Project and was removed from further consideration.

Our evaluation of alternative sites also considered construction and operations of two land-based sites and two dockside sites. Las Mareas Bay is approximately 6 miles (10 km) east of the Aguirre Plant with access to the area off Puerto Rico Highway 3. This industrial area has sufficient land to allow for the development of an onshore LNG facility; however, it would require the construction of a new onshore or dockside terminal, a large dredging and bay development project to accommodate large LNG carriers, and a 6-mile (10 km) pipeline to the Aguirre Plant. Impacted areas would mainly consist of previously developed upland but would also include areas of palustrine emergent wetland located along the coastal area. We concluded that the associated environmental impacts with this alternative would be greater than the proposed Project. For these reasons, we conclude that a new land-based or dockside LNG facility within Las Mareas Bay would not present any significant environmental advantage compared to the proposed Project.

The Aguirre Plant was also considered to be utilized as either a land-based or dockside terminal location. It is estimated that 30 acres (31 cuerdas) would be required to construct storage tanks, regasification equipment, and other infrastructure to support the facility. In reviewing the area around the Aguirre Plant, 30 contiguous acres (31 cuerdas) were not available that would avoid population centers. In addition, the land-based terminal would require deepwater access and a turning basin. The lack of available land, the need to create a deepwater access and turning basin, and the proximity to a population center makes a land-based terminal less environmentally preferable than the Proposed Action. A dockside terminal facility would also require deepwater access and a turning basin large enough for both the FSRU and the LNG carrier, as well as modification at the plant to build a dock for the FSRU. The existing jetty at the facility cannot accommodate an FSRU as well as the LNG carrier. Considering its proximity to the Aguirre community, and the extensive amount of in-water work (dredging and pier construction) that would be required, we consider that the environmental impacts would be equal or greater than the proposed Project, and did not evaluate this alternative further.

We evaluated four alternative offshore terminal sites with pipelines to the terminal and conducted field review of each site and corresponding pipeline. The four terminal sites have similar water depths and seafloor conditions; however, the length of pipeline required and distance to the closest population centers varied. We also analyzed five major terminal/pipeline alternatives in response to concerns from the public and NMFS, EPA, FWS, and DNER concerning impacts from the proposed pipeline route through Boca del Infierno pass on federally threatened and endangered coral species, coral reef habitat, seagrass within Jobos Bay, and the Antillean manatee. The objective of each alternative was to minimize the impacts on environmentally sensitive resources, which includes federally threatened and endangered species, recreational users, and general population areas. The construction techniques included direct lay and trenching for burial in the Jobos Bay barge channel. Finally, we evaluated three pipeline route variations from the proposed terminal site to the Aguirre Plant. We determined that each of the terminal locations and pipeline routes would have environmental impacts greater than or similar to the proposed terminal location and pipeline and did not evaluate these alternatives further.

5.2 FERC STAFF'S RECOMMENDED MITIGATION

If the Commission authorizes the Aguirre Offshore GasPort Project, we recommend that the following measures be included as specific conditions of the Commission's Order. We believe that these measures would further mitigate the environmental impacts associated with construction and operation of the proposed Project. In the following section, "file" means to file with the Secretary of the Commission.

1. Aguirre LLC shall follow the construction procedures and mitigation measures described in its application, supplemental filings (including responses to staff data requests), and as identified in the EIS, unless modified by the Commission's Order. Aguirre LLC must:

    a. request any modification to these procedures, measures, or conditions in a filing;

    b. justify each modification relative to site-specific conditions;

    c. explain how that modification provides an 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 OEP has delegated authority to 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. stop-work authority and authority to cease operation; and

    b. the design and implementation of any additional measures deemed necessary to assure continued compliance with the intent of the conditions of the Order.

3. **Prior to any construction**, Aguirre LLC shall file an affirmative statement, 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 construction and restoration activities.

4. The authorized facility locations shall be as depicted in the EIS, as supplemented by filed alignment sheets. **As soon as they are available, and before the start of construction**, Aguirre LLC shall file any revised detailed survey alignment maps/sheets at a scale not smaller than 1:6,000 with station positions for all facilities approved by the Order. All requests for modifications of environmental conditions of the Order or site-specific clearances must be written and must reference locations designated on these alignment maps/sheets.

5. Aguirre LLC shall file detailed alignment maps/sheets and aerial photographs at a scale not smaller than 1:6,000 identifying all route realignments or facility relocations, and staging areas, pipe storage yards, new access roads, and other areas that would be used or disturbed and have not been previously identified in filings. Approval for each of these areas must be explicitly requested 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 or 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/sheets/aerial photographs. Each area must be approved in writing by the Director of OEP **before construction in or near that area**.

   Examples of alterations requiring approval include all route realignments and facility location changes resulting from:

   a. implementation of cultural resources mitigation measures;

   b. implementation of endangered, threatened, or special concern species mitigation measures; and

   c. recommendations by state regulatory authorities.

6. **Within 60 days of the acceptance of the Authorization and before construction begins**, Aguirre LLC shall file an Implementation Plan for review and written approval by the Director of OEP. Aguirre LLC must file revisions to the plan as schedules change. The plan shall identify:

   a. how Aguirre LLC 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 Aguirre LLC 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, and how Aguirre LLC 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 date of the environmental compliance training and instructions Aguirre LLC will give to all personnel involved with construction and restoration (initial and refresher training as the Project progresses and personnel changes), with the opportunity for OEP staff to participate in the training session;

   f. the company personnel (if known) and specific portion of Aguirre LLC' organization having responsibility for compliance;

   g. the procedures (including use of contract penalties) Aguirre LLC will follow if noncompliance occurs; and

h. 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. Aguirre LLC shall employ one or more EIs. The EIs shall be:

a. responsible for monitoring and ensuring compliance with all mitigation measures required by the Order and other grants, permits, certificates, or other authorizing 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, Aguirre LLC shall file updated status reports **on a bi-weekly basis** until all construction and restoration activities are complete. On request, these status reports will also be provided to other federal and state agencies with permitting responsibilities. Status reports shall include:

a. an update on Aguirre LLC's efforts to obtain the necessary federal authorizations;

b. the current construction status at the Offshore GasPort site and of the pipeline, work planned for the following reporting period, and any schedule changes for work in environmentally sensitive areas;

c. a listing of all problems encountered and each instance of noncompliance observed by the EI(s) 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 corrective actions implemented in response to all instances of noncompliance, and their cost;

e. the effectiveness of all corrective actions implemented;

f. a description of any resident complaints which may relate to compliance with the requirements of the Order, and the measures taken to satisfy their concerns; and

g. copies of any correspondence received by Aguirre LLC from other federal, state, or local permitting agencies concerning instances of noncompliance, and Aguirre LLC's response.

9. **Prior to receiving written authorization from the Director of OEP to commence construction of any Project facilities**, Aguirre LLC shall file documentation that they have received all applicable authorizations required under federal law (or evidence of waiver thereof).

10. Aguirre LLC must receive written authorization from the Director of OEP **prior to introducing hazardous fluids into the Project facilities**. 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. Aguirre LLC must receive written authorization from the Director of OEP **before placing the Project into service**. Such authorization will only be granted following a determination that the facilities have been constructed in accordance with FERC approval and applicable standards, can be expected to operate safely as designed, and the rehabilitation and restoration of areas affected by the Project are proceeding satisfactorily.

12. **Within 30 days of placing the Authorized facilities in service**, Aguirre LLC shall file an affirmative statement 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 of the authorization conditions Aguirre LLC 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**, Aguirre LLC shall file, for review and written approval by the Director of OEP, additional studies on the pipeline route seafloor slope angles and the liquefaction potential along the alignment and provide mitigation measures as needed. ***(Section 4.1.3.2)***

14. **Prior to construction**, Aguirre LLC shall file with the Secretary the updated offshore wave analyses as indicated in Aguirre LLC's December 5, 2013 response to the FERC's November 15, 2013 Environmental Information Request (questions 6 and 7). This analysis should be stamped and sealed by the professional engineer-of-record. ***(Section 4.1.4)***

15. **Prior to construction**, Aguirre LLC shall file the following information, stamped and sealed by the professional engineer-of-record:

a. marine terminal structures (including prefabricated and field constructed structures) and pile foundation design drawings and calculations. The marine terminal structures and pile foundation designs should incorporate criteria revisions agreed to by Aguirre LLC in its responses to FERC staff's June 17 and November 15, 2013 Environment Information Request;

b. seismic specifications used in conjunction with the procuring equipment; and

c. quality control procedures that would be used for design and construction. ***(Section 4.1.4)***

16. Aguirre LLC shall employ a special inspector during construction. The special inspector shall be responsible for:

    a. observing the construction of Aguirre Offshore Gasport to be certain it conforms to the design drawings and specifications;

    b. furnishing inspection reports to the engineer or architect of record, and other designated persons. The inspection reports should be summarized in monthly status reports and filed with the Secretary. All discrepancies should be brought to the immediate attention of the contractor for correction, then if uncorrected, to the engineer or architect of record; and

    c. submitting a final signed report stating whether the work requiring special inspection was, to the best of his/her knowledge, in conformance with approved plans and specifications and the applicable workmanship provisions. A copy of the report shall be filed with the Secretary. ***(Section 4.1.4)***

17. **Prior to the end of the draft EIS comment period**, Aguirre LLC shall file the results of the sediment transport analysis to support its determination that the redeposition of sediments disturbed during the construction activities at the offshore berthing platform would be limited to within 100 feet (30 m) of the pile foundation footprint and would be limited to within 10 feet (3 m) of the pipeline centerline. ***(Section 4.2.3.2)***

18. **Prior to construction**, Aguirre LLC shall file a site-specific spill prevention and control plan for the construction and operation phases of the onshore and offshore portion of the Project for review and written approval by the Director of OEP. ***(Section 4.3.3.3)***

19. **Prior to the end of the draft EIS comment period**, Aguirre LLC shall consult with NMFS, FWS, DNER, and other appropriate agencies in developing the Project's seagrass mitigation and monitoring plan and the coral reef restoration and/or mitigation plan. Aguirre LLC shall file drafts of these plans along with documentation of agency consultation on the drafts. ***(Sections 4.4.3 and 4.5.2.4)***

20. **Prior to construction**, Aguirre LLC shall consult with the NMFS regarding the type of screen (e.g., wedge-wire) that would be used for hydrostatic test water withdrawals during the construction of the Project. The results of this consultation shall be filed for review and written approval by the Director of OEP. ***(Section 4.5.2.4)***

21. **Prior to the end of the draft EIS comment period**, Aguirre LLC shall file an assessment of the potential use of a water-to-water HDD between approximate MPs 1.0 to 1.6 along the pipeline route to avoid direct impacts on coral reef habitat. The assessment shall discuss the feasibility of an HDD based on the substrate that would be crossed, estimate the area of seafloor disturbance that would be required, estimate the impacts on coral reef habitat and submerged aquatic vegetation, estimate the volume of sediment that would be displaced at the entry and exit locations of the HDD, and include a schedule for any necessary geotechnical studies. ***(Section 4.5.2.4)***

22. **Prior to the end of the draft EIS comment period**, Aguirre LLC shall conduct acoustic modeling associated with hammer pile driving at the offshore berthing platform and other areas where it may be used. Aguirre LLC shall also consult with the FWS, NMFS, and DNER to identify and include mitigation measures that it would implement to reduce noise levels associated with vibratory and hammer pile driving to 180 dB. ***(Section 4.5.3.3)***

23. **Prior to construction**, Aguirre LLC shall provide an assessment of potential noise impacts on resting and nesting birds during the construction (e.g., pile driving, vessels, and possible HDD) and operation of the Project, and identify mitigation measures that would be implemented to minimize or avoid these impacts. ***(Section 4.5.3.3)***

24. **Prior to construction**, Aguirre LLC shall develop and file a lighting plan that identifies specific measures that would be implemented to minimize or avoid impacts associated with the Project's operational nighttime lighting on avian species, fish species, marine mammals, and individuals on the shoreline. This plan shall be filed for review and approval by the Director of the OEP. ***(Section 4.5.3.3)***

25. Aguirre LLC shall not begin construction of the Project **until**:

    a. we receive comments from the FWS and NMFS regarding the proposed action;

    b. we complete formal consultation with the FWS and NMFS, if required; and

    c. Aguirre LLC has received written notification from the Director of OEP that construction or use of mitigation may begin. ***(Section 4.6)***

26. Aguirre LLC shall not begin construction of the project **until** it files with the Secretary a copy of the determination of consistency with the CZMP issued by the PRPB. ***(Section 4.7.3)***

27. Aguirre LLC shall not begin construction of facilities or use of staging areas **until**:

    a. Aguirre LLC files the SHPO's comments on the evaluative testing report;

    b. the ACHP is provided an opportunity to comment on the undertaking if historic properties would be adversely affected; and

    c. the FERC staff reviews and the Director of OEP approves all cultural resources survey reports and plans, and notifies Aguirre LLC in writing that construction may proceed.

    All material filed containing location, character, and ownership information about cultural resources must have the cover and any relevant pages therein clearly labeled in bold lettering: "CONTAINS PRIVILEGED INFORMATION - DO NOT RELEASE." ***(Section 4.9.5)***

28. Aguirre LLC shall file a noise survey **no later than 60 days** after placing the Aguirre Offshore GasPort Project in service. If a full load condition noise survey is not possible, Aguirre LLC should provide an interim survey at the maximum possible load and provide the full load survey **within 6 months**. If the noise attributable to operation of the Offshore GasPort under interim or full load conditions exceeds an L_{dn} of 55 dBA at any nearby NSAs, Aguirre LLC shall file a report on what changes are needed and shall install additional noise controls to meet the level **within 1 year** of the in-service date. Aguirre LLC shall confirm compliance with the above requirement by filing a second noise survey **no later than 60 days** after it installs the additional noise controls. ***(Section 4.10.2.5)***

Information pertaining to these specific recommendations shall be filed for review and written approval by the Director of OEP either: **prior to any construction**; **prior to construction of final design**; **prior to commissioning**; **prior to introduction of hazardous fluids**; or **prior to commencement of service**, as indicated by each specific condition. Specific engineering, vulnerability, or detailed design information meeting the criteria specified in Order No. 683 (Docket No. RM06-24-000), including security information, should be submitted as critical energy infrastructure information (CEII) pursuant to 18 CFR 388.112. See Critical Energy Infrastructure Information, Order No. 683, 71 FR 58,273 (October 3, 2006), FERC Stats. & Regs. 31,228 (2006). 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. ***(Section 4.11.3)***

29. **Prior to any construction**, Aguirre LLC shall file an ERP (including evacuation) and coordinate procedures with the USCG; Commonwealth and local emergency planning groups; fire departments; Commonwealth law enforcement; and appropriate federal agencies. This plan shall include at a minimum:

    a. designated contacts with Commonwealth 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 vessel to activate sirens and other warning devices.

    Aguirre LLC 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 4.11.8)***

30. **Prior to any construction**, Aguirre LLC shall file the ERP which includes a Cost-Sharing Plan identifying the mechanisms for funding all Project-specific security/emergency management costs that would be imposed on Commonwealth and local agencies. In addition to the funding of direct transit related security/emergency management costs, this comprehensive plan shall include funding mechanisms for the capital costs associated with any necessary security/emergency management equipment and personnel base. ***(Section 4.11.8)***

31. **Prior to any construction**, Aguirre LLC shall file the quality assurance and quality control procedures for construction activities. ***(Section 4.11.3)***

32. **Prior to any construction**, Aguirre LLC shall file a plot plan (area layout drawings) of the final design showing all major equipment, structures, buildings, and spill control systems. ***(Section 4.11.3)***

33. **Prior to any construction**, a technical review of facility design shall be filed that:

    a. identifies all combustion/ventilation air intake equipment and the distances to any possible hydrocarbon release (LNG, flammable refrigerants, flammable liquids, and flammable gases); and

b. demonstrates that these areas are adequately covered by hazard detection devices and indicate how these devices would isolate or shutdown any combustion equipment whose continued operation could add to or sustain an emergency. ***(Section 4.11.3)***

34. **The final design** shall include change logs that list and explain any changes made from the Front-End Engineering Design provided in Aguirre LLC'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. ***(Section 4.11.3)***

35. **The final design** shall provide up-to-date P&IDs, which include the following information:

a. equipment tag number, name, size, duty, capacity, and design conditions;

b. equipment insulation type and thickness;

c. valve high pressure side and internal and external vent locations;

d. piping with line number, piping class specification, size, and insulation type and thickness;

e. piping specification breaks and insulation limits;

f. all control and manual valves numbered;

g. relief valves with set points; and

h. drawing revision number and date. ***(Section 4.11.3)***

36. **The final design** shall provide an up-to-date complete equipment list, process and mechanical data sheets, and specifications. ***(Section 4.11.3)***

37. **The final design** shall provide 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 4.11.3)***

38. **The final design** shall provide complete plan drawings and a list of the fixed and wheeled dry-chemical, hand-held fire extinguishers, and other hazard control equipment. Drawings shall clearly show the location by tag number of all fixed, wheeled, and hand-held extinguishers. 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 4.11.3)***

39. **The final design** shall provide facility plans and drawings that show the location of the firewater system. Drawings shall clearly show: firewater piping and the location, and area covered by, each monitor, hydrant, deluge system, water-mist system, and sprinkler. The drawings shall also include piping and instrumentation diagrams of the firewater system. ***(Section 4.11.3)***

40. **The final design** shall include an updated fire protection evaluation of the proposed facilities carried out in accordance with the requirements of NFPA 59A 2013, chapter 12.2. A copy of the evaluation, a list of recommendations and supporting justifications, and actions taken on the recommendations shall be filed. ***(Section 4.11.3)***

41. **The final design** shall specify that for hazardous fluids, the piping and piping nipples 2 inches or less are to be no less than Schedule 160. ***(Section 4.11.3)***

42. **The final design** shall provide electrical area classification drawings. ***(Section 4.11.3)***

43. **The final design** shall include a hazard and operability review of the completed design prior to issuing the P&IDs for construction. A copy of the review, a list of recommendations, and actions taken on the recommendations shall be filed. ***(Section 4.11.3)***

44. **The final design** shall include the cause-and-effect matrices for the process instrumentation, fire and gas detection system, and emergency shutdown system. The cause-and-effect matrices shall include alarms and shutdown functions, details of the voting and shutdown logic, and set points. ***(Section 4.11.3)***

45. **The final design** shall include 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 would be accessible during an emergency. ***(Section 4.11.3)***

46. **The final design** shall include 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 cleanout, dry-out, purging, and tightness testing. ***(Section 4.11.3)***

47. **The final design** shall include the sizing basis and capacity for the final design of the vent stack and pressure relief valves for major process equipment and vessels. ***(Section 4.11.3)***

48. **The final design** shall provide the procedures for pressure/leak tests which address the requirements of ASME VIII and ASME B31.3. ***(Section 4.11.3)***

49. **The final design** flow rate of each firewater pump shall be based on the required firewater demand. ***(Section 4.11.3)***

50. **The final design** shall specify how the nitrogen purge piping to the vent stack would be used to extinguish an ignited vent. ***(Section 4.11.3)***

51. **Prior to commissioning**, Aguirre LLC shall file plans and detailed procedures for: testing the integrity of onsite mechanical installation; functional tests; introduction of hazardous fluids; operational tests; and placing the equipment into service. ***(Section 4.11.3)***

52. **Prior to commissioning**, Aguirre LLC shall provide 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. Aguirre LLC 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 4.11.3)***

53. **Prior to commissioning**, Aguirre LLC shall provide tag numbers on equipment and flow direction on piping. ***(Section 4.11.3)***

54. **Prior to commissioning**, Aguirre LLC shall tag all instrumentation and valves in the field, including drain valves, vent valves, main valves, and car-sealed or locked valves. ***(Section 4.11.3)***

55. **Prior to commissioning**, Aguirre LLC shall file the operation and maintenance procedures and manuals. ***(Section 4.11.3)***

56. **Prior to commissioning**, Aguirre LLC shall maintain a detailed training log to demonstrate that operating staff has completed the required training. ***(Section 4.11.3)***

57. **Prior to introduction of hazardous fluids**, Aguirre LLC shall complete 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 4.11.3)***

58. **Prior to introduction of hazardous fluids**, Aguirre LLC shall complete all pertinent tests (Factory Acceptance Tests, Site Acceptance Tests, Site Integration Tests) associated with the Distributed Control System and the Safety Instrumented System that demonstrates full functionality and operability of the system. ***(Section 4.11.3)***

59. **Prior to commencement of service**, Aguirre LLC shall file **monthly** reports of progress on the construction of the proposed systems. Details shall include a summary of activities, problems encountered, contractor non-conformance/deficiency logs, remedial actions taken, and current Project schedule. Problems of significant magnitude shall be reported to the FERC **within 24 hours**. ***(Section 4.11.3)***

60. **Prior to commencement of service**, Aguirre LLC shall provide a plan for:

    a. training frequency for operators;

    b. testing frequency of facility components; and

    c. record keeping for each training, equipment test, inspection or survey, and maintenance activity. ***(Section 4.11.3)***

61. **Prior to commencement of service**, Aguirre LLC shall receive written authorization from the Director of OEP at the Offshore GasPort. Such authorization will only be granted following a determination by the USCG, under its authorities under the Ports and Waterways Safety Act, the Magnuson Act, the Maritime Transportation Security Act of 2002, and the Safety 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 Aguirre LLC or other appropriate parties. ***(Section 4.11.7.1)***

In addition, recommendations 62–65 shall apply **throughout the life of the facility**:

62. Aguirre LLC shall ensure that the FSRU moored at the Offshore GasPort would be in compliance with 46 CFR 154 and shall remain classed throughout the life of the facility. ***(Section 4.11.3)***

63. The facility shall be subject to regular FERC staff technical reviews and site inspections on at least an **annual basis** or at other intervals as determined by the Director of OEP. Prior to each FERC staff technical review and site inspection, Aguirre LLC 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 piping and instrumentation diagrams 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 4.11.3)***

64. Semi-annual operational reports shall be filed to identify changes in facility design and operating conditions, abnormal operating experiences, activities (including ship arrivals, quantity and composition of imported LNG, vaporized quantities, boil-off/flash gas, etc.), facility modifications, including future plans and progress thereof. Abnormalities on the Offshore GasPort shall include, but not be limited to: hazardous conditions in associated cryogenic piping, significant equipment or instrumentation malfunctions or failures, non-scheduled maintenance or repair (and reasons therefore), hazardous fluids releases, fires involving hazardous fluids and/or from other sources. In addition, include unloading/loading/shipping problems, potential hazardous conditions from the FSRU or LNG carriers. 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)" also shall be included in the semi-annual operational reports. Such information would provide FERC staff with early notice of anticipated future construction/maintenance projects at the LNG facility. ***(Section 4.11.3)***

65. Significant non-scheduled events, including safety-related incidents (e.g., LNG or natural gas releases, fires, explosions, mechanical failures, unusual over pressurization, and major injuries) and security-related incidents shall be reported to FERC staff. In the event 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 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 five minutes or more;

f. unintended movement or abnormal loading by environmental causes, such as an earthquake, 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. 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;

k. safety-related incidents to hazardous fluids vessels occurring at or en route to and from the LNG facility; or

l. 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, 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. ***(Section 4.11.3)***

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APPENDIX B

U.S. COAST GUARD LETTER OF RECOMMENDATION AND ANALYSIS

U.S. Department of Homeland Security
United States Coast Guard

Commander
U.S. Coast Guard Sector San Juan

5 Calle La Puntilla
San Juan, PR 00901-1819
Phone: (787) 729-2300

16610
P 071-14
May 02, 2014

Director of Gas Environment and Engineering, PJ11
Attn: Ms. Lauren O'Donnell
Federal Energy Regulatory Commission
888 1st NE
Washington, DC 20426-002

Dear Ms. O'Donnell:

This Letter of Recommendation (LOR) is issued pursuant to 33 CFR 127.009 in response to the Letter of Intent (LOI) submitted by Excelerate Energy L.P. on December 20, 2011 proposing to transport Liquefied Natural Gas (LNG) by ship to the Aguirre Offshore GasPort Project proposed for operation in Salinas, along the southern shore of Puerto Rico in Commonwealth waters. This LOR conveys the Coast Guard's recommendation on the suitability of the waterway for LNG marine traffic as it relates to safety and security. In addition to meeting the requirements of 33 CFR 127.009, this letter also fulfills the Coast Guard's commitment for providing information to your agency under the Interagency Agreement signed in February 2004.

After reviewing the information in the applicant's LOI and the Waterway Suitability Assessment (WSA) and completing an evaluation of the waterway in consultation with a variety of Commonwealth and local port stakeholders, I recommend that the waterway surrounding the Jobos Bay be considered suitable for accommodating the type and frequency of LNG marine traffic associated with this project. My recommendation is based on review of the factors listed in 33 Code of Federal Regulations (CFR) 127.007 and 33 CFR 127.009. The reasons supporting my recommendation are outlined more thoroughly in the enclosed LOR Analysis, which contains a detailed summary of the WSA review.

On April 21, 2014, I completed a review of the WSA for the Aguirre Offshore GasPort Project, submitted by Excelerate Energy L.P. on January 10, 2014. This review was conducted following the guidance provided in U.S. Coast Guard Navigation and Vessel Inspection Circular (NVIC) 01-2011. The review focused on the navigation safety and maritime security aspects of LNG vessel transits along the affected waterway. My analysis included an assessment of the risks posed by these transits and possible management measures that should be imposed to mitigate these risks. During the review, I consulted with members from the South Coast Harbor Safety Committees, Area Maritime Security Committee, Commonwealth government and industry partners, and collected their expert input and recommendations relating to the future operations and potential impacts to the waterway surrounding the Jobos Bay. Following the formal consultation and validation of the WSA, my staff developed the enclosed LOR Analysis (LORA), which contains a detailed summary of the WSA review process that has guided this recommendation. Since certain sections of the LORA contain security-related data that is "Sensitive Security Information" (SSI), two versions are enclosed. The first contains SSI. The second has all SSI redacted and is maked as such. This is done to a redacted copy that is releasable to the general public.

16610
P 071-14
May 02, 2014

My recommendation of the suitability of this waterway is provided to assist you in your determination of whether the proposed facility should be commissioned. As with all issues related to waterway safety and security, I will assess each transit on a case by case basis to identify what, if any, safety and security measures are necessary to safeguard the public health and welfare, critical marine infrastructure and key resources, the port, the marine environment, and the vessel.

If you have questions regarding this recommendation, my point of contact is LCDR Jose Perez and can be reached at 787-729-2374 and at jose.a.perez3@uscg.mil.

Sincerely,

D. W. PEARSON
Captain, U. S. Coast Guard
Captain of the Port

Enclosures: (1) Letter of Recommendation Analysis (SSI)
(2) Letter of Recommendation Analysis (Redacted)

Copy: Commander Coast Guard District 7 (dp)
Commander Atlantic Area (ap)
Excelerate Energy L.P.

REDACTED

Enclosure (2)

ANALYSIS SUPPORTING THE LETTER OF RECOMMENDATION ISSUED BY COTP SECTOR SAN JUAN ON MAY 02, 2014

TABLE OF CONTENTS

1. INTRODUCTION

A. This analysis supplements the Letter of Recommendation (LOR) dated May 02, 2014, which conveys the San Juan Captain of the Port (COTP) recommendation on the suitability of the Aguirre Offshore GasPort Project for liquefied natural gas (LNG) marine traffic associated with the Aguirre Offshore GasPort, LLC (AOGP), an entirely owned subsidiary of Excelerate Energy L.P. (Excelerate Energy). AOGP is proposing to develop, construct, and operate the Aguirre Offshore GasPort Project (Project) to be located in Salinas, along the southern shore of the Commonwealth of Puerto Rico in Commonwealth waters. The Project is being developed in cooperation with the Puerto Rico Electric Power Authority (PREPA) for the purpose of receiving and storing liquefied natural gas (LNG) to be acquired by PREPA, regasifying the LNG, and delivering natural gas to PREPA's existing Aguirre Power Complex (Aguirre Plant). The Project will include an LNG terminal and facilities that will be sited, constructed and operated pursuant to Section 3 of the Natural Gas Act (NGA), 15 U.S.C. § 717b. It documents the processes followed in analyzing the AOGP's Waterway Suitability Assessment (WSA) completed on January 10, 2014, and the Coast Guard's assessment of the suitability of the waterway for LNG marine traffic identified above.

For the purposes of this analysis, the following assumptions were made:

1. The applicant is fully capable of, and would fully implement, any and all risk mitigation measures identified in their WSA and measures referenced in this LOR Analysis.

2. The conditions of the port area identified in the WSA fully and accurately describe the actual conditions of the GasPort area at the time of the WSA submission.

3. The conditions of the port area have not changed substantially during the analysis process.

4. The applicant will fully meet all regulatory requirements including the development and submission of an Emergency Manual and Operations Manual.

2. BACKGROUND

A. The data and information regarding the proposed LNG berthing and regasification platform (BRP) detailed in this Letter of Recommendation Analysis (LORA) were derived from Aguirre Offshore GasPort Project's Letter of Intent (LOI) and WSA provided directly to the COTP. The WSA is an applicant-prepared risk-based assessment, designed to document and address all safety concerns related to the marine transportation of LNG for a U.S. port or waterway. The scope of the Aguirre Offshore GasPort Project (AOGP) WSA was based on U.S. Code of

Federal Regulations (CFR) Part 127, and U.S. Coast Guard (USCG) policy guidance (in part) contained in Navigation and Vessel Inspection Circular (NVIC or Circular) 01-2011, *Guidance Related to Waterfront Liquefied Natural Gas (LNG) Facilities*, dated January 24, 2011.

B. The Aguirre Offshore GasPort Project's WSA considered the entire approach to the LNG BRP, with particular attention focused on all safety aspects of the waterway within 25 kilometers (15.5 miles) of the proposed platform location, as outlined in 33 CFR 127.007 and 127.009. Included in this evaluation were the hydrodynamics of the waterway (tides, currents etc.), density of deep-draft vessel traffic, recreational boating, commercial fishing, aids to navigation (ATON), climatic weather (winds and heavy seas), identification of environmentally sensitive areas, detection of hazards to navigation (shoaling, ledges etc.), and the available response capabilities along the transit route.

C. The lead federal agency responsible for the permitting of this LNG BRP is Federal Energy Regulatory Commission (FERC). Information contained in the AOGP's LOI and WSA enables the COTP to provide specific input, via this Letter of Recommendation (LOR) to FERC as to the suitability of the waterway to support LNG marine traffic associated with the AOGP LNG project. It should be noted that the LOR is based upon the Coast Guard's expertise in navigation safety and neither the LOR nor this LORA impose conditions on the FERC permit.

D. Regional stakeholders were invited to form an LNG working group. The LNG working group contributed to the information contained in this LOR Analysis. None of the participants were asked to "vote" or otherwise indicate whether the AOGP project proposal should be approved. Rather, members from the LNG working group were relied upon to provide valid input based on their expertise and regional familiarity in order to conduct a thorough review of the WSA. The input gathered from the LNG working group helped identify potential risks to navigational safety associated with the proposed project. Additionally, this input assisted with the development of operational parameters significant to the transit, and assisted in the identification of potential mitigation measures.

E. The LNG working group included participation of members from Harbor Safety Committee and other port stakeholders. On August 14, 2013 the LNG working group met in U.S. Coast Guard Resident Inspection Office in Ponce for the initial LNG working group meeting. Representatives from the following agencies and port stakeholders participated in this working group: South Coast Pilots, American Tugs Incorporated, Luis Ayala Vessel Agents, Gulf Harbor Shipping Agents, South Puerto Rico Towing, and CORCO. In addition to the member's from the LNG working group, the Puerto Rico's Departamento Recursos Naturales y Ambientes (DRNA) was also consulted during the review and validation of the WSA.

F. The LNG working group was provided electronic copies of the WSA; they then reviewed and commented on subject areas commensurate with their vocation, expertise, or regional familiarity. After the initial review, specified issues, concerns, and/or risks relating to the proposed project were reviewed by individual members and *ad hoc*, informal groups, for further consideration and recommended resolution.

3. RESOLUTION PRECISION

A. The following sections summarize the myriad specifics considered and reasoning behind the COTP's determination. This summary is not all inclusive; background information and amplifying data are contained in the applicant's WSA, to include vessel traffic studies, casualty analysis, port characterization appraisals, and risk-based safety assessments, among others.

B. COTP has confirmed that the hydrographic characteristics of the waterway as described in the WSA will sustain deep draft vessel movement confirming that the transit and maneuvers are comparatively feasible for the design range of LNG carriers anticipated. Identified safety risk mitigation measures, and/or implementation strategies from the WSA are discussed in the following paragraphs, where applicable.

C. COTP comments pertinent to a particular WSA recommendation, and/or the identification of additional risk management measures recommended by the COTP, are also provided where relevant.

4. PROJECT OVERVIEW

A. AOGP, a wholly owned subsidiary of Excelerate Energy is proposing to develop, construct, and operate the Aguirre Offshore GasPort Project to be located in Salinas, along the southern shore of the Commonwealth of Puerto Rico in Commonwealth waters. The Project is being developed in cooperation with the Puerto Rico Electric Power Authority (PREPA) for the purpose of receiving and storing LNG to be acquired by PREPA, regasifying the LNG, and delivering natural gas to PREPA's existing Aguirre Plant.

B. The purpose of the project is to provide up to 3.2 Bcf of LNG storage capacity and sustained deliverability of 500 MMscf/d, with a peaking deliverability of up to 600 MMscf/d of natural gas directly to the 1,492 MW Aguirre Plant. The project will allow PREPA to effectuate its long planned conversion of the Aguirre plant from fuel oil only to dual-fuel generation facility, capable of burning diesel and/or natural gas for the combined cycle units and fuel oil and natural gas for the thermoelectric plant. A diversified fuel supply at the Aguirre Plant will present an environmentally acceptable alternative to oil in meeting the project demand.

C. In order to deliver natural gas to the Aguirre Plant, PREPA is working with AOGP who will develop, construct and operate an LNG terminal off the coast of Aguirre. As part of this process, on December 20, 2011 Excelerate Energy submitted to the USCG Captain of the Port at San Juan, Puerto Rico, and an LOI to construct and operate an offshore LNG import terminal off the southern coast of Puerto Rico.

D. The project requires authorization from the FERC and be subject to a full public environmental review and analysis under the National Environmental Policy Act (NEPA). The Aguirre Offshore GasPort will be located approximately 3 miles from shore and approximately 0.6 miles from the barrier islands outside Bahía de Jobos, near the towns of Salinas and Guayama. The location is in waters approximately 60 ft deep and well clear of shipping lanes, established navigation channels, and other marine infrastructure.

E. The project will consist of three main components: 1) an offshore berthing platform; 2) an offshore LNG receiving facility (Offshore GasPort) consisting of a Floating Storage and Regasification Unit (FSRU) moored at the offshore berthing platform; and 3) a subsea pipeline connecting the Offshore GasPort to the Aguirre plant. The facility will consist of a fixed offshore berthing platform carrying all the topside facilities that will incorporate a berth for one of Excelerate Energy's eight existing Energy Bridge Regasification Vessels (EBRV) that will serve as the FSRU and a berth for LNG carriers (LNGC) with capacities ranging from 125,000 cubic meters (m3) up to 210,100 m3. Cargo will be transferred from the LNGC via the topside conventional LNG loading arms and cryogenic piping to the FSRU for storage.

F. The FSRU will remain moored at the facility continuously unless anticipated extreme weather conditions or maintenance needs dictate otherwise. The FSRU will be capable of storing up to a nominal 150,900m3 of LNG, the equivalent of approximately 3.2 billion cubic feet (Bcf) of natural gas in liquid form, and processing and transferring 500 million cubic ft per day (mmscfd) with peaking rates of up to 600 mmscfd to the Aguirre Plant via subsea pipeline. LNGCs will dock and offload at the facility on a regular basis except when extreme weather conditions are anticipated.

G. Along with the LOI, Excelerate Energy submitted a Preliminary Waterway Suitability Assessment (PWSA) for the project, in accordance with the requirements of 33 CFR 127.007 administered by the USCG and 18 CFR 157.21 administered by the FERC.

H. The Follow-On Waterway Suitability Assessment (WSA) was prepared to provide additional information on the project, including maritime safety assessments.

Figure 4A: Project Site Map

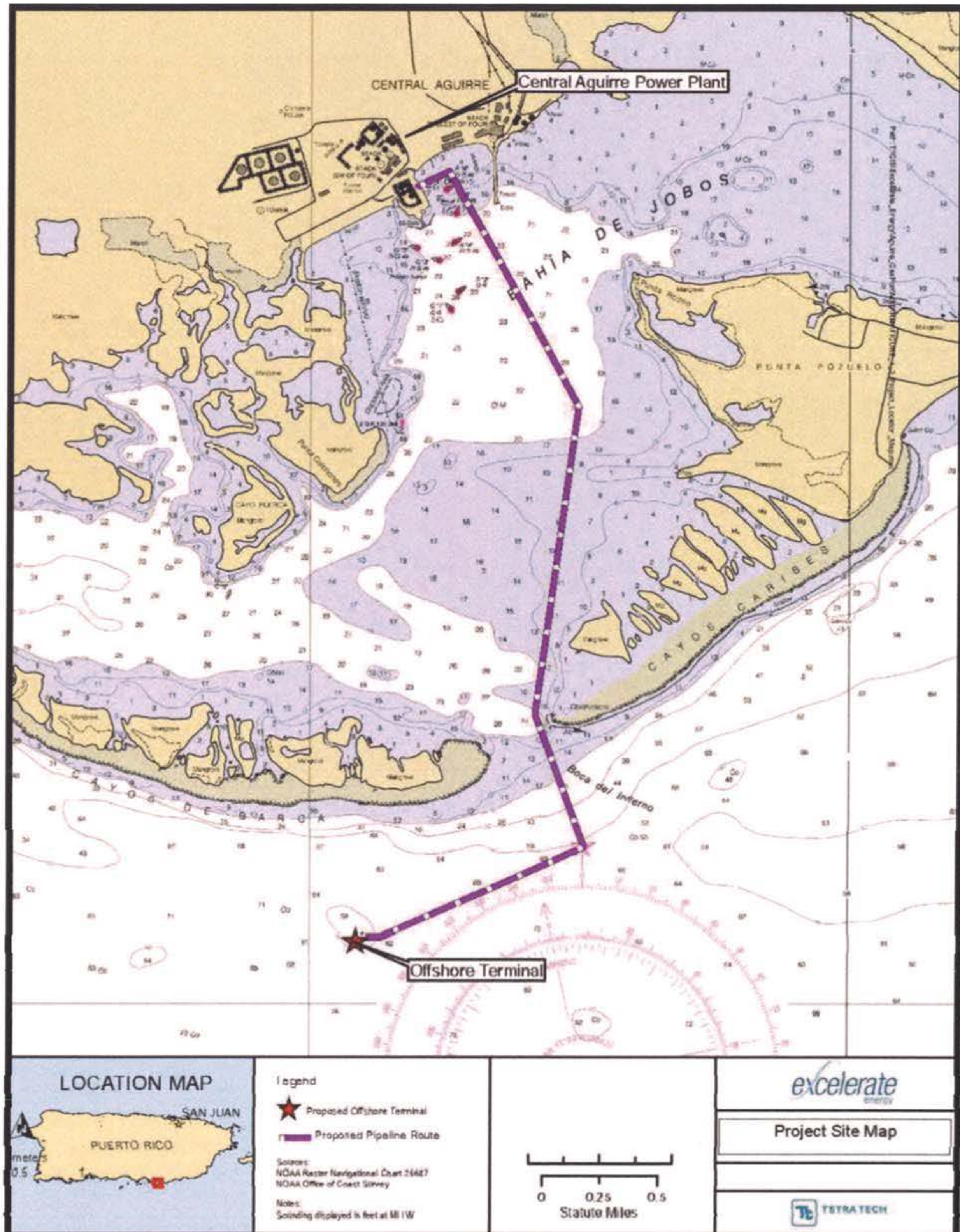


Figure 4B: Aguirre Offshore GasPort LNG Terminal

Figure 4C: Aguirre Offshore GasPort with FSRU

Figure 4D: Aguirre Offshore GasPort with FSRU and LNGC

5. MARINE TRANSPORTATION OF LIQUEFIED NATURAL GAS (LNG)

A. LNG consists almost entirely of methane (CH4), the simplest hydrocarbon compound. Typically, LNG is 85 to 95-plus percent methane, along with a few percent ethanes, even less propane and butane, and trace amounts of nitrogen. The exact composition of natural gas (and the LNG formed from it) varies according to its source and processing history. And, like methane, LNG is odorless, colorless, noncorrosive, and nontoxic. In general, deep draft or ocean-going "gas carriers" are categorized by the hazard potential of the cargo or cargoes they carry and are divided into (1) those that carry LHG cargoes and (2) those that carry LNG. As per the International Maritime Organization (IMO) Gas Carrier Code, they are further broken down into three types: IG, IIG, or IIIG, depending on vessel size, cargo tank design/placement, and level of protective measures intended to prevent the escape of cargo. Type IG is used for chlorine, ethylene oxide, methyl bromide, and sulfur dioxide cargoes; type IIG is used for LHG or LNG and applies to vessels over 150 meters (492 feet) in length, and type IIIG is intended for cargoes of nitrogen and refrigerant gases. LNG carriers calling on the AOGP will predominately be type IIG ships, built with independent cargo tanks, usually of prismatic shape, that are completely self-supporting, *i.e.,* they do not form part of the vessel's hull.

B. Cargoes carried in this type of cargo tank arrangement are fully refrigerated, and maintained at or near atmospheric pressure. For added safety and efficiency, modern LNG carriers of the above design have a secondary containment system, known as a "secondary barrier", surrounding each tank that is capable of containing the entire contents of the cargo tank. This is accomplished by building a second "skin" around the cargo tank itself, or building the hull out of special steels to accomplish the same. In either case, the space between the primary barrier and secondary barrier is filled with inert gas, which will not support combustion. Below is the Department of Energy's Liquefied Natural Gas Understand the Basic Facts.

Department of Energy; Liquefied Natural Gas: Understanding the Basic Facts

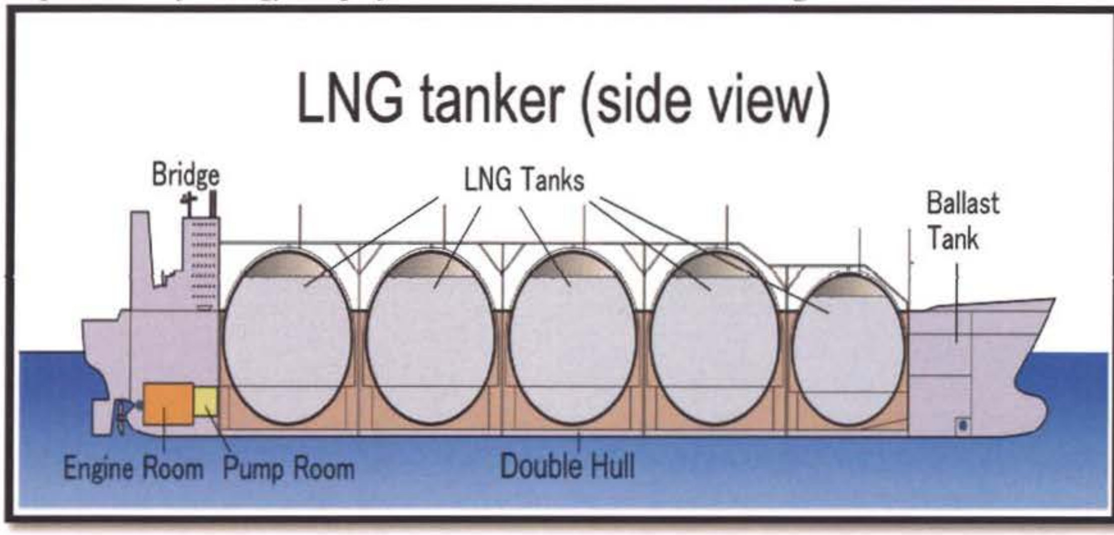


Figure 5A: LNG tanker side view

Figure 5B: Typical LNG carrier anticipated for the AOGP

While the marine transportation of liquefied gases incurs its own special hazards, some of the features are less hazardous than those of the heavier petroleum cargoes. Hazards peculiar to the carriage of LHG cargoes include:

- Cold from leaks and spillages can affect the strength and ductility of a vessel's structural steel. Likewise, skin contact with the liquids or escaping gases can produce frostbite and inhalation of the cold vapor can permanently damage certain organs, such as the lungs.

- Rupture of a pressure system containing LNG could release a massive evolution of vapor, termed a vapor cloud.

LHG transportation hazards that are reduced, as compared with "normal" petroleum tanker operations, include:

- Loading or ballasting does not eject gases to the atmosphere in the vicinity of decks and superstructures. Gas freeing is rarely performed and does not usually produce gas on deck.
- Liquefied gas compartments are never within flammable limits throughout the cargo cycle. Within a cargo tank the vapor space above the liquid cargo is virtually 100% rich with cargo vapor and thus far above the upper flammable limit. Static electricity and other in-tank ignition sources are, therefore, no hazard.
- There is no requirement for tank cleaning; therefore, the hazards associated with that operation are eliminated.
- Gas carriers are fitted with fixed water spray systems for added fire protection. The spray nozzles cover cargo tank domes, above-deck cargo tank areas, manifolds, and provide a curtain of spray over the front of accommodation spaces, cargo control rooms, etc.

6. WATERWAY TRANSIT CONSIDERATIONS.

6.1. TRANSIT ROUTE

A. The intended transit route for the deep-draft LNGCs, from sea to project site, excludes the Bahía de Jobos. Only smaller tug and barges delivering oil to the Aguirre Terminal will be continuing the use of the Bahia de Jobos. This area is located in Central Aguirre on the south coast of the Commonwealth of Puerto Rico at latitude 17 56'23" North and longitude 66 13'07" West between the towns of Salinas (population approximately 31,000) and Guayama (population approximately 45,500). Bahía de Jobos is an elliptical body of water, about 4 NM long in an east-west direction and about 2.5 nm wide at its widest points, with general depths ranging from 11 ft (3.4 m) to 30 ft (9.1 m). All aspects of the transit route to and from the proposed terminal and storage facility were evaluated, including tides and currents, prevailing weather, density and character of marine traffic, deep draft vessel management, recreational boating and commercial fishing, navigational aids, regional waterway events, surrounding community/port impacts, and relevant environmental/iconic considerations.

B. Applicable navigation charts are National Oceanic and Atmospheric Administration (NOAA) #'s 25677 *Guanica Light to Punta Tuna Light* and 25687 *Bahía de Jobos*. General information on the region is available from the U.S. Coast Pilot Volume 5 *Gulf of Mexico, Puerto Rico & the Virgin Islands, Chapter 13: Puerto Rico*. Figure 6A provides an overview of the Bahía de Jobos Waterway and the primary oil cargo delivery to the Aguirre Plant.

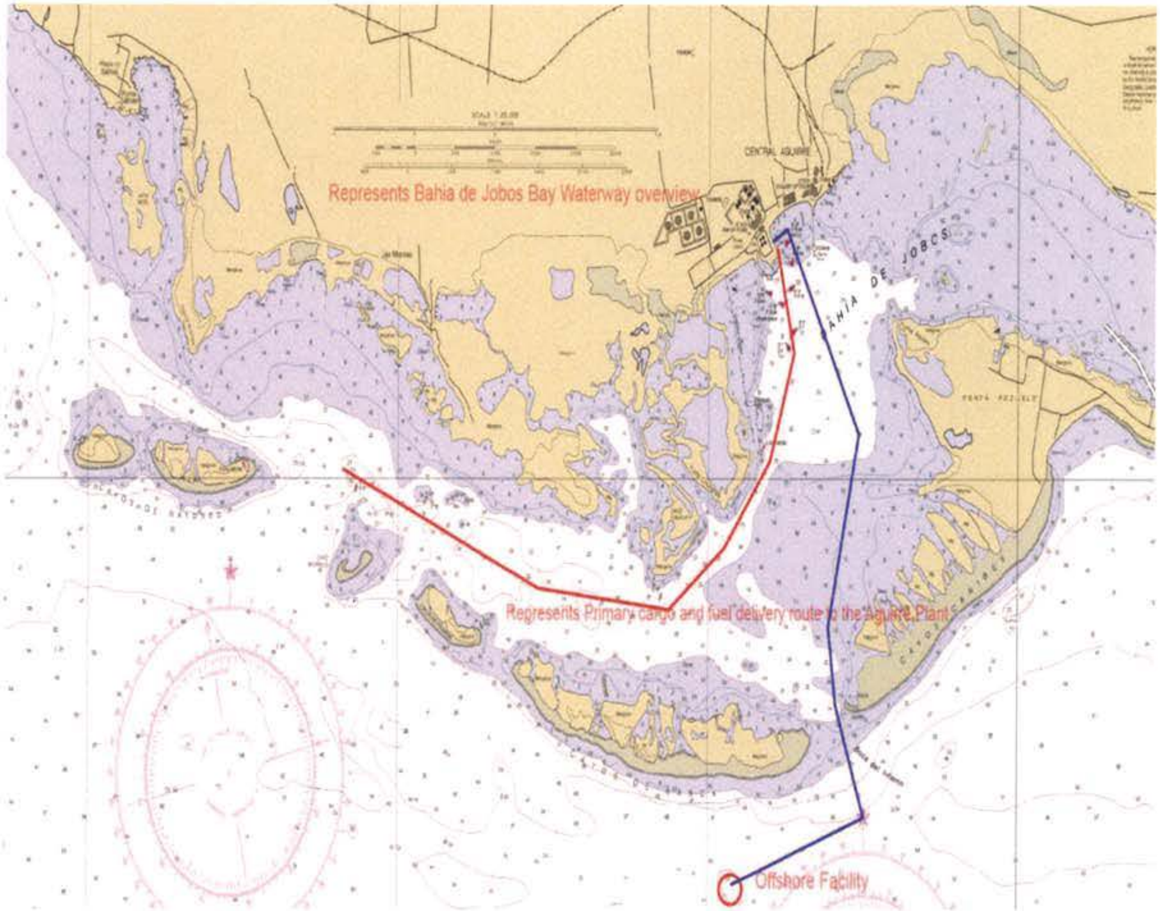


Figure 6A: Waterway overview

6.2. DEPTHS OF WATER & TIDAL RANGE

A. LNG carrier routes that will be used are open water deep transits. Depths at the LNG offshore facility will be approximately 60 feet with the further seaward the greater the depth and can be navigated throughout the tidal range. As per the recommendations made by the LNG working group (which included input from the South Coast Pilots), it was decided that the best location for the pilot boarding area would be two nautical miles due South of the LNG offshore facility. The identified pilot boarding area will be in depths greater than 80 feet, which does not pose a risk of grounding, see Figure 6B. Additionally, the LNG working group determined that the prevailing sea states at this location allow for the safe boarding of the pilots. NOAA tidal range prediction for the area in 2013 is a 1FT maximum high tide and a -0.3 maximum low tide. A typical monthly tide table is in Figure 6C shows that currents also have been steady from 2008 to 2012 with a Flood at 250 degrees True and Ebb at 055 degrees True.

REDACTED

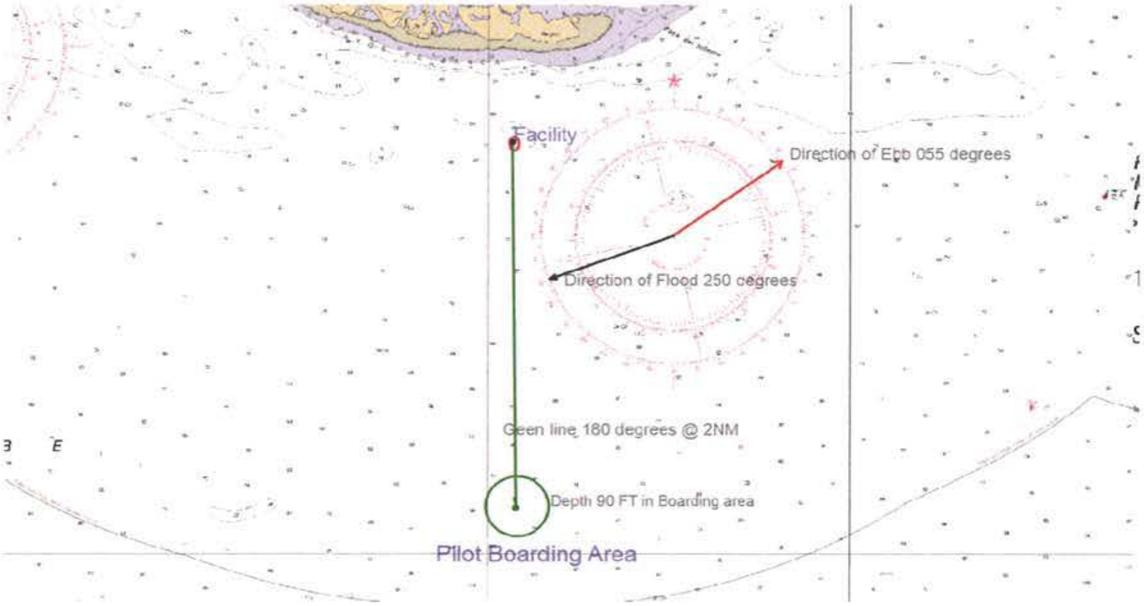


Figure 6B: Pilot Boarding Area, Facility location and current direction.

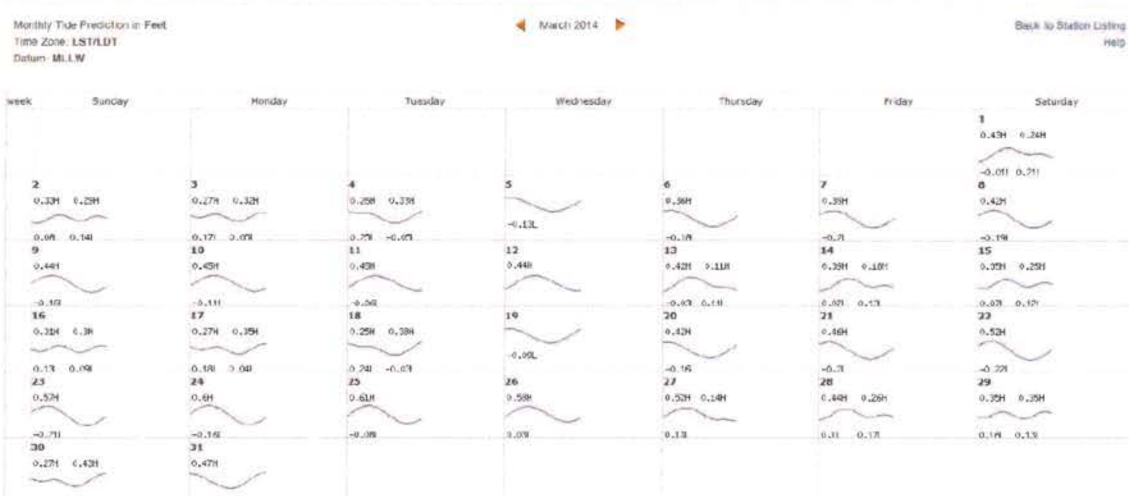
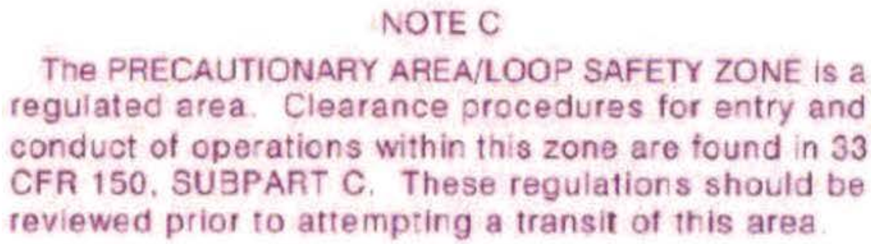


Figure 6C: Typical monthly tide table.

B. The submerged pipeline will be laid from the offshore gas port through the east side of Boca del Infierno and then continue north through Bahía de Jobos towards the Aguirre power plant. The submerged pipeline will be anchored on the bottom at depths between nine to 60 feet. The pipeline will extend 24 inches off the bottom and may pose a risk to vessels depending on their draft. Vessels with a deep draft should avoid the area along the pipeline due to the pipeline protruding 24 inches off the sea floor.

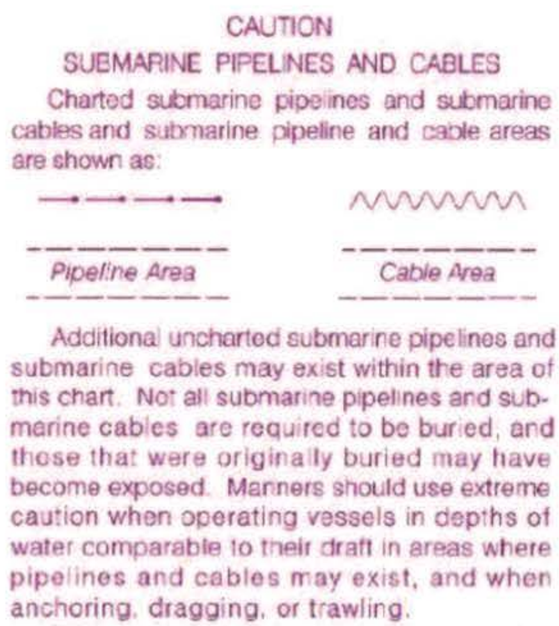
C. Anchoring and dredging should be avoided along the route of the pipeline. The route of the pipeline begins in an approximate position of 17 54'15"N, 066

13’50”W thence north-east to approximate position 17 54’17”N, 066 13’42”W thence north-west to approximate position 17 54’35”N, 066 12’59”W thence north to approximate position 17 55’03”N, 066 13’10”W thence north-west to approximate position 17 56’11N, 066 13’01”W and end at the Aguirre power plant, again all positions are approximate. The purpose of this pipeline is to transfer LNG from the Aguirre Offshore GasPort to the Aguirre power plant located approximately 3 miles from the offshore facility. It is recommended that an entry be made into the U.S. Coast Pilot Volume 5 *Gulf of Mexico, Puerto Rico & the Virgin Islands, Chapter 13: Puerto Rico.* This information will be available to all vessels transiting the area and inform mariners of the dangers associated with the pipeline. It is also recommended that the pipeline, facility and note be charted on NOAA charts informing mariners of the dangers of a submerged pipeline in the area. Examples of the notes to be added to NOAA Charts are listed in Figure 6C and Figure 6D.


NOTE C

The PRECAUTIONARY AREA/LOOP SAFETY ZONE is a regulated area. Clearance procedures for entry and conduct of operations within this zone are found in 33 CFR 150, SUBPART C. These regulations should be reviewed prior to attempting a transit of this area.

Figure 6C: Note Example for Chart


CAUTION

SUBMARINE PIPELINES AND CABLES

Charted submarine pipelines and submarine cables and submarine pipeline and cable areas are shown as:

Pipeline Area

Cable Area

Additional uncharted submarine pipelines and submarine cables may exist within the area of this chart. Not all submarine pipelines and submarine cables are required to be buried, and those that were originally buried may have become exposed. Mariners should use extreme caution when operating vessels in depths of water comparable to their draft in areas where pipelines and cables may exist, and when anchoring, dragging, or trawling.

Figure 6D: Example of Caution note for Chart

6.3. HYDROGRAPHIC & WEATHER CHARACTERISTICS

A. The vessel master and port facility operator shall monitor weather conditions and forecasts by official weather advisories to ensure cargo unloading and regasification operations occur within the safe operating parameters of the port facility. Should existing conditions or forecasts exceed normal safe operating parameters established for the port facility, the vessel master and port facility operator shall follow a Severe Weather Action Plan, published in the Operations Manual, in accordance with 33 CFR 127.019. The Severe Weather Action Plan shall be developed and in place before the port facility is placed into operation and shall include the following basic provisions:

1. While an LNG carrier is moored and discharging cargo at the port facility, weather shall be monitored by the port facility operator and vessel master. Any significant weather disturbances within a 500-mile radius of the port facility shall warrant special attention. Additional weather information shall be made available through several sources, including commercial weather services, the NOAA Tropical Prediction Center, the National Data Buoy Center, and local weather broadcasts;

2. As stated within the WSA, and as per the normal operating procedures that the Aguirre GasPort will implement, LNGCs and the FSRU moored to the port facility will make initial preparations to depart the port facility when a weather disturbance is forecasted to generate wave heights in excess of 3 meters and is projected to approach the port facility within 24-hours;

3. LNG carriers moored at the port facility shall secure LNG transfer operations, disconnect from the port facility, and depart whenever a weather disturbance forecasted to generate wave heights in excess of 3 meters is projected at the port facility within 12-hours, or at any time the port facility operator or LNG master determine there is an unsafe condition or other occurrence that requires the need for the LNG carrier to depart the port facility;

4. The FSRU moored at the port facility shall make initial preparations to depart the port facility when a weather disturbance forecasted to generate wave heights in excess of 3 meters is projected to approach the port facility within 24-hours;

5. The FSRU vessel shall secure regasification operations, disconnect from the port facility and depart whenever a weather disturbance forecasted to generate wave heights in excess of 3 meters is projected at the port facility within 12-hours, or anytime the port facility operator or vessel master determine there is an unsafe condition or other occurrence that requires the need for the vessel to depart the port facility; and

6. For all situations where a LNG carrier or FSRU departs the port facility due to weather or unsafe conditions, permission to return to the port facility shall not

be granted by the port facility operator until the weather disturbance is well clear of the area, sea and swell have subsided, and the port facility is prepared to return to normal operation in accordance with the established safe operating parameters and permission from the COTP has been granted to resume operations. The platform may be inspected by COTP to ensure is safe to return to operations.

B. In an emergency situation, the LNG carrier and / or FSRU can activate the Emergency Shut-Down (ESD) System immediately suspending all cargo transfer and regasification operations and isolate the cargo system and other safety devices in a prescribed sequence. The port facility operator shall be able to activate the ESD System independently of either vessel, isolate and disconnect the HPMLA or cargo transfer arms and standby to activate the quick-release mooring hooks thereby releasing the vessel to depart the port facility under her own power in approximately 20-minutes.

C. The average wind speeds in Puerto Rico vary by season and by month. In summer the island is windier in comparison to winter. The prevailing winds of the island under normal conditions come from the northeast trade winds. Due to the close proximity to shore the facility shouldn't be affected by wind driven waves. The barrier islands to the north and Cayos Caribes to the northeast of the facility should create a lee and provide protection against the winds. During hurricane season the facility may be affected depending on the course of the storm. Due to the location of the offshore facility there is a possibility for wind and wave damage during a storm since there is no protection from the southeast to southwest of the offshore facility. There are five port conditions implemented by COTP. Condition 4 is to be set by all vessels and waterfront facilities from 1 June through 30 November. All remaining conditions shall be set when gale force winds (34KTS/39 MPH) are expected: Port Condition Whiskey 72 hrs, X-ray 48 hrs, Yankee 24 hrs, and Zulu 12 hrs. All ocean going commercial vessels greater than 500 GT are required to depart port or the designated representative must request permission in writing, for the COTP prior to setting Port Condition X-Ray and all ocean going commercial vessels over 500 GT not having written permission to remain in port must be at open sea when Port Condition Yankee is set in the COTP zone. It is recommended that the offshore facility implement the five port conditions as per the COTP requirements.

7. PORT LEVEL CONSIDERATIONS

7.1. MARITIME COMMERCE

A. The Aguirre GasPort will be constructed within the land and waters of Bahía de Jobos and the areas surrounding the Boca del Inferno leading to the contiguous Caribbean Sea. Currently, there are no federally regulated shipping lanes in the vicinity of the terminal site and traffic along the coast is mainly recreational and smaller size fishing boats. Furthermore, the proposed pipeline that extends from the location of the platform to the landside Aguirre Power plant will remain outside the privately maintained navigational channel.

B. No other deep draft vessel traffic passes or is expected near the offshore platform site. Fuel oil is delivered to the Aguirre Plant by a tug and barge. The tugs run inside the barrier islands then follow the non-federally regulated channel across Bahía de Jobos to the PREPA terminal, thus directly avoiding any proximity to the proposed pipeline.

C. The majority of the marine traffic in the area consists of commercial, recreational fishing and sport diving vessels. A summary of the findings include:

1. The Bahía de Jobos and surrounding keys plays host to a significant and diverse range of motor, sail, and manually-propelled boaters

2. The geographical setting promotes boating and ecotourism activities because of multiple mangrove canals, some of which form tunnels that local resident refer to as, "Los Placeres" (The Pleasures).

3. Over 50 small commercial vessels and 75 recreational fishermen utilize the water surrounding Bay the Jobos and the keys adjacent to the offshore platform.

4. There are no oil transfer anchorage areas, which alleviate the necessity or requirements for commercial vessels to anchor or to conduct fuel/oil transfer operations.

5. The amount of recreational boating traffic remains constant throughout the year.

6. The waterway is relatively wide and there is no established population along the route that the LNG carriers or in the vicinity of the offshore platform. If a casualty occurred involving an underway LNG carrier and resulted in a breach and release of cargo, potentially the platform staff, local recreational and fishing vessels transiting near or outside the safety zone will be affected. Population densities (persons per square mile) for the nearby areas located along the intended vessel route and the Aguirre GasPort are considered "low" e.g., less than 1,000.

7.2. REGIONAL IMPACT

A. An accidental spill or release of LNG consequent to a marine casualty could pose serious harm and multiple hazards to the general population, the navigable waterway, and surrounding environment. The nature and severity of the spill, climatic and sea conditions are all factors that must be taken into consideration in order to mount a rapid and effective response.

B. Safety zone parameters have been determined taking in consideration the worst case impact originated from a spill and the areas of concerns listed within the WSA. A fixed safety zone around a moored LNG carrier will be established, and will minimally impact the public's ability to access this particular area. Most significantly, the vessel traffic will not be able to access the water surrounding the Aguirre GasPort without permission from the COTP.

7.3. CULTURAL/ECONOMIC IMPACT

A. This region has a maritime footprint and few commercial operations that include: commercial and sport fishing, ecotourism industry and oil barge supply trade. Tourism and sport diving operations supplements the local economy, with much of the tourist pull centered on boating, canoeing/kayaking, recreational fishing, and day excursions to the cays in the vicinity of the offshore platform. The local municipalities along the shoreline depend on tourist-related and commercial fishing businesses to increase local capital and bolster employment opportunities. The residents of the municipality of Salinas have depended heavily on the coastal resources of Bahía de Jobos and the Caribbean Sea. Access to the Bay is an important means of subsisting.

B. Additionally, Salinas and Guayama have extensive shoreline resources including the second largest mangrove forest in Puerto Rico; beach facilities are located on the offshore islands and cays that ring the southern boundary of Bahía de Jobos. The geographical setting promotes boating and ecotourism activities because of multiple mangrove canals within the Bay, some of which form tunnels that local residents refer to as, "Los Placeres" (The Pleasures).

C. According to some residents and local businesses who are concerned with the Aguirre GasPort, the establishment of restricted zones and limitation of access to Bahía de Jobos and the Caribbean Sea via the cays in proximity to the project is a critical issue to the fishing community. Establishing restriction beyond the proposed safety zone of 500 yards could prevent the local fishermen from gaining access their fishing grounds. Additionally, the siting of the project in the midst of the cays threatens to severely hamper the ecotourism and recreational activities and might well tip the balance of the Bay towards further industrial activities.

D. The COTP appreciates the above-stated concerns and considered each throughout the WSA review and validation process. While this project does represent an increase in deep-draft vessel traffic and the enforcement of a regulated navigable area, it is taking into consideration not to expand restrictions that impact the nearby coastal resources beyond the proposed 500 yard safety zone.

8. OPERATIONAL CONSIDERATIONS

8.1. SHORE-SIDE EMERGENCY RESPONSE.

A. COTP comment: It's logical for one to expect that, in general, shore-based fire departments, emergency response units, and emergency management organizations located in close proximity would have the appropriate training and equipment necessary to launch an initial response capability to an LNG fire and/or related medical emergency. Unfortunately, in keeping with the rural nature of the area, that capability does not currently exist in the Bahia de Jobos. In all LNG project evaluations where the Federal Energy Regulatory Commission (FERC) is the lead federal jurisdictional agency and ultimately authorizes the sitting of the LNG terminal, the Commission Order will dictate that emergency response needs and related planning strategies must be addressed as per Section 311(d) of the Energy Policy Act of 2005, and the Natural Gas Act, 15 U.S.C § 717b-1. In addition, the Energy Policy Act of 2005 and ultimately, the FERC commission, require a cost sharing plan within the Emergency Response Plan (ERP), again applicable to LNG, that identifies the funding mechanism for all project-specific safety/emergency management costs that would be borne by state and local agencies to include:

1. Direct reimbursement (overtime for police and fire, *etc.*)
2. Capital costs associated with emergency management equipment (patrol boats, firefighting equipment, *etc*.); and
3. Annual costs associated with specialized training for fire departments, mutual aid, *etc*.

B. Accordingly, the need for offshore emergency plan development, resource identification, response training, and a public education program on emergency response management were acknowledged in the safety risk assessment portions of the WSA. Risk reduction measures such as these will need to be further considered by the FERC as the lead federal agency with siting authority for this project, in joint collaboration with the Commonwealth of Puerto Rico.

8.2. MARINE FIREFIGHTING CAPABILITIES

A. Fire is one of the most dangerous emergency conditions onboard a LNG ship. Therefore, LNGC onboard firefighting capabilities must be in compliance with rigorous requirements established by the International Gas Carrier (IGC) Code under the International Convention for the Safety of Life at Sea (SOLAS) 1974. In that firefighting resources aboard a vessel are physically limited, prevention is significantly important. The Fire Safety System (FSS) Code provides specific standards of engineering for fire safety systems onboard these vessels, to include fixed gas, foam, water pressure and spray extinguishing systems, personal protection equipment, and detection and alarm systems, just to name a few.

B. Due to the nature of LNG cargoes, and the potential for severe consequence subsequent to a major casualty, most LNG escort and assist tug boats are equipped with firefighting equipment that meet the International Association of Classification Societies (IACS) "FiFi 1" notation; *i.e.,* vessels are equipped with at least ***one monitor*** that, in total, have a discharge rate of 2400 m³/hr, and are able to spray water to a height of 45 meters and to a minimum distance of 120 meters and capable of conducting sustained firefighting operations for at least 24 hours. In addition to the water stream requirements, at all levels of FiFi categories (1, 2, and 3) the vessels must have a deluge system, comprised of piping and associated sprinkler heads and nozzles along the deck and pilot house, which will provide a protective curtain of water and protect the tug/response vessel and crew from the effects of radiant heat. This would allow the tug to escape the scene of a fire in order to reach an area of refuge, or it might enable the tug to enter an area of high heat to affect a rescue. The National Fire Protection Academy, as outlined in its publication NFPA 1915 – *Standard on Marine Fire-Fighting Vessels,* also requires similar criteria for towing vessels in order that they maintain Class 1 certification. While there is no federal requirement that specifies that tugs in the service of escorting or assisting LHG vessels meet the FiFi 1 criteria; it has widely become the industry standard. Therefore, the COTP will require at least one tug in service to any LNGC or the FSRU to have FiFi 1 capability at all times.

C. The tug service for the Bahía de Jobos area is provided by South Puerto Rico Towing Company located in Guayanilla, PR. South Puerto Rico Towing is the principal towing company operating in the South and West coast of Puerto Rico serving EcoElectrica for more than 12 years moving more than 28 LNG tank vessels per year. The 03 tugs available to assist the LNG transit and mooring of LNG carriers are the:

1. 4,500 HP M/V MR FRANKIE P, which is powered by two GM diesel engines married to Ulstein "z-drives", has a 40 short-ton bollard pull and one FiFi fire pump monitor 850 hp hydraulic motor 5,300 gallons per minute (GPM) PSI 1400 RPM;

2. 4,300 HP twin-propellers M/V AZIMUTH TRACTOR TUG HECTOR P, which has a one monitor fitted with one FiFi fire pump and two other fire pumps firefighting system rated at 5,280 GPM; and

3. 3,800 HP twin-propellers powered M/V TUG DON HIRAM P, which has a 27 short-ton bollard pull and is equipped with a firefighting system capable of supplying 2,500 GPM. Currently, this vessel's system does not meet the FiFi 1 criteria.

D. Currently, two of the listed tugs are equipped with firefighting capabilities that meet the criteria specified for a FiFi 1 category. However, the South Puerto Rico Towing Tractor Tug Company, has examined the feasibility of retrofitting the

M/V TUG DON HIRAM P with the necessary drives, pumps, and associated piping etc. in order to produce water stream capacities that will meet the Fifi 1 criteria.

E. The COTP concurs on the need and significance of adequate firefighting capabilities for the port area and appreciates the tug company intentions to improve the capabilities of the M/V TUG DON HIRAM P. Enhanced firefighting capabilities will not only serve the LNG proposal, it will increase the margin of safety for all deep draft freighters and petroleum tankers servicing the south coast area.

8.3. APPLICATION OF ZONES OF CONCERN

A. An important consideration in assessing the suitability of the proposed transit route and approaches to support LNG marine traffic, is establishing the zones of concern, associated with a large release of LNG. The criterion used to define the outer limits of Zone 1 and 2 is incident flux, i.e., thermal radiation that would be expected from an intense LNG vapor fire over a specified time period.

Zone 1: The area within 500 meters (0.3 statute mile; 0.25 nm) of an LNG carrier where a LNG spill could pose a severe public safety and property hazard and could damage or significantly disrupt key assets located within that area.

Zone 2: Is the area from 500 meters (0.3 statute mile; 0.25 nm) to 1,600 meters (1 statute mile; 0.9 nm) of an LNG carrier where an LNG spill would have less severe consequences for public safety, property, and key assets.

Zone 3: The area from 1,600 meters (1 statute mile; 0.9 nm) to 3,500 meters (2.2 statute miles; 1.9 nm)from an LNG carrier where an LNG spill would have the least likelihood of severe consequences in the event that three cargo tanks are breached and a vapor cloud disperses with initial ignition at the source. The Sandia Report defines Zone 3 further: "This zone covers LNG shipments and deliveries that occur more than approximately 750 meters from major infrastructures, population/commercial centers, or in large bays or open water, where the risks and consequences to people and property of an accidental LNG spill over water are minimal. Thermal radiation poses minimal risks to public safety and property". This definition characterizes the Aguirre Near shore GasPort location.

9. RISK ASSESSMENT AND MANAGEMENT STRATEGIES

9.1. ASSESMENT METHODOLOGY

A. The **safety** risk assessment portion of the WSA evaluated the risks of an *accidental* release of LNG from a carrier, where events may be triggered by incidents such as collisions, groundings, or spill during cargo transfer/handling, etc. Potential problems that could lead to an accidental release were considered and the likelihood and consequences of these events further evaluated. Successful mitigation measures generally fall into one of two categories: prevention and consequence management. Whereas prevention seeks to avoid an accident, consequence management seeks to reduce the negative impacts should an accident or incident occur.

B. Tetra Tech, Inc., Protective Services Group, performed and documented the risk assessments for the Aguirre Terminal. The risk assessment summarizes the risks associated with those changes and identifies current mitigation strategies.

These included:

1. The COTP's jurisdictional authority under 33 CFR Part 127, as defined in 33 CFR 127.005, is that part of a waterfront facility located between the vessel, or where the vessel moors, and the first shutoff valve on the pipeline immediately inland of the terminal manifold or loading arm.

2. The Aguirre GasPort and associated LNG carriers that serve them will comply with all applicable international treaty requirements and federal laws and regulations regarding the implementation of safety measures, and other specifically mandated requirements.

3. Only a single LNGC will be transiting to and from the Aguirre GasPort at any one time; i.e., there will be no opposing LNG traffic.

4. There will be no routine bunkering operations conducted at the terminal or anywhere along the transit route involving LNGCs.

C. The safety analysis also took into consideration historical data and informational exchanges with area stakeholders. The safety measures currently in place at the Eco-Electrica Terminal (existing LNG facility) were utilized to analyze and help mitigate the risks associated with the marine transportation of LNG. Specific questions that the safety assessments were structured to answer included:

1. What potential incidents involving an LNG carrier transiting through the proposed route would threaten members of the public, commerce, or the environment?

2. What is the likelihood and consequence of such events?

3. What additional safety measures are needed to reduce the identified risks?

D. **The Aguirre GasPort's risk-based assessment methodology suggests that the likelihood of accidental releases and/or threats of intentional interference are relatively low.** This assessment was based on the current and previous deep-draft vessel activity, the remoteness of the terminal, the substantial width and relative depth of the transit route, and population densities.

E. In consideration of the risk factors acknowledged in the Aguirre GasPort WSA, substantiated in part with the findings of the LNG working group, it's clearly apparent that it will be a sound recommendation to implement the mitigation measures stated in the WSA to effectively manage the identified navigation, safety and environmental risks associated with the project.

9.2. SAFETY RISK ASSESMENT AND SCENARIOS

A. Consistent with the guidelines contained in NVIC 01-2011, the Aguirre GasPort applied the Coast Guard's *Risk-Based Decision-Making Guidelines* to develop a comprehensive assessment strategy that adequately analyzes the safety risks that arise with the potential introduction of LNG operations into the waterway surrounding Bahía de Jobos.

B. In turn the Safety Risk Assessment was performed with the base assumption that the Offshore Gas Port will be located approximately 3 miles offshore, and LNGCs will approach the Offshore Gas Port from open water only. There is no defined waterway that will be used by LNGCs en route or departing from the Offshore GasPort, and there are no shoreline areas adjacent to the approach that will be used by LNGCs.

C. WSA's Tables 6-4 through 6-16 document the qualitative analysis of the safety related scenarios applied to each phase. For each risk based scenario, the corresponding tables provided:

1. A description of the scenario examined (*Event*, e.g., collision, allision, spill while transferring cargo, etc.);

2. The causes that would result in a scenario occurring *(Causes*, e.g., severe weather, mechanical failure, human error, breakage of mooring lines, poor communications, etc.);

9.3. PROPOSED MITIGATION MEASURES

A. To counter or reduce risks and consequences associated with the LNG operations of the Aguirre GasPort the following mitigation measures provide the most realistic and viable alternatives:

1. There are international protocols, design standards, and operational measures that promote the safe marine transportation of LNG. These include:

   a. Enhanced crew competency linked to the internationally required "Standards of Training, Certification and Watch keeping" (STCW);

   b. Higher classification society standards regarding carrier design, construction, and Flag State Control

   c. Employment of Automatic Identification System (AIS);

   d. USCG Port State Control safety-related boarding's and testing of operational and cargo systems.

2. Additionally, the WSA provided the following list of potential risks and mitigation measures:

   Risk 1: Normal marine risks associated with transit inside the 9 nm Territorial Sea
   Level of risk: Minimal
   Mitigated by:
   1. Open, deep water transit all the way to the facility;
   2. No natural hazards along the route;
   3. Low levels of marine traffic overall; and
   4. Sea condition data readily available to LNGCs and pilots from the Caribbean Regional Association (CaRA) Integrated Coastal Ocean Observing System (ICOOS).
   5. Additional needs: None.

   Risk 2: Increased level of deep draft vessel traffic
   Level of risk: Minimal
   Mitigated by:
   1. Low volume of traffic, ranging from one or two ships monthly to a peak volume of one ship per week;
   2. Offshore platform location well clear of traditional Bahía de Jobos shipping paths; and
   3. Pilots do not anticipate problems due to traffic volume or vessels size.
   4. Additional needs: None.

Risk 3: Potential for LNGC to run aground
Level of risk: Minimal
Mitigated by:

1. Water depth approaching and around the facility is approximately 60 ft, 1.5 times the maximum draft of a LNGC;
2. No submerged hazards in the region; and
3. Redundant controls and safety features minimize the potential for a LNGC to lose all propulsion and steering control and drift ashore.
4. Additional needs: None.

Risk 4: Maneuvering to and from the offshore facility
Level of risk: Minimal.
Mitigated by:

1. Maneuvering simulation study results confirm that the waterways and maneuvering area are adequate for all vessels expected to use the terminal.
2. Additional needs: None.

Risk 5: Navigation challenges presented by other traffic
Level of risk: Minimal.
Mitigated by:

1. Relatively low volumes of traffic overall;
2. Low volume of LNGC traffic; and
3. 500 yards Safety zone around FSRUs and LNGCs while underway and moored
4. Additional needs: USCG Safety zone regulation.

Risk 6: Risk of collision and potential for collision damage
Level of risk: Minimal.
Mitigated by:

1. Overall low levels of traffic;
2. Clear navigation area;
3. Safety zone around FSRUs and LNGCs while underway and moored; and
4. LNG carrier design minimizes potential for damage if a collision did occur.
5. Additional needs: None.

Risk 7: LNG carrier allision
Level of risk: Minor.
Mitigated by:

1. Redundant operating systems and pre-arrival systems checks minimize the risk of vessel control system failure; and
2. Tugs in attendance.
3. Additional needs:
    a. Pilot familiarity with FSRUs, LNGCs, and offshore facility; and
    b. Maneuvering training for pilots for tug operations at the terminal.

Risk 8: Risk of a passing vessel alliding with a moored FSRU, LNGC, or offshore berthing platform

Level of risk: Minimal.

Mitigated by:

1. Low level of traffic overall; few large vessels operate in the region;
2. Offshore berthing platform structure will be well marked;
3. FSRU and LNGCs will be highly visible; and
4. 500 yards Safety zone around FSRUs and LNGCs while underway and moored.
5. Additional needs: None.

Risk 9: Weather and sea conditions could make port entry impracticable

Level of risk: Minor.

Mitigated by:

1. Moderate wind effects can be overcome with tug assistance as demonstrated in simulation studies;
2. Pilots will determine safe operating parameters based on individual vessel handling characteristics and other factors; and
3. Risks and hazards associated with tropical storms and hurricanes will be addressed in facility operating plans and terminal and vessel emergency plans.
4. Additional needs: None.

Risk 10: Environmental risks

Level of risk: Minimal.

Mitigated by:

1. The potential for a casualty that could result in a release of a harmful pollutant (i.e. fuel oil) is very low;
2. LNGC design minimizes the potential for damage that could result in a release;
3. No environmental risks associated with LNG cargo, as the liquid is non-polluting and would evaporate quickly; and
4. Sensitive environmental areas along the LNG carrier route are primarily wetlands, sea grasses and fish habitat that are not likely to be affected by a spill of LNG onto the surface of the water.
5. Additional needs: None.

10. EMERGENCY RESPONSE PLANNING

A. As per 33 CFR 127.1307, the Aguirre GasPort owner and operator must submit the Emergency Manual to the COTP.

B. Additionally, the owner and operator are also required to submit an *Operations Manual* to the COTP as per 33 CFR 127.019.

11. RECOMMENDED RISK MITIGATION MEASURES

A. Based on the Aguirre GasPort WSA, LNG workgroup effort, and comprehensive assessment conducted of the waterway surrounding Bahía de Jobos, the COTP has determined that the following mitigation measures shall be established and maintained:

1. Inbound, loaded or partially loaded LNG carriers shall only transit the waterway during daylight hours, with daylight being interpreted, in practical terms, as being able to clearly see the horizon, shoreline and receiving berths clearly under conditions of natural light.

2. A minimum of two miles of clear visibility shall be required for the movement of LNG carrier. In marginal weather conditions visibility can vary significantly along the route; the decision as to whether sufficient visibility exists, and is likely to continue to exist for the full transit, is a judgment call that will need to be made jointly between the attending pilot(s) in consultation with, and the concurrence of, the COTP.

3. Thirty knots shall be the maximum sustained true wind speed, as measured on the LNG carrier, at which an inbound or outbound transit should be allowed to commence, and 25 knots gusting, during docking/undocking evolutions. As with visibility, significant variation in wind conditions can exist along the route, and the decision as to whether wind conditions permit a safe transit will be made by the attending pilot(s) in consultation with, and concurrence by, the COTP.

4. The Aguirre GasPort should plan and successfully conduct full mission bridge simulator training for those pilots providing services to LNG carriers. The training should take into account the full spectrum of vessel design and length, cargo carrying capacity, method of propulsion, steering and rudder configuration, thruster arrangements, and maneuvering characteristics for those carriers being considered for charter. In addition, expanded simulator training incorporating the number and design of tug boats having the minimum performance and operating criteria should be conducted.

5. The Aguirre GasPort must prepare and submit an Operations Manual, as required by 33 C.F.R. § 127.305, and an Emergency Manual, as required by 33 C.F.R. § 127.307, to the COTP for review and approval. The Operations and Emergency Manuals must be submitted at least 30 days before any transfer of LNG can take place. Comprehensive and coordinated response planning should consider:

   a. In-transit and dockside emergency procedures in the event of fire, mechanical malfunction, allision, grounding, and/or need of safe anchorage or refuge.

b. The potential environmental impact of an LNG release and the identification and acquisition of joint resource needs to respond to the potential release.
c. A contingency response plan specific to LNG and focusing on a layered response approach.
d. Coordinated marine firefighting training and emergency response, with an emphasis on containing and extinguishing LNG fires.
e. An incident management training and collaborative exercise program.

6. As per the enclosure (10) of NVIC 1-11, and prior to commencement of LNG operations, the Aguirre GasPort must provide the COTP with the following information pertaining to vessels that are reasonably anticipated to be servicing Aguirre GasPort: a) Intended LNGCs nation of registry; b) The nationality or citizenship of the officers serving on board the intended LNGCs; and c) The nationality or citizenship of the crew members serving on board the intended LNGCs.

7. Until the facility goes into operation, the Aguirre GasPort must conduct an annual review of their WSA and provide the COTP with an update that accurately reflects all changes (actual and planned), to include changes of planned LNG carrier size or load frequency, port characterization modifications, facility-related design alternations, and conditions potentially affecting cumulative considerations. The annual review cycle should coincide with the anniversary date of the LOR.

8. The Aguirre GasPort should consider providing an education program directed at personnel residing or working near the proposed operation that outlines the steps the Aguirre GasPort operators and local emergency response organizations may take in the event of an emergency, and what the public can do to contribute to their own safety if an LNG release should occur.

9. Aguirre GasPort shall provide necessary data pertaining to the depth and keel clearance of the underwater pipeline. Most significantly at any area that the pipeline approaches the vicinity of the keys, entrance to the Boca del Infierno or any other shoal areas. These areas are frequently used by local fishermen and recreational boaters. To mitigate the risk of an unintentionally grounding or anchoring, the pipeline shall be mark and updated with NOAA so that is updated with the appropriate nautical charts. Areas where the keel clearance is less than 10 feet shall also be properly marked to warn any vessel transiting in close proximity of the pipeline.

10. The USCG proposes to establish a moving 100 yards safety zone for all LNG carriers entering the surrounding areas of Bahía de Jobos while on approach and departure to the offshore terminal. The Aguirre GasPort will have a fixed 500 yards safety zone at all times. Once the LNG vessel is moored, the vessel will be part of the 500 yards safety zone regulation.

11. As described in the WSA, marine firefighting capabilities are limited in this region. In order to improve firefighting capabilities able to respond to the Aguirre GasPort and LNGC, it is highly recommended to retrofit another commercial tug boat with FiFi 1 equipment, which will provide a third viable resource to combat at sea fire emergencies. As stated in Section 8.2.B., the COTP will require at least one tug in service to any LNGC, or the FSRU, to have FiFi 1 capability at all times. Additionally, the Commonwealth should assess the availability of marine firefighting resources in this region and develop a strategic plan in cooperation with the Aguirre GasPort that addresses all potential resource shortfalls.

12. CONCLUSIONS

Based on a review and validation of the information contained in the Aguirre Offshore Gas Port WSA as per 33 CFR 127.007 and 33 CFR 127.009 respectively, and evaluation of the waterway in consultation with a variety of port stakeholders, the COTP has determined that the Bahía de Jobos transit route is suitable for the type and frequency of marine traffic associated with this proposed project.

The U. S. Coast Guard's evaluation focused on the navigation safety aspects of LNG vessel transits along the intended waterway and included analyses of safety risk methodologies and corresponding risk mitigation measures. These port management plans and risk mitigation measures are *recommended* tools intended to enhance maritime safety and effectively manage waterway priorities and mitigate safety resource shortfalls.

If the conditions of the waterway change and/or situational awareness dictate the need, the COTP may reconsider this determination. Pursuant to his authority under the Ports and Waterways Safety Act of 1972 (33 U.S.C.§1221 et.seq.), among other authorities, the COTP will continue to assess the Bahía de Jobos waterway to determine and implement controls and safeguards as necessary for the protection of the public's health, welfare and marine environment. Any orders to this effect may well be separate and apart from this LOR process.

APPENDIX C

FERC UPLAND EROSION CONTROL, REVEGETATION, AND MAINTENANCE PLAN AND WETLAND AND WATERBODY CONSTRUCTION AND MITIGATION PROCEDURES

UPLAND EROSION CONTROL, REVEGETATION, AND MAINTENANCE PLAN

UPLAND EROSION CONTROL, REVEGETATION, AND MAINTENANCE PLAN

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UPLAND EROSION CONTROL, REVEGETATION, AND MAINTENANCE PLAN (PLAN)

I. APPLICABILITY

A. The intent of this Plan is to assist project sponsors by identifying baseline mitigation measures for minimizing erosion and enhancing revegetation. Project sponsors shall specify in their applications for a new FERC authorization and in prior notice and advance notice filings, any individual measures in this Plan they consider unnecessary, technically infeasible, or unsuitable due to local conditions and fully describe any alternative measures they would use. Project sponsors shall also explain how those alternative measures would achieve a comparable level of mitigation.

Once a project is authorized, project sponsors can request further changes as variances to the measures in this Plan (or the applicant's approved plan). The Director of the Office of Energy Projects (Director) will consider approval of variances upon the project sponsor's written request, if the Director agrees that a variance:

1. provides equal or better environmental protection;

2. is necessary because a portion of this Plan is infeasible or unworkable based on project-specific conditions; or

3. is specifically required in writing by another federal, state, or Native American land management agency for the portion of the project on its land or under its jurisdiction.

Sponsors of projects planned for construction under the automatic authorization provisions in the FERC's regulations must receive written approval for any variances in advance of construction.

Project-related impacts on wetland and waterbody systems are addressed in the staff's Wetland and Waterbody Construction and Mitigation Procedures (Procedures).

II. SUPERVISION AND INSPECTION

A. ENVIRONMENTAL INSPECTION

1. At least one Environmental Inspector is required for each construction spread during construction and restoration (as defined by section V). The number and experience of Environmental Inspectors assigned to each construction spread shall be appropriate for the length of the construction spread and the number/significance of resources affected.

2. Environmental Inspectors shall have peer status with all other activity inspectors.

3. Environmental Inspectors shall have the authority to stop activities that violate the environmental conditions of the FERC's Orders, stipulations of other environmental permits or approvals, or landowner easement agreements; and to order appropriate corrective action.

B. RESPONSIBILITIES OF ENVIRONMENTAL INSPECTORS

At a minimum, the Environmental Inspector(s) shall be responsible for:

1. Inspecting construction activities for compliance with the requirements of this Plan, the Procedures, the environmental conditions of the FERC's Orders, the mitigation measures proposed by the project sponsor (as approved and/or modified by the Order), other environmental permits and approvals, and environmental requirements in landowner easement agreements.

2. Identifying, documenting, and overseeing corrective actions, as necessary to bring an activity back into compliance;

3. Verifying that the limits of authorized construction work areas and locations of access roads are visibly marked before clearing, and maintained throughout construction;

4. Verifying the location of signs and highly visible flagging marking the boundaries of sensitive resource areas, waterbodies, wetlands, or areas with special requirements along the construction work area;

5. Identifying erosion/sediment control and soil stabilization needs in all areas;

6. Ensuring that the design of slope breakers will not cause erosion or direct water into sensitive environmental resource areas, including cultural resource sites, wetlands, waterbodies, and sensitive species habitats;

7. Verifying that dewatering activities are properly monitored and do not result in the deposition of sand, silt, and/or sediment into sensitive environmental resource areas, including wetlands, waterbodies, cultural resource sites, and sensitive species habitats; stopping dewatering activities if such deposition is occurring and ensuring the design of the discharge is changed to prevent reoccurrence; and verifying that dewatering structures are removed after completion of dewatering activities;

8. Ensuring that subsoil and topsoil are tested in agricultural and residential areas to measure compaction and determine the need for corrective action;

9. Advising the Chief Construction Inspector when environmental conditions (such as wet weather or frozen soils) make it advisable to restrict or delay construction activities to avoid topsoil mixing or excessive compaction;

10. Ensuring restoration of contours and topsoil;

11. Verifying that the soils imported for agricultural or residential use are certified as free of noxious weeds and soil pests, unless otherwise approved by the landowner;

12. Ensuring that erosion control devices are properly installed to prevent sediment flow into sensitive environmental resource areas (e.g., wetlands, waterbodies, cultural resource sites, and sensitive species habitats) and onto roads, and determining the need for additional erosion control devices;

13. Inspecting and ensuring the maintenance of temporary erosion control measures at least:

    a. on a daily basis in areas of active construction or equipment operation;

    b. on a weekly basis in areas with no construction or equipment operation; and

    c. within 24 hours of each 0.5 inch of rainfall;

14. Ensuring the repair of all ineffective temporary erosion control measures within 24 hours of identification, or as soon as conditions allow if compliance with this time frame would result in greater environmental impacts;

15. Keeping records of compliance with the environmental conditions of the FERC's Orders, and the mitigation measures proposed by the project sponsor in the application submitted to the FERC, and other federal or state environmental permits during active construction and restoration;

16. Identifying areas that should be given special attention to ensure stabilization and restoration after the construction phase; and

17. Verifying that locations for any disposal of excess construction materials for beneficial reuse comply with section III.E.

III. PRECONSTRUCTION PLANNING

The project sponsor shall do the following before construction:

A. CONSTRUCTION WORK AREAS

1. Identify all construction work areas (e.g., construction right-of-way, extra work space areas, pipe storage and contractor yards, borrow and disposal areas, access roads) that would be needed for safe construction. The project sponsor must ensure that appropriate cultural resources and biological surveys are conducted, as determined necessary by the appropriate federal and state agencies.

2. Project sponsors are encouraged to consider expanding any required cultural resources and endangered species surveys in anticipation of the need for activities outside of authorized work areas.

3. Plan construction sequencing to limit the amount and duration of open trench sections, as necessary, to prevent excessive erosion or sediment flow into sensitive environmental resource areas.

B. DRAIN TILE AND IRRIGATION SYSTEMS

1. Attempt to locate existing drain tiles and irrigation systems.

2. Contact landowners and local soil conservation authorities to determine the locations of future drain tiles that are likely to be installed within 3 years of the authorized construction.

3. Develop procedures for constructing through drain-tiled areas, maintaining irrigation systems during construction, and repairing drain tiles and irrigation systems after construction.

4. Engage qualified drain tile specialists, as needed to conduct or monitor repairs to drain tile systems affected by construction. Use drain tile specialists from the project area, if available.

C. GRAZING DEFERMENT

Develop grazing deferment plans with willing landowners, grazing permittees, and land management agencies to minimize grazing disturbance of revegetation efforts.

D. ROAD CROSSINGS AND ACCESS POINTS

Plan for safe and accessible conditions at all roadway crossings and access points during construction and restoration.

E. DISPOSAL PLANNING

Determine methods and locations for the regular collection, containment, and disposal of excess construction materials and debris (e.g., timber, slash, mats, garbage, drill cuttings and fluids, excess rock) throughout the construction process. Disposal of materials for beneficial reuse must not result in adverse environmental impact and is subject to compliance with all applicable survey, landowner or land management agency approval, and permit requirements.

F. AGENCY COORDINATION

The project sponsor must coordinate with the appropriate local, state, and federal agencies as outlined in this Plan and/or required by the FERC's Orders.

1. Obtain written recommendations from the local soil conservation authorities or land management agencies regarding permanent erosion control and revegetation specifications.

2. Develop specific procedures in coordination with the appropriate agencies to prevent the introduction or spread of invasive species, noxious weeds, and soil pests resulting from construction and restoration activities.

3. Develop specific procedures in coordination with the appropriate agencies and landowners, as necessary, to allow for livestock and wildlife movement and protection during construction.

4. Develop specific blasting procedures in coordination with the appropriate agencies that address pre- and post-blast inspections; advanced public notification; and mitigation measures for building foundations, groundwater wells, and springs. Use appropriate methods (e.g., blasting mats) to prevent damage to nearby structures and to prevent debris from entering sensitive environmental resource areas.

G. SPILL PREVENTION AND RESPONSE PROCEDURES

The project sponsor shall develop project-specific Spill Prevention and Response Procedures, as specified in section IV of the staff's Procedures. A copy must be filed with the Secretary of the FERC (Secretary) prior to construction and made available in the field on each construction spread. The filing requirement does not apply to projects constructed under the automatic authorization provisions in the FERC's regulations.

H. RESIDENTIAL CONSTRUCTION

For all properties with residences located within 50 feet of construction work areas, project sponsors shall: avoid removal of mature trees and landscaping within the construction work area unless necessary for safe operation of construction equipment, or as specified in landowner agreements; fence the edge of the construction work area for a distance of 100 feet on either side of the residence; and restore all lawn areas and landscaping immediately following clean up operations, or as specified in landowner agreements. If seasonal or other weather conditions prevent compliance with these time frames, maintain and monitor temporary erosion controls (sediment barriers and mulch) until conditions allow completion of restoration.

I. WINTER CONSTRUCTION PLANS

If construction is planned to occur during winter weather conditions, project sponsors shall develop and file a project-specific winter construction plan with the FERC application. This filing requirement does not apply to projects constructed under the automatic authorization provisions of the FERC's regulations.

The plan shall address:

1. winter construction procedures (e.g., snow handling and removal, access road construction and maintenance, soil handling under saturated or frozen conditions, topsoil stripping);

2. stabilization and monitoring procedures if ground conditions will delay restoration until the following spring (e.g., mulching and erosion controls, inspection and reporting, stormwater control during spring thaw conditions); and

3. final restoration procedures (e.g., subsidence and compaction repair, topsoil replacement, seeding).

IV. INSTALLATION

A. APPROVED AREAS OF DISTURBANCE

1. Project-related ground disturbance shall be limited to the construction right-of-way, extra work space areas, pipe storage yards, borrow and disposal areas, access roads, and other areas approved in the FERC's Orders. Any project-related ground disturbing activities outside these areas will require prior Director approval. This requirement does not apply to activities needed to comply with the Plan and Procedures (i.e., slope breakers, energy-dissipating devices, dewatering structures, drain tile system repairs) or minor field realignments and workspace shifts per landowner needs and requirements that do not affect other landowners or sensitive environmental resource areas. All construction or restoration activities outside of authorized areas are subject to all applicable survey and permit requirements, and landowner easement agreements.

2. The construction right-of-way width for a project shall not exceed 75 feet or that described in the FERC application unless otherwise modified by a FERC Order. However, in limited, non-wetland areas, this construction right-of-way width may be expanded by up to 25 feet without Director approval to accommodate full construction right-of-way topsoil segregation and to ensure safe construction where topographic conditions (e.g., side-slopes) or soil limitations require it. Twenty-five feet of extra construction right-of-way width may also be used in limited, non-wetland or non-forested areas for truck turn-arounds where no reasonable alternative access exists.

   Project use of these additional limited areas is subject to landowner or land management agency approval and compliance with all applicable survey and permit requirements. When additional areas are used, each one shall be identified and the need explained in the weekly or biweekly construction reports to the FERC, if required. The following material shall be included in the reports:

   a. the location of each additional area by station number and reference to previously filed alignment sheets, or updated alignment sheets showing the additional areas;

   b. identification of the filing at FERC containing evidence that the additional areas were previously surveyed; and

c. a statement that landowner approval has been obtained and is available in project files.

Prior written approval of the Director is required when the authorized construction right-of-way width would be expanded by more than 25 feet.

B. TOPSOIL SEGREGATION

1. Unless the landowner or land management agency specifically approves otherwise, prevent the mixing of topsoil with subsoil by stripping topsoil from either the full work area or from the trench and subsoil storage area (ditch plus spoil side method) in:

   a. cultivated or rotated croplands, and managed pastures;

   b. residential areas;

   c. hayfields; and

   d. other areas at the landowner's or land managing agency's request.

2. In residential areas, importation of topsoil is an acceptable alternative to topsoil segregation.

3. Where topsoil segregation is required, the project sponsor must:

   a. segregate at least 12 inches of topsoil in deep soils (more than 12 inches of topsoil); and

   b. make every effort to segregate the entire topsoil layer in soils with less than 12 inches of topsoil.

4. Maintain separation of salvaged topsoil and subsoil throughout all construction activities.

5. Segregated topsoil may not be used for padding the pipe, constructing temporary slope breakers or trench plugs, improving or maintaining roads, or as a fill material.

6. Stabilize topsoil piles and minimize loss due to wind and water erosion with use of sediment barriers, mulch, temporary seeding, tackifiers, or functional equivalents, where necessary.

C. DRAIN TILES

1. Mark locations of drain tiles damaged during construction.

2. Probe all drainage tile systems within the area of disturbance to check for damage.

3. Repair damaged drain tiles to their original or better condition. Do not use filter-covered drain tiles unless the local soil conservation authorities and the landowner agree. Use qualified specialists for testing and repairs.

4. For new pipelines in areas where drain tiles exist or are planned, ensure that the depth of cover over the pipeline is sufficient to avoid interference with drain tile systems. For adjacent pipeline loops in agricultural areas, install the new pipeline with at least the same depth of cover as the existing pipeline(s).

D. IRRIGATION

Maintain water flow in crop irrigation systems, unless shutoff is coordinated with affected parties.

E. ROAD CROSSINGS AND ACCESS POINTS

1. Maintain safe and accessible conditions at all road crossings and access points during construction.

2. If crushed stone access pads are used in residential or agricultural areas, place the stone on synthetic fabric to facilitate removal.

3. Minimize the use of tracked equipment on public roadways. Remove any soil or gravel spilled or tracked onto roadways daily or more frequent as necessary to maintain safe road conditions. Repair any damages to roadway surfaces, shoulders, and bar ditches.

F. TEMPORARY EROSION CONTROL

Install temporary erosion controls immediately after initial disturbance of the soil. Temporary erosion controls must be properly maintained throughout construction (on a daily basis) and reinstalled as necessary (such as after backfilling of the trench) until replaced by permanent erosion controls or restoration is complete.

1. Temporary Slope Breakers

   a. Temporary slope breakers are intended to reduce runoff velocity and divert water off the construction right-of-way. Temporary slope breakers may be constructed of materials such as soil, silt fence, staked hay or straw bales, or sand bags.

b. Install temporary slope breakers on all disturbed areas, as necessary to avoid excessive erosion. Temporary slope breakers must be installed on slopes greater than 5 percent where the base of the slope is less than 50 feet from waterbody, wetland, and road crossings at the following spacing (closer spacing shall be used if necessary):

Slope (%)	Spacing (feet)
5 - 15	300
>15 - 30	200
>30	100

c. Direct the outfall of each temporary slope breaker to a stable, well vegetated area or construct an energy-dissipating device at the end of the slope breaker and off the construction right-of-way.

d. Position the outfall of each temporary slope breaker to prevent sediment discharge into wetlands, waterbodies, or other sensitive environmental resource areas.

2. Temporary Trench Plugs

Temporary trench plugs are intended to segment a continuous open trench prior to backfill.

a. Temporary trench plugs may consist of unexcavated portions of the trench, compacted subsoil, sandbags, or some functional equivalent.

b. Position temporary trench plugs, as necessary, to reduce trenchline erosion and minimize the volume and velocity of trench water flow at the base of slopes.

3. Sediment Barriers

Sediment barriers are intended to stop the flow of sediments and to prevent the deposition of sediments beyond approved workspaces or into sensitive resources.

a. Sediment barriers may be constructed of materials such as silt fence, staked hay or straw bales, compacted earth (e.g., driveable berms across travelways), sand bags, or other appropriate materials.

b. At a minimum, install and maintain temporary sediment barriers across the entire construction right-of-way at the base of slopes greater than 5 percent where the base of the slope is less than 50 feet from a waterbody, wetland, or road crossing until revegetation is successful as defined in this Plan. Leave adequate room between the base of the slope and the sediment barrier to accommodate ponding of water and sediment deposition.

c. Where wetlands or waterbodies are adjacent to and downslope of construction work areas, install sediment barriers along the edge of these areas, as necessary to prevent sediment flow into the wetland or waterbody.

4. Mulch

a. Apply mulch on all slopes (except in cultivated cropland) concurrent with or immediately after seeding, where necessary to stabilize the soil surface and to reduce wind and water erosion. Spread mulch uniformly over the area to cover at least 75 percent of the ground surface at a rate of 2 tons/acre of straw or its equivalent, unless the local soil conservation authority, landowner, or land managing agency approves otherwise in writing.

b. Mulch can consist of weed-free straw or hay, wood fiber hydromulch, erosion control fabric, or some functional equivalent.

c. Mulch all disturbed upland areas (except cultivated cropland) before seeding if:

(1) final grading and installation of permanent erosion control measures will not be completed in an area within 20 days after the trench in that area is backfilled (10 days in residential areas), as required in section V.A.1; or

(2) construction or restoration activity is interrupted for extended periods, such as when seeding cannot be completed due to seeding period restrictions.

d. If mulching before seeding, increase mulch application on all slopes within 100 feet of waterbodies and wetlands to a rate of 3 tons/acre of straw or equivalent.

e. If wood chips are used as mulch, do not use more than 1 ton/acre and add the equivalent of 11 lbs/acre available nitrogen (at least 50 percent of which is slow release).

f. Ensure that mulch is adequately anchored to minimize loss due to wind and water.

g. When anchoring with liquid mulch binders, use rates recommended by the manufacturer. Do not use liquid mulch binders within 100 feet of wetlands or waterbodies, except where the product is certified environmentally non-toxic by the appropriate state or federal agency or independent standards-setting organization.

h. Do not use synthetic monofilament mesh/netted erosion control materials in areas designated as sensitive wildlife habitat, unless the product is specifically designed to minimize harm to wildlife. Anchor erosion control fabric with staples or other appropriate devices.

V. RESTORATION

A. CLEANUP

1. Commence cleanup operations immediately following backfill operations. Complete final grading, topsoil replacement, and installation of permanent erosion control structures within 20 days after backfilling the trench (10 days in residential areas). If seasonal or other weather conditions prevent compliance with these time frames, maintain temporary erosion controls (i.e., temporary slope breakers, sediment barriers, and mulch) until conditions allow completion of cleanup.

   If construction or restoration unexpectedly continues into the winter season when conditions could delay successful decompaction, topsoil replacement, or seeding until the following spring, file with the Secretary for the review and written approval of the Director, a winter construction plan (as specified in section III.I). This filing requirement does not apply to projects constructed under the automatic authorization provisions of the FERC's regulations.

2. A travel lane may be left open temporarily to allow access by construction traffic if the temporary erosion control structures are installed as specified in section IV.F. and inspected and maintained as specified in sections II.B.12 through 14. When access is no longer required the travel lane must be removed and the right-of-way restored.

3. Rock excavated from the trench may be used to backfill the trench only to the top of the existing bedrock profile. Rock that is not returned to the trench shall be considered construction debris, unless approved for use as mulch or for some other use on the construction work areas by the landowner or land managing agency.

4. Remove excess rock from at least the top 12 inches of soil in all cultivated or rotated cropland, managed pastures, hayfields, and residential areas, as well as other areas at the landowner's request. The size, density, and distribution of rock on the construction work area shall be similar to adjacent areas not disturbed by construction. The landowner or land management agency may approve other provisions in writing.

5. Grade the construction right-of-way to restore pre-construction contours and leave the soil in the proper condition for planting.

6. Remove construction debris from all construction work areas unless the landowner or land managing agency approves leaving materials onsite for beneficial reuse, stabilization, or habitat restoration.

7. Remove temporary sediment barriers when replaced by permanent erosion control measures or when revegetation is successful.

B. PERMANENT EROSION CONTROL DEVICES

1. Trench Breakers

   a. Trench breakers are intended to slow the flow of subsurface water along the trench. Trench breakers may be constructed of materials such as sand bags or polyurethane foam. Do not use topsoil in trench breakers.

   b. An engineer or similarly qualified professional shall determine the need for and spacing of trench breakers. Otherwise, trench breakers shall be installed at the same spacing as and upslope of permanent slope breakers.

   c. In agricultural fields and residential areas where slope breakers are not typically required, install trench breakers at the same spacing as if permanent slope breakers were required.

   d. At a minimum, install a trench breaker at the base of slopes greater than 5 percent where the base of the slope is less than 50 feet from a waterbody or wetland and where needed to avoid draining a waterbody or wetland. Install trench breakers at wetland boundaries, as specified in the Procedures. Do not install trench breakers within a wetland.

2. Permanent Slope Breakers

a. Permanent slope breakers are intended to reduce runoff velocity, divert water off the construction right-of-way, and prevent sediment deposition into sensitive resources. Permanent slope breakers may be constructed of materials such as soil, stone, or some functional equivalent.

b. Construct and maintain permanent slope breakers in all areas, except cultivated areas and lawns, unless requested by the landowner, using spacing recommendations obtained from the local soil conservation authority or land managing agency.

In the absence of written recommendations, use the following spacing unless closer spacing is necessary to avoid excessive erosion on the construction right-of-way:

Slope (%)	Spacing (feet)
5 - 15	300
>15 - 30	200
>30	100

c. Construct slope breakers to divert surface flow to a stable area without causing water to pool or erode behind the breaker. In the absence of a stable area, construct appropriate energy-dissipating devices at the end of the breaker.

d. Slope breakers may extend slightly (about 4 feet) beyond the edge of the construction right-of-way to effectively drain water off the disturbed area. Where slope breakers extend beyond the edge of the construction right-of-way, they are subject to compliance with all applicable survey requirements.

C. SOIL COMPACTION MITIGATION

1. Test topsoil and subsoil for compaction at regular intervals in agricultural and residential areas disturbed by construction activities. Conduct tests on the same soil type under similar moisture conditions in undisturbed areas to approximate preconstruction conditions. Use penetrometers or other appropriate devices to conduct tests.

2. Plow severely compacted agricultural areas with a paraplow or other deep tillage implement. In areas where topsoil has been segregated, plow the subsoil before replacing the segregated topsoil.

If subsequent construction and cleanup activities result in further compaction, conduct additional tilling.

3. Perform appropriate soil compaction mitigation in severely compacted residential areas.

D. REVEGETATION

1. General

a. The project sponsor is responsible for ensuring successful revegetation of soils disturbed by project-related activities, except as noted in section V.D.1.b.

b. Restore all turf, ornamental shrubs, and specialized landscaping in accordance with the landowner's request, or compensate the landowner. Restoration work must be performed by personnel familiar with local horticultural and turf establishment practices.

2. Soil Additives

Fertilize and add soil pH modifiers in accordance with written recommendations obtained from the local soil conservation authority, land management agencies, or landowner. Incorporate recommended soil pH modifier and fertilizer into the top 2 inches of soil as soon as practicable after application.

3. Seeding Requirements

a. Prepare a seedbed in disturbed areas to a depth of 3 to 4 inches using appropriate equipment to provide a firm seedbed. When hydroseeding, scarify the seedbed to facilitate lodging and germination of seed.

b. Seed disturbed areas in accordance with written recommendations for seed mixes, rates, and dates obtained from the local soil conservation authority or the request of the landowner or land management agency. Seeding is not required in cultivated croplands unless requested by the landowner.

c. Perform seeding of permanent vegetation within the recommended seeding dates. If seeding cannot be done within those dates, use appropriate temporary erosion control measures discussed in section IV.F and perform seeding of permanent vegetation at the beginning of the next recommended seeding season. Dormant seeding or temporary seeding of annual species may also be used, if necessary, to establish cover, as approved by the Environmental Inspector. Lawns may be seeded on a schedule established with the landowner.

d. In the absence of written recommendations from the local soil conservation authorities, seed all disturbed soils within 6 working days of final grading, weather and soil conditions permitting, subject to the specifications in section V.D.3.a through V.D.3.c.

e. Base seeding rates on Pure Live Seed. Use seed within 12 months of seed testing.

f. Treat legume seed with an inoculant specific to the species using the manufacturer’s recommended rate of inoculant appropriate for the seeding method (broadcast, drill, or hydro).

g. In the absence of written recommendations from the local soil conservation authorities, landowner, or land managing agency to the contrary, a seed drill equipped with a cultipacker is preferred for seed application.

Broadcast or hydroseeding can be used in lieu of drilling at double the recommended seeding rates. Where seed is broadcast, firm the seedbed with a cultipacker or roller after seeding. In rocky soils or where site conditions may limit the effectiveness of this equipment, other alternatives may be appropriate (e.g., use of a chain drag) to lightly cover seed after application, as approved by the Environmental Inspector.

VI. OFF-ROAD VEHICLE CONTROL

To each owner or manager of forested lands, offer to install and maintain measures to control unauthorized vehicle access to the right-of-way. These measures may include:

A. signs;

B. fences with locking gates;

C. slash and timber barriers, pipe barriers, or a line of boulders across the right-of-way; and

D. conifers or other appropriate trees or shrubs across the right-of-way.

VII. POST-CONSTRUCTION ACTIVITIES AND REPORTING

A. MONITORING AND MAINTENANCE

1. Conduct follow-up inspections of all disturbed areas, as necessary, to determine the success of revegetation and address landowner concerns. At a minimum, conduct inspections after the first and second growing seasons.

2. Revegetation in non-agricultural areas shall be considered successful if upon visual survey the density and cover of non-nuisance vegetation are similar in density and cover to adjacent undisturbed lands. In agricultural areas, revegetation shall be considered successful when upon visual survey, crop growth and vigor are similar to adjacent undisturbed portions of the same field, unless the easement agreement specifies otherwise.

   Continue revegetation efforts until revegetation is successful.

3. Monitor and correct problems with drainage and irrigation systems resulting from pipeline construction in agricultural areas until restoration is successful.

4. Restoration shall be considered successful if the right-of-way surface condition is similar to adjacent undisturbed lands, construction debris is removed (unless otherwise approved by the landowner or land managing agency per section V.A.6), revegetation is successful, and proper drainage has been restored.

5. Routine vegetation mowing or clearing over the full width of the permanent right-of-way in uplands shall not be done more frequently than every 3 years. However, to facilitate periodic corrosion/leak surveys, a corridor not exceeding 10 feet in width centered on the pipeline may be cleared at a frequency necessary to maintain the 10-foot corridor in an herbaceous state. In no case shall routine vegetation mowing or clearing occur during the migratory bird nesting season between April 15 and August 1 of any year unless specifically approved in writing by the responsible land management agency or the U.S. Fish and Wildlife Service.

6. Efforts to control unauthorized off-road vehicle use, in cooperation with the landowner, shall continue throughout the life of the project. Maintain signs, gates, and permanent access roads as necessary.

B. REPORTING

1. The project sponsor shall maintain records that identify by milepost:

   a. method of application, application rate, and type of fertilizer, pH modifying agent, seed, and mulch used;

   b. acreage treated;

   c. dates of backfilling and seeding;

   d. names of landowners requesting special seeding treatment and a description of the follow-up actions;

   e. the location of any subsurface drainage repairs or improvements made during restoration; and

   f. any problem areas and how they were addressed.

2. The project sponsor shall file with the Secretary quarterly activity reports documenting the results of follow-up inspections required by section VII.A.1; any problem areas, including those identified by the landowner; and corrective actions taken for at least 2 years following construction.

   The requirement to file quarterly activity reports with the Secretary does not apply to projects constructed under the automatic authorization, prior notice, or advanced notice provisions in the FERC's regulations.

WETLAND AND WATERBODY CONSTRUCTION AND MITIGATION PROCEDURES

WETLAND AND WATERBODY CONSTRUCTION AND MITIGATION PROCEDURES

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WETLAND AND WATERBODY
CONSTRUCTION AND MITIGATION PROCEDURES (PROCEDURES)

I. APPLICABILITY

A. The intent of these Procedures is to assist project sponsors by identifying baseline mitigation measures for minimizing the extent and duration of project-related disturbance on wetlands and waterbodies. Project sponsors shall specify in their applications for a new FERC authorization, and in prior notice and advance notice filings, any individual measures in these Procedures they consider unnecessary, technically infeasible, or unsuitable due to local conditions and fully describe any alternative measures they would use. Project sponsors shall also explain how those alternative measures would achieve a comparable level of mitigation.

Once a project is authorized, project sponsors can request further changes as variances to the measures in these Procedures (or the applicant's approved procedures). The Director of the Office of Energy Projects (Director) will consider approval of variances upon the project sponsor's written request, if the Director agrees that a variance:

1. provides equal or better environmental protection;

2. is necessary because a portion of these Procedures is infeasible or unworkable based on project-specific conditions; or

3. is specifically required in writing by another federal, state, or Native American land management agency for the portion of the project on its land or under its jurisdiction.

Sponsors of projects planned for construction under the automatic authorization provisions in the FERC's regulations must receive written approval for any variances in advance of construction.

Project-related impacts on non-wetland areas are addressed in the staff's Upland Erosion Control, Revegetation, and Maintenance Plan (Plan).

B. DEFINITIONS

1. "Waterbody" includes any natural or artificial stream, river, or drainage with perceptible flow at the time of crossing, and other permanent waterbodies such as ponds and lakes:

   a. "minor waterbody" includes all waterbodies less than or equal to 10 feet wide at the water's edge at the time of crossing;

   b. "intermediate waterbody" includes all waterbodies greater than 10 feet wide but less than or equal to 100 feet wide at the water's edge at the time of crossing; and

   c. "major waterbody" includes all waterbodies greater than 100 feet wide at the water's edge at the time of crossing.

2. "Wetland" includes any area that is not in actively cultivated or rotated cropland and that satisfies the requirements of the current federal methodology for identifying and delineating wetlands.

II. PRECONSTRUCTION FILING

A. The following information must be filed with the Secretary of the FERC (Secretary) prior to the beginning of construction, for the review and written approval by the Director:

1. site-specific justifications for extra work areas that would be closer than 50 feet from a waterbody or wetland; and

2. site-specific justifications for the use of a construction right-of-way greater than 75-feet-wide in wetlands.

B. The following information must be filed with the Secretary prior to the beginning of construction. These filing requirements do not apply to projects constructed under the automatic authorization provisions in the FERC's regulations:

1. Spill Prevention and Response Procedures specified in section IV.A;

2. a schedule identifying when trenching or blasting will occur within each waterbody greater than 10 feet wide, within any designated coldwater fishery, and within any waterbody identified as habitat for federally-listed threatened or endangered species. The project sponsor will revise the schedule as necessary to provide FERC staff at least 14 days advance notice. Changes within this last 14-day period must provide for at least 48 hours advance notice;

3. plans for horizontal directional drills (HDD) under wetlands or waterbodies, specified in section V.B.6.d;

4. site-specific plans for major waterbody crossings, described in section V.B.9;

5. a wetland delineation report as described in section VI.A.1, if applicable; and

6. the hydrostatic testing information specified in section VII.B.3.

III. ENVIRONMENTAL INSPECTORS

A. At least one Environmental Inspector having knowledge of the wetland and waterbody conditions in the project area is required for each construction spread. The number and experience of Environmental Inspectors assigned to each construction spread shall be appropriate for the length of the construction spread and the number/significance of resources affected.

B. The Environmental Inspector's responsibilities are outlined in the Upland Erosion Control, Revegetation, and Maintenance Plan (Plan).

IV. PRECONSTRUCTION PLANNING

A. The project sponsor shall develop project-specific Spill Prevention and Response Procedures that meet applicable requirements of state and federal agencies. A copy must be filed with the Secretary prior to construction and made available in the field on each construction spread. This filing requirement does not apply to projects constructed under the automatic authorization provisions in the FERC's regulations.

1. It shall be the responsibility of the project sponsor and its contractors to structure their operations in a manner that reduces the risk of spills or the accidental exposure of fuels or hazardous materials to waterbodies or wetlands. The project sponsor and its contractors must, at a minimum, ensure that:

a. all employees handling fuels and other hazardous materials are properly trained;

b. all equipment is in good operating order and inspected on a regular basis;

c. fuel trucks transporting fuel to on-site equipment travel only on approved access roads;

d. all equipment is parked overnight and/or fueled at least 100 feet from a waterbody or in an upland area at least 100 feet from a wetland boundary. These activities can occur closer only if the Environmental Inspector determines that there is no reasonable alternative, and the project sponsor and its contractors have taken appropriate steps (including secondary containment structures) to prevent spills and provide for prompt cleanup in the event of a spill;

e. hazardous materials, including chemicals, fuels, and lubricating oils, are not stored within 100 feet of a wetland, waterbody, or designated municipal watershed area, unless the location is designated for such use by an appropriate governmental authority. This applies to storage of these materials and does not apply to normal operation or use of equipment in these areas;

f. concrete coating activities are not performed within 100 feet of a wetland or waterbody boundary, unless the location is an existing industrial site designated for such use. These activities can occur closer only if the Environmental Inspector determines that there is no reasonable alternative, and the project sponsor and its contractors have taken appropriate steps (including secondary containment structures) to prevent spills and provide for prompt cleanup in the event of a spill;

g. pumps operating within 100 feet of a waterbody or wetland boundary utilize appropriate secondary containment systems to prevent spills; and

h. bulk storage of hazardous materials, including chemicals, fuels, and lubricating oils have appropriate secondary containment systems to prevent spills.

2. The project sponsor and its contractors must structure their operations in a manner that provides for the prompt and effective cleanup of spills of fuel and other hazardous materials. At a minimum, the project sponsor and its contractors must:

a. ensure that each construction crew (including cleanup crews) has on hand sufficient supplies of absorbent and barrier materials to allow the rapid containment and recovery of spilled materials and knows the procedure for reporting spills and unanticipated discoveries of contamination;

b. ensure that each construction crew has on hand sufficient tools and material to stop leaks;

c. know the contact names and telephone numbers for all local, state, and federal agencies (including, if necessary, the U. S. Coast Guard and the National Response Center) that must be notified of a spill; and

d. follow the requirements of those agencies in cleaning up the spill, in excavating and disposing of soils or other materials contaminated by a spill, and in collecting and disposing of waste generated during spill cleanup.

B. AGENCY COORDINATION

The project sponsor must coordinate with the appropriate local, state, and federal agencies as outlined in these Procedures and in the FERC's Orders.

V. <u>WATERBODY CROSSINGS</u>

A. NOTIFICATION PROCEDURES AND PERMITS

1. Apply to the U.S. Army Corps of Engineers (COE), or its delegated agency, for the appropriate wetland and waterbody crossing permits.

2. Provide written notification to authorities responsible for potable surface water supply intakes located within 3 miles downstream of the crossing at least 1 week before beginning work in the waterbody, or as otherwise specified by that authority.

3. Apply for state-issued waterbody crossing permits and obtain individual or generic section 401 water quality certification or waiver.

4. Notify appropriate federal and state authorities at least 48 hours before beginning trenching or blasting within the waterbody, or as specified in applicable permits.

B. INSTALLATION

1. Time Window for Construction

Unless expressly permitted or further restricted by the appropriate federal or state agency in writing on a site-specific basis, instream work, except that required to install or remove equipment bridges, must occur during the following time windows:

a. coldwater fisheries - June 1 through September 30; and

b. coolwater and warmwater fisheries - June 1 through November 30.

2. Extra Work Areas

a. Locate all extra work areas (such as staging areas and additional spoil storage areas) at least 50 feet away from water's edge, except where the adjacent upland consists of cultivated or rotated cropland or other disturbed land.

b. The project sponsor shall file with the Secretary for review and written approval by the Director, site-specific justification for each extra work area with a less than 50-foot setback from the water's edge, except where the adjacent upland consists of cultivated or rotated cropland or other disturbed land. The justification must specify the conditions that will not permit a 50-foot setback and measures to ensure the waterbody is adequately protected.

c. Limit the size of extra work areas to the minimum needed to construct the waterbody crossing.

3. General Crossing Procedures

a. Comply with the COE, or its delegated agency, permit terms and conditions.

b. Construct crossings as close to perpendicular to the axis of the waterbody channel as engineering and routing conditions permit.

c. Where pipelines parallel a waterbody, maintain at least 15 feet of undisturbed vegetation between the waterbody (and any adjacent wetland) and the construction right-of-way, except where maintaining this offset will result in greater environmental impact.

d. Where waterbodies meander or have multiple channels, route the pipeline to minimize the number of waterbody crossings.

e. Maintain adequate waterbody flow rates to protect aquatic life, and prevent the interruption of existing downstream uses.

f. Waterbody buffers (e.g., extra work area setbacks, refueling restrictions) must be clearly marked in the field with signs and/or highly visible flagging until construction-related ground disturbing activities are complete.

g. Crossing of waterbodies when they are dry or frozen and not flowing may proceed using standard upland construction techniques in accordance with the Plan, provided that the Environmental Inspector verifies that water is unlikely to flow between initial disturbance and final stabilization of the feature. In the event of perceptible flow, the project sponsor must comply with all applicable Procedure requirements for "waterbodies" as defined in section I.B.1.

4. Spoil Pile Placement and Control

a. All spoil from minor and intermediate waterbody crossings, and upland spoil from major waterbody crossings, must be placed in the construction right-of-way at least 10 feet from the water's edge or in additional extra work areas as described in section V.B.2.

b. Use sediment barriers to prevent the flow of spoil or silt-laden water into any waterbody.

5. Equipment Bridges

a. Only clearing equipment and equipment necessary for installation of equipment bridges may cross waterbodies prior to bridge installation. Limit the number of such crossings of each waterbody to one per piece of clearing equipment.

b. Construct and maintain equipment bridges to allow unrestricted flow and to prevent soil from entering the waterbody. Examples of such bridges include:

(1) equipment pads and culvert(s);
(2) equipment pads or railroad car bridges without culverts;
(3) clean rock fill and culvert(s); and
(4) flexi-float or portable bridges.

Additional options for equipment bridges may be utilized that achieve the performance objectives noted above. Do not use soil to construct or stabilize equipment bridges.

c. Design and maintain each equipment bridge to withstand and pass the highest flow expected to occur while the bridge is in place. Align culverts to prevent bank erosion or streambed scour. If necessary, install energy dissipating devices downstream of the culverts.

d. Design and maintain equipment bridges to prevent soil from entering the waterbody.

e. Remove temporary equipment bridges as soon as practicable after permanent seeding.

f. If there will be more than 1 month between final cleanup and the beginning of permanent seeding and reasonable alternative access to the right-of-way is available, remove temporary equipment bridges as soon as practicable after final cleanup.

g. Obtain any necessary approval from the COE, or the appropriate state agency for permanent bridges.

6. Dry-Ditch Crossing Methods

a. Unless approved otherwise by the appropriate federal or state agency, install the pipeline using one of the dry-ditch methods outlined below for crossings of waterbodies up to 30 feet wide (at the water's edge at the time of construction) that are state-designated as either coldwater or significant coolwater or warmwater fisheries, or federally-designated as critical habitat.

b. Dam and Pump

(1) The dam-and-pump method may be used without prior approval for crossings of waterbodies where pumps can adequately transfer streamflow volumes around the work area, and there are no concerns about sensitive species passage.

(2) Implementation of the dam-and-pump crossing method must meet the following performance criteria:

(i) use sufficient pumps, including on-site backup pumps, to maintain downstream flows;
(ii) construct dams with materials that prevent sediment and other pollutants from entering the waterbody (e.g., sandbags or clean gravel with plastic liner);
(iii) screen pump intakes to minimize entrainment of fish;
(iv) prevent streambed scour at pump discharge; and
(v) continuously monitor the dam and pumps to ensure proper operation throughout the waterbody crossing.

c. Flume Crossing

The flume crossing method requires implementation of the following steps:

(1) install flume pipe after blasting (if necessary), but before any trenching;

(2) use sand bag or sand bag and plastic sheeting diversion structure or equivalent to develop an effective seal and to divert stream flow through the flume pipe (some modifications to the stream bottom may be required to achieve an effective seal);

(3) properly align flume pipe(s) to prevent bank erosion and streambed scour;

(4) do not remove flume pipe during trenching, pipelaying, or backfilling activities, or initial streambed restoration efforts; and

(5) remove all flume pipes and dams that are not also part of the equipment bridge as soon as final cleanup of the stream bed and bank is complete.

d. Horizontal Directional Drill

For each waterbody or wetland that would be crossed using the HDD method, file with the Secretary for the review and written approval by the Director, a plan that includes:

(1) site-specific construction diagrams that show the location of mud pits, pipe assembly areas, and all areas to be disturbed or cleared for construction;

(2) justification that disturbed areas are limited to the minimum needed to construct the crossing;

(3) identification of any aboveground disturbance or clearing between the HDD entry and exit workspaces during construction;

(4) a description of how an inadvertent release of drilling mud would be contained and cleaned up; and

(5) a contingency plan for crossing the waterbody or wetland in the event the HDD is unsuccessful and how the abandoned drill hole would be sealed, if necessary.

The requirement to file HDD plans does not apply to projects constructed under the automatic authorization provisions in the FERC's regulations.

7. Crossings of Minor Waterbodies

Where a dry-ditch crossing is not required, minor waterbodies may be crossed using the open-cut crossing method, with the following restrictions:

a. except for blasting and other rock breaking measures, complete instream construction activities (including trenching, pipe installation, backfill, and restoration of the streambed contours) within 24 hours.

Streambanks and unconsolidated streambeds may require additional restoration after this period;

b. limit use of equipment operating in the waterbody to that needed to construct the crossing; and

c. equipment bridges are not required at minor waterbodies that do not have a state-designated fishery classification or protected status (e.g., agricultural or intermittent drainage ditches). However, if an equipment bridge is used it must be constructed as described in section V.B.5.

8. Crossings of Intermediate Waterbodies

Where a dry-ditch crossing is not required, intermediate waterbodies may be crossed using the open-cut crossing method, with the following restrictions:

a. complete instream construction activities (not including blasting and other rock breaking measures) within 48 hours, unless site-specific conditions make completion within 48 hours infeasible;

b. limit use of equipment operating in the waterbody to that needed to construct the crossing; and

c. all other construction equipment must cross on an equipment bridge as specified in section V.B.5.

9. Crossings of Major Waterbodies

Before construction, the project sponsor shall file with the Secretary for the review and written approval by the Director a detailed, site-specific construction plan and scaled drawings identifying all areas to be disturbed by construction for each major waterbody crossing (the scaled drawings are not required for any offshore portions of pipeline projects). This plan must be developed in consultation with the appropriate state and federal agencies and shall include extra work areas, spoil storage areas, sediment control structures, etc., as well as mitigation for navigational issues. The requirement to file major waterbody crossing plans does not apply to projects constructed under the automatic authorization provisions of the FERC's regulations.

The Environmental Inspector may adjust the final placement of the erosion and sediment control structures in the field to maximize effectiveness.

10. Temporary Erosion and Sediment Control

Install sediment barriers (as defined in section IV.F.3.a of the Plan) immediately after initial disturbance of the waterbody or adjacent upland.

Sediment barriers must be properly maintained throughout construction and reinstalled as necessary (such as after backfilling of the trench) until replaced by permanent erosion controls or restoration of adjacent upland areas is complete. Temporary erosion and sediment control measures are addressed in more detail in the Plan; however, the following specific measures must be implemented at stream crossings:

a. install sediment barriers across the entire construction right-of-way at all waterbody crossings, where necessary to prevent the flow of sediments into the waterbody. Removable sediment barriers (or driveable berms) must be installed across the travel lane. These removable sediment barriers can be removed during the construction day, but must be re-installed after construction has stopped for the day and/or when heavy precipitation is imminent;

b. where waterbodies are adjacent to the construction right-of-way and the right-of-way slopes toward the waterbody, install sediment barriers along the edge of the construction right-of-way as necessary to contain spoil within the construction right-of-way and prevent sediment flow into the waterbody; and

c. use temporary trench plugs at all waterbody crossings, as necessary, to prevent diversion of water into upland portions of the pipeline trench and to keep any accumulated trench water out of the waterbody.

11. Trench Dewatering

Dewater the trench (either on or off the construction right-of-way) in a manner that does not cause erosion and does not result in silt-laden water flowing into any waterbody. Remove the dewatering structures as soon as practicable after the completion of dewatering activities.

C. RESTORATION

1. Use clean gravel or native cobbles for the upper 1 foot of trench backfill in all waterbodies that contain coldwater fisheries.

2. For open-cut crossings, stabilize waterbody banks and install temporary sediment barriers within 24 hours of completing instream construction activities. For dry-ditch crossings, complete streambed and bank stabilization before returning flow to the waterbody channel.

3. Return all waterbody banks to preconstruction contours or to a stable angle of repose as approved by the Environmental Inspector.

4. Install erosion control fabric or a functional equivalent on waterbody banks at the time of final bank recontouring. Do not use synthetic monofilament

mesh/netted erosion control materials in areas designated as sensitive wildlife habitat unless the product is specifically designed to minimize harm to wildlife. Anchor erosion control fabric with staples or other appropriate devices.

5. Application of riprap for bank stabilization must comply with COE, or its delegated agency, permit terms and conditions.

6. Unless otherwise specified by state permit, limit the use of riprap to areas where flow conditions preclude effective vegetative stabilization techniques such as seeding and erosion control fabric.

7. Revegetate disturbed riparian areas with native species of conservation grasses, legumes, and woody species, similar in density to adjacent undisturbed lands.

8. Install a permanent slope breaker across the construction right-of-way at the base of slopes greater than 5 percent that are less than 50 feet from the waterbody, or as needed to prevent sediment transport into the waterbody. In addition, install sediment barriers as outlined in the Plan.

   In some areas, with the approval of the Environmental Inspector, an earthen berm may be suitable as a sediment barrier adjacent to the waterbody.

9. Sections V.C.3 through V.C.7 above also apply to those perennial or intermittent streams not flowing at the time of construction.

D. POST-CONSTRUCTION MAINTENANCE

1. Limit routine vegetation mowing or clearing adjacent to waterbodies to allow a riparian strip at least 25 feet wide, as measured from the waterbody's mean high water mark, to permanently revegetate with native plant species across the entire construction right-of-way. However, to facilitate periodic corrosion/leak surveys, a corridor centered on the pipeline and up to 10 feet wide may be cleared at a frequency necessary to maintain the 10-foot corridor in an herbaceous state. In addition, trees that are located within 15 feet of the pipeline that have roots that could compromise the integrity of the pipeline coating may be cut and removed from the permanent right-of-way. Do not conduct any routine vegetation mowing or clearing in riparian areas that are between HDD entry and exit points.

2. Do not use herbicides or pesticides in or within 100 feet of a waterbody except as allowed by the appropriate land management or state agency.

3. Time of year restrictions specified in section VII.A.5 of the Plan (April 15 – August 1 of any year) apply to routine mowing and clearing of riparian areas.

VI. WETLAND CROSSINGS

A. GENERAL

1. The project sponsor shall conduct a wetland delineation using the current federal methodology and file a wetland delineation report with the Secretary before construction. The requirement to file a wetland delineation report does not apply to projects constructed under the automatic authorization provisions in the FERC's regulations.

   This report shall identify:

   a. by milepost all wetlands that would be affected;

   b. the National Wetlands Inventory (NWI) classification for each wetland;

   c. the crossing length of each wetland in feet; and

   d. the area of permanent and temporary disturbance that would occur in each wetland by NWI classification type.

   The requirements outlined in this section do not apply to wetlands in actively cultivated or rotated cropland. Standard upland protective measures, including workspace and topsoiling requirements, apply to these agricultural wetlands.

2. Route the pipeline to avoid wetland areas to the maximum extent possible. If a wetland cannot be avoided or crossed by following an existing right-of-way, route the new pipeline in a manner that minimizes disturbance to wetlands. Where looping an existing pipeline, overlap the existing pipeline right-of-way with the new construction right-of-way. In addition, locate the loop line no more than 25 feet away from the existing pipeline unless site-specific constraints would adversely affect the stability of the existing pipeline.

3. Limit the width of the construction right-of-way to 75 feet or less. Prior written approval of the Director is required where topographic conditions or soil limitations require that the construction right-of-way width within the boundaries of a federally delineated wetland be expanded beyond 75 feet. Early in the planning process the project sponsor is encouraged to identify site-specific areas where excessively wide trenches could occur and/or where spoil piles could be difficult to maintain because existing soils lack adequate unconfined compressive strength.

4. Wetland boundaries and buffers must be clearly marked in the field with signs and/or highly visible flagging until construction-related ground disturbing activities are complete.

5. Implement the measures of sections V and VI in the event a waterbody crossing is located within or adjacent to a wetland crossing. If all measures of sections V and VI cannot be met, the project sponsor must file with the Secretary a site-specific crossing plan for review and written approval by the Director before construction. This crossing plan shall address at a minimum:

   a. spoil control;

   b. equipment bridges;

   c. restoration of waterbody banks and wetland hydrology;

   d. timing of the waterbody crossing;

   e. method of crossing; and

   f. size and location of all extra work areas.

6. Do not locate aboveground facilities in any wetland, except where the location of such facilities outside of wetlands would prohibit compliance with U.S. Department of Transportation regulations.

B. INSTALLATION

1. Extra Work Areas and Access Roads

   a. Locate all extra work areas (such as staging areas and additional spoil storage areas) at least 50 feet away from wetland boundaries, except where the adjacent upland consists of cultivated or rotated cropland or other disturbed land.

   b. The project sponsor shall file with the Secretary for review and written approval by the Director, site-specific justification for each extra work area with a less than 50-foot setback from wetland boundaries, except where adjacent upland consists of cultivated or rotated cropland or other disturbed land. The justification must specify the site-specific conditions that will not permit a 50-foot setback and measures to ensure the wetland is adequately protected.

   c. The construction right-of-way may be used for access when the wetland soil is firm enough to avoid rutting or the construction right-of-way has been appropriately stabilized to avoid rutting (e.g., with timber riprap, prefabricated equipment mats, or terra mats).

      In wetlands that cannot be appropriately stabilized, all construction equipment other than that needed to install the wetland crossing shall use access roads located in upland areas. Where access roads in upland areas do not provide reasonable access, limit all other construction equipment to one pass through the wetland using the construction right-of-way.

d. The only access roads, other than the construction right-of-way, that can be used in wetlands are those existing roads that can be used with no modifications or improvements, other than routine repair, and no impact on the wetland.

2. Crossing Procedures

a. Comply with COE, or its delegated agency, permit terms and conditions.

b. Assemble the pipeline in an upland area unless the wetland is dry enough to adequately support skids and pipe.

c. Use “push-pull” or “float” techniques to place the pipe in the trench where water and other site conditions allow.

d. Minimize the length of time that topsoil is segregated and the trench is open. Do not trench the wetland until the pipeline is assembled and ready for lowering in.

e. Limit construction equipment operating in wetland areas to that needed to clear the construction right-of-way, dig the trench, fabricate and install the pipeline, backfill the trench, and restore the construction right-of-way.

f. Cut vegetation just above ground level, leaving existing root systems in place, and remove it from the wetland for disposal.

The project sponsor can burn woody debris in wetlands, if approved by the COE and in accordance with state and local regulations, ensuring that all remaining woody debris is removed for disposal.

g. Limit pulling of tree stumps and grading activities to directly over the trenchline. Do not grade or remove stumps or root systems from the rest of the construction right-of-way in wetlands unless the Chief Inspector and Environmental Inspector determine that safety-related construction constraints require grading or the removal of tree stumps from under the working side of the construction right-of-way.

h. Segregate the top 1 foot of topsoil from the area disturbed by trenching, except in areas where standing water is present or soils are saturated. Immediately after backfilling is complete, restore the segregated topsoil to its original location.

i. Do not use rock, soil imported from outside the wetland, tree stumps, or brush riprap to support equipment on the construction right-of-way.

j. If standing water or saturated soils are present, or if construction equipment causes ruts or mixing of the topsoil and subsoil in wetlands, use low-ground-weight construction equipment, or operate normal equipment on timber riprap, prefabricated equipment mats, or terra mats.

k. Remove all project-related material used to support equipment on the construction right-of-way upon completion of construction.

3. Temporary Sediment Control

Install sediment barriers (as defined in section IV.F.3.a of the Plan) immediately after initial disturbance of the wetland or adjacent upland. Sediment barriers must be properly maintained throughout construction and reinstalled as necessary (such as after backfilling of the trench). Except as noted below in section VI.B.3.c, maintain sediment barriers until replaced by permanent erosion controls or restoration of adjacent upland areas is complete. Temporary erosion and sediment control measures are addressed in more detail in the Plan.

a. Install sediment barriers across the entire construction right-of-way immediately upslope of the wetland boundary at all wetland crossings where necessary to prevent sediment flow into the wetland.

b. Where wetlands are adjacent to the construction right-of-way and the right-of-way slopes toward the wetland, install sediment barriers along the edge of the construction right-of-way as necessary to contain spoil within the construction right-of-way and prevent sediment flow into the wetland.

c. Install sediment barriers along the edge of the construction right-of-way as necessary to contain spoil and sediment within the construction right-of-way through wetlands. Remove these sediment barriers during right-of-way cleanup.

4. Trench Dewatering

Dewater the trench (either on or off the construction right-of-way) in a manner that does not cause erosion and does not result in silt-laden water flowing into any wetland. Remove the dewatering structures as soon as practicable after the completion of dewatering activities.

C. RESTORATION

1. Where the pipeline trench may drain a wetland, construct trench breakers at the wetland boundaries and/or seal the trench bottom as necessary to maintain the original wetland hydrology.

2. Restore pre-construction wetland contours to maintain the original wetland hydrology.

3. For each wetland crossed, install a trench breaker at the base of slopes near the boundary between the wetland and adjacent upland areas. Install a permanent slope breaker across the construction right-of-way at the base of slopes greater than 5 percent where the base of the slope is less than 50 feet from the wetland, or as needed to prevent sediment transport into the wetland. In addition, install sediment barriers as outlined in the Plan. In some areas, with the approval of the Environmental Inspector, an earthen berm may be suitable as a sediment barrier adjacent to the wetland.

4. Do not use fertilizer, lime, or mulch unless required in writing by the appropriate federal or state agency.

5. Consult with the appropriate federal or state agencies to develop a project-specific wetland restoration plan. The restoration plan shall include measures for re-establishing herbaceous and/or woody species, controlling the invasion and spread of invasive species and noxious weeds (e.g., purple loosestrife and phragmites), and monitoring the success of the revegetation and weed control efforts. Provide this plan to the FERC staff upon request.

6. Until a project-specific wetland restoration plan is developed and/or implemented, temporarily revegetate the construction right-of-way with annual ryegrass at a rate of 40 pounds/acre (unless standing water is present).

7. Ensure that all disturbed areas successfully revegetate with wetland herbaceous and/or woody plant species.

8. Remove temporary sediment barriers located at the boundary between wetland and adjacent upland areas after revegetation and stabilization of adjacent upland areas are judged to be successful as specified in section VII.A.4 of the Plan.

D. POST-CONSTRUCTION MAINTENANCE AND REPORTING

1. Do not conduct routine vegetation mowing or clearing over the full width of the permanent right-of-way in wetlands. However, to facilitate periodic corrosion/leak surveys, a corridor centered on the pipeline and up to 10 feet wide may be cleared at a frequency necessary to maintain the 10-foot corridor in an herbaceous state. In addition, trees within 15 feet of the pipeline with roots that could compromise the integrity of pipeline coating may be selectively cut and removed from the permanent right-of-way. Do not conduct any routine vegetation mowing or clearing in wetlands that are between HDD entry and exit points.

2. Do not use herbicides or pesticides in or within 100 feet of a wetland, except as allowed by the appropriate federal or state agency.

3. Time of year restrictions specified in section VII.A.5 of the Plan (April 15 – August 1 of any year) apply to routine mowing and clearing of wetland areas.

4. Monitor and record the success of wetland revegetation annually until wetland revegetation is successful.

5. Wetland revegetation shall be considered successful if all of the following criteria are satisfied:

   a. the affected wetland satisfies the current federal definition for a wetland (i.e., soils, hydrology, and vegetation);

   b. vegetation is at least 80 percent of either the cover documented for the wetland prior to construction, or at least 80 percent of the cover in adjacent wetland areas that were not disturbed by construction;

   c. if natural rather than active revegetation was used, the plant species composition is consistent with early successional wetland plant communities in the affected ecoregion; and

   d. invasive species and noxious weeds are absent, unless they are abundant in adjacent areas that were not disturbed by construction.

6. Within 3 years after construction, file a report with the Secretary identifying the status of the wetland revegetation efforts and documenting success as defined in section VI.D.5, above. The requirement to file wetland restoration reports with the Secretary does not apply to projects constructed under the automatic authorization, prior notice, or advance notice provisions in the FERC's regulations.

   For any wetland where revegetation is not successful at the end of 3 years after construction, develop and implement (in consultation with a professional wetland ecologist) a remedial revegetation plan to actively revegetate wetlands. Continue revegetation efforts and file a report annually documenting progress in these wetlands until wetland revegetation is successful.

VII. HYDROSTATIC TESTING

A. NOTIFICATION PROCEDURES AND PERMITS

1. Apply for state-issued water withdrawal permits, as required.

2. Apply for National Pollutant Discharge Elimination System (NPDES) or state-issued discharge permits, as required.

3. Notify appropriate state agencies of intent to use specific sources at least 48 hours before testing activities unless they waive this requirement in writing.

B. GENERAL

1. Perform 100 percent radiographic inspection of all pipeline section welds or hydrotest the pipeline sections, before installation under waterbodies or wetlands.

2. If pumps used for hydrostatic testing are within 100 feet of any waterbody or wetland, address secondary containment and refueling of these pumps in the project's Spill Prevention and Response Procedures.

3. The project sponsor shall file with the Secretary before construction a list identifying the location of all waterbodies proposed for use as a hydrostatic test water source or discharge location. This filing requirement does not apply to projects constructed under the automatic authorization provisions of the FERC's regulations.

C. INTAKE SOURCE AND RATE

1. Screen the intake hose to minimize the potential for entrainment of fish.

2. Do not use state-designated exceptional value waters, waterbodies which provide habitat for federally listed threatened or endangered species, or waterbodies designated as public water supplies, unless appropriate federal, state, and/or local permitting agencies grant written permission.

3. Maintain adequate flow rates to protect aquatic life, provide for all waterbody uses, and provide for downstream withdrawals of water by existing users.

4. Locate hydrostatic test manifolds outside wetlands and riparian areas to the maximum extent practicable.

D. DISCHARGE LOCATION, METHOD, AND RATE

1. Regulate discharge rate, use energy dissipation device(s), and install sediment barriers, as necessary, to prevent erosion, streambed scour, suspension of sediments, or excessive streamflow.

2. Do not discharge into state-designated exceptional value waters, waterbodies which provide habitat for federally listed threatened or endangered species, or waterbodies designated as public water supplies, unless appropriate federal, state, and local permitting agencies grant written permission.

APPENDIX D

BIOLOGICAL ASSESSMENT

Biological Assessment

Aguirre Offshore GasPort Project

Docket No. CP13-193-000

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

August 2014

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LIST OF ACRONYMS

Aguirre LLC	Aguirre Offshore GasPort, LLC
Aguirre Plant	Aguirre Power Plant Complex
BA	Biological Assessment
cm	centimeter
dB	decibel
DNER	Puerto Rico Department of Natural and Environmental Resources
ESA	Endangered Species Act
EEZ	Exclusive Economic Zone
FERC	Federal Energy Regulatory Commission
FSRU	Floating Storage and Regasification Unit
FWS	U.S. Fish and Wildlife Service
HDD	horizontal directional drilling
IUCN	International Union for Conservation of Nature
km	kilometer
LNG	liquefied natural gas
MMO	marine mammal operator
m	meter
m^3	cubic meter
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
PREPA	Puerto Rico Electric Power Authority
Project	Aguirre Offshore GasPort Project
Tetra Tech, Inc.	Tetra Tech

1.0 INTRODUCTION

1.1 PROPOSED ACTION

On April 17, 2013, Aguirre Offshore GasPort, LLC (Aguirre LLC), a wholly owned subsidiary of Excelerate Energy, LP filed an application with the Federal Energy Regulatory Commission (FERC) under Section 3 of the Natural Gas Act and Part 153 of the FERC's regulations. The application was assigned Docket No. CP13-193-000 and a Notice of Application was issued on April 30, 2013 and noticed in the Federal Register on May 6, 2013. Aguirre LLC is seeking authorization from the FERC to develop, construct, and operate a liquefied natural gas (LNG) import terminal off the southern coast of Puerto Rico. Aguirre LLC's proposal, referred to as the Aguirre Offshore GasPort Project (Project), is being developed in cooperation with the Puerto Rico Electric Power Authority (PREPA) for the purpose of receiving, storing, and regasifying the LNG to be acquired by PREPA, and delivering natural gas to PREPA's existing Aguirre Power Plant Complex (Aguirre Plant) in Salinas, Puerto Rico. The proposed Project is discussed in more detail in section 2.0.

1.2 PURPOSE OF THE BIOLOGICAL ASSESSMENT

Federal agencies are required by Section 7 of the Endangered Species Act (ESA, 19 USC § 1536(c)), as amended, to ensure that any actions authorized, funded, or carried out by the agency do not jeopardize the continued existence of a federally listed endangered or threatened species, or result in the destruction or adverse modification of the designated critical habitat of a federally listed species. The action agencies are required to consult with the U.S. Fish and Wildlife Service (FWS) and/or the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) to determine whether federally listed endangered or threatened species or designated critical habitat are found in the vicinity of the proposed project, and to determine the proposed action's 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 federal agency must prepare a Biological Assessment (BA) for those species that may be affected. The action agency must submit its BA to the FWS and/or NMFS and, if it is determined that the action would likely adversely affect a listed species, the federal agency must submit a request for formal consultation to comply with Section 7 of the ESA. 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. To ensure that impacts on ESA-listed species are addressed, we have recommended in section 4.6 of the draft environmental impact statement (EIS) that Aguirre LLC not begin construction until our formal consultation is completed

We have identified 23 federally listed threatened or endangered species, 10 species proposed for ESA listing, and 3 candidate species as occurring or potentially occurring in the Project area. Section 7 of the ESA only applies to federally listed or proposed species; therefore, the three candidate species are not included in this BA. The project is located within critical habitat for two federally listed coral species. Due to the distance of their primary habitat from the Project area it was determined that the Project would have *no effect* on nine of the listed species. Justification for these no effect determinations is provided in table 1.2-1. Therefore, these species were not assessed in this BA. The remaining species are summarized in table 1.2-2 and discussed in more detail in section 3.0.

TABLE 1.2-1

Justification for Determinations of No Effect on Federally Listed Species for the Aguirre Offshore GasPort Project Area

Common Name *Scientific Name*	Habitat Description and Project Assessment
Reptiles	
Puerto Rican boa *Epicrates inornatus*	Species occurs in moist and wet forest, woodland and shrub land mangrove, mature dry forest, and dry forest near waterbodies. No potential habitat is present in the Project Area.
Birds	
Puerto Rican broad-winged hawk *Buteo platypterus brunnescens*	Species occurs in subtropical wet forests and subtropical rain forests habitat types. May occur as a transient in the vicinity of the Project, but is not expected to utilize the Project area for foraging, nesting, or breeding.
Puerto Rican nightjar *Caprimulgus noctitherus*	Species occurs in forested areas in southern Puerto Rico. The Puerto Rican nightjar was documented approximately 3 miles northeast of the Project area, where the closest suitable habitat is located. However, there is no potential habitat is present in the Project area.
Puerto Rican plain pigeon *Columba inornata wetmorei*	Habitat generalist; nest, forage, and roost in trees near roads, breed in mature forests near water bodies. No potential habitat is present in the Project area.
Puerto Rican sharp-shinned hawk *Accipiter striatus venator*	Species occurs in subtropical wet forests habitat types. May occur as a transient in the vicinity of the Project, but is not expected to utilize the Project area for foraging, nesting, or breeding.
Amphibians	
Golden Coqui *Eleutherodactylus jasper*	Species occurs in forested mountains over 2,300 feet (700 meters) in elevation. No potential habitat is present in the Project area.
Plants	
Erubia *Solanum drymophilum*	Habitat includes evergreen forests on volcanic soils at elevations above 1,000 feet (305 meters). Population limited to Tetas de Cayey in the Sierra de Cayey in Central Puerto Rico. No potential habitat is present in the Project area.
Cobana Negra *Stahlia monosperma*	Species habitat includes uplands near brackish and seasonally flooded mangrove wetlands, mainly in northeast and southwest Puerto Rico. No potential habitat is present in the Project area.
Palo de ramon *Banara vaderbiltii*	Species habitat includes northwest limestone hills and central mountains of Puerto Rico in elevations above 300 feet (92 meters). No potential habitat is present in the Project area.

Sources: FWS, 2010 and 2011a

TABLE 1.2-2

Federally Listed and Proposed Species Potentially Affected by the Aguirre Offshore GasPort Project

Common Name	Scientific Name	Federal Status [a]	Areas Crossed by the Project Where Species May Occur [b]
Marine Mammals			
Antillean Manatee	*Trichechus manatus manatus*	E	Jobos Bay, Offshore
Blue whale	*Balaenoptera musculus*	E	Offshore
Fin whale	*Balaenoptera physalus*	E	Offshore
Humpback whale	*Megaptera novaenglia*	E	Offshore
Sei whale	*Balaenoptera borealis*	E	Offshore
Sperm whale	*Physeter macrocephalus*	E	Offshore
Reptiles			
Green sea turtle	*Chelonia mydas*	T, CH	Jobos Bay and Offshore
Hawksbill sea turtle	*Eretmochelys imbricate*	E, CH	Jobos Bay and Offshore
Leatherback sea turtle	*Dermochelys coriacea*	E, CH	Jobos Bay and Offshore
Loggerhead sea turtle	*Caretta caretta*	T	Jobos Bay and Offshore
Birds			
Piping plover	*Charadrius melodus*	T	Jobos Bay
Yellow-shouldered blackbird	*Agelaius xanthomus*	E, CH	Uplands
Rufa Red Knot	*Calidris canutus rufa*	PE	Jobos Bay and Offshore
Fishes			
Dwarf seahorse	*Hippocampus zosterae*	PE	Jobos Bay
Scalloped hammerhead shark	*Sphyrna lewini*	PT	Jobos Bay and Offshore
Invertebrates			
Boulder star coral	*Montastraea annularis*	PE	Jobos Bay and Offshore
Elkhorn coral	*Acropora palmata*	T/PE, CH [c]	Jobos Bay and Offshore
Elliptical star coral	*Dichocoenia stokesii*	PT	Jobos Bay and Offshore
Lamarck's sheet coral	*Agaricia lamarcki*	PT	Jobos Bay and Offshore
Mountainous star coral	*Montastraea faveolata*	PE	Jobos Bay and Offshore
Pillar coral	*Dendrogyra cylindrus*	PE	Jobos Bay and Offshore
Rough cactus coral	*Mycetophyllia ferox*	PE	Jobos Bay and Offshore
Staghorn coral	*Acropora cervicornis*	T/PE, CH [c]	Jobos Bay and Offshore
Star coral	*Montastraea franksi*	PE	Jobos Bay and Offshore

Sources: NMFS, FWS, Puerto Rico Department of Natural and Environmental Resources.

[a] E = Endangered, T = Threatened, PE = Proposed for Endangered Status, PT = Proposed for Threatened Status, CH = Critical Habitat

[b] Offshore refers to the area south of Jobos Bay (beyond the barrier islands).

[c] Critical habitat for this species is designated within the project area.

2.0 DESCRIPTION OF THE PROPOSED PROJECT

2.1 GENERAL DESCRIPTION

The Project would consist of an offshore terminal platform, an offshore marine LNG receiving facility consisting of a Floating Storage and Regasification Unit (FSRU) moored at the offshore terminal, and a subsea pipeline linking the receiving facility to PREPA's existing onshore Aguirre Plant. Aguirre LLC would construct the LNG terminal approximately 3 miles (4.8 kilometers [km]) off the southern coast of Puerto Rico, about 1 mile outside of Jobos Bay, near the towns of Salinas and Guayama. Aguirre LLC is also proposing to utilize a construction office, contractor staging area, and existing pier within the Aguirre Plant property.

The offshore terminal would be a fixed platform carrying topside facilities and two berths, one on each side of the fixed platform. Aguirre LLC would design the platform for long-term mooring of an FSRU and for receipt of LNG carriers ranging in size from 163,500 to 283,800 cubic yards (125,000 to 217,000 cubic meters [m^3]). The FSRU would moor at a berth on the north (landward) side of the platform, and the LNG carriers would temporarily dock on the south (seaward) side of the platform while unloading LNG cargo. LNG cargo would transfer from the LNG carrier from conventional LNG loading arms and cryogenic piping to the FSRU for storage.

The subsea interconnecting pipeline would extend approximately 4.1 miles (6.6 km) from the offshore terminal in the Caribbean Sea, northward through the Boca del Infierno inlet, and across the basin of Jobos Bay to the Aguirre Plant property where it would interconnect with existing plant piping. The subsea interconnecting pipeline would consist of an 18-inch-diameter (46 centimeter [cm]) steel pipe with a maximum allowable operating pressure of 1,450 pounds per square inch (9,997 kilopascals). Prior to shipment of the pipe to the Project site, the manufacturer would coat the pipe with concrete for an outside diameter of approximately 24 inches (61 cm). The pipeline segments would be fabricated on shallow water pipe lay barges then laid directly on the seafloor. A general Project location map is shown in figure 2.1-1. For a more detailed description, please see section 2.1 of the draft EIS issued in August 2014.

2.2 LAND REQUIREMENTS

As discussed above, Aguirre LLC would construct the majority of the Project facilities offshore, including the offshore terminal and subsea pipeline. The construction of these facilities would require approximately 156.7 acres (161.4 cuerdas) at the water surface and would directly impact 116.9 acres (120.4 cuerdas) of the seafloor. Approximately 25.3 acres (26.1 cuerdas) of seafloor would be permanently impacted by the operation of the offshore facilities. In addition, Aguirre LLC would impact about 1.5 acres (1.5 cuerdas) of land within the existing Aguirre Plant property for a temporary staging and support area where the subsea pipeline would reach landfall.

2.3 ACTION AREA

The action area (as defined in Section 7(a)(2) of the ESA) considered in this BA includes all areas of the Project: the offshore terminal site, subsea pipeline route, and onshore staging and support area. Areas beyond the footprint of the Project elements that could be affected by Project activities (i.e., construction activities causing sediments to be transported outside the Project area) were also considered part of the action area. Although the specific LNG carrier transit routes are unknown, LNG carrier transit within the exclusive economic zone (EEZ) on the southern side of Puerto Rico was also considered part of the action area. However, it is important to note that the FERC holds no regulatory authority over LNG carriers.

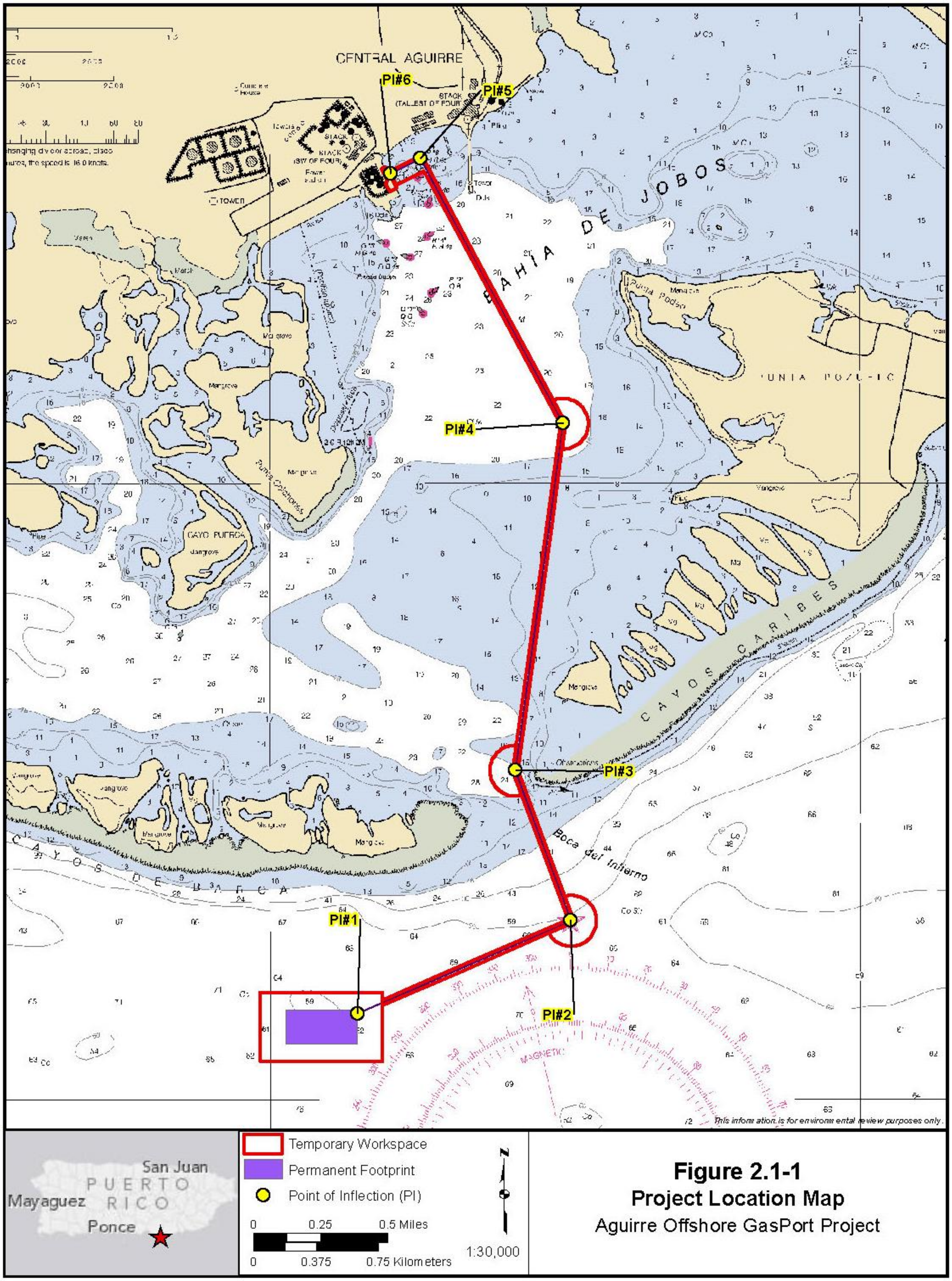

Figure 2.1-1
Project Location Map
Aguirre Offshore GasPort Project

2.4 FIELD SURVEYS CONDUCTED FOR THE PROJECT

Aguirre LLC conducted field surveys of the Project area to document the resources in Jobos Bay and the associated offshore waters of the proposed terminal. These surveys included:

- Baseline Benthic Characterization (Tetra Tech, Inc. [Tetra Tech], 2012)
  - Surveys were conducted in late April and early May 2012 and examined the proposed pipeline route and offshore terminal site.
  - Surveys included the characterization and mapping of coral reef habitat, seagrass beds, and other benthic habitat types.
- Marine Mammal and Sea Turtle Survey (Tetra Tech, 2013c)
  - Surveys were conducted in late April and early May 2012 and examined the proposed pipeline route and offshore terminal site.
  - Surveys documented the presence of ESA-listed marine mammals and sea turtles.
- ESA Coral Mapping and Demography (Tetra Tech, 2014b)
  - Surveys were conducted in November 2013 and examined the portion of the Project area within and offshore of Boca del Infierno pass.
  - Surveys included the identification and mapping of ESA-listed and proposed coral species and detailed mapping of seagrass beds and macroalgae.
  - Surveys also documented the presence of ESA-listed marine mammals and sea turtles.

Aguirre LLC also conducted four seasonal ichthyoplankton net sampling events proximate to the offshore terminal (Tetra Tech, 2013a; 2013d; 2013e; 2014c).

3.0 ESA SPECIES DESCRIPTION

The following sections provide a description of the endangered, threatened, and proposed species that could be affected by the Project; the results of surveys conducted by Aguirre LLC; our analysis of the potential impacts resulting from construction and operation of the Project; specific measures to avoid, minimize, and mitigate adverse effects on the species and habitats in the Project area; and our determination of effects on each ESA-listed or proposed species.

3.1 ANTILLEAN MANATEE

Background

The manatee is an herbivorous marine mammal most commonly found in coastal estuaries and rivers. There are three species worldwide, but only the West Indian manatee (*Trichechus manatus*) can be found in U.S. waters. The West Indian manatee is divided into two subspecies: the Antillean manatee (*Trichechus manatus manatus*) and the Florida manatee (*Trichechus manatus latirostris*). The West Indian manatee and its subspecies are listed as endangered under the ESA and depleted under the Marine Mammal Protection Act of 1972. Global protection of the Antillean manatee is provided by the International Union for Conservation of Nature (IUCN), which lists it as endangered (Self-Sullivan and Mignucci-Giannoni, 2008).

The Florida manatee is restricted to the coast of Florida during the winter months then travels north along the Atlantic coast (highest abundance in Georgia; as far north as Rhode Island) and west along the Gulf coast states (to Texas) from March to November, (Deutsch et al., 2008). Therefore, the Florida manatee is not expected to occur in the Project area.

Antillean manatees inhabit coastal areas of eastern Mexico and Central America, northern and eastern South America, and in the Greater Antilles (FWS, 2009b). The Antillean manatee population in Puerto Rico has been recorded in protected areas such as cays, bays, and shallow seagrass beds east of San Juan; and along the east, south, and southwest coasts where freshwater sources are available. However, Antillean manatees are most abundant and consistently found along the southern and eastern coasts, specifically in the Jobos Bay area and Roosevelt Roads Naval Station, Ceiba, which is approximately 45 miles (72 km) northeast of the Project area (FWS, 2009b; Field et al., 2003).

In 2008, the IUCN estimated the Antillean manatee subspecies population to be approximately 4,100 individuals. This population is projected to decline by 20 percent over the next 40 years (Deutsch et al., 2008). The decline is predicted to occur as a result of non-effective conservation actions from current and projected anthropogenic threats (Self-Sullivan and Mignucci-Giannoni, 2008). In 2009, the population in Puerto Rico was determined to be either stable or slightly increasing (FWS, 2009b), with Jobos Bay having the second largest Antillean manatee population in Puerto Rico (Field et al., 2003). The FWS estimates that the Antillean manatee population in Puerto Rico consists of 142 individuals (FWS, 2013a).

Manatees preferred habitat consists of protected shallow waters, some fresh water sources, and seagrass beds. They are known to congregate near warm water outflows associated with anthropogenic sources. Manatees feed on seagrasses and occasionally on other marine plants including green algae, mangroves, and water hyacinth (FWS, 2007). Manatees tagged around Puerto Rico showed both resident and transient patterns; some individuals were documented to move very little within the estuary in which they were tagged, while others traveled among estuaries along the southern coast (FWS, 2007). Breeding and calving occurs throughout the year and individuals live to 50 or 60 years of age (FWS, 1986).

Field Survey Results

Three Antillean manatees were observed over seagrass beds near Boca del Infierno pass during Aguirre LLC's marine mammal surveys in April/May 2012 (Tetra Tech, 2013c). One Antillean manatee was observed offshore of Boca del Infierno pass during Aguirre LLC's coral mapping in November 2013 (Tetra Tech, 2014b).

Potential Impacts

Principal stressors that could directly affect Antillean manatees include vessel strike and impedance of normal foraging, traveling, resting, mating, and nursing activities. These activities may be disrupted by the physical presence of vessels and equipment, temporary disruption of the seafloor habitat, and vibration and noise during construction activities that may cause manatees to temporarily avoid the Project area. During operation, LNG and tug vessels could encounter manatees within the offshore terminal area. Additionally, operational noise at the offshore berthing area could impact manatees.

Indirect effects to the Antillean manatee are also expected as a result of temporary and permanent loss of foraging habitat (e.g., seagrass beds). Construction activities such as vessel anchoring, pipe laying, and pile driving have the potential to impact seagrass and other benthic habitat types by direct disturbance of the seafloor, and the resuspension, transport, and redeposition of bottom sediments. Operational impacts would include the permanent alteration of the seafloor within the footprint of the pipeline and pilings at the offshore terminal and the shading associated with the terminal facilities. The potential impacts on benthic habitat types in the Project area are summarized in table 3.1-1 and illustrated on figure 3.3-1.

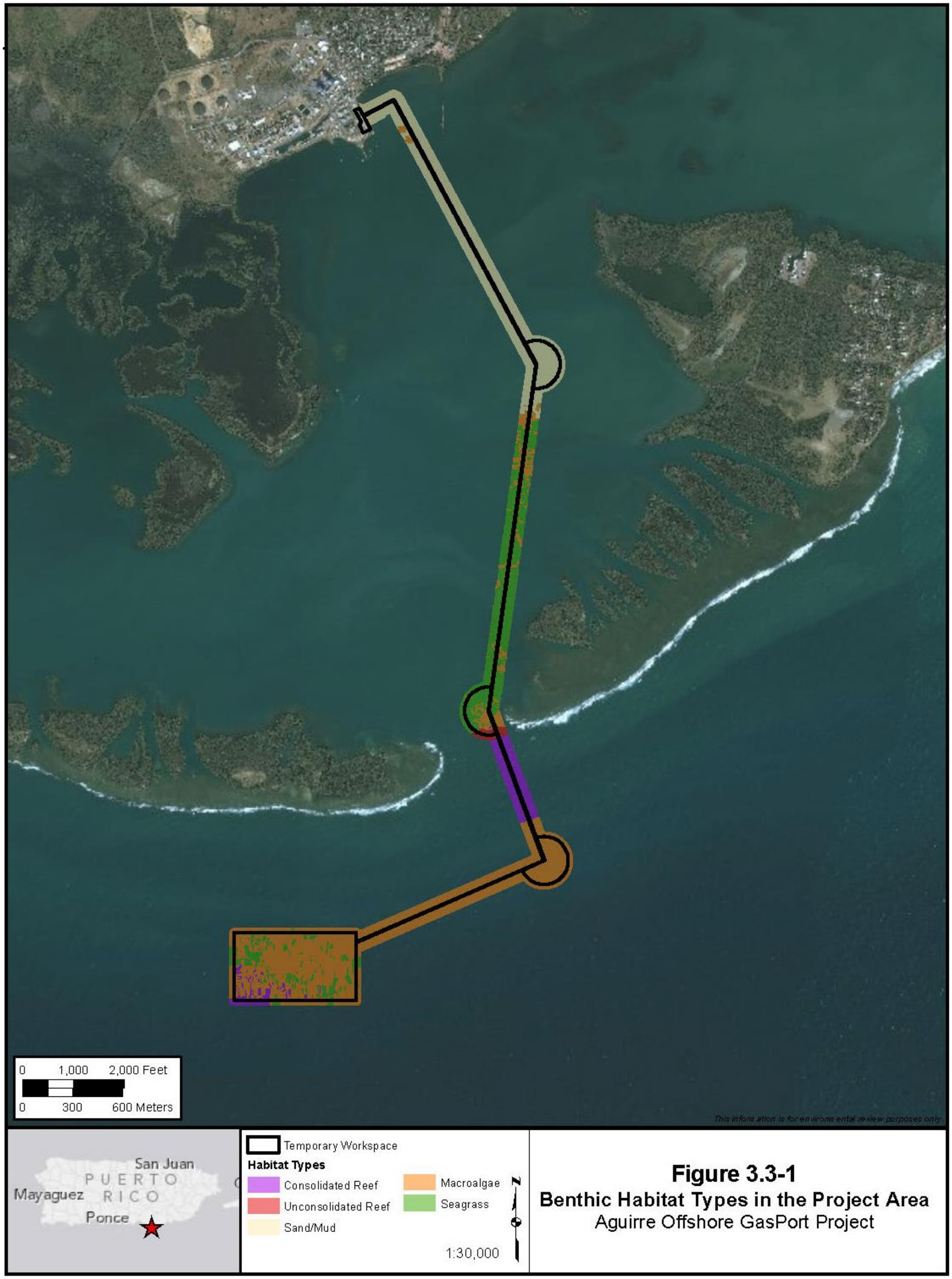

Figure 3.3-1
Benthic Habitat Types in the Project Area
Aguirre Offshore GasPort Project

TABLE 3.3-1

Benthic Habitat Types within the Aguirre Offshore GasPort Project Area (acres [cuerdas])

	Seagrass		Macroalgae		Coral Reef		Sand/Mud	
Project Component	Const.	Oper.	Const.	Oper.	Const.	Oper.	Const.	Oper.
Offshore Terminal	12.0 (12.4)	2.9 (3.0)	59.4 (61.2)	19.2 (19.8)	4.1 (4.2)	0.2 (0.2)	0.0	0.0
Subsea Pipeline	7.8 (8.0)	0.7 (0.7)	18.0 (18.5)	0.9 (0.9)	1.1 (1.1)	0.3 (0.3)	14.5 (14.9)	1.1 (1.1)
TOTAL	**19.8 (20.4)**	**3.6 (3.7)**	**77.4 (79.7)**	**20.1 (20.7)**	**5.2 (5.4)**	**0.5 (0.5)**	**14.5 (14.9)**	**1.1 (1.1)**

Note: Const. = temporary impacts during construction, Oper. = permanent impacts during operation

During operation, thermal plume discharges at the offshore berthing platform could impact manatees present within the offshore area. Operation of the FSRU would result in heated cooling water discharges from the Main Condenser Cooling System and the Auxiliary Seawater Cooling Service. Thermal plume discharges would also result from the LNG carriers when offloading LNG at the terminal. Thermal plume modeling conducted by Aguirre LLC predicts that the discharges from the FSRU and LNG carriers would meet Puerto Rico's maximum temperature criterion of 90 degrees Fahrenheit (32 degrees Celsius) at a maximum horizontal distance of 23 and 25 feet (7.0 and 7.6 meters [m]), respectively, under minimal current conditions. Impacts on manatees from thermal discharges would be minor, as they are mobile animals and would be able to move out of the zone of heated water.

Aguirre LLC proposes to utilize biocides in the form of sodium hypochlorite to prevent fouling of water intake systems and ballast tanks. This is standard practice in the shipping industry to prevent the growth of marine organisms. To treat the water intake system, sodium hypochlorite would be injected at the sea chests and allowed to disperse within the system. The target dose level of free residual chlorine within the water systems would be 0.1 to 0.15 ppm (0.1 to 0.15 mg/L). Following the treatment, residual sodium hypochlorite would be discharged as part of the cooling effluent. This residual chlorine concentration is not expected to significantly affect water quality, due to the low concentration of sodium hypochlorite; however, manatees in the immediate vicinity of the outfall may be exposed to harmful concentrations of sodium hypochlorite. Although the manatee's preferred habitat is within Jobos Bay, they may occur in the offshore Project area near the berthing platform.

Minor releases of hydrocarbons (e.g., LNG, fuel, and lubricants) during construction could result in impacts on manatees. Spills could originate from accidental spills from construction barges or support boats, loss of fuel during fuel transfers, or accidents resulting from collisions. The impacts of hydrocarbons are 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.

Noise from general construction would be generated at the offshore berthing platform site and along the pipeline route. Pile driving would be an additional source of noise at the berthing platform site. During a hydroacoustic survey undertaken in April 2012 (Tetra Tech, 2013b), Aguirre LLC measured background noise levels of around 120 dB at the offshore berthing platform site and closer to 140 dB within Jobos Bay. In discussing the impacts of sound on aquatic resources, it is important to note the difference in sound intensity in air versus water. Sound intensity in air uses a standard of 20 micropascals, while sound intensity measured in water uses a standard level of 1 micropascals. The discrepancy relates to differences in the acoustic impedance, density, and compressibility of air and water. For example, the threshold of hearing for humans is 0 decibels (dB) in the air, but 60 dB in water.

Similarly, direct tissue damage to humans can occur at 160 dB in the air, but rises to 222 dB in water (Tetra Tech, 2013b).

Within Jobos Bay, Aguirre LLC would install the temporary piles used during pipeline construction by vibratory hammers (rather than impact hammers) to reduce sound and pressures. Aguirre LLC's estimated sound levels would be 177 dB for general construction activities and 195 dB for vibratory pile driving. Nine structural jackets and four tri/quad pile structures would be installed at the offshore berthing platform site. Unlike the temporary piles for pipeline construction, Aguirre LLC may require impact hammers to install some of these structures. The estimated sound levels from the hammer pile driving were not provided by Aguirre LLC. Therefore, we are recommending in section 4.5.3.3 of the draft EIS that Aguirre LLC conduct acoustic subsea modeling to determine the noise impacts associated with hammer pile driving at the offshore berthing platform site and other areas where it may be used. We are further recommending[1] that Aguirre LLC consult with the FWS, NMFS, and the Puerto Rico Department of Natural and Environmental Resources (DNER) to identify mitigations measures that it would implement to reduce noise levels associated with vibratory and hammer pile driving to 180 dB, and provide us with the modeling results and the proposed mitigation measures prior to the end of the draft EIS comment period.

During operation, noise from incoming vessels and the offshore berthing platform operations would be generated within the immediate vicinity of the shipping route and platform location. During the hydroacoustic survey at the offshore berthing platform site, Aguirre LLC measured background noise levels approximating 120 dB. The modeled sound levels from LNG carriers transiting in and out of the berthing location are expected to be between 160 and 170 dB. Thrusters could be utilized upon the approach and berthing; this procedure is anticipated to be short in duration (less than 30 minutes) and raise the ambient noise levels to 183 dB.

NMFS defines two levels of harassment due to noise levels under the Marine Mammal Protection Act of 1972: Level A (180 dB) and Level B (160 dB intermittent, 120 dB continuous). These harassment levels are defined as:

- Level A – harassment that has the potential to injure a marine mammal; and
- Level B – harassment that has the potential to disturb a marine mammal by causing disruption of behavioral patterns, such as migration, breathing, nursing, breeding, feeding, or sheltering.

The modeling of noise attenuation completed by Aguirre LLC indicates that vibratory pile driving would exceed the 180 dB threshold within 33 feet (10 m) of the source of the sound and exceed the 160 dB threshold within 213 to 738 feet (65 to 225 m) (depending on the location of the pile) (Tetra Tech, 2013b). The 120 dB harassment level is not applicable for pile driving activities, as this is not continuous noise.

The modeling indicates that the estimated noise associated with the construction and support vessels would not exceed the Level A harassment threshold, but would exceed Level B harassment levels within 33 feet (10 m) of the source for the 160 dB limit, within 2.1 to 2.2 miles (3.4 to 3.5 km) for the 120 dB limit in the offshore terminal area, and within 0.4 to 1.4 miles (0.6 to 2.3 km) for the 120 dB limit within Jobos Bay (Tetra Tech, 2013b).

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1 The "recommendations" in the EIS text are not recommendations to the applicant (i.e., they are not mere suggestions to the project sponsor). Rather, they are recommendations to the FERC Commission for inclusion as mandatory conditions to any authorization it may issue for the Project. Please see section 5.2 of the draft EIS for how these conditions would appear in a FERC Order.

The modeling indicates that transiting LNG carrier noise would exceed the 120 dB limit within 1.0 to 1.1 miles (1.6 to 1.8 km) of the source of the sound, depending on the transiting direction of the LNG carrier. If thrusters are used, the sound generated is predicted to exceed the 160 dB limit within 164 feet (50 m) of the source and the 120 dB limit within 5.3 miles (8.5 km) of the source (Tetra Tech, 2013b). The 120 dB harassment level is not applicable for thrusters because it is not continuous noise.

Mitigation Methods

To minimize the potential for strikes, Aguirre LLC would operate vessels at safe speeds in order to avoid manatees and other wildlife that may be in the vicinity of the Project during construction activities. Crews would also receive protected species training that would include the identification of common marine mammals and turtles in Jobos Bay and a review of the effects of construction activities on these species, laws protecting the species, and potential fines associated with harassment of these species. Each vessel operator would verify attendance by signing attendance sheets that would be provided to regulatory agencies.

Additionally, each vessel and lay barge would have a certified marine mammal observer (MMO) on board during all phases of construction to identify if manatees, other marine mammals, or sea turtles are within the Project area. Aguirre LLC would contract firms with experienced biologists who are specially trained and certified in marine mammal observation. One qualified MMO would be assigned to each construction vessel and to each construction barge at all times (each operating individually in designated shifts to accommodate adequate rest schedules as needed if construction is expected to take place on a 24 hour schedule). Their exclusive responsibility would be to watch for marine mammals and to alert the construction crew supervisor if marine mammals are visually detected within the zone, generally within 1,600 feet (488 m) of the vessel, to allow for mitigating responses.

Whenever an observation of a marine mammal is made, the vessel MMO would radio call the lead MMO. The lead MMO would disseminate the information to the other vessel MMOs working at the time. The general response to a manatee siting is to maintain a distance of 50 yards (46 m) or more for one individual or to reduce vessel speed to 10 knots (18.5 kilometers per hour) or less and a minimum distance of 100 yards (91 m) when mother/calf pairs, groups, or large assemblages of cetaceans are observed near an underway vessel, when safety permits. MMOs would have stop work authority and would maintain *in situ* records while on watch. The shore-based MMO coordinator would also be assigned to collect remote data and collate all sighting data on a daily basis and submit daily, weekly, or monthly reports to agencies as requested.

Observing would take place at all hours of the day that viewing conditions are acceptable (visibility at least 500 feet [152 m] and Beaufort sea states[2] less than five). Night-time observations would be conducted with the aid of a night-vision scope where practical. Observers, using binoculars, would estimate distances to marine mammals either visually or by using reticle binoculars. If higher vantage points (greater than 25 feet [8 m]) are available, distances can be measured using inclinometers. Position data would be recorded using hand-held or vessel GPS units for each sighting, vessel position change, and any environmental change.

Environmental data would be collected at the time of each observation, including sea state, wind speed, wind direction, ambient temperature, precipitation, glare, and percent cloud cover. Wind and

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2 The Beaufort scale is an empirical measurement of sea or land conditions relating to wind speed and observed conditions. The sea state scale ranges from 0 to 12, with 0 being calm and 12 being hurricane conditions. A sea state of five is called a "Fresh Breeze," where winds range from 17 to 21 knots (31 to 39 kilometers per hour), waves are 6 feet (1.8 m) with white caps and the chance of spray (NOAA, undated).

temperature data would be extracted from onboard meteorological stations (when available). Animal data to be collected includes number, species, position, distance, behavior, direction of movement, and apparent reaction to construction activity. The MMOs would keep notes of activities and prepare and submit a daily report on a daily, weekly, or monthly basis, as requested by the applicable agencies (e.g., NMFS and the FWS).

To ensure impacts from accidental spills are minimized, Aguirre LLC would prepare a site-specific spill prevention and control plan to minimize the potential for inadvertent release and to establish protocol for the containment, remediation, and reporting of accidental releases. We are recommending in section 4.3.3.3 of the draft EIS that Aguirre LLC provide us this plan for review and approval prior to construction. Additionally, all discharges would be subject to the requirements of the National Pollutant Discharge Elimination System (NPDES) permit for the Project.

If a MMO spots an animal within 0.3 mile (0.5 km) of pile driving activities, all construction activities would cease until the animal leaves the area. To further minimize impacts to manatees resulting from pile driving noise, as stated previously, we are recommending in section 4.5.3.3 of the draft EIS that Aguirre LLC conduct acoustic subsea modeling to determine the noise impacts associated with hammer pile driving; consult with the FWS, NMFS, and the DNER to identify mitigations measures that Aguirre LLC would implement to reduce noise levels associated with vibratory and hammer pile driving to 180 dB; and provide us with the modeling results and the proposed mitigation measures prior to the end of the draft EIS comment period.

Aguirre LLC has agreed to prepare a seagrass mitigation and monitoring plan in consultation with respective agencies to offset short-term and/or permanent impacts on seagrass communities, which provide habitat and a vital food source for manatees. The plan would include seagrass planting and post-construction monitoring to determine Project effects and/or mitigation success. We are recommending in section 4.4.3 of the draft EIS that Aguirre LLC provide us with a draft of this plan prior to the end of the draft EIS comment period.

Determination of Effect

Based on the manatees' characteristics and habitat requirements, the Project's proposed construction and operation procedures, and Aguirre LLC's proposed mitigation methods, we have determined that the Project *is likely to adversely affect* the Antillean manatee. Construction related effects are expected to be temporary, as sedimentation and degradation of seagrass beds and discomfort caused by pile driving noise would stop with the completion of the facilities. The pipeline is not expected to impact a significant portion of the available seagrass in Jobos Bay, and is therefore unlikely to cause any noticeable impact manatee health in the area. Operation of the Project would result in permanent, minor impacts on manatees as a result of noise, thermal plume discharge, anti-fouling agents, and vessel strikes.

3.2 WHALES

Considering the Project-related activities and potential stressors, there are no meaningful differential susceptibilities among the protected whale species potentially occurring in the Project area. Therefore, these species were assessed as a group.

Background

Whales are long-lived marine mammals that are found throughout the world's oceans. Many species migrate extremely long distances to take advantage of seasonal food resources or calm wintering grounds for rearing young. They can be divided into two main groups: toothed whales and baleen whales. Feeding morphology and prey are the major differences between these groups. Commonly, whales utilize warm tropical waters during winter months when the polar seas are cold, ice covered, and food-poor, though some species stay in these regions year round.

The sperm whale (*Physeter macrocephalus*) is a toothed whale that inhabits the deeper waters of the world's oceans throughout the year. They feed primarily on squid and other deep sea creatures. Migrations are not as distinct as other species and thought to primarily follow the food resources (NMFS, 2010). The Atlantic population is considered a separate stock from the Pacific and Indian Ocean stocks. Additionally, the Gulf of Mexico stock has been petitioned for separate listing as a Distinct Population Segment under the ESA due to isolation in the northern Gulf of Mexico and the unique threats in that area such as oil and gas development and habitat degradation (WildEarth Guardians, 2011). Due to the complex bathymetry around Puerto Rico and the Caribbean Sea, sperm whales could utilize the offshore Project area as feeding grounds.

The humpback whale (*Megaptera novaeangliae*) is a baleen whale distributed throughout the world's oceans. They generally spend winter months in lower temperate and tropical waters then migrate northward and southward in summer months to feed in areas of high productivity (i.e., high latitudes). Within the Caribbean and western Atlantic, humpbacks are commonly found south of the Bahamas and along the Dominican Republic, with some activity on the western side of Puerto Rico and down the Lesser Antilles (NMFS, 1991). Calving occurs primarily during the winter months, and the only breeding ground in U.S. waters is on the northwestern coast of Puerto Rico (NMFS, 1991).

Other baleen whales, including the fin (*Balaenoptera physalus*), sei (*Balaenoptera borealis*), and blue whales (*Balaenoptera musculus*), are listed by NMFS as occurring within the southeast region (generally, the Gulf of Mexico and U.S. territories in the Caribbean). These whales are not commonly found around Puerto Rico, but could utilize the area during migrations or other movements. Feeding is not expected in or around Puerto Rico as these species usually feed on zooplankton and small fish aggregations during summer months in the north Atlantic (NMFS, 1998; 2010; 2011). Calving and breeding grounds have not been identified for these species in Puerto Rico.

<u>Field Survey Results</u>

No whales were observed during the marine mammal surveys conducted for the Project (Tetra Tech, 2013c). However, these surveys only occurred in late April through early May, which is a limited window for observing these wide-ranging and highly mobile animals.

<u>Potential Impacts</u>

The principal stressor that could directly affect whales would be vessel strikes. Impacts from vessel strikes are unlikely during construction because vessels approaching or operating in nearshore waters generally transit at much slower speeds than in open water; and because whales are less likely to occur in nearshore waters. During operation, LNG carriers, or the associated assist tugs, traveling to and from the FSRU could encounter whales along their transit routes within the EEZ; however, impacts would be minimal because LNG carriers are generally slower, generate more noise than typical large vessels, and would be more readily avoided by marine mammals. Impacts from LNG carriers moored at the FSRU during operation would not occur as they are stationary while docked. Noise from the LNG carriers and FSRU could also impact whales during operation; however, whales are highly mobile and would be able to avoid areas of noise that would cause them discomfort or harm.

Whales may also be affected by noise during construction; however, these impacts are expected to be minor because most whales would be offshore away from the Project area and outside of the areas where construction noise would reach harassment levels (see section 3.1). Similarly, inadvertent hydrocarbon spills, thermal plume discharges, and anti-fouling agents could affect whales present within the Project area (see section 3.1); however, these impacts are expected to be minor as most whale species reside outside of the Project area in deeper, offshore waters, and those that may be present, would be able to move out of discharge areas that would cause them discomfort or harm.

Mitigation Methods

As discussed in BA section 3.1, Aguirre LLC has stated that it would employ certified MMOs on all construction vessels during all construction phases of the Project. When whales are sighted, a distance of 100 yards (91 m) or greater would be maintained between the whale and the vessel. Vessels would reduce their speed to 10 knots (18.5 kilometers per hour) or less when mother/calf pairs, groups, or large assemblages are present in the area (safety permitting). A 0.3 mile (0.5 km) zone would also be established around pile driving activities to minimize the potential for noise impacts. If a MMO spots an animal within this zone, all construction activities would cease until the animal leaves the area. To further minimize impacts on whales resulting from pile driving noise, as stated previously, we are recommending in section 4.5.3.3 of the draft EIS that Aguirre LLC conduct acoustic subsea modeling to determine the noise impacts associated with hammer pile driving; consult with the FWS, NMFS, and the DNER to identify mitigations measures that Aguirre LLC would implement to reduce noise levels associated with vibratory and hammer pile driving to 180 dB, and provide us with the modeling results and the proposed mitigation measures prior to the end of the draft EIS comment period (see BA section 3.1).

As stated previously, we are recommending in section 4.3.3.3 of the draft EIS that Aguirre LLC prepare a site-specific spill prevention and control plan, for onshore and offshore, to minimize the potential impacts resulting from accidental spills (see BA section 3.1). Additionally, all discharges would be subject to the requirements of the NPDES permit for the Project.

Determination of Effect

Based on these whales' characteristics and habitat requirements, the Project's proposed construction and operation procedures, and Aguirre LLC's proposed mitigation methods, we have determined that the Project *is not likely to adversely affect* whales. The use of MMOs would significantly reduce the chance of a vessel strike during construction. During operation, LNG carriers, or the associated assist tugs, could come in contact with whales along transit routes within the EEZ; however, this potential is low because LNG carriers are generally slower, generate more noise than typical large vessels, and would be more readily avoided by whales.

3.3 GREEN AND HAWKSBILL SEA TURTLES

Considering the Project-related activities and potential stressors, there are no meaningful differential susceptibilities among these species. Both may transit and forage in the Project area, and neither are likely to nest in or adjacent to the Project area. Therefore, these species were assessed as a group.

Background

The green sea turtle (*Chelonia mydas*) is found throughout the world's oceans where temperatures remain above 68 degrees Fahrenheit (20 degrees Celsius). There are three breeding populations; the global population, which is considered threatened; and the two other breeding populations (Florida and Pacific Mexico), which are considered endangered (NMFS and FWS, 2007a).

While there are no major green sea turtle nesting sites on the island of Puerto Rico, the coastal waters are likely common foraging grounds for both the global and Florida-breeding populations (Lutz et al., 2003). Critical habitat for the green sea turtle is located on Culebra Island, Puerto Rico, which is over 60 miles (97 km) northeast of the Project area. Green sea turtles can exhibit high site fidelity with respect to both nesting and feeding, which can lead to common migratory routes (Luschi et al., 2003). However, some individuality and variation has been documented. As one of the more coastal species of sea turtle, green sea turtles forage primarily on benthic organisms. Food sources include seagrasses and algae as well as animals such as mollusks, crustaceans, bryozoans, sponges, jellyfish, polychaetes, echinoderms, fish, and fish eggs (Bjorndal, 1997; NMFS and FWS, 1991). In the Caribbean, the primary seagrass food source is turtle grass (Bjorndal, 1997), which is one of the dominant seagrass species in Jobos Bay.

The hawksbill sea turtle (*Eretmochelys imbricate*) is widely distributed throughout the tropical waters of the world's oceans. They have been shown to migrate significant distances between foraging and nesting sites (Plotkin, 2003). Hawksbills are commonly found in the waters around Puerto Rico and associated islands and nest on a number of beaches (NMFS and FWS, 2007b) both in Puerto Rico and throughout the Caribbean with the most important nesting sites found on the Yucatan Peninsula (NMFS and FWS, 1993). In Puerto Rico, hawksbill nests are known to occur on the beaches of Humacao, Isla Culebra, Isla Caja de Muertos, and Islas Mona and Monita (NMFS and FWS, 2007b). The Isla Mona and Isla Monita habitats, which are located over 100 miles west of the Project area, have been designated as critical habitat for the hawksbill sea turtle since 1998 (63 Federal Register [FR] 46693). Isla Caja de Muertos is approximately 20 miles west of the Project area, while Humacao is approximately 30 miles (48 km) east, suggesting hawksbills could utilize the area frequently. Young hawksbill sea turtles forage in association with macroalgae mats, and after leaving the pelagic stage they commonly forage over coral reefs and hard bottom substrate. They can also be found over seagrass and in bays fringed with mangroves (Bjorndal, 1997). In the Caribbean, sponges are the primary, and in many cases the exclusive, food source (Bjorndal, 1997).

Field Survey Results

Four green sea turtles were observed within the Boca del Infierno pass and adjacent offshore areas during Aguirre LLC's sea turtle surveys in late April through early May 2012 (Tetra Tech 2013c). One turtle was sighted offshore of the Boca del Infierno pass during Aguirre LLC's coral mapping in November 2013 (Tetra Tech, 2014b). It should be noted this was a limited survey window.

No hawksbill sea turtles were observed during the sea turtle surveys conducted for the Project (Tetra Tech, 2013c). However, these surveys only occurred in late April through early May, which is a limited window for observing these wide-ranging and highly mobile animals.

Potential Impacts

Impacts on green and hawksbill sea turtles could occur from disturbance to the seafloor, noise, vessel strikes, inadvertent spills, thermal plume discharge, anti-fouling agents and lighting (see section 3.1). Consequences of these stressors range from temporary disruption of normal behaviors to injury or mortality from vessel strikes. Noise and disturbance impacts would be mainly associated with the construction phase of the Project. However, permanent footprints of the pipeline and offshore terminal would result in a permanent loss of foraging habitat (i.e., seagrass beds and coral reefs). Additionally, LNG and tug vessels could encounter sea turtles within the vessel transit route and offshore berthing area during operation. Because of the extensive coverage of seagrass and coral reef habitat in the vicinity of the Project, the potential for detectable consequences to foraging habits is possible but not probable. Inadvertent hydrocarbon spills, thermal plume discharges, and anti-fouling agents could affect sea turtles present within the Project area (see section 3.1); however, these impacts are expected to be minor as sea turtles would be able to move out of discharge areas that would cause them discomfort or harm.

The Project would necessitate the installation of temporary lighting to facilitate construction activities during evening hours as well as safety requirements. Operation of the terminal would necessitate the installation of permanent lighting to meet operational safety and security requirements. Artificial lighting within the Project area during construction and operation could also cause disorientation for sea turtles which use cues from the moon to direct movements. However, sea turtles are the most vulnerable to these effects as hatchlings. Because there are no known nesting beaches in the vicinity of the Project area, this effect is unlikely to cause appreciable impact.

Mitigation Methods

As discussed in BA section 3.1, Aguirre LLC has stated that it would have certified MMOs assigned to all construction vessels during all construction phases of the Project. When sea turtles are sighted, a distance of 50 yards (46 m) or greater would be maintained whenever possible between the turtle and the vessel. Aguirre LLC would establish a 0.3-mile (0.5 km) zone around pile driving activities to minimize the potential for noise impacts. If a MMO spots an animal within this zone, all construction activities would cease until the animal leaves the area. To further minimize impacts on sea turtles resulting from pile driving noise, as stated previously, we are recommending in section 4.5.3.3 of the draft EIS that Aguirre LLC conduct acoustic subsea modeling to determine the noise impacts associated with hammer pile driving; consult with the FWS, NMFS, and the DNER to identify mitigations measures that Aguirre LLC would implement to reduce noise levels associated with vibratory and hammer pile driving to 180 dB; and provide us with the modeling results and the proposed mitigation measures prior to the end of the draft EIS comment period (see BA section 3.1).

As discussed in section 3.1, Aguirre LLC would prepare a seagrass mitigation and monitoring plan to offset short-term and/or long-term impacts on seagrass communities. Aguirre LLC would also develop, through continued consultation with NMFS and FWS, a coral reef restoration and/or mitigation plan to offset impacts from construction and operation of the Project (see section 3.8).

To ensure that impacts associated with nighttime lighting are minimized, we are recommending in section 4.5.3.3 of the draft EIS that Aguirre LLC develop a lighting plan that identifies specific measures that would be implemented to minimize or avoid impacts associated with nighttime lighting on avian species, fish species, marine mammals, and individuals on the shoreline. We are recommending that Aguirre LLC provide us this plan for review and approval prior to construction. As stated previously, we are recommending in section 4.3.3.3 of the draft EIS that that Aguirre LLC prepare a site-specific spill prevention and control plan, for offshore and onshore, to minimize the potential impacts resulting from accidental spills (see BA section 3.1). Additionally, all discharges would be subject to the requirements of the NPDES permit for the Project.

Determination of Effect

Based on the green and hawksbill sea turtles' characteristics and habitat requirements, the Project's proposed construction and operation procedures, and Aguirre LLC's proposed mitigation methods, we have determined that the Project *is not likely to adversely affect* either species. Construction-related impacts are expected to be temporary, as impacts such as increased chance for vessel strikes from construction vessels, construction lighting, sedimentation and degradation of seagrass beds, and discomfort caused by pile driving noise would stop with the completion of the facilities. The pipeline is not expected to impact a significant portion of the available seagrass in Jobos Bay, and is therefore unlikely to cause any noticeable impact on turtle health in the area. Operation of the Project would result in long-term, minor impacts on sea turtles as a result of noise, thermal plume discharge, anti-fouling agents, and lighting. During operation, LNG carriers, or the associated assist tugs, could come in contact with sea turtles along transit routes within the EEZ; however, the potential is low because LNG carriers are generally slower, generate more noise than typical large vessels, and would be more readily avoided by sea turtles.

3.4 LEATHERBACK AND LOGGERHEAD SEA TURTLES

Considering the Project-related activities and potential stressors, there are no meaningful differential susceptibilities among these species. They may rarely transit the Project area, but neither are likely to forage or nest in or adjacent to the Project area. Therefore, these species were assessed as a group.

Background

The leatherback sea turtle (*Dermochelys coriacea*) is the largest and most pelagic of the sea turtles. This species occurs globally, and ranges farther north and south than the other species, likely due to leatherbacks' ability to maintain warmer body temperatures (NMFS and FWS, 2007c). The largest breeding populations are found on the Pacific coast of Mexico. In the Caribbean, French Guiana supports the largest population followed by a number of other countries, while the U.S. Caribbean supports relatively few nesting colonies (NMFS and FWS, 1992). However, the number of leatherback nests in Puerto Rico has been increasing over the past 30 years, with at least 469 nests recorded each year from 2000 to 2005. Important nesting areas in Puerto Rico are near Fajardo and the Isla Culebra, approximately 40 and 60 miles to the northeast of the Project area, respectively. The nesting sites at Isla Culebra have been in steady decline since 2004, with only five females nesting on the island in 2012. Evidence suggests that this is not representative of a loss of breeding population but rather a shift in nesting site preference, which is still being studied (NMFS and FWS, 2013). Although considered omnivorous (feeding on sea urchins, crustaceans, fish, and floating seaweed), leatherbacks feed principally on soft foods such as cnidarians (medusae, siphonophores) and tunicates (salps, pyrosomas) (Bjorndal, 1997; NMFS and FWS, 1992).

The loggerhead sea turtle (*Caretta caretta*) is most commonly found over the continental shelves around the world and may be found within the Project area. Loggerheads can migrate significant distances between foraging areas, breeding areas, and nesting locations (Plotkin, 2003). Loggerheads nest around the Gulf of Mexico basin, including Cuba, and the southeastern coast of the mainland United States. (NMFS and FWS, 2008). Nesting is no longer observed along the rest of the Greater Antilles, including Puerto Rico (NMFS and FWS, 2007d). Loggerheads are omnivorous, feeding on a variety of benthic prey including shellfish, crabs, barnacles, oysters, jellyfish, squid, and sea urchins, and occasionally on fish, algae, and seaweed (Lutz and Musick, 1997; NMFS and FWS, 2008). As with green sea turtles, loggerheads move from pelagic foraging preferences to more benthic-associated feeding at a certain age (Bjorndal, 1997). They are known to forage over hard and soft benthic substrates. During their pelagic stage, they are often found associated with macroalgae mats.

Field Survey Results

While there were no sightings of leatherback or loggerhead sea turtles during the sea turtle surveys in April/May 2012 (Tetra Tech, 2013c); two loggerheads were observed offshore of the Boca del Infierno pass during the coral mapping in November 2013 (Tetra Tech, 2014b).

Potential Impacts

The principal stressor that could directly affect leatherback and loggerhead sea turtles is vessel strikes. Impacts from vessel strikes are unlikely during construction because vessels approaching or operating in nearshore waters generally transit at much slower speeds than in open water and because these sea turtles are less likely to occur in nearshore waters. Utilization of the Aguirre Plant pier for docking of construction vessels would limit construction vessel traffic to within the Project area. This would eliminate the need for construction vessels to travel in and out of the Project area on a daily basis, and reduce the likelihood of encountering leatherbacks and loggerheads in the offshore environment. During operation, impacts from LNG carriers transiting to and from the FSRU would be minimal because LNG carriers are generally slower, generate more noise than typical large vessels, and would be more readily avoided by sea turtles. Impacts from LNG carriers moored at the FSRU during operation would not occur as they are stationary while docked.

These sea turtles may also be affected by noise, inadvertent hydrocarbon spills, thermal plume discharges, and anti-fouling agents during construction and operation (see section 3.1); however, these animals are highly mobile and would be able to avoid areas of noise or inadvertent discharges that would cause them discomfort or harm.

As stated in section 3.3, artificial lighting within the Project area during construction and operation could cause disorientation for sea turtles which use cues from the moon to direct movements. However, sea turtles are the most vulnerable to this effect as hatchlings. Because there are no known nesting beaches in the vicinity of the Project area, this effect is unlikely to cause appreciable impact.

Mitigation Methods

Certified MMOs would be assigned to construction vessels during all construction phases of the Project to look for marine mammals and sea turtles. When sea turtles are sighted, a distance of 50 yards (46 m) or greater would be maintained between the turtle and the vessel. See section 3.1 above for more detail on the MMOs.

Aguirre LLC would maintain 0.3-mile (0.5 km) zone around pile driving activities to minimize the potential for noise impacts where all construction activities would cease until the animal leaves the area. To further minimize impacts on sea turtles resulting from pile driving noise, as stated previously, we are recommending in section 4.5.3.3 of the draft EIS that Aguirre LLC conduct acoustic subsea modeling to determine the noise impacts associated with hammer pile driving; consult with the FWS, NMFS, and the DNER to identify mitigations measures that Aguirre LLC would implement to reduce noise levels associated with vibratory and hammer pile driving to 180 dB; and provide us with the modeling results and the proposed mitigation measures prior to the end of the draft EIS comment period (see BA section 3.1).

As stated in BA section 3.3, we are recommending in section 4.5.3.3 of the draft EIS that Aguirre LLC develop a lighting plan that identifies specific measures that would be implemented to minimize or avoid impacts associated with nighttime lighting relating to the Project. We are also recommending in section 4.3.3.3 of the draft EIS that that Aguirre LLC prepare a site-specific spill prevention and control plan to minimize the potential impacts resulting from accidental spills (see BA section 3.1). Additionally, all discharges would be subject to the requirements of the NPDES permit for the Project.

Determination of Effect

Based on the leatherback and loggerhead sea turtles' characteristics and habitat requirements, the Project's proposed construction and operation procedures, and Aguirre LLC's proposed mitigation methods, we have determined that the Project *is not likely to adversely affect* these species. Construction-related impacts are expected to be temporary, as impacts such as increased chance for vessel strikes from construction vessels, construction lighting, and discomfort caused by pile driving noise would stop with the completion of the facilities. Operation of the Project would result in long-term, minor impacts on sea turtles as a result of noise, thermal plume discharge, anti-fouling agents, and lighting. During operation, LNG carriers could come in contact with turtles along transit routes within the EEZ; however, this potential is low because LNG carriers are generally slower, generate more noise than typical large vessels, and would be more readily avoided by turtles.

3.5 PIPING PLOVER, YELLOW-SHOULDERED BLACKBIRD, AND RUFA RED KNOT

Considering the Project-related activities and potential stressors, there are no meaningful differential susceptibilities among these species. Therefore, these species were assessed as a group.

Background

Piping plovers (*Charadrius melodus*) are migratory shore birds, wintering in warmer climates and migrating north during the summer months to breed. Three distinct breeding populations are recognized: the Atlantic Coast (threatened), Great Lakes (endangered), and Northern Great Plains (threatened) populations. Critical habitat designations have been established for the Great Lakes and Northern Great Plains populations, while no such designations were made for the Atlantic Coast Populations (FWS, 2009a). During the winter, these birds forage on coastal beaches, mudflats, and tidal flats along the wrack line for benthic epifaunal and infaunal prey. The FWS designates the coastal zones of Puerto Rico as habitat for the piping plovers; however, the majority of the population primarily winters only as far south as Florida and other Gulf of Mexico states. Piping plover abundance in Puerto Rico and other surveyed Caribbean islands is low (FWS, 2009a).

The yellow-shouldered blackbird (*Agelaius xanthomus*) is endemic to Puerto Rico and utilizes mud flats and salt flats, black mangrove forests, and offshore red mangrove cays for nesting habitat. Nests are usually built in clusters low in mangrove trees or in large deciduous trees near mangroves. Their breeding season is commonly April to August but varies to some degree as it coincides with the rainy season (FWS, 2011); it can occur as early as February and as late as November. Although the yellow-shouldered blackbird is non-migratory, portions of the population move inland from coastal areas during the non-breeding season to feed (FWS, 2011). This species feeds predominantly on insects, seeds, and nectar, but has been documented consuming cattle feed, dog food, fruit, cooked rice, and granulated sugar within bird feeders and around domestic animals. Yellow-shouldered blackbirds have been observed within the Jobos Bay National Estuarine Research Reserve where mangrove forests and Barca Cay and Caribe Cay may provide adequate nesting habitat (Field et al., 2003). Critical habitat for this species is designated in Puerto Rico; however, the closest critical habitat is over 40 miles (64 km) west of the Project area (42 FR 47842). Although yellow-shouldered blackbirds prefer to nest in black mangrove forests, they have been documented utilizing urban areas for nesting. In 2000, 11 yellow-shouldered blackbird nests were observed at the PREPA facilities in Aguirre and Guayama (FWS, 2011). Therefore, it is possible that this species could be found within the upland portion of the Project area.

The rufa red knot (*Calidris canutus rufa*) is a medium-sized shorebird, typically with a wingspan of 20 inches (102 cm) and a body length of 9 inches (23 cm) (FWS, 2013b). Each year, the rufa red knot migrates thousands of miles between its Canadian Arctic breeding grounds and wintering areas in South America (Harrington, 2001). Some individuals are known to migrate over 18,000 miles (29,000 km) each year (FWS, 2013b). Populations generally fly in large flocks northward through the contiguous United States from March to early June, and return southward July through August. These migrating knots can complete nonstop flights of 1,500 miles (2,400 km) and more, converging together on important stopover sites such as the Delaware Bay (FWS, 2013b). Relatively few birds are known to utilize Puerto Rico as wintering grounds, as a majority of the population spends the boreal winter about 5,000 miles south in a small area of Tierra del Fuego, Argentina (Niles et al., 2008). Increased commercial harvest of horseshoe crabs, the reduction in horseshoe crab populations, and the consequent reduction in red knot food resources (i.e., horseshoe crab eggs) during stopovers, have led to a worsening body condition during spring migration and is a major threat to the health of the species (Harrington, 2001). Horseshoe crab populations have stabilized over recent years, but the red knot is still under threat from a loss of quality wintering habitats due to human encroachment and the threat of climate change on its breeding grounds in the arctic (Niles et al., 2008).

Field Survey Results

Aguirre LLC did not conduct surveys for the piping plover, yellow-shouldered blackbird, or rufa red knot.

Potential Impacts

Piping plovers, yellow-shouldered blackbirds, and red knots present within or adjacent to the Project area may be impacted by construction noise and lighting during construction and operation of the Project. While piping plovers and red knots do not nest in the Project area, yellow-shouldered blackbirds could utilize the mangrove forest, cays, and urban areas within the Project area, including the existing Aguirre Plant, as nesting habitat.

Construction noise could disturb wintering piping plovers and red knots, as well as non-nesting yellow-shouldered blackbirds. These species could experience short-term moderate impacts as they may be temporarily displaced from areas with elevated noise levels during construction activity. Construction noise could disrupt breeding of yellow-shouldered blackbirds nesting within or adjacent to the Project area as their long breeding season may occur from February through November. Although the yellow-shouldered blackbird's preferred nesting habitat is mangrove forests, they have been documented nesting within onshore industrial facilities such as the existing Aguirre Plant. They are not commonly known to nest on offshore structures but have been documented nesting within industrial facilities; therefore, it is possible, yet unlikely, that yellow-shouldered blackbirds could utilize the FSRU as nesting habitat.

Artificial lighting during construction and operation of the Project could adversely affect piping plovers, yellow-shouldered blackbirds, and red knots. However, no additional lighting is proposed at the Aguirre Plant; therefore, impacts associated with lighting at this location are not anticipated. During operation of the Project, the FSRU and offshore berthing platform would be lit 24 hours per day by security lighting, navigation lights, and Federal Aviation Administration warning lights. The waters surrounding the Offshore GasPort are unlit due to the lack of permanent structures in the water and on uninhabited cays. Therefore, the nighttime lighting contrast between the Project and the background would be high.

Mitigation Methods

Aguirre LLC has not proposed any mitigation measures specific to the piping plover, yellow-shouldered blackbird, or rufa red knot; however, we are recommending in section 4.5.3.3 of the draft EIS that Aguirre LLC conduct an assessment of potential noise impacts on resting and nesting birds during the construction and operation of the Project and identify mitigation measures that would implemented to minimize or avoid these impacts. We are requesting that Aguirre LLC provide us the results of this assessment and the proposed mitigation measures prior to construction.

As discussed in BA section 3.3, we are also recommending in section 4.5.3.3 of the draft EIS that Aguirre LLC develop a lighting plan that identifies specific measures that would be implemented to minimize or avoid impacts associated with nighttime lighting relating to the Project.

Determination of Effect

Based on the characteristics and habitat requirements of these species, the Project's proposed construction and operation procedures, and Aguirre LLC's proposed mitigation methods, we have determined that the Project *is not likely to adversely affect* these three bird species. The Project would not result in a loss of nesting habitat for the yellow-shouldered blackbird as the mangrove cays adjacent to the Project area, which are this species' preferred nesting habitat, would not be impacted. Additionally, noise and lighting impacts on these species during construction and operation of the Project would be minimized and mitigated for through our recommendations as described above. Impacts associated with construction of the project are expected to be short-term and moderate as these species may be temporarily displaced from areas with elevated noise levels during construction activity.

3.6 DWARF SEAHORSE

Background

The dwarf seahorse (*Hippocampus zosterae*) is a reef fish that was recently proposed for ESA listing due to loss of habitat, commercial collection, and endangerment due to the 2010 BP Deepwater Horizon oil spill in the Gulf of Mexico (Center for Biological Diversity, 2011). This species occurs along the Atlantic coast of Florida and throughout the Gulf of Mexico and the Caribbean, inhabiting shallow seagrass beds at water depths of approximately 6 feet (1.8 m) or less in these warm water areas (Center for Biological Diversity, 2011). Dwarf seahorse feed on crustacean prey both pelagic and benthic. This species, the smallest seahorse in U.S. waters, grows to an adult length of about 1 inch (2.5 cm), lives about one year and reaches sexual maturity at about three months of age (Foster and Vincent, 2004). They form monogamous pairs and breed throughout the majority of the year, from February through November, as frequently as twice per month (Foster and Vincent, 2004). As with all seahorses, young are born after incubating in the male's pouch.

Field Survey Results

Aguirre LLC did not conduct surveys for the dwarf seahorse.

Potential Impacts

The principal project-related stressor to the dwarf seahorse would be the disturbance of its foraging and breeding habitat (e.g., seagrass beds). As this species resides in shallow water less than approximately 6 feet deep (1.8 m) and would not be located within the offshore Project area, the offshore terminal would have no effect on the dwarf seahorse and impacts would be limited to the pipeline in the nearshore Project area. These impacts would be mainly associated with the construction phase of the Project; however, the footprint of the pipeline would result in a permanent loss of foraging habitat for seahorses.

Dwarf seahorses may also be affected by noise and inadvertent spills during construction and operation (see section 3.1); however, these animals are mobile and would be able to avoid most areas of noise or inadvertent discharges that would cause them discomfort or harm.

Mitigation Methods

Aguirre LLC has not proposed any mitigation measures specific to the dwarf seahorse. However, to minimize impacts due to loss of foraging habitat, Aguirre LLC would prepare a seagrass mitigation and monitoring plan to offset short-term and/or long-term impacts to seagrass communities (see BA section 3.1). Aguirre LLC would also develop, through continued consultation with NMFS and FWS, a coral reef restoration and/or mitigation plan to offset impacts from construction and operation of the Project (see BA section 3.8).

As discussed in BA section 3.3, we are recommending in section 4.3.3.3 of the draft EIS that Aguirre LLC prepare a site-specific spill prevention and control plan to minimize the potential impacts resulting from accidental spills.

Determination of Effect

Based on the dwarf seahorse's characteristics and habitat requirements, the Project's proposed construction and operation procedures, and Aguirre LLC's proposed mitigation methods, we have determined that the Project *is not likely to adversely affect* this species. Impacts are expected to be temporary, as construction-related impacts such as sedimentation and degradation of seagrass beds and discomfort caused by noise are temporary and related to construction of the facilities. The pipeline is not expected to impact a significant portion of the available seagrass beds in Jobos Bay, and Aguirre LLC has proposed to mitigate for seagrass impacts; therefore, loss of seagrass is unlikely to cause any noticeable impact on seahorse health in the area.

3.7 SCALLOPED HAMMERHEAD SHARK

Background

The scalloped hammerhead shark (*Sphyrna lewini*) can be found throughout the tropical and warmer temperate oceans of the world. In tagging studies, scalloped hammerhead sharks have been shown to congregate in core areas and have site fidelity, but time spent away from original tagging locations varies widely (Miller et al., 2013). Scalloped hammerhead sharks can be found over continental and insular shelves and the adjacent deep waters, ranging from the surface to depths of up to 1,475 to 1,680 feet (450 to 512 m), occasionally diving to even deeper depths. They have also been documented entering enclosed bays and estuaries (Miller et al., 2013). The young often remain in shallow waters along the shore for up to one year to avoid predation (Miller et al., 2013). Diet consists of a variety of prey species, ranging from fish and crustaceans to gelatinous organisms. The western Atlantic population of the scalloped hammerhead shark has been shown to grow more slowly than other population segments (Miller et al., 2013). After hammerhead shark individuals mature to a certain size, they are capable of reproduction and give birth to live pups approximately once every two years.

Field Survey Results

Aguirre LLC did not conduct surveys for the scalloped hammerhead shark.

Potential Impacts

Impacts on scalloped hammerhead sharks could result from noise, vessel strikes, inadvertent spills, artificial lighting, thermal plume discharge, and anti-fouling agents (see BA section 3.1); however, these animals are highly mobile and would be able to avoid most areas of noise or inadvertent discharges that would cause them discomfort or harm. Noise disturbance impacts would be temporary and mainly associated with the construction phase of the Project. Impacts from vessel strikes are unlikely during construction because vessels approaching or operating in nearshore waters generally transit at much slower speeds than in open water. During operation, impacts are unlikely because LNG carriers are generally slower, generate more noise than typical large vessels, and would be more readily avoided. Small organisms are often attracted to lights, which in turn attracts larger predators such as the scalloped hammerhead shark to feed on the biological aggregations. Lights could cause artificially induced biological aggregations; however, impacts on the scalloped hammerhead shark would be minor as individual sharks may change their feeding habits based on these aggregations.

Mitigation Methods

Aguirre LLC has not proposed any mitigation measures specific to the scalloped hammerhead shark; however, as stated in BA section 3.3, we are recommending in section 4.5.3.3 of the draft EIS that Aguirre LLC develop a lighting plan that identifies specific measures that would be implemented to minimize or avoid impacts associated with nighttime lighting relating to the Project. We are also recommending that Aguirre LLC prepare a site-specific spill prevention and control plan to minimize the potential impacts resulting from accidental spills (see BA section 3.1). Additionally, all discharges would be subject to the requirements of the NPDES permit for the Project.

Determination of Effects

Based on the scalloped hammerhead shark's characteristics and habitat requirements, the Project's proposed construction and operation procedures, and Aguirre LLC's proposed mitigation methods, we have determined that the Project *is not likely to adversely affect* the species. Project-related impacts are expected to be temporary, as construction-related impacts such as increased chance for vessel strikes due to construction vessels and discomfort caused by pile driving noise would stop with the completion of the facilities. Operation of the Project would result in long-term, minor impacts on the scalloped hammerhead shark as a result of noise, thermal plume discharge, anti-fouling agents, lighting, and vessel strikes.

3.8 CORALS

Considering the Project-related activities and potential stressors, there are no meaningful differential susceptibilities among the protected coral species in the Project area. Therefore, these species were assessed as a group.

Background

Coral reefs are structurally and biologically complex ecosystems. The physical structure of reefs is provided primarily by scleractinian (stony) corals. These species grow in clear coastal waters and provide many services to the other species residing among them. In addition to providing structural habitat, they also produce energy via photosynthesis, recycle nutrients, deposit calcium carbonate, and produce sand (Brainard et al., 2011).

Most corals are clonal species, which means they can grow by adding additional polyps. Other than growth, a colony can expand through fragmentation where detached pieces can reattach to nearby substrate and continue growing (Acropora Biological Review Team [Acropora BRT], 2005). Additionally, corals can reproduce sexually, most commonly by broadcast spawning or brooding. Both growth mechanisms are important to survival as asexual reproduction allows for quick growth but may leave the colony susceptible to disease and other impacts due to the lack of genetic diversity.

Corals can feed both autotrophically (i.e., by synthesizing their own food) and heterotrophically (i.e., by feeding on other organisms). During daylight hours, coral colonies are provided with carbon through the photosynthetic process employed by symbiotic algae that live within the corals. Additionally, corals feed directly on zooplankton filtered from the water column, which provide additional nutrients not acquired through photosynthesis (Brainard et al., 2011).

Although coral reefs comprise only about 4 percent (0.8 square mile [2.1 square kilometers]) of the total benthic habitat in Jobos Bay (Zitello et al., 2008), they are some of the most productive habitats in the area, and provide important habitat for fish and invertebrates of commercial, recreational, and ecological value. Corals are often divided into two main types: stony, hard, or "reef-building" corals

(Scleractinia) and soft corals or gorgonians (Alcyonacea). The most common stony corals in Jobos Bay are mustard hill coral, followed by massive starlet coral, great star coral, and boulder star coral. Soft corals exhibit similar coverage patterns to hard corals. Of these, encrusting soft corals are most common in Jobos Bay, followed by sea plumes/rods/whips, and sea fans. Whitall et al. (2011) observed 24 coral species in Jobos Bay, with species richness ranging from 0 to 13 species present at individual sample sites.

Historically, elkhorn (*Acropora palmata*) and staghorn (*A. cervicornis*) corals were found throughout the shallow waters of the Caribbean sea, the southern Gulf of Mexico, and the central western Atlantic (Acropora BRT, 2005). However, in the early 1980s a major decline occurred, reducing populations by 97 percent of historic levels. Since this decline, there has been little appreciable recovery, and additional loss of established colonies was recorded throughout the late 1990s. The Acropora BRT (2005) assessed the status of these species and concluded there was no immediate threat of extinction but that there could be in the coming future; thus, these species were proposed for threatened status under the ESA in May 2005 (70 FR 24359). Approved a year later (71 FR 26852), they remained at the threatened level until they were proposed for the elevated listing of endangered in December 2012 (77 FR 73219). At that time critical habitat was designated (73 FR 72210), which includes all waters less than 98 feet (30 m) deep around Puerto Rico and associated islands. This critical habitat extends from the coast approximately 2.8 miles (4.8 km) offshore of Barca Cay, which is approximately 2.2 miles (3.5 km) south of the Project area. Elkhorn and staghorn coral critical habitat can be seen in figure 3.5.1-1 as the pink shaded areas surrounding Puerto Rico and the U.S. Virgin Islands.

Additional stony coral species proposed for endangered status in December 2012 are boulder star coral (*Montastraea annularis*), mountainous star coral (*M. faveolata*), star coral (*M. franksi*), pillar coral (*Dendrogyra cylindrus*), and rough cactus coral (*Mycetophyllia ferox*). Additional coral species proposed for threatened status are Lamarck's sheet coral (*Agaricia lamarcki*) and elliptical star coral (*Dichocoenia stokesii*).

Elkhorn coral is the largest of the *Acropora* genus, with sizeable specimens growing at least 6 feet (1.8 m) high and 12 feet (3.7 m) in diameter with thick, antler-like branches (Acropora BRT, 2005). These branches typically radiate outward from a central trunk that is attached to a hardbottom substrate. Colonies typically form asexually, with broken off branches reattaching to substrates and growing rapidly. Disease, temperature-induced bleaching, and hurricane damage seem to be the greatest threats to the species, and are likely to persist into the future as global temperatures and coastal development increase. Elkhorn coral is also very sensitive to shading effects caused by sedimentation. A study done by Rogers (1983) showed that single applications of 0.1 ounces per cubic inch (200 milligrams per cubic centimeter) of sediment to colonies caused coral tissue death as the sediments accumulated on the flattened branches of the species.

Staghorn coal is common in waters up to 66 feet (20 m) deep with colonies forming less dense structures in deeper habitat (Acropora BRT, 2005). Elkhorn coral is common in waters up to 50 feet (15 m) deep, but is most frequently found in waters less than 16 feet (5 m) deep. At these depths, colonies can be exposed at low tides and are particularly susceptible to increased energy during storm events (Acropora BRT, 2005).

Acropora spp. are at risk for extinction due to susceptibility to shading and lowered water quality conditions, in addition to disease and the major population declines already suffered. The Rogers (1983) study suggests that shading from the moored FSRU and offshore terminal may adversely affect any *Acropora* spp. that may be found in the area, resulting in reduced colony viability or mortality. LNG carriers docked at the terminal are expected to be temporary as they would be moored approximately 183 days each year (50 deliveries per year at 88 hours each). Therefore, shading from the LNG carriers could also adversely affect *Acropora* spp. found in the area.

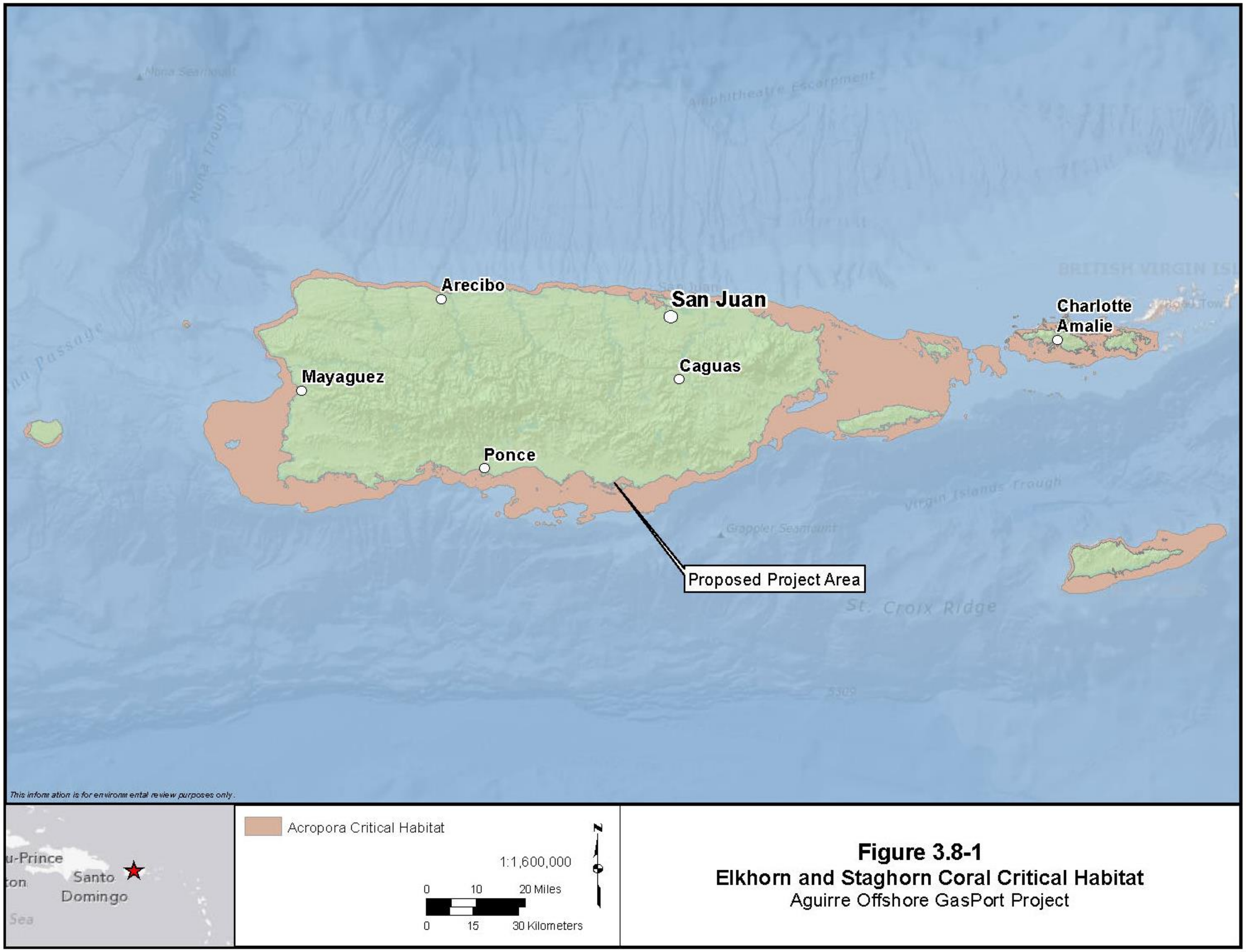

Figure 3.8-1
Elkhorn and Staghorn Coral Critical Habitat
Aguirre Offshore GasPort Project

Boulder star coral is divided into three sibling species (i.e., boulder star coral, mountainous star coral, and star coral) in the western Atlantic and Caribbean due to differences in morphology, depth range, ecology, and behavior; however, this is a recent species division with some caveats (Brainard et al., 2011). Mountainous star coral is the most genetically distinct out of the three species. It grows in heads or sheets that may be smooth or have keels or bumps. Boulder star coral grows in columns that exhibit rapid and regular upward growth; the live colonies usually lack ridges or bumps. Star coral is distinguished by large, unevenly arrayed polyps that give the colony its characteristic irregular surface (Brainard et al., 2011). Historically, these coral species were abundant in many reefs; however, the population dropped significantly in the 1990s and 2000s. The potential for recovery is low due to slow growth and low recruitment. These species are hermaphroditic broadcast spawners, and post-settlement growth rates are slow.

Elliptical star coral are spherical in structure and more common in shallower reefs. Colonies are gonochoric (i.e., male or female, rather than hermaphroditic) and spawning occurs twice per year. Juveniles are commonly found in nutrient poor waters, and the species has been shown to do well in these conditions (Brainard et al., 2011). Elliptical star coral is at risk due to population level impacts from disease. However, some tolerance may occur due to the variety of habitats this species can inhabit (Brainard et al., 2011).

Lamarck's sheet coral is an encrusting coral common at greater depths and can also occasionally be found in areas with less light than other corals (Brainard et al., 2011). The species has a thick skeleton and can be susceptible to breakage. Little is known about the reproduction of this species, but recruitment has been found to be very low (Brainard et al., 2011). Lamarck's sheet coral is at risk for extinction due to general degradation of conditions in the Caribbean and the susceptibility of this species to disease. However, it is found at greater depths than other species, where disturbances are less frequent (Brainard et al., 2011).

Pillar coral is a columnar coral that is rare, but easily identified during surveys (Brainard et al., 2011). Juveniles are infrequently identified during surveys, and asexual reproduction is thought to be the major mode of population growth. Pillar coral is at risk due to low population density (which may be part of the reason sexual reproduction is rare), low population, and disease (Brainard et al., 2011).

Rough cactus coral is an encrusting coral and is rare in Puerto Rico. It is hermaphroditic and reproduces by brooding (Brainard et al., 2011). Rough cactus coral is at risk due to low population density and disease.

<u>Field Survey Results</u>

Aguirre LLC conducted surveys of the Project area, including towed-diver video transects and sample quadrats, to characterize the benthic conditions along the proposed subsea pipeline route and within the offshore terminal site (Tetra Tech, 2012; 2014b). These surveys documented three zones in the Project area: a backreef zone, consisting mainly of dead coral rubble; a gorgonian (Alcyonacea) zone, consisting mainly of soft corals; and a forereef zone, consisting mainly of stony corals. The rubble fragments in the backreef zone were mixed with coarse-grained sand substrate. The substrate within the gorgonian zone and forereef zone was low to moderately rugose consolidated reef. Additionally, in the forereef zone, spur and groove coral formations with sand chutes were observed. Biotic cover in the forereef and gorgonian zone was approximately 85 percent, with turf algae as highest mean percent coverage at 22 percent, and followed by 22 percent macroalgae, 18 percent stony coral, 12 percent soft coral, 7 percent sponge, and 4 percent other algae and biota. During the 2012 survey work, 30 species of stony corals were documented, with starlet coral, symmetrical brain coral, and great star coral accounting for the highest cover. Sixteen species of soft coral were documented, with slimy sea plume accounting for the highest cover. All nine of the coral species that are ESA-listed or proposed for listing were observed in the Project area. Based on the survey results, Aguirre LLC estimates that there are likely

40,115 total coral colonies (421 of them being ESA-listed species) within the 20-foot-wide (6.1 m) pipeline corridor where Project construction impacts would occur. Aguirre LLC documented two ESA-listed coral species (elkhorn and staghorn coral) within offshore patch reefs at the proposed offshore berthing platform location during towed diver surveys.

Potential Impacts

Construction and operation of the pipeline and offshore terminal could cause direct physical damage to protected coral species through displacement, destruction, or shading. Physical damage may result from accidental equipment contact with the seafloor, propeller wash, and pipeline direct-lay procedures. Shading along the pipeline could result from increased sedimentation during construction, temporary placement of barges (estimated to be a maximum of six days at any given point), or from the suspension of the pipe over naturally occurring depressions in the reef. The offshore patch reef is especially susceptible to impacts from shading and mooring, with a permanent loss of coral species expected within the footprint of the offshore terminal. Physical damage can also be expected in this area from anchoring and mooring during the construction phase; however, these effects would subside upon completion of construction activities.

In addition to physical damage and shading, there are seven broadcast spawning ESA proposed and listed coral species found in the Project area (see table 3.8-1) that would be at risk of entrainment during one week in August and potentially one week in September/October, depending on the summer water temperature. Larvae at the depth of the FSRU water intake grates (23 and 36 feet [7 to 11 m] below the water surface) would be at the highest risk of entrainment. Coral gametes could be exposed to entrainment as they are spawned near the bottom, then rise to the surface and return through the water column to settle. There is also the possibility of them being carried through the water column again due to waves and currents. The larvae of the two ESA-listed species that brood would potentially be exposed to entrainment after they are released. However, brooded larvae are not buoyant and typically disperse only a short distance from their parent colony; thus, we conclude their risk of entrainment would be relatively low.

TABLE 3.8-1
Timing and Method of Reproduction for ESA Proposed and Listed Corals

Species [a]	Reproductive Method	Timing of Reproduction [b]	Time to Free-Swimming Larval Stage
Acropora cervicornis (T/PE)	Broadcast Spawning	3 days after August full moon, between approx. 7:00 to 10:30 PM	5 to 7 days
Acropora palmata (T/PE)	Broadcast Spawning	3 to 4 days after August full moon, approx. 9:00 PM	5 to 7 days
Agaricia lamarcki (PT)	Brooding	Small numbers released all night during September/October	Released as free-swimming larvae
Dendrogyra cylindrus (PE)	Broadcast Spawning	Not well known; possibly 3 to 4 days after August full moon, approx. 9:00 PM	Unknown
Dichocoenia stokesii (PT)	Broadcast Spawning	Near September/October full moon	Unknown
Montastraea annularis (PE)	Broadcast Spawning	6 to 7 days after September/October full moon; approx. 10:00 PM	3 to 8 days
Montastraea faveolata (PE)	Broadcast Spawning	6 to 7 days after September/October full moon; approx. 10:00 PM	3 to 8 days
Montastraea franksi (PE)	Broadcast Spawning	6 to 7 days after September/October full moon; approx. 10:00 PM	3 to 8 days
Mycetophyllia ferox (PE)	Brooding	February/March	Released as free-swimming larvae

Sources: Caribbean Marine Biological Institute 2012; National Marine Fisheries Service, 2012; Brainard et al. 2011; Baird et al. 2009; Riddle 2008

[a] T = Threatened; PE= Proposed for Endangered Status, PT = Proposed for Threatened Status

[b] Peak spawning times are listed, but there can be substantial variability.

In order to provide site-specific data on coral larvae densities in the vicinity of the proposed FSRU during periods of regular spawning activity, a sampling event was undertaken by Aguirre LLC between August 20 and 28, 2013 (Tetra Tech, 2014a). This period was chosen to coincide with the August 2013 spawning event predicted to take place after the monthly full moon. While the proposed FSRU would be over a benthic habitat that consists primarily of coarse sand with isolated corals occurring at low densities, the concentrated area of coral reefs found at Boca del Infierno pass (approximately 1 mile [1.6 km] to the east) must be considered when determining potential impacts from the Project (NMFS, 2012; Tetra Tech, 2012).

The subsurface plankton tow used in Tetra Tech (2014a) collects free-swimming larvae of many cnidarians including anemones, coral, and octocoral (most of which are 0.01 to 0.03 inches [300 to 700 micrometers] in size and collected with nets 300 micrometer mesh or smaller). While it is possible to distinguish anemone larvae from coral and octocoral under a microscope, it is difficult to distinguish between coral and octocoral and even more difficult to distinguish between coral families, genera, and species based on morphological features of the larvae. Most coral species are indistinguishable from one another until they settle to the bottom. Genetic analyses, which were not performed in the Tetra Tech study, could be used to determine which species are present. However, in addition to not being able to distinguish between the ESA-listed corals in the area, it was not possible to determine their density for a number of reasons, including: (a) a high diversity of hard and soft coral in the water column at the sampling depths (23 to 26 feet [7 to 8 m]; i.e., depth of the FSRU intakes) during the period of August and September (e.g., ESA species are not the only ones present), and (b) larvae are found in patchy, heterogeneous aggregations and undergo daily vertical migrations (Oliver and Willis, 1987; Richmond, 1997; Jones et al., 2010), increasing the difficulty in collecting them in tows (Tetra Tech, 2014a). Therefore, a gross density estimate of total coral larvae (i.e., total number per gallon [100 m^3]) was derived and compared with representative larvae densities from previous studies.

During a nine day period just before and following the full moon in August 2013, pre-spawn and post-spawn sampling using bongo nets with single diurnal and nocturnal tows was conducted along a single transect passing through the proposed moorage point for the FSRU (Tetra Tech, 2014a). Tows were conducted every second day during the sampling period. No coral larvae were detected during either the diurnal or nocturnal surveys on the first three days of sampling (August 22, 24, and 26). However, local anecdotal information indicated coral slicks were apparent along the southwestern Puerto Rican shore on August 24. Coral larvae were first detected on August 28 with an estimated 456 larvae collected in the nocturnal tow. However, no further sampling was conducted after this tow, so it is not possible to track densities after that point. Therefore, the range of density resulting from this one day of the sampling period was 0.085 coral larvae per 264 gallons (1 m^3) during the day and 5.31 larvae per 264 gallons (1 m^3) during the night. The range of coral larvae density (0 to 531 larvae per 26,400 gallons [100 m^3]) observed in Tetra Tech (2014a) is below that found in studies over natal reef conglomerate for other reef ecosystems (e.g., Pacific Ocean), where densities ranged from 10,000 to 1,000,000 per 26,400 gallons [100 m^3] (Hodgson, 1985; Oliver et al., 1992). However, the estimated high density of 531 larvae per 26,400 gallons (100 m^3) is more consistent with those observed in non-reef aggregate water or perimeter areas and where drift densities are remotely transported from a natal reef assemblage (Hodgson, 1985).

The two main sources of potential entrainment from the Project would be the water use at the FSRU intakes and at the LNG carriers while at berth at the Offshore GasPort. We performed an entrainment analysis for ichthyoplankton (including shellfish) and coral larvae, which are the two main types of plankton that would have the highest potential for impact. It is assumed that all pelagic eggs and larvae in the intake water would be entrained and suffer mortality. The entrainment analysis is provided in appendix E of the EIS. The entrainment of ichthyoplankton are discussed in section 4.5.4 of the draft EIS and the Essential Fish Habitat Assessment for the Project (appendix F of the draft EIS).

The entrainment estimates were calculated based on the anticipated water uses for the FSRU and LNG carriers (see table 3.8.2 below). There is a range in the potential daily operating intake volumes for the LNG carriers (based on values derived from past projects). Given the type and size of the LNG carriers in the current fleet, Aguirre LLC indicates that the higher end of that range is most likely to be representative of the Project. Thus, for the purposes of the analysis, the maximum LNG carrier intake volume of 81.6 million gallons per day (308,900 cubic meters per day) was used to estimate entrainment. We assumed that there would be 50 deliveries per year and each delivery would take 88 hours.

TABLE 3.8-2

Summary of Standard Vessel Water Use Intakes and Discharges at the Project Location

GasPort Vessels	Water Use	Seawater Intake (million gallons per day [cubic meters per day])
FSRU	Main condenser cooling system	47.0 (177,900)
	Auxiliary seawater cooling system	6.0 (22,700)
	Safety water curtain	0.6 (2,200)
	Ballast water	1.9 (7,200)
	Freshwater generator	0.3 (1,100)
	Marine growth preventative system	0.16 (605)
	Total	**55.96 (211,800)**
LNG Carriers	Main condenser cooling system	
	Auxiliary seawater cooling system	
	Safety water curtain	Variable; depending on actual vessel used
	Ballast water	
	Freshwater generator	
	Total (maximum while berthed)	**81.6 (308,900)**

Potential entrainment of coral larvae from the proposed FSRU and calling LNG carriers was estimated based on the minimum (daytime) and maximum (nighttime) density of coral larvae observed in the Tetra Tech (2014a) study, as it is the only information available at this time. The entrainment estimates of maximum daily entrainment apply only to planktonic coral densities present in the water column following the spawning activity, and should be considered a rough estimate as they are based on a single day of sampling in which larvae were present. In order to determine the number of coral larvae entrained annually, two factors need to be taken into account: 1) two major coral spawning events (August and September-October) have been identified for the southern shore of Puerto Rico, and 2) the duration of larval stage before settlement can range from 2 to 10 days (Baird, 2001). Therefore, the following equation can be used to estimate annual entrainment of coral larvae:

Number of Coral Larvae Entrained Annually (n) = $\Sigma(\text{Larvae}_{day} * 0.5\text{day} + \text{Larvae}_{night} * 0.5\text{ day}) * (\text{daily volume withdrawn m}^3) * (\text{duration of larval stage})$

Where:

Larvae_{day} = Density of larvae during daytime sampling event from Tetra Tech (2014a): 0.085 larvae/m^3);

Larvae_{night} = Density of larvae during nighttime sampling event from Tetra Tech (2014a): 5.31 larvae/m^3);

Daily Volume Withdrawn = Daily water withdrawal by the FSRU or LNG carriers (m^3), table 3.8-3;

Duration of Larval Stage = Estimated exposure duration for the coral larvae stage prior to settlement, 10 days (Baird, 2001) for two distinct spawning events.

This estimate assumes larvae would only be present at the depth of the intake 23 to 36 feet (7 to 11 m) during spawning events, which is a conservative assumption. Table 3.8-3 summarizes the annual converted entrainment for coral larvae for the FSRU and LNG carriers.

TABLE 3.8-3

Qualitative Annual Entrainment Estimate of Coral Larvae by Offshore GasPort FSRU and LNG Carriers for the Aguirre Offshore GasPort Project Area

Operating Scenario	Daytime Coral Larvae Density (no./264 gal [no./m^3]) [a]	Nighttime Coral Larvae Density (no./264 gal [no./m^3]) [a]	Duration of Larval Susceptibility to Entrainment (days)	Maximum Daily Entrainment Estimate (# of individuals)	Annual Entrainment Estimate (# of individuals)
FSRU	0.085	5.31	20 [b]	571,417	11,428,336
LNG Carries	0.085	5.31	12.7 [c]	833,231	10,582,031

[a] Source: Tetra Tech (2014a); total coral larvae collected on one sampling event – 28 August 2013
[b] Assumes two major spawning events per year with 10-day larval duration during each event.
[c] Assuming evenly spaced deliveries, one delivery would occur every 7.3 days. Therefore, a maximum of 1.7 deliveries (3.67 days in duration each) could occur during each of the two 10-day spawning events.

Equivalent adult analyses used in estimating entrainment impacts for fish cannot be used for coral larvae due to the lack of known population level parameters, the short temporal period for the pelagic stage, and the complex development of coral larvae from pelagic to sessile organisms. As a result, the annual entrainment estimates in table 3.8-3 could be considered conservative as they do not account for natural mortality of the larvae. However, these entrainment estimates need to be used with the important caveat that they are based on one day of sampling within a nine day sampling event in August 2013, which may not represent typical post-spawning larval densities.

During spawning periods, there is potential for entrainment of coral larvae with the highest risk occurring near the depth of the intake of the FSRU. Entrainment of coral larvae would likely result in a permanent, moderate impact on coral populations in the region.

While lab studies show that light can disrupt coral reproduction as spawning times are correlated to moonlight, current research is very limited and effects of lighting on corals are still largely unknown (Brady et al., 2009; Science Daily, 2008).

Coral reefs may also be affected by hydrocarbon spills (see section 3.1). These impacts would vary widely depending upon the depth and volume of the spill, as well as the properties of the material spilled.

Mitigation Methods

Aguirre LLC would float the pipeline segment that would cross the coral reef (mileposts 1.0 to 1.6) into place and tether the pipeline to piles placed outside of the reef. The pipeline would also be coated with concrete to eliminate negative buoyancy. Subsequent flooding of the pipeline segment would slowly and deliberately place the pipeline segment onto the seafloor. Once in place, the pipeline would be secured to the consolidated substrate with a series of augers (anchoring devices). This process would result in direct mortality and total loss of the benthic fauna within the footprint of the pipeline.

To potentially reduce impacts on coral reef habitat, we are recommending in section 4.5.2.4 of the draft EIS that Aguirre LLC assess the potential use of a water-to-water horizontal directional drill (HDD) between approximate mileposts 1.0 to 1.6 to avoid direct impacts on the majority of the coral reef habitat and listed coral species in the Project area. We are recommending that the assessment discuss the feasibility of an HDD based on the substrate that would be crossed and estimate the area of seafloor disturbance that would be required and volume of sediment that would be displaced at the entry and exit locations of the HDD. We are requesting that Aguirre LLC provide us the results of this assessment prior to the end of the draft EIS comment period.

Aguirre LLC proposes to relocate viable stony corals from the pipeline corridor and offshore terminal area prior to construction to minimize permanent shading and mortality impacts. Aguirre LLC has also agreed to prepare a coral reef restoration and/or mitigation plan in coordination with the NMFS and FWS to offset impacts from construction and operation of the Project. The plan would include one or more of the following: monitoring of the reef community prior to, during, and after construction; installation and monitoring of an artificial reef; coral cache and relocation to adjacent natural and/or artificial reef; development of a reef awareness/outreach program; and funding to support existing and on-going reef community programs. We are recommending in section 4.5.2.4 of the draft EIS that Aguirre LLC provide us with a draft of this plan prior to the end of the draft EIS comment period. In conjunction with seagrass and coral mitigation requirements, environmental regulatory agencies are likely to require a management plan that involves an educational program for construction personnel and work practices occurring near sensitive resources. Standard protection measures may be required which include the use of an integrated global positioning system to track vessel movement during construction activities.

To ensure that the entrainment of coral larvae is minimized or avoided, we are recommending in section 4.5.2.4 of the draft EIS that Aguirre LLC consult with the NMFS to determine the appropriate type of screen to be used during water withdrawals during construction. We are requesting that Aguirre LLC provide us the results of this consultation prior to construction.

As discussed in BA section 3.3, we are recommending in section 4.3.3.3 of the draft EIS that Aguirre LLC prepare a site-specific spill prevention and control plan to minimize the potential impacts resulting from accidental spills (see BA section 3.1). Additionally, all discharges would be subject to the requirements of the NPDES permit for the Project.

Determination of Effects

Based on the corals' characteristics and habitat requirements, the Project's proposed construction and operation procedures, and Aguirre LLC's proposed mitigation methods, we have determined that the Project *is likely to adversely affect* boulder star, elkhorn, elliptical, lamarck's sheet, mountainous star, pillar, rough cactus, staghorn, and star corals. The impacts on coral species, as well as critical habitat for elkhorn and staghorn corals, would be moderate and permanent, as the proposed direct lay technique would cause mortality of colonies and a permanent loss of substrate in the footprint of the pipeline as it crosses the Boca del Infierno. Based on the mitigation measures Aguirre LLC has proposed, along with our recommendations, we believe that impacts on proposed listed coral species and critical habitat would be minimized to the extent practicable. If indeed the method of pipe installation changes (either by Aguirre LLC proposing the HDD method or the Commission requiring it), we will note this in order to supplement the consultation record. However, we do not believe this would require re-starting Section 7 consultation, as the Project's adverse impacts on listed corals would be greatly reduced.

4.0 SUMMARY

The following table summarizes our effects determinations for the Project under Section 7 of the ESA. These determinations were based on the species' characteristics, habitat requirements, proposed construction and operation procedures, and Aguirre LLC's proposed mitigation methods.

TABLE 4-1
Determination of Effect Summary

Common Name	Scientific Name	Determination
Marine Mammals		
Antillean manatee	*Trichechus manatus manatus*	Likely to Adversely Affect
Blue whale	*Balaenoptera musculus*	Not Likely to Adversely Affect
Fin whale	*Balaenoptera physalus*	Not Likely to Adversely Affect
Humpback whale	*Megaptera novaenglia*	Not Likely to Adversely Affect
Sei whale	*Balaenoptera borealis*	Not Likely to Adversely Affect
Sperm whale	*Physeter macrocephalus*	Not Likely to Adversely Affect
Reptiles		
Green sea turtle	*Chelonia mydas*	Not Likely to Adversely Affect
Hawksbill sea turtle	*Eretmochelys imbricate*	Not Likely to Adversely Affect
Leatherback sea turtle	*Dermochelys coriacea*	Not Likely to Adversely Affect
Loggerhead sea turtle	*Caretta caretta*	Not Likely to Adversely Affect
Birds		
Piping plover	*Charadrius melodus*	Not Likely to Adversely Affect
Yellow-shouldered blackbird	*Agelaius xanthomus*	Not Likely to Adversely Affect
Rufa red knot	*Calidris canutus rufa*	Not Likely to Adversely Affect
Fishes		
Dwarf seahorse	*Hippocampus zosterae*	Not Likely to Adversely Affect
Scalloped hammerhead shark	*Sphyrna lewini*	Not Likely to Adversely Affect
Invertebrates		
Boulder star coral	*Montastraea annularis*	Likely to Adversely Affect
Elkhorn coral	*Acropora palmata*	Likely to Adversely Affect
Elliptical star coral	*Dichocoenia stokesii*	Likely to Adversely Affect
Lamarck's sheet coral	*Agaricia lamarcki*	Likely to Adversely Affect
Mountainous star coral	*Montastraea faveolata*	Likely to Adversely Affect
Pillar coral	*Dendrogyra cylindrus*	Likely to Adversely Affect
Rough cactus coral	*Mycetophyllia ferox*	Likely to Adversely Affect
Staghorn coral	*Acropora cervicornis*	Likely to Adversely Affect
Star coral	*Montastraea franksi*	Likely to Adversely Affect

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APPENDIX E

ICHTHYOPLANKTON ENTRAINMENT AND IMPINGEMENT ASSESSMENT FOR THE AGUIRRE OFFSHORE GASPORT PROJECT ENVIRONMENTAL IMPACT STATEMENT

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APPENDIX E

Ichthyoplankton Entrainment and Impingement Assessment for the Aguirre Offshore GasPort Project Environmental Impact Statement

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1.0 INTRODUCTION

This document presents the ichthyoplankton assessment model, assumptions, and data used by RPS ASA to calculate potential entrainment impacts on fish and invertebrate eggs and larvae associated with seawater intakes during operations of the proposed Aguirre Offshore GasPort Project. Note that entrainment impacts were calculated for the operation phase of the project only, as data on the water use intakes during construction were not provided. The calculations were performed in part by following the National Oceanic and Atmospheric Administration (NOAA)/U.S. Coast Guard (USCG) jointly developed ichthyoplankton methodology, as described in the ichthyoplankton assessment model appended to the Gulf Landing Final Environmental Impact Statement (USCG and MARAD, 2005 and subsequent revisions/clarifications). Not all of the steps described in this guidance were applicable in this case due to lack of extensive seasonal sampling. Because impingement is not a potential impact at the GasPort (e.g., intake velocity <0.5 fps, no screens), only entrainment is evaluated herein. Additionally, the Applicant performed their own entrainment and adult equivalents analysis (Tetra Tech, Inc. 2014b). While some inputs for this study (e.g., water intake volumes) were obtained from the Applicant’s study, the majority of the Applicant’s analysis was not used due to lack of detailed life history information for the taxa of concern. Detailed life history information is necessary to adequately determine the equivalent losses due to entrainment.

The modeling herein involves estimation of the:

- density of eggs and larvae in the intake water;

- numbers entrained based on density and volume flow in different seasons of the year (during continuous operation of the Floating Storage and Regasification Unit [FSRU] vessel and periodic deliveries from the liquefied natural gas carrier [LNGC] vessels);

- natural mortality the entrained organisms would have otherwise undergone before reaching one year of age (i.e., estimation of age-one equivalents); and

- growth and production foregone for lost individuals.

The ichthyoplankton assessment model is described in the next section. This is followed by assessments for specific species or taxa of concern that serve as indicators of the potential entrainment impacts of the project. The taxa are:

- Lutjanidae (snappers)
- Serranidae (groupers and sea basses)
- Carangidae (jacks)
- Haemulidae (grunts)
- Palinura (spiny lobster)
- Fish eggs (not identified to family)
- All unidentified and other fish larvae
- All other invertebrate larvae

The species/taxa analyzed for the ichthyoplankton entrainment assessment were chosen due to their adequate life history information and their ecological and economic importance. The density information provided by the Applicant, based on their towed ichthyoplankton net sampling as described in Tetra Tech (2012a), is only down to the family level. Therefore, key taxa of concern were chosen for entrainment calculations and specific species within those families were used as proxies for life history inputs to derive age-one equivalents and growth and production foregone for lost individuals. Table 1-1 lists the taxa of concern chosen for the entrainment analysis and their respective species used as representatives for life history inputs.

TABLE 1-1

Representative Taxa of Concern Chosen for Entrainment Calculations at the Project Location

Taxa	Common Name	Proxy Species for Life History Inputs	Rationale for Consideration
Fish Eggs	Fish Eggs	Engraulidae (bay anchovy) and Haemulidae (tomtate grunt)	Both abundant species in sampling events, thus prevalent in the area
Lutjanidae	Snappers	Silk snapper	Target reef fish in the commercial fishery
Serranidae	Groupers and Sea basses	Nassau grouper	Important continental shelf taxa
Carangidae	Jacks	Blue runner	High recreational landings as listed in the Shallow Water Reef Fish Fishery Management Plan (FMP)a
Haemulidae	Grunts	Tomtate grunt	High recreational landings as listed in the Shallow Water Reef Fish FMP
Palinura	Spiny lobsters	Caribbean spiny lobster	Important continental shelf taxa
Unidentified and All Other Fish Larvae	Unidentified and All Other Fish Larvae	Engraulidae (bay anchovy) and Haemulidae (tomtate grunt)	Majority of fish larvae collected during seasonal sampling[b]
All Other Invertebrate Larvae	Decapods, Mollusks and Cephlapods	-	Majority of invertebrate larvae collected during seasonal sampling

Sources:
[a] Caribbean Fishery Management Council (CFMC), 1985
[b] Tetra Tech 2013a, 2013b, 2013c and 2014a

Note that for the entrainment calculations of fish eggs and unidentified and other fish larvae, two proxy species were used for life history inputs in order to derive a range of growth and production foregone for lost individuals. Since the "other invertebrate larvae" is comprised of a wide range of taxa, no one proxy species could be chosen for life history inputs; thus, only raw entrainment numbers were calculated for this group.

2.0 INTAKE VOLUMES AND ASSUMPTIONS

The GasPort would accommodate two separate vessels; one for deliveries of LNG and another for LNG storage and regasification. The FSRU would be continuously moored at the GasPort, while the LNGC vessels would remain at the GasPort only while offloading product. A National Pollutant Discharge Elimination System (NPDES) permit for the FSRU would be the responsibility of the GasPort operator and the LNGCs would be privately owned and operated under permit of individual owners. Table 2-1 shows the frequency of operations for both vessels based on the expected number of deliveries per year at the proposed GasPort. The entrainment estimates were calculated based on the estimated volume of seawater that would be used by each vessel type while at the GasPort, therefore a total of four scenarios were evaluated as shown in Table 2-1.

TABLE 2-1

Operating Scenarios Evaluated for Plankton Entrainment Calculations at the Project Location for the LNGCs and FSRU

GasPort Operating Scenarios	Frequency
FSRU	Continuous Operation over all seasons (365 days each year of operation)
LNGC Vessel – 12 Deliveries per Year	3 LNG deliveries each season @ 88 hours each delivery (44 days each year of operation)
LNGC Vessel – 24 Deliveries per Year	6 LNG deliveries each season @ 88 hours each delivery (88 days each year of operation)
LNGC Vessel – 50 Deliveries per Year	12.5 LNG deliveries each season @ 88 hours each delivery (183 days each year of operation)

The normal water use requirements of the FSRU vessel would be approximately 55.96 million gallons per day (MGD) of seawater intake, operated continuously and year-round, at a rate of approximately 0.45 feet per second (fps) (Table 2-2). The water use of LNGC vessels is variable, depending on the actual vessel used for delivery (unknown at this time). However, the maximum intake volume for vessels of this class is estimated to be 81.6 MGD during offloading operations that include 88 hours of moorage at the berthing location. For the purposes of this study, the maximum intake volumes used to estimate entrainment for the FSRU and LNGC vessels are 55.96 MGD and 81.6 MGD, respectively. Entrainment impacts associated with the LNGC vessels would be associated with permits of the operators of the LNGCs.

TABLE 2-2

Summary of Standard Vessel Water Use Intakes and Discharges at the Project Location

GasPort Vessels	Water Use	Seawater Intake (MGD)
FSRU	Main condenser cooling system	47.0
	Auxiliary seawater cooling system	6.0
	Safety water curtain	0.6
	Ballast water	1.9
	Freshwater generator	0.3
	Marine growth preventative system	0.16
	Total	**55.96**
LNGCs	Main condenser cooling system	Variable; depending on actual vessel used
	Auxiliary seawater cooling system	
	Safety water curtain	
	Ballast water	
	Freshwater generator	
	Total (maximum while berthed)	**81.6**

3.0 MODEL DESCRIPTION

The NOAA/USCG jointly developed methodology for evaluating impacts of ichthyoplankton at deepwater ports was used to evaluate potential entrainment losses from the proposed project. It is assumed that all pelagic eggs and larvae in the intake water would be entrained and suffer mortality. Potential entrainment losses to eggs and larvae for a species or group due to GasPort operational intakes (FSRU continuous operation and LNGC deliveries at 12, 24, and 50 deliveries per year) were estimated by multiplying the total volume of water use by the estimated number of eggs and larvae per unit volume in the area of the GasPort. The number of eggs and larvae per unit volume was based on the Applicant's ichthyoplankton net seasonal sampling events (Tetra Tech 2013a, 2013b, 2013c and 2014a). Eggs were not identified to family or species in the Applicant's samples. These egg and larval densities represent the vertical mean for the water column, as the sampling was performed by oblique tows.

The numbers of age-one equivalents lost due to entrainment were calculated by multiplying by the survival rate from the entrained stage to one-year of age. For eggs, survival to age one (S_{e1}) is calculated as:

$$S_{e1} = 2\, S_e\, e^{-ln(1+Se)}\, S_L\, S_j$$

where S_e, S_L, and S_j are the survival rates for each stage: egg, larvae, and juvenile. For larvae, survival to age one (S_{L1}) is calculated as:

$$S_{L1} = 2\, S_L\, e^{-ln(1+SL)}\, S_j$$

For some taxa, the juvenile stage is broken into two or three stages.

To evaluate population level effects, the NOAA/USCG jointly developed ichthyoplankton entrainment methodology was used. This approach was recommended by NOAA Fisheries scientists advising the USCG, as described in USCG and MARAD (2005) and subsequent revisions/clarifications. The equations are based on fisheries models typically used for entrainment and impingement fisheries impact evaluations, which are described in Ricker (1975), Electric Power Research Institute (EPRI, 2004) and other sources.

The expected commercial and recreational harvest from the age-one equivalents (N_1) was estimated using natural and fishing mortality rates for annual age classes to estimate numbers that would remain alive by each age class. The number remaining alive at age t (years), N_t, is:

$$N_t = N_1\, e^{(-Z_a\,(t-1))}$$

$$Z_a = M_a + F_a$$

where Z_a is annual instantaneous total mortality, M_a is annual instantaneous natural mortality, and F_a is annual instantaneous fishing mortality, for age class a. The annual survival rate for age t (S_t) is thus:

$$S_t = e^{(-Z_t)}$$

The fraction dying in a year is 1-S_t.

Yield foregone (Y_k) (i.e., equivalent yield) as a result of water withdrawal was calculated using the Thompson-Bell equilibrium yield model (according to guidance from NOAA/USCG) where the harvest at each age class is calculated from number starting in the class multiplied by fishing mortality rate, $(F_a/Z_a)(1-e^{-Za})$:

$$Y_k = \sum_j \sum_a L_{jk}\, S_{ja}\, W_a\, (F_a/Z_a)(1-e^{-Za})$$

Y_k = foregone yield (kg) in year k

L_{jk} = losses of individual fish of stage j in the year k
S_{ja} = cumulative survival fraction from stage j to age a
W_a = average weight (kg) of fish at age a
F_a = instantaneous annual fishing mortality rate for fish of age a
Z_a = instantaneous annual total mortality rate for fish of age a

Total natural mortality (TM_k) is calculated using an analogous model:

$$TM_k = \sum_j \sum_a L_{jk} S_{ja} W_a (M_a/Z_a)(1-e^{-Za})$$

M_a = instantaneous annual natural mortality rate for fish of age a

For this analysis, the losses are for eggs and larvae translated to 1 year of age (i.e., one stage where j=1).

Length and weight at age were estimated using the von Bertalanffy equation and a power curve of weight versus length). The equations used are as follows. For length (mm) at age t (years):

$$L_t = L_\infty [1 - e^{(-K(t - t_0))}]$$

where L_t is length (mm) at age t (years), L_∞ is the asymptotic maximum length (mm), K is the Brody growth coefficient, and t_0 is a constant. Weight as a function of length (mm) is:

$$W_t = \alpha L_t^{\beta}$$

where W_t is wet weight (g) at age t years and α and β are constants.

Production foregone (Y_k, USEPA, 2004, Chapter A-5; based on Rago, 1984 and Jensen et al., 1988), which includes yield (harvest) and the production consumed in the food web, was also estimated, using:

$$Y_k = \sum_j \sum_a [G_a L_{jk} W_a (e^{Ga-Za-1})]/[G_a - Z_a]$$

where:

G_a is the instantaneous growth rate for individuals of age a
L_{jk} = losses of individual fish of stage j in the year k
W_a = average weight (kg) of fish at age a
Z_a = instantaneous annual total mortality rate for fish of age a

Life history parameters were compiled from available literature and are summarized by taxa in Section 5 below.

Discounting at 3% per year (NOAA, 1997) is included to translate losses of the age 1+ age classes in future years (interim loss) backwards to present-day values. The discounting multiplier for translating value n years over the life of the project is calculated as:

$$(1+d)^{-n} = 1/(1+d)^n,$$

where d = 0.03.

Thus, the losses in future years have a discounted value at the time of the initial intake. In this analysis, all discounting is calculated based on the number of years over the life of the project, which is assumed to be 40 years for the GasPort project.

4.0 ICHTHYOPLANKTON AND INVERTEBRATE ZOOPLANKTON DENSITY

Towed ichthyoplankton net sampling was conducted offshore of Boca del Infierno, near Guayama, about 1 mile outside of the Jobos Bay National Estuarine Research Reserve (JBNERR) along the southern shore of the Commonwealth of Puerto Rico in Commonwealth waters over four seasonal events between May 2012 and November 2013. During each season (May 2012, March 2013, August 2013 and November 2013), four transects were sampled during a single daytime event and a single nighttime event. The locations of these transects are shown in Figure 4-1 with the transition from the old to revised transects occurring during the March 2013 sampling event.

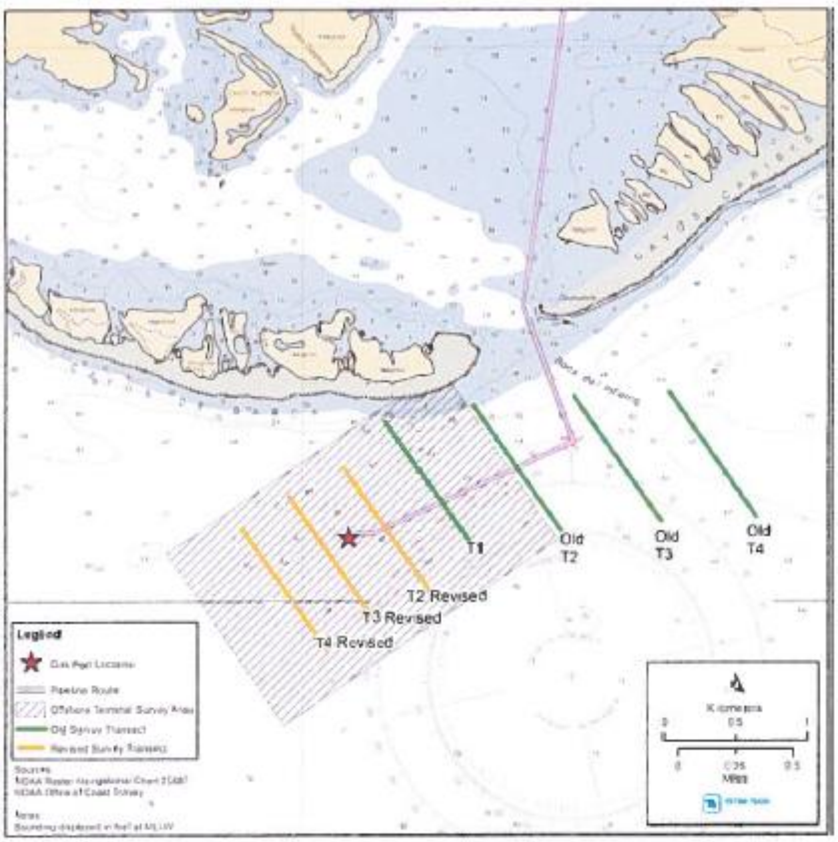

Figure 4-1. Offshore Ichthyoplankton Sampling Transects within the Project Area. Habitat and substrate types are described in Tetra Tech (2012a,b).

Ichthyoplankton were sampled from all depths across the four transects using a 0.75 m-diameter bongo net with 300-micron mesh towed from a 42 foot survey vessel. The bongo net consisted of dual 0.75 m diameter plankton nets. A collection efficiency of greater than 90 percent is typically desired and was calculated prior to the sampling event by towing the bongo net along a transect with both flowmeters and only one of the plankton nets attached, providing a ratio of the total flow measured both inside and outside of the net while under tow. This efficiency value was calculated for each sample event by dividing the total flow measured by the inside flowmeter by the total flow measured by the outside flowmeter in the frame without the cod end net. Equations for these calculations are provided in Tetra Tech, Inc. (2013b). All ichthyoplankton samples were collected at tow-speeds between 2 and 3 knots. At this speed, the duration of the 100 m^3 (minimum) target sample volume was estimated to be approximately 10 minutes. Tows were extended an additional 2 minutes to ensure the minimum sample volume was exceeded.

The collected fish and shellfish eggs and larvae were then hand-picked and sorted from each net sample. Most of the pre- and post-flexion fish larvae were identified to the family level. Shellfish larvae were identified down to class, order, or suborder, as appropriate. The total number of ichthyoplankton in each sample of a known filtered volume was used to calculate volume-based ichthyoplankton densities (number of eggs or larvae per 100 m^3 of water).

The densities of the representative taxa of concern chosen for entrainment calculations (Table 1-1) from each of the four seasonal sampling events are provided in Table 4-1.

TABLE 4-1

Densities (# of individuals) of Representative Taxa of Concern Chosen for Entrainment Calculations in the Project Area

Taxa	Mean Winter Density (#/100 m3)	Mean Winter Density (#/MG)	Mean Spring Density (#/100 m3)	Mean Spring Density (#/MG)	Mean Summer Density (#/100 m3)	Mean Summer Density (#/MG)	Mean Fall Density (#/100 m3)	Mean Fall Density (#/MG)
Total fish eggs	169	6,413	401	15,173	1,475	55,845	96	3,651
Lutjanidae	1	47	2	65	1	49	0	-
Serranidae	0.4	16	0.2	6	0	-	0.4	15
Carangidae	0	-	1	31	0.1	6	0	
Haemulidae	4	167	5	191	1	49	2	68
Palinura	3	110	0.2	9	1	45	1	36
Unidentified and other fish larvae	45	1,708	80	3,040	155	5,872	27	1,006
Other invertebrate larvae	1,151	43,573	1,481	56,068	1,629	61,661	1,847	69,907

MG = million gallons (one gallon = 0.0037854118 m^3)

5.0 MODEL INPUTS AND RESULTS FOR TAXA OF CONCERN

Data limitations exist with the density data provided by the Applicant, the primary of which is that the sampling only occurred over the course of four days, one day to represent each season. More sampling is typically needed to obtain an accurate depiction of the density of eggs and fish and invertebrate larvae in the area of the Project. These data limitations are compounded by the fact that ichthyoplankton abundance and distribution are highly variable and patchy. This patchiness derives from the natural variability of environmental influences such as water temperature, hydrographic features, spawning events and migration patterns. Additionally, the natural mortality of fish is also highly variable and depends on factors such as predation, starvation, weather, and location. Natural mortality varies among species and is greatest during early life-history stages (USEPA, 2002). Natural mortality can be as high as 96 percent for larvae and 99 percent for eggs (Houde, 1987; Lasker, 1987), and only a small percentage of newly hatched eggs or larvae typically survive to adulthood (Comyns et al., 2003).

The following subsections provide the life history information and entrainment results for each of the representative taxa of concern listed in Table 1-1.

5.1 LUTJANIDAE

Life history data were developed for silk snapper (*Lutjanus vivanus*), a prevalent species in the Project area, as a proxy species for the Lutjanidae larvae collected during sampling. These data are listed and described in Tables 5.1-1 to 5.1-6. Table 5.1-5 lists the implied number of individuals at each stage that would result in one age 1 individual, based on the assumed survival rates. Note that no Lutjanidae larvae were collected during the fall sampling event (Tetra Tech, Inc. 2014a).

Potential entrainment and impingement losses of snappers due to the intakes for the operating scenarios outlined in Table 2-1 (e.g., FSRU continuous operation and LNGC deliveries at 12, 24 and 50 per year) were estimated using the larval density data in Table 4-1. The losses were expressed as numbers of individuals entrained, equivalent numbers at age 1, and losses (kg) of age 1+ age classes per year and over the course of the project life (assumed to be 40 years) (Tables 5.1-7 to 5.1-14).

TABLE 5.1-1

Life History Parameters of Silk Snapper (*Lutjanus vivanus*)

Parameter	Value	References
Common name	Silk snapper	-
Latin name	*Lutjanus vivanus*	-
Length vs age (Von Bertalanffy equation parameters):		
L_∞ (mm)	757.0	Valle et al., 1997
K	0.1	Valle et al., 1997
t_0 (yr)	-2.08	Valle et al., 1997
Weight (g, wet) vs. Length (mm)		
α	2.07E-05	Frota, 2004
β	2.966	Frota, 2004

TABLE 5.1-2

Duration (in Days) of Life Stages of Silk Snapper (*Lutjanus vivanus)*

Stage	Stage Duration (days)	References
Egg	1	Rabalais et al., 1980
Larva	30	Assumed, typical
Juvenile 1	167	Calculated (remainder of first year)
Juvenile 2	167	Calculated (remainder of first year)

TABLE 5.1-3

Instantaneous Daily Mortality of Silk Snapper (*Lutjanus vivanus*)

Stage	Instantaneous Daily Mortality	References
Egg	0.2197	McGurk (1986) regression for fish eggs and larvae
Larva	0.08	McGurk (1986) regression for fish eggs and larvae
Juvenile 1	0.013	Peterson and Wroblewski (1984) regression
Juvenile 2	0.0037	Peterson and Wroblewski (1984) regression

TABLE 5.1-4

Instantaneous Mortality (*M* = natural, *F* = fishing), for Life Stage or Annually (Age 1+), of Silk Snapper (*Lutjanus vivanus*)

Stage	M	F	References
Egg	0.22	0.00	Calculated
Larva	2.40	0.00	Calculated
Juvenile 1	2.14	0.00	Calculated
Juvenile 2	0.62	0.00	Calculated
Age 1	0.00	0.00	Silvester et al., 1980; Pozo and Espinosa, 1982; Bryan et al., 2011; Tabash-Blanco et al., 1977
Age 2	0.40	0.30	Silvester et al., 1980; Pozo and Espinosa, 1982; Bryan et al., 2011; Tabash-Blanco et al., 1977
Age 3	0.40	0.30	Silvester et al., 1980; Pozo and Espinosa, 1982; Bryan et al., 2011; Tabash-Blanco et al., 1977
Age 4	0.40	0.30	Silvester et al., 1980; Pozo and Espinosa, 1982; Bryan et al., 2011; Tabash-Blanco et al., 1977
Age 5	0.40	0.30	Silvester et al., 1980; Pozo and Espinosa, 1982; Bryan et al., 2011; Tabash-Blanco et al., 1977
Age 6	0.40	0.30	Silvester et al., 1980; Pozo and Espinosa, 1982; Bryan et al., 2011; Tabash-Blanco et al., 1977
Age 7	0.40	0.30	Silvester et al., 1980; Pozo and Espinosa, 1982; Bryan et al., 2011; Tabash-Blanco et al., 1977
Age 8	0.40	0.30	Silvester et al., 1980; Pozo and Espinosa, 1982; Bryan et al., 2011; Tabash-Blanco et al., 1977
Age 9	0.40	0.30	Silvester et al., 1980; Pozo and Espinosa, 1982; Bryan et al., 2011; Tabash-Blanco et al., 1977
Age 10+	0.10	0.08	Silvester et al., 1980; Pozo and Espinosa, 1982; Bryan et al., 2011; Tabash-Blanco et al., 1977

TABLE 5.1-5

Number of Individuals at Each Stage that Would Result in One Age-1 Equivalent for Silk Snapper (*Lutjanus vivanus*)

Stage	Number of Individuals
Egg	196
Larva	95
Juvenile 1	9
Juvenile 2	1.4

TABLE 5.1-6

Additional Life History Inputs for Silk Snapper (*Lutjanus vivanus*) Entrainment Calculations

Parameter	Value
Survival to Age 1	3.88E-02
Production Foregone (g) per Individual Larva	1.63E-07

TABLE 5.1-7

Annual Population Impacts on Lutjanidae Larvae Under FSRU Continuous Operation

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	238,879	332,956	251,173	-
Number of Age-1 Equivalents Entrained per Year	0.039	0.054	0.041	-
Losses (kg) of Age 1+ Age Classes per Year	0.04	0.05	0.04	-

TABLE 5.1-8

Population Impacts Over 40 year Project Life on Lutjanidae Larvae Under FSRU Continuous Operation

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	9,555,150	13,318,258	10,046,937	-
Number of Age-1 Equivalents Entrained over 40 years	1.56	2.17	1.64	-
Losses (kg) of Age 1+ Age Classes over 40 years	1.48	2.06	1.56	-

TABLE 5.1-9

Annual Population Impacts on Lutjanidae Larvae Under 12 Annual LNGC Deliveries

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	42,574	58,688	43,792	-
Number of Age-1 Equivalents Entrained per Year	0.007	0.010	0.007	-
Losses (kg) of Age 1+ Age Classes per Year	0.01	0.01	0.01	-

TABLE 5.1-10

Population Impacts Over 40 year Project Life on Lutjanidae Larvae Under 12 Annual LNGC Deliveries

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	1,702,943	2,347,530	1,751,665	-
Number of Age-1 Equivalents Entrained over 40 years	0.28	0.38	0.29	-
Losses (kg) of Age 1+ Age Classes over 40 years	0.26	0.36	0.27	-

TABLE 5.1-11

Annual Population Impacts on Lutjanidae Larvae Under 24 Annual LNGC Deliveries

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	85,147	117,377	87,583	-
Number of Age-1 Equivalents Entrained per Year	0.014	0.019	0.014	-
Losses (kg) of Age 1+ Age Classes per Year	0.01	0.02	0.01	-

TABLE 5.1-12

Population Impacts Over 40 year Project Life on Lutjanidae Larvae Under 24 Annual LNGC Deliveries

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	3,405,886	4,695,060	3,503,330	-
Number of Age-1 Equivalents Entrained over 40 years	0.56	0.77	0.57	-
Losses (kg) of Age 1+ Age Classes over 40 years	0.53	0.73	0.54	-

TABLE 5.1-13

Annual Population Impacts on Lutjanidae Larvae Under 50 LNGC Annual Deliveries

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	177,390	244,534	182,465	-
Number of Age-1 Equivalents Entrained per Year	0.029	0.040	0.030	-
Losses (kg) of Age 1+ Age Classes per Year	0.03	0.04	0.03	-

TABLE 5.1-14

Population Impacts Over 40 year Project Life on Lutjanidae Larvae Under 50 Annual LNGC Deliveries

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	7,095,596	9,781,375	7,298,603	-
Number of Age-1 Equivalents Entrained over 40 years	1.157	1.594	1.190	-
Losses (kg) of Age 1+ Age Classes over 40 years	1.10	1.52	1.13	-

5.2 SERRANIDAE

Life history data were developed for Nassau grouper (*Epinephelus straitus*), a prevalent species in the Project area, as a proxy species for the Serranidae larvae collected during sampling. These data are listed and described in Tables 5.2-1 to 5.2-6. Table 5.2-5 lists the implied number of individuals at each stage that would result in one age 1 individual, based on the assumed survival rates. Note that no Serranidae larvae were collected during the summer sampling event (Tetra Tech, Inc. 2013c).

Potential entrainment and impingement losses of groupers due to the intakes for the operating scenarios outlined in Table 2-1 (e.g., FSRU continuous operation and LNGC deliveries at 12, 24 and 50 per year) were estimated using the larval density data in Table 4-1. The losses were expressed as numbers of individuals entrained, equivalent numbers at age 1, and losses (kg) of age 1+ age classes per year and over the course of the project life (assumed to be 40 years) (Tables 5.2-7 to 5.2-14).

TABLE 5.2-1

Life History Parameters of Nassau Grouper (*Epinephelus straitus*)

Parameter	Value	References
Common name	Nassau grouper	-
Latin name	*Epinephelus straitus*	-
Length vs age (Von Bertalanffy equation parameters):		
L_∞ (mm)	928.0	Valle et al. 1997
K	0.1	Valle et al. 1997
t_0 (yr)	0	Valle et al. 1997
Weight (g, wet) vs. Length (mm)		
α	5.67E-06	Olsen and LaPlace 1979
β	3.233	Olsen and LaPlace 1979

TABLE 5.2-2

Duration (in Days) of Life Stages of Nassau Grouper (*Epinephelus straitus*)

Stage	Stage Duration (days)	References
Egg	1	Rabalais et al., 1980
Larva	30	Assumed, typical
Juvenile 1	167	Calculated (remainder of first year)
Juvenile 2	167	Calculated (remainder of first year)

TABLE 5.2-3

Instantaneous Daily Mortality of Nassau Grouper (*Epinephelus straitus*)

Stage	Instantaneous Daily Mortality	References
Egg	0.2197	McGurk (1986) regression for fish eggs and larvae
Larva	0.08	McGurk (1986) regression for fish eggs and larvae
Juvenile 1	0.016	Peterson and Wroblewski (1984) regression
Juvenile 2	0.0062	Peterson and Wroblewski (1984) regression

TABLE 5.2-4

Instantaneous Mortality (*M* = natural, *F* = fishing), for Life Stage or Annually (Age 1+), of Nassau Grouper (*Epinephelus straitus*)

Stage	M	F	References
Egg	0.22	0.00	Calculated
Larva	2.40	0.00	Calculated
Juvenile 1	2.63	0.00	Calculated
Juvenile 2	1.03	0.00	Calculated
Age 1	0.18	0.37	Sadovy and Eklund, 1999
Age 2	0.18	0.37	Sadovy and Eklund, 1999
Age 3	0.18	0.37	Sadovy and Eklund, 1999
Age 4	0.18	0.37	Sadovy and Eklund, 1999
Age 5	0.18	0.37	Sadovy and Eklund, 1999
Age 6	0.18	0.37	Sadovy and Eklund, 1999
Age 7	0.18	0.37	Sadovy and Eklund, 1999
Age 8	0.18	0.37	Sadovy and Eklund, 1999
Age 9	0.18	0.37	Sadovy and Eklund, 1999
Age 10+	0.18	0.37	Sadovy and Eklund, 1999

TABLE 5.2-5

Number of Individuals at Each Stage that Would Result in One Age-1 Equivalent for Nassau Grouper (*Epinephelus straitus*)

Stage	Number of Individuals
Egg	483
Larva	234
Juvenile 1	21
Juvenile 2	1.9

TABLE 5.2-6

Additional Life History Inputs for Nassau Grouper (*Epinephelus straitus*) Entrainment Calculations

Parameter	Value
Survival to Age 1	2.71E-08
Production Foregone (g) per Individual Larva	5.97E-05

TABLE 5.2-7

Annual Population Impacts on Serranidae Larvae Under FSRU Continuous Operation

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	80,497	31,347	-	78,897
Number of Age-1 Equivalents Entrained per Year	0.002	0.001	-	0.002
Losses (kg) of Age 1+ Age Classes per Year	0.005	0.002	-	0.005

TABLE 5.2-8

Population Impacts Over 40 year Project Life on Serranidae Larvae Under FSRU Continuous Operation

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	3,219,890	1,257,486	-	3,155,868
Number of Age-1 Equivalents Entrained over 40 years	0.09	0.03	-	0.09
Losses (kg) of Age 1+ Age Classes over 40 years	0.19	0.08	-	0.19

TABLE 5.2-9

Annual Population Impacts on Serranidae Larvae Under 12 Annual LNGC Deliveries

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	14,346	5,541	-	13,755
Number of Age-1 Equivalents Entrained per Year	0.0004	0.0002	-	0.0004
Losses (kg) of Age 1+ Age Classes per Year	0.0009	0.0003	-	0.0008

TABLE 5.2-10

Population Impacts Over 40 year Project Life on Serranidae Larvae Under 12 Annual LNGC Deliveries

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	573,857	221,649	-	550,220
Number of Age-1 Equivalents Entrained over 40 years	0.02	0.01	-	0.01
Losses (kg) of Age 1+ Age Classes over 40 years	0.03	0.01	-	0.03

TABLE 5.2-11

Annual Population Impacts on Serranidae Larvae Under 24 Annual LNGC Deliveries

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	28,693	11,082	-	27,511
Number of Age-1 Equivalents Entrained per Year	0.001	0.0003	-	0.001
Losses (kg) of Age 1+ Age Classes per Year	0.002	0.001	-	0.002

TABLE 5.2-12

Population Impacts Over 40 year Project Life on Serranidae Larvae Under 24 Annual LNGC Deliveries

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	1,147,714	443,299	-	1,100,440
Number of Age-1 Equivalents Entrained over 40 years	0.03	0.01	-	0.03
Losses (kg) of Age 1+ Age Classes over 40 years	0.07	0.03	-	0.07

TABLE 5.2-13

Annual Population Impacts on Serranidae Larvae Under 50 Annual LNGC Deliveries

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	59,777	23,088	-	57,315
Number of Age-1 Equivalents Entrained per Year	0.002	0.001	-	0.002
Losses (kg) of Age 1+ Age Classes per Year	0.004	0.001	-	0.003

TABLE 5.2-14

Population Impacts Over 40 year Project Life on Serranidae Larvae Under 50 Annual LNGC Deliveries

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	2,391,071	923,540	-	2,292,582
Number of Age-1 Equivalents Entrained over 40 years	0.065	0.025	-	0.062
Losses (kg) of Age 1+ Age Classes over 40 years	0.14	0.06	-	0.14

5.3 CARANGIDAE

Life history data were developed for blue runner (*Caranx crysos*), a prevalent species in the Project area, as a proxy species for the Carangidae larvae collected during sampling. These data are listed and described in Tables 5.3-1 to 5.3-6. Table 5.3-5 lists the implied number of individuals at each stage that would result in one age 1 individual, based on the assumed survival rates. Note that no Carangidae larvae were collected during the winter or fall sampling events (Tetra Tech, Inc. 2013b; 2014a).

Potential entrainment and impingement losses of jacks due to the intakes for the operating scenarios outlined in Table 2-1 (e.g., FSRU continuous operation and LNGC deliveries at 12, 24 and 50 per year) were estimated using the larval density data in Table 4-1. The losses were expressed as numbers of individuals entrained, equivalent numbers at age 1, and losses (kg) of age 1+ age classes per year and over the course of the project life (assumed to be 40 years) (Tables 5.3-7 to 5.3-14).

TABLE 5.3-1

Life History Parameters of Blue Runner (*Caranx crysos*)

Parameter	Value	References
Common name	Blue runner	-
Latin name	*Caranx crysos*	-
Length vs age (Von Bertalanffy equation parameters):		
L_∞ (mm)	412	Goodwin and Johnson, 1986
K	0.35	Goodwin and Johnson, 1986
t_0 (yr)	-1.17	Goodwin and Johnson, 1986
Weight (g, wet) vs. Length (mm)		
α	4.21E-05	Frota et al., 2004
β	2.861	Frota et al., 2004

TABLE 5.3-2

Duration (in Days) of Life Stages of Blue Runner (*Caranx crysos*)

Stage	Stage Duration (days)	References
Egg	1	Rabalais et al., 1980
Larva	30	Assumed, typical
Juvenile 1	167	Calculated (remainder of first year)
Juvenile 2	167	Calculated (remainder of first year)

TABLE 5.3-3

Instantaneous Daily Mortality of Blue runner (*Caranx crysos*)

Stage	Instantaneous Daily Mortality	References
Egg	0.2197	McGurk (1986) regression for fish eggs and larvae
Larva	0.08	McGurk (1986) regression for fish eggs and larvae
Juvenile 1	0.012	Peterson and Wroblewski (1984) regression
Juvenile 2	0.0034	Peterson and Wroblewski (1984) regression

TABLE 5.3-4

Instantaneous Mortality (*M* = natural, *F* = fishing), for Life Stage or Annually (Age 1+), of Blue Runner (*Caranx crysos*)

Stage	M	F	References
Egg	0.22	0.00	(calculated)
Larva	2.40	0.00	(calculated)
Juvenile 1	2.07	0.00	(calculated)
Juvenile 2	0.57	0.00	(calculated)
Age 1	0.47	0.16	Frota et al. 2004; Goodwin and Johnson 1986
Age 2	0.47	0.16	Frota et al. 2004; Goodwin and Johnson 1986
Age 3	0.47	0.16	Frota et al., 2004; Goodwin and Johnson, 1986
Age 4	0.47	0.16	Frota et al., 2004; Goodwin and Johnson, 1986
Age 5	0.47	0.16	Frota et al., 2004; Goodwin and Johnson, 1986
Age 6	0.47	0.16	Frota et al., 2004; Goodwin and Johnson, 1986
Age 7	0.47	0.16	Frota et al., 2004; Goodwin and Johnson, 1986
Age 8	0.47	0.16	Frota et al., 2004; Goodwin and Johnson, 1986
Age 9	0.47	0.16	Frota et al., 2004; Goodwin and Johnson, 1986
Age 10+	0.47	0.16	Frota et al., 2004; Goodwin and Johnson, 1986

TABLE 5.3-5

Number of Individuals at Each Stage that Would Result in One Age-1 Equivalent for Blue Runner (*Caranx crysos*)

Stage	Number of Individuals
Egg	174
Larva	85
Juvenile 1	8
Juvenile 2	1.4

TABLE 5.3-6

Additional Life History Inputs for Blue Runner (*Caranx crysos*) Entrainment Calculations

Parameter	Value
Survival to Age 1	2.10E-07
Production Foregone (g) per Individual Larva	1.96E-04

TABLE 5.3-7

Annual Population Impacts on Carangidae Larvae Under FSRU Continuous Operation

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	-	155,721	28,338	-
Number of Age-1 Equivalents Entrained per Year	-	0.033	0.006	-
Losses (kg) of Age 1+ Age Classes per Year	-	0.03	0.01	-

TABLE 5.3-8

Population Impacts Over 40 year Project Life on Carangidae Larvae Under FSRU Continuous Operation

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	-	6,228,833	1,133,514	-
Number of Age-1 Equivalents Entrained over 40 years	-	1.31	0.24	-
Losses (kg) of Age 1+ Age Classes over 40 years	-	1.22	0.22	-

TABLE 5.3-9

Annual Population Impacts on Carangidae Larvae Under 12 Annual LNGC Deliveries

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	-	27,448	4,941	-
Number of Age-1 Equivalents Entrained per Year	-	0.006	0.001	-
Losses (kg) of Age 1+ Age Classes per Year	-	0.005	0.001	-

TABLE 5.3-10

Population Impacts Over 40 year Project Life on Carangidae Larvae Under 12 Annual LNGC Deliveries

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	-	1,097,919	197,626	-
Number of Age-1 Equivalents Entrained over 40 years	-	0.23	0.04	-
Losses (kg) of Age 1+ Age Classes over 40 years	-	0.22	0.04	-

TABLE 5.3-11

Annual Population Impacts on Carangidae Larvae Under 24 Annual LNGC Annual Deliveries

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	-	54,896	9,881	-
Number of Age-1 Equivalents Entrained per Year	-	0.012	0.002	-
Losses (kg) of Age 1+ Age Classes per Year	-	0.011	0.002	-

TABLE 5.3-12

Population Impacts Over 40 year Project Life on Carangidae Larvae Under 24 Annual LNGC Deliveries

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	-	2,195,839	395,252	-
Number of Age-1 Equivalents Entrained over 40 years	-	0.46	0.08	-
Losses (kg) of Age 1+ Age Classes over 40 years	-	0.43	0.08	-

TABLE 5.3-13

Annual Population Impacts on Carangidae Larvae Under 50 Annual LNGC Deliveries

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	-	114,367	20,586	-
Number of Age-1 Equivalents Entrained per Year	-	0.024	0.004	-
Losses (kg) of Age 1+ Age Classes per Year	-	0.022	0.004	-

TABLE 5.3-14

Population Impacts Over 40 year Project Life on Carangidae Larvae Under 50 Annual LNGC Deliveries

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	-	4,574,664	823,442	-
Number of Age-1 Equivalents Entrained over 40 years	-	0.961	0.173	-
Losses (kg) of Age 1+ Age Classes over 40 years	-	0.90	0.16	-

5.4 HAEMULIDAE

Life history data were developed for tomtate grunt (*Haemulon aurolineatum*), a prevalent species in the Project area, as a proxy species for the Haemulidae larvae collected during sampling. These data are listed and described in Tables 5.4-1 to 5.4-6. Table 5.4-5 lists the implied number of individuals at each stage that would result in one age 1 individual, based on the assumed survival rates.

Potential entrainment and impingement losses of grunts due to the intakes for the operating scenarios outlined in Table 2-1 (e.g., FSRU continuous operation and LNGC deliveries at 12, 24 and 50 per year) were estimated using the larval density data in Table 4-1. The losses were expressed as numbers of individuals entrained, equivalent numbers at age 1, and losses (kg) of age 1+ age classes per year and over the course of the project life (assumed to be 40 years) (Tables 5.4-7 to 5.4-14).

TABLE 5.4-1

Life History Parameters of Tomtate Grunt (*Haemulon aurolineatum*)

Parameter	Value	References
Common name	Tomtate grunt	-
Latin name	*Haemulon aurolineatum*	-
Length vs age (Von Bertalanffy equation parameters):		
L∞ (mm)	230.0	Munro, 1974
K	0.35	Munro, 1974
t0 (yr)	0	Munro, 1974
Weight (g, wet) vs. Length (mm)		
α	6.19E-06	Bohnsack and Harper, 1988
β	3.208	Bohnsack and Harper, 1988

TABLE 5.4-2

Duration (in Days) of Life Stages of Tomtate Grunt (*Haemulon aurolineatum*)

Stage	Stage Duration (days)	References
Egg	30	Assumed, typical (e.g., red snapper)
Larva	167	Calculated (remainder of first year))
Juvenile 1	167	Calculated (remainder of first year)
Juvenile 2	30	Assumed, typical (e.g., red snapper)

TABLE 5.4-3

Instantaneous Daily Mortality of Tomtate Grunt (*Haemulon aurolineatum*)

Stage	Instantaneous Daily Mortality	References
Egg	0.2197	McGurk (1986) regression for fish eggs and larvae
Larva	0.08	McGurk (1986) regression for fish eggs and larvae
Juvenile 1	0.017	Peterson and Wroblewski (1984) regression
Juvenile 2	0.0074	Peterson and Wroblewski (1984) regression

TABLE 5.4-4

Instantaneous Mortality (*M* = natural, *F* = fishing), for Life Stage or Annually (Age 1+), of Tomtate Grunt (*Haemulon aurolineatum*)

Stage	M	F	References
Egg	0.22	0.00	Calculated
Larva	2.40	0.00	Calculated
Juvenile 1	2.82	0.00	Calculated
Juvenile 2	1.23	0.00	Calculated
Age 1	1.19	0.00	Munro, 1974; Manooch and Barans, 1982
Age 2	1.19	0.00	Munro, 1974; Manooch and Barans, 1982
Age 3	1.19	0.00	Munro, 1974; Manooch and Barans, 1982
Age 4	1.19	0.00	Munro, 1974; Manooch and Barans, 1982
Age 5	1.19	0.00	Munro, 1974; Manooch and Barans, 1982
Age 6	1.19	0.00	Munro, 1974; Manooch and Barans, 1982
Age 7	1.19	0.00	Munro, 1974; Manooch and Barans, 1982
Age 8	1.19	0.00	Munro, 1974; Manooch and Barans, 1982
Age 9	1.19	0.00	Munro, 1974; Manooch and Barans, 1982
Age 10+	1.19	0.00	Munro, 1974; Manooch and Barans, 1982

TABLE 5.4-5

Number of Individuals at Each Stage that Would Result in One Age-1 Equivalent for Tomtate Grunt (*Haemulon aurolineatum*)

Stage	Number of Individuals
Egg	712
Larva	346
Juvenile 1	30
Juvenile 2	2.2

TABLE 5.4-6

Additional Life History Inputs for Tomtate Grunt (*Haemulon aurolineatum*) Entrainment Calculations

Parameter	Value
Survival to Age 1	1.32E-08
Production Foregone (g) per Individual Larva	4.21E-05

TABLE 5.4-7

Annual Population Impacts on Haemulidae Larvae Under FSRU Continuous Operation

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	842,299	971,437	253,764	347,772
Number of Age-1 Equivalents Entrained per Year	0.011	0.013	0.003	0.005
Losses (kg) of Age 1+ Age Classes per Year	0.04	0.04	0.01	0.01

TABLE 5.4-8

Population Impacts Over 40 year Project Life on Haemulidae Larvae Under FSRU Continuous Operation

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	33,691,974	38,857,481	10,150,575	13,910,875
Number of Age-1 Equivalents Entrained over 40 years	0.44	0.51	0.13	0.18
Losses (kg) of Age 1+ Age Classes over 40 years	1.42	1.64	0.43	0.59

TABLE 5.4-9

Annual Population Impacts on Haemulidae Larvae Under 12 Annual LNGC Deliveries

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	150,117	171,229	44,243	60,633
Number of Age-1 Equivalents Entrained per Year	0.002	0.002	0.001	0.001
Losses (kg) of Age 1+ Age Classes per Year	0.006	0.007	0.002	0.003

TABLE 5.4-10

Population Impacts Over 40 year Project Life on Haemulidae Larvae Under 12 Annual LNGC Deliveries

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	6,004,669	6,849,177	1,769,734	2,425,335
Number of Age-1 Equivalents Entrained over 40 years	0.08	0.09	0.02	0.03
Losses (kg) of Age 1+ Age Classes over 40 years	0.25	0.29	0.07	0.10

TABLE 5.4-11

Annual Population Impacts on Haemulidae Larvae Under 24 Annual LNGC Deliveries

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	300,233	342,459	88,487	121,267
Number of Age-1 Equivalents Entrained per Year	0.004	0.005	0.001	0.002
Losses (kg) of Age 1+ Age Classes per Year	0.013	0.014	0.004	0.005

TABLE 5.4-12

Population Impacts Over 40 year Project Life on Haemulidae Larvae Under 24 Annual LNGC Deliveries

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	12,009,338	13,698,354	3,539,468	4,850,670
Number of Age-1 Equivalents Entrained over 40 years	0.16	0.18	0.05	0.06
Losses (kg) of Age 1+ Age Classes over 40 years	0.51	0.58	0.15	0.20

TABLE 5.4-13

Annual Population Impacts on Haemulidae Larvae Under 50 Annual LNGC Deliveries

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	625,486	713,456	184,347	252,639
Number of Age-1 Equivalents Entrained per Year	0.008	0.009	0.002	0.003
Losses (kg) of Age 1+ Age Classes per Year	0.03	0.03	0.01	0.01

TABLE 5.4-14

Population Impacts Over 40 year Project Life on Haemulidae Larvae Under 50 Annual LNGC Deliveries

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	25,019,455	28,538,237	7,373,891	10,105,563
Number of Age-1 Equivalents Entrained over 40 years	0.329	0.376	0.097	0.133
Losses (kg) of Age 1+ Age Classes over 40 years	1.05	1.20	0.31	0.43

5.5 PALINURA

Life history data were developed for Caribbean spiny lobster (*Panulirus argus*) as a proxy species for the Palinura larvae collected during sampling. These data are listed and described in Tables 5.5-1 to 5.5-6. Table 5.5-5 lists the implied number of individuals at each stage that would result in one age 1 individual, based on the assumed survival rates.

Potential entrainment and impingement losses of spiny lobsters due to the intakes for the operating scenarios outlined in Table 2-1 (e.g., FSRU continuous operation and LNGC deliveries at 12, 24 and 50 per year) were estimated using the larval density data in Table 4-1. The losses were expressed as numbers of individuals entrained, equivalent numbers at age 1, and losses (kg) of age 1+ age classes per year and over the course of the project life (assumed to be 40 years) (Tables 5.5-7 to 5.5-14).

TABLE 5.5-1

Life History Parameters of Caribbean Spiny Lobster (*Panulirus argus*)

Parameter	Value	References
Common name	Atlantic spiny lobster	-
Latin name	*Panulirus argus*	-
Length vs age (Von Bertalanffy equation parameters):		
L_∞ (mm)	190.0	Marx and Herrnkind, 1986
K	0.22	Marx and Herrnkind, 1986
t_0 (yr)	0	Marx and Herrnkind, 1986
Weight (g, wet) vs. Length (mm)		
α	4.12E-03	Marx and Herrnkind, 1986
β	2.64	Marx and Herrnkind, 1986

TABLE 5.5-2

Duration (in Days) of Life Stages of Caribbean Spiny Lobster (*Panulirus argus*)

Stage	Stage Duration (days)	References
Egg	1	Rabalais et al., 1980
Larva	5	Assumed age in plankton sample
Juvenile 1	179.5	Calculated (remainder of first year)
Juvenile 2	179.5	Calculated (remainder of first year)

TABLE 5.5-3

Instantaneous Daily Mortality of Caribbean Spiny Lobster (*Panulirus argus*)

Stage	Instantaneous Daily Mortality	References
Egg	1.1599	McGurk 1986 regression for fish eggs and larvae
Larva	0.73	McGurk 1986 regression for fish eggs and larvae
Juvenile 1	0.026	Peterson and Wroblewski (1984) regression
Juvenile 2	0.0058	Peterson and Wroblewski (1984) regression

TABLE 5.5-4

Instantaneous Mortality (*M* = natural, *F* = fishing), for Life Stage or Annually (Age 1+), of Caribbean Spiny Lobster (*Panulirus argus*)

Stage	M	F	References
Egg	1.16	0.00	Calculated
Larva	3.66	0.00	Calculated
Juvenile 1	4.71	0.00	Calculated
Juvenile 2	1.04	0.00	Calculated
Age 1	0.40	0.00	Marx and Herrnkind, 1986
Age 2	0.40	1.80	Marx and Herrnkind, 1986
Age 3	0.40	1.80	Marx and Herrnkind, 1986
Age 4	0.40	1.80	Marx and Herrnkind, 1986
Age 5	0.40	1.80	Marx and Herrnkind, 1986
Age 6	0.40	1.80	Marx and Herrnkind, 1986
Age 7	0.40	1.80	Marx and Herrnkind, 1986
Age 8	0.40	1.80	Marx and Herrnkind, 1986
Age 9	0.40	1.80	Marx and Herrnkind, 1986
Age 10+	0.40	1.80	Marx and Herrnkind, 1986

TABLE 5.5-5

Number of Individuals at Each Stage that Would Result in One Age-1 Equivalent for Caribbean Spiny Lobster (*Panulirus argus*)

Stage	Number of Individuals
Egg	25,621
Larva	6,272
Juvenile 1	159
Juvenile 2	1.9

TABLE 5.5-6

Additional Life History Inputs for Caribbean Spiny Lobster (*Panulirus argus*) Entrainment Calculations

Parameter	Value
Survival to Age 1	3.61E-08
Production Foregone (g) per Individual Larva	2.78E-05

TABLE 5.5-7

Annual Population Impacts on Palinura Larvae Under FSRU Continuous Operation

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	552,055	47,130	232,997	186,543
Number of Age-1 Equivalents Entrained per Year	0.020	0.002	0.008	0.007
Losses (kg) of Age 1+ Age Classes per Year	0.015	0.001	0.006	0.005

TABLE 5.5-8

Population Impacts Over 40 year Project Life on Palinura Larvae Under FSRU Continuous Operation

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	22,082,204	1,885,200	9,319,880	7,461,724
Number of Age-1 Equivalents Entrained over 40 years	0.80	0.07	0.34	0.27
Losses (kg) of Age 1+ Age Classes over 40 years	0.61	0.05	0.26	0.21

TABLE 5.5-9

Annual Population Impacts on Palinura Larvae Under 12 Annual LNGC Deliveries

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	98,389	8,307	40,623	32,523
Number of Age-1 Equivalents Entrained per Year	0.0036	0.0003	0.0015	0.0012
Losses (kg) of Age 1+ Age Classes per Year	0.0027	0.0002	0.0011	0.0009

TABLE 5.5-10

Population Impacts Over 40 year Project Life on Palinura Larvae Under 12 Annual LNGC Deliveries

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	3,935,547	332,293	1,624,904	1,300,938
Number of Age-1 Equivalents Entrained over 40 years	0.14	0.01	0.06	0.05
Losses (kg) of Age 1+ Age Classes over 40 years	0.11	0.01	0.05	0.04

TABLE 5.5-11

Annual Population Impacts on Palinura Larvae Under 24 Annual LNGC Deliveries

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	196,777	16,615	81,245	65,047
Number of Age-1 Equivalents Entrained per Year	0.007	0.001	0.003	0.002
Losses (kg) of Age 1+ Age Classes per Year	0.0055	0.0005	0.0023	0.0018

TABLE 5.5-12

Population Impacts Over 40 year Project Life on Palinura Larvae Under 24 Annual LNGC Deliveries

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	7,871,093	664,586	3,249,807	2,601,875
Number of Age-1 Equivalents Entrained over 40 years	0.3	0.0	0.1	0.1
Losses (kg) of Age 1+ Age Classes over 40 years	0.2	0.02	0.1	0.1

TABLE 5.5-13

Annual Population Impacts on Palinura Larvae Under 50 Annual LNGC Deliveries

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	409,953	34,614	169,261	135,514
Number of Age-1 Equivalents Entrained per Year	0.015	0.001	0.006	0.005
Losses (kg) of Age 1+ Age Classes per Year	0.011	0.001	0.005	0.004

TABLE 5.5-14

Population Impacts Over 40 year Project Life on Palinura Larvae Under 50 Annual LNGC Deliveries

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	16,398,111	1,384,554	6,770,432	5,420,574
Number of Age-1 Equivalents Entrained over 40 years	0.59	0.05	0.24	0.20
Losses (kg) of Age 1+ Age Classes over 40 years	0.46	0.04	0.19	0.15

5.6 FISH EGGS

To derive age-1 equivalent and production foregone losses for fish eggs, life history data for Haemulidae, with tomtate grunt (*Haemulon aurolineatum)* as the proxy, and Engraulidae, with bay anchovy (*Anchoa mitchilli)* as the proxy, were used to develop of a range of results. The data for bay anchovy are listed and described in Tables 5.6-1 to 5.6-6. Table 5.6-5 lists the implied number of individuals at each stage that would result in one age 1 individual, based on the assumed survival rates. The life history data used for tomtate grunt are provided in Tables 5.4-1 to 5.4-6.

Potential entrainment and impingement losses of fish eggs due to the intakes for the operating scenarios outlined in Table 2-1 (e.g., FSRU continuous operation and LNGC deliveries at 12, 24 and 50 per year) were estimated using the egg density data in Table 4-1. The losses were expressed as numbers of individuals entrained, equivalent numbers at age 1, and losses (kg) of age 1+ age classes per year and over the course of the project life (assumed to be 40 years) (Tables 5.6-7 to 5.6-14 using Engraulidae life history, and 5.6-15 to 5.6-22 using Haemulidae life history). Note that the number of age-1 equivalents entrained, production foregone, and losses of age 1+ age classes in future years were all calculated from the fertilized egg stage. The total raw entrainment numbers are based on the actual number of fish eggs counted from the four seasonal sampling events.

TABLE 5.6-1

Life History Parameters of Bay Anchovy (*Anchoa mitchilli)*

Parameter	Value	References
Common name	Bay anchovy	-
Latin name	*Anchoa mitchilli*	-
Length vs age (Von Bertalanffy equation parameters):		
L_∞ (mm)	107.0	Newberger and Houde, 1995
K	0.36	Newberger and Houde, 1995
t_0 (yr)	-0.81	Newberger and Houde, 1995
Weight (g, wet) vs. Length (mm)		
α	9.51E-06	Dawson, 1965
β	3.18	Dawson, 1965

TABLE 5.6-2

Duration (in Days) of Life Stages of Bay Anchovy (*Anchoa mitchilli)*

Stage	Stage Duration (days)	References
Egg	1	Rabalais et al., 1980
Larva	30	Assumed, typical
Juvenile 1	167	Calculated (remainder of first year)
Juvenile 2	167	Calculated (remainder of first year)

TABLE 5.6-3

Instantaneous Daily Mortality of Bay Anchovy (*Anchoa mitchilli)*

Stage	Instantaneous Daily Mortality	References
Egg	0.2197	McGurk (1986) regression for fish eggs and larvae
Larva	0.08	McGurk (1986) regression for fish eggs and larvae
Juvenile 1	0.018	Peterson and Wroblewski (1984) regression
Juvenile 2	0.0083	Peterson and Wroblewski (1984) regression

TABLE 5.6-4

Instantaneous Mortality (*M* = natural, *F* = fishing), for Life Stage or Annually (Age 1+), of Bay anchovy (*Anchoa mitchilli)*

Stage	M	F	References
Egg	0.22	0	Calculated
Larva	2.40	0	Calculated
Juvenile 1	2.96	0	Calculated
Juvenile 2	1.38	0	Calculated
Age 1	2.30	0	USEPA, 2002
Age 2	2.30	0	USEPA, 2002
Age 3	2.30	0	USEPA, 2002
Age 4	2.30	0	USEPA, 2002
Age 5	2.30	0	USEPA, 2002
Age 6	2.30	0	USEPA, 2002
Age 7	2.30	0	USEPA, 2002
Age 8	2.30	0	USEPA, 2002
Age 9	2.30	0	USEPA, 2002
Age 10+	2.30	0	USEPA, 2002

TABLE 5.6-5

Number of Individuals at Each Stage that Would Result in One Age-1 Equivalent for Bay Anchovy (*Anchoa mitchilli)*

Stage	Number of Individuals
Egg	952
Larva	462
Juvenile 1	40
Juvenile 2	2.5

TABLE 5.6-6

Additional Life History Inputs for Bay Anchovy (*Anchoa mitchilli)* Entrainment Calculations

Parameter	Value
Survival to Age 1	7.79E-09
Production Foregone (g) per Individual Larva	3.88E-05

TABLE 5.6-7

Annual Population Impacts on Fish Eggs Under FSRU Continuous Operation, Assuming Life History of Bay Anchovy (proxy for Engraulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	25,926,039	62,024,952	230,798,420	15,091,059
Number of Age-1 Equivalents Entrained per Year	0.202	0.483	1.798	0.118
Losses (kg) of Age 1+ Age Classes per Year [a]	1.0	2.4	9.0	0.6

[a] Estimates calculated using eggs at time of hatching

TABLE 5.6-8

Population Impacts Over 40 year Project Life on Fish Eggs Under FSRU Continuous Operation, Assuming Life History of Bay Anchovy (proxy for Engraulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	1,037,041,556	2,480,998,082	9,231,936,782	603,642,374
Number of Age-1 Equivalents Entrained over 40 years	8.1	19.3	71.9	4.7
Losses (kg) of Age 1+ Age Classes over 40 years	40.2	96.3	358.3	23.4

TABLE 5.6-9

Annual Population Impacts on Fish Eggs Under 12 Annual LNGC Deliveries, Assuming Life History of Bay Anchovy (proxy for Engraulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	4,620,605	10,932,769	40,239,274	2,631,098
Number of Age-1 Equivalents Entrained per Year	0.04	0.09	0.31	0.02
Losses (kg) of Age 1+ Age Classes per Year [a]	0.2	0.4	1.6	0.1

[a] Estimates calculated using eggs at time of hatching

TABLE 5.6-10

Population Impacts Over 40 year Project Life on Fish Eggs Under 12 Annual LNGC Deliveries, Assuming Life History of Bay Anchovy (proxy for Engraulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	184,824,180	437,310,771	1,609,570,978	105,243,923
Number of Age-1 Equivalents Entrained over 40 years	1.4	3.4	12.5	0.8
Losses (kg) of Age 1+ Age Classes over 40 years	7.2	17.0	62.5	4.1

TABLE 5.6-11

Annual Population Impacts on Fish Eggs Under 24 Annual LNGC Deliveries, Assuming Life History of Bay Anchovy (proxy for Engraulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	9,241,209	21,865,539	80,478,549	5,262,196
Number of Age-1 Equivalents Entrained per Year	0.1	0.2	0.6	0.0
Losses (kg) of Age 1+ Age Classes per Year [a]	0.4	0.8	3.1	0.2

[a] Estimates calculated using eggs at time of hatching

TABLE 5.6-12

Population Impacts Over 40 year Project Life on Fish Eggs Under 24 Annual LNGC Deliveries, Assuming Life History of Bay Anchovy (proxy for Engraulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	369,648,360	874,621,542	3,219,141,955	210,487,846
Number of Age-1 Equivalents Entrained over 40 years	2.9	6.8	25.1	1.6
Losses (kg) of Age 1+ Age Classes over 40 years	14.3	33.9	124.9	8.2

TABLE 5.6-13

Annual Population Impacts on Fish Eggs Under 50 Annual LNGC Deliveries, Assuming Life History of Bay Anchovy (proxy for Engraulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	19,252,519	45,553,205	167,663,644	10,962,909
Number of Age-1 Equivalents Entrained per Year	0.1	0.4	1.3	0.1
Losses (kg) of Age 1+ Age Classes per Year [a]	0.7	1.8	6.5	0.4

[a] Estimates calculated using eggs at time of hatching

TABLE 5.6-14

Population Impacts Over 40 year Project Life on Fish Eggs Under 50 Annual LNGC Deliveries, Assuming Life History of Bay Anchovy (proxy for Engraulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	770,100,751	1,822,128,213	6,706,545,740	438,516,346
Number of Age-1 Equivalents Entrained over 40 years	6.0	14.2	52.2	3.4
Losses (kg) of Age 1+ Age Classes over 40 years	29.9	70.7	260.3	17.0

TABLE 5.6-15

Annual Population Impacts on Fish Eggs Under FSRU Continuous Operation, Assuming Life History of Tomtate Grunt (proxy for Haemulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	25,926,039	62,024,952	230,798,420	15,091,059
Number of Age-1 Equivalents Entrained per Year	0.34	0.82	3.04	0.20
Losses (kg) of Age 1+ Age Classes per Year [a]	1.1	2.6	9.7	0.6

[a] Estimates calculated using eggs at time of hatching

TABLE 5.6-16

Population Impacts Over 40 year Project Life on Fish Eggs Under FSRU Continuous Operation, Assuming Life History of Tomtate Grunt (proxy for Haemulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	1,037,041,556	2,480,998,082	9,231,936,782	603,642,374
Number of Age-1 Equivalents Entrained over 40 years	13.6	32.6	121.5	7.9
Losses (kg) of Age 1+ Age Classes over 40 years	43.6	104.4	388.5	25.4

TABLE 5.6-17

Annual Population Impacts on Fish Eggs Under 12 Annual LNGC Deliveries, Assuming Life History of Tomtate Grunt (proxy for Haemulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	4,620,605	10,932,769	40,239,274	2,631,098
Number of Age-1 Equivalents Entrained per Year	0.1	0.1	0.5	0.0
Losses (kg) of Age 1+ Age Classes per Year [a]	0.2	0.5	1.7	0.1

[a] Estimates calculated using eggs at time of hatching

TABLE 5.6-18

Population Impacts Over 40 year Project Life on Fish Eggs Under 12 Annual LNGC Deliveries, Assuming Life History of Tomtate Grunt (proxy for Haemulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	184,824,180	437,310,771	1,609,570,978	105,243,923
Number of Age-1 Equivalents Entrained over 40 years	2.4	5.8	21.2	1.4
Losses (kg) of Age 1+ Age Classes over 40 years	7.8	18.4	67.7	4.4

TABLE 5.6-19

Annual Population Impacts on Fish Eggs Under 24 Annual LNGC Deliveries, Assuming Life History of Tomtate Grunt (proxy for Haemulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	9,241,209	21,865,539	80,478,549	5,262,196
Number of Age-1 Equivalents Entrained per Year	0.1	0.3	1.1	0.1
Losses (kg) of Age 1+ Age Classes per Year [a]	0.4	0.9	3.4	0.2

[a] Estimates calculated using eggs at time of hatching

TABLE 5.6-20

Population Impacts Over 40 year Project Life on Fish Eggs Under 24 Annual LNGC Deliveries, Assuming Life History of Tomtate Grunt (proxy for Haemulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	369,648,360	874,621,542	3,219,141,955	210,487,846
Number of Age-1 Equivalents Entrained over 40 years	4.9	11.5	42.4	2.8
Losses (kg) of Age 1+ Age Classes over 40 years	15.6	36.8	135.5	8.9

TABLE 5.6-21

Annual Population Impacts on Fish Eggs Under 50 Annual LNGC Deliveries, Assuming Life History of Tomtate Grunt (proxy for Haemulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	19,252,519	45,553,205	167,663,644	10,962,909
Number of Age-1 Equivalents Entrained per Year	0.3	0.6	2.2	0.1
Losses (kg) of Age 1+ Age Classes per Year[a]	0.8	1.9	7.1	0.5

[a] Estimates calculated using eggs at time of hatching

TABLE 5.6-22

Population Impacts Over 40 year Project Life on Fish Eggs Under 50 Annual LNGC Deliveries, Assuming Life History of Tomtate Grunt (proxy for Haemulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	770,100,751	1,822,128,213	6,706,545,740	438,516,346
Number of Age-1 Equivalents Entrained over 40 years	10.1	24.0	88.3	5.8
Losses (kg) of Age 1+ Age Classes over 40 years	32.4	76.7	282.2	18.5

5.7 ALL OTHER FISH LARVAE

To derive age-1 equivalent and production foregone losses for all other fish larvae (including the unidentified larvae collected during sampling), life history data for Haemulidae, with tomtate grunt (*Haemulon aurolineatum)* as the proxy, and Engraulidae, with bay anchovy (*Anchoa mitchilli)* as the proxy, were used to develop of a range of results. The life history data used for bay anchovy are provided in Tables 5.6-1 to 5.6-6, and the data for tomtate grunt are provided in Tables 5.4-1 to 5.4-6. Table 5.7-1 lists all of the taxa collected during the four seasonal sampling events (Tetra Tech 2013a, 2013b, 2013c and 2014a).

Potential entrainment and impingement losses of all other fish larvae due to the intakes for the operating scenarios outlined in Table 2-1 (e.g., FSRU continuous operation and LNGC deliveries at 12, 24 and 50 per year) were estimated using the larval density data in Table 4-1. The losses were expressed as numbers of individuals entrained, equivalent numbers at age 1, and losses (kg) of age 1+ age classes per year and over the course of the project life (assumed to be 40 years) (Tables 5.7-2 to 5.7-9 using life history inputs for Engraulidae, and Tables 5.7-10 to 5.7-17 using life history inputs for Haemulidae).

TABLE 5.7-1

Species List of Ichthyoplankton Collected by Aguirre LLC at the Proposed FSRU Location

Family	Common Name
Nemichthyidae	Snipe eels
Ophichthidae	Snake eels
Atherinidae	Silversides
Synodontidae	Lizardfishes
Unknown Beloniformid	--
Hemiramphidae	Half-beaks
Exocoetidae	Flying fishes
Berycidae	Redfishes/Alfonsinos
Clupeidae/Engraulidae	Sardines/Anchovies
Gobiesocidae	Clingfishes
Antennariidae	Frogfishes
Myctophidae	Myctophids
Mugiliformes	Mugilidae
Ophidiidae	Cusk-eels
Bythitidae	Brotulas
Apogonidae	Cardinalfishes
Bleniidae	Blennies
Callionymidae	Dragonets
Carangidae	Jacks
Coryphaenidae	Dolphinfishes
Eleotridae	Sleepers
Ephippidae	Spadefishes
Gerreidae	Mojarras
Gobiidae	Gobies
Haemulidae	Grunts
Labridae	Wrasses
Lutjanidae	Snappers
Microdesmidae	Wormfishes
Opistognathidae	Jawfishes
Pleuronectiformes	Flounders
Pomacanthidae	Angelfishes
Pomacentridae	Damselfishes
Scaridae	Parrotfishes
Sciaenidae	Drums/Croakers
Scombridae	Tunas/Mackerels
Serranidae	Sea Basses/Groupers

TABLE 5.7-1 (cont'd)

Species List of Ichthyoplankton Collected by Aguirre LLC at the Proposed FSRU Location

Family	Common Name
Sparidae	Porgies
Sphyraenidae	Barracudas
Tripterygiidae	Triplefin Blennies
Bothidae	Left-eye Flounders
Scorpaenidae	Scorpionfishes
Syngnathidae	Pipefishes
Aulostomidae	Trumpetfishes
Balistidae	Triggerfishes
Monacanthidae	Filefishes
Ostraciidae	Trunkfishes
Tetraodontidae	Porcupinefishes
Fish egg	--
Unidentified fish larvae	--

TABLE 5.7-2

Annual Population Impacts on Other and Unidentified Fish Larvae Under FSRU Continuous Operation, Assuming Life History of Bay Anchovy (proxy for Engraulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	8,602,885	15,480,914	30,230,885	5,178,506
Number of Age-1 Equivalents Entrained per Year	0.1	0.1	0.2	0.0
Losses (kg) of Age 1+ Age Classes per Year	0.3	0.6	1.2	0.2

TABLE 5.7-3

Population Impacts Over 40 year Project Life on Fish Eggs Under FSRU Continuous Operation, Assuming Life History of Bay Anchovy (proxy for Engraulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	344,115,396	619,236,549	1,209,235,386	207,140,227
Number of Age-1 Equivalents Entrained over 40 years	2.7	4.8	9.4	1.6
Losses (kg) of Age 1+ Age Classes over 40 years	13.4	24.0	46.9	8.0

TABLE 5.7-4

Annual Population Impacts on Other and Unidentified Fish Larvae Under 12 Annual LNGC Deliveries, Assuming Life History of Bay Anchovy (proxy for Engraulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	1,533,228	2,728,729	5,270,698	902,863
Number of Age-1 Equivalents Entrained per Year	0.01	0.02	0.04	0.01
Losses (kg) of Age 1+ Age Classes per Year	0.1	0.1	0.2	0.0

TABLE 5.7-5

Population Impacts Over 40 year Project Life on Fish Eggs Under FSRU Continuous Operation, Assuming Life History of Bay Anchovy (proxy for Engraulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	61,329,120	109,149,142	210,827,937	36,114,513
Number of Age-1 Equivalents Entrained over 40 years	0.5	0.9	1.6	0.3
Losses (kg) of Age 1+ Age Classes over 40 years	2.4	4.2	8.2	1.4

TABLE 5.7-6

Annual Population Impacts on Other and Unidentified Fish Larvae Under 24 Annual LNGC Deliveries, Assuming Life History of Bay Anchovy (proxy for Engraulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	3,066,456	5,457,457	10,541,397	1,805,726
Number of Age-1 Equivalents Entrained per Year	0.02	0.04	0.08	0.01
Losses (kg) of Age 1+ Age Classes per Year	0.12	0.21	0.41	0.07

TABLE 5.7-7

Population Impacts Over 40 year Project Life on Fish Eggs Under FSRU Continuous Operation, Assuming Life History of Bay Anchovy (proxy for Engraulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	122,658,240	218,298,285	421,655,873	72,229,025
Number of Age-1 Equivalents Entrained over 40 years	1.6	2.9	5.5	1.0
Losses (kg) of Age 1+ Age Classes over 40 years	4.8	8.5	16.4	2.8

TABLE 5.7-8

Annual Population Impacts on Other and Unidentified Fish Larvae Under 50 Annual LNGC Deliveries, Assuming Life History of Bay Anchovy (proxy for Engraulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	6,388,450	11,369,702	21,961,243	3,761,928
Number of Age-1 Equivalents Entrained per Year	0.05	0.09	0.17	0.03
Losses (kg) of Age 1+ Age Classes per Year	0.25	0.44	0.85	0.15

TABLE 5.7-9

Population Impacts Over 40 year Project Life on Fish Eggs Under FSRU Continuous Operation, Assuming Life History of Bay Anchovy (proxy for Engraulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	255,537,999	454,788,093	878,449,736	150,477,136
Number of Age-1 Equivalents Entrained over 40 years	2.0	3.5	6.8	1.2
Losses (kg) of Age 1+ Age Classes over 40 years	9.9	17.6	34.1	5.8

TABLE 5.7-10

Annual Population Impacts on Other and Unidentified Fish Larvae Under FSRU Continuous Operation, Assuming Life History of Tomtate Grunt (proxy for Haemulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	8,602,885	15,480,914	30,230,885	5,178,506
Number of Age-1 Equivalents Entrained per Year	0.1	0.2	0.4	0.1
Losses (kg) of Age 1+ Age Classes per Year	0.4	0.7	1.3	0.2

TABLE 5.7-11

Population Impacts Over 40 year Project Life on Fish Eggs Under FSRU Continuous Operation, Assuming Life History of Tomtate Grunt (proxy for Haemulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	344,115,396	619,236,549	1,209,235,386	207,140,227
Number of Age-1 Equivalents Entrained over 40 years	4.5	8.1	15.9	2.7
Losses (kg) of Age 1+ Age Classes over 40 years	14.5	26.1	50.9	8.7

TABLE 5.7-12

Annual Population Impacts on Other and Unidentified Fish Larvae Under 12 Annual LNGC Deliveries, Assuming Life History of Tomtate Grunt (proxy for Haemulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	1,533,228	2,728,729	5,270,698	902,863
Number of Age-1 Equivalents Entrained per Year	0.02	0.04	0.07	0.01
Losses (kg) of Age 1+ Age Classes per Year	0.1	0.1	0.2	0.04

TABLE 5.7-13

Population Impacts Over 40 year Project Life on Fish Eggs Under FSRU Continuous Operation, Assuming Life History of Tomtate Grunt (proxy for Haemulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	61,329,120	109,149,142	210,827,937	36,114,513
Number of Age-1 Equivalents Entrained over 40 years	0.8	1.4	2.8	0.5
Losses (kg) of Age 1+ Age Classes over 40 years	2.6	4.6	8.9	1.5

TABLE 5.7-14

Annual Population Impacts on Other and Unidentified Fish Larvae Under 24 Annual LNGC Deliveries, Assuming Life History of Tomtate Grunt (proxy for Haemulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	3,066,456	5,457,457	10,541,397	1,805,726
Number of Age-1 Equivalents Entrained per Year	0.04	0.07	0.14	0.02
Losses (kg) of Age 1+ Age Classes per Year	0.13	0.23	0.44	0.08

TABLE 5.7-15

Population Impacts Over 40 year Project Life on Fish Eggs Under FSRU Continuous Operation, Assuming Life History of Tomtate Grunt (proxy for Haemulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	122,658,240	218,298,285	421,655,873	72,229,025
Number of Age-1 Equivalents Entrained over 40 years	1.6	2.9	5.5	1.0
Losses (kg) of Age 1+ Age Classes over 40 years	5.2	9.2	17.7	3.0

TABLE 5.7-16

Annual Population Impacts on Other and Unidentified Fish Larvae Under 50 Annual LNGC Deliveries, Assuming Life History of Tomtate Grunt (proxy for Haemulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained per Year	6,388,450	11,369,702	21,961,243	3,761,928
Number of Age-1 Equivalents Entrained per Year	0.1	0.1	0.3	0.05
Losses (kg) of Age 1+ Age Classes per Year	0.3	0.5	0.9	0.2

TABLE 5.7-17

Population Impacts Over 40 year Project Life on Fish Eggs Under FSRU Continuous Operation, Assuming Life History of Tomtate Grunt (proxy for Haemulidae)

Estimated Loss	Winter	Spring	Summer	Fall
Total Number of Individuals Entrained over 40 years	255,537,999	454,788,093	878,449,736	150,477,136
Number of Age-1 Equivalents Entrained over 40 years	3.4	6.0	11.6	2.0
Losses (kg) of Age 1+ Age Classes over 40 years	10.8	19.1	37.0	6.3

5.8 ALL OTHER INVERTEBRATE LARVAE

The other invertebrate larvae collected during the four seasonal sampling events included hermit crabs (Section Anomura), true crabs (Section Brachyura), shrimps (Sub-Order Natantia), gastropods (Class Gastropoda), and squids (Order Teuthoidea). Since the life history of all of these groups is so varied, estimates of equivalent numbers at age 1, and losses (kg) of age 1+ age classes in future years were not derived for this group. The total annual number of individuals entrained for these other invertebrate larval groups is provided in Table 5.8-1 and the total entrainment over the project life of 40 years is in Table 5.8-2.

TABLE 5.8-1

Total Annual Entrainment (# of individuals) for Other Invertebrate Larvae Under All Operating Scenarios

Operating Scenario	Winter	Spring	Summer	Fall
FSRU Continuous Operation	218,823,329	284,703,259	316,543,183	358,877,082
LNGC, 12 Annual Deliveries	39,111,075	50,326,843	55,346,961	62,748,962
LNGC, 24 Annual Deliveries	78,222,151	100,653,687	110,693,923	125,497,923
LNGC, 50 Annual Deliveries)	162,962,814	209,695,180	230,612,339	261,454,007

TABLE 5.8-2

Total Entrainment (# of individuals) Over Project Life of 40 Years for Other Invertebrate Larvae Under All Operating Scenarios

Operating Scenario	Winter	Spring	Summer	Fall
FSRU Continuous Operation	8,752,933,160	11,388,130,360	12,661,727,320	14,355,083,280
LNGC, 12 Annual Deliveries	1,564,443,000	2,013,073,720	2,213,878,440	2,509,958,480
LNGC, 24 Annual Deliveries	3,128,886,040	4,026,147,480	4,427,756,920	5,019,916,920
LNGC, 50 Annual Deliveries)	6,518,512,560	8,387,807,200	9,224,493,560	10,458,160,280

5.9 SUMMARY

The predicted entrainment and mortality results are summarized by representative taxa of concern in Tables 5.9-1 to 5.9-8.

TABLE 5.9-1

Annual Population Impacts Under FSRU Continuous Operations

Taxa	Common Name	Stage	Number of Individuals (millions)	Number of Age-1 Equivalents	Annual Losses of Age 1+ Age Classes	
					lbs	kg
Lutjanidae	snappers	larvae	0.8	0.13	0.3	0.1
Serranidae	groupers	larvae	0.2	0.01	0.28	0.13
Carangidae	jacks	larvae	0.2	0.04	0.03	0.01
Haemulidae	grunts	larvae	2.4	0.03	0.08	0.04
Palinura	spiny lobster	larvae	1.0	0.04	0.22	0.10
All other fish taxa as Engraulidae	anchovies	larvae	59.5	0.46	0.06	0.03
All other fish taxa as Haemulidae	grunts	larvae	59.5	0.78	0.22	0.10
Fish eggs as Engraulidae	anchovies	eggs	333.8	2.60	5.52	2.50
Fish eggs as Haemulidae	grunts	eggs	333.8	4.39	28.56	12.96

TABLE 5.9-2

Population Impacts Over Project Life of 40 Years Under FSRU Continuous Operations

Taxa	Common Name	Stage	Number of Individuals (millions)	Number of Age-1 Equivalents	Losses of Age 1+ Age Classes Over Future (40) Years	
					lbs	kg
Lutjanidae	snappers	larvae	32.9	5.4	11.2	5.1
Serranidae	groupers	larvae	7.6	0.2	1.0	0.5
Carangidae	jacks	larvae	7.4	1.5	3.2	1.4
Haemulidae	grunts	larvae	96.6	1.3	9.0	4.1
Palinura	spiny lobster	larvae	40.7	1.5	2.5	1.1
All other fish taxa as Engraulidae	anchovies	larvae	2,379.7	18.5	9.0	4.1
All other fish taxa as Haemulidae	grunts	larvae	2,379.7	31.3	220.8	100.1
Fish eggs as Engraulidae	anchovies	eggs	13,353.6	104.0	1,142.5	518.2
Fish eggs as Haemulidae	grunts	eggs	13,353.6	175.7	1,238.8	561.9

TABLE 5.9-3

Annual Population Impacts Under 12 LNGC Deliveries per Year

Taxa	Common Name	Stage	Number of Individuals (millions)	Number of Age-1 Equivalents	Annual Losses of Age 1+ Age Classes	
					lbs	kg
Lutjanidae	snappers	larvae	0.1	0.02	0.05	0.02
Serranidae	groupers	larvae	0.03	0.001	0.004	0.002
Carangidae	jacks	larvae	0.03	0.01	0.01	0.01
Haemulidae	grunts	larvae	0.4	0.01	0.04	0.02
Palinura	spiny lobster	larvae	0.2	0.01	0.01	0.01
All other fish taxa as Engraulidae	anchovies	larvae	10.4	0.08	0.04	0.02
All other fish taxa as Haemulidae	grunts	larvae	10.4	0.14	0.97	0.44
Fish eggs as Engraulidae	anchovies	eggs	58.4	0.46	5.00	2.27
Fish eggs as Haemulidae	grunts	eggs	58.4	0.77	5.42	2.46

TABLE 5.9-4

Population Impacts Over Project Life of 40 Years Under 12 LNGC Deliveries per Year

Taxa	Common Name	Stage	Number of Individuals (millions)	Number of Age-1 Equivalents	Losses of Age 1+ Age Classes Over Future (40) Years	
					lbs	kg
Lutjanidae	snappers	larvae	5.8	0.9	2.0	0.9
Serranidae	groupers	larvae	1.35	0.04	0.2	0.1
Carangidae	jacks	larvae	1.30	0.3	0.6	0.3
Haemulidae	grunts	larvae	17.0	0.2	1.6	0.7
Palinura	spiny lobster	larvae	7.2	0.3	0.4	0.2
All other fish taxa as Engraulidae	anchovies	larvae	417.4	3.3	1.6	0.7
All other fish taxa as Haemulidae	grunts	larvae	417.4	5.5	38.7	17.6
Fish eggs as Engraulidae	anchovies	eggs	2,336.9	18.2	199.9	90.7
Fish eggs as Haemulidae	grunts	eggs	2,336.9	30.8	216.8	98.3

TABLE 5.9-5

Annual Population Impacts Under 24 LNGC Deliveries per Year

Taxa	Common Name	Stage	Number of Individuals (millions)	Number of Age-1 Equivalents	Annual Losses of Age 1+ Age Classes	
					lbs	kg
Lutjanidae	snappers	larvae	0.3	0.05	0.10	0.04
Serranidae	groupers	larvae	0.1	0.002	0.01	0.004
Carangidae	jacks	larvae	0.1	0.01	0.03	0.01
Haemulidae	grunts	larvae	0.9	0.01	0.08	0.04
Palinura	spiny lobster	larvae	0.4	0.01	0.02	0.01
All other fish taxa as Engraulidae	anchovies	larvae	20.9	0.16	0.08	0.04
All other fish taxa as Haemulidae	grunts	larvae	20.9	0.27	1.94	0.88
Fish eggs as Engraulidae	anchovies	eggs	116.8	0.91	10.00	4.53
Fish eggs as Haemulidae	grunts	eggs	116.8	1.54	10.84	4.92

TABLE 5.9-6

Population Impacts Over Project Life of 40 Years Under 24 LNGC Deliveries per Year

Taxa	Common Name	Stage	Number of Individuals (millions)	Number of Age-1 Equivalents	Losses of Age 1+ Age Classes Over Future (40) Years	
					lbs	kg
Lutjanidae	snappers	larvae	11.6	1.9	4.0	1.8
Serranidae	groupers	larvae	2.7	0.1	0.4	0.2
Carangidae	jacks	larvae	2.6	0.5	1.1	0.5
Haemulidae	grunts	larvae	34.1	0.4	3.2	1.4
Palinura	spiny lobster	larvae	14.4	0.5	0.9	0.4
All other fish taxa as Engraulidae	anchovies	larvae	834.8	6.5	3.2	1.4
All other fish taxa as Haemulidae	grunts	larvae	834.8	11.0	77.4	35.1
Fish eggs as Engraulidae	anchovies	eggs	4,673.9	36.4	399.9	181.4
Fish eggs as Haemulidae	grunts	eggs	4,673.9	61.5	433.6	196.7

TABLE 5.9-7

Annual Population Impacts Under 50 LNGC Deliveries per Year

Taxa	Common Name	Stage	Number of Individuals (millions)	Number of Age-1 Equivalents	Annual Losses of Age 1+ Age Classes	
					lbs	kg
Lutjanidae	snappers	larvae	0.6	0.10	0.21	0.09
Serranidae	groupers	larvae	0.1	0.004	0.02	0.01
Carangidae	jacks	larvae	0.1	0.03	0.06	0.03
Haemulidae	grunts	larvae	1.8	0.02	0.16	0.07
Palinura	spiny lobster	larvae	0.7	0.03	0.05	0.02
All other fish taxa as Engraulidae	anchovies	larvae	43.5	0.34	0.16	0.07
All other fish taxa as Haemulidae	grunts	larvae	43.5	0.57	4.03	1.83
Fish eggs as Engraulidae	anchovies	eggs	243.4	1.90	20.83	9.45
Fish eggs as Haemulidae	grunts	eggs	243.4	3.20	22.58	10.24

TABLE 5.9-8

Population Impacts Over Project Life of 40 Years Under 50 LNGC Deliveries per Year

Taxa	Common Name	Stage	Number of Individuals (millions)	Number of Age-1 Equivalents	Losses of Age 1+ Age Classes Over Future (40) Years	
					Lbs	kg
Lutjanidae	snappers	larvae	24.2	3.9	8.3	3.7
Serranidae	groupers	larvae	5.6	0.2	0.7	0.3
Carangidae	jacks	larvae	5.4	1.1	2.3	1.1
Haemulidae	grunts	larvae	71.0	0.9	6.6	3.0
Palinura	spiny lobster	larvae	30.0	1.1	1.8	0.8
All other fish taxa as Engraulidae	anchovies	larvae	1,739.3	13.5	6.6	3.0
All other fish taxa as Haemulidae	grunts	larvae	1,739.3	22.9	161.3	73.2
Fish eggs as Engraulidae	anchovies	eggs	9,737.3	75.9	833.1	377.9
Fish eggs as Haemulidae	grunts	eggs	9,737.3	128.1	903.3	409.7

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APPENDIX F

ESSENTIAL FISH HABITAT ASSESSMENT

Essential Fish Habitat Assessment

Aguirre Offshore GasPort Project

Docket No. CP13-193-000

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

August 2014

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LIST OF ACRONYMS

Aguirre LLC	Aguirre Offshore GasPort, LLC
Aguirre Plant	Aguirre Power Plant Complex
cm	centimeter
CMFC	Caribbean Fishery Management Council
dB	decibel
°C	degrees Celsius
°F	degrees Fahrenheit
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
FERC	Federal Energy Regulatory Commission
FMP	Fishery Management Plan
FSRU	Floating Storage and Regasification Unit
FWS	U.S. Fish and Wildlife Service
HDD	horizontal directional drilling
HMS	Highly Migratory Species
km	kilometer
LNG	liquefied natural gas
m	meter
m^3	cubic meter
mg/L	milligrams per liter
MP	milepost
MSA	Magnuson-Stevens Fishery Management and Conservation Act
NMFS	National Marine Fisheries Service
ppm	parts per million
PREPA	Puerto Rico Electric Power Authority
Project	Aguirre Offshore GasPort Project
Tetra Tech	Tetra Tech, Inc.
USCG	U.S. Coast Guard

1.0 INTRODUCTION AND PROPOSED ACTION

On April 17, 2013, Aguirre Offshore GasPort, LLC (Aguirre LLC), a wholly owned subsidiary of Excelerate Energy, LP filed an application with the Federal Energy Regulatory Commission (FERC) under Section 3 of the Natural Gas Act and Part 153 of the FERC's regulations. The application was assigned Docket No. CP13-193-000 and a Notice of Application was issued on April 30, 2013 and noticed in the Federal Register on May 6, 2013. Aguirre LLC is seeking authorization from the FERC to develop, construct, and operate a liquefied natural gas (LNG) import terminal off the southern coast of Puerto Rico. Aguirre LLC's proposal, referred to as the Aguirre Offshore GasPort Project (Project), is being developed in cooperation with the Puerto Rico Electric Power Authority (PREPA) for the purpose of receiving, storing, and regasifying the LNG to be acquired by PREPA, and delivering natural gas to PREPA's existing Aguirre Power Plant Complex (Aguirre Plant) in Salinas, Puerto Rico. The proposed Project is discussed in more detail in section 2.0.

2.0 PURPOSE OF THE ESSENTIAL FISH HABITAT ASSESSMENT

The Magnuson-Stevens Fishery Management and Conservation Act of 1976 (MSA) was established to promote conservation of marine fishery (shellfish and finfish) resources. This included the establishment of eight regional fishery management councils that develop fishery management plans to properly manage fishery resources within their jurisdictional waters. The 1986 and 1996 amendments to the MSA recognized that many fisheries are dependent on nearshore and estuarine habitats for at least part of their lifecycles and included evaluation of habitat loss and protection of critical habitat. The marine environments important to marine fisheries are referred to as essential fish habitat (EFH) and are defined to include "those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity." The act further mandates the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) division to coordinate with other federal agencies to avoid, minimize, or otherwise offset adverse effects on EFH that could result from proposed activities. This EFH assessment evaluates the impacts on EFH from construction and operation of the Project per the requirements of the MSA, as amended.

2.1 OVERVIEW OF THE ESSENTIAL FISH HABITAT ASSESSMENT

Seven habitat types are identified by the Caribbean Fishery Management Council (CFMC) as EFH within the Project area. These habitats include reef/hard bottom, reef rubble, seagrass, benthic algae, sand/shell bottom, soft bottom, and water column. Additionally, the Jobos Bay National Estuarine Research Reserve mangroves have been identified as an EFH area having particular ecological importance to Caribbean reef fish species and, as such, this area is designated as a Habitat Area of Particular Concern under the Reef Fish Fishery Management Plan (FMP).

Four CFMC-managed fisheries are present in the Project area (Spiny Lobster, Queen Conch, Reef Fish, and Coral [which includes corals and reef-associated plants and invertebrates]). Four species of fish are also found in the area and managed under the highly migratory species (HMS) plan administered by the Office of Sustainable Fisheries. These fisheries could potentially be affected by construction-related activities.

Aguirre LLC completed benthic surveys in May 2012 (Tetra Tech, Inc. [Tetra Tech], 2012), during which 74 fish species were observed within the Project area, 48 of which are listed in the Reef Fish FMP. Of the 159 species of coral and reef associated plants and invertebrates documented, over 107 are managed under the Coral FMP. All conch and spiny lobster that were observed are managed under their respective FMPs. Construction would affect the habitat of these species; however, reef fish, lobster, and HMS are highly mobile and construction should not cause direct mortality of these species. Conch and reef associated plants and invertebrates are less mobile and construction may cause mortality if encountered during construction.

3.0 DESCRIPTION OF THE PROPOSED PROJECT

The Project would consist of an offshore terminal platform, an offshore marine LNG receiving facility, consisting of a Floating Storage and Regasification Unit (FSRU) moored at the offshore terminal, and a subsea pipeline linking the receiving facility to PREPA's existing onshore Aguirre Plant. Aguirre LLC would construct the LNG terminal approximately 3 miles off the southern coast of Puerto Rico, about 1 mile outside of Jobos Bay, near the towns of Salinas and Guayama. Aguirre LLC is also proposing to utilize a construction office, contractor staging area, and existing pier within the Aguirre Plant property.

The offshore terminal would be a fixed platform carrying topside facilities and two berths, one on each side of the fixed platform. Aguirre LLC would design the platform for long-term mooring of an FSRU and for receipt of LNG carriers ranging in size from 163,500 to 283,800 cubic yards (125,000 to 217,000 cubic meters [m^3]). The FSRU would moor at a berth on the north (landward) side of the platform and the LNG carriers would temporarily dock on the south (seaward) side of the platform while unloading LNG cargo. LNG cargo would transfer from the LNG carrier from conventional LNG loading arms and cryogenic piping to the FSRU for storage.

The subsea interconnecting pipeline would extend approximately 4.1 miles (6.6 kilometer [km]) from the offshore terminal in the Caribbean Sea, northward through the Boca del Infierno pass, and across the basin of Jobos Bay to the Aguirre Plant property where it would interconnect with existing plant piping. The subsea interconnecting pipeline would consist of an 18-inch-diameter (46 centimeter [cm]) steel pipe with a maximum allowable operating pressure of 1,450 pounds per square inch (9,997,000 Pascals). Prior to shipment of the pipe to the Project site, the manufacturer would coat the pipe with concrete for an outside diameter of approximately 24 inches (61 cm). The pipeline segments would be fabricated on shallow water pipe lay barges then laid directly on the seafloor. A general Project location map is shown in figure 2.1-1. For a more detailed description, please see section 2.1 of the draft environmental impact statement (EIS) issued in August 2014.

3.1 LAND REQUIREMENTS

As discussed above, Aguirre LLC would construct the majority of the Project facilities offshore, including the offshore terminal and subsea pipeline. The construction of these facilities would require approximately 156.7 acres (161.4 cuerdas) at the water surface and would directly impact 116.9 acres (120.4 cuerdas) of the seafloor. The Project would permanently impact about 25.3 acres (26.1 cuerdas) of seafloor by the operation of the offshore facilities. In addition, Aguirre LLC would impact about 1.5 acres (1.5 cuerdas) of land within the existing Aguirre Plant property for a temporary staging and support area where the subsea pipeline would reach landfall.

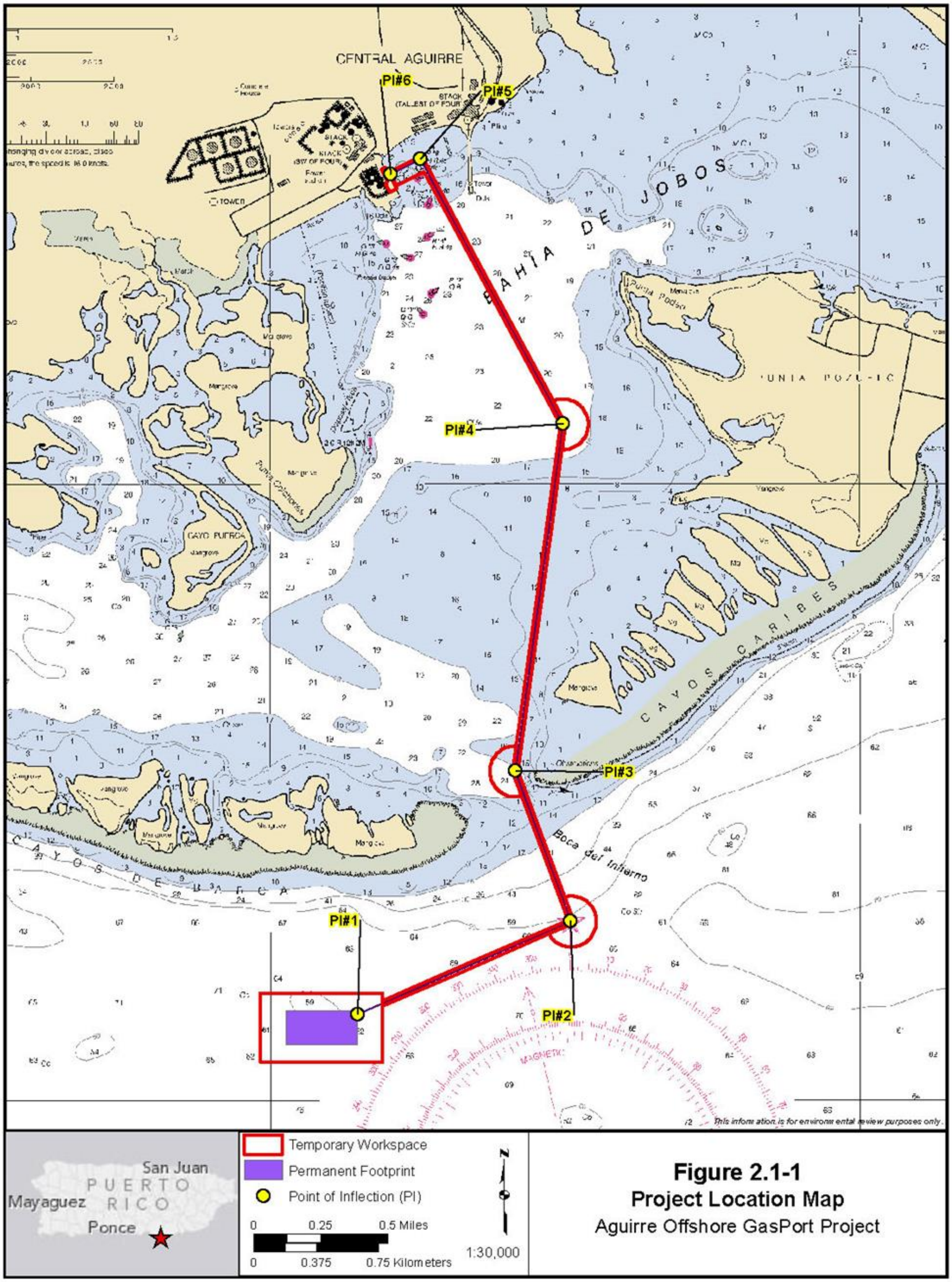

Figure 2.1-1
Project Location Map
Aguirre Offshore GasPort Project

4.0 ESSENTIAL FISH HABITAT

Seven habitat types are identified by the CFMC as EFH within the Project area: reef/hard bottom, reef rubble, seagrass, benthic algae, sand/shell bottom, soft bottom, and water column. For the purpose of this EFH analysis, the reef/hard bottom and reef rubble habitat types were merged together based on their similarities in topography, benthic community structure, ecological function, and offshore location within the Project area. Sand/shell and soft bottom habitat types, although distinct, both consist of unconsolidated sediments with low biotic cover and are therefore presented together in the same section. Mangrove habitat was not mapped as it is not within the Project area; however, mangroves are immediately adjacent to the Project area and are given consideration due to their association with seagrass and coral reef habitats. Lastly, water column habitat was not mapped but is included as an inherent component of benthic EFH, and described below. Habitat types in the Project area are summarized in table 3-1 and their locations within the Project area are displayed in figure 3-1.

TABLE 3-1

Benthic Habitat Types within the Aguirre Offshore GasPort Project Area

	Seagrass		Macroalgae		Coral Reef		Sand/Soft Bottom	
Project Component	Const.	Oper.	Const.	Oper.	Const.	Oper.	Const.	Oper.
Offshore Terminal (acres [cuerdas])	12.0 (12.4)	2.9 (3.0)	59.4 (61.2)	19.2 (19.8)	4.1 (4.2)	0.2 (0.2)	0.0	0.0
Subsea Pipeline (acres [cuerdas])	7.8 (8.0)	0.7 (0.7)	18.0 (18.5)	0.9 (0.9)	1.1 (1.1)	0.3 (0.3)	14.5 (14.9)	1.1 (1.1)
TOTAL(acres [cuerdas])	**19.8 (20.4)**	**3.6 (3.7)**	**77.4 (79.7)**	**20.1 (20.7)**	**5.2 (5.3)**	**0.5 (0.5)**	**14.5 (14.9)**	**1.1 (1.1)**

Note: Const. = temporary impacts during construction (includes operational impacts), Oper. = permanent impacts during operation

4.1 REEF/HARD BOTTOM AND REEF RUBBLE

Reef/hard bottom and reef rubble are considered to be EFH for species within the four CFMC FMPs (Spiny Lobster, Queen Conch, Reef Fish, and Coral). Coral, as defined by the MSA, includes both fish and habitat. Many fish species and crustaceans of commercial and recreational value depend on coral reefs during some or all of their life stages. The CFMC designates coral reef communities as EFH and Habitat Area of Particular Concern for a variety of managed species which include: snapper, grouper, spiny lobster, corals, and live hard bottom. Species diversity of reef fishes and the percent of live coral cover in reefs around Puerto Rico have a positive correlation (Garcia-Sais et al., 2008). Coral reefs also provide a buffer against shoreline erosion and influence the deposition and maintenance of sand on the beaches that they protect (CFMC, 2004).

Hard bottom habitat is defined by Street et al. (2005) as “exposed areas of rock or consolidated sediments, distinguished from surrounding unconsolidated sediments, which may or may not be characterized by a thin veneer of live or dead biota, generally in the ocean rather than in the estuarine system.” Natural hard bottom can also be referred to as “live rock” or “live bottom.” These coral communities occur in temperate, subtropical, and tropical regions that lack the coral diversity, density, and reef development of other types of coral communities (Deaton et al., 2010). Hard bottom habitats vary in topographic relief from relatively flat outcrops with gentle slopes to a scarped ledge with up to 33 feet (10 meters [m])of vertical, sloped, or stepped relief (Deaton et al., 2010). Hard bottom is valuable to fish because it provides structural complexity for foraging and refuge in marine waters.

The importance of corals and reef-associated plants and invertebrates lies in their relationship to the marine ecosystem. The coral reef areas are the most productive tropical marine systems and thus are the backbone of the associated food web. The fishery resources managed under other FMPs occupy the upper levels of this food web. Coral reefs serve as breeding grounds, nurseries, feeding grounds, and

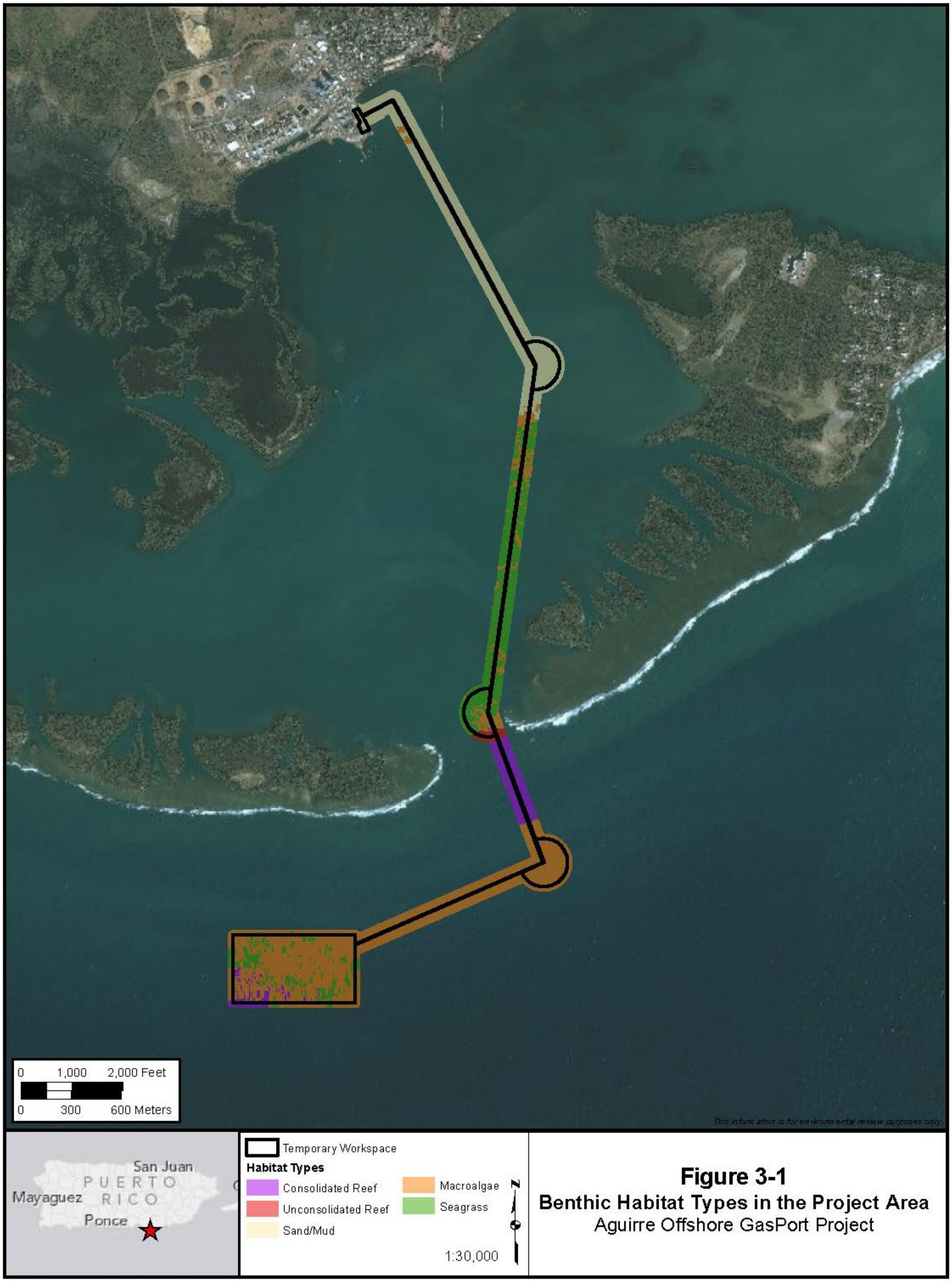

Figure 3-1
Benthic Habitat Types in the Project Area
Aguirre Offshore GasPort Project

refuge for most protected species, all of which, like the reefs themselves, are vulnerable to overfishing (Puerto Rico Department of Natural and Environmental Resources, 2010).

The coral reefs of Jobos Bay consist of emergent and submerged structures that are primarily fringing, patch, and shelf edge formations (Garcia-Sais et al., 2008). The south coast of Puerto Rico, including Jobos Bay, has small islands called cays (cayos) that are fringed by coral reefs. Linear and patch reefs are the most productive habitat in Jobos Bay and comprise less than 494 acres (509 cuerdas) (4 percent) of total benthic habitat in the bay (Zitello et al., 2008). The reefs provide nursery grounds and habitat for fish and invertebrates of recreational and commercial value (Zitello et al., 2008).

During the previously referenced benthic investigation (Tetra Tech, 2012), Aguirre LLC conducted multiple surveys of the Project area, including towed-diver video transects and sample quadrats, to characterize the benthic conditions along the proposed subsea pipeline route and at the offshore terminal site. Both reef/hard bottom and reef rubble strata were documented within the Project area. Reef habitat includes 123 acres (127 cuerdas) that stretch across the mouth of the Boca del Infierno pass and along the seaward margin of Cayos de Barca and Cayos Caribes. There was 4.1 acres (4.2 cuerdas) of patch reef documented within the temporary work zone of the offshore terminal. Substrate complexity varies within this stratum and includes flat pavement areas of low topographic complexity as well as spur and groove formations. The reef rubble stratum is within the Boca del Infierno pass, at the interface of the offshore reef and the inshore lagoon system. This stratum is characterized by coral rubble, smaller in size in the back reef and larger in the shallower areas of the reef. The rubble is generally well integrated into the sediments and stable. In general, this stratum is a high energy environment.

Biotic cover in the reef/hard bottom and reef rubble habitat was approximately 85 percent, including 22 percent turf algae, 22 percent macroalgae, 18 percent stony coral, 12 percent soft coral, 7 percent sponge, and 4 percent other algae and biota. During the 2012 survey work, 30 species of stony corals were documented, with starlet coral, symmetrical brain coral, and great star coral accounting for the highest cover. Sixteen species of soft coral were documented, with slimy sea plume accounting for the highest cover.

4.2 SEAGRASS

Seagrasses are considered to be EFH for species within the four CFMC FMPs (Spiny Lobster, Queen Conch, Reef Fish, and Coral). Submerged aquatic vegetation is the most common benthic type cover in Jobos Bay. Seagrass is the dominant cover in approximately 30 percent (3,000 acres [3,089 cuerdas]) of the bay; macroalgae (seaweed) is the dominant cover in an additional 20 percent (2,000 acres [2,049 cuerdas]) (Whitall et al., 2011). Seagrasses provide food and shelter to commercial and recreational fishery species, as well as invertebrates and birds. Seagrasses also reduce wave and current action and improve water clarity and quality. Seagrass beds are more prevalent near the shore, where they cover about 70 percent of Jobos Bay's shallows (Field et al., 2003). The seagrass flora in Jobos Bay is relatively diverse and includes turtle grass, manatee grass, shoal grass, paddle grass, and Florida Keys seagrass. The distribution pattern for these species is controlled by salinity, light, and air exposure. Generally, shoal grass inhabits the shallowest areas, turtle and manatee grass occupy the intermediate areas, and paddle grass and Florida Keys seagrass grow in the deepest areas. While seagrass cover is most common on sandy or muddy substrate, macroalgae grow in both soft sediments and on hardbottom. Both seagrass and macroalgae are distributed throughout Jobos Bay, providing habitat for commercially and recreationally important fish and invertebrates.

Seagrass is the most abundant benthic cover in the Project area. Within inshore regions of the Project area, turtle grass has the highest areal extent, followed by macroalgae, paddle grass, manatee grass, and shoal grass. Turtle grass dominated areas immediately shoreward of the cays, giving way to a mix of manatee grass, shoal grass, and paddle grass toward the center of Jobos Bay. Seagrass was not observed on the northernmost leg of the proposed subsea pipeline route (milepost [MP] 0.0 to MP 1.5). The seagrass found within the survey area for the offshore terminal consisted of large mono-specific Florida Keys seagrass stands with smaller patches of paddle grass intermixed.

4.3 BENTHIC ALGAE

Benthic algae habitat is considered to be EFH for species within the four CFMC FMPs (Spiny Lobster, Queen Conch, Reef Fish, and Coral). In Puerto Rico, benthic algae habitat occurs in both estuarine and marine environments. Benthic algae habitat is likely underrepresented because mixed algal/seagrass areas are classified as seagrass in the mapping process. Puerto Rico has 473 species of benthic algae, of which 57 percent are rhodophytes, 14 percent are phaeophytes, and 29 percent are chlorophytes (CFMC, 2004). Benthic algae substrate generally consists of sand or a sand/mud complex and may be sparsely or densely vegetated with red or green algae. Benthic algae can thickly cover large areas and form an important shelter for a diversity of invertebrate species. They are important contributors of material to shallow marine sediments and generally occur in close association with a number of seagrass species (CFMC, 1994).

Macroalgae are foraged extensively by a large assemblage of herbivores and the prey of many commercial species may be found in these meadows (e.g., conch, clams, parrotfish, snappers, and grunts) (CFMC, 1994). Managed species that use benthic algae habitat include queen conch and early life history stages of spiny lobster. Sea turtles feed on some benthic algal species. This habitat is also inhabited by invertebrate species, including mollusks and crustaceans, which are eaten by various fishes. Gorgonians, sponges, and macroalgae—managed under the Coral FMP—also occur in benthic algae habitat. Most fishes in this zone are relatively small species of little commercial value; however, some commercial species may use this habitat as a nursery area. (CFMC, 2004)

Macroalgae within the Project area had a discontinuous distribution and were intermixed with seagrass in some areas, while occurring as monospecific assemblages in other areas. Macroalgal cover was particularly extensive within the reef zone. The most common taxon, out of the 39 genera documented, was *Halimeda* spp. Macroalgae was the dominant biotic cover near the offshore terminal site and accounted for more than half of the area surveyed.

4.4 SAND/SHELL AND SOFT BOTTOM

Sand/shell and soft bottom habitats are EFH for species within three of the four CFMC FMPs (Queen Conch, Reef Fish, and Coral). Although sand/shell and soft bottom are two distinct habitat types, they are described together here based on their similarities in topography, benthic community structure, and ecological function in their respective zones (marine and estuarine) within the Project area. Sand/shell and soft bottom habitats are distinguished from other habitat types by having unconsolidated sediment that may be sand, silt, silt/sand, or mud and a lack of vascular plants such as seagrass; however, macroalgae may be present (Karaszia and Wilber, 2011). Despite a lack of structure, these surface sediments support an abundance of microscopic plants and burrowing animals such as polychaetes, crustaceans, mollusks, and echinoderms (Karaszia and Wilber, 2011). High concentrations of organic matter are transported to and produced on soft bottom. These factors make soft bottom habitat optimal forage grounds for managed species (Karaszia and Wilber, 2011).

Soft bottom habitat was documented in the estuarine (inshore) zone during the benthic characterization and includes the north leg of the proposed pipeline route. This habitat type is characterized by a flat bathymetry and unconsolidated, loose silt and mud. The seafloor within this habitat consists strictly of fine, unconsolidated sediments: silt and mud coverage is 100 percent. The average maximum sediment depth observed during surveys was 12 inches (30 cm). This corresponds with the depth limit of the recording instrument used; therefore, the thickness of the sediment layer probably extends beyond 12 inches (30 cm). In the offshore terminal environment, seagrasses and benthic algae were the dominant cover, but utilized the sand/shell and soft bottom substrate that was present on the seafloor.

4.5 MANGROVES

Mangroves are considered to be EFH for stocks within three of the four FMPs (Spiny Lobster, Reef Fish, and Coral). Mangroves are estuarine, intertidal, emergent scrub-shrub wetlands that are usually found along shorelines in the intertidal zone between open water and upland habitat (NMFS, 2011b). Mangroves serve as sediment traps, causing the accumulation of sediments, production of organic matter, and prevention of erosion. They are a vital component in the estuarine food chain, providing habitat for a large variety or organisms, which serve as a base to the food chain. Mangroves provide essential ecosystem services for Jobos Bay, including habitat for a variety of marine organisms (Whitall et al., 2011).

Spiny lobster (*Panulirus argus*) is the most economically important commercial and recreational invertebrate fishery and is commonly found among the prop roots[1] of mangroves. Snook (*Centropomus undecimalis*), goliath grouper (*Epinephelus itajara*), leatherjacket (*Oligoplites saurus*), gray snapper (*Lutjanus griseus*), dog snapper (*Lutjanus jocu*), sailors choice (*Haemulon parra),* and bluestriped grunt (*Haemulon sciurus*) also are common to this habitat, using it as refuge and as a ready source of food. Collections in both seagrass beds and mangroves suggest that there is an integral link between these habitats with tripletail, snook, gray snapper, and goliath grouper, for example, occurring over seagrass beds or other adjacent bottoms as adults or large juveniles but using the mangrove roots as juveniles (CFMC, 2004).

Mangrove cays, including Cayos de Barca and Cayos Caribes, are on the southern and western edges of Jobos Bay and cover approximately 25 percent of the entire bay. Four species of mangroves are found within Jobos Bay: red, black, white, and buttonwood mangroves. The majority of the shoreline in the bay is dominated by red mangrove, which grows in silty soils in tidally flooded areas and is the most water-tolerant of the four mangrove species.

Although mangroves are present along the fringes of Jobos Bay, the Project as currently planned is not expected to directly or indirectly impact mangroves or transect the mangroves and associated areas. As such, this habitat type was not included during the benthic surveys.

4.6 WATER COLUMN

The pelagic subsystem (i.e., water column within the marine zone) explicitly includes the habitat of pelagic fishes, while the benthic component of these areas, including demersal fishes, is included in other subsystems (CFMC, 2004). In general, primary productivity in this zone is low and patchily distributed. Pelagic productivity is higher in nearshore areas than in offshore “blue water” areas (CFMC, 2004). Information on the fishes inhabiting the pelagic zone is sparse. Some pelagic fishes, such as dolphin fish and young flying fish, congregate beneath objects floating at or near the surface, such as seagrass and macroalgae debris. The pelagic system is inhabited by the eggs and larval stages of many reef fishes, highly migratory fishes, and invertebrates, some of which, like the spiny lobster, are commercially important. Some fish, such as billfishes, tunas, mackerels, jacks, and flying fish occur in the pelagic environment as adults as well. Cartilaginous fishes, including sharks such as the shortfin mako, and pelagic rays like the Atlantic manta, also live in this zone (CFMC, 2004).

The water column is between the sediment-water interface and the surface of the water. It is an inherent component of all the habitats discussed above.

5.0 MANAGED FISH SPECIES

The CFMC manages 179 fish stocks in Puerto Rico and the U.S. Virgin Islands under four FMPs: Spiny Lobster Fishery; Queen Conch Resources; Reef Fish Fishery; and Corals and Reef Associated Invertebrates. The HMS division of NMFS also manages a number of species under two FMPs: Atlantic

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[1] In mangroves, “prop” roots are adventitious roots that grow above the water surface and are modified for aerial support.

Tunas, Swordfish, and Sharks; and The Atlantic Billfishes (CFMC, 2005). A summary of the FMP units and the species most likely to be found in the Project area is provided in table 4-1, as derived from NMFS's online EFH Mapper (NMFS, 2014).

Table 4-1

Summary of Fishery Management Plans, Units, and Included Species

Common Name	Scientific Name	Common Name	Scientific Name
Queen Conch Resources		**Reef Fish Fishery (cont'd)**	
queen conch	*Strombus gigas*	anchor tilefish	*Caulolatilus intermedius*
Spiny Lobster Fishery		blueline tilefish	*Caulolatilus microps*
spiny lobster	*Panulirus argus*	golden tilefish	*Lopholatilus chamaeleonticeps*
slipper lobster	*Scyllarides nodifer*	dwarf sand perch	*Diplectrum bivittatum*
Reef Fish Fishery		sand perch	*Diplectrum formosum*
gray triggerfish	*Balistes capriscus*	rock hind	*Epinephelus adscensionis*
Greater amberjack	*Seriola dumerili*	speckled hind	*Epinephelus drummondhayi*
lesser amberjack	*Seriola fasciata*	yellowedge grouper	*Epinephelus flavolimbatus*
almaco jack	*Seriola rivoliana*	red hind	*Epinephelus guttatus*
banded rudderfish	*Seriola zonata*	goliath grouper	*Epinephelus itajara*
hogfish	*Lachnolaimus maximus*	red grouper	*Epinephelus morio*
queen snapper	*Etelis oculatus*	misty grouper	*Epinephelus mystacinus*
mutton snapper	*Lutjanus analis*	warsaw grouper	*Epinephelus nigritus*
schoolmaster	*Lutjanus apodus*	snowy grouper	*Epinephelus niveatus*
blackfin snapper	*Lutjanus buccanella*	nassau grouper	*Epinephelus striatus*
red snapper	*Lutjanus campechanus*	marbled grouper	*Epinephelus inermis*
cubera snapper	*Lutjanus cyanopterus*	black grouper	*Mycteroperca bonaci*
gray snapper	*Lutjanus griseus*	yellowmouth grouper	*Mycteroperca interstitialis*
dog snapper	*Lutjanus jocu*	gag	*Mycteroperca microlepis*
mahogany snapper	*Lutjanus mahogoni*	scamp	*Mycteroperca phenax*
lane snapper	*Lutjanus synagris*	yellowfin grouper	*Mycteroperca venenosa*
silk snapper	*Lutjanus vivanus*	**Highly Migratory Species**	
yellowtail snapper	*Ocyurus chrysurus*	lemon shark	*Negraprion brevirostris*
wenchman	*Pristipomoides aquilonaris*	sailfish	*Istiophorus platypterus*
vermillion snapper	*Rhomboplites aurorubens*	longbill spearfish	*Tetrapturus pfluegeri*
goldface tilefish	*Caulolatilus chrysops*	tiger shark	*Galeocerdo cuvier*
blackline tilefish	*Caulolatilus cyanops*	**Corals and Reef Associated Invertebrates** [a]	

[a] Includes over 100 species of coral and over 60 species of plants and invertebrates

<u>Spiny Lobster</u>

EFH for the Spiny Lobster Fishery in the U.S. Caribbean includes all waters from mean high water to the outer boundary of the exclusive economic zone (EEZ) as habitats used by the phyllosome larvae, whereas seagrass, benthic algae, mangroves, corals, and live/hard bottom substrates from mean high water to 100 fathoms (183 m) deep are used by other life stages (CFMC, 2005).

The spiny lobster occurs throughout the Caribbean Sea and the western Atlantic Ocean and Gulf of Mexico in the southern United States and northern South America. Caribbean spiny lobsters occupy several habitat types throughout their life cycle. Adult lobsters utilize offshore environments, living in social groups and utilizing rock outcrops, reef holes, or artificially created structures as closed den habitat. Larvae are released near reef edges or coastal shelves and spend six to ten months in a series of planktonic stages that distribute them throughout the Caribbean. Young lobsters often inhabit clusters of red algae, seagrass beds, sponges, or submerged mangrove roots, which provide refuge and food sources. Juvenile and sub-adult lobsters utilize coral reefs, caves, and sponges for habitat. Caribbean spiny lobsters will migrate in single-file lines to deeper water to avoid stressful environments such as cold and turbid water (NMFS, 2005).

On average, the spiny lobster represents approximately half of all invertebrate commercial landings within the Caribbean. The spiny lobster fishery comprised approximately nine percent of the total commercial landings in Salinas and Guayama municipalities between 1993 and 2003. Historically, spiny lobsters were primarily caught using fish or lobster pots and traps; however, in recent years, commercial fishermen have utilized diving as a primary method to capture this species. Commercial landings for the spiny lobster have shown a general decreasing trend.

Caribbean spiny lobsters utilize a variety of habitat types that are present throughout the Project area, including coral reef, algal and seagrass beds, mangroves, and offshore habitat. No Caribbean spiny lobsters were documented within Jobos Bay during benthic surveys conducted in June 2009 (Whitall et al., 2011). During Aguirre LLC's benthic surveys in May 2012, two sub-adult individuals were documented within coral reef habitat.

Queen Conch

EFH for the Queen Conch Fishery in the U.S. Caribbean includes all waters from mean high water to the outer boundary of the EEZ as habitats used by eggs and larvae, whereas seagrass, benthic algae, corals, and live/hard bottom substrates from mean high water to 100 fathoms (183 m) are used by other life stages (CFMC, 2005).

This species matures late in life, grows slowly, and reproduces in groups in shallow water, making it very susceptible to overfishing. Queen conch is primarily harvested by hand, both commercially and recreationally. Commercial and recreational fishermen are limited to harvesting a limited amount of conch per day and within the seasonal timeframe of November 1 to July 31 within territorial waters of Puerto Rico. The CFMC coordinated the Queen Conch Working Group (previously known as the International Queen Conch Initiative) to promote a universal strategy for the management of queen conch resources in the Caribbean (CFMC, 2012).

Reef Fish

EFH for the Reef Fish Fishery in the U.S. Caribbean includes all waters from mean high water to the outer boundary of the EEZ as habitats used by eggs and larvae, whereas all substrates from mean high water to 100 fathoms (183 m) are used by other life stages (CFMC, 2005).

The Reef Fish FMP is comprised of over 137 reef fish species, of which 55 are associated with the aquarium trade. Reef fish consist of a variety of different types including snapper, sea bass, grouper, parrotfish, grunts, goatfish, porgies, squirrelfish, tilefish, jacks, sturgeonfish, triggerfish, filefish, boxfish, wrasses, and angelfish (CFMC, 1985). The recreational landings for reef fish in Puerto Rico are included in table 4-2.

TABLE 4-2

Recreational Landings of Reef Fish for Puerto Rico in 2011

Species Group	Total Reported Catch (No. Individuals)	Percent of Annual Catch Limit
Angelfish	167	3.7
Aquarium trade	1405	17.2
Boxfish	2477	53.7
Goatfish	277	77.3
Grunts	2113	42.0
Jacks	31982	62.3
Porgies	1787	70.7
Squirrelfish	754	19.4
Triggerfish & Filefish	1970	9.0
Wrasses	5539	109.7

Source: NMFS, 2011a

Coral and Reef Associated Plants and Invertebrates

EFH for the Coral Fishery in the U.S. Caribbean consists of all waters from mean low water to the outer boundary of the EEZ as habitats used by larvae, whereas coral and hard bottom substrates from mean low water to 100 fathoms (183 m) deep are used by other life stages (CFMC, 2005).

Over 100 species of coral and over 60 species of plants and invertebrates are included in the FMP for corals and reef associated plants. Seagrasses, hydrocorals, anthozoans, gorgonian corals, hard corals, and black corals are currently prohibited from being extracted in the territorial waters of Puerto Rico unless permitted for scientific research or education, or unless restoration is completed. Live rock, snapping shrimp, emerald crab, olive snail, cushion sea star, banded shrimp, golden shrimp, yellow arrow crab, and anemone shrimp are all targeted commercially for the aquarium trade (CFMC, 1994).

Highly Migratory Species

EFH for the HMS is more challenging to assign because although some species may frequent waters of the continental shelf or even inshore waters, they are primarily associated with the open ocean. Their distributions rely on features relating to the water column such as oceanic fronts, river plumes, current boundaries, shelf edges, sea mounts, and temperature discontinuities. It is these features that must be characterized as the habitat for the pelagic life stages of the species (NMFS, 1999).

6.0 IMPACTS AND MITIGATION MEASURES

Development of the Project would result in direct and indirect impacts on EFH and managed species. For the purpose of this EFH analysis, impacts associated with coral reef will encompass both reef/hard bottom and reef rubble EFH as well as managed coral and invertebrate species. Similarly, impacts associated with seagrass will refer to both seagrass EFH and managed seagrass species; and impacts on soft bottom will encompass both sand/shell and soft bottom EFH and managed invertebrate species.

Direct adverse impacts on EFH and managed species include the loss or alteration of seagrasses, benthic algae, coral reef, soft bottom, and water column habitat. Direct adverse impacts on managed species could include entrainment of reef fish eggs and larvae and direct mortality of individuals as a consequence of construction activities. Indirect adverse impacts on EFH and managed species during construction would result from changes in turbidity, water quality, noise, and lighting. Operation of the Project would result in permanent, minor adverse impacts on managed fishery resources and EFH from entrainment of reef fish eggs and larvae, shading, anti-fouling agents, thermal plume discharges, noise, and lighting; permanent moderate adverse impacts from EFH alteration/loss associated with the pipeline; and short-term, moderate adverse impacts from potential inadvertent spills of hydrocarbon materials.

6.1 IN-WATER CONSTRUCTION ACTIVITIES

Managed fishery resources and EFH could be impacted by in-water construction activities. Direct impacts of in-water construction activities on managed fisheries would include the displacement of managed species within the affected area and direct mortality of some individuals. Species managed under the HMS and reef fish FMPs as well as the spiny lobster are highly mobile and would be expected to leave the vicinity of the Project area during construction activities. However, construction activities could cause mortality of less mobile species, including the queen conch and invertebrates managed under the Corals and Reef Associated Invertebrates FMP if encountered during construction. Construction activities such as vessel anchoring, platform construction, pile driving, and pipeline installation would result in direct impacts on approximately 19.8 acres (20.4 cuerdas) of seagrass, 77.4 acres (79.7 cuerdas) of benthic algae, 5.2 acres (5.4 cuerdas) of coral reef, and 14.5 acres (14.9 cuerdas) of soft bottom habitat. To minimize impacts resulting from in-water construction activities, Aguirre LLC would relocate stony corals prior to construction and develop a seagrass mitigation and monitoring plan and a coral reef restoration and/or mitigation plan. Further information regarding proposed impacts and mitigation for construction and operation of the Project is provided in section 5.5.

6.2 HYDROSTATIC TESTING

Hydrostatic testing involves filling pipelines with water, performing pressure tests in accordance with applicable regulations, and discharging the test water following completion of the test. The water used for testing would be withdrawn from Jobos Bay or the Caribbean Sea, depending on the section of pipeline being tested. Aguirre LLC would fit the hydrostatic test water intake with a 100-micron (0.1-millimeter) mesh screen to minimize the entrainment of fish and other organisms. To ensure that the entrainment of fish and other organisms is minimized or avoided, we are recommending[2] in section 4.5.2.4 of the draft EIS that Aguirre LLC consult with the NMFS to determine the appropriate type of screen to be used during water withdrawals during construction. We are requesting that Aguirre LLC provide us the results of this consultation prior to construction.

The intake rate would be between 1.6 and 3.0 feet per second (0.50 and 0.92 meters per second). Aguirre LLC estimates that 240,000 gallons (909 m^3) of water would be required for each test event. Under normal circumstances, only one test would be required, but there is a possibility that retesting of the pipeline could be required. Following completion of a testing event, the untreated seawater would be discharged to Jobos Bay at the shore approach. The water would be discharged at least 6 feet (1.8 m) below the water surface through a pipe fitted with a diffuser head to reduce discharge velocity and minimize impacts on EFH.

Benthic cover at the shore approach is almost exclusively benthic algae (estimated at 14 percent cover) and soft bottom EFH. Thus, impacts would likely be minor and limited to local mortality in the immediate discharge plume. Macroalgae affected by the discharge plume would likely recolonize on surrounding soft bottom EFH in a matter of months. Resuspended sediment would reduce light availability for macroalgae and seagrass EFH in a more widespread area beyond the immediate discharge plume;

[2] The "recommendations" in the EIS text are not recommendations to the applicant (i.e., they are not mere suggestions to the project sponsor). Rather, they are recommendations to the FERC Commission for inclusion as mandatory conditions to any authorization it may issue for the Project. Please see section 5.2 of the draft EIS for how these conditions would appear in a FERC Order.

however, this impact would be temporary (limited to a one or two time event) and localized at the discharge location.

6.3 SEDIMENT RESUSPENSION

An increase in turbidity due to sediment resuspension from installation of the proposed pipeline and FSRU moorings has the potential to cause short-term minor adverse effects on seagrass, benthic algae, coral reef, and water column EFH. Elevated siltation and turbidity during installation would be short-term and restricted to the area surrounding the Project footprint. Impacts associated with sediment resuspension also include reduced filtering efficiencies in certain invertebrates, potentially impacting their growth and survival, and decreased foraging efficiency in visual predators. Coral reefs may be particularly sensitive to sediment impacts, which include smothering, burial, and shading. Nonetheless, benthic substrates beneath the proposed terminal site are predominately coarse sands, which would settle quickly and not be subject to prolonged transport. Placement of the proposed pipeline could result in the resuspension of finer sediments, but the increased turbidity is expected to be minor and confined to the immediate vicinity of the pipeline.

Overall, turbidity increases during construction would be temporary in duration and localized in scope, so the impact on plankton is expected to be minor and short-term. However, the pipeline could also result in persistent siltation and turbidity from scour and sediment deposition around the pipeline, reducing light penetration and lowering photosynthesis rates and primary productivity in the immediate area. Thus, impacts may vary depending on the degree to which the pipeline self-buries. Water discharges from the LNG carriers could also cause sediment resuspension at the offshore berthing platform during operation. Turbidity increases associated with scour around the pipeline and the LNG carrier discharges would be localized in scope, so the impact on plankton is expected to be permanent but minor.

6.4 INADVERTENT HYDROCARBON SPILLS

Minor releases of hydrocarbons (e.g., LNG, fuel, and lubricants) during construction could result in short-term, minor to moderate adverse impacts on EFH and managed species. Accidental spills could originate from construction barges or support boats, loss of fuel during fuel transfers, or accidents involving collisions or allisions. The impacts of hydrocarbons are 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.

Construction contractors and port operations personnel must comply with all laws and regulations related to handling of fuels and lubricants, including 40 CFR 110, and vessel-to-vessel transfers, including 33 CFR 155. Aguirre LLC would prepare a site-specific spill prevention and control plan to minimize the potential for inadvertent release and to establish protocol for the containment, remediation, and reporting of accidental releases. We are recommending in section 4.4.3 of the draft EIS that Aguirre LLC provide us this plan for review and approval prior to construction.

6.5 HABITAT ALTERATION/LOSS

Construction activities such as vessel anchoring, platform construction, and pipeline installation would result in direct impacts on approximately 19.8 acres (20.4 cuerdas) of seagrass, 77.4 acres (79.7 cuerdas) of benthic algae, 5.2 acres (5.4 cuerdas) of coral reef, and 14.5 acres (14.9 cuerdas) of soft bottom habitat. Generally, seagrasses can recover from damage to leaves but not from damage to roots. Coral growth rates have been observed to range from 2 to 5 percent per year (Osborne et al., 2011); thus, recovery may take decades, even if corals are relocated prior to construction, as all may not transplant successfully.

To potentially enable impacts on coral reef habitat to be minimized or avoided as much as possible, we are recommending in section 4.5.2.4 of the draft EIS that Aguirre LLC assess the potential use of a water-to-water horizontal directional drill (HDD) between approximate MPs 1.0 to 1.6. We are recommending that the assessment discuss the feasibility of an HDD based on the substrate that would be crossed and estimate the area of seafloor disturbance that would be required and volume of sediment that would be displaced at the entry and exit locations of the HDD. We are requesting that Aguirre LLC provide us the results of this assessment prior to the end of the draft EIS comment period.

The operation of the offshore pipeline would result in permanent impacts on approximately 0.7 acre (0.7 cuerda) of seagrass, 0.9 acre (0.9 cuerda) of benthic algae, and 0.2 acre (0.2 cuerda) of coral reef, based on the permanent habitat conversion being limited to a 6-foot-wide (1.8 m) right-of-way centered over the pipeline. These impacts would include EFH loss (i.e., seagrass and coral species) in the 2-foot-wide (0.6 m) pipeline footprint and reduced growth due to shading in areas adjacent to the pipeline. Therefore, impacts on EFH and managed species are expected to be permanent and moderate.

Resuspension and mixing of fine sediments with underlying coarse sediments may alter substrate composition and adversely impact managed species that rely on soft bottom habitats. Overall, the impact of this habitat modification is expected to be short-term and minor.

The offshore habitat beneath the offshore berthing platform would be permanently altered by shading and thermal plume discharges from the FSRU and visiting LNG carriers. These permanent impacts include approximately 2.9 acres (3.0 cuerdas) of seagrass and soft bottom EFH as well as 0.2 acre (0.2 cuerda) of reef/hard bottom and reef rubble EFH. Similarly, managed seagrass and coral species would also be permanently impacted. Aguirre LLC proposes to relocate viable stony corals prior to construction. We conclude the impact of the proposed terminal on benthic habitat would be permanent and moderate because there would be a permanent change in the benthic community and EFH composition in this location. However, abundant similar EFH types are adjacent to the offshore platform.

Because we do not anticipate that the entire pipeline would completely self-bury, localized habitat conversion would occur, and the pipeline would present a barrier to migration for managed species including queen conch and benthic invertebrates. This permanent barrier could present a permanent, moderate impact for these species; however, these species are generally able to traverse voids or hills along the substrate within Jobos Bay where the topography is not completely flat. Spiny lobsters are capable of swimming, and thus would likely be less affected by the presence of the proposed pipeline. Utilizing the HDD construction method, if determined to be feasible, would also help minimize impacts as it would create access across the pipeline for about 0.6 mile (1.0 km).

Aguirre LLC has agreed to prepare a seagrass mitigation and monitoring plan in consultation with the appropriate agencies to offset short-term and/or permanent impacts on seagrasses. The plan would include seagrass planting and post-construction monitoring to determine Project effects and/or mitigation success. After construction, Aguirre LLC would perform seagrass mitigation in areas where the impact has occurred. In areas of impact where planting would not be feasible, Aguirre LLC would identify alternative mitigation sites where existing seagrass beds of similar species are thriving. Planting at these sites will increase the chance of mitigation success, as adequate water quality, substrate, depth, and light penetration area ideal for seagrass growth in these areas.

Aguirre LLC has also agreed to prepare a coral reef restoration and/or mitigation plan in coordination with the NMFS and U.S. Fish and Wildlife Service (FWS) to offset impacts on managed coral reefs from construction and operation of the Project. The plan would include one or more of the following: monitoring of the reef community prior to, during, and after construction; installation and monitoring of an artificial reef; coral cache and relocation to adjacent natural and/or artificial reef; development of a reef awareness/outreach program; and funding to support existing and ongoing reef community programs. In conjunction with seagrass and coral mitigation requirements, environmental regulatory agencies are likely to require a management plan that involves an educational program for construction personnel and addresses work practices occurring near sensitive resources. Standard protection measures may be required, which include the use of an integrated global positioning system to track vessel movement during construction activities.

To ensure that impacts on seagrass and coral reef are minimized and/or properly mitigated, we are recommending in sections 4.4.3 and 4.5.2.4 of the EIS that Aguirre LLC consult with NMFS, FWS, and the Puerto Rico Department of Natural and Environmental Resources, and other appropriate agencies in developing the seagrass mitigation and monitoring plan and the coral reef restoration and/or mitigation plan. We are requesting that Aguirre LLC provide us with drafts of these plans, along with documentation of agency comments on the drafts, prior to the end of the draft EIS comment period.

6.6 NOISE

The noise levels reported in this section may appear higher than those commonly noted for construction because the reference value for underwater sound pressure is 1 micro-Pascal, whereas in-air sound uses a reference of 20 micro-Pascal. The discrepancy relates to differences in the acoustic impedance, density and compressibility of air and water. For example, the threshold of hearing for humans is 0 decibels (dB) in the air, but 60 dB in water. Similarly, direct tissue damage to humans can occur at 160 dB in the air, but rises to 222 dB in water (Tetra Tech, 2013b).

Noise from general construction would be generated at the offshore berthing platform site and along the pipeline route. Pile driving would be an additional source of noise at the berthing platform site. During a hydroacoustic survey undertaken in April 2012 (Tetra Tech, 2013b), Aguirre LLC measured background noise levels of around 120 dB at the offshore berthing platform site and closer to 140 dB within Jobos Bay.

Within Jobos Bay, Aguirre LLC would install the temporary piles used during pipeline construction by vibratory hammers (rather than impact hammers) to reduce sound and pressures. Aguirre LLC's estimated sound levels are 177 dB for general construction activities and 195 dB for vibratory pile driving. Nine structural jackets and four tri/quad pile structures would be installed at the offshore berthing platform site. Unlike the temporary piles for pipeline construction, Aguirre LLC may require impact hammering to install some of these structures. The noise impacts due to the hammer pile driving were not provided by Aguirre LLC. Therefore, we are recommending in section 4.5.3.3 of the draft EIS that Aguirre LLC conduct acoustic subsea modeling to determine the noise impacts associated with hammer pile driving at the offshore berthing platform site and other areas where it may be used; consult with the FWS, NMFS, and the Puerto Rico Department of Natural and Environmental Resources to identify mitigations measures that it would implement to reduce noise levels associated with vibratory and hammer pile driving to 180 dB; and provide us with the modeling results and the proposed mitigation measures prior to the end of the draft EIS comment period.

During operation, noise from incoming vessels and the offshore berthing platform operations would be generated within the immediate vicinity of the shipping route and platform location. During the hydroacoustic survey at the offshore berthing platform site, Aguirre LLC measured background noise levels approximating 120 dB. The modeled sound levels from LNG carriers transiting in and out of the berthing location are expected to be between 160 and 170 dB. Thrusters could be utilized upon the approach and berthing; this procedure is anticipated to be short in duration (less than 30 minutes) and raise the ambient noise levels to 183 dB.

NMFS defines two levels of harassment due to noise levels under the Marine Mammal Protection Act of 1972: Level A (180 dB) and Level B (160 dB intermittent, 120 dB continuous). These harassment levels are defined as:

- Level A – harassment that has the potential to injure a marine mammal; and
- Level B – harassment that has the potential to disturb a marine mammal by causing disruption of behavioral patterns, such as migration, breathing, nursing, breeding, feeding, or sheltering.

The modeling of noise attenuation completed by Aguirre LLC indicates that vibratory pile driving would exceed the 180 dB threshold within 33 feet (10 m) of the source of the sound and exceed the 160 dB threshold within 213 to 738 feet (65 to 225 m) (depending on the location of the pile) (Tetra Tech, 2013b). The 120 dB harassment level is not applicable for pile driving activities because it is not continuous noise.

The modeling also indicates that the estimated noise associated with the construction and support vessels would not exceed the Level A harassment threshold, but would exceed Level B harassment levels within 33 feet (10 m) of the source for the 160 dB limit, within 2.1 to 2.2 miles (3.4 to 3.5 km) for the 120 dB limit in the offshore terminal area, and within 0.4 to 1.4 miles (0.6 to 2.3 km) for the 120 dB limit within Jobos Bay (Tetra Tech, 2013b).

The modeling also indicates that transiting LNG carrier noise would exceed the 120 dB limit within 1.0 to 1.1 miles (1.6 to 1.8 km) of the source of the sound, depending on the transiting direction of the LNG carrier. If thrusters are used, the sound generated is predicted to exceed the 160 dB limit within 164 feet (50 m) of the source (Tetra Tech, 2013b). The 120 dB harassment level is not applicable for thrusters because it is not continuous noise.

Unfortunately, relatively little is known about the effects from exposure to underwater sound on most aquatic organisms, particularly fish, although studies indicate intense sound pressure waves can change fish behavior or injure/kill fish through rupturing swim bladders or causing internal hemorrhaging (Popper and Hastings, 2009). Even in cases where data are available, most experts recommend extreme caution in attempting to extrapolate between species (Popper and Hastings, 2009). In general, fish with swim bladders are more susceptible to noise impacts. Operational impacts on fishery resources are expected to be permanent and minor.

6.7 LIGHTING

Aguirre LLC would install temporary lighting to facilitate construction activities during evening hours and meet safety requirements. Operation of the offshore terminal would require permanent lighting to meet operational safety and security requirements. To minimize lighting effects during operation, Aguirre LLC would limit the number and wattage of operational lights to the minimum possible for safe operations. Light bulbs would be tinted or filtered, well shielded, and directed downwards toward the facilities so as to minimize illumination of surrounding waters.

The response of fishery species to artificial lights can be quite variable depending on a number of factors such as the species, life stage, and the intensity of the light. Managed species, primarily HMS and reef fish, could be affected by artificial lights. Small organisms are often attracted to lights, which in turn attracts larger predators to feed on the biological aggregations. Lights could cause artificially induced biological aggregations. Generally, impacts on managed fishery resources would be minor as these species may change their feeding habits based on these aggregations. Overall, with mitigation measures in place, the effect of construction and operational lighting on managed species is expected to be permanent and minor due to the highly localized nature of the impact.

To ensure that impacts associated with nighttime lighting are minimized, we are recommending in section 4.5.3.3 of the draft EIS that Aguirre LLC develop a lighting plan that includes specific measures that Aguirre LLC would implement to minimize or avoid impacts associated with nighttime lighting on fish species. We are recommending that Aguirre LLC provide us this plan for review and approval prior to construction.

6.8 SHADING

During construction, barges may result in potential shading impacts on managed seagrass, benthic algae, and coral reefs. The barges would be approximately 250 feet (76 m) long by 75 feet (23 m) wide, resulting in a shaded area of approximately 0.43 acre (0.44 cuerda) per barge. To minimize potential shading impacts, Aguirre LLC would limit barge operations to the vicinities of MP 1.0 and MP 3.0, where coral reefs are absent and seagrass and benthic algae are sparse. Barges would remain in a single location for no more than six days. Seagrass require relatively high light levels and may begin to experience physiological impacts after several days of shading. Potential shading impacts on coral reefs could result during pipeline installation. Permanent shading to coral reefs could result from suspension of the pipe over natural depressions in the reef.

There is also the potential for shading of coral reef, benthic algae, and seagrass during construction of the offshore berthing platform, arising from the use of floating vessels and equipment. Based on the benthic characterization study conducted by Aguirre LLC (Tetra Tech, 2012), EFH in the vicinity of the proposed terminal consists of approximately 16 percent seagrass, 79 percent benthic algae, and 5 percent coral reef. Aguirre LLC proposes to relocate viable stony corals prior to construction to minimize shading impacts. We conclude that the impacts of shading would be minor due to the short-term nature of the construction activities and the relatively low extent of seagrass, benthic algae, and coral cover in the area.

The operation of the offshore berthing platform and pipeline would result in the permanent shading of the area beneath the FSRU structure and immediately adjacent to the pipeline. This would represent permanent impacts on seagrass and coral reef. As discussed above, we are recommending in sections 4.4.3 and 4.5.2.4 of the draft EIS that Aguirre LLC develop plans to mitigate for impacts on seagrass and coral reef. Impacts of this EFH loss on fishery species are anticipated to be mitigated by Aguirre LLC.

6.9 THERMAL PLUME DISCHARGE

Operation of the FSRU would result in heated cooling water discharges from the Main Condenser Cooling System and the Auxiliary Seawater Cooling Service. Thermal plume discharges would also come from the LNG carriers when offloading LNG at the terminal. Based on previous projects (FERC, 2009; FERC, 2008; CH_2M Hill, 2008), the thermal discharges from the FSRU are assumed to be approximately 21.6 degrees Fahrenheit (°F) (12 degrees Celsius [°C]) above ambient temperature, and the discharges from the LNG carriers are assumed to be approximately 5.4 °F (3 °C) above ambient. Assuming an ambient temperature of 84.6 °F (29.2 °C), this translates to a discharge temperature of about 106.2 °F (41.2 °C) from the proposed FSRU and about 90 °F (32.2 °C) from the LNG carriers.

Thermal plume modeling conducted by Aguirre LLC predicts that the discharges from the FSRU and LNG carries would meet Puerto Rico's maximum temperature criterion of 90 °F (32.2 °C) at a maximum horizontal distance of 23.4 feet (7.1 m) and 25.4 feet (7.5 m), respectively, under minimal current conditions. The modeling predicted the plume from the FSRU discharges would dissipate beneath the hull and would not reach the seafloor. However, the discharge form the LNG carriers is predicted to reach the seafloor. Water temperature at this plume-substrate interface is anticipated to be approximately 86 °F (30 °C), just below Puerto Rico's maximum temperature criterion. Over time, the discharge plume from the LNG carriers would displace finer soft bottom EFH material (less than 0.04 inch [1 millimeter]) away from the site and the concentration of coarser sand/shell EFH materials would increase at the seabed surface. This transition to coarser sands would permanently alter the composition of the benthic community at the proposed terminal site, favoring burrowing, infaunal species that construct reinforced burrows, rather than species using unconsolidated excavated burrows. However, impacts on EFH and managed fishery resources are expected to be minor, as impacts on EFH and non-mobile species would be restricted to a relatively localized area beneath the LNG carrier, and mobile organisms would be able to move out of the zone of heated water.

6.10 BRINE WATER DISCHARGE

Operation of the proposed offshore berthing platform would result in approximately 0.27 million gallons per day (1,022 cubic meters per day) of brine water discharge from the desalination reverse osmosis unit. The salinity levels of brine discharges from the offshore berthing platform are estimated to be 64 to 70 parts per thousand (64 to 70 centigrams per liter), which is roughly double that of the supplied feed water. Changes in water salinity can influence managed species in various ways including species development, reproduction, and population density (Danoun, 2007). Water salinity changes can additionally influence larval stages of managed species.

The brine water plume from the desalination reverse osmosis unit is expected to dissipate quickly due to local currents and vertical mixing near the offshore berthing platform. Prior to dispersion, mobile organisms can move out of the zone of increased salinity water. Minimal impacts on managed fishery resources are expected from brine water discharges.

6.11 ANTI-FOULING AGENTS

Aguirre LLC proposes to use sodium hypochlorite as a biocide to prevent fouling of water intake systems and ballast tanks on the FSRU. The LNG carriers would use similar antifouling measures to treat the cooling water used while docked at the FSRU. This is standard practice in the shipping industry to prevent the undesirable growth of marine organisms. To treat the water intake system, sodium hypochlorite would be injected through the sea chests and allowed to disperse within the system. The target dose level of free residual chlorine within the water systems would be 0.10 to 0.15 parts per million (ppm) (0.10 to 0.15 milligrams per liter [mg/L]). Following the treatment, residual sodium hypochlorite would be discharged as part of the cooling effluent. This residual chlorine concentration is not expected to significantly affect water quality, due to the low concentration of sodium hypochlorite that may be present in the discharge; however, managed fishery species in the immediate vicinity of the outfall may be exposed to harmful concentrations of sodium hypochlorite.

The effects of residual chlorine on aquatic life in estuarine ecosystems have been studied extensively; however, little research has been conducted regarding effects on tropical reef fish communities. In laboratory studies, continuous residual chlorine concentrations that produced 100 percent mortality in fathead minnows were between 0.16 and 0.21 ppm (0.16 and 0.21 mg/L) with threshold concentrations between 0.04 and 0.05 ppm (0.04 and 0.05 mg/L) (Zillich, 1972). Although not documented for tropical fish and smaller invertebrate species, behavioral avoidance of chlorinated discharges has been documented for other fish and larger invertebrates, such as white perch, grass shrimp, and blue crab (Brungs, 1976). This behavior, if present in managed fish species within the Project area, would reduce overall exposure to any residual chorine present in the discharge. The behavior would also reduce the managed fishery species use of any habitat in proximity to the discharge plume. Residual chlorine has been shown to cause mortality in larval fish routinely exposed to concentrations greater than 0.10 ppm (0.10 mg/L) (Zillich, 1972).

The Puerto Rico Environmental Quality Board water quality standard for residual chlorine in Class SC waters, where the offshore berthing platform is located, is currently under revision to limit concentrations to 0.011 ppm (0.011 mg/L). The Puerto Rico Environmental Quality Board will regulate residual chlorine in the water quality certificate based on the water quality standard in effect at the time of issuance of the water quality certificate. The U.S. Environmental Protection Agency's recommended water quality criteria for residual chlorine are 0.013 ppm (0.013 mg/L) for continuous maximum concentration and 0.007 ppm (0.007 mg/L) for continuous chronic concentration in marine waters (U.S. Environmental Protection Agency, 1986). All operational discharges would be subject to the requirements of the National Pollutant Discharge Elimination System permit for the Project.

6.12 SEAWATER INTAKE

Operational uses of seawater by the FSRU and LNG carriers have the potential to adversely affect managed fish populations via entrainment of larval stages. Tetra Tech, on behalf of Aguirre LLC, conducted ichthyoplankton net sampling offshore of the Boca del Infierno pass, approximately 1 mile (1.6 km) outside of the Jobos Bay National Estuarine Research Reserve along the southern shore of Puerto Rico (Tetra Tech, 2014a). The sampling was performed during one-day sampling events over four seasons between May 2012 and November 2013 (Tetra Tech, 2013a; 2013c; 2013d; and 2014b). A list of the ichthyoplankton larvae collected during these events is provided in table 5.12-1.

The total fish larvae densities ranged from an average of 29 to 158 larvae per 26,400 gallons (100 m^3) during the winter, spring, summer, and fall sampling (Tetra Tech, 2013a; 2013c; 2013d; and 2014). This estimate is lower than the mean abundance of fish larvae (418 individuals per 26,400 gallons [100 m^3]) collected during day samples over a course of a year at the Aguirre Intake Station (Washington Engineers PSC, 2005) and the 180 fish larvae per 26,400 gallons (100 m^3) reported prior to the operation of the APPC (Youngbluth, 1974). The fish larvae sampled, as described in Tetra Tech (2014a), were identified to the lowest practical taxa (typically family).

TABLE 5.12-1

Species List of Ichthyoplankton Collected by Aguirre LLC at the Proposed FSRU Location for the Aguirre Offshore GasPort Project Area

Family	Common Name	Family	Common Name
Antennariidae	Frogfishes	Mugiliformes	Mugilidae
Apogonidae	Cardinalfishes	Myctophidae	Myctophids
Atherinidae	Silversides	Nemichthyidae	Snipe eels
Aulostomidae	Trumpetfishes	Ophichthidae	Snake eels
Balistidae	Triggerfishes	Ophidiidae	Cusk-eels
Berycidae	Redfishes / Alfonsinos	Opistognathidae	Jawfishes
Bleniidae	Blennies	Ostraciidae	Trunkfishes
Bothidae	Left-eye Flounders	Pleuronectiformes	Flounders
Bythitidae	Brotulas	Pomacanthidae	Angelfishes
Callionymidae	Dragonets	Pomacentridae	Damselfishes
Carangidae	Jacks	Scaridae	Parrotfishes
Clupeidae / Engraulidae	Sardines / Anchovies	Sciaenidae	Drums / Croakers
Coryphaenidae	Dolphinfishes	Scombridae	Tunas / Mackerels
Eleotridae	Sleepers	Scorpaenidae	Scorpionfishes
Ephippidae	Spadefishes	Serranidae	Sea Basses / Groupers
Exocoetidae	Flying fishes	Sparidae	Porgies
Gerreidae	Mojarras	Sphyraenidae	Barracudas
Gobiesocidae	Clingfishes	Syngnathidae	Pipefishes
Gobiidae	Gobies	Synodontidae	Lizardfishes
Haemulidae	Grunts	Tetraodontidae	Porcupinefishes
Hemiramphidae	Half-beaks	Tripterygiidae	Triplefin Blennies
Labridae	Wrasses	Unknown Beloniformid	--
Lutjanidae	Snappers	Unknown fish larvae	--
Microdesmidae	Wormfishes	Fish egg	--
Monacanthidae	Filefishes		

Source: Tetra Tech, 2013a; 2013c; 2013d; and 2014b

Relatively high abundances of fish eggs were collected during the winter, spring, and summer sampling at the proposed FSRU location (Tetra Tech, 2014a). This could be a result of long-shore transport of eggs from coastal reefs and pelagic waters in and around the Boca del Infierno pass and from adjacent seagrass habitat serving as spawning habitat for many fish species. The fish egg densities were particularly high during the summer sampling event, potentially as a result of the lunar spawning activities of serranids, sciaenids, and other common fish species in Puerto Rican waters (Sale, 1993). The average egg densities were 169, 401, 1,475, and 96 eggs per 26,400 gallons (100 m^3) during the winter, spring, summer, and fall samplings, respectively (Tetra Tech, 2013a; 2013c; 2013d; and 2014b). The density of eggs (1.475 per 26,400 gallons [100 m^3]) collected in summer was comparable with the mean abundance of eggs collected near the Aguirre Plant at 2,252 eggs per 26,400 gallons (100 m^3) during day samplings and 1,711 larvae per 26,400 gallons (100 m^3) during night samplings (PREPA, 2005). For this study (Tetra Tech, 2014a), eggs were not differentiated based on shape, and thus were not identified to a specific taxa. Table 5.12-2 lists the mean densities of several key taxa of concern, based on the results of the Aguirre LLC's seasonal sampling events.

TABLE 5.12-2

Densities (# of individuals) of Representative Taxa of Concern Chosen for Entrainment Calculations in the Project Area

Taxa (Eggs and/or Larvae)	Common Name	Mean Winter Density		Mean Spring Density		Mean Summer Density		Mean Fall Density	
		#/100 m^3	#/MG	#/100 m^3	#/MG	#/100 m^3	#/MG	#/100 m^3	#/MG
Lutjanidae	Snappers	1	47	2	65	1	49	0	-
Serranidae	Groupers and Sea basses	0.4	16	0.2	6	0	-	0.4	15
Carangidae	Jacks	0	-	1	31	0.1	6	0	
Haemulidae	Grunts	4	167	5	191	1	49	2	68
Palinura	Spiny lobsters	3	110	0.2	9	1	45	1	36
Total fish eggs	--	169	6,413	401	15,173	1,475	55,845	96	3,651
Unidentified and other fish larvae	--	45	1,708	80	3,040	155	5,872	27	1,006
Other invertebrate larvae	--	1,151	43,573	1,481	56,068	1,629	61,661	1,847	69,907

MG = million gallons (1 MG = 3,785 m^3)

The two main sources of potential entrainment from the proposed Project are the water use at the FSRU intakes and at the LNG carriers while at berth at the Offshore GasPort. We performed an entrainment analysis for ichthyoplankton (including shellfish) and coral larvae, which are the two main types of plankton that would have the highest potential for impact. It is assumed that all pelagic eggs and larvae in the intake water would be entrained and suffer mortality. The entrainment analysis is provided in appendix E of the EIS. The entrainment of coral larvae are also discussed in section 4.5.4 of the draft EIS and the Biological Assessment for the Project.

The entrainment estimates were calculated based on the anticipated water uses for the proposed FSRU and LNG carriers (see table 5.12-3 below). There is a range in the potential daily operating intake volumes for the LNG carriers (based on values derived from past projects). Given the type and size of the LNG carriers in the current fleet, Aguirre LLC indicates that the higher end of that range is most likely to be representative of the Project. Thus, for the purposes of the analysis, the maximum LNG carrier intake volume of 81.6 million gallons per day (308,900 cubic meters per day) was used to estimate entrainment. We assumed that there would be 50 deliveries per year and each delivery would take 88 hours.

Aguirre LLC conducted an evaluation to estimate the annual entrainment impact in terms of equivalent adult losses for the Project using the four seasonal sampling events collected to date (Tetra Tech, Inc. 2014a). However, Aguirre LLC's study was inadequate because it did not include age-specific mortality or survival rates necessary to accurately convert raw entrainment and impingement numbers into age-1 equivalents. Thus, we conducted a separate equivalent loss analysis to estimate potential entrainment impacts on fish and spiny lobster eggs and larvae associated with seawater intakes during operations of the proposed Aguirre Offshore GasPort Project. Note that entrainment impacts were calculated for the operational phase of the Project only, as data on water use during construction were not provided. Our full analysis is provided in appendix E of the EIS and is summarized briefly below.

TABLE 5.12-3

Summary of Standard Carrier Water Use Intakes and Discharges at the Project Location

GasPort Vessels	Water Use	Seawater Intake (million gallons per day [cubic meters per day])
FSRU	Main condenser cooling system	47.0 (177,900)
	Auxiliary seawater cooling system	6.0 (22,700)
	Safety water curtain	0.6 (2,300)
	Ballast water	1.9 (7,200)
	Freshwater generator	0.3 (1,100)
	Marine growth preventative system	0.16 (600)
	Total	55.96 (211,800)
LNG Carriers	Main condenser cooling system	Variable; depending on actual vessel used
	Auxiliary seawater cooling system	
	Safety water curtain	
	Ballast water	
	Freshwater generator	
	Total (maximum while berthed)	81.6 (308,900)

The entrainment calculations were performed in part by following the National Oceanic and Atmospheric Administration and U.S. Coast Guard (USCG) jointly developed methodology for ichthyoplankton entrainment, as described in the ichthyoplankton assessment model appended to the Gulf Landing Final EIS (USCG and U.S. Maritime Administration, 2005 and subsequent revisions/clarifications). Not all of the steps described in this guidance were applicable for this Project due to lack of extensive seasonal ichthyoplankton sampling.

A selection of specific species and taxa of concern was analyzed to serve as indicators of the potential entrainment impacts of the project. The species/taxa analyzed for the ichthyoplankton entrainment assessment were chosen due to their adequate life history information and their ecological and economic importance. The density information provided by Aguirre LLC, based on the towed ichthyoplankton net sampling as described in Tetra Tech (2014a), is only down to the family level. Thus, specific species within each of the key taxa were selected and used as proxies for the life history inputs necessary to derive age-one equivalents and growth and production foregone for lost individuals. Table 5.12-4 lists the taxa of concern chosen for the entrainment analysis and their respective proxy species for life history inputs. For the entrainment calculations of fish eggs and unidentified and other fish larvae, two proxy species were used for life history inputs in order to derive a range of growth and production foregone for lost individuals. Since the "other invertebrate larvae" category is comprised of a wide range of taxa, no one proxy species could be chosen for life history inputs; thus, only raw entrainment numbers were calculated for this group.

TABLE 5.12-4

Representative Taxa of Concern Chosen for Entrainment Calculations at the Project Location

Taxa (Eggs and/or Larvae)	Common Name	Proxy Species for Life History Inputs	Rationale for Consideration
Lutjanidae	Snappers	Silk snapper	Target reef fish in the commercial fishery
Serranidae	Groupers and Sea basses	Nassau grouper	Important continental shelf taxa
Carangidae	Jacks	Blue runner	High recreational landings as listed in the Shallow Water Reef Fish Fishery Management Plan (FMP) [a]
Haemulidae	Grunts	Tomtate grunt	High recreational landings as listed in the Shallow Water Reef Fish FMP
Palinura	Spiny lobsters	Caribbean spiny lobster	Important continental shelf taxa
Fish Eggs	--	Engraulidae (bay anchovy) and Haemulidae (tomtate grunt)	Both abundant species in sampling events, thus prevalent in the area

TABLE 5.12-4

Representative Taxa of Concern Chosen for Entrainment Calculations at the Project Location

Taxa (Eggs and/or Larvae)	Common Name	Proxy Species for Life History Inputs	Rationale for Consideration
Unidentified and All Other Fish Larvae	--	Engraulidae (bay anchovy) and Haemulidae (tomtate grunt)	Majority of fish larvae collected during seasonal sampling [b]
All Other Invertebrate Larvae	Decapods, Mollusks and Cephlapods	-	Majority of invertebrate larvae collected during seasonal sampling

Sources:
[a] CFMC, 1985
[b] Tetra Tech, 2013a; 2013c; 2013d; and 2014b

Tables 5.12-5 and 5.12-6 present the results of the entrainment analysis for the FSRU and LNG carriers, respectively. These tables include the raw number individuals entrained, the number of age-1 equivalents lost, and losses of age 1+ age classes per year and over the life of the Project, which was assumed to be 40 years.

TABLE 5.12-5

Annual Population Impacts Under FSRU Continuous Operations

			No. Individuals Lost (millions)		No. Age-1 Equivalents Lost		Losses of Age 1+ Age Classes (pounds [kilograms])	
Taxa	Common Name	Stage	Annually	Project Life [a]	Annually	Project Life [a]	Annually	Project Life [a]
Lutjanidae	Snappers	Larvae	0.8	32.9	0.13	5.4	0.28 (0.13)	11.2 (5.1)
Serranidae	Groupers	Larvae	0.2	7.6	0.01	0.2	0.03 (0.01)	1.0 (0.5)
Carangidae	Jacks	Larvae	0.2	7.4	0.04	1.5	0.08 (0.04)	3.2 (1.4)
Haemulidae	Grunts	Larvae	2.4	96.6	0.03	1.3	0.22 (0.10)	9.0 (4.1)
Palinura	Spiny Lobster	Larvae	1.0	40.7	0.04	1.5	0.06 (0.03)	2.5 (1.4)
All other fish taxa as Engraulidae	Anchovies	Larvae	59.5	2,379.7	0.46	18.5	0.22 (0.10)	9.0 (4.1)
All other fish taxa as Haemulidae	Grunts	Larvae	59.5	2,379.7	0.78	31.3	5.52 (2.50)	220.8 (101.1)
Fish eggs as Engraulidae	Anchovies	Eggs	333.8	13,353.6	2.60	104.0	28.56 (12.96)	1,142.5 (518.2)
Fish eggs as Haemulidae	Grunts	Eggs	333.8	13,353.6	4.39	175.7	30.97 (14.05)	1,238.8 (561.9)

[a] The Project life was assumed to be 40 years.

TABLE 5.12-6

Annual Population Impacts Associated with LNG Carrier Deliveries

Taxa	Common Name	Stage	No. Individuals Lost (millions) Annually	No. Individuals Lost (millions) Project Life [a]	No. Age-1 Equivalents Lost Annually	No. Age-1 Equivalents Lost Project Life [a]	Losses of Age 1+ Age Classes (pounds [kilograms]) Annually	Losses of Age 1+ Age Classes (pounds [kilograms]) Project Life [a]
Lutjanidae	Snappers	Larvae	0.6	24.2	0.10	3.9	0.21 (0.09)	8.3 (3.7)
Serranidae	Groupers	Larvae	0.1	5.6	0.00	0.2	0.02 (0.01)	0.7 (0.3)
Carangidae	Jacks	Larvae	0.1	5.4	0.03	1.1	0.06 (0.03)	2.3 (1.1)
Haemulidae	Grunts	Larvae	1.8	71.0	0.02	0.9	0.16 (0.07)	6.6 (3.0)
Palinura	Spiny Lobster	Larvae	0.7	30.0	538.62	1.1	0.05 (0.02)	1.8 (0.8)
All other fish taxa as Engraulidae	Anchovies	Larvae	43.5	1,739.3	0.34	13.5	0.16 (0.07)	6.6 (3.0)
All other fish taxa as Haemulidae	Grunts	Larvae	43.5	1,739.3	0.57	22.9	4.03 (1.83)	161.3 (73.2)
Fish eggs as Engraulidae	Anchovies	Eggs	243.4	9,737.3	1.90	75.9	20.83 (9.45)	833.1 (377)
Fish eggs as Haemulidae	Grunts	Eggs	243.4	9,737.3	3.20	128.1	22.58 (10.24)	903.3 (409.7)

[a] The Project life was assumed to be 40 years.

Based on the results of the ichthyoplankton entrainment analysis, annual losses of fish and invertebrates are relatively low. However, these entrainment estimates need to be used with the caveat that they are only based on four one-day seasonal sampling events to derive fish and invertebrate plankton densities. More sampling is generally needed to adequately estimate plankton densities, which are highly variable in space and time. Based on the information available, operation of the Project would result in a permanent, minor impact on fish and shellfish populations in the region due to entrainment. The loss of planktonic fish and shellfish due to entrainment would also result in a reduction in food availability for fish and invertebrates species that prey on these items. This impact is expected to be permanent and minor.

6.13 INTRODUCTION OF EXOTIC SPECIES

LNG carriers in transit to and from the offshore berthing platform could import exotic species on their hulls and exterior equipment. The FSRU would undergo dry-dock maintenance about every 5 years. During scheduled dry-dock periods, PREPA may require Aguirre LLC to use a similar FSRU to meet contractual send-out rates. Therefore the new and/or returning FSRU could also import exotic species on its hull and exterior equipment. Operators of commercial vessels have a significant economic interest in maintaining underwater body hull platings in a clean condition. Fouling of bottom platings would result in increased fuel costs for voyages and could also reduce the vessel's maximum transit speed. To prevent fouling and the associated economic costs, operators aggressively and conscientiously apply hull plating preservation and maintenance programs.

LNG carriers would not discharge ballast water while unloading LNG at the offshore berthing platform. However, the commissioning of the new and/or returning FSRU associated with the dry-dock maintenance would likely require the discharge of ballast water from an offsite location. The USCG has developed responses to exotic/invasive organisms associated with foreign vessels. The USCG Office of Operating and Environmental Standards developed *Mandatory Practices for All Vessels with Ballast Tanks on All Waters of the United States*. The mandatory practices include requirements to rinse anchors and anchor chains during retrieval to remove organisms and sediments at their place of origin and remove fouling organisms from hull, piping, and tanks on a regular basis and dispose of any removed substances in accordance with local, state, and federal regulations.

Based on above descriptions of hull plating surface treatments, the mandatory practices required by the USCG, the lack of ballast water being discharged by the LNG carriers, and the infrequency of the ballast water discharges from the new and/or returning FSRUs, operation of the Project would not likely introduce exotic or invasive species into the Project area.

One exotic species of particular regional significance is the lionfish (*Pterois volitans*), an invasive species found in the U.S. south Atlantic and Caribbean Sea including Puerto Rico. Lionfish are predatory in nature and have very few known natural predators. Lionfish are known to greatly reduce fish populations in reefs where they become established and could adversely impact managed reef fish populations if present within the Project area. Operation of the terminal is not expected to impact the already established lionfish populations in or surrounding the Project area.

7.0 CONCLUSIONS

The construction and operation of the Project would cause temporary and permanent impacts on reef/hard bottom, seagrass, benthic algae, sand/soft bottom, and water column EFH of Jobos Bay, the Boca del Infierno pass, and the proposed offshore terminal site. There are no foreseeable impacts on mangrove EFH that is immediately adjacent to the Project area. However, managed species including spiny lobster, queen conch, reef fish, HMS, and corals and associated invertebrates would be impacted by construction and operation of the Project.

Temporary construction impacts would result from vessel mooring, anchor drag, cable sweep, and other subsurface disturbances, causing increased turbidity, sedimentation, noise, and shading, along with the possible displacement of and direct injury to resident biota. Based on an overall subsea construction footprint of 116.9 acres (120.4 cuerdas), and Aguirre LLC's habitat assessment, the Project would impact 19.8 acres (20.4 cuerdas) of seagrass, 77.4 acres (79.7 cuerdas) of benthic algae, 5.2 acres (5.4 cuerdas) of coral reef, and 14.5 acres (14.9 cuerdas) of soft bottom habitat. Construction–related impacts would dissipate once construction activities are complete.

Permanent operational impacts would result from EFH alternation though displacement of existing EFH by facility structures, and environmental modifications caused directly or indirectly by the presence of the structures, such as increased shading, scour, smothering, and sedimentation. Uptake and discharge of water at the offshore berthing platform could cause displacement of and harm to resident managed species through entrainment and/or localized and intermittent increases in temperature, chlorinated water, and salinity associated with discharge plumes. Based on a subsea operational footprint of 25.3 acres (26.1 cuerdas), and Aguirre LLC's habitat assessment, the Project would permanently impact 3.7 acres (3.8 cuerdas) of seagrass, 20.0 acres (20.6 cuerdas) of benthic algae, 0.5 acre (0.5 cuerdas) of coral reef, and 1.1 acres (1.1 cuerdas) of soft bottom habitat.

Aguirre LLC is considering several mitigation options in consultation with regulatory agencies for impacts on seagrass and coral reef habitat, including: seagrass transplanting, relocation of stony corals, artificial reef installation, reef awareness and outreach programs, and funding for on-going reef programs. As stated above, we are recommending in sections 4.4.3 and 4.5.2.4 of the draft EIS that Aguirre LLC provide us with a draft of these plans prior to the end of the draft EIS comment period.

Based on the Project's proposed construction and operation procedures and Aguirre LLC's anticipated mitigation methods, we have determined that the Project would result in adverse impacts on coral reef, seagrass, and benthic algae EFH, and EFH managed coral and queen conch species. This is due to an anticipated reduction in the abundance and health of corals, seagrass, and algae in the immediate footprint of the proposed offshore terminal and subsea pipeline. However, seagrass beds and benthic algae habitats are found in other areas of the bay and offshore waters; therefore, an overall impact on the health and abundance of the seagrass and macroalgae community is anticipated to be minimal. Corals are also found elsewhere, yet their recovery time from a major natural or anthropogenic event may take decades to return to pre-disturbed conditions. This may result in a noticeable reduction of managed reef fish and coral stocks in the Project area. The pipeline could present a barrier to migration for queen conch, representing a permanent, moderate impact for this species.

We have also concluded that the Project would not result in significant impacts on sand/shell, soft bottom, and water column EFH. The sand/shell and soft bottom impacts would only take place in the inshore pipeline portion of the Project, where the construction technique could result in partially buried pipe and benthic disturbance that would only impact relatively immobile managed species. The water column is subject to construction impacts (e.g., increased turbidity and noise) although these would be temporary; operational impacts would be confined to those associated with intermittent highly localized water uptake and discharge events, and operational noise and lighting at the offshore berthing platform.

We have concluded that the Project would not result in significant impacts on EFH managed spiny lobster, HMS, or reef fish species. These species are mobile and would be able to avoid areas of noise, lighting, or discharges that would cause them discomfort or harm. Impacts on these species would largely be temporary as construction related impacts such increased turbidity, sedimentation, noise, and shading would cease with the completion of the facilities. Some impacts could result during operation through entrainment and/or localized and intermittent increases in temperature, chlorinated water, and salinity associated with discharge plumes, and operational noise and lighting; however, these impacts are expected to be intermittent and highly localized. As such, we conclude they would not be expected to result in widespread cumulative impacts.

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APPENDIX G

PROCEDURES GUIDING THE UNANTICIPATED DISCOVERY OF CULTURAL RESOURCES AND HUMAN REMAINS

APPENDIX 4C

Procedures Guiding the Unanticipated Discovery of Cultural Resources and Human Remains

Introduction

This plan represents the approach that Excelerate Energy will use to address the unanticipated discovery of any potentially significant submerged cultural resources during the Excelerate Energy Aguirre Offshore GasPort Project (Project), as well as, any unanticipated discoveries within the onshore portion of the Project. This plan has been prepared pursuant to Section 106 of the National Historic Preservation Act of 1966 (36 CFR 800) as amended, and the Native American Graves Protection and Repatriation Act (NAGPRA) (43 CFR 10). All work is undertaken pursuant to the Secretary of Interior's Standards and Guidelines for Archaeology and Historic Preservation (48 Fed. Reg. 44716-42). For portions of the Project in waters under the jurisdiction of the Commonwealth of Puerto Rico, this plan is prepared pursuant to *Law 112 or Law for the Protection of the Terrestrial Archaeological Patrimony of Puerto Rico (Ley de Protección del Patrimonio Arqueológico Terrestre de Puerto Rico* This set of regulations was enacted in 1988 with recent amendments to the regulatory structure; *Law 10 of 1987 Law for the Protection, Conservation and Study of Subaquatic Sites and Archaeological Resources (Ley de Protección, Conservación y Estudio de Sitios y Recursos Arqueológicos Subacuaticos)* and *Law 111 of 1985 Law for the Protection and Conservation of Caves, Caverns or Sinkholes of Puerto Rico (Ley para la Protección y Conservación de Cuevas, Cavernas o Sumideros de Puerto Rico).*

The purpose of the archaeological investigations undertaken as part of Excelerate Energy's Aguirre GasPort Project is to determine the presence or absence of potentially significant submerged and/or onshore cultural resources in the proposed project area. However, in the event of an unanticipated discovery, work in the vicinity of the find will not resume until the FERC agrees that work may resume.

Notification Procedures

Artifacts encountered during the Project will be guided by The Commonwealth of Puerto Rico's laws and guidelines, federal regulations 36 CFR 800.13, and 43 CFR 10.5.

Artifact Discoveries

1. In the unlikely event that artifacts or features are uncovered or damaged, including but not limited to pottery, bone, stone, tools, archaeological features and shipwrecks, that activity shall be halted immediately until such time as it can be determined whether or not the materials in question are cultural, and if so whether they represent a potentially significant archaeological site.
2. If artifacts are identified by construction personnel, the contractor's construction foreman will be notified immediately. The foreman will notify Excelerate Energy's construction manager. Notification will include details including but not limited to the precise location and time of the discovery, as well as the nature of the discovery.
3. Upon notification of such a discovery, Excelerate Energy will notify the Puerto Rico SHPO (PRSHPO), and Excelerate Energy's cultural resource consultants within 48 hours to review the discovery.

4. In consultation with the above-mentioned parties (i.e., PRSHPO and cultural resource consultant), Excelerate Energy or its agents will determine the cultural significance of the discovery. If the discovery is deemed potentially significant, Excelerate Energy, in consultation with the above mentioned parties, will take steps to mitigate further adverse effects to the discovery, including avoidance or further archaeological analysis. Should further archaeological analysis be deemed necessary, the objective of any cultural resource investigations will be to collect the data as accurately as possible and in a timely manner in order to minimize construction delays.

Discovery of Human Remains

Treatment of human remains encountered during the project will be guided by the Advisory Council on Historic Preservation, 36 CFR 800, the Commonwealth of Puerto Rico's laws and guidelines, and the Commonwealth of Puerto Rico's guidance on human burials. According to the Advisory Council, treatment of human remains should follow these principles:

1. Human remains should not be disinterred unless required in advance of some kind of disturbance.
2. Disinterment should be done carefully, respectfully and completely and in accordance with proper archaeological methods.
3. Human remains and associated grave goods shall be reburied in consultation with the descendants of the dead.
4. Prior to reburial, scientific studies should be performed as necessary.
5. Where objections exist to the scientific study by the descendants of the dead, the study shall not be carried out unless the value of the scientific research of the remains outweighs the objections descendants may have to the study.

These procedures will be followed in the event human remains are discovered during Project activities:

1. If human remains are identified during construction, all construction activities will cease immediately in the area of the find.
2. Excelerate Energy's construction manager will be notified immediately and informed of the discovery.
3. Excelerate Energy's construction manager will in turn notify the proper jurisdictional authorities including the Medical Examiner, the PRSHPO, and the archaeological consultant.
4. The Medical Examiner will determine whether the remains are recent or archaeological.
5. The proper jurisdictional authorities will determine the disposition of the remains.
6. Excelerate Energy will delay commencement of work pending receipt of notification from FERC that work may resume.

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LIST OF PREPARERS

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APPENDIX I
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