

UNITED STATES GOVERNMENT
MEMORANDUM

April 26, 2024

To: Public Information
From: Plan Coordinator, Plans Section

Subject: Public Information copy of plan

Control # - S-08143
Type - Supplemental Exploration Plan
Lease(s) - OCS-G36103 Block - 337 Alaminos Canyon Area
Operator - LLOG Exploration Offshore, L.L.C.
Description - Subsea wells F and F Alt
Rig Type - DP Semi or Drill Ship

Attached is a copy of the subject plan.

It has been deemed submitted as of this date and is under review for approval.

Laura Christensen
Plan Coordinator

Site Type/Name	Botm Lse/Area/Blk	Surface Location	Surf Lse/Area/Blk
WELL/F	G36103/AC/337	6480 FSL, 2170 FWL	G36103/AC/337
WELL/F ALT	G36103/AC/337	6430 FSL, 2170 FWL	G36103/AC/337

**LLOG EXPLORATION OFFSHORE, L.L.C.
1001 Ochsner Boulevard, Suite 100 -
Covington, Louisiana 70433**

**SUPPLEMENTAL PLAN OF EXPLORATION
OCS-G-36492, OCS-G-36102 & OCS-G-36103 LEASES
ALAMINOS CANYON BLOCKS 335, 336 & 337**

PUBLIC INFORMATION COPY

Prepared By:

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Regulatory Specialist
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Date: February 2024

LLOG EXPLORATION OFFSHORE, L.L.C.
SUPPLEMENTAL EXPLORATION PLAN
OCS-G-36492, OCS-G-36102 & OCS-G-36103 LEASES
ALAMINOS CANYON 335, 336 & 337

APPENDIX A	<i>Plan Contents</i>
APPENDIX B	<i>General Information</i>
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APPENDIX A
PLAN CONTENTS
(30 CFR Part 550.211 and 550.241)

A. Plan information

In accordance with 30 CFR 550.211 and 550.241(a), NTL No. 2008-G04 and NTL 2015-N01, LLOG Exploration Offshore, LLC (LLOG) would like to supplement approved Revised EP (R-7280) to add Location F. The Alaminos Canyon 335, 336 & 337 leases, OCS-G-36492, OCS-G-36102 & OCS-G-36103 are part of Unit #754319001. LLOG proposes the drilling, completion, testing and installation of subsea wellhead for one (1) proposed surface location F well, on Lease OCS-G-36103, and proposes (1) mirrored well (F Alt) to be drilled only in the event of a failure. All other aspects of revised exploratory plan R-7280 will remain the same. The operations proposed in this plan will not utilize pile-driving, nor is the Operator proposing any new pipelines expected to make landfall.

Included as *Attachment A-1* is Form BOEM 137 “OCS Plan Information Form”, which provides for the drilling, sub-sea completion and testing of all well locations.

B. Location

Attachment A-2 – Well Location Plat

Attachment A-3 – Bathymetry Map

C. Safety & Pollution Features

LLOG will utilize a Drillship or a DP semi-submersible drilling rig for the proposed operations. A description of the drilling units is included on the OCS Plans Information Form. Rig specifications will be made part of the Application for Permit to Drill.

Safety features on the drilling unit will include well control, pollution prevention, and blowout prevention equipment as described in Title 30 CFR Part 250, Subparts C, D, E and G; and further clarified by BOEM’s Notices to Lessees, and currently policy making invoked by BOEM, EPA and USCG. Appropriate life rafts, life jackets, ring buoys, etc., will be maintained on the facility at all times.

Pollution prevention measures include installation of curbs, gutters, drip pans, and drains on the drilling deck areas to collect all contaminants and debris.

D. Storage Tanks and Vessels

The following table details the storage tanks and/or production vessels that will store oil (capacity greater than 25 bbls. or more) and be used to support the proposed activities (MODU, barges, platforms, etc.):

Type of Storage Tank	Type of Facility	Tank Capacity (bbls)	Number of tanks	Total Capacity (bbls)	Fluid Gravity (API)
Fuel Oil Storage Tank	Drillship	16,564	1	16,564	No. 2 Diesel - 43
Fuel Oil Storage Tank		16,685.5	1	16,685.5	No. 2 Diesel - 43
Fuel Oil Settling Tank		836.6	2	1,673.2	No. 2 Diesel - 43
Fuel Oil Day Tanks		836.6	2	1,673.2	No. 2 Diesel - 43

Type of Storage Tank	Type of Facility	Tank Capacity (bbls)	Number of tanks	Total Capacity (bbls)	Fluid Gravity (API)
Fuel Oil (Marine Diesel)	DP Semi-Submersible	164	1	164	30
Fuel Oil Day		367	2	734	30
Emergency Generator		31	1	31	30
Forward Hull Fuel Oil		4634	2	9268	30
Lower Aft Hull Fuel Oil		3462	2	6924	30
Lube Oil Services		117 10.5 4.6	1 1 1	132.1	45
Dirty Lube Oil		38 28	1 1	66	45
Dirty Bilge		190	4	760	10

E. Pollution Prevention Measures: Not applicable. The State of Florida is not an affected State by the proposed activities in this plan.

F. Additional measures: LLOG does not propose any additional safety, pollution prevention, or early detection measures, beyond those required in 30 CFR 250 and per December 13, 2010 – Guidance for Deepwater Drillers to Comply with Strengthened Safety and Environmental Standards.

OCS Plan Information Form

Attachment A-1 (Proprietary Information)

OCS PLAN INFORMATION FORM

General Information										
Type of OCS Plan:	Exploration Plan (EP)		Development Operations Coordination Document (DOCD)							
Supplemental										
Company Name: LLOG EXPLORATION OFFSHORE, L.L.C.				BOEM Operator Number: 02058						
Address:				Contact Person: Sue Sachitana						
1001 OCHSNER BOULEVARD, SUITE 100				Phone Number: 985-801-4300						
COVINGTON, LA 70433				E-Mail Address: sue.sachitana@llog.com						
If a service fee is required under 30 CFR 550.125(a), provide the				Amount paid	\$4,348.00	Receipt No.	27C4BVVU			
Project and Worst Case Discharge (WCD) Information										
Lease(s): OCS-G-36102, OCS-G-36103 & OCS-G-36492			Area: AC	Block(s): 335/336/337	Project Name (If Applicable): Blacktip North					
Objective(s)	<input checked="" type="checkbox"/>	Oil	<input type="checkbox"/>	Gas	<input type="checkbox"/>	Sulphur	<input type="checkbox"/>	Salt	Onshore Support Base(s): FOURCHON	
Platform/Well Name: Location A			Total Volume of WCD: ~27,709 BOPD			API Gravity: 35°				
Distance to Closest Land (Miles): 160				Volume from uncontrolled blowout: 1.62 MMBBL						
Have you previously provided information to verify the calculations and assumptions for your WCD?							<input checked="" type="checkbox"/>	Yes	<input type="checkbox"/>	No
If so, provide the Control Number of the EP or DOCD with which this information was provided							N-10128			
Do you propose to use new or unusual technology to conduct your activities?							<input type="checkbox"/>	Yes	<input checked="" type="checkbox"/>	No
Do you propose to use a vessel with anchors to install or modify a structure?							<input type="checkbox"/>	Yes	<input checked="" type="checkbox"/>	No
Do you propose any facility that will serve as a host facility for deepwater subsea development?							<input type="checkbox"/>	Yes	<input checked="" type="checkbox"/>	No
Description of Proposed Activities and Tentative Schedule (Mark all that apply)										
Proposed Activity			Start Date		End Date		No. of Days			
Exploration drilling			See Attached Activity Schedule							
Development drilling										
Well completion										
Well test flaring (for more than 48 hours)										
Installation or modification of structure										
Installation of production facilities										
Installation of subsea wellheads and/or manifolds										
Installation of lease term pipelines										
Commence production										
Other (Specify and attach description)										
Description of Drilling Rig					Description of Structure					
<input type="checkbox"/>	Jackup	<input checked="" type="checkbox"/>	Drillship		<input type="checkbox"/>	Caisson	<input type="checkbox"/>	Tension leg platform		
<input type="checkbox"/>	Gorilla Jackup	<input type="checkbox"/>	Platform rig		<input type="checkbox"/>	Fixed platform	<input type="checkbox"/>	Compliant tower		
<input type="checkbox"/>	Semisubmersible	<input type="checkbox"/>	Submersible		<input type="checkbox"/>	Spar	<input type="checkbox"/>	Guyed tower		
<input checked="" type="checkbox"/>	DP Semisubmersible	<input type="checkbox"/>	Other (Attach Description)		<input type="checkbox"/>	Floating production system	<input type="checkbox"/>	Other (Attach Description)		
Drilling Rig Name (If Known):										
Description of Lease Term Pipelines										
From (Facility/Area/Block)		To (Facility/Area/Block)		Diameter (Inches)		Length (Feet)				

Kim DeSopo

From: notification@pay.gov
Sent: Thursday, February 22, 2024 3:45 PM
To: Kim DeSopo
Subject: Pay.gov Payment Confirmation: BOEM Exploration Plan - BF

EXTERNAL SOURCE EMAIL



An official email of the United States government



Your payment has been submitted to the designated government agency through [Pay.gov](https://www.pay.gov) and the details are below. Please note that this is just a confirmation of transaction submission. To confirm that the payment processed as expected, you may refer to your bank statement on the scheduled payment date. If you have any questions or wish to cancel this payment, you will need to contact the agency you paid at your earliest convenience.

You will receive a reminder email several days before the payment is processed. If you wish to cancel this transaction, sign in to your account at <https://www.pay.gov/> and choose the Pending tab of the Payment Activity page.

Application Name: BOEM Exploration Plan - BF
[Pay.gov](https://www.pay.gov) Tracking ID: 27C4BVVU
Agency Tracking ID: 76642932570

Account Holder Name: LLOG Exploration Offshore, LLC
Transaction Type: ACH Debit
Transaction Amount: \$4,348.00
Payment Date: 02/23/2024

Account Type: Business Checking
Routing Number: 065403626
Account Number: *****8323

Transaction Date: 02/22/2024 04:44:37 PM EST
Total Payments Scheduled: 1
Frequency: OneTime

Region: Gulf of Mexico
Contact: Kim DeSopo (504) 801-4728

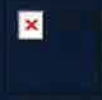
Company Name/No: LLOG Exploration Offshore, LLC, 02058

Lease Number(s): 36103

Area-Block: Alaminos Canyon AC,337

Surface Locations: 1

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ACTIVITY SCHEDULE

WELL / EVENT	SPUD	TD	COMPL START	COMPL FINISH	DESCRIPTION
Location F	6/1/2024	12/18/2024	1/1/2025	1/1/2026	Drill, TA, Complete

Years	Number of Days
2024	200.00
2025	365.00
2026	365.00
2027	365.00
2028	365.00
2029	365.00
2030	365.00
2031	365.00
2032	365.00
2033	365.00

Our rig schedule is fluid and while we know we are going to drill the well in 2024, it is uncertain when we will complete it, which is why we are asking for 365 days per year.

OCS PLAN INFORMATION FORM (CONTINUED)
Include one copy of this page for each proposed well/structure

Proposed Well/Structure Location										
Well or Structure Name/Number (If renaming well or structure, reference previous name): Loc F				Previously reviewed under an approved EP or DOCD?			Yes	<input checked="" type="checkbox"/>	No	
Is this an existing well or structure?		Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>	If this is an existing well or structure, list the Complex ID or API No.				
Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?							<input checked="" type="checkbox"/>	Yes	<input type="checkbox"/>	No
WCD info	For wells, volume of uncontrolled blowout (Bbls/day): 27,709 BOPD			For structures, volume of all storage and pipelines (Bbls): N/A			API Gravity of fluid		35°	
Surface Location				Bottom-Hole Location (For Wells)			Completion (For multiple completions, enter separate lines)			
Lease No.	OCS G-36103			OCS			OCS OCS			
Area Name	Alaminos Canyon									
Block No.	337									
Blockline Departures (in feet)	N/S Departure: F <u> </u> L			N/S Departure: F <u> </u> L			N/S Departure: F <u> </u> L		F <u> </u> L	
	6,480'						N/S Departure: F <u> </u> L		F <u> </u> L	
	E/W Departure: F <u> </u> L			E/W Departure: F <u> </u> L			E/W Departure: F <u> </u> L		F <u> </u> L	
	2,170'						E/W Departure: F <u> </u> L		F <u> </u> L	
Lambert X-Y coordinates	X: 1,142,650			X:			X:			
	Y: 9,668,880			Y:			Y:			
Latitude/ Longitude	Latitude 26° 38' 16.791" N			Latitude			Latitude		Latitude	
	Longitude 94° 31' 27.157" W			Longitude			Longitude		Longitude	
Water Depth (Feet): 4,436'				MD (Feet):		TVD (Feet):		MD (Feet):		TVD (Feet):
Anchor Radius (if applicable) in feet:								MD (Feet):		TVD (Feet):
Anchor Locations for Drilling Rig or Construction Barge (If anchor radius supplied above, not necessary)										
Anchor Name or No.	Area	Block	X Coordinate		Y Coordinate		Length of Anchor Chain on Seafloor			
			X =		Y =					
			X =		Y =					
			X =		Y =					
			X =		Y =					
			X =		Y =					
			X =		Y =					
			X =		Y =					
			X =		Y =					

OCS PLAN INFORMATION FORM (CONTINUED)
Include one copy of this page for each proposed well/structure

Proposed Well/Structure Location									
Well or Structure Name/Number (If renaming well or structure, reference previous name): Loc F Alt				Previously reviewed under an approved EP or DOCD?		Yes	<input checked="" type="checkbox"/>	No	
Is this an existing well or structure?		Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>	If this is an existing well or structure, list the Complex ID or API No.			
Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?						<input checked="" type="checkbox"/>	Yes	<input type="checkbox"/>	No
WCD info	For wells, volume of uncontrolled blowout (Bbls/day): 27,709 BOPD			For structures, volume of all storage and pipelines (Bbls): N/A			API Gravity of fluid		35°
Surface Location				Bottom-Hole Location (For Wells)			Completion (For multiple completions, enter separate lines)		
Lease No.	OCS G-36103			OCS			OCS OCS		
Area Name	Alaminos Canyon								
Block No.	337								
Blockline Departures (in feet)	N/S Departure: F <u> </u> L			N/S Departure: F <u> </u> L			N/S Departure: F <u> </u> L		
	6,430'						N/S Departure: F <u> </u> L		
	E/W Departure: F <u> </u> L			E/W Departure: F <u> </u> L			E/W Departure: F <u> </u> L		
	2,170'						E/W Departure: F <u> </u> L		
Lambert X-Y coordinates	X: 1,142,650			X:			X:		
	Y: 9,668,830			Y:			Y:		
Latitude/Longitude	Latitude 26° 38' 16.296" N			Latitude			Latitude		
	Longitude 94° 31' 27.150" W			Longitude			Longitude		
Water Depth (Feet): 4,436'				MD (Feet):		TVD (Feet):		MD (Feet):	
Anchor Radius (if applicable) in feet:								TVD (Feet):	
Anchor Locations for Drilling Rig or Construction Barge (If anchor radius supplied above, not necessary)									
Anchor Name or No.	Area	Block	X Coordinate		Y Coordinate		Length of Anchor Chain on Seafloor		
			X =		Y =				
			X =		Y =				
			X =		Y =				
			X =		Y =				
			X =		Y =				
			X =		Y =				
			X =		Y =				

Well Location Plat

Attachment A-2 (Proprietary Information)

Y = 9,678,240.00

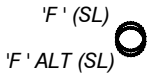


PROPOSED WELL LOCATION

LOCATION	BLOCK	CALLS		COORDINATES		LATITUDE	LONGITUDE	WD	MD	TVD
'F' (SL)	AC/337	2,170.00' FWL	6,480.00' FSL	X = 1,142,650.00	Y = 9,668,880.00	26° 38' 16.791"N	94° 31' 27.157"W	4,436'		
'F' ALT (SL)	AC/337	2,170.00' FWL	6,430.00' FSL	X = 1,142,650.00	Y = 9,668,830.00	26° 38' 16.296"N	94° 31' 27.150"W	4,436'		

AC337
OCS-G36103
 LLOG EXPLORATION OFFSHORE LLC

X = 1,140,480.00



X = 1,156,320.00

Y = 9,662,400.00

PUBLIC INFORMATION

**LLOG EXPLORATION
 OFFSHORE, L.L.C.**



36499 Perkins Road
 Prairieville, Louisiana 70769
 Tel: 225-673-2163



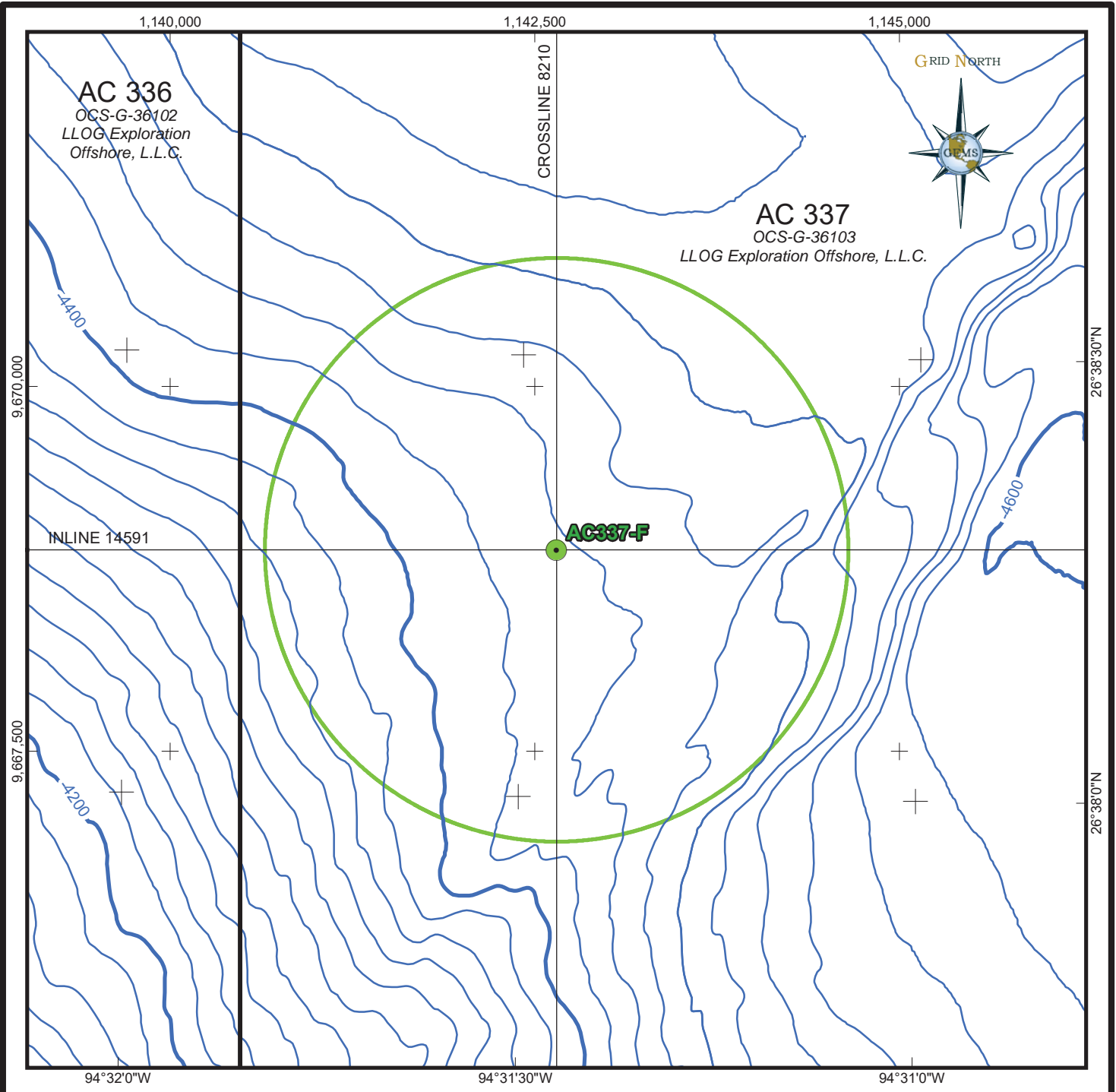
EXPLORATION PLAT
PROPOSED WELLS 'F' & 'F' ALT
OCS-G36103 BLOCK 337
ALAMINOS CANYON AREA

GULF OF MEXICO

DATUM: NAD 27	SPHEROID: CLARKE 1866	PROJECTION: U.T.M.	ZONE: 15	DRAWN BY: RJN	CHK. BY: MEK	REV. No.: 1	JOB No.: 23-050	DWG No.: 23-050-AC337_EXP F_REV1
				DATE: 12-27-23	REV. DATE: 2/29/24	SCALE: 1"=2,000'	SHEET 1 OF 1	

Bathymetry Map

Attachment A-3 (Public Information)



PROPOSED SURFACE LOCATION
CIRCLE REPRESENTS 2000 FT RADIUS
AROUND PROPOSED WELLSITE.



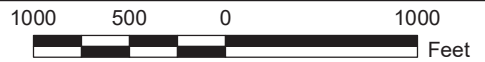
WATER DEPTH IN FEET. CONTOUR INTERVAL = 20 FT.

— 3D SURVEY LINE.

LLOG Exploration Offshore, L.L.C.

BATHYMETRY MAP

**BLOCK 337
ALAMINOS CANYON
GULF OF MEXICO**



SCALE 1:12,000 OR 1" = 1,000'

GEODETIC DATUM: NAD 1927
ELLIPSOID: CLARKE 1866
ZONE: 15N
GRID UNITS: US FEET



DATE: 09 FEBRUARY 2024
FILE NAME: AC337-F-1.mxd
PROJECT NO.: 1023-3216

MAP NO. AC337-F-1

APPENDIX B
GENERAL INFORMATION
(30 CFR Part 550.213 and 550.243)

A. Applications and Permits

There are no Federal/State applications to be submitted for the activities provided for in this Plan (exclusive to BOEM permit applications and general permits issued by the EPA and COE)

Application/Permit	Issuing Agency	Status
APD	BSEE	To be filed

B. Drilling Fluids

Type of Drilling Fluid	Estimated Volume of Drilling Fluid to be used per Well
Water Based (seawater, freshwater, barite)	See Appendix F, Table 1 of this Plan
Oil-based (diesel, mineral oil)	N/A
Synthetic-based (internal olefin, ester)	See Appendix F, Table 2 of this Plan

C. New Or Unusual Technology

LLOG does not propose using any new and/or unusual technology for the operations proposed in this Revised Plan.

D. Bonding Statement

The bond requirements for the activities and facilities proposed in this Revised Exploration Plan are satisfied by an area wide bond, furnished, and maintained according to 30 CFR Part 256; subpart I; NTL No. 2000-G16, “Guidelines for General Lease Surety Bonds,” and additional security under 30 CFR 256.53(d) and NTL No. 2003-N06 “Supplemental Bond Procedures.”

E. Oil Spill Responsibility (OSFR)

LLOG Exploration Offshore, L.L.C (MMS Co. No. 02058) will demonstrate oil spill financial responsibility for the facilities proposed in this Supplemental EP according to 30 CFR Part 553, and NTL No. 2008-N05 “Guidelines for Oil Spill Financial Responsibility (OSFR) for Covered Facilities.”

F. Deepwater Well Control Statement

LLOG Exploration Offshore, L.L.C. (MMS Co. No. 02058) has the financial capability to drill a relief well and conduct other emergency well control operations.

G. Blowout Scenario

The Worst-Case Discharge (WCD) Calculations for the proposed well have been calculated as 27,709 BOPD. The calculations for the WCD were prepared and submitted by Shell in plan N-10128. The Blowout Scenario is submitted in this plan as *Attachment B-1*.

Attachment B-1

Blowout Scenario (Public Information)



**BLOWOUT SCENARIO
AC 337**

Created by: Adam Currier
Last Revised: 2/21/2024 Rev00
Page 1 of 6
Confidential

BLOWOUT SCENARIO

Pursuant with 30 CFR 550.213(g), 550.219, 550,250 and NTL 2015-N01 the following attachment provides a blowout scenario description, information regarding any oil spill, WCD results and assumptions of potential spill and additional measures taken to firstly enhance the ability to prevent a blowout and secondly to manage a blowout scenario if it occurred.

INFORMATION REQUIREMENTS

PROPOSED PROSPECT INFORMATION

Well Surface Location	WD	X (NAD 27)	Y (NAD 27)	Latitude	Longitude
AC 337 #1 ST00 OCS-G 36103	4,436	1,142,650	9,668,880	26° 38' 16.791"	94° 31' 21.157"

INFORMATION REQUIREMENTS

A) Blowout scenario

The AC 337 well(s) to be drilled to potential outlined in the Geological and Geophysical Information Section of this plan utilizing a typical subsea wellhead system, conductor, surface and intermediate casing strings and a MODU rig with marine riser and a subsea BOP system. A hydrocarbon influx and a well control event occurring from the objective sand is modeled with no drill pipe or obstructions in the wellbore followed by a failure of the subsea BOP's and loss of well control at the seabed. The simulated flow and worst case discharge (WCD) results for all wells are calculated and the highest WCD is used for this unrestricted blowout scenario.

B) Estimated flow rate of the potential blowout

Category	Initial EP
Type of Activity	Drilling
Facility Location (area / block)	AC 337 (surface location)
Facility Designation	MODU
Distance to Nearest Shoreline (nautical miles)	~139
Uncontrolled Blowout (Volume per day)	27,709 bbls (max. est. - Merlin®) (see attached)
Type of Fluid	Crude (35 API oil)

C) Total volume and maximum duration of the potential blowout

Duration of Flow (days)	60 days total (see Relief Well Response Estimate below)
Total Volume of Spill (bbls)	~1.62 MMBO based on 60 days of uncontrolled flow based on simulator models (Merlin®)

D) Assumptions and calculations used in determining the worst case discharge

The WCD calculations were previously submitted by Shell as a part of their Initial EP, N-10128.

E) Potential for the well to bridge over

Mechanical failure/collapse of the borehole in a blowout scenario is influenced by several factors including in-situ stress, rock strength and fluid velocities at the sand face. Given the substantial fluid velocities inherent in the WCD, and the scenario as defined where the formation is not supported by a cased and cemented wellbore, it is possible that the borehole may fall/collapse/bridge over within a span of a few days, significantly reducing the outflow of the rates. For this blowout scenario, no bridging is considered.

F) Likelihood for intervention to stop blowout

The likelihood of surface intervention to stop a blowout is based on some of the following equipment specific to potential MODU's to be contracted for this well. It is reasonable to assume that the sooner you are able to respond to the initial blowout, the better likelihood there is to control and contain the event due to reduced pressures at the wellhead, less exposure of well fluids to erode and compromise the well control equipment, and less exposure of hydrocarbons to the surface to safeguard personnel and equipment in an emergency situation. This equipment includes:

- Secondary Acoustic BOP Control System – based on specific rig contracted for work, BOP's possibly available with active secondary acoustic controls for specific BOP functions. This system has the ability to communicate and function specific BOP controls from the surface in the event of a failure of the primary umbilical control system. This system typically can establish BOP controls from the surface acoustic system package on the rig or by deploying a second acoustic package from a separate vessel of opportunity. This system may not be included on all MODU's presently in GOM. This system is typically configured to function the following:
 - Blind/shear ram close
 - Pipe ram close
 - LMRP disconnect

- ROV Intervention BOP Control System – includes one or more ROV intervention panels mounted on the subsea BOP's located on the seabed allows a ROV utilizing standard ROV stabs to access and function the specific BOP controls. These functions will be tested at the surface as part of the required BOP stump test and selectively at the seafloor to ensure proper functionality. These function include the following (at a minimum):
 - Blind/shear ram close
 - Pipe ram close
 - LMRP disconnect
 - WH disconnect

- Deadman / Autoshear function – typically fitted on DP MODU's and but to be on all MODU's operating in the GOM according to new requirements, this equipment allows for an automated pre-programmed sequence of functions to close the casing shear rams and the blind/shear rams in the event of an inadvertent or emergency disconnect of the LMRP or loss of both hydraulic and electrical supply from the surface control system.

In the event that the intervention systems for the subsea BOP's fail, LLOG will initiate call out of a secondary containment / surface intervention system supported by the Helix Well Containment Group (HWCG) of which LLOG is a member. This system incorporates a capping stack capable of being



**BLOWOUT SCENARIO
AC 337**

Created by: Adam Currier
Last Revised: 2/21/2024 Rev00
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deployed from the back of a vessel of opportunity equipped with an ROV or from the Helix Q4000 Or Q5000 DP MODU. Based on the potential integrity concerns of the well, a “cap and flow” system can be deployed which may include the HWCG single vessel solution utilizing the PTS processing module capable of handling up to 130,000 BOPD flowback. The vertical intervention work is contingent upon the condition of the blowing out well and what equipment is intact to access the wellbore for kill or containment operations. The available intervention equipment may also require modifications based on actual wellbore conditions. Standard equipment is available through the Helix Deepwater Containment System to fit the wellhead and BOP stack profiles used for the drilling of the above mentioned well.

G) Availability of rig to drill relief well, rig constraints and timing of rigs

LLOG currently has two deepwater MODU under contract (Seadrill West Neptune and Noble Valiant DP drillships). In the event of a blowout scenario that does not involve loss or damage to the rig such as an inadvertent disconnect of the BOP’s, then the existing contracted rig may be available for drilling the relief well and vertical intervention work. If the blowout scenario involves damage to the rig or loss of the BOP’s and riser, a replacement rig or rigs will be required.

With the current activity level in the GOM, 21 deepwater MODU’S are potentially available to support the relief well drilling operations. Rig share and resource sharing agreements are in place between members of the Helix Well Containment Group. The ability to negotiate and contract an appropriate rig or rigs to drill relief wells is highly probable in a short period of time. If the rig or rigs are operating, the time to properly secure the well and move the rig to the relief well site location is estimated to be about 14 to 21 days.

VESSELS OF OPPORTUNITY

Based on the water depth restrictions for the proposed locations the following “Vessels of Opportunity” are presently available for utilization for intervention and containment and relief well operations. These may include service vessels and drilling rigs capable of working in the potential water depths and may include moored vessels and dynamically positioned vessels. The specific conditions of the intervention or relief well operations will dictate the “best fit” vessel to efficiently perform the desired results based on the blowout scenario. The list included below illustrates specific option that may vary according to the actual timing / availability at the time the vessels are needed.

OPERATION	SPECIFIC VESSEL OF OPPORTUNITY
Intervention and Containment	<ul style="list-style-type: none"> • Helix Q4000/Q5000 (DP Semi) • HWCG PTS Well Test Skid (Single Vessel Solution)
Relief Well Drilling Rigs	<ul style="list-style-type: none"> • Seadrill West Neptune (DP Drillship) • Sevan LA (DP Semi) • Noble Valiant (DP Drillship) • Seadrill West Vela (DP Drillship)
ROV / Multi-Purpose Service Vessels	<ul style="list-style-type: none"> • Oceaneering (numerous DP ROV vessels) • HOS Achiever, Iron Horse 1 and 2 (DP MPSV) • Helix Pipe Lay Vessel (equipped w/ 6” PL – 75,000’) • Other ROV Vessels – (Chouest, HOS, Fugro, Subsea 7)
Shuttle Tanker / Barge Support	<ul style="list-style-type: none"> • OSG Ship Management

H) Measures taken to enhance ability to prevent blowout

Pursuant to BOEM-2010-034 Final Interim Rules, measures to enhance the ability to prevent or reduce the likelihood of a blowout are largely based on proper planning and communication, identification of potential hazards, training and experience of personnel, use of good oil field practices and proper equipment that is properly maintained and inspected for executing drilling operations of the proposed well or wells to be drilled.

When planning and designing the well, ample time is spent analyzing offset data, performing any needed earth modeling and identifying any potential drilling hazards or well specific conditions to safeguard the safety of the crews when well construction operations are underway. Once the design criteria and well design is established, the well design is modeled for the lifecycle of the wellbore to ensure potential failure modes are eliminated. Pursuant to BOEM-2010-0034 Interim Final Rules implemented additional considerations of a minimum of 2 independent barriers for both internal and external flow paths in addition to proper positive and negative testing of the barriers.

The proper training of crew members and awareness to identify and handle well control event is the best way prevent a blowout incident. Contractor's personnel and service personnel training requirements are verified per regulatory requirements per guidelines issued in BOEM-2010-034 Interim Final Rules. Drills are performed frequently to verify crew training and improve reaction times.

Good communication between rig personnel, office support personnel is critical to the success of the operations. Pre-spud meetings are conducted with rig crews and service providers to discuss, inform and as needed improve operations and well plans for safety and efficiency considerations. Daily meetings are conducted to discuss planning and potential hazards to ensure state of preparedness and behavior is enforced to create an informed and safe culture for the operations. Any changes in the planning and initial wellbore design is incorporated and communicated in a Management of Change (MOC) process to ensure continuity for all personnel.

Use of established good oil field practices that safeguard crews and equipment are integrated to incorporate LLOG's, the contractor and service provider policies.

Additional personnel and equipment will be used as needed to elevate awareness and provide real time monitoring of well conditions while drilling such as MWD/LWD/PWD tools used in the bottom hole assemblies. The tool configuration for each open hole section varies to optimize information gathered including the use of Formation-Pressure-While-Drilling (FPWD) tools to establish real time formation pressures and to be used to calibrates pore pressure models while drilling. Log information and pressure data is used by the drilling engineers, geologist, and pore pressure engineers to maintain well control and reduced potential events such as well control events and loss circulation events.

Mud loggers continuously monitor return drilling fluids, drill gas levels and cuttings as well as surface mud volumes and flow rates, rate of penetration and lithology/paleo to aid in understanding trends and geology being drilled. Remote monitoring of real time drilling parameters and evaluation of geologic markers and pore pressure indicators is used to identify potential well condition changes.

Proper equipment maintenance and inspection program for same to before the equipment is required. Programmed equipment inspections and maintenance will be performed to ensure the equipment operability and condition. Operations will cease as needed in order to ensure equipment and well conditions are maintained and controlled for the safety of personnel, rig and subsurface equipment and the environment.

I) Measures to conduct effective and early intervention in the event of a blowout

In conjunction with the LLOG Exploration’s “Well Control Emergency Response Plan” and as required by NTL 2010-N06, the following is provided to demonstrate the potential time needed for performing secondary intervention and drilling of a relief well to handle potential worst case discharge for the proposed prospect. Specific plans are integrated into the Helix Well Containment Groups procures to be approved and submitted with the Application for Permit to Drill. Equipment availability, backup equipment and adaptability to the potential scenarios will need to be addressed based on the initial site assessment of the seafloor conditions for intervention operations. Relief well equipment such as backup wellhead equipment and tubulars will be available in LLOG’s inventory for immediate deployment as needed to address drilling the relief well(s).

SITE SPECIFIC PROPOSED RELIEF WELL AND INTERVENTION PLANNING

No platform was considered for drilling relief wells for this location due to location, water depth and lack of appropriate platform within the area. For this reason, a moored or DP MODU will be preferred / required.

Relief well sites have been initially identified to address blowout scenarios for the potential geologic targets for the proposed well. A total of **3** relief well surface locations in AC 380 are proposed for location of the #2 ST01. Based on actual seafloor state unforeseen at this time, the final location(s) may need to be revised. The locations have been selected based on proximity to the targets sands and potential shallow hazards.

Proposed EP Well	Proposed Relief Well	X (NAD 27)	Y (NAD 27)
AC 337 #1 ST01 OCS-G 36103	AC 380 RW-1 Relief Well #1	1,143,985'	9,671,945'
	AC 380 RW-2 Relief Well #2	1,145,470'	9,670,720'
	AC 380 RW-3 Relief Well #3	1,145,630	9,667,105



**BLOWOUT SCENARIO
AC 337**

Created by: Adam Currier
Last Revised: 2/21/2024 Rev00
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RELIEF WELL RESPONSE TIME ESTIMATE

OPERATION	TIME ESTIMATE (DAYS)
IMMEDIATE RESPONSE <ul style="list-style-type: none"> • safeguard personnel, render first-aid • make initial notifications • implement short term intervention (if possible) • implement spill control • develop Initial Action Plan 	1
INTERIM REPSONSE <ul style="list-style-type: none"> • establish Onsite Command Center and Emergency Management Team • assess well control issues • mobilize people and equipment (Helix DW Containment System) • implement short term intervention and containment (if possible) • develop Intervention Plan • initiate relief well planning • continue spill control measures 	4
INTERVENTION AND CONTAIMENT OPERATIONS <ul style="list-style-type: none"> • mobilize equipment and initiate intervention and containment operations • perform TA operations and mobilize relief wells rig(s) • finalize relief well plans, mobilize spud equipment, receive approvals • continue spill control measures 	10
RELIEF WELL(S) OPERATIONS <ul style="list-style-type: none"> • continue intervention and containment measures • continue spill control measures • drill relief well (s) 	40
PERFORM HYDRAULIC KILL OPERATIONS / SECURE BLOWNOUT WELL <ul style="list-style-type: none"> • continue intervention and containment measures • continue spill control measures • perform hydraulic kill operations, monitor well, secure well 	5
ESTIMATED TOTAL DAYS OF UNCONTROLLED FLOW	60
SECURE RELIELF WELL(S) / PERFORM P&A / TA OPERATIONS / DEMOBE	30
TOTAL DAYS	90

APPENDIX C
GEOLOGICAL AND GEOPHYSICAL INFORMATION
(30 CFR Part 550.214 and 550.244)

A. Geological Description

Included as **Attachment C-1** are the geological targets and a narrative of trapping features proposed in this Plan.

B. Structure Contour Maps

Included as **Attachment C-2** are current structure maps (depth base and expressed in feet subsea) depicting the entire lease coverage area; drawn on top of the prospective hydrocarbon sands. The maps depict each proposed bottom hole location and applicable geological cross section.

C. Interpreted Seismic Lines

Included as **Attachment C-3** is a copy of the migrated and annotated (shot points, timelines, well paths) deep seismic line within 500 feet of the surface location being proposed in this Plan.

D. Geological Structure Cross-Sections

An interpreted geological cross section depicting the proposed well locations and depth of the proposed wells is included as **Attachment C-4**. Such cross section corresponds to each seismic line being submitted.

E. Shallow Hazards Report

Geoscience Earth & Marine Services, Inc., (GEMS) “Shallow Hazards and Archaeological Assessment, Blocks 335 (OCS-G-36492), 336 (OCS-G-36102), and 337 (OCS-G-36103) Alaminos Canyon Area, Gulf of Mexico” (GEMS Project No. 0619-2881) submitted to Shell in September 2020.

F. Shallow Hazards Assessment

LLOG Exploration Offshore, LLC (LLOG) contracted Geoscience Earth and Marine Services (GEMS) to provide an assessment of the seafloor and shallow geologic conditions to determine favorability of drilling operations for the proposed Location F whose surface is in Alaminos Canyon Block 337. A copy of the wellsite clearance letter that was prepared by GEMS on February 12, 2024, is attached for your review as **Attachment C-5**.

G. High Resolution Seismic Lines

LLOG did not run 3-D seismic for this prospect.

H. Stratigraphic Column

A generalized biostratigraphic/lithostratigraphic column from the seafloor to the total depth of the proposed wells is included as **Attachment C-6**.

I. Time vs Depth Tables

LLOG has determined that there is existing sufficient well control data for the target areas proposed in this Plan; therefore, tables providing seismic time versus depth for the proposed well locations are not required.

Geological Description

Attachment C-1 (Proprietary Information)

Structure Maps

Attachment C-2 (Proprietary Information)

Deep Seismic Lines

Attachment C-3 (Proprietary Information)

Cross Section Maps

Attachment C-4 (Proprietary Information)

Shallow Hazards Assessment

Attachment C-5 (Public Information)

February 12, 2024

Project No.: 1023-3216

LLOG Exploration Offshore, LLC
City Centre Three
842 W. Sam Houston Pkwy N.,
Suite 600
Houston, TX 77024

Attention: Mr. Jaime Mata

**Site Clearance Letter,
Proposed Wellsite F
Block 337 (OCS-G-36103),
Alaminos Canyon Area,
Gulf of Mexico**

LLOG Exploration Offshore, LLC (LLOG) contracted Geoscience Earth & Marine Services (GEMS) to provide an assessment of the seafloor and shallow geologic conditions to determine the favorability of drilling operations for the proposed location F whose surface location is in Block 337 (OCS-G-36103, Alaminos Canyon (AC) Area, Gulf of Mexico.

This letter addresses specific seafloor and subsurface conditions around the proposed location to the Top of Salt, at about 6,665 ft below the mudline (bml); -11,101 below sea level (bsl). Surface conditions appear feasible for drilling at the proposed wellsite. There is a negligible to low potential for encountering shallow gas or shallow water flow in the sediments above salt. This letter provides details specific to the well location, including available data, Notice to Lessees (NTL) requirements, man-made features, and wellsite conditions.

Proposed Well Location

The surface location for the proposed Wellsite F lies in the west-central portion of AC 337. The coordinates for the proposed wellsite are as follows:

Table F-1 Proposed AC337-F Coordinates

Proposed Wellsite AC337-F			
Spheroid & Datum: Clarke 1866 NAD27 Projection: UTM Zone 15 North		Line Reference	Block Calls
X: 1,142,650 ft	Latitude: 26° 38' 16.7910" N	Inline 14591	2,170 ft FWL
Y: 9,668,880 ft	Longitude: 94° 31' 27.1566" W	Crossline 8210	6,480 ft FSL

Table F-2. Proposed Re-Spud Location AC337-F alt

Proposed Wellsite AC337-F alt			
Spheroid & Datum: Clarke 1866 NAD27 Projection: UTM Zone 15 North		Line Reference	Block Calls
X: 1,142,650 ft	Latitude: 26° 38' 16.7910" N	Inline 14590	2,170 ft FWL
Y: 9,668,830 ft	Longitude: 94° 31' 27.1500" W	Crossline 8210	6,430 ft FSL

LLOG will drill this well using a dynamically positioned drilling vessel. Our assessment addresses the seafloor conditions within a 2,000 ft radius of the surface location.

A re-spud (alternative) location, ALT F, lies approximately 50 ft South of the proposed primary wellsite. The seafloor and subsurface conditions to the Top of Salt are expected to be very similar to the currently proposed wellsite.

Available Data

The wellsite assessment is based on the findings provided within the geological and archaeological assessments of this report (Volumes I and II). The text, maps, and figures included in the geohazard report provide detail on the regional geology of the Study Area (Volume I). Information on the mapped sonar contacts is provided in the archaeological assessment (Volume II).

LLOG provide an exploration 3-D seismic time volume covering the area of interest. The data volume covers an approximate 121.5 square-mile area that includes all or portions of 15 Federal lease blocks centered on the Study Area. In addition, LLOG obtained two high-resolution geophysical datasets collected using an AUV (Autonomous Underwater Vehicle), covering the entirety of the Study Area. The AUV survey extends into portions of the surrounding blocks. Fugro USA Marine, Inc. (Fugro) collected the high-resolution data in 2019. The Fugro AUV data included 2.5-6.5 kHz subbottom profiler, 105/410 kHz side-scan sonar, and 3-meter bin multibeam bathymetry data. The detailed data specifications are listed in Appendix B of the GEMS shallow hazards and archaeological report (GEMS, 2024).

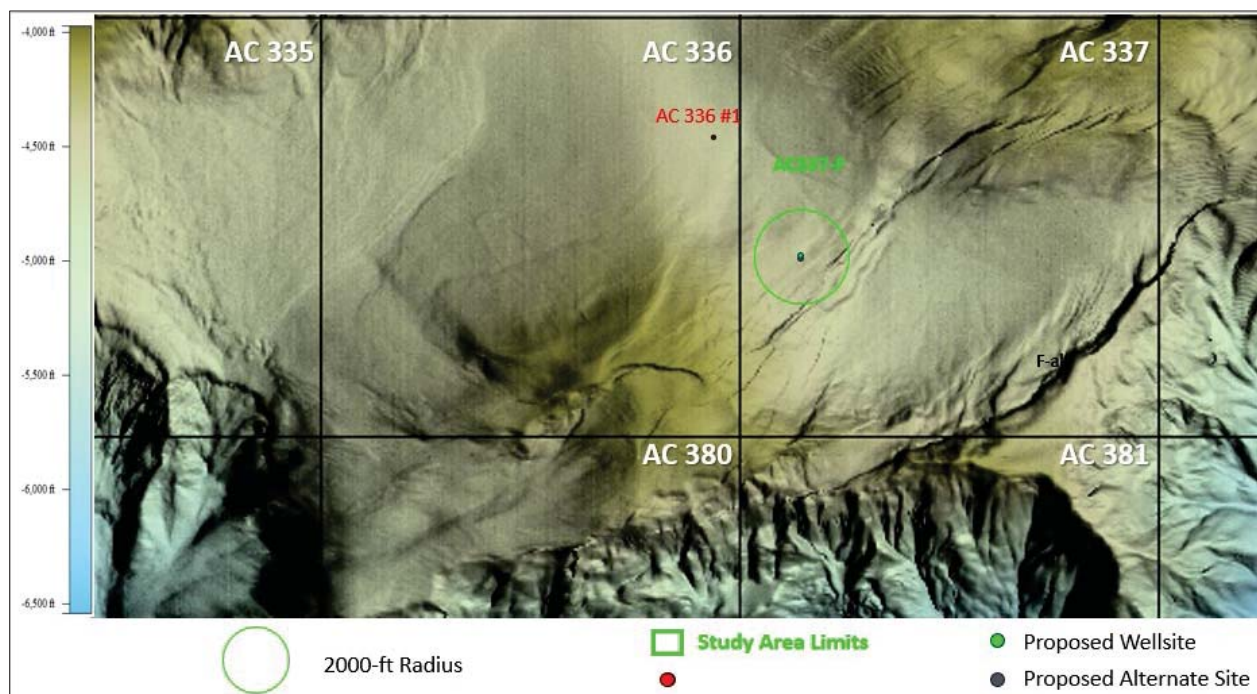


Figure F-1. Seafloor Rendering Showing the Proposed Wellsite Location

Attachments

Wellsite maps are centered on the Proposed Wellsite B and are displayed at a 1 inch = 1,000 ft scale (1:12,000). The maps included in this letter are as follows:

- Map No. AC 337-F-1: Bathymetry Map
- Map No. AC 337-F-2: Seafloor Features Map
- Map No. AC 337-F-3: Side-Scan Sonar Mosaic
- Map No. AC 337-F-4: Seafloor Amplitude Rendering
- Map No. AC 337-F-5: Geologic Features Map

The accompanying illustrations were extracted from the available datasets and are listed below:

- Illustration AC 337-F-1: Portion of Subbottom Profiler Line 754 Showing Near-Surface Conditions Beneath Proposed Wellsite F, Alaminos Canyon Area, Block 337
- Illustration AC 337-F-2: Portions of Inline 14591 and Crossline 8210 Showing Conditions Beneath Proposed Wellsite F. Surface Location in Alaminos Canyon Area, Block 337

Illustration AC 337-F-3: Tophole Prognosis Chart, Proposed Wellsite F. Surface Location in Alaminos Canyon Area, Block 337

NTL Requirements

The following letter complies with the Bureau of Ocean Energy Management (BOEM) Notices to Lessees (NTL's) 2008-G04, 2009-G40, and 2022-G01, (MMS, 2008, 2010, and BOEM 2022) with respect to benthic community and shallow hazard assessments.

BOEM may require an assessment for potential archaeological resources prior to conducting drilling operations (MMS, 2005). To satisfy NTL requirements, GEMS completed an archaeological assessment using high-resolution geophysical Autonomous Underwater Vehicle (AUV) survey data. The requirements of NTL 2005-G07 (MMS, 2020), which are applicable for exploration or production activity, have been satisfied and the results were provided in Volume II of the GEMS shallow hazards and archaeological report (GEMS, 2024).

As specified in NTL 2022-G01 (BOEM, 2022), GEMS generated a power spectrum diagram from the 3-D seismic data cube provided by LLOG at the proposed wellsite (Figure F-2). The extraction is generated from the data within a 2,000 ft radius of the proposed well and from the seafloor to Top of Salt. GEMS converted the amplitude vs. frequency spectrum, generated by the IHS software, to power vs. frequency by squaring the amplitude values as described by J. A. Coffeen, 1978. The frequency bandwidth at 50% power ranges between 13 Hz and 61 Hz.

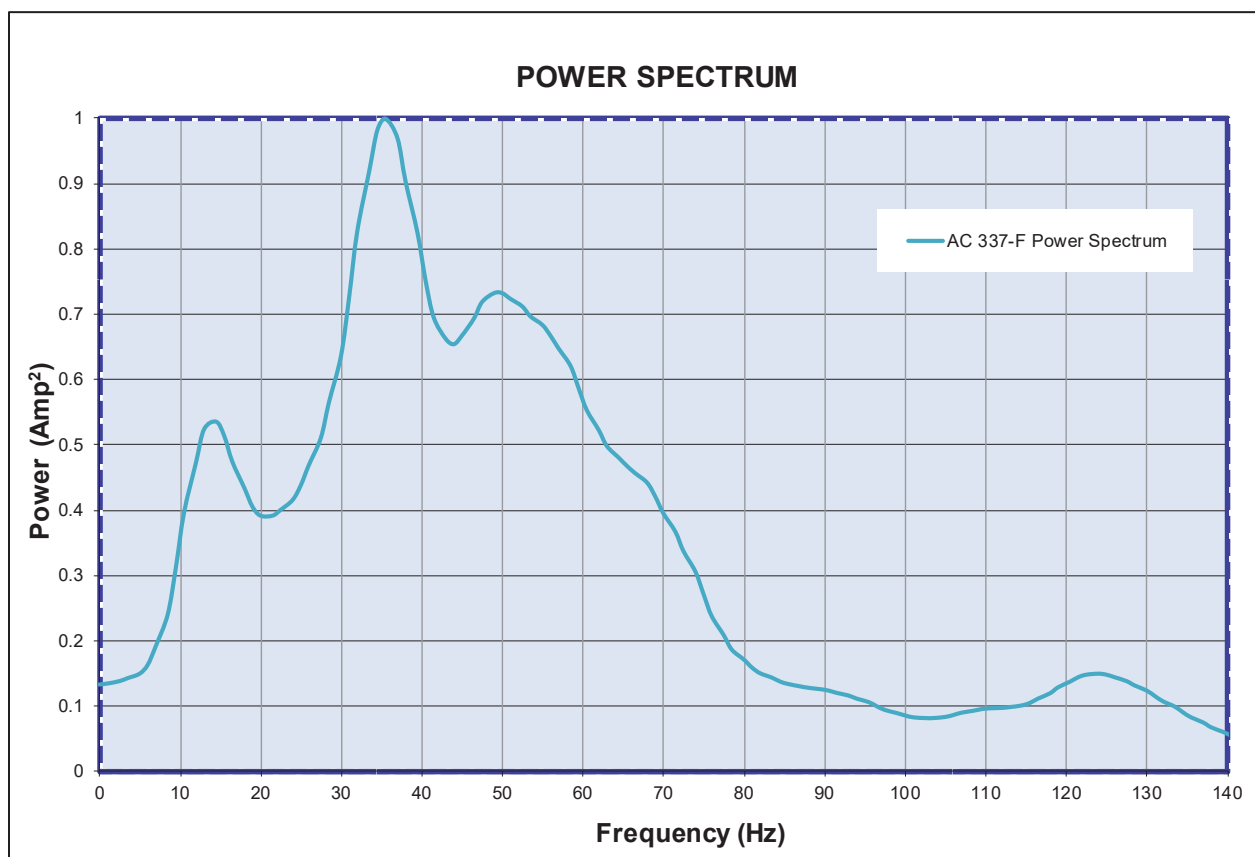


Figure F-2. Power Spectrum Curve (Frequency vs Power)

Man-Made Features

The surface location is clear of any wells, pipelines, or platforms within a 2,000 ft radius around the proposed wellsite. The closest existing well (LLOG AC 336 #1) is located 1.07 miles northwest of the Proposed Wellsite F (Figure F-1), BOEM 2024a. The well was drilled in 2022 to a total vertical depth (TVG) of 29,850 ft. The nearest pipeline lies about over 16 miles northwest of the proposed wellsite.

Archaeological Assessment

The GEMS archaeologist reviewed the side-scan sonar, multibeam, and subbottom profiler data within AC 337 and surrounding blocks (GEMS, 2024). The data analysis detected 254 sonar contacts within the AC 335-337, 380-381, and 424 Study Area and all contacts were considered modern debris (GEMS, 2024). The sonar contacts do not have an acoustic signature indicative of archaeological resources. Four sonar contacts occur within 2,000 ft of the proposed F wellsite location (Table F-3 and Maps AC337-F-2 and -3). Based on the archaeological review of available AUV data, the Area of Potential Effect around the proposed F wellsite location appears clear of archaeological resources.

BOEM guidelines (BOEM, 2022) recommends a 100 ft avoidance of unidentified, non-cultural contacts.

Table F-3. Side-Scan Sonar Contacts within 2,000 ft of Proposed Wellsite F

CONTACT	AREA/BLOCK	LENGTH (FT)	WIDTH (FT)	HEIGHT (FT)	DESCRIPTION	X NAD 27 (FT)	Y NAD 27 (FT)	DISTANCE/DIRECTION FROM SITE
41	AC 337	24.95	1.60	0	Linear	1,141,069.71	9,669,813.54	1,836 FT / Northwest
43	AC 337	7.20	3.61	0	Irregular	1,140,829.00	9,669,508.36	1,927 FT / Northwest
48	AC 337	23.79	3.86	0	Irregular	1,141,083.89	9,668,608.11	1,590 FT/ West-Northwest
54	AC 337	13.22	3.47	0	Irregular	1,143,690.67	9,667,842.36	1,470 FT/Southeast

Wellsite Conditions

The surface location occurs within a structural low formed by salt-cored highs to the northeast and southwest. A large fault system trend northeast to southwest between the highs and divides the low. A major erosional escarpment occurs about 6,500 ft (1.25 miles) to the south. The escarpment is the northern boundary of Alaminos Canyon.

The proposed Wellsite F surface location is clear of any constraining seafloor conditions as defined by the AUV and 3-D seismic data. Overall, the proposed wellbore will likely penetrate clayey- to sandy-turbidites interbedded with mud-prone mass-transport deposits (MTDs). There is a negligible to low potential for minor shallow gas accumulations and overpressured sands within the suprasalt stratigraphy.

Water Depth and Seafloor Conditions. The water depth at the location is -4,436 ft below sea level (Map AC 337-F-1). The seafloor slope about 2.3° to the northeast. The seafloor morphology appears smooth at the proposed surface location. There are no indications of hard bottom areas, seep, or expulsion features within 2,000 ft of the location. Deepwater benthic communities are not expected at the proposed wellsite. The seafloor and surficial sediments consist of very soft to soft clay and silty clay.

Several seafloor faults lie to the southwest, south, east, and northeast of the proposed location. The faults trend northeast to southwest and have variable offset. The nearest seafloor fault to the proposed location lies about 750 ft to the southeast (Map AC 337-F-2). The seafloor fault is downthrown to the southeast away from the proposed wellsite. Seafloor slopes along this fault scarp are only about 1° and the seafloor offset is approximately <1 ft. The wellbore at this location will not intersect any the seafloor faults.

The side-scan sonar reflectivity and low seafloor amplitude response within a 2,000 ft radius of the proposed wellsite suggest the seabed is covered by very soft to soft clays (Maps AC 337-F-3 and F-4). A weakly stratified, low-amplitude drape-like layer occurs at the seafloor around Proposed Wellsite F. The drape represents hemipelagic silty clays that are soft and have high water contents (Illustration AC 337-F-1).

Deepwater Benthic Communities. No features or areas were interpreted within 2,000 ft of the proposed location that can support high-density chemosynthetic or other deepwater benthic communities. There are no apparent geophysical indicators and/or geologic features at the seafloor or within the subbottom profiler record that would suggest conditions capable of supporting high-density deepwater benthic communities at the proposed wellsite or within the 2,000 ft radius (Maps AC 337-F-2 through F-4). The side-scan sonar mosaic and multibeam backscatter indicate a uniformly textured seabed near the proposed location. The generally low reflectivity suggests normal Gulf of Mexico surficial sediments. No water bottom anomalies, as defined by BOEM, occur within 2,000 ft of the proposed location (BOEM, 2024b). In addition, the amplitude-enhanced seafloor rendering extracted from the 3-D dataset does not show any high amplitudes near Proposed Wellsite

F (Map AC 337-F-4). BOEM and BSEE have not reported the existence of high-density deepwater benthic communities within Federal lease Block AC 337 (MMS, 2010).

Stratigraphy. Stratigraphic conditions from the subbottom profiler and 3-D seismic data are shown on Illustrations AC337-F-1 through F-3. The seafloor, six horizons (Horizons 10 – 40, 42, and 50), and the Top of Salt (ToS) were mapped within the suprasalt stratigraphy to define seven sediment units (Units 1-7) within the Study Area (GEMS, 2024). Inferences from the seismic facies analysis suggest the stratigraphic section beneath the wellsite is characterized by hemipelagic clays, turbidites, and mass-transport deposits containing a mixture of clays, silts, and sands.

The subbottom profiler data define the near-surface stratigraphy around Proposed Wellsite to ~265 ft below the mudline (bml). The uppermost surficial sediments (drape) beneath the seafloor are represented by low-amplitude, generally parallel reflectors, likely indicating soft, high water content clays and silty-clays (Illustration AC337-F-1). The sediments transition to moderately higher-amplitude parallel beds at a depth of 35 ft below mudline (bml). The higher-amplitude reflectors may indicate greater higher silt contents and an increase in shear strength and decrease in water content with depth. A thin MTD exists from 95 ft to 135 ft below the proposed location. The MTD is expected to be of mud-rich sediment. Some variations in sediment geotechnical properties may be encountered.

Unit 1 (Seafloor to Horizon 10). Unit 1 occurs between the Seafloor and 257 ft bml. The sequence consists of low-amplitude, semi-continuous to chaotic reflectors, representing hemipelagic clays and clay-rich turbidites interbedded with fine-grained mass-transport deposits.

Unit 2 (Horizon 10 to Horizon 20). Unit 2 occurs between 257 ft and 474 ft bml beneath the proposed wellsite. The sequence consists mainly of low-amplitude parallel and continuous reflectors. The sediments are likely alternating mud-rich turbidites intercalated with thin mass-transport deposits (MTD).

Unit 3 (Horizon 20 to Horizon 30). Unit 3 occurs between 474 ft and 634 ft bml. The unit consists of layered low to moderate-amplitude, continuous reflectors at the top and base of the unit. These reflectors represent turbidites consisting of alternating layers of clay, silty clay, silt, and very thin sands. Reflectors in the middle portion of Unit 3 are more discontinuous. Mass-transport deposits are likely within this interval but are likely mud-rich sediments. Thin sand layers are possible within the turbidite intervals.

Unit 4 (Horizon 30 to Horizon 40). Unit 4 occurs between 634 ft and 1,001 ft bml. The sequence consists of low-amplitude and parallel reflectors with varying continuity. These sediments are likely alternating mud-rich turbidites intercalated with thin mud-rich mass-transport deposits. Very thin sand layers may occur within the turbidites.

Unit 5 (Horizon 40 to Horizon 42). Unit 5 occurs between 1,001 ft and 3,244 ft bml. The sequence consists of an upper interval of generally low-amplitude reflectors with varying continuity. These sediments are likely alternating mud-rich turbidites intercalated with thin mud-rich mass-transport deposits. Thin sand layers may occur within the turbidites. The lower interval consists of dipping, semi-parallel, but mostly dis-continuous reflectors. The change in dip is caused by faulting and folding to the south and southeast. The age of the strata in the lower portion of Unit 5 may be markedly older and more consolidated than the overlying beds.

Unit 6 (Horizon 42 to 50; Top of Raft). Unit 6 occurs between 3,244 ft and 4,924 ft bml. The units consist of low-amplitude, chaotic reflections. The sediments in Unit 6 are likely mud-rich turbidites.

Unit 7 (Top of Raft to Top of Salt). Unit 7 occurs between 4,924 ft and 6,665 ft bml. The unit generally consists of chaotic to semi-continuous, low to moderate-amplitude reflectors. The sediments in Unit 7 are likely alternating fine-grained turbidites and mass-transport deposits that have been disturbed from the influx of shallow salt. Some isolated sands may be encountered. This basal interval has elevated amplitudes and may indicate a rubble zone of fracture carbonate material. Engineers should be aware of the probability of encountering highly variable lithologic conditions, geotechnical properties, and strength profiles while drilling through the rubble interval of Unit 7.

Faults. 3-D data indicate a vertical wellbore at the proposed surface location is not expected to penetrate any seafloor faults above the salt interface (Illustrations AC 337-F-2 and F-3). Buried faults defined by the 3-D data are projected to intersect the wellbore at about **1,063 ft bml (5,415 bsl)** and **1,834 ft bml (6,270 ft bsl)**. There is no geophysical evidence to suggest the fault is an active pathway for fluid/gas migration. Loss of circulation may occur across these fault planes.

Many small undifferentiated faults (below the resolution of the 3-D seismic data) probably exist within the suprasalt stratigraphy at this location. Such highly faulted intervals represent potential zones of borehole instability or drilling fluid loss.

Shallow Gas and Shallow Water Flow. Significant shallow gas is not likely to be encountered within the shallow sediments from the seafloor to the Top of Salt (6,665 ft bml), Illustration AC 337-F-3. The potential for shallow water flow is considered negligible to low.

Shallow Gas. There are no significant subsurface high-amplitude anomalies directly below the proposed wellsite (Map AC337-F-5). A low potential is assigned to Units 4 through 7. Sand layers are possible within the turbidites, but no high amplitude events occur within 2,000 ft of the proposed wellsite. The closest amplitude anomaly is about 4,050 ft to the SSE. This anomaly is located within Unit 7 (Top of Raft to Top of Salt).

Gas Hydrates. A portion of the shallow section at the proposed wellsite falls within the gas hydrate stability zone. The base of gas hydrate stability (BGHSZ) is estimated at 2,165 ft bml. However, sediments above the BGHSZ are predominantly clays and silty clays with very thin sand layers and seams or other permeable formations for gas hydrate to accumulate. A bottom simulating reflector is not identified in the area beneath the proposed wellsite. Therefore, we assess the potential for significant gas hydrate accumulations to be negligible.

Shallow Water Flow. The potential for shallow water flow at this well location from the Seafloor to Top of Salt, 6,665 ft bml is considered negligible to low. SWF was not reported while drilling the wells near the proposed wellsite in AC 336 and AC 380.

Results

The Proposed Wellsite F and alternate wellsite F-Alt, in Alaminos Canyon Block 336, appear suitable for exploration drilling operations. No areas with the potential for deepwater benthic communities are identified within 2,000 ft of the proposed location. There are no sonar contacts in the vicinity of the wellsite that are recommended for archaeological investigation or avoidance.

It is possible that thin sands will be encountered within turbidites intervals between the Seafloor and the Top of Salt; however, there is a negligible to low potential for encountering overpressured sands or shallow gas. The potential for gas hydrates in the near-surface section is negligible.

A highly fractured carbonate "rubble zone" may be encountered just above the salt surface (Unit 7, Top of Raft).

The proposed well will not penetrate any seafloor faults. Two buried faults will be intersected by a vertical well at this location. Drillers should be aware of the potential for loss circulation across these faults.

AC 337 is in Military Warning Area, W-602 (BOEM, 2014). Therefore, the appropriate military command must be notified prior to the commencement of drilling operations.

There are no archaeological avoidances or known shipwrecks near the proposed surface location. If any wood, ceramics, textiles, or ferrous objects become exposed during bottom disturbing operations, all activities must be halted and BOEM/BSEE be notified within 48 hours.

Closing

We appreciate the opportunity to be of service to LLOG and look forward to working together on future projects.



John Hoffman.
Snr. Consulting Geoscientist

Sincerely,

GEOSCIENCE EARTH & MARINE SERVICES



Daniel Lanier
President



Erin Janes
Project Manager/Snr. Geoscientist

Attachments (5 Maps and 3 Illustrations)

Distribution:

Mr. Jaime Mata, LLOG Exploration Offshore, LLC, Houston, TX (draft)

REFERENCES

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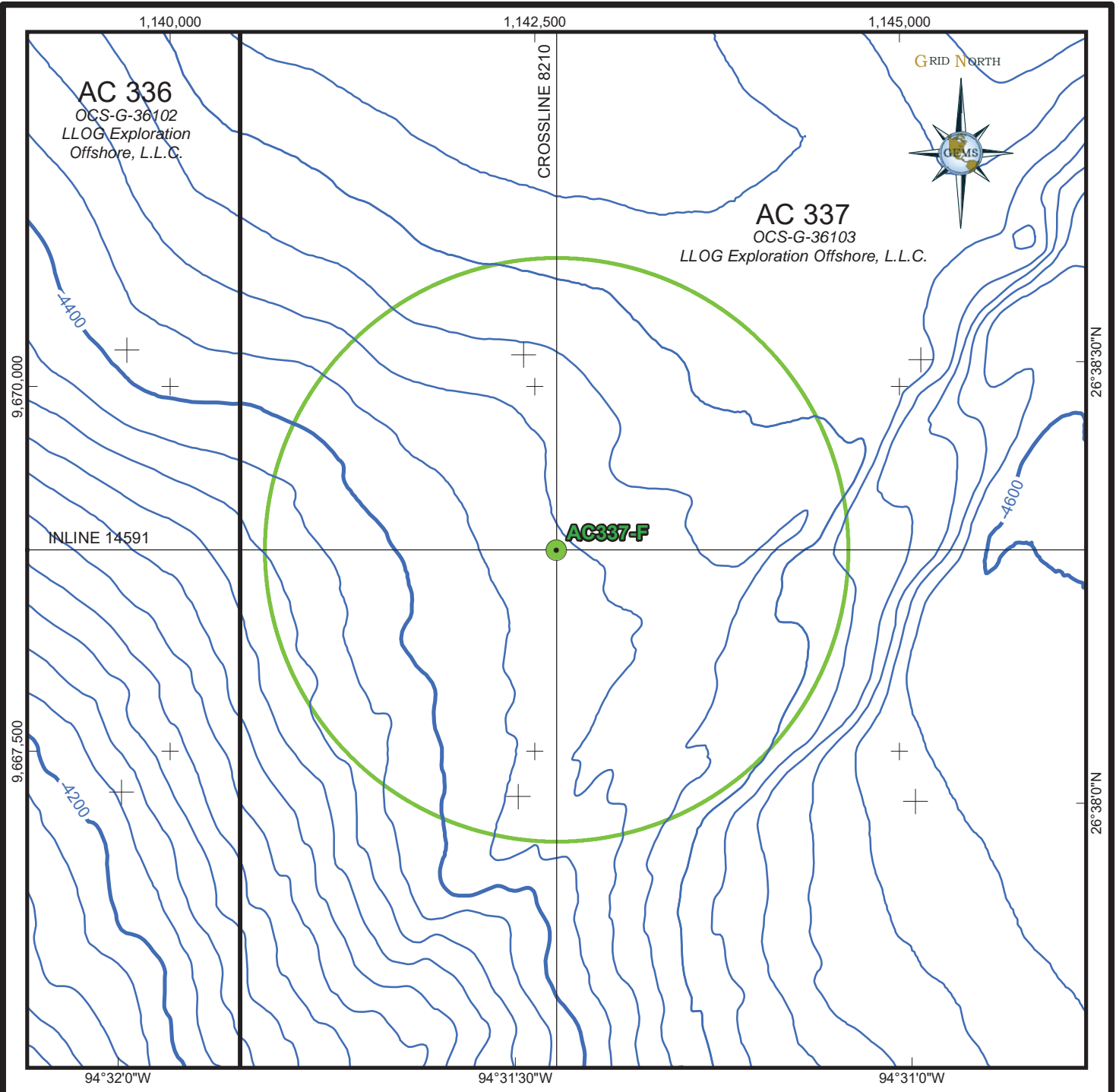
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Minerals Management Service (MMS), 2010, Notice to lessees and operators of federal oil and gas leases in the outer continental shelf, Gulf of Mexico OCS region, deepwater benthic communities: U. S. Department of the Interior, Minerals Management Service, Gulf of Mexico, NTL 2009-G40. Effective Date January 27, 2010.



PROPOSED SURFACE LOCATION
CIRCLE REPRESENTS 2000 FT RADIUS
AROUND PROPOSED WELLSITE.



WATER DEPTH IN FEET. CONTOUR INTERVAL = 20 FT.



3D SURVEY LINE.

LLOG Exploration Offshore, L.L.C.

BATHYMETERY MAP

**BLOCK 337
ALAMINOS CANYON
GULF OF MEXICO**



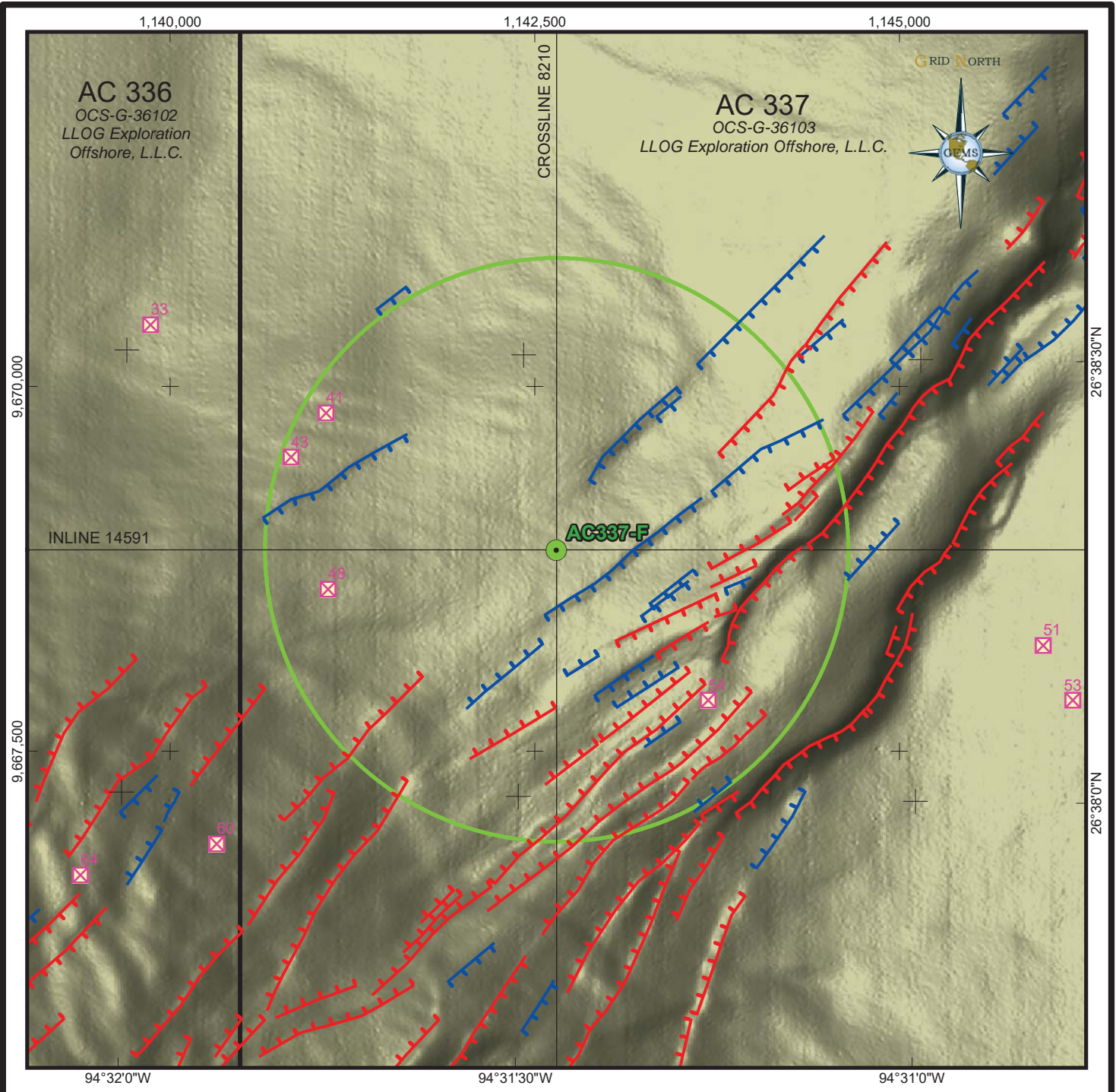
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DATE: 09 FEBRUARY 2024
FILE NAME: AC337-F-1.mxd
PROJECT NO.: 1023-3216

MAP NO. AC337-F-1

GEODETIC DATUM: NAD 1927
ELLIPSOID: CLARKE 1866
ZONE: 15N
GRID UNITS: US FEET



-  SIDE-SCAN SONAR CONTACT.
-  SEAFLOOR FAULTS.
TICKS INDICATE DOWNTHROWN SIDE OF FAULT.
-  SHALLOW BURIED FAULTS WITH SEAFLOOR EXPRESSION.
TICKS INDICATE DOWNTHROWN SIDE OF FAULT.
-  PROPOSED SURFACE LOCATION
CIRCLE REPRESENTS 2000 FT RADIUS
AROUND PROPOSED WELLSITE.
-  3D SURVEY LINE.

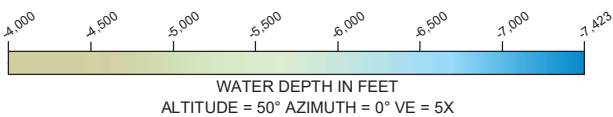
LLOG Exploration Offshore, L.L.C.

**SEAFLOOR
FEATURES MAP**

**BLOCK 337
ALAMINOS CANYON
GULF OF MEXICO**



GEODETIC DATUM: NAD 1927
 ELLIPSOID: CLARKE 1866
 ZONE: 15N
 GRID UNITS: US FEET



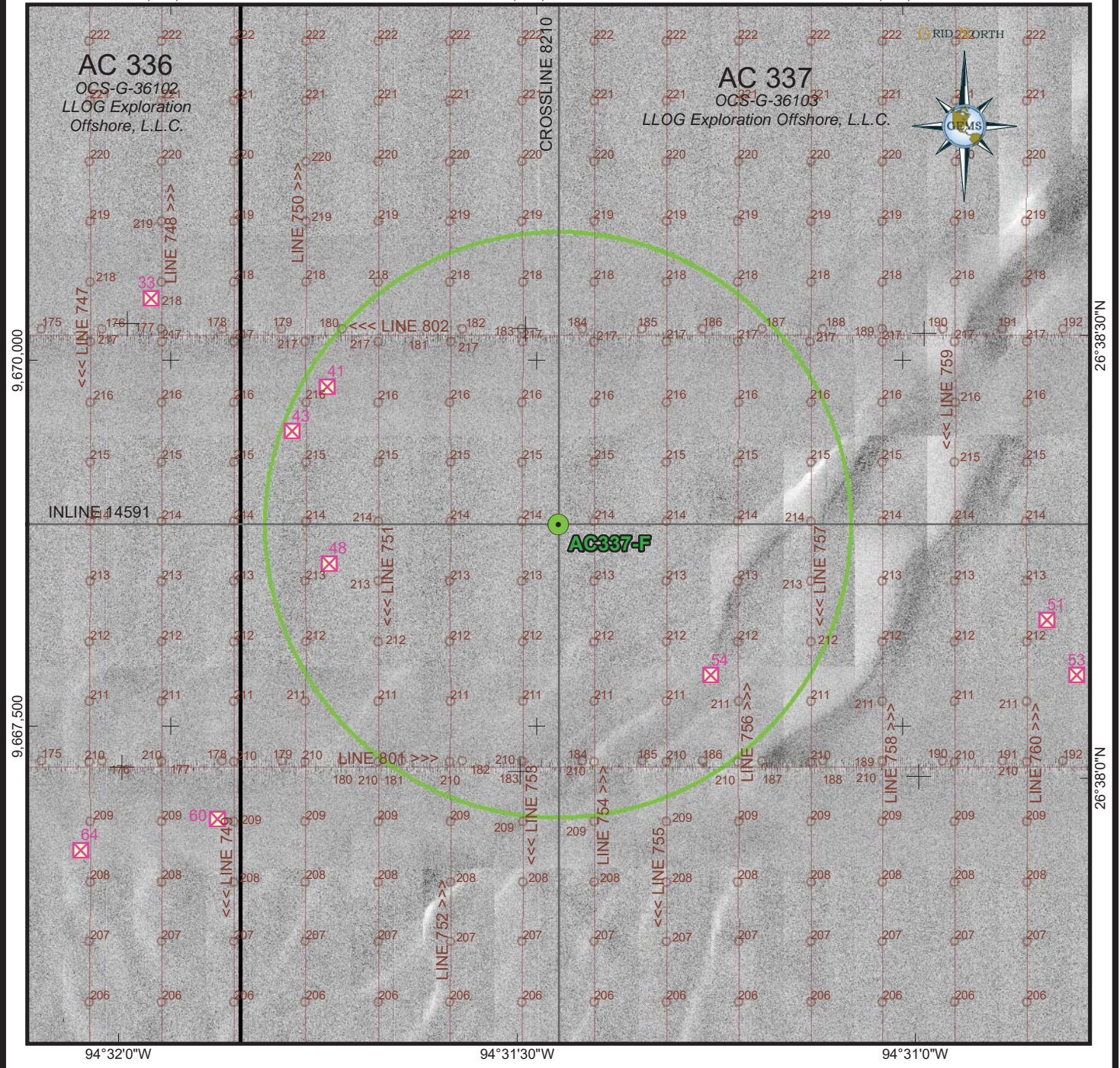
DATE: 09 FEBRUARY 2024
 FILE NAME: AC337-F-2.mxd
 PROJECT NO.: 1023-3216

MAP NO. AC337-F-2

1,140,000

1,142,500

1,145,000



94°32'0"W

94°31'30"W





94°31'0"W

9,670,000

9,667,500

26°38'30"N

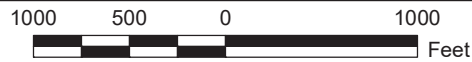
26°38'0"N

-  SIDE-SCAN SONAR CONTACT.
-  PROPOSED SURFACE LOCATION
CIRCLE REPRESENTS 2000 FT RADIUS
AROUND PROPOSED WELLSITE.
-  3D SURVEY LINE.
-  AUV TRACKLINE WITH SHOTPOINTS.

LLOG Exploration Offshore, L.L.C.

**SIDE-SCAN SONAR
MOSAIC MAP**

**BLOCK 337
ALAMINOS CANYON
GULF OF MEXICO**



SCALE 1:12,000 OR 1" = 1,000'

LOW  HIGH

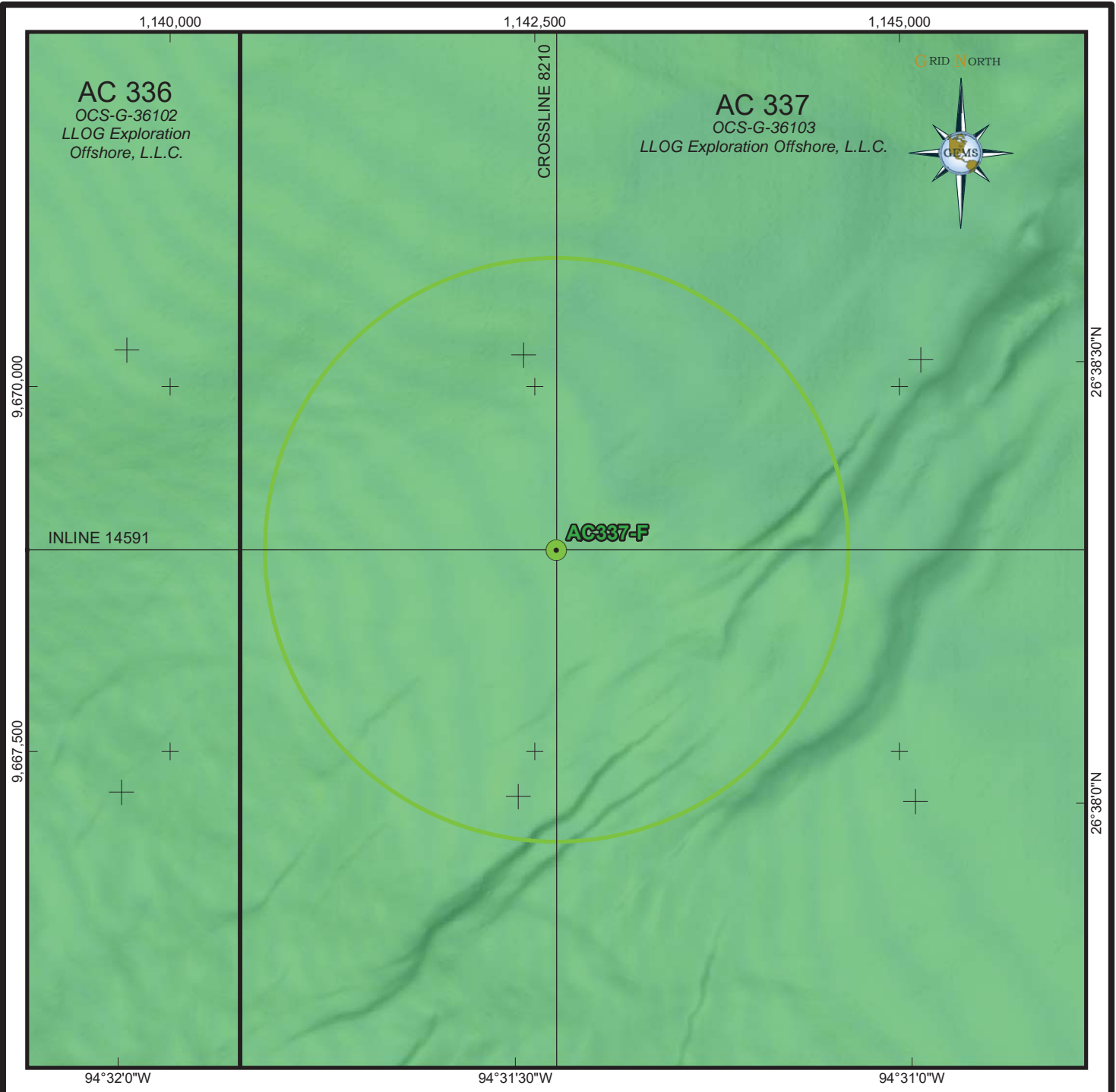
GEODETIC DATUM: NAD 1927
ELLIPSOID: CLARKE 1866
ZONE: 15N
GRID UNITS: US FEET

SONAR REFLECTIVITY



DATE: 09 FEBRUARY 2024
FILE NAME: AC337-F-3.mxd
PROJECT NO.: 1023-3216

MAP NO. AC337-F-3



PROPOSED SURFACE LOCATION
CIRCLE REPRESENTS 2000 FT RADIUS
AROUND PROPOSED WELLSITE.

— 3D SURVEY LINE.

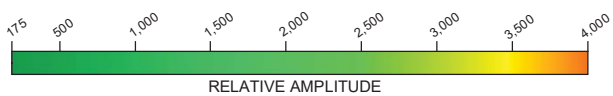
LLOG Exploration Offshore, L.L.C.

**SEAFLOOR AMPLITUDE
RENDERING MAP**

**BLOCK 337
ALAMINOS CANYON
GULF OF MEXICO**



SCALE 1:12,000 OR 1" = 1,000'



GEODETIC DATUM: NAD 1927
ELLIPSOID: CLARKE 1866
ZONE: 15N
GRID UNITS: US FEET



DATE: 09 FEBRUARY 2024
FILE NAME: AC337-F-4.mxd
PROJECT NO.: 1023-3216

MAP NO. AC337-F-4

Stratigraphic Column

Attachment C-6 (Proprietary Information)

APPENDIX D
HYDROGEN SULFIDE (H₂S) INFORMATION
(30 CFR Part 550.215 and 550.245)

A. Concentration

LLOG does not anticipate encountering H₂S while conducting the proposed exploratory operations provided for under this plan.

B. Classification

In accordance with 30 CFR 250.490 (c) and NTL No. 2009-G31 “Hydrogen Sulfide,” LLOG these wells have been determined to be H₂S absent as per approval letter for Revised EP R-7087.

C. H₂S Contingency Plan

Not applicable for the proposed operations.

D. Modeling Report

Not applicable to the proposed operations.

APPENDIX E
BIOLOGICAL, PHYSICAL AND SOCIOECONOMIC INFORMATION
(30 CFR Part 550.216 and 550.247)

A. High-Density Deepwater Benthic Communities Information

No features or areas were interpreted within 2,000 ft of the proposed location that can support high-density chemosynthetic or other deepwater benthic communities. There are no apparent geophysical indicators and/or geologic features at the seafloor or within the subbottom profiler record that would suggest conditions capable of supporting high-density deepwater benthic communities at the proposed wellsite or within the 2,000 ft radius. The side-scan sonar mosaic and multibeam backscatter indicate a uniformly textured seabed near the proposed location. The generally low reflectivity suggests normal Gulf of Mexico surficial sediments. No water bottom anomalies, as defined by BOEM, occur within 2,000 ft of the proposed location (BOEM, 2024b). In addition, the amplitude-enhanced seafloor rendering extracted from the 3-D dataset does not show any high amplitudes near Proposed Wellsite F. BOEM and BSEE have not reported the existence of high-density deepwater benthic communities within Federal lease Block AC 337 (MMS, 2010).

B. Topographic Features Map

The activities proposed in this Plan are not affected by a topographic feature.

C. Topographic Features Statement (Shunting)

The activities proposed in this Plan are not affected by a topographic feature; therefore, LLOG is not required to shunt drill cuttings and drill fluids.

D. Live Bottoms (Pinnacle Trend) Map

Alaminos Canyon Block 337 is not located within the vicinity of a proposed live bottom (Pinnacle trend) area.

E. Live Bottoms (Low Relief) Map

Alaminos Canyon Block 337 is not located within the vicinity of a proposed live bottom (Low Relief) area.

F. Potentially Sensitive Biological Features Map

Alaminos Canyon Block 337 is not located within the vicinity of a proposed sensitive biological feature area.

G. Threatened or Endangered Species, Critical Habitat, and Marine Mammal Information.

Proposed activities in **Alaminos Canyon Block 337** are not located in a critical habitat designated under ESA and marine mammals protected under the MMPA although federally protected marine mammals are always anticipated. LLOG will mitigate impact through compliance with BOEM NTL 2016-G01, G02 and NTL 2015 BSEE-G03. See *Attachment E-1* for a list of the NOAA Species known in the Gulf of Mexico. In the event federally listed species become present on Alaminos Canyon Block 337, LLOG will mitigate impact through compliance with BOEM NTL 2016-G01, G02, NTL 2015 BSEE-G03 and the Biological Opinion of the Endangered Species Act Section 7. See Attachment E-1 for a list of the NOAA Species known in the Gulf of Mexico. Moon pool daily observation log shall be maintained on the bridge. The deck supervisor on tour shall go to the bridge and log time, date, and results of each moon pool inspection. STOP WORK AUTHORITY shall be used and implemented, in a safe and timely manner, for any work that could affect marine life listed on the Endangered Species Act.

H. Archaeological Information

Geoscience Earth & Marine Services, Inc., (GEMS) Geologic, Stratigraphic, and Archaeological Assessment of Blocks 335 (OCS G-36492), 336 (OCS G-36102), and 337 (OCS G-36103), Alaminos Canyon, Gulf of Mexico: Volume I & II, GEMS Project No. 0619-2881, submitted to Shell in September 2020 and has been submitted to BOEM under separate cover by Shell.

I. Air and Water Quality Information

Not applicable to proposed operations.

J. Socioeconomic Information

Not applicable to proposed operations.

NOAA Species Known in GOM

Attachment E-1 (Public Information)

Endangered Species List Common to the Gulf of Mexico

Geophysical surveys, including the use of airguns and airgun arrays, may have an impact on marine wildlife. Many marine species are protected under the Endangered Species Act (ESA) and all marine mammals (including manatees) are protected under the Marine Mammal Protection Act (MMPA). The following Gulf of Mexico species are listed under the ESA:

Gulf of Mexico Bryde's Whale (<i>Balaenoptera edeni</i>)
Sperm Whale (<i>Physeter macrocephalus</i>)
Green Turtle (<i>Chelonia mydas</i>) – North Atlantic DPS and South Atlantic DPS
Hawksbill Turtle (<i>Eretmochelys imbricata</i>)
Kemp's Ridley Turtle (<i>Lepidochelys kempii</i>)
Leatherback Turtle (<i>Dermochelys coriacea</i>) - Northwest Atlantic
Loggerhead Turtle (<i>Caretta caretta</i>) – Northwest Atlantic Ocean DPS
Gulf Sturgeon (<i>Acipenser oxyrinchus desotoi</i>)
Oceanic Whitetip Shark (<i>Carcharhinus longimanus</i>)
Giant Manta Ray (<i>Manta birostris</i>)
West Indian Manatee (<i>Trichechus manatus</i>)*

Note that this list can change as other species are listed/delisted, and this protocol shall be applied to any ESA protected species (and all marine mammals) that occur in the Gulf of Mexico, including rare and extralimital species.

LLOG's proposed operations in this plan will not impact the critical habitats of the marine species listed in the Endangered Species Act.

*Managed by the US Fish and Wildlife Service

APPENDIX F
WASTE AND DISCHARGE INFORMATION
(30 CFR PART 550.217 AND 550.248)

C. Projected Generated Wastes

See the following tables:

TABLE 1. Wastes you will generate, treat and downhole dispose or discharge to the GOM

TABLE 2. Wastes you will transport and /or dispose of onshore

B. Modeling

Not applicable. Proposed activities will be covered by U.S. EPA NPDES General Permit.

TABLE 1. WASTES YOU WILL GENERATE, TREAT AND DOWNHOLE DISPOSE OR DISPOSE OR DISCHARGE IN THE GOM

please specify if the amount reported is a total or per well amount

AC 380

Projected generated waste			Projected ocean discharges		Downhole Disposal
Type of Waste	Composition	Projected Amount	Discharge rate	Discharge Method	Answer yes or no
Will drilling occur ? If yes, fill in the muds and cuttings.					
<i>EXAMPLE: Cuttings wetted with synthetic based fluid</i>	<i>Cuttings generated while using synthetic based drilling fluid.</i>	<i>X bbl/well</i>	<i>X bbl/day/well</i>	<i>discharge overboard</i>	<i>No</i>
Water-based drilling fluid	Water based mud additives, barite and gel used for WBM	127,509 bbls/well	10,352 bbls/day/well	Discharge overboard	No
Cuttings wetted with water-based fluid	Cuttings generated while using water based drilling fluid.	5,281 bbls/well	429 bbls/day/well	Discharge overboard	No
Cuttings wetted with synthetic-based fluid	Cuttings generated while using synthetic based drilling fluid.	3,755 bbls/well	210 bbls/day/well	Discharge overboard	No
Will humans be there? If yes, expect conventional waste					
<i>EXAMPLE: Sanitary waste water</i>	Sanitary waste from living quarters	X bbl/well	X bbl/hr/well	chlorinate and discharge overboard	No
Domestic waste	Misc waste for living quarters	9,604 bbls/well	3.1 bbls/hr/well	Discharge overboard (no free oil)	No
Sanitary waste	Processed sanitary waste from living quarters	6,403 bbls/well	2.1 bbls/hr/well	Chlorinate and discharge overboard	No
Is there a deck? If yes, there will be Deck Drainage					
Deck Drainage	Accumulated drainage due to rainfall	0 to 47,261 bbls/well	0 to 167 bbls/hr/well	Test for oil and grease and discharge overboard	No
Will you conduct well treatment, completion, or workover?					
Well treatment fluids	NPDES approved treatment fluid used for well operations	100 bbls/well	20 bbls/hr/well	Test for oil and grease and discharge overboard.	No
Well completion fluids	Clear brines used for completion operations	500 bbls/well	100 bbls/hr/well	Test for oil and grease and discharge overboard. This excludes clear brines containing Zinc	No
Workover fluids	N/A	N/A	NA	NA	No
Miscellaneous discharges. If yes, only fill in those associated with your activity.					
Desalinization unit discharge	N/A	N/A	N/A	N/A	N/A
Blowout prevent fluid	N/A	N/A	N/A	N/A	N/A
Ballast water	Uncontaminated seawater used for ballast control	0 to 100,000 bbls/well	16,350 bbls/hr/well	Discharge overboard	No
Bilge water	N/A	N/A	N/A	N/A	N/A
Excess cement at seafloor	Excess cement slurry and mixwater used for cementing operation - NPDES allowed	300 bbls/well	360 bbls/hr/well	Discharge at mudline	No
Fire water	Uncontaminated seawater used for fire control system	0 to 10,000 bbls/well	16,350 bbls/hr/well	Discharge overboard	No
Cooling water	N/A	N/A	N/A	N/A	N/A
Will you produce hydrocarbons? If yes fill in for produced water.					
Produced water	NA	NA	NA	NA	N/A
Will you be covered by an individual or general NPDES permit ?					
			GMG 290180		
			comply with the requirements of the NPDES permit.		

NOTE: If you will not have a type of waste, enter NA in the row.

TABLE 2. WASTES YOU WILL TRANSPORT AND /OR DISPOSE OF ONSHORE

Please specify whatever the amount reported is a total or per well					
AC 380		Projected generated waste	Solid and Liquid Wastes Transportation	Waste Disposal	
Type of Waste	Composition	Transport Method	Name/Location of Facility	Amount	Disposal Method
			Newport Environmental Services Inc., Ingleside, TX	X bbl/well	Recycled
Oil-based drilling fluid or mud	N/A	NA	N/A	NA	NA
Synthetic-based drilling fluid or mud	Internal oilfin, ester nbased mud	Barged in 25 bbls cutting boxes and / or liquid mud tanks for supply vessels	Newpark Transfer Station, Fourchon, LA	6750 bbls / well	Recycled
Cuttings wetted with Water-based fluid	N/A	NA	N/A	NA	NA
Cuttings wetted with Synthetic-based fluid	N/A	NA	N/A	NA	NA
Cuttings wetted with oil-based fluids	N/A	NA	N/A	NA	NA
Will you produce hydrocarbons? If yes fill in for produced sand.					
Produced sand					
Will you have additional wastes that are not permitted for discharge? If					
<i>EXAMPLE: trash and debris (recyclables)</i>	<i>Plastic, paper, aluminum</i>	<i>barged in a storage bin</i>	<i>ARC, New Iberia, LA</i>	<i>X lb/well</i>	<i>Recycled</i>
Trash and debris	Plastic, paper, aluminum	Barged in a storage bin	Blanchard Landfill, Golden Meadows, LA	4000 lbs / well	Recycled
Used oil	Spent oil from machinery	Barged in USCG approved transfer tote tanks.	L&L Services, Fourchon, LA	200 bbls / well	Recycled
Wash water	Wash water w/ SBM residue and surfactants	Barged in 25 bbls cutting boxes and / or liquid mud tanks for supply vessels	Newpark Transfer Station, Fourchon, LA	2000 bbls / well	Approved disposal well injection or land farm
Chemical product wastes	Spent treatment and / or damaged chemicals used in operations	Barged in 25 bbls cutting boxes and / or cutting boxes	L&L Services, Fourchon, LA	10 bbls / well	Recycled
NOTE: If you will not have a type of waste, enter NA in the row.					

APPENDIX G
AIR EMISSIONS INFORMATION
(30 CFR PART 550.218 AND 550.249)

E. Emissions Worksheets and Screening Questions

The Projected Quality Emissions Report (Form MMS-138) addresses the proposed drilling, completion and potential testing operations utilizing a typical drillship, with related support vessels and construction barge information.

As evidenced by *Attachment G-1*, the worksheets were completed based on the proposed flaring and burning operations.

<i>Screening Questions for EP's</i>	<i>Yes</i>	<i>No</i>
Is any calculated Complete Total (CT) Emission amount (in tons associated with your proposed exploration activities more than 90% of the amounts calculated using the following formulas: $CT = 3400D (2/3)$ for CO, and $CT = 33.3D$ for the other air pollutants (where D = distance to shore in miles)?		X
Does your emission calculations include any emission reduction measures or modified emission factors?		X
Are your proposed exploration activities located east of 87.5 degrees W longitude?		X
Do you expect to encounter H ² S at concentrations greater than 20 parts per million (ppm)?		X
Do you propose to flare or vent natural gas for more than 48 continuous hours from any proposed well?		X
Do you propose to burn produced hydrocarbon liquids?		X

E. Emissions Reduction Measures

The projected air emissions are within the exemption level; therefore, no emission reduction measures are being proposed.

E. Verification of Nondefault Emissions Factors

LLOG has elected to use the default emission factors as provided in *Attachment G-1*.

E. Non-Exempt Activities

The proposed activities are within the exemption amount as provided in *Attachment G-1*.

E. Modeling Report

This section of the Plan is not applicable to the proposed operations.

Air Quality Emissions Report

Attachment G-1 (Public Information)

COMPANY	LLOG Exploration Offshore, L.L.C.
AREA	Alaminos Canyon
BLOCK	335 / 336 / 337
LEASE	OCS-G-36492, OCS-G-36102 & OCS-G-36103
FACILITY	
WELL	Location F and alternate well
COMPANY CONTACT	Sue Sachitana
TELEPHONE NO.	985-801-4300
REMARKS	Drillship

LEASE TERM PIPELINE CONSTRUCTION INFORMATION:		
YEAR	NUMBER OF PIPELINES	TOTAL NUMBER OF CONSTRUCTION DAYS
2024		
2025		
2026		
2027		
2028		
2029		
2030		
2031		
2032		
2033		

AIR EMISSIONS COMPUTATION FACTORS

Fuel Usage Conversion Factors	Natural Gas Turbines		Natural Gas Engines		Diesel Recip. Engine		Diesel Turbines	
	SCF/hp-hr	9.524	SCF/hp-hr	7.143	GAL/hp-hr	0.0514	GAL/hp-hr	0.0514

Equipment/Emission Factors	units	TSP	PM10	PM2.5	SOx	NOx	VOC	Pb	CO	NH3	REF.	DATE	Reference Links
Natural Gas Turbine	g/hp-hr		0.0086	0.0086	0.0026	1.4515	0.0095	N/A	0.3719	N/A	AP42 3.1-1& 3.1-2a	4/00	https://www3.epa.gov/ttnchie1/ap42/ch03/final/c03s01.pdf
RECIP. 2 Cycle Lean Natural Gas	g/hp-hr		0.1293	0.1293	0.0020	6.5998	0.4082	N/A	1.2009	N/A	AP42 3.2-1	7/00	https://www3.epa.gov/ttn/chief/ap42/ch03/final/c03s02.pdf
RECIP. 4 Cycle Lean Natural Gas	g/hp-hr		0.0002	0.0002	0.0020	2.8814	0.4014	N/A	1.8949	N/A	AP42 3.2-2	7/00	https://www3.epa.gov/ttn/chief/ap42/ch03/final/c03s02.pdf
RECIP. 4 Cycle Rich Natural Gas	g/hp-hr		0.0323	0.0323	0.0020	7.7224	0.1021	N/A	11.9408	N/A	AP42 3.2-3	7/00	https://www3.epa.gov/ttn/chief/ap42/ch03/final/c03s02.pdf
Diesel Recip. < 600 hp	g/hp-hr	1	1	1	0.0279	14.1	1.04	N/A	3.03	N/A	AP42 3.3-1	10/96	https://www3.epa.gov/ttnchie1/ap42/ch03/final/c03s03.pdf
Diesel Recip. > 600 hp	g/hp-hr	0.32	0.182	0.178	0.0055	10.9	0.29	N/A	2.5	N/A	AP42 3.4-1 & 3.4-2	10/96	https://www3.epa.gov/ttn/chief/ap42/ch03/final/c03s04.pdf
Diesel Boiler	lbs/bbl	0.0840	0.0420	0.0105	0.0089	1.0080	0.0084	5.14E-05	0.2100	0.0336	AP42 1.3-6; Pb and NH3: WebFIRE (08/2018)	9/98 and 5/10	https://cfpub.epa.gov/webfire/
Diesel Turbine	g/hp-hr	0.0381	0.0137	0.0137	0.0048	2.7941	0.0013	4.45E-05	0.0105	N/A	AP42 3.1-1 & 3.1-2a	4/00	https://www3.epa.gov/ttnchie1/ap42/ch03/final/c03s01.pdf
Dual Fuel Turbine	g/hp-hr	0.0381	0.0137	0.0137	0.0048	2.7941	0.0095	4.45E-05	0.3719	0.0000	AP42 3.1-1& 3.1-2a; AP42 3.1-1 & 3.1-2a	4/00	https://cfpub.epa.gov/webfire/
Vessels – Propulsion	g/hp-hr	0.320	0.1931	0.1873	0.0047	7.6669	0.2204	2.24E-05	1.2025	0.0022	USEPA 2017 NEITSP refer to Diesel Recip. > 600 hp reference	3/19	https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-net-data
Vessels – Drilling Prime Engine, Auxiliary	g/hp-hr	0.320	0.1931	0.1873	0.0047	7.6669	0.2204	2.24E-05	1.2025	0.0022	USEPA 2017 NEITSP refer to Diesel Recip. > 600 hp reference	3/19	
Vessels – Diesel Boiler	g/hp-hr	0.0466	0.1491	0.1417	0.4400	1.4914	0.0820	3.73E-05	0.1491	0.0003	USEPA 2017 NEITSP (units converted) refer to Diesel Boiler Reference	3/19	
Vessels – Well Stimulation	g/hp-hr	0.320	0.1931	0.1873	0.0047	7.6669	0.2204	2.24E-05	1.2025	0.0022	USEPA 2017 NEITSP refer to Diesel Recip. > 600 hp reference	3/19	
Natural Gas Heater/Boiler/Burner	lbs/MMscf	7.60	1.90	1.90	0.60	190.00	5.50	5.00E-04	84.00	3.2	AP42 1.4-1 & 1.4-2; Pb and NH3: WebFIRE (08/2018)	7/98 and 8/18	https://www3.epa.gov/ttnchie1/tsp2/chu1/hba/c01s04.pdf
Combustion Flare (no smoke)	lbs/MMscf	0.00	0.00	0.00	0.57	71.40	35.93	N/A	325.5	N/A	AP42 13.5-1, 13.5-2	2/18	
Combustion Flare (light smoke)	lbs/MMscf	2.10	2.10	2.10	0.57	71.40	35.93	N/A	325.5	N/A	AP42 13.5-1, 13.5-2	2/18	https://www3.epa.gov/ttn/chief/ap42/ch13/final/C13S05_02-05-18.pdf
Combustion Flare (medium smoke)	lbs/MMscf	10.50	10.50	10.50	0.57	71.40	35.93	N/A	325.5	N/A	AP42 13.5-1, 13.5-2	2/18	
Combustion Flare (heavy smoke)	lbs/MMscf	21.00	21.00	21.00	0.57	71.40	35.93	N/A	325.5	N/A	AP42 13.5-1, 13.5-2	2/18	
Liquid Flaring	lbs/bbl	0.42	0.0966	0.0651	5.964	0.84	0.01428	5.14E-05	0.21	0.0336	AP42 1.3-1 through 1.3-3 and 1.3-5	5/10	https://www3.epa.gov/ttnchie1/ap42/ch01/final/c01s03.pdf
Storage Tank	tons/yr/tank								4.300		2014 Gulfwide Inventory; Avg emiss (upper bound of 95% CI)	2017	https://www.boem.gov/environment/environmental-studies/2014-gulfwide-emission-inventory
Fugitives	lbs/hr/component								0.0005		API Study	12/93	https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-net-data
Glycol Dehydrator	tons/yr/dehydrator								19.240		2011 Gulfwide Inventory; Avg emiss (upper bound of 95% CI)	2014	https://www.boem.gov/environment/environmental-studies/2011-gulfwide-emission-inventory
Cold Vent	tons/yr/vent								44.747		2014 Gulfwide Inventory; Avg emiss (upper bound of 95% CI)	2017	https://www.boem.gov/environment/environmental-studies/2014-gulfwide-emission-inventory
Waste Incinerator	lb/ton		15.0	15.0	2.5	2.0	N/A	N/A	20.0	N/A	AP 42 2.1-12	10/96	https://www3.epa.gov/ttnchie1/ap42/ch02/final/c02s01.pdf
On-Ice – Loader	lbs/gal	0.043	0.043	0.043	0.040	0.604	0.049	N/A	0.130	0.003	USEPA NONROAD2008 model; TSP (units converted) refer to Diesel Recip. <600 reference	2009	
On-Ice – Other Construction Equipment	lbs/gal	0.043	0.043	0.043	0.040	0.604	0.049	N/A	0.130	0.003	USEPA NONROAD2008 model; TSP (units converted) refer to Diesel Recip. <600 reference	2009	
On-Ice – Other Survey Equipment	lbs/gal	0.043	0.043	0.043	0.040	0.604	0.049	N/A	0.130	0.003	USEPA NONROAD2008 model; TSP (units converted) refer to Diesel Recip. <600 reference	2009	https://www.epa.gov/moves/nonroad2008a-installation-and-updates
On-Ice – Tractor	lbs/gal	0.043	0.043	0.043	0.040	0.604	0.049	N/A	0.130	0.003	USEPA NONROAD2008 model; TSP (units converted) refer to Diesel Recip. <600 reference	2009	
On-Ice – Truck (for gravel island)	lbs/gal	0.043	0.043	0.043	0.040	0.604	0.049	N/A	0.130	0.003	USEPA NONROAD2008 model; TSP (units converted) refer to Diesel Recip. <600 reference	2009	
On-Ice – Truck (for surveys)	lbs/gal	0.043	0.043	0.043	0.040	0.604	0.049	N/A	0.130	0.003	USEPA NONROAD2008 model; TSP (units converted) refer to Diesel Recip. <600 reference	2009	
Man Camp - Operation (max people/day)	tons/person/day		0.0004	0.0004	0.0004	0.006	0.001	N/A	0.001	N/A	BOEM 2014-1001	2014	https://www.boem.gov/sites/default/files/uploadedFiles/BOEM/BOEM_Newsroom/Library/Publications/2014-1001.pdf
Vessels - Ice Management Diesel	g/hp-hr	0.320	0.1931	0.1873	0.0047	7.6669	0.2204	2.24E-05	1.2025	0.0022	USEPA 2017 NEITSP refer to Diesel Recip. > 600 hp reference	3/19	https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-net-data
Vessels - Hovercraft Diesel	g/hp-hr	0.320	0.1931	0.1873	0.0047	7.6669	0.2204	2.24E-05	1.2025	0.0022	USEPA 2017 NEITSP refer to Diesel Recip. > 600 hp reference	3/19	

Sulfur Content Source	Value	Units
Fuel Gas	3.38	ppm
Diesel Fuel	0.0015	% weight
Produced Gas (Flare)	3.38	ppm
Produced Oil (Liquid Flaring)	1	% weight

Density and Heat Value of Diesel Fuel		
Density	7.05	lbs/gal
Heat Value	19,300	Btu/lb

Heat Value of Natural Gas	
Heat Value	1,050 MMBtu/MMscf

Natural Gas Flare Parameters	Value	Units
VOC Content of Flare Gas	0.6816	lb VOC/lb-mol gas
Natural Gas Flare Efficiency	98	%

AIR EMISSIONS COMPUTATION FACTORS

COMPANY	AREA	BLOCK	LEASE	FACILITY	WELL	CONTACT	PHONE	REMARKS																	
LLOG Exploration Offshore, L.L.C.	Alamos Canyon	335 / 336 / 337	OCS-G-98492	0	Location F and alternate well	Sue Sachiana	985-801-4300	Drillship																	
OPERATIONS	EQUIPMENT	EQUIPMENT ID	RATING	MAX. FUEL	ACT. FUEL	RUN TIME	MAXIMUM POUNDS PER HOUR										ESTIMATED TONS								
	Nat. Gas Engines		HP	SCF/HR	GAL/D		TSP	PM10	PM2.5	SOx	NOx	VOC	Pb	CO	NH3	TSP	PM10	PM2.5	SOx	NOx	VOC	Pb	CO	NH3	
	Burners		MMBTU/HR	SCF/HR	SCF/D	HR/D	D/YR																		
DRILLING	VESSELS - Drilling - Propulsion Engine - Diesel		62800	3230.8088	77539.41	24	200	44.30	26.73	25.93	0.64	1061.49	30.52	0.00	166.49	0.31	106.33	64.15	62.23	1.55	2547.57	73.25	0.01	399.58	0.74
	VESSELS - Drilling - Propulsion Engine - Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS - Drilling - Propulsion Engine - Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS - Drilling - Propulsion Engine - Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Vessels - Diesel Boiler		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Vessels - Drilling Prime Engine, Auxiliary		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPELINE INSTALLATION	VESSELS - Pipeline Laying Vessel - Diesel		12000	617.352	14816.45	24	0	8.47	5.11	4.95	0.12	202.83	5.83	0.00	31.81	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS - ROV vessel		8000	411.568	9877.63	24	0	5.64	3.41	3.30	0.08	135.22	3.89	0.00	21.21	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FACILITY INSTALLATION	VESSELS - Heavy Lift Vessel/Derrick Barge Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRODUCTION	RECIP <600hp Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	RECIP >600hp Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	VESSELS - Shuttle Tankers		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS - Well Stimulation		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Natural Gas Turbine		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Diesel Turbine		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Dual Fuel Turbine		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	RECIP 2 Cycle Lean Natural Gas		0	0	0.00	0	0	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	RECIP 4 Cycle Lean Natural Gas		0	0	0.00	0	0	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	RECIP 4 Cycle Rich Natural Gas		0	0	0.00	0	0	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	Diesel Boiler		0	0	0.00	0	0	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	Natural Gas Heater/Boiler/Burner		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MISC.			BPD	SCF/HR	COUNT																				
	STORAGE TANK				0	0	0	--	--	--	--	--	#DIV/0!	--	--	--	--	--	--	--	--	0.00	--	--	--
	COMBUSTION FLARE - no smoke			162500	0	24	7	0.00	0.00	0.00	0.00	0.00	11.60	5.24	52.99	--	0.00	0.00	0.00	0.01	0.97	--	4.44	--	
	COMBUSTION FLARE - light smoke		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--	
	COMBUSTION FLARE - medium smoke		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--	
	COMBUSTION FLARE - heavy smoke		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--	
	COLD VENT				0	0	0	--	--	--	--	--	#DIV/0!	--	--	--	--	--	--	--	--	0.00	--	--	--
	FLUGTIVES				0	0	0	--	--	--	--	--	#DIV/0!	--	--	--	--	--	--	--	--	0.00	--	--	--
	GLYCOL DEHYDRATOR				0	0	0	--	--	--	--	--	#DIV/0!	--	--	--	--	--	--	--	--	0.00	--	--	--
	WASTE INCINERATOR		0	0	0.00	0	0	--	0.00	0.00	0.00	0.00	--	0.00	--	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--	
DRILLING WELL TEST	Liquid Flaring		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	COMBUSTION FLARE - no smoke		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	COMBUSTION FLARE - light smoke		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	COMBUSTION FLARE - medium smoke		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	COMBUSTION FLARE - heavy smoke		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--
ALASKA-SPECIFIC SOURCES	VESSELS		KW			HR/D	D/YR																		
	VESSELS - Ice Management Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	2024 Facility Total Emissions							58.41	35.24	34.19	0.94	1,411.15	#DIV/0!	0.00	272.41	0.41	106.33	64.15	62.23	1.56	2,548.55	73.74	0.01	404.02	0.74
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES																5,328.00				5,328.00	5,328.00	5,328.00		100,205.66
	160.0																								
DRILLING	VESSELS - Crew Diesel		7200	370.4112	8889.87	12	86	5.08	3.06	2.97	0.07	121.70	3.50	0.00	19.09	0.04	2.61	1.58	1.53	0.04	62.59	1.80	0.00	9.82	0.02
	VESSELS - Supply Diesel		7200	370.4112	8889.87	12	171	5.08	3.06	2.97	0.07	121.70	3.50	0.00	19.09	0.04	5.22	3.15	3.06	0.08	125.18	3.60	0.00	19.83	0.04
	VESSELS - Tugs Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPELINE INSTALLATION	VESSELS - Support Diesel, Laying		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS - Support Diesel, Burying		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS - Crew Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS - Supply Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FACILITY INSTALLATION	VESSELS - Material Tug Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS - Crew Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS - Supply Diesel		0	0</																					

AIR EMISSIONS COMPUTATION FACTORS

COMPANY	AREA	BLOCK	LEASE	FACILITY	WELL	CONTACT	PHONE	REMARKS																	
LLOG Exploration Offshore, L.L.C.	Alamos Canyon	335 / 336 / 337	OCS-G-98492	0	Location F and alternate well	Sue Sachiana	985-801-4300	Drillship																	
OPERATIONS	EQUIPMENT	EQUIPMENT ID	RATING	MAX. FUEL	ACT. FUEL	RUN TIME	MAXIMUM POUNDS PER HOUR										ESTIMATED TONS								
	Nat. Gas Engines		HP	SCF/HR	GAL/D		TSP	PM10	PM2.5	SOx	NOx	VOC	Pb	CO	NH3	TSP	PM10	PM2.5	SOx	NOx	VOC	Pb	CO	NH3	
	Burners		MMBTU/HR	SCF/HR	SCF/D	HR/D	D/YR																		
DRILLING	VESSLS - Drilling - Propulsion Engine - Diesel		62800	3230.8088	77539.41	24	365	44.30	26.73	25.93	0.64	1061.49	30.52	0.00	166.49	0.31	194.05	117.08	113.56	2.82	4649.32	133.68	0.01	729.24	1.36
	VESSLS - Drilling - Propulsion Engine - Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSLS - Drilling - Propulsion Engine - Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSLS - Drilling - Propulsion Engine - Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Vessels - Diesel Boiler		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Vessels - Drilling Prime Engine, Auxiliary		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
for	VESSLS - Pipeline Laying Vessel - Diesel		10000	514.46	12347.04	0	0	7.05	4.26	4.13	0.10	169.03	4.86	0.00	26.51	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION	SUPPORT VESSEL - Diesel - (ROV) for Well Jumper		8605	452.98203	10871.57	0	0	6.21	3.75	3.64	0.09	148.83	4.28	0.00	23.34	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FACILITY INSTALLATION	VESSLS - Heavy Lift Vessel/Derrick Barge Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRODUCTION	RECIP <600hp Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	RECIP >600hp Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	VESSLS - Shuttle Tankers		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSLS - Well Stimulation		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Natural Gas Turbine		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Diesel Turbine		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Dual Fuel Turbine		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	RECIP 2 Cycle Lean Natural Gas		0	0	0.00	0	0	--	0.00	0.00	0.00	0.00	--	0.00	--	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--	
	RECIP 4 Cycle Lean Natural Gas		0	0	0.00	0	0	--	0.00	0.00	0.00	0.00	--	0.00	--	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--	
	RECIP 4 Cycle Rich Natural Gas		0	0	0.00	0	0	--	0.00	0.00	0.00	0.00	--	0.00	--	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--	
	Diesel Boiler		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Natural Gas Heater/Boiler/Burner		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MISC.			BPD	SCF/HR	COUNT																				
	STORAGE TANK				0	1	1	--	--	--	--	0.00	--	--	--	--	--	--	--	--	0.00	--	--	--	--
	COMBUSTION FLARE - no smoke			162500	0	24	7	0.00	0.00	0.00	0.00	11.60	0.00	--	52.99	--	0.00	0.00	0.00	0.01	9.97	--	44.44	--	
	COMBUSTION FLARE - light smoke			0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--	
	COMBUSTION FLARE - medium smoke			0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--	
	COMBUSTION FLARE - heavy smoke			0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--	
	COLD VENT				0	1	0	--	--	--	--	#DIV/0!	--	--	--	--	--	--	--	--	0.00	--	--	--	--
	FLUITIVES				0	0	0	--	--	--	--	0.00	--	--	--	--	--	--	--	--	0.00	--	--	--	--
	GLYCOL DEHYDRATOR				0	1	0	--	--	--	--	#DIV/0!	--	--	--	--	--	--	--	--	0.00	--	--	--	--
	WASTE INCINERATOR			0	0	0	0	--	0.00	0.00	0.00	0.00	--	0.00	--	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--	
DRILLING	Liquid Flaring		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WELL TEST	COMBUSTION FLARE - no smoke		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	COMBUSTION FLARE - light smoke		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	COMBUSTION FLARE - medium smoke		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	COMBUSTION FLARE - heavy smoke		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--
ALASKA-SPECIFIC SOURCES	VESSLS		KW			HR/D	D/YR																		
	VESSLS - Ice Management Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	0.00
	2026 Facility Total Emissions							57.57	34.73	33.69	0.93	1,390.95	#DIV/0!	0.00	269.24	0.40	194.05	117.08	113.56	2.83	4,650.30	134.17	0.01	733.68	1.36
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES																5,328.00			5,328.00	5,328.00	5,328.00		100,205.66	
	160.0																								
DRILLING	VESSLS - Crew Diesel		7200	370.4112	8889.87	12	156	5.08	3.06	2.97	0.07	121.70	3.50	0.00	19.09	0.04	4.77	2.88	2.79	0.07	114.22	3.28	0.00	17.92	0.03
	VESSLS - Supply Diesel		7200	370.4112	8889.87	12	313	5.08	3.06	2.97	0.07	121.70	3.50	0.00	19.09	0.04	9.53	5.75	5.58	0.14	228.45	6.57	0.00	35.83	0.07
	VESSLS - Tugs Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPELINE INSTALLATION	VESSLS - Support Diesel, Laying		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSLS - Support Diesel, Burying		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSLS - Crew Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSLS - Supply Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FACILITY INSTALLATION	VESSLS - Material Tug Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSLS - Crew Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSLS - Supply Diesel		0	0																					

AIR EMISSIONS COMPUTATION FACTORS

COMPANY	AREA	BLOCK	LEASE	FACILITY	WELL	CONTACT	PHONE	REMARKS																	
LLOG Exploration Offshore, L.L.C.	Alamos Canyon	335 / 336 / 337	OCS-G-38492	0	Location F and alternate well	Sue Sachiana	985-801-4300	Drillship																	
OPERATIONS	EQUIPMENT	EQUIPMENT ID	RATING	MAX. FUEL GAL/HR	ACT. FUEL GAL/D	RUN TIME	MAXIMUM POUNDS PER HOUR											ESTIMATED TONS							
	Nat. Gas Engines	HP	MMBTU/HR	SCF/HR	SCF/D	HR/D	D/YR	TSP	PM10	PM2.5	SOx	NOx	VOC	Pb	CO	NH3	TSP	PM10	PM2.5	SOx	NOx	VOC	Pb	CO	NH3
DRILLING	VESSLS - Drilling - Propulsion Engine - Diesel		62800	3230.8088	77539.41	24	365	44.30	26.73	25.93	0.64	1061.49	30.52	0.00	166.49	0.31	194.05	117.08	113.56	2.82	4649.32	133.68	0.01	729.24	1.36
	VESSLS - Drilling - Propulsion Engine - Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSLS - Drilling - Propulsion Engine - Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSLS - Drilling - Propulsion Engine - Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Vessels - Diesel Boiler		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Vessels - Drilling Prime Engine, Auxiliary		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPELINE INSTALLATION	VESSLS - Pipeline Laying Vessel - Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSLS - Pipeline Burying - Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FACILITY INSTALLATION	VESSLS - Heavy Lift Vessel/Derrick Barge Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRODUCTION	RECIP <600hp Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	RECIP >600hp Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	VESSLS - Shuttle Tankers		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSLS - Well Stimulation		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Natural Gas Turbine		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Diesel Turbine		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Dual Fuel Turbine		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	RECIP 2 Cycle Lean Natural Gas		0	0	0.00	0	0	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	RECIP 4 Cycle Lean Natural Gas		0	0	0.00	0	0	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	RECIP 4 Cycle Rich Natural Gas		0	0	0.00	0	0	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	Diesel Boiler		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Natural Gas Heater/Boiler/Burner		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MISC.			BPD	SCF/HR	COUNT																				
	STORAGE TANK				0	0	0	--	--	--	--	--	#DIV/0!	--	--	--	--	--	--	--	--	0.00	--	--	--
	COMBUSTION FLARE - no smoke		162500	0	24	7	0.00	0.00	0.00	0.00	0.00	11.60	5.24	0.00	52.99	--	0.00	0.00	0.00	0.01	9.97	0.00	--	4.44	--
	COMBUSTION FLARE - light smoke		0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	COMBUSTION FLARE - medium smoke		0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	COMBUSTION FLARE - heavy smoke		0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	COLD VENT			0	1	0	--	--	--	--	--	--	#DIV/0!	--	--	--	--	--	--	--	--	0.00	--	--	--
	FLUGTIVES			0	0	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	--	--	--
	GLYCOL DEHYDRATOR			0	1	0	--	--	--	--	--	--	#DIV/0!	--	--	--	--	--	--	--	--	0.00	--	--	--
	WASTE INCINERATOR		0	0	0	0	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--
DRILLING WELL TEST	Liquid Flaring		0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	COMBUSTION FLARE - no smoke		0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	COMBUSTION FLARE - light smoke		0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	COMBUSTION FLARE - medium smoke		0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	COMBUSTION FLARE - heavy smoke		0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--
ALASKA-SPECIFIC SOURCES	VESSLS		KW		HR/D	D/YR																			
	VESSLS - Ice Management Diesel		0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	0.00
2027 Facility Total Emissions							44.30	26.73	25.93	0.74	1,073.09	#DIV/0!	0.00	219.39	0.31	194.05	117.08	113.56	2.83	4,650.30	134.17	0.01	733.68	1.36	
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES																5,328.00			5,328.00	5,328.00	5,328.00		100,205.66	
	160.0																								
DRILLING	VESSLS - Crew Diesel		7200	370.4112	8899.87	12	156	5.08	3.06	2.97	0.07	121.70	3.50	0.00	19.09	0.04	4.77	2.88	2.79	0.07	114.22	3.28	0.00	17.92	0.03
	VESSLS - Supply Diesel		7200	370.4112	8899.87	12	313	5.08	3.06	2.97	0.07	121.70	3.50	0.00	19.09	0.04	9.53	5.75	5.58	0.14	228.45	6.57	0.00	35.83	0.07
	VESSLS - Tugs Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPELINE INSTALLATION	VESSLS - Support Diesel, Laying		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSLS - Support Diesel, Burying		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSLS - Crew Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSLS - Supply Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FACILITY INSTALLATION	VESSLS - Material Tug Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSLS - Crew Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSLS - Supply Diesel		0	0	0.00	0	0	0.00	0.00	0.00															

AIR EMISSIONS CALCULATIONS

COMPANY	AREA	BLOCK	LEASE	FACILITY	WELL
LLOG Exploration Offshore, L.L.C.	Alaminos Canyon	335 / 336 / 337	OCS-G-36492, OCS-G-36102 &	Location F and alternate well	

Year	Facility Emitted Substance								
	TSP	PM10	PM2.5	SOx	NOx	VOC	Pb	CO	NH3
2024	106.33	64.15	62.23	1.56	2548.55	73.74	0.01	404.02	0.74
2025	194.05	117.08	113.56	2.83	4650.30	134.17	0.01	733.68	1.36
2026	194.05	117.08	113.56	2.83	4650.30	134.17	0.01	733.68	1.36
2027	194.05	117.08	113.56	2.83	4650.30	134.17	0.01	733.68	1.36
2028	194.05	117.08	113.56	2.83	4650.30	134.17	0.01	733.68	1.36
2029	194.05	117.08	113.56	2.83	4650.30	134.17	0.01	733.68	1.36
2030	194.05	117.08	113.56	2.83	4650.30	134.17	0.01	733.68	1.36
2031	194.05	117.08	113.56	2.83	4650.30	134.17	0.01	733.68	1.36
2032	194.05	117.08	113.56	2.83	4650.30	134.17	0.01	733.68	1.36
2033	194.05	117.08	113.56	2.83	4650.30	134.17	0.01	733.68	1.36
Allowable	5328.00			5328.00	5328.00	5328.00		100205.66	

COMPANY	LLOG Exploration Offshore, L.L.C.
AREA	Alaminos Canyon
BLOCK	335 / 336 / 337
LEASE	OCS-G-36492, OCS-G-36102 & OCS-G-36103
FACILITY	
WELL	Location F and alternate well
COMPANY CONTACT	Sue Sachitana
TELEPHONE NO.	985-801-4300
REMARKS	Semi Submersible

LEASE TERM PIPELINE CONSTRUCTION INFORMATION:		
YEAR	NUMBER OF PIPELINES	TOTAL NUMBER OF CONSTRUCTION DAYS
2024		
2025		
2026		
2027		
2028		
2029		
2030		
2031		
2032		
2033		

AIR EMISSIONS COMPUTATION FACTORS

Fuel Usage Conversion Factors	Natural Gas Turbines		Natural Gas Engines		Diesel Recip. Engine		Diesel Turbines	
	SCF/hp-hr	9.524	SCF/hp-hr	7.143	GAL/hp-hr	0.0483	GAL/hp-hr	0.0514

Equipment/Emission Factors	units	TSP	PM10	PM2.5	SOx	NOx	VOC	Pb	CO	NH3	REF.	DATE	Reference Links
Natural Gas Turbine	g/hp-hr		0.0086	0.0086	0.0025	1.4515	0.0095	N/A	0.3719	N/A	AP42 3.1-1& 3.1-2a	4/00	https://www3.epa.gov/ttnchie1/ap42/ch03/final/c03s01.pdf
RECIP. 2 Cycle Lean Natural Gas	g/hp-hr		0.1293	0.1293	0.0020	6.5998	0.4082	N/A	1.2009	N/A	AP42 3.2-1	7/00	https://www3.epa.gov/ttnchie1/ap42/ch03/final/c03s02.pdf
RECIP. 4 Cycle Lean Natural Gas	g/hp-hr		0.0002	0.0002	0.0020	2.8814	0.4014	N/A	1.8949	N/A	AP42 3.2-2	7/00	https://www3.epa.gov/ttnchie1/ap42/ch03/final/c03s02.pdf
RECIP. 4 Cycle Rich Natural Gas	g/hp-hr		0.0323	0.0323	0.0020	7.7224	0.1021	N/A	11.9408	N/A	AP42 3.2-3	7/00	https://www3.epa.gov/ttnchie1/ap42/ch03/final/c03s02.pdf
Diesel Recip. < 600 hp	g/hp-hr	1	1	1	0.0279	14.1	1.04	N/A	3.03	N/A	AP42 3.3-1	10/96	https://www3.epa.gov/ttnchie1/ap42/ch03/final/c03s03.pdf
Diesel Recip. > 600 hp	g/hp-hr	0.32	0.182	0.178	0.1468	10.9	0.29	N/A	2.5	N/A	AP42 3.4-1 & 3.4-2	10/96	https://www3.epa.gov/ttnchie1/ap42/ch03/final/c03s04.pdf
Diesel Boiler	lbs/bbl	0.0840	0.0420	0.0105	0.2386	1.0080	0.0084	5.14E-05	0.2100	0.0336	AP42 1.3-6; Pb and NH3: WebFIRE (08/2018)	9/98 and 5/10	https://www3.epa.gov/ttnchie1/ap42/ch03/final/c03s04.pdf
Diesel Turbine	g/hp-hr	0.0358	0.0137	0.0137	0.1283	2.7941	0.0013	4.45E-05	0.0105	N/A	AP42 3.1-1 & 3.1-2a	4/00	https://www3.epa.gov/ttnchie1/ap42/ch03/final/c03s01.pdf
Dual Fuel Turbine	g/hp-hr	0.0358	0.0137	0.0137	0.1283	2.7941	0.0095	4.45E-05	0.3719	0.0000	AP42 3.1-1& 3.1-2a; AP42 3.1-1 & 3.1-2a	4/00	https://www3.epa.gov/ttnchie1/ap42/ch03/final/c03s01.pdf
Vessels – Propulsion	g/hp-hr	0.320	0.1931	0.1873	0.0047	7.6669	0.2204	2.24E-05	1.2025	0.0022	USEPA 2017 NEITSP refer to Diesel Recip. > 600 hp reference	3/19	https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-net-data
Vessels – Drilling Prime Engine, Auxiliary	g/hp-hr	0.320	0.1931	0.1873	0.0047	7.6669	0.2204	2.24E-05	1.2025	0.0022	USEPA 2017 NEITSP refer to Diesel Recip. > 600 hp reference	3/19	
Vessels – Diesel Boiler	g/hp-hr	0.0466	0.1491	0.1417	0.4400	1.4914	0.0820	3.73E-05	0.1491	0.0003	USEPA 2017 NEITSP (units converted) refer to Diesel Boiler Reference	3/19	
Vessels – Well Stimulation	g/hp-hr	0.320	0.1931	0.1873	0.0047	7.6669	0.2204	2.24E-05	1.2025	0.0022	USEPA 2017 NEITSP refer to Diesel Recip. > 600 hp reference	3/19	
Natural Gas Heater/Boiler/Burner	lbs/MMscf	7.60	1.90	1.90	0.60	190.00	5.50	5.00E-04	84.00	3.2	AP42 1.4-1 & 1.4-2; Pb and NH3: WebFIRE (08/2018)	7/98 and 8/18	https://www3.epa.gov/ttnchie1/ap42/ch01/final/c01s04.pdf
Combustion Flare (no smoke)	lbs/MMscf	0.00	0.00	0.00	0.56	71.40	35.93	N/A	325.5	N/A	AP42 13.5-1, 13.5-2	2/18	
Combustion Flare (light smoke)	lbs/MMscf	2.10	2.10	2.10	0.56	71.40	35.93	N/A	325.5	N/A	AP42 13.5-1, 13.5-2	2/18	https://www3.epa.gov/ttnchie1/ap42/ch13/final/C13S05_02-05-18.pdf
Combustion Flare (medium smoke)	lbs/MMscf	10.50	10.50	10.50	0.56	71.40	35.93	N/A	325.5	N/A	AP42 13.5-1, 13.5-2	2/18	
Combustion Flare (heavy smoke)	lbs/MMscf	21.00	21.00	21.00	0.56	71.40	35.93	N/A	325.5	N/A	AP42 13.5-1, 13.5-2	2/18	
Liquid Flaring	lbs/bbl	0.42	0.0966	0.0651	5.964	0.84	0.01428	5.14E-05	0.21	0.0336	AP42 1.3-1 through 1.3-3 and 1.3-5	5/10	https://www3.epa.gov/ttnchie1/ap42/ch01/final/c01s03.pdf
Storage Tank	tons/yr/tank								4.300		2014 Gulfwide Inventory: Avg emiss (upper bound of 95% CI)	2017	https://www.boem.gov/environment/environmental-studies/2014-gulfwide-emission-inventory
Fugitives	lbs/hr/component								0.0005		API Study	12/93	https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-net-data
Glycol Dehydrator	tons/yr/dehydrator								19.240		2011 Gulfwide Inventory: Avg emiss (upper bound of 95% CI)	2014	https://www.boem.gov/environment/environmental-studies/2011-gulfwide-emission-inventory
Cold Vent	tons/yr/vent								44.747		2014 Gulfwide Inventory: Avg emiss (upper bound of 95% CI)	2017	https://www.boem.gov/environment/environmental-studies/2014-gulfwide-emission-inventory
Waste Incinerator	lb/ton		15.0	15.0	2.5	2.0	N/A	N/A	20.0	N/A	AP 42 2.1-12	10/96	https://www3.epa.gov/ttnchie1/ap42/ch02/final/c02s01.pdf
On-Ice – Loader	lbs/gal	0.043	0.043	0.043	0.040	0.604	0.049	N/A	0.130	0.003	USEPA NONROAD2008 model; TSP (units converted) refer to Diesel Recip. <600 reference	2009	
On-Ice – Other Construction Equipment	lbs/gal	0.043	0.043	0.043	0.040	0.604	0.049	N/A	0.130	0.003	USEPA NONROAD2008 model; TSP (units converted) refer to Diesel Recip. <600 reference	2009	
On-Ice – Other Survey Equipment	lbs/gal	0.043	0.043	0.043	0.040	0.604	0.049	N/A	0.130	0.003	USEPA NONROAD2008 model; TSP (units converted) refer to Diesel Recip. <600 reference	2009	https://www.epa.gov/moves/nonroad2008a-installation-and-updates
On-Ice – Tractor	lbs/gal	0.043	0.043	0.043	0.040	0.604	0.049	N/A	0.130	0.003	USEPA NONROAD2008 model; TSP (units converted) refer to Diesel Recip. <600 reference	2009	
On-Ice – Truck (for gravel island)	lbs/gal	0.043	0.043	0.043	0.040	0.604	0.049	N/A	0.130	0.003	USEPA NONROAD2008 model; TSP (units converted) refer to Diesel Recip. <600 reference	2009	
On-Ice – Truck (for surveys)	lbs/gal	0.043	0.043	0.043	0.040	0.604	0.049	N/A	0.130	0.003	USEPA NONROAD2008 model; TSP (units converted) refer to Diesel Recip. <600 reference	2009	
Man Camp - Operation (max people/day)	tons/person/day		0.0004	0.0004	0.0004	0.006	0.001	N/A	0.001	N/A	BOEM 2014-1001	2014	https://www.boem.gov/sites/default/files/uploadedFiles/BOEM/BOEM_Newsroom/Library/Publications/2014-1001.pdf
Vessels - Ice Management Diesel	g/hp-hr	0.320	0.1931	0.1873	0.0047	7.6669	0.2204	2.24E-05	1.2025	0.0022	USEPA 2017 NEITSP refer to Diesel Recip. > 600 hp reference	3/19	https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-net-data
Vessels - Hovercraft Diesel	g/hp-hr	0.320	0.1931	0.1873	0.0047	7.6669	0.2204	2.24E-05	1.2025	0.0022	USEPA 2017 NEITSP refer to Diesel Recip. > 600 hp reference	3/19	

Sulfur Content Source	Value	Units
Fuel Gas	3.33	ppm
Diesel Fuel	0.04	% weight
Produced Gas (Flare)	3.33	ppm
Produced Oil (Liquid Flaring)	1	% weight

Density and Heat Value of Diesel Fuel		
Density	7.05	lbs/gal
Heat Value	19,300	Btu/lb

Heat Value of Natural Gas	
Heat Value	1,050 MMBtu/MMscf

Natural Gas Flare Parameters	Value	Units
VOC Content of Flare Gas	0.6816	lb VOC/lb-mol gas
Natural Gas Flare Efficiency	98	%

AIR EMISSIONS COMPUTATION FACTORS

COMPANY	AREA	BLOCK	LEASE	FACILITY	WELL	CONTACT	PHONE	REMARKS																	
LLOG Exploration Offshore, L.L.C.	Alamos Canyon	335 / 336 / 337	OCS-G-38492	0	Location F and alternate well	Sue Sachiana	985-801-4300	Semi Submersible																	
OPERATIONS	EQUIPMENT	EQUIPMENT ID	RATING	MAX. FUEL	ACT. FUEL	RUN TIME	MAXIMUM POUNDS PER HOUR										ESTIMATED TONS								
	Nat. Gas Engines		HP	GAL/HR	GAL/D		TSP	PM10	PM2.5	SOx	NOx	VOC	Pb	CO	NH3	TSP	PM10	PM2.5	SOx	NOx	VOC	Pb	CO	NH3	
	Burners		MMBTU/HR	SCF/HR	SCF/D	HR/D	D/YR																		
DRILLING	VESSELS - Drilling - Propulsion Engine - Diesel		61200	2955.96	70943.04	24	200	43.18	26.05	25.27	0.63	1034.45	29.74	0.00	162.25	0.30	103.62	62.52	60.64	1.51	2482.67	71.38	0.01	389.40	0.72
	VESSELS - Drilling - Propulsion Engine - Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS - Drilling - Propulsion Engine - Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS - Drilling - Propulsion Engine - Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Vessels - Diesel Boiler		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Vessels - Drilling Prime Engine, Auxiliary		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPELINE INSTALLATION	VESSELS - Pipeline Laying Vessel - Diesel		12000	579.6	13910.40	24	0	8.47	5.11	4.95	0.12	202.83	5.83	0.00	31.81	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS - ROV vessel		8000	386.4	9273.60	24	0	5.64	3.41	3.30	0.08	135.22	3.89	0.00	21.21	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FACILITY INSTALLATION	VESSELS - Heavy Lift Vessel/Derrick Barge Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRODUCTION	RECIP <600hp Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	RECIP >600hp Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	VESSELS - Shuttle Tankers		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS - Well Stimulation		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Natural Gas Turbine		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Diesel Turbine		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Dual Fuel Turbine		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	RECIP 2 Cycle Lean Natural Gas		0	0	0.00	0	0	--	0.00	0.00	0.00	0.00	--	0.00	--	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--	
	RECIP 4 Cycle Lean Natural Gas		0	0	0.00	0	0	--	0.00	0.00	0.00	0.00	--	0.00	--	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--	
	RECIP 4 Cycle Rich Natural Gas		0	0	0.00	0	0	--	0.00	0.00	0.00	0.00	--	0.00	--	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--	
	Diesel Boiler		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Natural Gas Heater/Boiler/Burner		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MISC.			BPD	SCF/HR	COUNT																				
	STORAGE TANK				0	0	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	COMBUSTION FLARE - no smoke			162500	0	24	7	0.00	0.00	0.00	0.00	11.60	#DIV/0!	--	52.99	--	0.00	0.00	0.00	0.01	0.97	--	4.44	--	
	COMBUSTION FLARE - light smoke			0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--	
	COMBUSTION FLARE - medium smoke			0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--	
	COMBUSTION FLARE - heavy smoke			0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--	
	COLD VENT				0	0	0	--	--	--	--	--	#DIV/0!	--	--	--	--	--	--	--	--	--	--	--	--
	FLUITIVES				0	0	0	--	--	--	--	--	#DIV/0!	--	--	--	--	--	--	--	--	--	--	--	--
	GLYCOL DEHYDRATOR				0	0	0	--	--	--	--	--	#DIV/0!	--	--	--	--	--	--	--	--	--	--	--	--
	WASTE INCINERATOR		0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	--	0.00	--	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--	
DRILLING	Liquid Flaring		0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WELL TEST	COMBUSTION FLARE - no smoke			0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	COMBUSTION FLARE - light smoke			0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	COMBUSTION FLARE - medium smoke			0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	COMBUSTION FLARE - heavy smoke			0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--
ALASKA-SPECIFIC SOURCES	VESSELS		KW			HR/D	D/YR																		
	VESSELS - Ice Management Diesel		0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--
	2024 Facility Total Emissions							57.28	34.56	33.52	0.93	1,384.10	#DIV/0!	0.00	266.17	0.40	103.62	62.52	60.64	1.52	2,463.64	71.87	0.01	393.84	0.72
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES																5,328.00			5,328.00	5,328.00	5,328.00		100,205.66	
	160.0																								
DRILLING	VESSELS - Crew Diesel		7200	347.76	8346.24	12	86	5.08	3.06	2.97	0.07	121.70	3.50	0.00	19.09	0.04	2.61	1.58	1.53	0.04	62.59	1.80	0.00	9.82	0.02
	VESSELS - Supply Diesel		7200	347.76	8346.24	12	171	5.08	3.06	2.97	0.07	121.70	3.50	0.00	19.09	0.04	5.22	3.15	3.06	0.08	125.18	3.60	0.00	19.63	0.04
	VESSELS - Tugs Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPELINE INSTALLATION	VESSELS - Support Diesel, Laying		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS - Support Diesel, Burying		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS - Crew Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS - Supply Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FACILITY INSTALLATION	VESSELS - Material Tug Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS - Crew Diesel		0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS - Supply Diesel		0	0	0.0																				

AIR EMISSIONS COMPUTATION FACTORS

COMPANY	AREA	BLOCK	LEASE	FACILITY	WELL	CONTACT	PHONE	REMARKS	ESTIMATED TONS																	
LLOG Exploration Offshore, L.L.C.	Alamos Canyon	335 / 336 / 337	OCS-G-38492	0	Location F and alternate well	Sue Sachiana	985-801-4300	Sem Submersible																		
OPERATIONS	EQUIPMENT	EQUIPMENT ID	RATING	MAX. FUEL		ACT. FUEL		RUN TIME		MAXIMUM POUNDS PER HOUR																
				HP	GAL/HR	GAL/D	HR/D	D/YR	TSP	PM10	PM2.5	SOx	NOx	VOC	Pb	CO	NH3	TSP	PM10	PM2.5	NOx	VOC	Pb	CO	NH3	
Nat. Gas Engines		MMBTU/HR	SCF/HR	SCF/D	HR/D	D/YR	TSP	PM10	PM2.5	SOx	NOx	VOC	Pb	CO	NH3	TSP	PM10	PM2.5	NOx	VOC	Pb	CO	NH3			
DRILLING	VESSLS - Drilling - Propulsion Engine - Diesel	61200	2955.96	70943.04	24	365	43.18	26.05	25.27	0.63	1034.45	29.74	0.00	162.25	0.30	189.11	114.09	110.67	2.75	4530.87	130.27	0.01	710.66	1.32		
	VESSLS - Drilling - Propulsion Engine - Diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
	VESSLS - Drilling - Propulsion Engine - Diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
	VESSLS - Drilling - Propulsion Engine - Diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
	Vessels - Diesel Boiler	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
	Vessels - Drilling Prime Engine, Auxiliary	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
PIPELINE INSTALLATION	VESSLS - Pipeline Laying Vessel - Diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
	SUPPORT VESSEL Diesel (ROV) for Well Jumpers	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
FACILITY INSTALLATION	VESSLS - Heavy Lift Vessel/Derrick Barge Diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
PRODUCTION	RECIP <600hp Diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--		
	RECIP >600hp Diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--		
	VESSLS - Shuttle Tankers	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	VESSLS - Well Stimulation	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	Natural Gas Turbine	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--		
	Diesel Turbine	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	Dual Fuel Turbine	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	RECIP 2 Cycle Lean Natural Gas	0	0	0.00	0	0	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--		
	RECIP 4 Cycle Lean Natural Gas	0	0	0.00	0	0	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--		
	RECIP 4 Cycle Rich Natural Gas	0	0	0.00	0	0	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--		
	Diesel Boiler	0	0	0.00	0	0	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--		
	Natural Gas Heater/Boiler/Burner	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
MISC.		BPD	SCF/HR	COUNT																						
	STORAGE TANK			0	0	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
	COMBUSTION FLARE - no smoke	162500	0	24	7	0.00	0.00	0.00	0.00	0.00	0.00	11.60	#DIV/0!	--	52.99	--	0.00	0.00	0.00	0.01	9.97	--	44.44	--		
	COMBUSTION FLARE - light smoke	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--		
	COMBUSTION FLARE - medium smoke	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--		
	COMBUSTION FLARE - heavy smoke	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--		
	COLD VENT		0	1	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
	FLUITIVES		0	0	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
	GLYCOL DEHYDRATOR		0	1	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
	WASTE INCINERATOR	0	0	0	0	--	0.00	0.00	0.00	0.00	0.00	--	--	0.00	--	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--		
DRILLING WELL TEST	Liquid Flaring	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	COMBUSTION FLARE - no smoke	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--		
	COMBUSTION FLARE - light smoke	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--		
	COMBUSTION FLARE - medium smoke	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--		
	COMBUSTION FLARE - heavy smoke	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--		
ALASKA-SPECIFIC SOURCES	VESSLS		KW		HR/D	D/YR																				
	VESSLS - Ice Management Diesel	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	--	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--		
	2025 Facility Total Emissions					43.18	26.05	25.27	0.72	1,046.05	#DIV/0!	0.00	215.14	0.30	189.11	114.09	110.67	2.76	4,531.84	130.76	0.01	715.10	1.32			
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES																									
	160.0																									
DRILLING	VESSLS - Crew Diesel	7200	347.76	8346.24	12	156	5.08	3.06	2.97	0.07	121.70	3.50	0.00	19.09	0.04	4.77	2.88	2.79	0.07	114.22	3.28	0.00	17.92	0.03		
	VESSLS - Supply Diesel	7200	347.76	8346.24	12	313	5.08	3.06	2.97	0.07	121.70	3.50	0.00	19.09	0.04	9.53	5.75	5.58	0.14	228.45	6.57	0.00	35.83	0.07		
	VESSLS - Tugs Diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
PIPELINE INSTALLATION	VESSLS - Support Diesel, Laying	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	VESSLS - Support Diesel, Burying	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	VESSLS - Crew Diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	VESSLS - Supply Diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
FACILITY INSTALLATION	VESSLS - Material Tug Diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	VESSLS - Crew Diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	VESSLS - Supply Diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
PRODUCTION	VESSLS - Support Diesel	0	0	0.00	0	0	0.00																			

AIR EMISSIONS CALCULATIONS

COMPANY	AREA	BLOCK	LEASE	FACILITY	WELL
LLOG Exploration Offshore, L.L.C.	Alaminos Canyon	335 / 336 / 337	OCS-G-36492, OCS-G-36102 &	Location F and alternate well	

Year	Facility Emitted Substance								
	TSP	PM10	PM2.5	SOx	NOx	VOC	Pb	CO	NH3
2024	103.62	62.52	60.64	1.52	2483.64	71.87	0.01	393.84	0.72
2025	189.11	114.09	110.67	2.76	4531.84	130.76	0.01	715.10	1.32
2026	189.11	114.09	110.67	2.76	4531.84	130.76	0.01	715.10	1.32
2027	189.11	114.09	110.67	2.76	4531.84	130.76	0.01	715.10	1.32
2028	189.11	114.09	110.67	2.76	4531.84	130.76	0.01	715.10	1.32
2029	189.11	114.09	110.67	2.76	4531.84	130.76	0.01	715.10	1.32
2030	189.11	114.09	110.67	2.76	4531.84	130.76	0.01	715.10	1.32
2031	189.11	114.09	110.67	2.76	4531.84	130.76	0.01	715.10	1.32
2032	189.11	114.09	110.67	2.76	4531.84	130.76	0.01	715.10	1.32
2033	189.11	114.09	110.67	2.76	4531.84	130.76	0.01	715.10	1.32
Allowable	5328.00			5328.00	5328.00	5328.00		100205.66	

APPENDIX H
OIL SPILL INFORMATION
(30 CFR PART 550.219 AND 550.250)

A. Oil Spill Response Planning

All the proposed activities in this Revised Exploration Plan will be covered by the Oil Spill Response Plan filed by LLOG (No. 02058) in accordance with 30 CFR 254, our biennial update was found to be “in-compliance” on September 8, 2022. Our OSRP revision was approved on November 27, 2023.

B. Spill Response Sites

The following locations will be used in the event an oil spill occurs as a result of the proposed activities.

Primary Response Equipment Location	Pre-Planned Staging Location(s)
Houma, LA	Fort Jackson, LA

C. OSRO Information

The O’Brien Group (TOG) will provide trained personnel capable of providing supervisory management of the oil spill response in addition to contacting and deploying cleanup personnel and equipment.

LLOG utilizes Clean Gulf Associates (CGA) as its primary provider for equipment, which is an industry cooperative owning an inventory of oil spill clean-up equipment. CGA is supported by the Marine Spill Response Corporation’s (MSRC), which is responsible for storing, inspecting, maintaining, and dispatching CGA’s equipment. The MSRC STARS network provides for the closest available personnel, as well as an MSRC supervisor to operate the equipment.

D. Worst-Case Scenario Information

<i>Category</i>	<i>Regional OSRP</i>	<i>EP</i>
Type of Activity	Exploratory MODU	Exploratory MODU
Facility Surface Location	Mississippi Canyon Block 386/387	Alaminos Canyon Block 336
Facility Description	Location Well 001 (Revised Location B)	(Loc A)
Distance to Nearest Shoreline (Miles)	58 miles	160 miles
Volume: Storage Tanks (total) Facility Piping (total) Lease Term Pipeline Uncontrolled Blowout (day) Barging Potential 24 Hour Volume (bbls)	396,602 bbls	27,709 bbls
Type of Liquid Hydrocarbon	Crude Oil	Crude Oil
API Gravity	25°	35.0°

LLOG Exploration Offshore, L.L.C. (LLOG) has the capability to respond to the appropriate worst-case spill scenario included in its regional OSRP Plan, filed by LLOG (No. 02058) in accordance with 30 CFR 254, our biennial update was found to be “in-compliance” on September 8, 2022. Our OSRP revision was approved on November 27, 2023.

Since LLOG Exploration Offshore, L.L.C. (LLOG) has the capability to respond to the appropriate worst-case spill scenario included in its regional OSRP Plan filed by LLOG (Operator No.02058) in accordance with 30 CFR 254 Biennial update modification approved on July 21, 2020 and since the worst case discharge determined in Exploration Plan for Mississippi Canyon Block 387 is the worst case discharge outlined in our Regional OSRP, I hereby certify that LLOG Exploration Offshore, L.L.C. has the capability to respond, to the maximum extent practicable, to a worst-case discharge, or a substantial threat of such a discharge, resulting from the activities proposed in this Exploration Plan.

LLOG Exploration Offshore, L.L.C., Company No. 02058, previously submitted the Regional OSRP Exploration WCD volume in Plan R-6763, Revised Exploration Plan, which was approved on November 2, 2018.

The required proprietary data outlined in NTL 2015-N01 was submitted to BOEM within the Confidential Copy of the Revised Exploration Plan, R-6763.

LLOG Exploration Offshore, L.L.C., Company No. 02058 will not use any new or unusual technology in responding to an oil spill.

E. Oil Spill Response Discussion

See the following Oil Spill Response Discussion.

SPILL RESPONSE DISCUSSION

For the purpose of NEPA and Coastal Zone Management Act analysis, the largest spill volume originating from the proposed activity would be a well blowout during drilling operations, estimated to be 1.62 mmbbl oil with an API gravity of 35°.

Land Segment and Resource Identification

Trajectories of a spill and the probability of it impacting a land segment have been projected utilizing information in the BOEM Oil Spill Risk Analysis Model (OSRAM) for the Central and Western Gulf of Mexico available on the BOEM website. The results are shown in **Figure 1**. The BOEM OSRAM identifies an 8% probability of impact to the shorelines of Matagorda County, Texas within 30 days. Matagorda County stretches from Matagorda Bay, across the Colorado River and up to the border of San Bernard Wildlife Refuge (immediately west of the San Bernard River). The county includes Matagorda Peninsula on the Gulf coast and Matagorda Bay. This area is primarily open beach. However, marshland exists along the east side of Matagorda Bay. Several bird rookeries are present around the peninsula. Seagrass is present off of Matagorda Peninsula on the bay side.

Response

LLOG will make every effort to respond to the Worst Case Discharge as effectively as practicable. A description of the response equipment under contract to contain and recover the Worst Case Discharge is shown in **Figure 2**.

Using the estimated chemical and physical characteristics of crude oil, an ADIOS weathering model was run on a similar product from the ADIOS oil database. The results indicate 33% or approximately 9,144 barrels of crude oil would be evaporated/dispersed within 24 hours, with approximately 18,565 barrels remaining.

Natural Weathering Data: AC336, Location A	Barrels of Oil
WCD Volume	27,709
Less 33% natural evaporation/dispersion	9,144
Remaining volume	18,565

Figure 2 outlines equipment, personnel, materials and support vessels as well as temporary storage equipment available to respond to the worst case discharge. The volume accounts for the amount remaining after evaporation/dispersion at 24 hours. The list estimates individual

times needed for procurement, load out, travel time to the site and deployment. **Figure 2** also indicates how operations will be supported.

LLOG's Oil Spill Response Plan includes alternative response technologies such as dispersants and in-situ burn. Strategies will be decided by Unified Command based on an operations safety analysis, the size of the spill, weather and potential impacts. If aerial dispersants are utilized, 8 sorties (9,600 gallons) from two of the DC-3 aircrafts and 4 sorties (8,000 gallons) from the Basler aircraft would provide a daily dispersant capability of 7,540 barrels. If the conditions are favorable for in-situ burning, the proper approvals have been obtained and the proper planning is in place, in-situ burning of oil may be attempted. Slick containment boom would be immediately called out and on-scene as soon as possible. Offshore response strategies may include attempting to skim utilizing CGA's and MSRC's spill response equipment with a total derated skimming capacity of 689,114 barrels. Temporary storage associated with skimming equipment equals 138,996 barrels. If additional storage is needed, various tank barges with a total of 658,000+ barrels of storage capacity may be mobilized and centrally located to provide temporary storage and minimize off-loading time. **Safety is first priority. Air monitoring will be accomplished and operations deemed safe prior to any containment/skimming attempts.**

If the spill went unabated, shoreline impact in Matagorda County, Texas would depend upon existing environmental conditions. Shoreline protection would include the use of CGA's and MSRC's near shore and shallow water skimmers with a totaled derated skimming capacity of 317,986 barrels. Temporary storage associated with skimming equipment equals 5,979 barrels. If additional storage is needed, various tank barges with a total of 373,000+ barrels of storage capacity may be mobilized and centrally located to provide temporary storage and minimize off-loading time. Onshore response may include the deployment of shoreline boom on beach areas, or protection and sorbent boom on vegetated areas. Contracts with OMI Environmental and MSRC will ensure access to 123,750 feet of 18" shoreline protection boom. **Figure 2** outlines individual times needed for procurement, load out, travel time to the site and deployment. Strategies would be based upon surveillance and real time trajectories that depict areas of potential impact given actual sea and weather conditions. Applicable Area Contingency Plans (ACPs), Geographic Response Plans (GRPs), and Unified Command (UC) will be consulted to ensure that environmental and special economic resources are correctly identified and prioritized to ensure optimal protection. Shoreline protection strategies depict the protection response modes applicable for oil spill clean-up operations. As a secondary resource, the State of Louisiana Initial Oil Spill Response Plan will be consulted as appropriate to provide detailed shoreline protection strategies and describe necessary action to keep the oil spill from entering Louisiana's coastal wetlands. The UC should take into consideration all appropriate items detailed in the Tactics discussion of this Appendix. The UC and their personnel have the option

to modify the deployment and operation of equipment to allow for a more effective response to site-specific circumstances. LLOG's contract Incident Management Team has access to the applicable ACP(s) and GRP(s).

Based on the anticipated worst case discharge scenario, LLOG can be onsite with contracted oil spill recovery equipment with adequate response capacity to contain and recover surface hydrocarbons, and prevent land impact, to the maximum extent practicable, within an estimated 78 hours (based on the equipment's Effective Daily Recovery Capacity (EDRC)).

Initial Response Considerations

Actual actions taken during an oil spill response will be based on many factors to include but not be limited to:

- Safety
- Weather
- Equipment and materials availability
- Ocean currents and tides
- Location of the spill
- Product spilled
- Amount spilled
- Environmental risk assessments
- Trajectory and product analysis
- Well status, i.e., shut in or continual release

LLOG will take action to provide a safe, aggressive response to contain and recover as much of the spilled oil as quickly as it is safe to do so. In an effort to protect the environment, response actions will be designed to provide an “in-depth” protection strategy meant to recover as much oil as possible as far from environmentally sensitive areas as possible. Safety will take precedence over all other considerations during these operations.

Coordination of response assets will be supervised by the designation of a SIMOPS Group as necessary for close quarter vessel response activities. Most often, this group will be used during source control events that require a significant number of large vessels operating independently to complete a common objective, in close coordination and support of each other. This group must also monitor the subsurface activities of each vessel (ROV, dispersant application, well control support, etc.). The SIMOPS Group Supervisor reports to the Source Control Section Chief.

In addition, these activities will be monitored by the Incident Management Team (IMT) and Unified Command via a structured Common Operating Picture (COP) established to track resource and slick movement in real time.

Upon notification of a spill, the following actions will be taken:

- Information will be confirmed
- An assessment will be made and initial objectives set
- OSROs and appropriate agencies will be notified
- ICS 201, Initial Report Form completed
- Initial Safety plan will be written and published

- Unified Command will be established
 - Overall safety plan developed to reflect the operational situation and coordinated objectives
 - Areas of responsibility established for Source Control and each surface operational site
 - On-site command and control established

Offshore Response Actions

Equipment Deployment

Surveillance

- Surveillance Aircraft: within two hours of QI notification, or at first light
- Provide trained observer to provide on-site status reports
- Provide command and control platform at the site if needed
- Continual surveillance of oil movement by remote sensing systems, aerial photography and visual confirmation
- Continual monitoring of vessel assets using vessel monitoring systems

Dispersant application assets

- Put ASI on standby
- With the FOSC, conduct analysis to determine appropriateness of dispersant application (refer to Section 18)
- Gain FOSC approval for use of dispersants on the surface
- Deploy aircraft in accordance with a plan developed for the actual situation
- Coordinate movement of dispersants, aircraft, and support equipment and personnel
- Confirm dispersant availability for current and long range operations
- Start ordering dispersant stocks required for expected operations

Containment boom

- Call out early and expedite deployment to be on scene ASAP
- Ensure boom handling and mooring equipment is deployed with boom
- Provide continuing reports to vessels to expedite their arrival at sites that will provide for their most effective containment
- Use Vessels of Opportunity (VOO) to deploy and maintain boom

Oceangoing Boom Barge

- Containment at the source
- Increased/enhanced skimmer encounter rate
- Protection booming

In-situ Burn assets

- Determine appropriateness of in-situ burn operation in coordination with the FOSC and affected SOSC
- Determine availability of fire boom and selected ignition systems

- Start ordering fire boom stocks required for expected operations
- Contact boom manufacturer to provide training & tech support for operations, if required
- Determine assets to perform on water operation
- Build operations into safety plan
- Conduct operations in accordance with an approved plan
- Initial test burn to ensure effectiveness

Dedicated offshore skimming systems

General

- Deployed to the highest concentration of oil
- Assets deployed at safe distance from aerial dispersant and in-situ burn operations

CGA HOSS Barge

- Use in areas with heaviest oil concentrations
- Consider for use in areas of known debris (seaweed, and other floating materials)

CGA 95' Fast Response Vessels (FRVs)

- Designed to be a first vessel on scene
- Capable of maintaining the initial Command and Control function for on water recovery operations
- 24 hour oil spill detection capability
- Highly mobile and efficient skimming capability
- Use as far offshore as safely possible

CGA FRUs

- To the area of the thickest oil
- Use as far offshore as allowed
- VOOs 140' – 180' in length
- VOOs with minimum of 18' x 38' or 23' x 50' of optimum deck space
- VOOs in shallow water should have a draft of <10 feet when fully loaded

T&T Koseq Skimming Systems

- To the area of the thickest oil
- Use as far offshore as allowed
- VOOs with a minimum of 2,000 bbls storage capacity
- VOOs at least 200' in length

- VOOs with deck space of 100' x 40' to provide space for arms, tanks, and crane
- VOOs for shallow water should be deck barges with a draft of <10 feet when fully loaded

Storage Vessels

- Establish availability of CGA contracted assets (See Appendix E)
- Early call out (to allow for tugboat acquisition and deployment speeds)
- Phase mobilization to allow storage vessels to arrive at the same time as skimming systems
- Position as closely as possible to skimming assets to minimize offloading time

Vessels of Opportunity (VOO)

- Use LLOG's contracted resources as applicable
- Industry vessels are ideal for deployment of Vessel of Opportunity Skimming Systems (VOSS)
- Acquire additional resources as needed
- Consider use of local assets, i.e. fishing and pleasure craft for ISB operations or boom tending
- Expect mission specific and safety training to be required
- Plan with the US Coast Guard for vessel inspections
- Place VOOs in Division or Groups as needed
- Use organic on-board storage if appropriate
- Maximize non-organic storage appropriate to vessel limitations
- Decant as appropriate after approval to do so has been granted
- Assign bulk storage barges to each Division/Group
- Position bulk storage barges as close to skimming units as possible
- Utilize large skimming vessel (e.g. barges) storage for smaller vessel offloading
- Maximize skimming area (swath) to the optimum width given sea conditions and available equipment
- Maximize use of oleophilic skimmers in all operations, but especially offshore
- Nearshore, use shallow water barges and shuttle to skimming units to minimize offloading time
- Plan and equip to use all offloading capabilities of the storage vessel to minimize offloading time

Adverse Weather Operations:

In adverse weather, when seas are ≥ 3 feet, the use of larger recovery and storage vessels, oleophilic skimmers, and large offshore boom will be maximized. KOSEQ Arm systems are built for rough conditions, and they should be used until their operational limit (9.8' seas) is met. Safety will be the overriding factor in all operations and will cease at the order of the Unified Command, vessel captain, or in an emergency, "stop work" may be directed by any crew member.

Surface Oil Recovery Considerations and Tactics (Offshore and Near-shore Operations)

Maximization of skimmer-oil encounter rate

- Place barges in skimming task forces, groups, etc., to reduce recovered oil offloading time
- Place barges alongside skimming systems for immediate offloading of recovered oil when practicable
- Use two vessels, each with heavy sea boom, in an open-ended "V" configuration to funnel surface oil into a trailing skimming unit's organic, V-shaped boom and skimmer (see page 7, *CGA Equipment Guide Book and Tactic Manual (CGATM)*)
- Use secondary vessels and heavy sea boom to widen boom swath beyond normal skimming system limits (see page 15, *CGATM*)
- Consider night-time operations, first considering safety issues
- Utilize all available advanced technology systems (IR, X-Band Radar, etc.) to determine the location of, and move to, recoverable oil
- Confirm the presence of recoverable oil prior to moving to a new location

Maximize skimmer system efficiency

- Place weir skimming systems in areas of calm seas and thick oil
- Maximize the use of oleophilic skimming systems in heavier seas
- Place less mobile, high EDRC skimming systems (e.g. HOSS Barge) in the largest pockets of the heaviest oil
- Maximize onboard recovered oil storage for vessels.
- Obtain authorization for decanting of recovered water as soon as possible
- Use smaller, more agile skimming systems to recover streamers of oil normally found farther from the source. Place recovered oil barges nearby

Recovered Oil Storage

- Smaller barges in larger quantities will increase flexibility for multi-location skimming operations
- Place barges in skimming task forces, groups, etc., to reduce recovered oil offloading time
- Procure and deploy the maximum number of portable tanks to support Vessel of Opportunity Skimming Systems if onboard storage is not available
- Maximize use of the organic recovered oil storage capacity of the skimming vessel

Command, Control, and Communications (C³)

- Publish, implement, and fully evaluate an appropriate communications plan
- Design an operational scheme, maintaining a manageable span of control
- Designate and mark C³ vessels for easy aerial identification
- Designate and employ C³ aircraft for task forces, groups, etc.
- Use reconnaissance aircraft and Rapid Response Teams (RAT) to confirm the presence of recoverable oil

On Water Recovery Group

When the first skimming vessel arrives on scene, a complete site assessment will be conducted before recovery operations begin. Once it is confirmed that the air monitoring readings for O₂, LEL, H₂S, CO, VOC, and Benzene are all within the permissible limits, oil recovery operations may begin.

As skimming vessels arrive, they will be organized to work in areas that allow for the most efficient vessel operation and free vessel movement in the recovery of oil. Vessel groups will vary in structure as determined by the Operations Section of the Unified Command, but will generally consist, at a minimum, of the following dedicated assets:

- 3 to 5 – Offshore skimming vessels (recovery)
- 1 – Tank barge (temporary storage)
- 1 – Air asset (tactical direction)
- 2 – Support vessels (crew/utility for supply)
- 6 to 10 – Boom vessels (enhanced booming)

Example (Note: Actual organization of TFs will be dependent on several factors including, asset availability, weather, spilled oil migration, currents, etc.)

The 95' FRV Breton Island out of Venice arrives on scene and conducts an initial site assessment. Air monitoring levels are acceptable and no other visual threats have been observed. The area is cleared for safe skimming operations. The Breton Island assumes command and control (CoC) of on-water recovery operations until a dedicated non-skimming vessel arrives to relieve it of those duties.

A second 95' FRV arrives and begins recovery operations alongside the Breton Island. Several more vessels begin to arrive, including a third 95' FRV out of Galveston, the HOSS Barge (High Volume Open Sea Skimming System) out of Harvey, a boom barge (CGA 300) with 25,000' of 42" auto boom out of Leeville, and 9 Fast Response Units (FRUs) from the load-out location at C-Port in Port Fourchon.

As these vessels set up and begin skimming, they are grouped into task forces (TFs) as directed by the Operations Section of the Unified Command located at the command post.

Initial set-up and potential actions:

- A 1,000 meter safety zone has been established around the incident location for vessels involved in Source Control
- The HOSS Barge is positioned facing the incident location just outside of this safety zone or at the point where the freshest oil is reaching the surface
- The HOSS Barge engages its Oil Spill Detection (OSD) system to locate the heaviest oil and maintains that ability for 24-hour operations
- The HOSS Barge deploys 1,320' of 67" Sea Sentry boom on each side, creating a swath width of 800'
- The Breton Island and H.I. Rich skim nearby, utilizing the same OSD systems as the HOSS Barge to locate and recover oil
- Two FRUs join this group and it becomes TF1
- The remaining 7 FRUs are split into a 2 and 3 vessel task force numbered TF2 and TF3
- A 95' FRV is placed in each TF
- The boom barge (CGA 300) is positioned nearby and begins deploying auto boom in sections between two utility vessels (1,000' to 3,000' of boom, depending on conditions) with chain-link gates in the middle to funnel oil to the skimmers
- The initial boom support vessels position in front of TF2 and TF3
- A 100,000+ barrel offshore tank barge is placed with each task force as necessary to facilitate the immediate offload of skimming vessels

The initial task forces (36 hours in) may be structured as follows:

TF 1

- 1 – 95' FRV
- 1 – HOSS Barge with 3 tugs
- 2 – FRUs
- 1 – 100,000+ barrel tank barge and associated tug(s)
- 1 – Dedicated air asset for tactical direction
- 8 – 500' sections of auto boom with gates
- 8 – Boom-towing vessels
- 2 – Support vessels (crew/utility)

TF 2

- 1 – 95' FRV
- 4 – FRUs
- 1 – 100,000+ barrel tank barge and associated tug(s)
- 1 – Dedicated air asset for tactical direction
- 10 – 500' sections of auto boom with gates

- 10 – Boom-towing vessels
- 2 – Support vessels (crew/utility)

TF 3

- 1 – 95' FRV
- 3 – FRUs
- 1 – 100,000+ barrel tank barge and associated tug(s)
- 1 – Dedicated air asset for tactical direction
- 8 – 500' sections of auto boom with gates
- 8 – Boom-towing vessels
- 2 – Support vessels (crew/utility)

Offshore skimming equipment continues to arrive in accordance with the ETA data listed in figure H.3a; this equipment includes 2 AquaGuard skimmers and 11 sets of Koseq Rigid Skimming Arms. These high volume heavy weather capable systems will be divided into functional groups and assigned to specific areas by the Operations Section of the Unified Command.

At this point of the response, the additional TFs may assume the following configurations:

TF 4

- 2 – Sets of Koseq Rigid Skimming Arms w/ associated 200'+ PIDVs
- 1 – AquaGuard Skimmer
- 1 – 100,000+ barrel tank barge and associated tug(s)
- 1 – Dedicated air asset for tactical direction
- 2 – Support vessels (crew/utility)
- 6 – 500' sections of auto boom with gates
- 6 – Boom-towing vessels

TF 5

- 3 – Sets of Koseq Rigid Skimming Arms w/ associated 200'+ PIDVs
- 1 – AquaGuard Skimmer
- 1 – 100,000+ barrel tank barge and associated tug(s)
- 1 – Dedicated air asset for tactical direction
- 2 – Support vessels (crew/utility)
- 8 – 500' sections of auto boom with gates
- 8 – Boom-towing vessels

TF 6

- 3 – Sets of Koseq Rigid Skimming Arms w/ associated 200'+ PIDVs
- 1 – 100,000+ barrel tank barge and associated tug(s)
- 1 – Dedicated air asset for tactical direction
- 2 – Support vessels (crew/utility)
- 6 – 500' sections of auto boom with gates
- 6 – Boom-towing vessels

TF 7

- 3 – Sets of Koseq Rigid Skimming Arms w/ associated 200'+ PIDVs
- 1 – 100,000+ barrel tank barge and associated tug(s)
- 1 – Dedicated air asset for tactical direction
- 2 – Support vessels (crew/utility)
- 6 – 500' sections of auto boom with gates
- 6 – Boom-towing vessels

CGA Minimum Acceptable Capabilities for Vessels of Opportunity (VOO)

Minimum acceptable capabilities of Petroleum Industry Designed Vessels (PIDV) for conducting Vessel of Opportunity (VOO) skimming operations are shown in the table below. PIDVs are “purpose-built” to provide normal support to offshore oil and gas operators. They include but are not limited to utility boats, offshore supply vessels, etc. They become VOOs when tasked with oil spill response duties.

Capability	FRU	KOSEQ	AquaGuard
Type of Vessel	Utility Boat	Offshore Supply Vessel	Utility Boat
Operating parameters			
Sea State	3-5 ft max	9.8 ft max	3-5 ft max
Skimming speed	≤1 kt	≤3 kts	≤1 kt
Vessel size			
Minimum Length	100 ft	200 ft	100 ft
Deck space for: <ul style="list-style-type: none"> • Tank(s) • Crane(s) • Boom Reels • Hydraulic Power Units • Equipment Boxes 	18x32 ft	100x40 ft	18x32 ft
Communication Assets	Marine Band Radio	Marine Band Radio	Marine Band Radio

Tactical use of Vessels of Opportunity (VOO): LLOG will take all possible measures to maximize the oil-to-skimmer encounter rate of all skimming systems, to include VOOs, as discussed in this section. VOOs will normally be placed within an On-water recovery unit as shown in figures below.

Skimming Operations: PIDVs are the preferred VOO skimming platform. OSROs are more versed in operating on these platforms and the vessels are generally large enough with crews more likely versed in spill response operations. They also have a greater possibility of having on-board storage capacity and the most likely vessels to be under contract, and therefore more readily available to the operator. These vessels would normally be assigned to an on-water recovery group/division (see figure below) and outfitted with a VOSS suited for their size and capabilities. Specific tactics used for skimming operations would be dependent upon many parameters which include, but are not limited to, safety concerns, weather, type VOSS on board, product being recovered, and area of oil coverage. Planners would deploy these assets

with the objective of safely maximizing oil- to-skimmer encounter rate by taking actions to minimize non-skimming time and maximizing boom swath. Specific tactical configurations are shown in the figures below.

The Fast Response Unit (FRU): A self-contained, skid based, skimming system that is deployed from the right side of a vessel of opportunity (VOO). An outrigger holds a 75' long section of air inflatable boom in place that directs oil to an apex for recovery via a Foilex 250 weir skimmer. The outrigger creates roughly a 40' swath width dependent on the VOO beam. The lip of the collection bowl on the skimmer is placed as close to the oil and water interface as possible to maximize oil recovery and minimize water retention. The skimmer then pumps all fluids recovered to the storage tank where it is allowed to settle, and with the approval of the Coast Guard, the water is decanted from the bottom of the tank back into the water ahead of the containment boom to be recycled through the system. Once the tank is full of as much pure recovered oil as possible it is offloaded to a storage barge for disposal in accordance with an approved disposal plan. A second 100 barrel storage tank can be added if the appropriate amount of deck space is available to use as secondary storage.

Tactical Overview

Mechanical Recovery – The FRU is designed to provide fast response skimming capability in the offshore and nearshore environment in a stationary or advancing mode. It provides a rated daily recovery capacity of 4,100 barrels. An additional boom reel with 440' of offshore boom can be deployed along with the FRU, and a second support vessel for boom towing, to extend the swath width when attached to the end of the fixed boom. The range and sustainability offshore are dependent on the VOO that the unit is placed on, but generally these can stay offshore for extended periods. The FRU works well independently or assigned with other on-water recovery assets in a task force. In either case, it is most effective when a designated aircraft is assigned to provide tactical direction to ensure the best placement in recoverable oil.

Maximum Sea Conditions – Under most circumstances the FRU can maintain standard oil spill recovery operations in 2' to 4' seas. Ultimately, the Coast Guard licensed Captain in charge of the VOO (with input from the CGAS Supervisor assigned) will be responsible to determine when the sea conditions have surpassed the vessel's safe operating capabilities.

Possible Task Force Configuration (Multiple VOOs can be deployed in a task force)

- 1 – VOO (100' to 165' Utility or Supply Vessel)
- 1 – Boom reel w/support vessel for towing
- 1 – Tank barge (offshore) for temporary storage
- 1 – Utility/Crewboat (supply)

1 – Designated spotter aircraft



The VOSS (yellow) is being deployed and connected to an out-rigger arm. This is suitable for collection in both large pockets of oil and for recovery of streaming oil. The oil-to-skimmer encounter rate is limited by the length of the arm. Skimming pace is ≤ 1 knot.



Through the use of an additional VOO, and using extended sea boom, the swath of the VOSS is increased therefore maximizing the oil-to-skimmer encounter rate. Skimming pace is < 1 knot.

The Koseq Rigid Sweeping Arm: A skimming system deployed on a vessel of opportunity. It requires a large Offshore or Platform Supply Vessel (OSV/PSV), greater than 200' with at least 100' x 50' of free deck space. On each side of the vessel, a 50' long rigid framed Arm is deployed that consists of pontoon chambers to provide buoyancy, a smooth nylon face, and a hydraulically adjustable mounted weir skimmer. The Arm floats independently of the vessel and is attached by a tow bridle and a lead line. The movement of the vessel forward draws the rubber end seal of the arm against the hull to create a collection point for free oil directed to the weir by the Arm face. The collection weir is adjusted to keep the lip as close to the oil water interface as possible to maximize oil recovery while attempting to minimize excess water collection. A transfer pump (combination of positive displacement, screw type and centrifuge suited for highly viscous oils) pump the recovered liquid to portable tanks and/or dedicated fixed storage tanks onboard the vessel. After being allowed to sit and separate, with approval from the Coast Guard, the water can be decanted (pumped off) in front of the collection arm to be reprocessed through the system. Once full with as much pure recovered oil as possible, the oil is transferred to a temporary storage barge where it can be disposed of in accordance with an approved disposal plan.

Tactical Overview

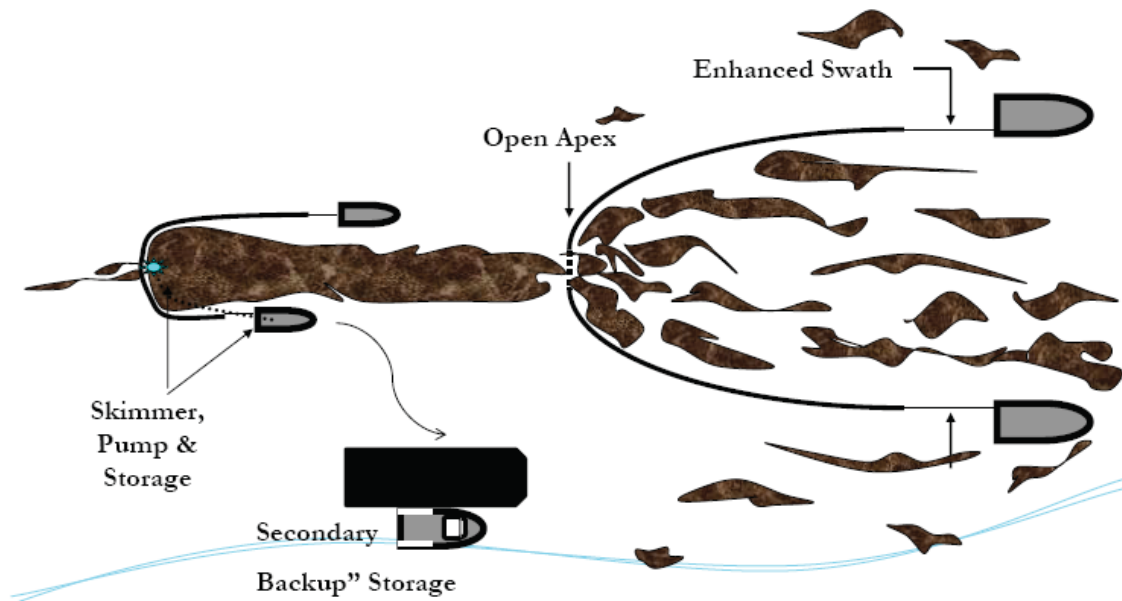
Mechanical Recovery – Deployed on large vessels of opportunity (VOO) the Koseq Rigid Sweeping Arms are high volume surge capacity deployed to increase recovery capacity at the source of a large oil spill in the offshore and outer nearshore environment of the Gulf of Mexico. They are highly mobile and sustainable in rougher sea conditions than normal skimming vessels (9.8' seas). The large Offshore Supply Vessels (OSV) required to deploy the Arms are able to remain on scene for extended periods, even when sea conditions pick up. Temporary storage on deck in portable tanks usually provides between 1,000 and 3,000 bbls. In most cases, the OSV will be able to pump 20% of its deadweight into the liquid mud tanks in accordance with the vessels Certificate of Inspection (COI). All storage can be offloaded utilizing the vessels liquid transfer system.

Maximum Sea Conditions - Under most circumstances the larger OSVs are capable of remaining on scene well past the Skimming Arms maximum sea state of 9.8'. Ultimately it will be the decision of the VOO Captain, with input from the T&T Supervisor onboard, to determine when the sea conditions have exceeded the safe operating conditions of the vessel.

Command and Control – The large OSVs in many cases have state of the art communication and electronic systems, as well as the accommodations to support the function of directing all skimming operations offshore and reporting back to the command post.

Possible Task Force Configuration (Multiple Koseq VOOs can be deployed in a task force)

- 1 – $\geq 200'$ Offshore Supply Vessels (OSV) with set of Koseq Arms
- 2 to 4 portable storage tanks (500 bbl)
- 1 – Modular Crane Pedestal System set (MCPS) or 30 cherry picker (crane) for deployment
- 1 – Tank barge (offshore) for temporary storage
- 1 – Utility/Crewboat (supply)
- 1 – Designated spotter aircraft
- 4 – Personnel (4 T&T OSRO)



Scattered oil is “caught” by two VOO and collected at the apex of the towed sea boom. The oil moves through a “gate” at that apex, forming a larger stream of oil which moves into the boom of the skimming vessel. Operations are paced at >1 . A recovered oil barge stationed nearby to minimize time taken to offload recovered oil.





This is a depiction of the same operation as above but using KOSEQ Arms. In this configuration, the collecting boom speed dictates the operational pace at ≥ 1 knot to minimize entrainment of the oil.

Clean Gulf Associates (CGA) Procedure for Accessing Member-Contracted and other Vessels of Opportunity (VOOs) for Spill Response

- CGA has procedures in place for CGA member companies to acquire vessels of opportunity (VOOs) from an existing CGA member's contracted fleet or other sources for the deployment of CGA portable skimming equipment including Koseq Arms, Fast Response Units (FRUs) and any other portable skimming system(s) deemed appropriate for the response for a potential or actual oil spill, WCD oil spill or a Spill of National Significance (SONS).
- CGA uses Port Vision, a web-based vessel and terminal interface that empowers CGA to track vessels through Automatic Identification System (AIS) and terminal activities using a Geographic Information System (GIS). It provides live AIS/GIS views of waterways showing current vessel positions, terminals, created vessel fleets, and points-of-interest. Through this system, CGA has the ability to get instant snapshots of the location and status of all vessels contracted to CGA members, day or night, from any web-enabled PC.

Near Shore Response Actions

Timing

- Put near shore assets on standby and deployment in accordance with planning based on the actual situation, actual trajectories and oil budgets
- VOO identification and training in advance of spill nearing shoreline if possible
- Outfitting of VOOs for specific missions
- Deployment of assets based on actual movement of oil

Considerations

- Water depth, vessel draft
- Shoreline gradient
- State of the oil
- Use of VOOs
- Distance of surf zone from shoreline

Surveillance

- Provide trained observer to direct skimming operations
- Continual surveillance of oil movement by remote sensing systems, aerial photography and visual confirmation
- Continual monitoring of vessel assets

Dispersant Use

- Generally will not be approved within 3 miles of shore or with less than 10 meters of water depth
- Approval would be at Regional Response Team level (Region 6)

Dedicated Near Shore skimming systems

- FRVs
- Egmpol and Marco SWS
- Operate with aerial spotter directing systems to observed oil slicks

VOO

- Use LLOG's contracted resources as applicable
- Industry vessel are usually best for deployment of Vessel of Opportunity Skimming Systems (VOSS)
- Acquire additional resources as needed

- Consider use of local assets, i.e. fishing and pleasure craft
- Expect mission specific and safety training to be required
- Plan with the US Coast Guard for vessel inspections
- Operate with aerial spotter directing systems to oil patches

Shoreline Protection Operations

Response Planning Considerations

- Review appropriate Area Contingency Plan(s)
- Locate and review appropriate Geographic Response and Site Specific Plans
- Refer to appropriate Environmentally Sensitive Area Maps
- Capability for continual analysis of trajectories run periodically during the response
- Environmental risk assessments (ERA) to determine priorities for area protection
- Time to acquire personnel and equipment and their availability
- Refer to the State of Louisiana Initial Oil Spill Response Plan, Deep Water Horizon, dated 2 May 2010, as a secondary reference
- Aerial surveillance of oil movement
- Pre-impact beach cleaning and debris removal
- Shoreline Cleanup Assessment Team (SCAT) operations and reporting procedures
- Boom type, size and length requirements and availability
- Possibility of need for In-situ burning in near shore areas
- Current wildlife situation, especially status of migratory birds and endangered species in the area
- Check for Archeological sites and arrange assistance for the appropriate state agency when planning operations that may impact these areas

Placement of boom

- Position boom in accordance with the information gained from references listed above and based on the actual situation
- Determine areas of natural collection and develop booming strategies to move oil into those areas
- Assess timing of boom placement based on the most current trajectory analysis and the availability of each type of boom needed. Determine an overall booming priority and conduct booming operations accordingly. Consider:
 - Trajectories
 - Weather forecast
 - Oil Impact forecast
 - Verified spill movement
 - Boom, manpower and vessel (shallow draft) availability
 - Near shore boom and support material, (stakes, anchors, line)

Beach Preparation - Considerations and Actions

- Use of a 10 mile go/no go line to determine timing of beach cleaning
- SCAT reports and recommendations
- Determination of archeological sites and gaining authority to enter
- Monitoring of tide tables and weather to determine extent of high tides
- Pre cleaning of beaches by moving waste above high tide lines to minimize waste
- Determination of logistical requirements and arranging of waste removal and disposal
- Staging of equipment and housing of response personnel as close to the job site as possible to maximize on-site work time
- Boom tending, repair, replacement and security (use of local assets may be advantageous)
- Constant awareness of weather and oil movement for resource re-deployment as necessary
- Earthen berms and shoreline protection boom may be considered to protect sensitive inland areas
- Requisitioning of earth moving equipment
- Plan for efficient and safe use of personnel, ensuring:
 - A continual supply of the proper Personal Protective Equipment
 - Heating or cooling areas when needed
 - Medical coverage
 - Command and control systems (i.e. communications)
 - Personnel accountability measures
- Remediation requirements, i.e., replacement of sands, rip rap, etc.
- Availability of surface washing agents and associated protocol requirements for their use (see National Contingency Plan Product Schedule for list of possible agents)
- Discussions with all stakeholders, i.e., landowners, refuge/park managers, and others as appropriate, covering the following:
 - Access to areas
 - Possible response measures and impact of property and ongoing operations
 - Determination of any specific safety concerns
 - Any special requirements or prohibitions
 - Area security requirements
 - Handling of waste
 - Remediation expectations
 - Vehicle traffic control
 - Domestic animal safety concerns
 - Wildlife or exotic game concerns/issues

Considerations and Actions

- All considered response methods will be weighed against the possible damage they may do to the marsh. Methods will be approved by the Unified Command only after discussions with local Stakeholder, as identified above.
 - In-situ burn may be considered when marshes have been impacted
- Passive cleanup of marshes should be considered and appropriate stocks of sorbent boom and/or sweep obtained.
- Response personnel must be briefed on methods to traverse the marsh, i.e.,
 - use of appropriate vessel
 - use of temporary walkways or roadways
- Discuss and gain approval prior cutting or moving vessels through vegetation
- Discuss use of vessels that may disturb wildlife, i.e, airboats
- Safe movement of vessels through narrow cuts and blind curves
- Consider the possibility that no response in a marsh may be best
- In the deployment of any response asset, actions will be taken to ensure the safest, most efficient operations possible. This includes, but is not limited to:
 - Placement of recovered oil or waste storage as near to vessels or beach cleanup crews as possible.
 - Planning for stockage of high use items for expeditious replacement
 - Housing of personnel as close to the work site as possible to minimize travel time
 - Use of shallow water craft
 - Use of communication systems appropriate ensure command and control of assets
 - Use of appropriate boom in areas that I can offer effective protection
 - Planning of waste collection and removal to maximize cleanup efficiency
- Consideration or on-site remediation of contaminated soils to minimize replacement operations and impact on the area

Decanting Strategy

Recovered oil and water mixtures will typically separate into distinct phases when left in a quiescent state. When separation occurs, the relatively clean water phase can be siphoned or decanted back to the recovery point with minimal, if any, impact. Decanting therefore increases the effective on-site oil storage capacity and equipment operating time. FOSC/SOSC approval will be requested prior to decanting operations. This practice is routinely used for oil spill recovery.

CGA Equipment Limitations

The capability for any spill response equipment, whether a dedicated or portable system, to operate in differing weather conditions will be directly in relation to the capabilities of the vessel the system is placed on. Most importantly, however, the decision to operate will be based on the judgment of the Unified Command and/or the Captain of the vessel, who will ultimately have the final say in terminating operations. Skimming equipment listed below may have operational limits which exceed those safety thresholds. As was seen in the Deepwater Horizon (DWH) oil spill response, vessel skimming operations ceased when seas reached 5-6 feet and vessels were often recalled to port when those conditions were exceeded. Systems below are some of the most up-to-date systems available and were employed during the DWH spill.

Boom	3 foot seas, 20 knot winds
Dispersants	Winds more than 25 knots Visibility less than 3 nautical miles Ceiling less than 1,000 feet.
FRU	8 foot seas
HOSS Barge/OSRB	8 foot seas
Koseq Arms	8 foot seas
OSRV	4 foot seas

Environmental Conditions in the GOM

Prevailing winds, waves and currents along the Texas coast are from the southeast and northeast quadrants. Ten to 20 foot waves may occur during hurricanes. The combined effect of the winds, surface currents, and waves refracting shoreward produce the prevailing westerly longshore currents.

Tides are semi-diurnal and diurnal, and range in height from less than 1 foot to 2.5 feet. The direction, force, and duration of the wind has a considerable effect on the tides and currents. Fifteen foot tides may be expected during severe hurricanes and very low tides may accompany strong northerlies of long duration.

Surface water temperature averages slightly less than 90° F and ranges between 80 and 100° F during the late summer. During the winter the average is slightly less than 60° F and the range is between 35 and 80° F.

The Atlantic and Gulf of Mexico hurricane season is officially from 1 June to 30 November. 97% of all tropical activity occurs within this window. The Atlantic basin shows a very peaked season from August through October, with 78% of the tropical storm days, 87% of the minor (Saffir-Simpson Scale categories 1 and 2) hurricane days, and 96% of the major (Saffir-Simpson categories 3, 4 and 5) hurricane days occurring then. Maximum activity is in early to mid-September. Once in every few years there may be a hurricane occurring "out of season" - primarily in May or December. Globally, September is the most active month and May is the least active month.

**FIGURE 1
TRAJECTORY BY LAND SEGMENT**

<p>Trajectory of a spill and the probability of it impacting a land segment have been projected utilizing LLOG’s WCD and information in the BOEM Oil Spill Risk Analysis Model (OSRAM) for the Central and Western Gulf of Mexico available on the BOEM website using 30 day impact. The results are tabulated below.</p>				
Area/Block	OCS-G	Launch Area	Land Segment and/or Resource	Conditional Probability (%)
<p>AC 336</p> <p>AC 336, Well Location A</p> <p><i>160 miles from shore</i></p>	G36102	W024	<p>Cameron, TX</p> <p>Willacy, TX</p> <p>Kenedy, TX</p> <p>Kleberg, TX</p> <p>Nueces, TX</p> <p>Aransas, TX</p> <p>Calhoun, TX</p> <p>Matagorda, TX</p> <p>Brazoria, TX</p> <p>Galveston, TX</p> <p>Jefferson, TX</p> <p>Cameron, LA</p> <p>Vermilion, LA</p>	<p>3</p> <p>1</p> <p>4</p> <p>3</p> <p>3</p> <p>3</p> <p>4</p> <p>8</p> <p>2</p> <p>4</p> <p>2</p> <p>3</p> <p>1</p>

WCD Scenario– BASED ON WELL BLOWOUT DURING DRILLING OPERATIONS (160 miles from shore)

18,565bbls of crude oil (Volume considering natural weathering)

API Gravity 35°

FIGURE 2 – Equipment Response Time to AC 336, Location A

Dispersants/Surveillance

Dispersant/Surveillance	Dispersant Capacity (gal)	Persons Req.	From	Hrs to Procure	Hrs to Loadout	Travel to site	Total Hrs
ASI							
Basler 67T	2000	2	Houma	2	2	1.2	5.2
DC 3	1200	2	Houma	2	2	1.6	5.6
Aero Commander	NA	2	Houma	2	2	1.2	5.2
MSRC							
737-500	4,125	4	Weyers Cave	4	0	2.1	6.1

Offshore Response

Offshore Equipment Pre-Determined Staging	EDRC	Storage Capacity	VOO	Persons Required	From	Hrs to Procure	Hrs to Loadout	Hrs to GOM	Travel to Spill Site	Hrs to Deploy	Total Hrs
CGA											
HOSS Barge	76285	4000	3 Tugs	8	Harvey	6	0	10	60	2	78
95' FRV	22885	249	NA	6	Galveston	2	0	2	10	1	15
95' FRV	22885	249	NA	6	Leeville	2	0	2	16	1	21
95' FRV	22885	249	NA	6	Venice	2	0	2	18	1	23
95' FRV	22885	249	NA	6	Vermilion	2	0	2	12	1	17
Boom Barge (CGA-300) 42" Auto Boom (25000')	NA	NA	1 Tug 50 Crew	4 (Barge) 2 (Per Crew)	Leeville	8	0	4	55	2	69

Recovered Oil Storage Pre-Determined Staging	EDRC	Storage Capacity	VOO	Persons Required	From	Hrs to Procure	Hrs to Loadout	Hrs to GOM	Travel to Spill Site	Hrs to Deploy	Total Hrs
Enterprise Marine Services LLC (Available through contract with CGA)											
CTCo 2603	NA	25000	1 Tug	6	Amelia	6	0	6	35	1	48
CTCo 2604	NA	20000	1 Tug	6	Amelia	6	0	6	35	1	48
CTCo 2605	NA	20000	1 Tug	6	Amelia	6	0	6	35	1	48
CTCo 2606	NA	20000	1 Tug	6	Amelia	6	0	6	35	1	48
CTCo 2607	NA	23000	1 Tug	6	Amelia	6	0	6	35	1	48

Recovered Oil Storage Pre-Determined Staging	EDRC	Storage Capacity	VOO	Persons Required	From	Hrs to Procure	Hrs to Loadout	Hrs to GOM	Travel to Spill Site	Hrs to Deploy	Total Hrs
Kirby Offshore (available through contract with CGA)											
RO Barge	NA	80000+	1 Tug	6	Venice	20	0	4	35	1	60
RO Barge	NA	80000+	1 Tug	6	Venice	20	0	4	35	1	60
RO Barge	NA	80000+	1 Tug	6	Venice	20	0	4	35	1	60
RO Barge	NA	150000+	1 Tug	6	Venice		0	4		1	60
RO Barge	NA	160000+	1 Tug	6	Venice	20	0	4	35	1	60

Offshore Equipment Pre-determined Staging	EDRC	Storage Capacity	VOO	Persons Required	From	Hrs to Procure	Hrs to Loadout	Hrs to GOM	Travel to Spill Site	Hrs to Deploy	Total Hrs
MSRC											
Gulf Coast Responder Transrec 350 + OSRV 2,640' 67" Curtain Pressure Boom	10567	4000	NA	11	Lake Charles, LA	2	1	4	12	1	20
Texas Responder Transrec 350 + OSRV 2,640' 67" Curtain Pressure Boom	10567	4000	NA	11	Galveston, TX	2	1	1	10	1	15
MSRC 570 Offshore Barge 2 Crucial Disk 88/30 2,640' 67" Curtain Pressure Boom	22244	56900	3 Tugs	9	Galveston, TX	4	1	2	20	1	28
Southern Responder Transrec 350 + OSRV 2,640' 67" Curtain Pressure Boom	10567	4000	NA	11	Ingleside, TX	2	1	2	8	1	14
MSRC 403 Offshore Barge 1 Crucial Disk 88/30 2,640' 67" Curtain Pressure Boom	11122	40300	3 Tugs	9	Ingleside, TX	4	1	3	14	1	23

Staging Area: Ingleside

Offshore Equipment With Staging	EDRC	Storage Capacity	VOO	Persons Req.	From	Hrs to Procure	Hrs to Loadout	Travel to Staging	Travel to Site	Hrs to Deploy	Total Hrs
T&T Marine (available through direct contract with CGA)											
Aqua Guard Triton RBS (1)	22323	2000	1 Utility	6	Galveston	4	12	6	14	2	38
Koseq Skimming Arms (10) Lamor brush	228850	10000	5 OSV	30	Galveston	24	24	6	14	2	70
Koseq Skimming Arms (6) MariFlex 150 HF	108978	6000	3 OSV	18	Galveston	24	24	6	14	2	70
CGA											
FRU (2) + 100 bbl Tank (4)	8502	400	2 Utility	12	Vermilion	2	6	12	12	1	33
FRU (1) + 100 bbl Tank (2)	4251	200	1 Utility	6	Galveston	2	6	6	12	1	27
FRU (1) + 100 bbl Tank (2)	4251	200	1 Utility	6	Aransas Pass	2	6	2	12	1	23

Staging Area: Ingleside

Offshore Equipment Preferred Staging	EDRC	Storage Capacity	VOO	Persons Req.	From	Hrs to Procure	Hrs to Loadout	Travel to Staging	Travel to Site	Hrs to Deploy	Total Hrs
MSRC											
Crucial Disk 56/30 Skimmer (1)	5671	400	1 Utility	6	Ingleside	1	2	1	12	1	17
GT-185 Skimmer w Adaptor (1)	1371	400	1 Utility	6	Ingleside	1	2	1	12	1	17
Foilex 250 Skimmer (1)	3977	400	1 Utility	6	Ingleside	1	2	1	12	1	17
Stress I Skimmer (1)	15840	400	1 Utility	6	Ingleside	1	2	1	12	1	17
Walosep W4 Skimmer (1)	3017	400	1 Utility	6	Ingleside	1	2	1	12	1	17
Crucial Disk 88/30 Skimmer (1)	11122	1000	1 PSV	9	Galveston	1	2	6	12	1	22
Crucial Disk 88/30 Skimmer (1)	11122	1000	1 PSV	9	Galveston	1	2	6	12	1	22
GT-185 Skimmer w Adaptor (2)	2742	400	2 Utility	12	Galveston	1	2	6	12	1	22
Walosep 4 Skimmer (1)	3017	400	1 Utility	6	Galveston	1	2	6	12	1	22
Foilex 250 Skimmer (1)	3977	400	1 Utility	6	Galveston	1	2	6	12	1	22
Stress I Skimmer (1)	15840	400	1 Utility	6	Galveston	1	2	6	12	1	22
GT-185 Skimmer w Adaptor (1)	1371	400	1 Utility	6	Port Arthur	1	2	15	12	1	31

Offshore Equipment Preferred Staging	EDRC	Storage Capacity	VOO	Persons Req.	From	Hrs to Procure	Hrs to Loadout	Travel to Staging	Travel to Site	Hrs to Deploy	Total Hrs
CGA											
Hydro-Fire Boom	NA	NA	8 Utility	40	Harvey	0	24	2	30	6	62
MSRC											
67" Curtain Pressure Boom	NA	NA	80*	160	Houston	1	2	12	15	1	31
1000' Fire Resistant Boom	NA	NA	3*	6	Galveston	1	4	13	10	6	34
16000' Fire Resistant Boom	NA	NA	3*	6	Houston	1	4	12	15	6	38
2000' Hydro Fire Boom	NA	NA	8*	8	Lake Charles	1	4	8	25	6	44

* Utility Boats, Crew Boats, Supply Boats, or Fishing Vessels

Nearshore Response

Nearshore Equipment Pre-determined Staging	EDRC	Storage Capacity	VOO	Persons Required	From	Hrs to Procure	Hrs to Loadout	Hrs to GOM	Travel to Spill Site	Hrs to Deploy	Total Hrs
CGA											
Mid-Ship SWS	22885	249	NA	4	Leeville	2	0	N/A	48	1	51
Mid-Ship SWS	22885	249	NA	4	Venice	2	0	N/A	48	1	51
Mid-Ship SWS	22885	249	NA	4	Galveston	2	0	N/A	48	1	51
Trinity SWS	21500	249	NA	4	Leeville	2	0	N/A	48	1	51
Trinity SWS	21500	249	NA	4	Lake Charles	2	0	N/A	48	1	51
Trinity SWS	21500	249	NA	4	Vermilion	2	0	N/A	48	1	51
Trinity SWS	21500	249	NA	4	Galveston	2	0	N/A	48	1	51
46' FRV	15257	65	NA	4	Aransas Pass	2	0	2	2	1	7
46' FRV	15257	65	NA	4	Leeville	2	0	2	17	1	22
46' FRV	15257	65	NA	4	Lake Charles	2	0	2	10	1	15
46' FRV	15257	65	NA	4	Venice	2	0	2	22	1	27
Mid-Ship SWS	22885	249	NA	4	Galveston	2	0	N/A	48	1	51
Trinity SWS	21500	249	NA	4	Galveston	2	0	N/A	48	1	51
46' FRV	15257	65	NA	4	Aransas Pass	2	0	2	2	1	7
46' FRV	15257	65	NA	4	Lake Charles	2	0	2	10	1	15
MSRC											
30 ft. Kvichak <i>Marco I Skimmer (1)</i>	3588	24	NA	6	Ingleside	1	1	2	1	0	5
30 ft. Kvichak <i>Marco I Skimmer (1)</i>	3588	24	NA	6	Galveston	1	1	2	6	0	10
MSRC Quick Strike 2 LORI Brush Pack	5000	50	NA	6	Lake Charles	2	0	1	15	1	19
Enterprise Marine Services LLC (Available through contract with CGA)											
CTCo 2608	NA	23000	1 Tug	6	Amelia	11	0	6	30	1	48
CTCo 2609	NA	23000	1 Tug	6	Amelia	11	0	6	30	1	48
CTCo 5001	NA	47000	1 Tug	6	Amelia	11	0	6	30	1	48
Kirby Offshore (available through contract with CGA)											
RO Barge	NA	80000+	1 Tug	6	Venice	20	0	4	31	1	60
RO Barge	NA	100000+	1 Tug	6	Venice	20	0	4	31	1	60
RO Barge	NA	100000+	1 Tug	6	Venice	20	0	4	31	1	60

Staging Area: Ingleside

Nearshore Equipment With Staging	EDRC	Storage Capacity	VOO	Persons Req.	From	Hrs to Procure	Hrs to Load Out	Travel to Staging	Travel to Deployment	Hrs to Deploy	Total Hrs
CGA											
SWS Egmopol	1810	100	NA	3	Galveston	2	2	6	2	1	13
Foilex Skim Package (TDS 150)	1131	50	NA	3	Galveston	4	12	6	2	2	26
MSRC											
WP 1 Skimmer (1)	3017	400	1 Utility	4	Ingleside	1	1	9.5	2	0	13.5
Queensboro Skimmer (1)	905	400	1 Utility	4	Galveston	1	1	5	2	0	9
Queensboro Skimmer (5)	4525	2000	5 Utility	20	Lake Charles	1	1	1	2	0	5
AardVac Skimmer (1)	3840	400	1 Utility	4	Lake Charles	1	1	1	2	0	5

Shoreline Protection

Shoreline Protection Boom	VOO	Persons Req.	Storage/Warehouse Location	Hrs to Procure	Hrs to Loadout	Travel to Ingleside	Travel to Deployment Site	Hrs to Deploy	Total Hrs
MSRC									
50' 18" Boom	1 Crew	2	Port Arthur, TX	1	1	9	2	3	16
150' 18" Boom	1 Crew	2	Galveston, TX	1	1	6	2	3	13
50' 18" Boom	1 Crew	2	Ingleside, TX	1	1	1	2	3	8
9,700' 18" Boom	5 Crew	10	Lake Charles, LA	1	1	12	2	3	19
100' 18" Boom	1 Crew	2	Belle Chasse, LA	1	1	16	2	3	23

Shoreline Protection Boom	VOO	Persons Req.	Storage/Warehouse Location	Hrs to Procure	Hrs to Loadout	Travel to Ingleside	Travel to Deployment Site	Hrs to Deploy	Total Hrs
OMI Environmental (available through MSA)									
3,500' 18" Boom	2 Crew	4	Belle Chasse, LA	1	1	16	2	3	23
2,000' 18" Boom	1 Crew	2	Sulfur, LA	1	1	16	2	3	23
4,100' 18" Boom	1 Crew	2	Gonzalez, LA	1	1	14	2	3	21
10,000' 18" Boom	5 Crew	10	Harvey, LA	1	1	16	2	3	23
14,000' 18" Boom	6 Crew	12	Cut Off, LA	1	1	15	2	3	22
2,300' 18" Boom	2 Crew	4	Morgan City, LA	1	1	14	2	3	21
32,200' 18" Boom	10 Crew	20	New Iberia, LA	1	1	13	2	3	20
3,500' 18" Boom	1 Crew	2	Venice, LA	1	1	18	2	3	25
16,000' 18" Boom	6 Crew	12	Deer Park, TX	1	1	6	2	3	13
6,100' 18" Boom	3 Crew	6	La Marque, TX	1	1	6	2	3	13
20,000' 18" Boom	6 Crew	12	Port Arthur, TX	1	1	9	2	3	16

Wildlife Response	EDRC	Storage Capacity	VOO	Persons Req.	From	Hrs to Procure	Hrs to Loadout	Travel to Staging	Travel to Deployment	Hrs to Deploy	Total Hrs
CGA											
Wildlife Support Trailer	NA	NA	NA	2	Harvey	2	2	3	1	2	10
Bird Scare Guns (24)	NA	NA	NA	2	Harvey	2	2	3	1	2	10
Bird Scare Guns (12)	NA	NA	NA	2	Galveston	2	2	12	1	2	19
Bird Scare Guns (12)	NA	NA	NA	2	Aransas Pass	2	2	16.5	1	2	23.5
Bird Scare Guns (48)	NA	NA	NA	2	Lake Charles	2	2	7	1	2	14
Bird Scare Guns (24)	NA	NA	NA	2	Leeville	2	2	2	1	2	9

Response Asset	Total (bbls)
Offshore EDRC	689,114
Offshore Recovered Oil Storage	796,996+
Nearshore / Shallow Water EDRC	317,986
Nearshore / Shallow Water Recovered Oil Storage	379,079+

APPENDIX I
ENVIRONMENTAL MONITORING INFORMATION
(30 CFR PART 550.221 AND 550.252)

E. **Monitoring Systems**

LLOG subscribes to StormGeo Weather Service which provides access to real-time weather conditions and provides periodic updates on impending inclement weather conditions such as tropical depressions, storms and/or hurricanes entering the Gulf of Mexico.

LLOG also relies on the National Weather Service to support the aforementioned subscribed service. During impending inclement weather conditions, LLOG closely coordinates the activity with our contractors and field personnel to ensure the safety of people for evacuation; measures to prepare the facility for evacuation to ensure protection of the environment and the facility/equipment.

Alaminos Canyon Block 337 are in water depths greater than 400 meters (1,312’); therefore, LLOG will follow the guidelines of the applicable NTL 2018-G01 by monitoring and gathering ocean current data using Acoustic Doppler Current Profile (ADCP) while the MODU is on location.

E. **Incidental Takes**

LLOG is sensitive to the marine life and the environment we work in, especially regarding activities in or around the moon pool. LLOG will implement and adhere to, the BSEE NTL No. 2015-G03 “Marine Trash and Debris Awareness Training and Elimination” and BOEM NTL No. 2016-G01 “Vessel Strike Avoidance and Injured/Dead Protected Species Reporting”, and BOEM NTL No. 2016-G02 “Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program”. Moon pool daily observation log shall be maintained on the bridge. The deck supervisor on tour shall go to the bridge and log time, date, and results of each moon pool inspection. STOP WORK AUTHORITY shall be used and implemented, in a safe and timely manner, for any work that could affect marine life listed on the Endangered Species Act.

LLOG will operate in accordance with the regulations, agency guidance, and Appendix B of the National Marine Fisheries Service Endangered Species Act (ESA) Section 7 Biological Opinion, and also avoid accidental loss of solid waste items by maintaining waste management plans, manifesting trash sent to shore, and using special precautions such as covering outside trash bins to prevent accidental loss of solid waste. Special caution will be exercised when handling and disposing of small items and packaging materials, particularly those made of non-biodegradable, environmentally persistent

materials such as plastic or glass. LLOG will collect and remove flotsam resulting from activities related to proposed operations.

Informational placards will be posted on all vessels and facilities having sleeping or food preparation capabilities. All offshore personnel, including contractors and other support services-related personnel (e.g. helicopter pilots, vessel captains and boat crews) will be indoctrinated on waste procedures, and will view the video (or Microsoft PowerPoint presentation), “Think About It” (previously “All Washed Up: The Beach Litter Problem”). Thereafter, all personnel will view the marine trash and debris training video annually. Offshore personnel will also receive an explanation from LLOG management or the designated lease operator management that emphasizes their commitment to waste management in accordance with NTL No. 2015-G03-BSEE.

Contract vessel operators can avoid marine mammals and reduce potential deaths by maintaining a vigilant watch for marine mammals and maintaining a safe distance of 91 meters or greater from whales and a distance of 45 meters or greater from small cetaceans. When assemblages of cetaceans are observed vessel speeds will be reduced to 10 knots or less. Vessel personnel should use a Gulf of Mexico reference guide to help identify the twenty-one species of whales and dolphins, and the single species of manatee that may be encountered in the Gulf of Mexico OCS. Contract vessel operators will comply with the measures included in Appendix C of the NMFS Biological Opinion, BOEM NTL 2016-G01 “Vessel Strike Avoidance and Injured/Dead Protected Species Reporting” and requirements of the Protected Species Lease Stipulation, except under extraordinary circumstances when the safety of the vessel or crew is in doubt or the safety of life at sea is in question.

Vessel personnel must report sightings of any injured or dead protected marine mammal species immediately, regardless of whether the injury or death is caused by their vessel, to the NMFS Southeast Marine Mammal Stranding Hotline at (877) WHALE-HELP (877-942-5343). Additional information may be found at the following website: (<https://www.fisheries.noaa.gov/report>). Any injured or dead protected species should also be reported to takereport.nmfs@noaa.gov. In addition, if the injury or death was caused by a collision with the operator’s vessel, an entrapment within the operator’s equipment or vessel (e.g. moon pool), or an entanglement within the operator’s equipment, the operator must further notify BOEM and BSEE within 24 hours of the strike or entrapment/entanglement by email to protectedspecies@boem.gov and protectedspecies@bsee.gov. If the vessel is the responsible party, it is required to remain available to assist the respective salvage and stranding network as needed.

These proposed operations may utilize a moon pool(s) to conduct various subsea activities. LLOG’s contractor or company representative will provide a dedicated crew member to monitor and continually survey the moon pool area during the operations for sea turtles. If any sea turtle is detected in the moon pool, LLOG will cease operations and contact NMFS at nmfs.psoreview@noaa.gov and BSEE at protectedspecies@bsee.gov and 985-722-7902 for additional guidance and incidental report information. The procedures found in Appendix J of the NMFS Biological Opinion will be employed to free entrapped or entangled marine life safely.

The specific rig that will be used in the proposed operations has not been identified. A deepwater drilling rig, most likely a dual activity dynamically positioned Drillship with a moonpool will be necessary for the operations. Moonpools on Drillships range in size from 35ft to 45ft in width and 70ft to 130ft in length. The moonpool, located underneath the drilling rig rotary floor, is open to the sea below to allow for passage of wellbore equipment necessary for the construction of the well on the seafloor.

The proposed operations covered by this plan include the drilling and completion of one well. The estimated time to conduct these operations through the moonpool involves approximately 150 drilling days and 150 completion days for the well.

The initial start of each drilling operation consists of 7 days of riserless drilling operations where the drilling tools are tripped in and out through the moonpool to the seabed to drill and install the conductor and surface casings and the subsea wellhead which will be installed 10 feet above the seafloor. After the wellhead is in place and included in this initial 7 day time frame, the Blowout Preventer (BOP) will be run on joints of riser through the moonpool and the BOP will be latched onto the wellhead with the joints of riser pipe extending through the moonpool and connected to the rig floor. The remainder of the drilling operations (193 days) will be conducted through the inside of the riser pipe. The riser pipe will be the only equipment utilized through the moonpool during this time frame. At the end of the drilling operation, the riser and BOP will be retrieved by pulling the equipment through the moonpool and storing on the rig.

The completion operations will involve running the BOP and riser through the moonpool and latching the BOP to the wellhead with joints of riser pipe extending through the moonpool and connected to the rig floor. The entire completion operation will be conducted through the inside of the riser pipe. The riser pipe will be the only equipment utilized through the moonpool during this operation. At the end of the completion, the BOP and riser will be retrieved by pulling the equipment through the moonpool and storing on the rig. The estimated 150 completion days includes 2 days to run the BOP and riser and 2 days to retrieve the equipment.

E. Flower Garden Banks National Marine Sanctuary

This section of the plan is not applicable to the proposed operations.

APPENDIX J
LEASE STIPULATIONS/SPECIAL CONDITIONS INFORMATION
(30 CFR PART 550.222 AND 550.253)

A. Lease Stipulations

Stipulation No 1 – Military Areas

(a) Hold and Save Harmless

Whether compensation for such damage or injury might be due under a theory of strict or absolute liability or otherwise, the lessee assumes all risks of damage or injury to persons or property which occur in, on, or above the Outer Continental Shelf (OCS), and to any persons or to any property of any person or persons who are agents, employees, or invitees of the lessee, its agents, independent contractors, or subcontractors doing business with the lessee in connection with any activities being performed by the lessee in, on, or above the OCS, if such injury or damage to such person or property occurs by reason of the activities of any agency of the United States (U.S.) Government, its contractors or subcontractors, or any of its officers, agents or employees, being conducted as a part of, or in connection with, the programs and activities of the command headquarters listed at the end of this stipulation.

Notwithstanding any limitation of the lessee's liability in Section 14 of the lease, the lessee assumes this risk whether such injury or damage is caused in whole or in part by any act or omission, regardless of negligence or fault, of the U.S. Government, its contractors or subcontractors, or any of its officers, agents, or employees. The lessee further agrees to indemnify and safe harmless the U.S. Government against all claims for loss, damage, or injury sustained by the lessee, or to indemnify and save harmless the U.S. Government against all claims for loss, damage, or injury sustained by the agents, employees, or invitees of the lessee, its agents, or any independent contractors or subcontractors doing business with the lessee in connection with the programs and activities of the aforementioned military installation, whether the same be caused in whole or in part by the negligence or fault of the U.S. Government, its contractors, or subcontractors, or any of its officers, agents, or employees and whether such claims might be sustained under a theory of strict or absolute liability or otherwise.

(b) Electromagnetic Emissions

The lessee agrees to control its own electromagnetic emissions and those of its agents, employees, invitees, independent contractors or subcontractors emanating from individual designated defense warning areas in accordance with requirements specified by the commander of the command headquarters listed in the following

table to the degree necessary to prevent damage to, or unacceptable interference with, Department of Defense flight, testing, or operations activities conducted within individual designated warning areas. Necessary monitoring control and coordination with the lessee, its agents, employees, invitees, independent contractors or subcontractors will be effected by the commander of the appropriate onshore military installation conducting operations in the particular warning area; provided, however, that control of such electromagnetic emissions shall in no instance prohibit all manner of electromagnetic communication during any period of time between a lessee, its agents, employees, invitees, independent contractors or subcontractors and onshore facilities.

(c) Operational

The lessee, when operating or causing to be operated on its behalf, boat, ship or aircraft traffic into the individual designated warning areas, shall enter into an agreement with the commander of the individual command headquarters listed in the following list, upon utilizing and individual designated warning area prior to commencing such traffic. Such an agreement will provide for positive control of boats, ships, and aircraft operating into the warning areas at all times.

W-602 VQ-4
Operations Department
7791 Mercury Road
Tinker AFB, Oklahoma 73145-8704
Telephone (405) 739-5700/5702

Stipulation No. 4 - Protected Species

- A. The Endangered Species Act (16 U.S.C. 1531 et seq.) and the Marine Mammal Protection Act (MMPA) (16 U.S.C. 1361 et seq.) are designed to protect threatened and endangered species and marine mammals and apply to activities on the OCS. The OCS Lands Act (43 U.S.C. 1331, et seq.) provides that the OCS should be made available for expeditious and orderly development subject to environmental safeguards, in a manner which is consistent with the maintenance of competition and other national needs. Both BOEM and BSEE comply with these laws on the OCS.
- B. The lessee and its operators must:
- 1) Collect and remove flotsam resulting from activities related to exploration, development, and production of this lease;
 - 2) Post signs in prominent places on all vessels and platforms used as a result of activities related to exploration, development, and production of this lease detailing the reasons (legal and ecological) why release of debris must be eliminated;
 - 3) Observe for marine mammals and sea turtles while on vessels, reduce vessel speed to 10 knots or less when assemblages of cetaceans are observed, and maintain a distance of 91 meters or greater from whales and a distance of 45 meters or greater from small cetaceans and sea turtles;
 - 4) Employ mitigation measures prescribed by BOEM/BSEE or the National Marine Fisheries Service (NMFS) for all seismic surveys, including the use of an "exclusion zone" based upon the appropriate water depth, ramp-up, and shutdown procedures, visual monitoring, and reporting;
 - 5) Identify important habitats, including designated critical habitat, used by listed species (e.g., sea turtle nesting beaches, piping plover critical habitat), in oil spill contingency planning and require the strategic placement of spill cleanup equipment to be used only by personnel trained in less-intrusive cleanup techniques on beaches and bay shores; and
 - 6) Immediately report all sightings and locations of injured or dead protected species (e.g., marine mammals and sea turtles) to the appropriate stranding network. If oil and gas industry activity is responsible for the injured or dead animal (e.g., because of a vessel strike), the responsible parties should remain available to assist the stranding network. If the injury or death was caused by a collision with the lessee's vessel, the lessee must notify BSEE within 24 hours of the strike.

BOEM and BSEE issue Notices to Lessees and Operators (NTLs), which more fully describe measures implemented in support of the above-mentioned implementing statutes and regulations, as well as measures identified by the U.S. Fish and Wildlife Service and NMFS arising from, among others, conservation recommendations, rulemakings pursuant to the MMPA, or consultation. The lessee and its operators, personnel, and subcontractors, while undertaking activities authorized under this lease,

must implement and comply with the specific mitigation measures outlined in the following NTLs:

- BOEM NTL No. 2016-G01 (Vessel Strike Avoidance and Injured/Dead Protected Species Reporting), (available at <http://www.boem.gov/BOEM-NTL-No-2016-G01>);
- BOEM NTL No. 2016-G02 (Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program)(available at <http://www.boem.gov/BOEM-NTL-2016-G02>); and
- BSEE NTL No. 2015-G03 (Marine Trash and Debris Awareness and Elimination) (available at <https://www.bsee.gov/sites/bsee.gov/files/notices-to-lessees-ntl/alerts/ntl-2015-g03.pdf>).

At the lessee's option, the lessee, its operators, personnel, and contractors may comply with the most current measures to protect species in place at the time an activity is undertaken under this lease, including, but not limited to, new or updated versions of the NTLs identified in this paragraph. The lessee and its operators, personnel, and subcontractors will be required to comply with the mitigation measures, identified in the above referenced NTLs, and any additional measures in the conditions of approvals for their plans or permits.

APPENDIX K
ENVIRONMENTAL MITIGATION MEASURES INFORMATION
(30 CFR Part 550.23 and 550.54)

A. Measures Taken to Avoid, Minimize, and Mitigate Impacts

This section does not apply to the operations as proposed herein.

C. Incidental Takes

LLOG is sensitive to the marine life and the environment we work in, especially regarding activities in or around the moon pool. LLOG will implement and adhere to, the BSEE NTL No. 2015-G03 “Marine Trash and Debris Awareness Training and Elimination”; BOEM NTL No. 2016-G01 “Vessel Strike Avoidance and Injured/Dead Protected Species Reporting”; and BOEM NTL No. 2016-G02 “Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program”. LLOG will also comply with Appendix B, C & J of the Biological Opinion as further stated in Appendix I of this plan.

APPENDIX L
RELATED FACILITIES AND OPERATIONS INFORMATION
(30 CFR PART 550.256)

A. **Produced Liquid Hydrocarbon Transportation Vessels**

Not applicable to proposed operations.

APPENDIX M
SUPPORT VESSELS AND AIRCRAFT INFORMATION
(30 CFR PART 550.224 AND 550.257)

A. General

Personnel involved in the proposed operations will typically use their own vehicles as transportation to and from the selected onshore base; whereas the selected vendors will transport the equipment by a combination of trucks, boats and/or helicopters to the onshore base. The personnel and equipment will then be transported to the drilling rig via the transportation methods and frequencies shown, taking the most direct route feasible as mandated by weather and traffic conditions. Vessel personnel must report sightings of any injured or dead protected marine mammal species immediately, regardless of whether the injury or death is caused by their vessel, to the NMFS Southeast Marine Mammal Stranding Hotline at (877) WHALE-HELP (877-942-5343). Any injured or dead protected species should also be reported to takereport.nmfsser@noaa.gov. In addition, if the injury or death was caused by a collision with the operator’s vessel, an entrapment within the operator’s equipment or vessel (e.g. moon pool), or an entanglement within the operator’s equipment, the operator must further notify BOEM and BSEE within 24 hours of the strike or entrapment / entanglement by email to protectedspecies@boem.gov and protectedspecies@bsee.gov. If the vessel is the responsible party, it is required to remain available to assist the respective salvage and stranding network as needed.

Drillship and DP Semisubmersible Rig:

Type	Maximum Fuel Tank Storage Capacity	Maximum No. in Area at Any Time	Trip Frequency or Duration
Supply Boats	500 bbls	1	Six times weekly
Crew Boats	500 bbls	1	Three times weekly
Aircraft	279 gallons	1	As Needed

B. Diesel Oil Supply Vessels

Size of Fuel Supply Vessel	Capacity of fuel Supply Vessel	Frequency of Fuel Transfers	Route Fuel Supply Vessel Will Take
180’ OSV	1900 bbls	1/weekly	Fourchon, LA to Alaminos Canyon Block 337

C. Drilling Fluids Transportation

See Table 2 – Wastes you will Transport and/or Dispose of Onshore, located in Appendix F of this Plan.

D. Solid and Liquid Wastes Transportation

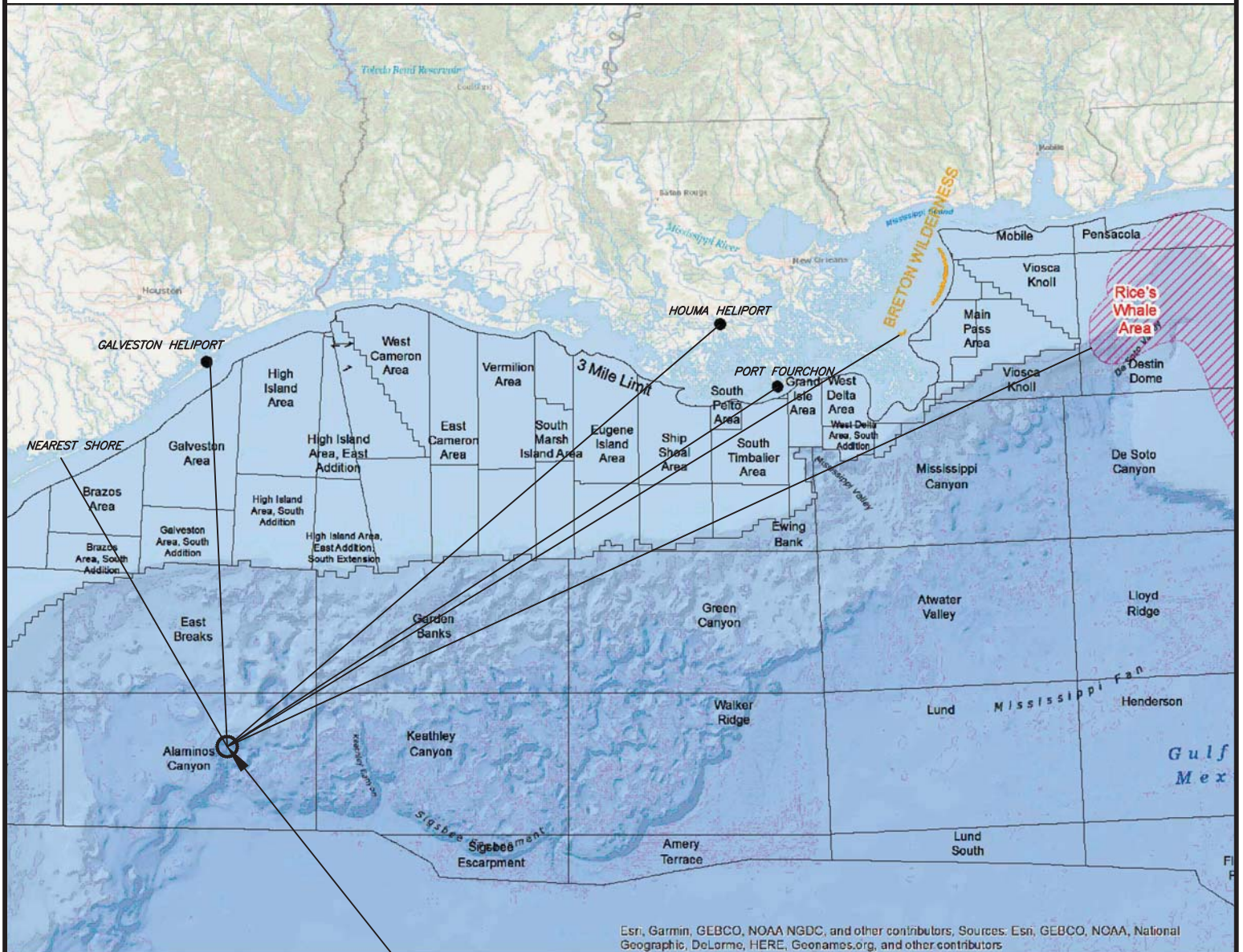
See Table 2 – Wastes you will Transport and/or Dispose of Onshore, located in Appendix F of this Plan.

E. Vicinity Map

The Vicinity Plat showing the location of **Alaminos Canyon Blocks 337** relative to the nearest shoreline and onshore base is included as *Attachment M-1*. Any rigs, vessels, supply boats, etc. utilized for these proposed activities will not transit the Rice’s whale area.

Vicinity Map

Attachment M-1 (Public Information)



Esr, Garmin, GEBCO, NOAA NGDC, and other contributors; Sources: Esr, GEBCO, NOAA, National Geographic, DeLorme, HERE, Geonames.org, and other contributors

SITE OF PROPOSED WELLS

- ~160 STATUTE (139 NAUTICAL) MILES TO MATAGORDA COUNTY (NEAREST SHORE)
COORDINATE TO NEAREST POINT ON SHORELINE X = 741,638 Y = 10,414,572
- ~314 STATUTE (273 NAUTICAL) MILES TO PORT FOURCHON, LA
- ~310 STATUTE (269 NAUTICAL) MILES TO HOUMA HELIPORT, HOUMA, LA
- ~185 STATUTE (160 NAUTICAL) MILES TO GALVESTON HELIPORT, GALVESTON, TX
- ~528 STATUTE (459 NAUTICAL) MILES TO RICE'S WHALE AREA
- ~608 KILOMETERS TO BRETON WILDERNESS

VICINITY MAP

THE DISTANCES SHOWN HEREON ARE FROM THE PROPOSED WELL TO THE NEAREST COASTLINE POINT AS OBTAINED FROM NOAA, ENTITLED NOAA MEDIUM RESOLUTION SHORELINE. <[HTTP://SHORELINE.NOAA.GOV/DATA/DATASHEETS/MEDRES.HTML](http://SHORELINE.NOAA.GOV/DATA/DATASHEETS/MEDRES.HTML)>.

LLOG EXPLORATION OFFSHORE, L.L.C. 		EXPLORATION PLAT PROPOSED WELLS 'F' & 'F' ALT OCS-G36103 BLOCK 337 ALAMINOS CANYON AREA GULF OF MEXICO	
36499 Perkins Road Prairieville, Louisiana 70769 Tel: 225-673-2163		NOT TO SCALE	
DATUM: NAD 27	SPHEROID: CLARKE 1866	PROJECTION: U.T.M.	ZONE: 15
DRAWN BY: RJN	CHK. BY: MEK	REV. No.:	JOB No.: 23-050 DWG No.: 23-050-AC337_EXP F
DATE: 12-27-23	REV. DATE:	SCALE: N.T.S.	SHEET 1 OF 1

APPENDIX N
ONSHORE SUPPORT FACILITIES INFORMATION
(30 CFR PART 550.225 AND 550.258)

A. General

The proposed surface disturbances in **Alaminos Canyon Block 337** will be located approximately 160 statute miles from the nearest Texas shoreline, and approximately 314 statute miles from the following onshore support base and 185 statute miles from PHI Heliport in Galveston, TX and 310 statute miles from the PHI Heliport in Houma, Louisiana and the proposed surface disturbances:

Name	Location	Existing/New/Modified
GIS Yard	Fourchon, LA	Existing
PHI US LLC and/or Bristow US LLC – Heliports	Galveston, TX	Existing
PHI US LLC – Heliport	Houma, LA	Existing

LLOG will use an existing onshore base to accomplish the following routine operations:

- Loading/Offloading point for equipment supporting the offshore operations.
- Dispatching personnel and equipment and does not anticipate the need for any expansion of the selected facilities as a result of the activities proposed in this Revised Plan.
- Temporary storage for materials and equipment.
- 24 Hour Dispatcher

B. Support Base Construction or Expansion

The proposed operations are temporary in nature and do not require any immediate action to acquire additional land or expand existing base facilities.

C. Support Base Construction or Expansion Timetable

This section of the plan is not applicable to the proposed operations.

D. Waste Disposal

See Table 2 – Wastes you will Transport and/or Dispose of Onshore, located in Appendix F of this Plan.

APPENDIX O
COASTAL ZONE MANAGEMENT ACT (CZMA) INFORMATION
(30 CFR PART 550.226 AND 550.260)

A. Consistency Certification

A certificate of Coastal Zone Management Consistency for the States of Louisiana and Texas is not required for supplemental exploratory plans.

APPENDIX P
COASTAL ZONE MANAGEMENT ACT (CZMA) INFORMATION
(30 CFR PART 550.226 AND 550.260)

The EIA was originally submitted by Shell as part of the initial EP N-10128. A copy of the previously submitted EIA is attached for your review (Attachment P-1).

Environmental Impact Analysis

Attachment P-1 (Public Information)

SECTION 18: ENVIRONMENTAL IMPACT ANALYSIS (EIA)

Environmental Impact Analysis

for an

Exploration Plan

Alaminos Canyon Block 335 (OCS-G 36492)

Alaminos Canyon Block 336 (OCS-G 36102)

Alaminos Canyon Block 337 (OCS-G 36103)

Offshore Texas

October 2020

Prepared for:

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P.O. Box 61933
New Orleans, Louisiana 70161
Telephone: (504) 425-6021

Prepared by:

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Acronyms and Abbreviations

§	section	PAH	polycyclic aromatic hydrocarbon
μPa	micropascal	PM	particulate matter
AC	Alaminos Canyon	re	referenced to
ac	acre	SBM	synthetic-based mud
ADIOS	Automated Data Inquiry for Oil Spills	SEL	cumulative sound exposure level
Alt	Alternate	Shell	Shell Offshore Inc.
AQR	Air Quality Emissions Report	SPL	sound pressure level
bbl	barrel	SPL _{rms}	root-mean-square sound pressure level
BOEM	Bureau of Ocean Energy Management	USCG	U.S. Coast Guard
BOP	blowout preventer	USDOJ	U.S. Department of the Interior
BSEE	Bureau of Safety and Environmental Enforcement	USEPA	U.S. Environmental Protection Agency
CFR	Code of Federal Regulations	USFWS	U.S. Fish and Wildlife Service
dB	decibel	VOC	volatile organic compound
DP	dynamic positioning	WBM	water-based drilling muds
DPS	distinct population segment	WCD	worst case discharge
EFH	Essential Fish Habitat		
EIA	Environmental Impact Analysis		
EIS	Environmental Impact Statement		
EP	Exploration Plan		
ESA	Endangered Species Act		
FAD	fish-aggregating device		
FR	Federal Register		
GMFMC	Gulf of Mexico Fishery Management Council		
ha	hectare		
HAPC	Habitat Area of Particular Concern		
IPF	impact-producing factor		
MARPOL	International Convention for the Prevention of Pollution from Ships		
MMC	Marine Mammal Commission		
MMPA	Marine Mammal Protection Act		
MMS	Minerals Management Service		
MODU	mobile offshore drilling unit		
MWCC	Marine Well Containment Company		
NAAQS	National Ambient Air Quality Standards		
nd	no date		
NEPA	National Environmental Policy Act		
NMFS	National Marine Fisheries Service		
NOAA	National Oceanic and Atmospheric Administration		
NPDES	National Pollutant Discharge Elimination System		
NTL	Notice to Lessees and Operators		
NWR	National Wildlife Refuge		
OCS	Outer Continental Shelf		
OCSLA	Outer Continental Shelf Lands Act		
OSRA	Oil Spill Risk Analysis		
OSRP	Oil Spill Response Plan		

Introduction

Project Summary

Shell Offshore Inc. (Shell) is submitting an Exploration Plan (EP) for Alaminos Canyon (AC) Blocks 335 (AC 335), 336 (AC 336), and 337 (AC 337) for 15 wells (A, A-Alt, A-Alt2, B, B-Alt, B2, B2-Alt, C, C-Alt, D, D-Alt, E, E-Alt, E2, and E2-Alt). The Environmental Impact Analysis (EIA) provides information on potential impacts to environmental resources that could be affected by Shell's proposed activities in the project area under this EP.

The project area is in the Western Planning Area, approximately 161 miles (259 km) from the nearest shoreline (Texas), 316 miles (509 km) from the onshore support base at Port Fourchon, Louisiana, and 185 miles (298 km) from the helicopter base in Galveston, Texas. Estimated water depths at the proposed well sites range from approximately 4,414 to 4,604 ft (1,345 to 1,403 m). All distances are in statute miles.

Mobile offshore drilling units (MODUs), which will be either a dynamically positioned (DP) drillship or a DP semisubmersible rig, will be used for this project. Drilling operations are expected to require up to 365 days per well from 2021 to 2024 for AC 335, up to 365 days per year from 2021 to 2025 for AC 336, and up to 365 days per year from 2021 to 2026 for AC 337. The EIA addresses the environmental impacts from the proposed EP activities.

Purpose of the Environmental Impact Analysis

The EIA was prepared pursuant to the requirements of the Outer Continental Shelf Lands Act (OCSLA), 43 United States Code §§ 1331-1356 as well as regulations including 30 Code of Federal Regulations (CFR) § 550.212 and § 550.227. The EIA is a project- and site-specific analysis of Shell's planned activities under this EP.

The EIA presents data, analyses, and conclusions to support the Bureau of Ocean Energy Management (BOEM) reviews as required by the National Environmental Policy Act (NEPA) and other relevant federal laws, including the Endangered Species Act (ESA) and Marine Mammal Protection Act (MMPA). The EIA addresses impact-producing factors (IPFs), resources, and impacts associated with the proposed project activities. It identifies mitigation measures to be implemented in connection with the planned activities. Potential environmental impacts of a blowout scenario and worst-case discharge (WCD) are also analyzed.

Potential impacts have been analyzed at a broader level in the 2017 to 2022 Programmatic Environmental Impact Statement (EIS) for the Outer Continental Shelf (OCS) Oil and Gas Leasing Program (BOEM, 2016a) and in multisale EISs for the Western and Central Gulf of Mexico Planning Areas (BOEM, 2012a,b, 2013, 2014, 2015, 2016b, 2017a).

The most recent multisale EISs update environmental baseline information in light of the Macondo (*Deepwater Horizon*) incident and address potential impacts of a catastrophic spill (BOEM, 2012a,b, 2013, 2014, 2015, 2016b, 2017a). Numerous technical studies have also been conducted to address the impacts of the incident. The findings of the post *Deepwater Horizon* incident studies have been incorporated into this report and are supplemented by site-specific analyses, where applicable. The EIA relies on the analyses from these documents, technical studies, and post *Deepwater Horizon* incident studies, where applicable, to provide BOEM and

other regulatory agencies with the necessary information to evaluate Shell’s EP and ensure that oil and gas exploration activities are performed in an environmentally sound manner, with minimal impacts on the environment.

Outer Continental Shelf Regulatory Framework

The regulatory framework for OCS activities in the Gulf of Mexico is summarized by BOEM in its Final Programmatic EIS for the OCS Oil and Gas Leasing Program for 2017 to 2022 (BOEM, 2016a). Under the OCSLA, the U.S. Department of the Interior (USDOI) is responsible for the administration of mineral exploration and development of the OCS. Within the USDOI, BOEM and the Bureau of Safety and Environmental Enforcement (BSEE) are responsible for managing and regulating the development of OCS oil and gas resources in accordance with the provisions of the OCSLA. The BSEE offshore regulations are in 30 CFR Chapter II, Subchapter B. BOEM offshore regulations are in 30 CFR Chapter V, Subchapter B.

In implementing its responsibilities under the OCSLA and NEPA, BOEM consults numerous federal departments and agencies that have authority to comment on permitting documents under their jurisdiction and maintain ocean resources pursuant to other federal laws. Among these are the U.S. Coast Guard (USCG), U.S. Environmental Protection Agency (USEPA), U.S. Fish and Wildlife Service (USFWS), and the National Oceanic and Atmospheric Administration (NOAA) through the National Marine Fisheries Service (NMFS). Federal laws (e.g., ESA, MMPA, Coastal Zone Management Act of 1972, Magnuson-Stevens Fishery Conservation and Management Act) establish the consultation and coordination processes with federal, state, and local agencies. The NMFS Biological Opinion on the Federally Regulated Oil and Gas Program Activities in the Gulf of Mexico assess impacts and mitigation measures to listed species (NMFS, 2020a).

In addition, Notices to Lessees and Operators (NTLs) are formal documents issued by BOEM and BSEE that provide clarification, description, or interpretation of pertinent regulations or standards. **Table 1** lists and summarizes the NTLs applicable to the EIA.

Table 1. Notices to Lessees and Operators (NTLs) that are applicable to this Environmental Impact Analysis (EIA), ordered from most recent to oldest.

NTL	Title	Summary
BOEM NTL No. 2020-G01	Air Quality Information Requirements for Exploration Plans, Development Operations Coordination Documents, and Development and Production Plans in the Gulf of Mexico Region	Cancels and supersedes the air emission information portion of NTL 2008-G04, Information Requirement for Exploration Plans and Development Operations Coordination Documents, effective date May 5, 2008.

NTL	Title	Summary
BOEM-2016-G01	Vessel Strike Avoidance and Injured/Dead Protected Species Reporting	<p>Recommends protected species identification training; recommends that vessel operators and crews maintain a vigilant watch for marine mammals and slow down or stop their vessel to avoid striking protected species; and requires operators to report sightings of any injured or dead protected species.</p> <p>Reissued in June 2020 to address instances where guidance in the 2020 National Marine Fisheries Service (NMFS) Biological Opinion Appendix C (NMFS, 2020a) replaces compliance with this NTL.</p>
BSEE-2015-G03	Marine Trash and Debris Awareness and Elimination	<p>Instructs operators to exercise caution in the handling and disposal of small items and packaging materials; requires the posting of placards at prominent locations on offshore vessels and structures; and mandates a yearly marine trash and debris awareness training and certification process. Reissued in June 2020 to address instances where guidance in the 2020 NMFS Biological Opinion Appendix B (NMFS, 2020a) replaces compliance with this NTL.</p>
BOEM-2015-N02	Elimination of Expiration Dates on Certain Notice to Lessees and Operators Pending Review and Reissuance	<p>Eliminates the expiration dates on past or upcoming expiration dates from NTLs currently posted on the Bureau of Ocean Energy Management website.</p>
BOEM-2015-N01	Information Requirements for Exploration Plans, Development and Production Plans, and Development Operations Coordination Documents on the Outer Continental Shelf (OCS) for Worst Case Discharge (WCD) Blowout Scenarios	<p>Provides guidance regarding information required in WCD descriptions and blowout scenarios.</p>
BOEM-2014-G04	Military Warning and Water Test Areas	<p>Provides contact links to individual command headquarters for the military warning and water test areas in the Gulf of Mexico.</p>
BSEE-2014-N01	Elimination of Expiration Dates on Certain Notices to Lessees and Operators Pending Review and Reissuance	<p>Eliminates expiration dates (past or upcoming) of all NTLs currently posted on the Bureau of Safety and Environmental Enforcement website.</p>
BSEE-2012-N06	Guidance to Owners and Operators of Offshore Facilities Seaward of the Coast Line Concerning Regional Oil Spill Response Plans	<p>Provides clarification, guidance, and information for preparation of regional Oil Spill Response Plans. Recommends description of response strategy for WCD scenarios to ensure capability to respond to oil discharges is both efficient and effective.</p>
2011-JOINT-G01	Revisions to the List of OCS Blocks Requiring Archaeological Resource Surveys and Reports	<p>Provides new information on which OCS blocks require archaeological surveys and reports and line spacing required in each block. This NTL augments NTL 2005-G07.</p>

NTL	Title	Summary
2010-N10	Statement of Compliance with Applicable Regulations and Evaluation of Information Demonstrating Adequate Spill Response and Well Containment Resources	Informs operators using subsea or surface blowout preventers on floating facilities that applications for well permits must include a statement signed by an authorized company official stating that the operator will conduct all activities in compliance with all applicable regulations, including the increased safety measures regulations (75 <i>Federal Register</i> 63346). Informs operators that the Bureau of Ocean Energy Management will be evaluating whether each operator has submitted adequate information demonstrating that it has access to and can deploy containment resources to promptly respond to a blowout or other loss of well control.
2009-G40	Deepwater Communities Benthic	Provides guidance for avoiding and protecting high-density deepwater benthic communities (including chemosynthetic and deepwater coral communities) from damage caused by OCS oil and gas activities in water depths greater than 984 ft (300 m). Prescribes separation distances of 2,000 ft (610 m) from each mud and cuttings discharge location and 250 ft (76 m) from all other seafloor disturbances.
2009-G39	Biologically Sensitive Underwater Features and Areas	Provides guidance for avoiding and protecting biologically sensitive features and areas (i.e., topographic features, pinnacles, low-relief live bottom areas, and other potentially sensitive biological features) when conducting OCS operations in water depths less than 984 ft (300 m) in the Gulf of Mexico.
2009-N11	Air Quality Jurisdiction on the OCS	Clarifies jurisdiction for regulation of air quality in the Gulf of Mexico OCS.
2008-G04	Information Requirements for Exploration Plans and Development Operations Coordination Documents	Provides guidance on the information requirements for OCS plans, including EIA requirements and information regarding compliance with the provisions of the Endangered Species Act and the Marine Mammal Protection Act.
2005-G07	Archaeological Resource Surveys and Reports	Provides guidance on regulations regarding archaeological discoveries, specifies requirements for archaeological resource surveys and reports, and outlines options for protecting archaeological resources.

Oil Spill Prevention and Contingency Planning

Shell has an approved Gulf of Mexico Regional Oil Spill Response Plan (OSRP) as a fundamental component of the planned drilling program that certifies Shell's capability to respond to the maximum extent practicable to a WCD (30 CFR § 254.2) (see EP Section 9). The OSRP

demonstrates Shell’s capability to rapidly and effectively manage oil spills that may result from drilling operations. Despite the extremely low likelihood of a large oil spill occurring during the project, Shell has designed its response program based on a regional capability of responding to a range of spill volumes that increase from small operational spills to a WCD from a well blowout. Shell’s program is intended to meet the response planning requirements of the relevant coastal states and federal oil spill planning regulations. The OSRP includes information regarding Shell’s regional oil spill organization, dedicated response assets, potential spill risks, and local environmental sensitivities. The OSRP presents specific information on the response program that includes a description of personnel and equipment mobilization, the incident management team organization, and the strategies and tactics used to implement effective and sustained spill containment and recovery operations.

Environmental Impact Analysis Organization

The EIA is organized into **Sections A** through **I** corresponding to the requirements of NTL 2008-G04 (as extended by NTL 2015-N02), which provides guidance regarding information required by 30 CFR Part 550 for EIAs. The main impact-related discussions are in **Section A** (Impact-Producing Factors) and **Section C** (Impact Analysis).

A. Impact-Producing Factors

Based on the description of Shell’s proposed activities, a series of IPFs have been identified. **Table 2** identifies the environmental resources that may be affected in the left column and identifies sources of impacts associated with the proposed project across the top. **Table 2** was adapted from Form BOEM-0142 and developed *a priori* to focus the impact analysis on those environmental resources that may be impacted as a result of one or more IPFs. The tabular matrix indicates which routine activities and accidental events could affect specific resources. An “X” indicates that an IPF could reasonably be expected to affect a certain resource, and a dash (–) indicates no impact or negligible impact. Where there may be an effect, an analysis is provided in **Section C**. Potential IPFs for the proposed activities are listed below and briefly discussed in the following sections.

- MODU presence (including noise and lights);
- Physical disturbance to the seafloor;
- Air pollutant emissions;
- Effluent discharges;
- Water intake;
- Onshore waste disposal;
- Marine debris;
- Support vessel and helicopter traffic; and
- Accidents.

Table 2. Matrix of impact-producing factors and affected environmental resources. X = potential impact on the resource; dash (--) = no impact or negligible impact on the resource.

Environmental Resources	Impact-producing Factors									Accidents	
	MODU Presence (incl. noise & lights)	Physical Disturbance to Seafloor	Air Pollutant Emissions	Effluent Discharges	Water Intake	Onshore Waste Disposal	Marine Debris	Support Vessel/Helicopter Traffic	Small Fuel Spill	Large Oil Spill	
Physical/Chemical Environment											
Air quality	--	--	X(5)	--	--	--	--	--	X(6)	X(6)	
Water quality	--	--	--	X	--	--	--	--	X(6)	X(6)	
Seafloor Habitats and Biota											
Soft bottom benthic communities	--	X	--	X	--	--	--	--	--	X(6)	
High-density deepwater benthic communities	--	--(4)	--	--(4)	--	--	--	--	--	X(6)	
Designated topographic features	--	--(1)	--	--(1)	--	--	--	--	--	--	
Pinnacle trend area live bottoms	--	--(2)	--	--(2)	--	--	--	--	--	--	
Eastern Gulf live bottoms	--	--(3)	--	--(3)	--	--	--	--	--	--	
Threatened, Endangered, and Protected Species and Critical Habitat											
Sperm whale (Endangered)	X(8)	--	--	--	--	--	--	X(8)	X(6,8)	X(6,8)	
Bryde's whale (Endangered)	X(8)	--	--	--	--	--	--	X(8)	X(6,8)	X(6,8)	
West Indian manatee (Endangered)	--	--	--	--	--	--	--	X(8)	--	X(6,8)	
Non-endangered marine mammals (protected)	X	--	--	--	--	--	--	X	X(6)	X(6)	
Sea turtles (Endangered/Threatened)	X(8)	--	--	--	--	--	--	X(8)	X(6,8)	X(6,8)	
Piping Plover (Threatened)	--	--	--	--	--	--	--	--	--	X(6)	
Whooping Crane (Endangered)	--	--	--	--	--	--	--	--	--	X(6)	
Oceanic whitetip shark (Threatened)	X	--	--	--	--	--	--	--	--	X(6)	
Giant manta ray (Threatened)	X	--	--	--	--	--	--	--	--	X(6)	
Gulf sturgeon (Threatened)	--	--	--	--	--	--	--	--	--	X(6)	
Nassau grouper (Threatened)	--	--	--	--	--	--	--	--	--	X(6)	
Smalltooth sawfish (Endangered)	--	--	--	--	--	--	--	--	--	X(6)	
Beach mice (Endangered)	--	--	--	--	--	--	--	--	--	X(6)	
Florida salt marsh vole (Endangered)	--	--	--	--	--	--	--	--	--	X(6)	
Threatened coral species	--	--	--	--	--	--	--	--	--	X(6)	
Coastal and Marine Birds											
Marine birds	X	--	--	--	--	--	--	X	X(6)	X(6)	
Coastal birds	--	--	--	--	--	--	--	X	--	X(6)	
Fisheries Resources											
Pelagic communities and ichthyoplankton	X	--	--	X	X	--	--	--	X(6)	X(6)	
Essential Fish Habitat	X	--	--	X	X	--	--	--	X(6)	X(6)	
Archaeological Resources											
Shipwreck sites	--	--(7)	--	--	--	--	--	--	--	X(6)	
Prehistoric archaeological sites	--	--(7)	--	--	--	--	--	--	--	X(6)	
Coastal Habitats and Protected Areas											
Coastal Habitats and Protected Areas	--	--	--	--	--	--	--	X	--	X(6)	
Socioeconomic and Other Resources											
Recreational and commercial fishing	X	--	--	--	--	--	--	--	X(6)	X(6)	
Public health and safety	--	--	--	--	--	--	--	--	--	X(6)	
Employment and infrastructure	--	--	--	--	--	--	--	--	--	X(6)	
Recreation and tourism	--	--	--	--	--	--	--	--	--	X(6)	
Land use	--	--	--	--	--	--	--	--	--	X(6)	
Other marine uses	--	--	--	--	--	--	--	--	--	X(6)	

Numbers in parentheses refer to table footnotes on the following page. MODU = mobile offshore drilling unit.

Table 2 Footnotes and Applicability:

- (1) *Activities that may affect a marine sanctuary or topographic feature. Specifically, if the well, platform site, or any anchors will be on the seafloor within the following:*
 - (a) *4-mile zone surrounding the Flower Garden Banks, or the 3-mile zone of Stetson Bank;*
 - (b) *1,000-m, 1-mile, or 3-mile zone of any topographic feature (submarine bank) protected by the Topographic Features Stipulation attached to an Outer Continental Shelf (OCS) lease;*
 - (c) *Essential Fish Habitat (EFH) criteria of 500 ft from any no-activity zone; or*
 - (d) *Proximity of any submarine bank (500-ft buffer zone) with relief greater than 2 m that is not protected by the Topographic Features Stipulation attached to an OCS lease.*
 - None of these conditions (a through d) are applicable. The project area is not within the given range (buffer zone) of any marine sanctuary, topographic feature, or no-activity zone. There are no submarine banks in the project area.
- (2) *Activities with any bottom disturbance within an OCS lease block protected through the Live Bottom (Pinnacle Trend) Stipulation attached to an OCS lease.*
 - The Live Bottom (Pinnacle Trend) Stipulation is not applicable to the project area.
- (3) *Activities within any Eastern Gulf OCS block and portions of Pensacola and Destin Dome area blocks in the Central Planning Area where seafloor habitats are protected by the Live Bottom (Low-Relief) Stipulation attached to an OCS lease.*
 - The Live Bottom (Low-Relief) Stipulation is not applicable to the project area.
- (4) *Activities on blocks designated by the Bureau of Ocean Energy Management (BOEM) as being in water depths 300 m or greater.*
 - No impacts on high-density deepwater benthic communities are anticipated. Shallow geohazards assessment found that no features indicative of high-density chemosynthetic communities or coral communities were identified within 2,000 ft (610 m) of the proposed well locations (Geoscience Earth & Marine Services, Inc., 2020a).
- (5) *Exploration or production activities where hydrogen sulfide (H₂S) concentrations greater than 500 parts per million might be encountered.*
 - Alaminos Canyon Blocks 335, 336, and 337 are classified as H₂S “absent”. Based on the H₂S absent classification, no further discussion on H₂S impacts is warranted.
- (6) *All activities that could result in an accidental spill of produced liquid hydrocarbons or diesel fuel that you determine would impact these environmental resources. If the proposed action is located a sufficient distance from a resource that no impact would occur, the Environmental Impact Analysis (EIA) can note that in a sentence or two.*
 - Accidental hydrocarbon spills could affect the resources marked (X) in the matrix, and impacts are analyzed in **Section C**.
- (7) *All activities that involve seafloor disturbances, including anchor emplacements, in any OCS block designated by the BOEM as having high-probability for the occurrence of shipwrecks or prehistoric sites, including such blocks that will be affected that are adjacent to the lease block in which the planned activity will occur. If the proposed activities are located a sufficient distance from a shipwreck or prehistoric site that no impact would occur, the EIA can note that in a sentence or two.*
 - No impacts on archaeological resources are expected from routine activities. Alaminos Canyon Blocks 335, 336, and 337 are not on BOEM’s list of archaeology survey blocks (BOEM, 2011) and the locations of the proposed activities are well beyond the 197 ft (60 m) depth contour used by BOEM as the seaward extent for prehistoric archaeological site potential in the Gulf of Mexico. A dynamically positioned mobile offshore drilling unit will be used; therefore, seafloor disturbances due to anchoring will not occur.
- (8) *All activities that might have an adverse effect on Endangered or Threatened marine mammals or sea turtles or their critical habitats.*
 - IPFs that may affect marine mammals or sea turtles include mobile offshore drilling unit presence and emissions, support vessel and helicopter traffic, and accidents. See **Section C**.
- (9) *Production activities that involve transportation of produced fluids to shore using shuttle tankers or barges.*
 - Not applicable.

A.1 Mobile Offshore Drilling Unit Presence (including noise and lights)

The MODUs to be used for the wells will be either a DP drillship or a DP semisubmersible drilling rig that will be on site for an estimated up to 365 days per well from 2021 to 2024 for AC 335, up to 365 days per year from 2021 to 2025 for AC 336, and up to 365 days per year from 2021 to 2026 for AC 337. A DP MODU is self-propelled and maintains position using a global positioning system, specific computer software, and sensors in conjunction with a series of thrusters or azimuth propellers. Potential impacts to marine resources from the MODU include the physical presence of the MODU in the ocean, increased light from working and safety lighting on the vessel, and audible noise above and below the water's surface.

The physical presence of a MODU in the ocean can attract pelagic fishes and other marine life. The MODU would be a single structure that may concentrate small epipelagic fish species, resulting in the attraction of epipelagic predators. See **Section C.5.1** for further discussion.

The MODU will maintain exterior lighting for working at night and navigational and aviation safety in accordance with federal navigation and aviation safety regulations (International Regulations for Preventing Collisions at Sea, 1972 [72 COLREGS], Part C). Artificial lighting may attract and directly or indirectly impact natural resources, particularly birds, as discussed in **Section C.4**.

MODU can be expected to produce noise from station keeping, drilling, and maintenance operations. The noise levels produced by DP vessels largely depend on the level of thruster activity required to keep position and, therefore, vary based on environmental site conditions, vessel thruster specifications, and operational requirements. Representative source levels for vessels in DP mode range from 184 to 190 decibels referenced to one micropascal meter (dB re 1 μ Pa m) with a primary frequency below 600 hertz (Hz) (Blackwell and Greene Jr., 2003, McKenna et al., 2012b, Kyhn et al., 2014). Zykov (2016) characterized a noisier MODU thruster at 190 to 195 dB re 1 μ Pa at 1m SPL_{rms}. The source level for the thrusters used by Zykov (2016) were estimated for power output close to the nominal value (the maximum sustainable) for all thrusters; it is highly unlikely that all the thrusters of all vessels will be operated at such conditions for a prolonged period of time.

Drilling operations produce noise that includes strong tonal components at low frequencies (Minerals Management Service [MMS], 2000). When drilling, the drill string represents a long vertical sound source (McCauley, 1998). Source levels associated with drilling activities have a maximum broadband (10 Hz to 10 kilohertz [kHz]) energy of approximately 190 dB re 1 μ Pa m (Hildebrand, 2005). Based on available data, marine sound generated from MODUs during drilling and in the absence of thrusters can be expected to range between 154 and 176 dB re 1 μ Pa m (Nedwell et al., 2001). The use of thrusters, whether drilling or not, can elevate sound source levels from a drillship or semisubmersible to approximately 188 dB re 1 μ Pa m (Nedwell and Howell, 2004).

Positioning of the MODU requires the use of a vessel-mounted transducer and a series of transceivers placed on the seafloor. The transducer employs a high frequency acoustic signal (i.e., main energy between 21 and 31 kHz) throughout the operation. While the acoustic signal emitted by the transducer is similar to that emitted by a commercial echosounder, its source level will vary depending upon water depth (i.e., higher source levels required in deeper water). Sound source levels for the vessel-mounted transceiver are estimated at >200 dB re 1 μ Pa at 1m SPL_{rms}, focused toward the seafloor (Equinor, 2019). The directionality and frequency of the source results in minimal propagation outside the main beam of the pulse.

The response of marine mammals, sea turtles, and fishes to a perceived marine sound depends on a range of factors, including 1) the sound pressure level (SPL), frequency, duration, and novelty of the sound; 2) the physical and behavioral state of the animal at the time of perception; and 3) the ambient acoustic features of the environment (Hildebrand, 2004).

A.2 Physical Disturbance to the Seafloor

The 15 proposed wells will be drilled using a DP MODU. Therefore, there will be minimal disturbance to the seafloor and soft bottom communities during positioning of the wellbore and blowout preventers (BOPs). Physical disturbance of the seafloor will be limited to the immediate vicinity near where the wellbore penetrates the substrate and where mud and drill cuttings will be deposited.

A.3 Air Pollutant Emissions

Estimates of air pollutant emissions are provided in EP Section 8. Offshore air pollutant emissions will result from operations of the MODU as well as service vessels and helicopters. These emissions occur mainly from combustion of diesel. Primary air pollutants typically associated with OCS activities are suspended particulate matter (PM_{2.5} and PM₁₀), sulfur oxides (SO_x), nitrogen oxides (NO_x), ammonia (NH₃), lead (Pb), volatile organic compounds (VOCs), and carbon monoxide (CO) (Reşitoğlu et al., 2015).

The project area is located westward of 87.5° W longitude; thus, air quality is under BOEM jurisdiction, as explained in NTL 2009-N11. Anticipated emissions from the proposed project activities are calculated in the Air Quality Emissions Report (AQR) (see EP Section 8) prepared in accordance with BOEM requirements provided in 30 CFR Part 550 Subpart C. The AQR shows that the projected emissions associated with the proposed activities meet BOEM's exemption criteria.

A.4 Effluent Discharges

Effluent discharges from drilling operations are summarized in EP Section 7. Discharges from the MODU is required to comply with the National Pollutant Discharge Elimination System (NPDES) General Permit for Oil and Gas Activities (Permit No. GMG290103). Support vessel discharges are expected to be in accordance with USCG regulations.

Water-based drilling muds (WBM) and cuttings will be released at the seafloor during the initial well intervals before the marine riser is set. Excess cement slurry and BOP fluid will also be released at the seafloor.

A synthetic-based mud (SBM) system will be used for drilling activities after the marine riser is installed, which allows recirculation of the SBM fluids and cuttings and their subsequent processing aboard the surface vessel. Unused or residual SBM will be collected and transported to Port Fourchon, Louisiana, for recycling. Drill cuttings wetted with SBM will be discharged overboard via a downpipe below the water surface after treatment that complies with the NPDES permit limits for synthetic fluid retained on cuttings. The estimated volume of drill cuttings to be discharged is provided in EP Section 7.

Other effluent discharges from the MODU and support vessels are expected to include treated sanitary and domestic wastes, deck drainage, non-contaminated well treatment and completion fluids, desalination unit discharge, ballast water, bilge water, cement slurry, fire water, hydrate

inhibitor, and non-contact cooling water. All discharges shall comply with the NPDES General Permit and/or USCG regulations, as applicable.

A.5 Water Intake

Seawater will be drawn from several meters below the ocean surface for various services, including firewater and once-through, non-contact cooling of machinery on the MODU (EP Table 7a).

Section 316(b) of the Clean Water Act requires NPDES permits to ensure that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available to minimize adverse environmental impacts from impingement and entrainment of aquatic organisms. The NPDES General Permit No. GMG290103 specifies requirements for new facilities for which construction commenced after July 17, 2006, with cooling water intake structures having a design intake capacity of greater than 2 million gallons of water per day, of which at least 25% is used for cooling purposes.

The MODU selected for this project meets the described applicability for new facilities, and the vessel's water intakes are expected to be in compliance with the design, monitoring, and recordkeeping requirements of the NPDES permit.

A.6 Onshore Waste Disposal

Wastes generated during exploration activities are tabulated in EP Section 7. Used SBMs and additives will be transported to shore for recycling, reconditioning, or deep well injection at Halliburton Drilling Fluids, M-I SWACO, Newpark Drilling Fluids, Ecoserv, or R360 Environmental Solutions, in Port Fourchon, Louisiana. Exploration and production wastes and cuttings wetted with SBMs will be transported to shore for deep well injection or landfarm at Ecoserv or R360 Environmental Solutions, in Port Fourchon, Louisiana or Ecoserv in Winnie, Texas. Completion fluids will be transported to shore for recycling or deep well injection at Haliburton, Baker Hughes, Superior, Tetra, Ecoserv, or R360 Environmental Solutions in Port Fourchon, Louisiana. Salvage hydrocarbons will be transported to shore for recycling or deep well injection at PSC Industrial Outsourcing, Inc. in Jeanerette, Louisiana.

Recyclable trash and debris generated during the proposed project will be recycled at Omega Waste Management in West Patterson, Louisiana, or at a similarly permitted facility. Non-recyclable trash and debris will be transported to the Riverbirch Landfill in Avondale, Louisiana; or to a similarly permitted facility. Used oil and glycol will be transported to Omega Waste Management in West Patterson, Louisiana; Chemical Waste Management, Lake Charles, Louisiana; or at a similarly permitted facility. Non-hazardous waste will be transported to the Waste Management Woodside Landfill in Walker, Louisiana or to a similarly permitted facility. Non-hazardous oilfield waste will be transported to Ecoserv in Port Arthur, Texas. Universal waste items such as batteries, lamps, glass, and mercury contaminated waste will be sent to Chemical Waste Management in Sulphur, Louisiana; or to a similarly permitted facility, for processing. Hazardous waste will be sent to Chemical Waste Management in Lake Charles, Louisiana; Clean Harbors in Colfax, Louisiana; or to a similarly permitted facility. Wastes will be recycled or disposed according to applicable regulations at the respective onshore facilities.

A.7 Marine Debris

Trash and debris released into the marine environment can harm marine animals through entanglement and ingestion. Shell will adhere to the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) Annex V requirements, USEPA and USCG regulations, and BSEE regulations and NTLs regarding solid wastes. BSEE regulations at 30 CFR § 250.300(a) and (b)(6) prohibit operators from deliberately discharging containers and other materials (e.g., trash, debris) into the marine environment, and BSEE regulation 30 CFR § 250.300(c) requires durable identification markings on equipment, tools and containers (especially drums), and other material. USCG and USEPA regulations require operators to become proactive in avoiding accidental loss of solid waste items by developing waste management plans, manifesting trash sent to shore, and using special precautions such as covering outside trash bins to prevent accidental loss of solid waste. Additionally, the debris awareness training, instruction, and placards required by the Protected Species Lease Stipulation should minimize the amount of debris that is accidentally lost overboard by offshore personnel (NMFS [2020a] Appendix B). Shell will comply with NTL BSEE-2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of informational placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process. Compliance with these requirements is expected to result in either no or negligible impacts from this factor.

A.8 Support Vessel and Helicopter Traffic

Shell will use existing shore-based facilities in Port Fourchon, Louisiana, for onshore support of vessels and in Galveston, Texas, for air transportation support. No terminal expansion or construction is planned at either location.

IPFs associated with support vessel and helicopter traffic include their physical presence and operational noise. Each factor is discussed in the following subsections.

A.8.1 Physical Presence

The supply base in Port Fourchon, Louisiana, is operated by Shell and located on Bayou Lafourche, approximately 3 miles (5 km) from the Gulf of Mexico. There will likely be at least one support vessel in the field at all times during drilling activities. NMFS (2020a) has found that support vessel traffic has the potential to disturb protected species (e.g., marine mammals, sea turtles, fishes) and creates a risk of vessel strikes. The probability of a vessel strike depends on the number, size, and speed of vessels as well as the distribution, abundance, and behavior of the species (Conn and Silber, 2013, Hazel et al., 2007, Jensen and Silber, 2004, Laist et al., 2001, Vanderlaan and Taggart, 2007, NMFS, 2020a). To reduce the potential for vessel strikes, BOEM issued NTL BOEM-2016-G01, which recommends protected species identification training and that vessel operators and crews maintain a vigilant watch for marine mammals and slow down or stop their vessel to avoid striking protected species and requires operators to report sightings of any injured or dead protected species. Supply vessels will normally move to the project area via the most direct route from the shorebase.

Helicopters transporting personnel and small supplies will normally take the most direct route of travel between the helicopter base in Galveston, Texas, and the project area when air traffic and weather conditions permit. Helicopters typically maintain a minimum altitude of 700 ft (213 m)

while in transit offshore; 1,000 ft (305 m) over unpopulated areas or across coastlines; and 2,000 ft (610 m) over-populated areas and sensitive habitats such as wildlife refuges and park properties. Additional guidelines and regulations specify that helicopters maintain an altitude of 1,000 ft (305 m) within 328 ft (100 m) of marine mammals (NMFS, 2020a).

A.8.2 Noise

Vessel noise is one of the main contributors to overall noise in the sea (National Research Council, 2003b, Jasny et al., 2005). Offshore supply and service vessels associated with the proposed project will contribute to the overall acoustic environment by transmitting noise through both air and water. The support vessels will use conventional diesel-powered screw propulsion. Vessel noise is a combination of narrow-band (tonal) and broadband sound (Richardson et al., 1995, Hildebrand, 2009, McKenna et al., 2012). The vessel tonal noise typically dominates frequencies up to approximately 50 Hz, whereas broadband sounds may extend to 100 kHz. The primary sources of vessel noise are propeller cavitation, propeller singing (high-pitched, clear harmonic tone), and propulsion; other sources include auxiliary engine noise, flow noise from water dragging along the hull, and bubbles breaking in the vessel's wake while moving through the water (Richardson et al., 1995). The intensity of noise from service vessels is approximately related to ship size, weight, and speed. Large ships tend to be noisier than small ones, and ships underway with a full load (or towing or pushing a load) produce more noise than unladed vessels. For any given vessel, relative noise tends to increase with increased speed, and propeller cavitation is usually the dominant underwater noise source. Broadband source levels for most small ships (a category that includes support vessels) are anticipated to be in the range of 150 to 180 dB re 1 μ Pa m (Richardson et al., 1995, Hildebrand, 2009, McKenna et al., 2012).

Helicopters used for offshore oil and gas operational support are potential sources of noise to the marine environment. Helicopter noise is generated from their jet turbine engines, airframe, and rotors. The dominant tones for helicopters are generally below 500 Hz (Richardson et al., 1995). Richardson et al. (1995) reported received SPLs in water of 109 dB re 1 μ Pa from a Bell 212 helicopter flying at an altitude of 500 ft (152 m). Penetration of helicopter noise below the sea surface is greatest directly below the aircraft; at angles greater than 13 degrees from vertical, much of the sound is reflected from the sea surface and so does not penetrate into the water (Richardson et al., 1995). The duration of underwater sound from passing aircraft is much shorter in water than air. For example, a helicopter passing at an altitude of 500 ft (152 m) that is audible in air for 4 minutes may be detectable under water for only 38 seconds at 10 ft (3 m) depth and for 11 seconds at 59 ft (18 m) depth (Richardson et al., 1995). Additionally, the sound amplitude is greatest as the aircraft approaches or leaves a location.

A.9 Accidents

The analysis in the EIA focuses on two types of potential accidents:

- a small fuel spill (<1,000 barrels [bbl]), which is the most likely type of spill during OCS exploration and development activities; and
- an oil spill resulting from an uncontrolled blowout. A blowout resulting in a large oil spill (>1,000 bbl) is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures detailed in EP Section 2j.

The following subsections summarize assumptions about the sizes and fates of these spills as well as Shell's spill response plans. Impacts are analyzed in **Section C**.

The lease sale EISs (BOEM, 2012a, 2015, 2016b, 2017a) discuss other types of accidents: loss of well control, pipeline failures, vessel collisions, chemical and drilling fluid spills, and H₂S release. These are briefly discussed in this section. No other site-specific issues have been identified for the EIA. The analysis in the lease sale EISs for these topics is incorporated by reference.

Loss of Well Control. A loss of well control is the uncontrolled flow of a reservoir fluid that may result in the release of gas, condensate, oil, drilling fluids, sand, or water. Loss of well control is a broad term that includes very minor up to the most serious well control incidents, while blowouts are considered to be a subset of more serious incidents with greater risk of oil spill or human injury (BOEM, 2016a, 2017a). Loss of well control may result in the release of drilling fluid or loss of oil. Not all loss of well control events result in blowouts (BOEM, 2012a). In addition to the potential release of gas, condensate, oil, sand, or water, the loss of well control can also suspend and disperse bottom sediments (BOEM, 2012a, 2017a). BOEM (2016a) noted that most OCS blowouts have resulted in the release of gas; ABSG Consulting Inc. (2018) reported that most loss of well control event spills were <1,000 bbl.

Shell has a robust system in place to prevent loss of well control. Included in this EP is Shell's response to NTL 2015-N01, which includes descriptions of measures to prevent a blowout, reduce the likelihood of a blowout, and conduct effective and early intervention in the event of a blowout. Shell will comply with NTL 2010-N10, as extended under NTL 2015-N02, which specify additional safety measures for OCS activities. See EP Sections 2j and 9b for further information.

Pipeline Failures. Pipeline failures can result from mass sediment movements and mudslides, impacts from anchor drops, and accidental excavation in the case that the exact location of a pipeline is uncertain (BOEM, 2012a, 2013, 2015). The project area has been evaluated through geologic and geohazard surveys and found to be geologically suitable for the proposed exploration drilling (Geoscience Earth & Marine Services, Inc., 2020a).

Vessel Collisions. BSEE data show that there were 171 OCS-related collisions between 2007 and 2018 (BSEE, 2018). Most collision mishaps are the result of service vessels colliding with platforms or vessel collisions with pipeline risers. Approximately 10% of vessel collisions with platforms in the OCS resulted in diesel spills, and in several collision incidents, fires resulted from hydrocarbon releases. To date, the largest diesel spill associated with a collision occurred in 1979 when an anchor-handling boat collided with a drilling platform in the Main Pass project area, spilling 1,500 bbl. Diesel fuel is the product most frequently spilled, but oil, natural gas, corrosion inhibitor, hydraulic fluid, and lube oil have also been released as the result of vessel collisions. Human error accounted for approximately half of all reported vessel collisions from 2006 to 2009. As summarized by BOEM (2017c), vessel collisions occasionally occur during routine operations. Some of these collisions have caused spills of diesel fuel or chemicals. Shell intends to comply with all USCG- and BOEM-mandated safety requirements to minimize the potential for vessel collisions.

Chemical Spills. Chemicals are stored and used for pipeline hydrostatic testing, and during drilling and in well completion operations. The relative quantities of their use is reflected in the largest volumes spilled (BOEM, 2017c). Completion, workover, and treatment fluids are the largest quantity used and comprise the largest releases. Between 2007 and 2014, an average of two

chemical spills <50 bbl in volume and three chemical spills >50 bbl in volume occurred each year (BOEM, 2017a).

Drilling Fluid Spills. There is the potential for drilling fluids, specifically SBMs, to be spilled due to an accidental riser disconnect (BOEM, 2017a). SBMs are relatively nontoxic to the marine environment and have the potential to biodegrade (BOEM, 2014). The majority of SBM releases are <50 bbl in size, but accidental riser disconnects may result in the release of medium (238 to 2,380 bbl) to large (>2,381 bbl) quantities of drilling fluids. In the event of an SBM spill, there could be short-term localized impacts on water quality and the potential for localized benthic impacts due to SBM deposition on the seafloor (Stout and Payne, 2018). Benthic impacts would be similar to those described in **Section C.2.1**. The potential for riser disconnect SBM spills will be minimized by adhering to the requirements of applicable regulations.

H₂S Release. AC 335, AC 336, and AC 337 are classified as H₂S “absent”. Based on the H₂S absent classification, no further discussion on H₂S impacts is warranted.

A.9.1 Small Fuel Spill

Spill Size. According to the analysis by BOEM (2017a), the most likely type of small spill (<1,000 bbl) resulting from OCS activities is a failure related to the storage of oil or diesel fuel. Historically, most diesel spills have been ≤1 bbl, and this is predicted to be the most common spill volume in ongoing and future OCS activities in the Western and Central Gulf of Mexico Planning Areas (Anderson et al., 2012). As the spill volume increases, the incident rate declines dramatically (BOEM, 2017a). The median size for spills ≤1 bbl is 0.024 bbl, and the median volume for spills of 1 to 10 bbl is 3 bbl (Anderson et al., 2012). For the EIA, a small diesel fuel spill of 3 bbl is used. Operational experience suggests that the most likely cause of such a spill would be a rupture of the fuel transfer hose resulting in a loss of contents (<3 bbl of fuel) (BOEM, 2012a).

Spill Fate. The fate of a small fuel spill in the project area would depend on meteorological and oceanographic conditions at the time of the spill as well as the effectiveness of spill response activities. However, given the open ocean location of the project area and the short duration of a small spill, it is expected that the opportunity for impacts to occur would be very brief.

The water-soluble fractions of diesel are dominated by two- and three-ringed polycyclic aromatic hydrocarbons (PAHs), which are moderately volatile (National Research Council, 2003a). The constituents of these oils are light to intermediate in molecular weight and can be readily degraded by aerobic microbial oxidation. Diesel density is such that it will not sink to the seafloor unless it is dispersed in the water column and adheres to suspended sediments, but this generally occurs only in coastal areas with high-suspended solids loads (National Research Council, 2003a). Adherence to suspended sediments is not expected to occur to any appreciable degree in offshore waters of the Gulf of Mexico. Diesel oil is readily and completely degraded by naturally occurring microbes (NOAA, 2019).

The fate of a small diesel fuel spill was estimated using NOAA’s Automated Data Inquiry for Oil Spills (ADIOS) 2 model (NOAA, 2016a). This model uses the physical properties of oils in its database to predict the rate of evaporation and dispersion over time as well as changes in the density, viscosity, and water content of the product spilled. It is estimated that more than 90% of a small diesel spill would evaporate or naturally disperse within 24 hours. Based on the results of the ADIOS 2 model, the area of diesel fuel on the sea surface would range from 1.2 to 12 acres (ac) (0.5 to 5 hectares [ha]), depending on sea state and weather conditions.

The project area is 161 miles (259 km) from the nearest shoreline (Texas). Slicks from fuel spills are expected to persist for relatively short periods of time ranging from minutes (<1 bbl) to hours (<10 bbl) to a few days (10 to 1,000 bbl) and rapidly spread out, evaporate, and disperse into the water column (BOEM, 2012a). Because of the distance from shore of these potential spills and their lack of persistence, it is unlikely that a small diesel spill would make landfall prior to dissipation (BOEM, 2012a).

Spill Response. In the unlikely event of a fuel spill, response equipment and trained personnel would be available to ensure that spill effects are localized and would result only in short-term, localized environmental consequences. EP Section 9b provides a detailed discussion of Shell's oil spill response plans.

A.9.2 Large Oil Spill

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures detailed in EP Section 2j. Blowouts are rare events, and most well control incidents do not result in oil spills (BOEM, 2016a). According to ABS Consulting Inc. (2016), the spill rate for spills >1,000 bbl is 0.22 spills per billion bbl. The baseline risk of loss of well control spill >10,000 bbl on the OCS is estimated to be once every 27.5 years (ABSG Consulting, 2018).

Spill Size. Shell has calculated the WCD for this EP using the requirements prescribed by NTL 2015-N01. The calculated initial release volume is 27,709 bbl of oil during the first day, and the calculated 30-day average WCD rate is 27,600 bbl of oil per day. The total potential spill volume along with a detailed analysis of this calculation can be found in EP Section 2j. The WCD scenario for this EP has a low probability of being realized. Some of the factors that are likely to reduce rates and volumes, which are not incorporated in the WCD calculation, include, but are not limited to, obstructions or equipment in the wellbore, well bridging, and early intervention such as containment.

Shell has a robust system in place to prevent blowouts. Shell's response to NTL 2015-N01, which includes descriptions of measures to prevent a blowout, reduce the likelihood of a blowout, and conduct effective and early intervention in the event of a blowout, can be found in EP Sections 2j and 9b. Shell will also comply with NTL 2010-N10 and applicable drilling regulations in 30 CFR Part 250, Subpart D, which specify additional safety measures for OCS activities.

Spill Trajectory. The fate of a large oil spill in the project area would depend on meteorological and oceanographic conditions at the time. The Oil Spill Risk Analysis (OSRA) model is a computer simulation of oil spill transport that uses realistic data for winds and currents to predict spill fate. The OSRA report by Ji et al. (2004) provides conditional contact probabilities for shoreline segments in the Gulf of Mexico.

The results for Launch Area 24 (the launch area where AC 335, AC 336, and AC 337 are located) are presented in **Table 3**. The 30-day OSRA model predicts a <0.5% chance of shoreline contact within 3 days and 10 days of a spill. Within 30 days of a spill, a 1% to 8% chance of shoreline contact is predicted from Cameron County, Texas to Vermilion Parish, Louisiana. Counties whose conditional probability for shoreline contact is <0.5% for 3, 10, and 30 days are not shown in **Table 3**.

Table 3. Conditional probabilities of a spill in the project area (AC 335, AC 336, and AC 337) contacting shoreline segments based on a 30-day Oil Spill Risk Analysis (OSRA) (From: Ji et al., 2004). Values are conditional probabilities that a hypothetical spill in the project area (represented by OSRA Launch Area 24) could contact shoreline segments within 3, 10, or 30 days.

Shoreline Segment	County or Parish, State	Conditional Probability of Contact ¹ (%)		
		3 Days	10 Days	30 Days
C01	Cameron, Texas	--	--	3
C02	Willacy, Texas	--	--	1
C03	Kenedy, Texas	--	--	4
C04	Kleberg, Texas	--	--	3
C05	Nueces, Texas	--	--	3
C06	Aransas, Texas	--	--	3
C07	Calhoun, Texas	--	--	4
C08	Matagorda, Texas	--	--	8
C09	Brazoria, Texas	--	--	2
C10	Galveston, Texas	--	--	4
C12	Jefferson, Texas	--	--	2
C13	Cameron, Louisiana	--	--	3
C14	Vermilion, Louisiana	--	--	1

¹ Conditional probability refers to the probability of contact within the stated time period, assuming that a spill has occurred. -- indicates <0.5% probability of contact.

The OSRA model presented by Ji et al. (2004) does not evaluate the fate of a spill over time periods longer than 30 days, nor does it predict the fate of a release that continues over a period of weeks or months. Also as noted in Ji et al. (2004), the OSRA model does not take into account the chemical composition or biological weathering of oil spills, the spreading and splitting of oil spills, or spill response activities. The model does not assume a particular spill size; however, the model has generally been used by BOEM to evaluate contact probabilities for spills greater than 1,000 bbl. Thus, OSRA is a preliminary risk assessment model. In the event of an actual oil spill, trajectory modeling would be conducted using the location and estimated amount of spilled oil as well as current and wind data.

Weathering. Following an oil spill, several physical, chemical, and biological processes, collectively called weathering, interact to change the properties of the oil, and thereby influence its potential effects on marine organisms and ecosystems. The most important weathering processes include spreading, evaporation, dissolution, dispersion into the water column, formation of water-in-oil emulsions, photochemical oxidation, microbial degradation, adsorption to suspended PM, and stranding on shore or sedimentation to the seafloor (National Research Council, 2003a, International Tanker Owners Pollution Federation Limited, 2018).

Weathering decreases the concentration of oil and produces changes in its chemical composition, physical properties, and toxicity (BOEM, 2017a). The more toxic, light aromatic and aliphatic hydrocarbons in the oil are lost rapidly by evaporation and dissolution on the water surface. Evaporated hydrocarbons are degraded rapidly by sunlight. Biodegradation of oil on the water surface and in the water column by marine bacteria removes first the n-alkanes and then the light aromatics from the oil. Other petroleum components are biodegraded more slowly.

Photo-oxidation attacks mainly the medium and high molecular weight PAHs in the oil on the water surface.

Spill Response. Shell is a founding member of the Marine Well Containment Company (MWCC) and has access to an integrated subsea well control and containment system that can be rapidly deployed through the MWCC. The MWCC is a non-profit organization that assists with the subsea containment system during a response. The near-term containment response capability will be specifically addressed in Shell's NTL 2010-N10 submission of an Application for Permit to Drill. The application will include equipment and services available to Shell through MWCC's near-term containment capabilities and other industry response sources. Shell is a member of Clean Caribbean & Americas, Marine Preservation Association (which funds Marine Spill Response Corporation), Clean Gulf Associates, and Oil Spill Response Limited: organizations that are committed to providing the resources necessary to respond to a spill as outlined in Shell's OSRP.

MWCC also offers its members access to equipment, instruments, and supplies for marine environmental sampling and monitoring in the event of an oil spill in the Gulf of Mexico. Members have access to a mobile laboratory container, operations container, and a launch and recovery system, which enables water sampling and monitoring to water depths of 3,000 m. The two 8-foot × 20-foot containers have been certified for offshore use by Det Norske Veritas and the American Bureau of Shipping. The launch and recovery system is a combined winch, A-frame, and 3,000-meter long cable customized for instruments in the containers. The containers are designed to enable rapid mobilization of equipment to an incident site. The required equipment includes redundant systems to avoid downtime and supplies for sample handling and storage. Once deployed on a suitable vessel, the mobile containers then act as workspaces for scientists and operations personnel.

Mechanical recovery capabilities are addressed in the OSRP. The mechanical recovery response equipment that could be mobilized to the spill location in normal and adverse weather conditions is included in the Offshore On-Water Recovery Activation List in the OSRP.

Chemical dispersion capabilities are also readily available from resources identified in the OSRP. Available equipment for surface and subsea application of dispersants, response times, and support resources are identified in the OSRP.

Open water *in-situ* burning may also be used as a response strategy, depending on the circumstances of the release. If appropriate conditions exist and approval from the Unified Command is received, one or multiple *in situ* burning task forces could be deployed offshore. See EP Section 9b for a detailed description of spill response measures.

B. Affected Environment

The project area is in the Central Planning Area, approximately 161 miles (259 km) from the nearest shoreline (Texas), 316 miles (509 km) from the onshore support base at Port Fourchon, Louisiana, and 185 miles (298 km) from the helicopter base in Galveston, Texas. Estimated water depths at the proposed wellsites range from approximately 4,414 to 4,604 ft (1,345 to 1,403 m).

The shallow geohazards assessment did not identify any seafloor anomalies within 2,000 ft (610 m) of the proposed wellsites that would indicate the potential for chemosynthetic or high-density deepwater benthic communities (Geoscience Earth & Marine Services, Inc., 2020a). Additionally, no archaeologically significant sonar contacts were identified within 2,000 ft (610 m) of the proposed wellsites during the wellsite assessment (Geoscience Earth & Marine Services, Inc., 2020b).

A detailed description of the regionally affected environment is provided by BOEM (2016b, 2017a), including meteorology, oceanography, geology, air and water quality, benthic communities, Threatened and Endangered species, biologically sensitive resources, archaeological resources, socioeconomic conditions, and other marine uses. These regional descriptions are based on extensive literature reviews and are incorporated by reference. General background information is presented in the following sections, and brief descriptions of each potentially affected resource are presented in **Section C**, including site-specific or new information if available.

The local environment in the project area is not known to be unique with respect to the physical/chemical, biological, or socioeconomic conditions found in this region of the Gulf of Mexico. The baseline environmental conditions in the project area are expected to be consistent with the regional description of the locations evaluated by BOEM (2016b, 2017a).

C. Impact Analysis

This section analyzes the potential direct and indirect environmental impacts of routine activities and accidents; cumulative impacts are discussed in **Section C.9**.

Environmental impacts have been analyzed extensively in lease sale EISs for the Central and Western Gulf of Mexico Planning Areas (BOEM, 2012a, 2013, 2014, 2015, 2016b, 2017a). Site-specific issues are addressed in this section as appropriate and are organized by the environmental resources identified in **Table 2** that addresses each potential IPF.

C.1 Physical/Chemical Environment

C.1.1 Air Quality

Due to the distance from shore-based pollution sources, offshore air quality is expected to be good. The attainment status of federal OCS waters is unclassified because there is no provision in the Clean Air Act for classification of areas outside state waters (BOEM, 2012a).

In general, ambient air quality on coastal counties along the Gulf of Mexico is relatively good (BOEM, 2012a). As of September 2020, Mississippi, Alabama, and Florida Panhandle coastal

counties are in attainment of the National Ambient Air Quality Standards (NAAQS) for all criteria pollutants (USEPA, 2020). St. Bernard Parish in Louisiana and Hillsborough County in Florida are nonattainment areas for sulfur dioxide based on the 2010 standard. One coastal metropolitan area in Texas (Houston-Galveston-Brazoria) is a nonattainment area for 8-hour ozone (2015 Standard). One coastal metropolitan area in Florida (Tampa) was reclassified in 2018 from a nonattainment area to maintenance status for lead based on the 2008 Standard (USEPA, 2020).

Winds in the region are driven by the clockwise circulation around the Bermuda High (BOEM, 2017a). The Gulf of Mexico is located to the southwest of this center of circulation, resulting in a prevailing southeasterly to southerly flow, which is conducive to transporting emissions toward shore. However, circulation is also affected by tropical cyclones (hurricanes) during summer and fall and by extratropical cyclones (cold fronts) during winter.

IPFs that could potentially affect air quality are air pollutant emissions associated with both types of accidents: a small fuel spill (<1,000 bbl) and a large oil spill (≥1,000 bbl).

Impacts of Air Pollutant Emissions

Air pollutant emissions are the only routine IPF anticipated to affect air quality. Offshore air pollutant emissions will result from the operation of the MODU and associated equipment as well as helicopters and service vessels as described in **Section A.3**. These emissions occur mainly from combustion or burning of diesel and Jet-A aircraft fuel. Primary air pollutants typically associated with OCS activities are suspended PM_{2.5 and 10}, SO_x, NO_x, NH₃, Pb, VOCs, and CO.

Due to the distance from shore, routine operations in the project area are not expected to impact air quality along the coast. As noted by BOEM (BOEM, 2012a, 2013, 2014, 2015, 2016b, 2017b), emissions of air pollutants from routine activities in the project area are projected to have minimal impacts on onshore air quality because of the prevailing atmospheric conditions, emission heights, emission rates, and the distance of these emissions from the coastline.

AC 335, AC 336, and AC 337 are located west of 87.5° W longitude; thus, air quality is under BOEM jurisdiction as explained in NTL 2009-N11. The BOEM-implementing regulations are provided in 30 CFR Part 550 Subpart C. The AQR (see EP Section 8) prepared in accordance with BOEM requirements shows that the projected emissions from sources associated with the proposed activities meet BOEM's exemption criteria. Therefore, this EP is exempt from further air quality review pursuant to 30 CFR § 550.303(d).

The Breton Wilderness Area, which is part of the Breton National Wildlife Refuge (NWR), is designated under the Clean Air Act as a Prevention of Significant Deterioration Class I air quality area. Per NTL 2020-G01, Shell will coordinate with the USFWS if emissions from proposed projects may affect the Breton Class I area. The project area is approximately 374 miles (602 km) from the Breton Wilderness Area. Shell will comply with emissions requirements as directed by USFWS. No further analysis or control measures are required.

There are three Class I air quality areas on the west coast of Florida: St Mark's Wildlife Refuge in Wakulla County, Florida, Chassahowitzka Wilderness Area in Hernando County, Florida, and Everglades National Park in Monroe, Miami-Dade, and Collier counties, Florida. The project area is approximately 740 miles (1,191 km) from the closest Florida Class I air quality area (Saint Mark's Wildlife Refuge Class I Air Quality Area). Shell will comply with emissions requirements as directed by BOEM. No further analysis or control measures are required.

Greenhouse gas emissions contribute to climate change, with impacts on temperature, rainfall, frequency of severe weather, ocean acidification, and sea level rise (Intergovernmental Panel on Climate Change, 2014). Carbon dioxide (CO₂) and methane (CH₄) emissions from the project would constitute a very small incremental contribution to greenhouse gas emissions from all OCS activities. According to the Programmatic EIS (BOEM, 2016a) and OCS lease sale EISs (e.g., BOEM, 2017a), estimated CO₂ emissions from OCS oil and gas sources are 0.4% of the U.S. total. Greenhouse gas emissions from the proposed project represent a negligible contribution to the total greenhouse gas emissions from reasonably foreseeable activities in the Gulf of Mexico area and would not significantly alter any of the climate change impacts evaluated in the Programmatic EIS (BOEM, 2016a).

Impacts of a Small Fuel Spill

Potential impacts of a small spill on air quality are expected to be consistent with those analyzed and discussed by BOEM (2012a, 2015, 2016b, 2017a). **Section A.9.1** discusses the size and fate of a potential small diesel fuel spill as a result of Shell's proposed activities. EP Section 9b provides detail on spill response measures. Given the open ocean location of the project area, the extent and duration of air quality impacts at the project area from a small spill would not be significant.

A small fuel spill would likely affect air quality near the spill site by introducing VOCs into the atmosphere through evaporation. The ADIOS 2 model (see **Section A.9.1**) indicates that more than 90% of a small diesel spill would evaporate or disperse within 24 hours. The area of diesel fuel on the sea surface would range from 1.2 to 12 ac (0.5 to 5 ha), depending on sea state and weather conditions. Given the open ocean location of the project area, the extent and duration of air quality impacts at the project area from a small spill would not be significant.

A small fuel spill would not affect coastal air quality because the spill would be expected to dissipate prior to making landfall or reaching coastal waters (see **Section A.9.1**).

Impacts of a Large Oil Spill

Potential impacts of a large oil spill on air quality are expected to be consistent with those analyzed and discussed by BOEM (2012a, 2015, 2016b, 2017a).

A large oil spill would likely affect air quality by introducing VOCs into the atmosphere through evaporation from the oil on the water surface. The extent and persistence of impacts would depend on the meteorological and oceanographic conditions at the time and the effectiveness of spill response measures. Additional air quality impacts could occur if response measures approved by the Unified Command included *in situ* burning of the floating oil. *In situ* burning would generate a plume of black smoke offshore and result in emissions of NO_x, SO_x, CO, and PM as well as greenhouse gases.

Due to the project area location, most air quality impacts would occur in offshore waters. Depending on the spill trajectory and the effectiveness of spill response measures, coastal air quality could also be affected. Based on the 30-day OSRA modeling (**Table 3**), coastal areas would not likely be affected within 3 to 10 days. Coastal areas between Cameron County, Texas, and Vermilion Parish, Louisiana, may be affected within 30 days of a spill (1% to 8% conditional probability).

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j.

In the unlikely event of a large oil spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures. No significant spill impacts on air quality are expected.

C.1.2 Water Quality

There are no site-specific baseline water quality data for the project area. Due to the lease location in deep, offshore waters, water quality is expected to be good, with low levels of contaminants. As noted by BOEM (2017a), deepwater areas in the northern Gulf of Mexico are relatively homogeneous with respect to temperature, salinity, and oxygen. Kennicutt (2000) noted that the deepwater region has little evidence of contaminants in the dissolved or particulate phases of the water column. IPFs that could potentially affect water quality are effluent discharges and two types of accidents (i.e., a small fuel spill and a large oil spill).

Impacts of Effluent Discharges

As described in **Section A.4**, NPDES General Permit No. GMG290103 establishes permit limits and monitoring requirements for effluent discharges from the MODU and support vessels.

WBM and cuttings will be released at the seafloor during the initial well intervals before the marine riser is set, which allows their return to the surface vessel. Excess cement slurry and BOP fluid will also be released at the seafloor. The seafloor discharges of WBM and associated drill cuttings will produce turbidity near the seafloor. The turbidity plume will be carried away from the well by near-bottom currents and may be detectable within tens to hundreds of meters of the wellbore. As resuspended sediments settle to the seafloor, the water clarity will return to background conditions within minutes to a few hours after drilling of these well intervals ceases (Neff, 1987). Discharges of WBM and cuttings are likely to have little or no impact on water quality due to the low toxicity and rapid dispersion of these discharges (National Research Council, 1983, Neff, 1987, Hinwood et al., 1994).

Cuttings wetted with SBMs will be discharged overboard in accordance with the NPDES permit. After discharge, SBM retained on cuttings would be expected to adhere to the cuttings particles and, consequently, would not produce much turbidity as the cuttings sink through the water column (Neff et al., 2000). A Recent EIS concluded that the discharge of treated SBM cuttings will not cause persistent impacts on water quality in the project area (BOEM, 2017a). NPDES permit limits and requirements are expected to be met, and little or no impact on water quality is anticipated.

Treated sanitary and domestic wastes will be discharged by the MODU and support vessels and may have a transient effect on water quality in the immediate vicinity of these discharges. NPDES permit limits and USCG requirements are expected to be met, as applicable, and little or no impact on water quality is anticipated.

Deck drainage includes effluents resulting from rain, deck washings, and runoff from curbs, gutters, and drains, including drip pans in work areas. Rainwater that falls on uncontaminated areas of the MODU will flow overboard without treatment. However, rainwater that falls on the MODU deck and other areas that may be contaminated with chemicals, such as chemical storage areas or places where equipment is exposed, will be collected and processed to separate oil and water to meet NPDES permit requirements. Negligible impact on water quality is anticipated.

Other effluent discharges from the MODU and support vessels are expected to include non-contaminated well treatment and completion fluids, desalination unit discharge, BOP fluid, ballast water, bilge water, cement slurry, fire water, hydrate inhibitor, and non-contact cooling water. The MODU and support vessel discharges are expected to be in compliance with NPDES permit and USCG regulations, as applicable, and therefore are not expected to cause significant impacts on water quality.

Impacts of a Small Fuel Spill

Potential impacts of a small spill on water quality are expected to be consistent with those analyzed and discussed by BOEM (2012a, 2015, 2016b, 2017a). **Section A.9.1** discusses the size and fate of a potential small diesel fuel spill as a result of Shell's proposed activities. EP Section 9b provides detail on spill response measures. Given the open ocean location of the project area, the extent and duration of water quality impacts from a small spill would not be significant.

The water-soluble fractions of diesel are dominated by two- and three-ringed PAHs, which are moderately volatile (National Research Council, 2003a). The constituents of these oils are light to intermediate in molecular weight and can be readily degraded by aerobic microbial oxidation. Diesel oil is much lighter than water (specific gravity is between 0.83 and 0.88, compared to 1.03 for seawater). When spilled on water, diesel oil spreads very quickly to a thin film of rainbow and silver sheens, except for marine diesel, which may form a thicker film of dull or dark colors. However, because diesel oil has a very low viscosity, it is readily dispersed into the water column when winds reach 5 to 7 knots or with breaking waves (NOAA, 2019). It is possible for diesel oil that is dispersed by wave action to form droplets that are small enough to be kept in suspension and moved by the currents.

Diesel dispersed in the water column can adhere to suspended sediments, but this generally occurs only in coastal areas with high suspended solids loads (National Research Council, 2003a) and would not be expected to occur to any appreciable degree in offshore waters of the Gulf of Mexico.

The extent and persistence of water quality impacts from a small diesel fuel spill would depend on the meteorological and oceanographic conditions at the time and the effectiveness of spill response measures. It is estimated that more than 90% of a small diesel spill would evaporate or disperse within 24 hours (see **Section A.9.1**). The sea surface area covered with a very thin layer of diesel fuel would range from 1.2 to 12 ac (0.5 to 5 ha), depending on sea state and weather conditions. In addition to removal by evaporation, constituents of diesel oil are readily and completely degraded by naturally occurring microbes (NOAA, 2019). Given the open ocean location of the project area, the extent and duration of water quality impacts from a small spill would not be significant.

A small fuel spill would not affect coastal water quality because the spill would not be expected to make landfall or reach coastal waters due to response efforts that would be undertaken as well as natural degradation and dilution (**Section A.9.1**).

Impacts of a Large Oil Spill

Potential impacts of a large oil spill on water quality are expected to be consistent with those analyzed and discussed by BOEM (2012a, 2015, 2016b, 2017a). **Section A.9.2** discusses the size and fate of a potential large oil spill as a result of Shell's proposed activities. A large spill would

likely affect water quality by producing a slick on the water surface and increasing the concentrations of petroleum hydrocarbons and their degradation products. The extent and persistence of impacts would depend on the meteorological and oceanographic conditions at the time of the spill as well as the effectiveness of the spill response measures. Most of the spilled oil would be expected to form a slick at the surface, although observations following the *Deepwater Horizon* incident indicate that plumes of submerged oil droplets can be produced when subsea dispersants are applied at the wellhead (Camilli et al., 2010, Hazen et al., 2010, NOAA, 2011a,b,c). Recent analyses of the entire set of samples associated with the *Deepwater Horizon* incident have confirmed that the application of subsurface dispersants resulted in subsurface hydrocarbon plumes (Spier et al., 2013). A report by Kujawinski et al. (2011) indicates that chemical components of subsea dispersants used during the *Deepwater Horizon* incident persisted for up to 2 months and were detectable up to 186 miles (300 km) from the wellsite at water depths of 3,280 to 3,937 ft (1,000 to 1,200 m). Dispersants were detectable in <9% of the samples (i.e., 353 of the 4,114 total water samples), and concentrations in the samples were significantly below the chronic screening level for dispersants (BOEM, 2012b).

Once oil enters the ocean, a variety of physical, chemical, and biological processes take place that degrade and disperse the oil. These processes include spreading, evaporation of the more volatile constituents, dissolution into the water column, emulsification of small droplets, agglomeration sinking, microbial modification, photochemical modification, and biological ingestion and excretion (National Research Council, 2003a). Marine water quality would be temporarily affected by the dissolved components and small oil droplets that do not rise to the surface or are mixed down by surface turbulence. Liu et al. (2017) observed that after the *Deepwater Horizon* incident, hydrocarbon levels were reduced in the surface waters from May 2010 to August 2010 by either rapid weathering and/or physical dilution. A combination of dispersion by currents that dilutes the constituents and microbial degradation which removes the oil from the water column reduces concentrations to background levels. Most crude oil blends will emulsify quickly when spilled, creating a stable mousse that presents a more persistent cleanup and removal challenge (NOAA, 2017).

A large oil spill could result in a release of gaseous hydrocarbons that could affect water quality. During the *Deepwater Horizon* incident, large volumes of CH₄ were released, causing localized oxygen depletion as methanotrophic bacteria rapidly metabolized the hydrocarbons (Joye et al., 2011, Kessler et al., 2011). However, a broader study of the deepwater Gulf of Mexico found that although some stations showed slight depression of dissolved oxygen concentrations relative to climatological background values, the findings were not indicative of hypoxia (<2.0 mg L⁻¹) (Operational Science Advisory Team, 2010). Stations revisited around the Macondo wellhead in October 2010, approximately 6 months after the beginning of the event showed no measurable oxygen depressions (Operational Science Advisory Team, 2010).

Due to the project area's location, most water quality impacts would occur in offshore waters. Depending on the spill trajectory and the effectiveness of spill response measures, coastal water quality could be affected. Based on the 30-day OSRA modeling (**Table 3**), coastal areas would not likely be affected within 3 to 10 days. Coastal areas between Cameron County, Texas, and Vermilion Parish, Louisiana, may be affected within 30 days of a spill (1% to 8% conditional probability).

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures detailed in EP Section 2j. In

the event of a large spill, water quality could be temporarily affected, but no long-term significant impacts are expected. In the unlikely event of a spill, implementation of Shell’s OSRP will mitigate and reduce any resultant impacts. EP Section 9b provides detail on spill response measures.

C.2 Seafloor Habitats and Biota

The water depth at the proposed wellsites ranges from approximately 4,414 to 4,604 ft (1,345 to 1,403 m). See EP Section 6a for further information.

According to BOEM (2016b, 2017a), existing information for the deepwater Gulf of Mexico indicates that the seafloor is composed primarily of soft sediments; exposed hard substrate habitats and associated biological communities are rare. No features or areas that could support significant, high-density benthic communities were found within 2,000 ft (610 m) of the proposed wellsites (Geoscience Earth & Marine Services, Inc., 2020a). As a result, high-density deepwater benthic communities are not expected to be present.

C.2.1 Soft Bottom Benthic Communities

There are no site-specific benthic community data from the project area. However, data from various gulf-wide studies have been conducted to regionally characterize the continental slope habitats and benthic ecology (Wei, 2006, Rowe and Kennicutt, 2009, Wei et al., 2010, Carvalho et al., 2013, Spies et al., 2016), which can be used to describe typical baseline benthic communities that could be present in vicinity of the proposed wellsites. **Table 4** summarizes data from two stations in the vicinity of the proposed wells. Sediments at these two stations were similar, predominantly clay (60% at Station AC1 and 64% at Station RW5) and silt (35% at Station AC1 and 28% at Station RW5), respectively (Rowe and Kennicutt, 2009).

Table 4. Baseline benthic community data from stations near to the project area in water depths similar to those sampled during the Northern Gulf of Mexico Continental Slope Habitats and Benthic Ecology Study (From: Wei, 2006, Rowe and Kennicutt, 2009).

Station	Location Relative to Lease Area	Water Depth (m)	Abundance		
			Meiofauna (individuals m ⁻²)	Macroinfauna (individuals m ⁻²)	Megafauna (individuals ha ⁻¹)
AC1	16 miles (26 km)	2,550	129,974	637	1,620
RW5	24 miles (39 km)	1,629	170,633	1,372	576

Densities of meiofauna (animals that pass through a 0.5-millimeter sieve but are retained on a 0.062-millimeter sieve) in sediments collected at water depths representative of the project area ranged from approximately 130,000 to 171,000 individuals m⁻² (Rowe and Kennicutt, 2009). Nematodes, nauplii, and harpacticoid copepods were the three dominant groups in the meiofauna, accounting for approximately 90% of total abundance.

The benthic macroinfauna is characterized by small mean individual sizes and low densities, both of which reflect the intrinsically low primary production in surface waters of the Gulf of Mexico continental slope (Wei, 2006). Densities decrease exponentially with water depth (Carvalho et al., 2013). Based on an equation presented by Wei (2006), the macroinfaunal density in the water depths of the proposed wellsites are estimated to range from approximately 2,403 to 2,509 individuals m⁻²; however, actual densities at the proposed wellsites are unknown and often highly variable.

Polychaetes are typically the most abundant macroinfaunal group on the northern Gulf of Mexico continental slope, followed by amphipods, tanaids, bivalves, and isopods (Rowe and Kennicutt, 2009). Carvalho et al. (2013) found polychaete abundance to be higher in the central region of the northern Gulf of Mexico when compared to the eastern and western regions. Wei (2006) recognized four depth-dependent faunal zones (1 through 4), two of which (Zones 2 and 3) are divided horizontally. The project area is located in Zones 2W and 3W. Zone 2W is on the middle Texas-Louisiana slope. The most abundant species in this zone were the polychaetes *Aricidea suecica*, *Levinsenia uncinata*, *Macrochaeta clavicornis*, *Paraonella monilaris*, and *Tharyx marioni* (Wei, 2006, Wei et al., 2010). Zone 3W is on the mid Texas-Louisiana Slope ranging in depth from 1,875 to 3,008 m (6,152 to 9,869 ft). The most abundant species in this zone were the polychaetes *Levinsenia uncinata*, *Paraonella monilaris*, and *Tachytrypa* sp. A; the bivalve *Heterodonta* sp. B; and the isopod *Macrostylis* sp. (Wei, 2006, Wei et al., 2010).

Megafaunal density at a nearby stations in the vicinity of the proposed wellsites ranged from approximately 576 to 1,620 individuals ha⁻¹ (Table 4). Common megafauna included motile groups such as decapods, holothurians, and demersal fishes as well as sessile groups such as sponges, gorgonians, and alcyonaria (Rowe and Kennicutt, 2009).

Bacteria are the foundation of deep-sea chemosynthetic communities (Ross et al., 2012) and are an important component in terms of biomass and cycling of organic carbon (Cruz-Kaegi, 1998). Bacterial biomass at the depth range of the project area typically is approximately 1 to 2 g C m⁻² in the top 6 inches (15 cm) of sediments (Rowe and Kennicutt, 2009). In deep-sea sediments, Main et al. (2015) observed that microbial oxygen consumption rates increased and bacterial biomass decreased with hydrocarbon contamination.

IPFs that could potentially affect benthic communities are physical disturbance to the seafloor, effluent discharges (drilling mud and cuttings), and a large oil spill resulting from a well blowout at the seafloor. A small fuel spill would not affect benthic communities because the diesel fuel would float and dissipate on the sea surface.

Impacts of Physical Disturbance to the Seafloor

In water depths such as those that are encountered in the project area, DP MODU disturb the seafloor only around the wellbore (seafloor surface hole location) where the bottom template and BOP are located. Depending upon the specific well configuration, this area is generally about 0.62 ac (0.25 ha) per well (BOEM, 2012a).

The areal extent of these impacts will be small compared to the project area itself. Soft bottom communities are ubiquitous along the northern Gulf of Mexico continental slope (Gallaway et al., 2003, Rowe and Kennicutt, 2009). Physical disturbance to the seafloor during this project will be localized and are likely to have no significant impact on soft bottom benthic communities on a regional basis.

Impacts of Effluent Discharges

Drilling mud and cuttings are the only effluents likely to affect these soft bottom benthic communities that could be present in vicinity of the wellsites. During initial well interval(s) before the marine riser is set, cuttings and seawater-based “spud mud” will be released at the seafloor. Excess cement slurry will also be released at the seafloor by casing installation during the riserless portion of the drilling operations. Cement slurry components typically include cement mix and some of the same chemicals used in WBM (Boehm et al., 2001, Fink, 2015). The main impacts will

be burial and smothering of benthic organisms within several meters to tens of meters around the wellbore. Small amounts of water-based BOP fluid will be released at the seafloor and are expected to be rapidly diluted and dispersed.

Benthic community effects of drilling discharges have been reviewed extensively by the National Research Council (1983), Neff (1987), Neff et al. (2005), and Hinwood et al. (1994). Due to the low toxicity of WBM and associated drill cuttings, the main mechanism of impact to benthic communities is increased sedimentation, possibly resulting in burial or smothering within several meters to tens of meters around the wellbore. Monitoring programs have shown that benthic impacts of drilling are minor and localized within a few hundred meters of the wellsite (National Research Council, 1983, Neff, 1987, Neff et al., 2005, Continental Shelf Associates, 2006). Soft bottom sediments disturbed by cuttings, drilling mud, cement slurry, and BOP fluid will eventually be recolonized through larval settlement and migration from adjacent areas. Because some deep-sea biota grow and reproduce slowly, recovery may require several years.

Discharges of treated SBM associated cuttings from the MODU may affect benthic communities, primarily within several hundred meters of the wellsites. The fate and effects of SBM cuttings have been reviewed by Neff et al. (2000), and monitoring studies have been conducted in the Gulf of Mexico by Continental Shelf Associates (2004, 2006). In general, cuttings with adhering SBM tend to clump together and form thick cuttings piles close to the drillsites. Areas of SBM cuttings deposition may develop elevated organic carbon concentrations and anoxic conditions (Continental Shelf Associates, 2006). Where SBM cuttings accumulate and concentrations exceed approximately 1,000 mg kg⁻¹, benthic infaunal communities may be adversely affected due to both the toxicity of the base fluid and organic enrichment (with resulting anoxia) (Neff et al., 2000). Infaunal numbers may increase and diversity may decrease as opportunistic species that tolerate low oxygen and high H₂S predominate (Continental Shelf Associates, 2006). As the base SBM is biodegraded by microbes, the area will gradually recover to pre-drilling conditions. Disturbed sediments will be recolonized through larval settlement and migration from adjacent areas.

The areal extent of impacts from drilling discharges will be small; the typical effect radius is approximately 1,640 ft (500 m) around each wellsite. Soft bottom benthic communities are ubiquitous along the northern Gulf of Mexico continental slope (Gallaway, 1988, Gallaway et al., 2003, Rowe and Kennicutt, 2009); thus impacts from drilling discharges during this project will have no significant impact on soft bottom benthic communities on a regional basis.

Impacts of a Large Oil Spill

Potential impacts of a large oil spill on the benthic community are expected to be consistent with those analyzed and discussed by BOEM (2012a, 2015, 2016b, 2017a). Impacts from a subsea blowout could include smothering and exposure to toxic hydrocarbons from oiled sediment settling to the seafloor. The most likely effects of a subsea blowout on benthic communities would be within a few hundred meters of the wellsites. BOEM (2012a) estimated that a severe subsurface blowout could suspend and disperse sediments within a 984 ft (300 m) radius. Although coarse sediments (sands) would probably settle at a rapid rate within 1,312 ft (400 m) from the blowout site, fine sediments (silts and clays) could be suspended for more than 30 days and dispersed over a much wider area. A previous study characterized surface sediments at the sampling stations in the vicinity of the proposed wellsites. Sediments at these two stations were

similar, predominantly clay (60% at Station AC1 and 64% at Station RW5) and silt (35% at Station AC1 and 28% at Station RW5) (Rowe and Kennicutt, 2009).

Previous analyses by BOEM (2016b, 2017a) concluded that oil spills would be unlikely to affect benthic communities beyond the immediate vicinity of the wellhead (i.e., due to physical impacts of a blowout) because the oil would rise quickly to the sea surface directly over the spill location. During the *Deepwater Horizon* incident, the use of subsea dispersants at the wellhead caused the formation of subsurface plumes (NOAA, 2011b). While the behavior and impacts of subsurface plumes are not well known, a subsurface plume could contact the seafloor and affect benthic communities beyond the 984 ft (300 m) radius (BOEM, 2012a), depending on its extent, trajectory, and persistence (Spier et al., 2013). This contact could result in smothering and/or toxicity to benthic organisms. The subsurface plumes observed following the *Deepwater Horizon* incident were reported in water depths of approximately 3,600 ft (1,100 m), extending at least 22 miles (35 km) from the wellsite and persisting for more than a month (Camilli et al., 2010). The subsurface plumes apparently resulted from the use of subsea dispersants at the wellhead (NOAA, 2011b, Spier et al., 2013). Montagna et al. (2013) estimated that the most severe impacts to soft bottom benthic communities (e.g., reduction of faunal abundance and diversity) from the *Deepwater Horizon* incident extended 2 miles (3 km) from the wellhead in all directions, covering an area of approximately 9 miles² (24 km²). Moderate impacts were observed up to 11 miles (17 km) to the southwest and 5 miles (8.5 km) to the northeast of the wellhead, covering an area of 57 miles² (148 km²). NOAA (2016b) documented a footprint of over 772 miles² (2,000 km²) of impacts to benthic habitats surrounding the *Deepwater Horizon* incident site. The analysis also identified a larger area of approximately 3,552 miles² (9,200 km²) of potential exposure and uncertain impacts to benthic communities (NOAA, 2016b). Stout and Payne (2018) also noted that SBM released as a result of the blowout covered an area of 2.5 miles² (6.5 km²).

While the behavior and impacts of subsurface oil plumes are not well known, the Macondo findings indicate that benthic impacts likely extend beyond the immediate vicinity of the wellsite, depending on the extent, trajectory, and persistence of the plume. Baguley et al. (2015) noted that while nematode abundance increased with proximity to the Macondo wellhead, copepod abundance, relative species abundance, and diversity decreased in response to the *Deepwater Horizon* incident. Washburn et al. (2017) noted that richness, diversity, and evenness were affected within a radius of 0.62 miles (1 km) of the wellhead. Reuscher et al. (2017) found that meiofauna and macrofauna community diversity was significantly lower in areas that were impacted by Macondo oil. Demopoulos et al. (2016) reported abnormally high variability in meiofaunal and macrofaunal density in areas near the Macondo wellhead, which supports the Valentine et al. (2014) supposition that hydrocarbon deposition and impacts in the vicinity of the Macondo wellhead were patchy. Noirungsee et al. (2020) observed that pressure has a significant influence on deep-sea sediment microbial communities with the addition of dispersant and oil with dispersants being shown to have an inhibitory effect on hydrocarbon degraders. Thus, the dispersant persistence due to hydrostatic pressure could further limit microbial oil biodegradation (Noirungsee et al., 2020). While there are some indications of partial recovery of benthic fauna, as of 2015, full recovery has not occurred (Montagna et al., 2016, Reuscher et al., 2017, Washburn et al., 2017).

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will minimize potential impacts.

EP Section 9b provides detail on spill response measures. No significant spill impacts on soft bottom communities are expected.

C.2.2 High-Density Deepwater Benthic Communities

As defined in NTL 2009-G40, high-density deepwater benthic communities are features or areas that could support high-density chemosynthetic communities, high-density deepwater corals, or other associated high-density hard bottom communities. Chemosynthetic communities were discovered in the central Gulf of Mexico in 1984 and have been studied extensively (MacDonald, 2002). Deepwater coral communities are also known from numerous locations in the Gulf of Mexico (Cordes et al., 2008, Brooks et al., 2012, Demopoulos et al., 2017, Hourigan et al., 2017). These communities occur almost exclusively on exposed authigenic carbonate rock created by a biogeochemical (microbial) process, and on shipwrecks.

Monitoring programs on the Gulf of Mexico continental slope have shown that benthic impacts from drilling discharges typically are concentrated within approximately 1,640 ft (500 m) of the wellsite, although detectable deposits may extend beyond this distance (Continental Shelf Associates, 2004, 2006, Neff et al., 2005). The nearest known high-density deepwater benthic communities are found in AC Block 645, approximately 18 miles (30 km) from the project area (BOEM, nd).

In water depths such as those encountered in the project area, the DP MODU will disturb the seafloor only in the immediate vicinity of the drill sites (**Section A.2**). Based on the shallow geohazards assessment, no features or areas that could support significant, high-density benthic communities were found within 2,000 ft (610 m) of the proposed wellsites (Geoscience Earth & Marine Services, Inc., 2020a). As a result, high-density deepwater benthic communities are not expected to be present.

The only IPF identified for this project that could potentially affect high-density deepwater benthic communities is a large oil spill from a well blowout at the seafloor. Physical disturbances and effluent discharges are not likely to affect high-density deepwater benthic communities since these are generally limited to localized impacts. A small fuel spill would not affect benthic communities because the diesel fuel would float and dissipate from the sea surface.

Impacts of a Large Oil Spill

BOEM (2012a, 2015, 2016c, 2017a) concluded that oil spills would be unlikely to affect benthic communities beyond the immediate vicinity of the wellhead (i.e., due to physical impacts of a blowout) because the oil would rise quickly to the sea surface directly over the spill location. However, subsea oil plumes resulting from a seafloor blowout could affect sensitive deepwater communities (BOEM, 2016b). During the *Deepwater Horizon* incident, subsurface plumes were reported at a water depth of approximately 3,600 ft (1,100 m), extending at least 22 miles (35 km) from the wellsite and persisting for more than a month (Camilli et al., 2010). The subsurface plumes apparently resulted from the use of subsea dispersants at the wellhead (NOAA, 2011c). Chemical components of subsea dispersants used during the *Deepwater Horizon* incident persisted for up to 2 months and were detectable up to 186 miles (300 km) from the wellsite at water depths of 3,280 to 3,937 ft (1,000 to 1,200 m) (Kujawinski et al., 2011). However, estimated dispersant concentrations in the subsea plume were below levels known to be toxic to marine life. While the behavior and impacts of subsurface plumes are not well known, a subsurface plume could have the potential to contact high-density deepwater benthic communities beyond the 984

ft (300 m) radius estimated by (BOEM, 2016a) depending on its extent, trajectory, and persistence (Spier et al., 2013). Potential impacts on sensitive resources would be an integral part of the decision and approval process for the use of dispersants.

Potential impacts of oil on high-density deepwater benthic communities are discussed by BOEM (2012a, 2015, 2016c, 2017a). Oil plumes that directly contact localized patches of sensitive benthic communities before degrading could potentially impact the resource. However, the potential impacts would be localized due to the directional movement of oil plumes by the water currents and because the sensitive habitats have a scattered, patchy distribution. The more likely result would be exposure to widely dispersed, biodegraded particles that “rain” down from a passing oil plume. While patches of habitat may be affected, the Gulf-wide ecosystem of live bottom communities would be expected to suffer no significant effects (BOEM, 2016b).

Although chemosynthetic communities live among hydrocarbon seeps, natural seepage occurs at a relatively constant low rate compared with the potential rates of oil release from a blowout. In addition, seep organisms require unrestricted access to oxygenated water at the same time as exposure to hydrocarbon energy sources (MacDonald, 2002). Oil droplets or oiled sediment particles could come into contact with chemosynthetic organisms. As discussed by BOEM (2017a), impacts could include loss of habitat and biodiversity; destruction of hard substrate; change in sediment characteristics; and reduction or loss of one or more commercial and recreational fishery habitats.

Sublethal effects are possible for deepwater coral communities that receive a lower level of oil impact. Effects to deepwater coral communities could be temporary (e.g., lack of feeding, loss of tissue mass) or long lasting and could affect the resilience of coral colonies to natural disturbances (e.g., elevated water temperature, diseases) (BOEM, 2012a, 2015, 2016b, 2017a). The potential for a spill to affect deepwater corals was observed during an October 2010 survey of deepwater coral habitats in water depths of 4,600 ft (1,400 m) approximately 7 miles (11 km) southwest of the Macondo wellhead. Much of the soft coral observed in a location measuring approximately 50 ft × 130 ft (15 m × 40 m) was covered by a brown flocculent material (Bureau of Ocean Energy Management, Regulation, and Enforcement, 2010) with signs of stress, including varying degrees of tissue loss and excess mucous production (White et al., 2012). Hopanoid petroleum biomarker analysis of the flocculent material indicated that it contained oil from the *Deepwater Horizon* incident. The injured and dead corals were in an area in which a subsea plume of oil had been documented during the spill in June 2010. The deepwater coral at this location showed signs of tissue damage that was not observed elsewhere during these surveys or in previous deepwater coral studies in the Gulf of Mexico. The team of researchers concluded that the observed coral injuries likely resulted from exposure to the subsurface oil plume (White et al., 2012). Apparent recovery of some affected areas by March 2012 correlated negatively with the proportion of the coral covered with floc in late 2010 (Hsing et al., 2013). Fisher et al. (2014b) reported two additional coral areas affected by the *Deepwater Horizon* incident; one 4 miles (6 km) south of the Macondo wellsite, and the other 14 miles (22 km) to the southeast. Prouty et al. (2016) found evidence that corals located northeast of the *Deepwater Horizon* incident were also affected. In addition to direct impacts on corals and other sessile epifauna, the spill also affected macroinfauna associated with these hard bottom communities (Fisher et al., 2014a).

Although no known deepwater coral communities are likely to be impacted by a subsurface plume, previously unidentified communities may be encountered if a large subsurface oil spill occurs. However, because of the scarcity of deepwater hard bottom communities, their

comparatively low surface area, and the requirements set by BOEM in NTL 2009-G40, it is unlikely that a sensitive habitat would be located adjacent to a seafloor blowout or that concentrated oil would contact the site (BOEM, 2012a).

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on Shell's spill response measures. Potential impacts on sensitive resources would be an integral part of the decision and approval process for the use of dispersants.

C.2.3 Designated Topographic Features

The project location is not within or near a designated topographic feature or a no-activity zone as identified in NTL 2009-G39. The nearest designated topographic feature stipulation block is East Breaks Block 165, located approximately 79 miles (127 km) from the project area. There are no IPFs associated with either routine operations or accidents that could cause impacts to designated topographic features due to their distance from the project area.

C.2.4 Pinnacle Trend Area Live Bottoms

The project area is not covered by the Live Bottom (Pinnacle Trend) Stipulation. As defined in NTL 2009-G39, the nearest pinnacle trend block is Main Pass Block 290, approximately 406 miles (653 km) from the project area. There are no IPFs associated with either routine operations or accidents that could cause impacts to pinnacle trend area live bottoms due to the distance from the project area.

C.2.5 Eastern Gulf Live Bottoms

The project area is not covered by the Live Bottom (Low-Relief) Stipulation, which pertains to seagrass communities and low-relief hard bottom reef within the Gulf of Mexico Eastern Planning Area blocks in water depths of 328 ft (100 m) or less and portions of Pensacola and Destin Dome Area Blocks in the Central Planning Area. The nearest block covered by the Live Bottom Stipulation, as defined in NTL 2009-G39, is Destin Dome Block 573, located approximately 449 miles (723 km) from the project area. There are no IPFs associated with either routine operations or accidents that could cause impacts to eastern Gulf of Mexico live bottom areas due to the distance from the project area.

C.3 Threatened, Endangered, and Protected Species and Critical Habitat

This section discusses species listed as Endangered or Threatened under the ESA. In addition, it includes marine mammal species in the region that are protected under the MMPA.

Endangered, Threatened, or species of concern that may occur in the project area and/or along the northern Gulf Coast are listed in **Table 5**. The table also indicates the location of designated critical habitat in the Gulf of Mexico. Critical habitat is defined as (1) specific areas within the geographical area occupied by the species at the time of listing, if they contain physical or biological features essential to conservation, and those features may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species if the agency determines that the area itself is essential for conservation. NMFS has jurisdiction over ESA-listed marine mammals (cetaceans) and fishes in the Gulf of Mexico, and

USFWS has jurisdiction over ESA-listed birds and the West Indian manatee. These two agencies share federal jurisdiction over sea turtles, with NMFS having lead responsibility at sea and USFWS on nesting beaches.

Table 5. Federally listed Endangered and Threatened species potentially present in the project area and along the northern Gulf Coast. Adapted from U.S. Fish and Wildlife Service (2020a) and NOAA Fisheries (2020).

Species	Scientific Name	Status	Potential Presence		Critical Habitat Designated in Gulf of Mexico
			Project Area	Coastal	
Marine Mammals					
Bryde's whale	<i>Balaenoptera edeni</i>	E	X	--	None
Sperm whale	<i>Physeter macrocephalus</i>	E	X	--	None
West Indian manatee	<i>Trichechus manatus</i> ¹	T	--	X	Florida (Peninsular)
Sea Turtles					
Loggerhead turtle	<i>Caretta caretta</i>	T,E ²	X	X	Nesting beaches and nearshore reproductive habitat in Mississippi, Alabama, and Florida; <i>Sargassum</i> habitat including most of the central & western Gulf of Mexico.
Green turtle	<i>Chelonia mydas</i>	T	X	X	None
Leatherback turtle	<i>Dermochelys coriacea</i>	E	X	X	None
Hawksbill turtle	<i>Eretmochelys imbricata</i>	E	X	X	None
Kemp's ridley turtle	<i>Lepidochelys kempii</i>	E	X	X	None
Birds					
Piping Plover	<i>Charadrius melodus</i>	T	--	X	Coastal Texas, Louisiana, Mississippi, Alabama, and Florida
Whooping Crane	<i>Grus americana</i>	E	--	X	Coastal Texas (Aransas National Wildlife Refuge)
Fishes					
Oceanic whitetip shark	<i>Carcharhinus longimanus</i>	T	X	--	None
Giant manta ray	<i>Mobula birostris</i>	T	X	X	None
Gulf sturgeon	<i>Acipenser oxyrinchus desotoi</i>	T	--	X	Coastal Louisiana, Mississippi, Alabama, and Florida
Nassau grouper	<i>Epinephelus striatus</i>	T	--	X	None
Smalltooth sawfish	<i>Pristis pectinata</i>	E	--	X	Southwest Florida
Invertebrates					
Elkhorn coral	<i>Acropora palmata</i>	T	--	X	Florida Keys and the Dry Tortugas
Staghorn coral	<i>Acropora cervicornis</i>	T	--	X	Florida Keys and the Dry Tortugas
Pillar coral	<i>Dendrogyra cylindrus</i>	T	--	X	None
Rough cactus coral	<i>Mycetophyllia ferox</i>	T	--	X	None
Lobed star coral	<i>Orbicella annularis</i>	T	--	X	None
Mountainous star coral	<i>Orbicella faveolata</i>	T	--	X	None
Boulder star coral	<i>Orbicella franksi</i>	T	--	X	None

Species	Scientific Name	Status	Potential Presence		Critical Habitat Designated in Gulf of Mexico
			Project Area	Coastal	
Terrestrial Mammals					
Beach mice (Alabama, Choctawhatchee, Perdido Key, St. Andrew)	<i>Peromyscus polionotus</i>	E	--	X	Alabama and Florida (Panhandle) beaches
Florida salt marsh vole	<i>Microtus pennsylvanicus dukecampbelli</i>	E	--	X	None

-- = not present; E = Endangered; T = Threatened; X = potentially present.

¹ There are two subspecies of West Indian manatee: the Florida manatee (*T. m. latirostris*), which ranges from the northern Gulf of Mexico to Virginia, and the Antillean manatee (*T. m. manatus*), which ranges from northern Mexico to eastern Brazil. Only the Florida manatee subspecies is likely to be found in the northern Gulf of Mexico.

² The Northwest Atlantic Ocean Distinct Population Segment (DPS) of loggerhead turtles is designated as Threatened (76 *Federal Register [FR]* 58868). The National Marine Fisheries Service and the U.S. Fish and Wildlife Service designated critical habitat for this DPS, including beaches and nearshore reproductive habitat in Mississippi, Alabama, and the Florida Panhandle as well as *Sargassum* spp. habitat throughout most of the central and western Gulf of Mexico (79 *FR* 39756 and 79 *FR* 39856).

Coastal Endangered or Threatened species that may occur along the U.S. Gulf Coast include the West Indian manatee (*Trichechus manatus*), Piping Plover (*Charadrius melodus*), Florida salt marsh vole (*Microtus pennsylvanicus dukecampbelli*), Whooping Crane (*Grus americana*), Gulf sturgeon (*Acipenser oxyrinchus desotoi*), smalltooth sawfish (*Pristis pectinate*), and four subspecies of beach mouse. Critical habitat has been designated for all of these species (except the Florida salt marsh vole) as indicated in **Table 5** and discussed in individual sections. Two other coastal bird species (Bald Eagle [*Haliaeetus leucocephalus*] and Brown Pelican [*Pelecanus occidentalis*]) are no longer federally listed as Endangered or Threatened; these are discussed in **Section C.4.2**.

Five sea turtle species, the sperm whale (*Physeter macrocephalus*), and the oceanic whitetip shark (*Carcharhinus longimanus*) are the only Endangered or Threatened species likely to occur within the project area. The listed sea turtles include the leatherback turtle (*Dermochelys coriacea*), Kemp's ridley turtle (*Lepidochelys kempii*), hawksbill turtle (*Eretmochelys imbricata*), loggerhead turtle (*Caretta caretta*), and green turtle (*Chelonia mydas*) (Pritchard, 1997). Effective August 11, 2014, NMFS has designated certain marine areas as critical habitat for the northwest Atlantic distinct population segment (DPS) of the loggerhead sea turtle (**Section C.3.5**). No critical habitat has been designated in the Gulf of Mexico for the leatherback turtle, Kemp's ridley turtle, hawksbill turtle, or the green turtle. Listed marine mammal species include one odontocete (sperm whale) which is known to occur in the Gulf of Mexico (Würsig et al., 2017); no critical habitat has been designated for the sperm whale. The Bryde's whale (*Balaenoptera edeni*) exists in the Gulf of Mexico as a small, resident population. It is the only baleen whale known to be resident to the Gulf. The genetically distinct Northern Gulf of Mexico stock is severely restricted in range, being found only in the northeastern Gulf in the waters of the DeSoto Canyon (Waring et al., 2016) and are therefore not likely to occur within the project area. The giant manta ray (*Mobula birostris*) could occur in the project area but is most commonly observed in the Gulf of Mexico at the Flower Garden Banks. The Nassau grouper (*Epinephelus striatus*) has been observed in the Gulf of Mexico at the Flower Garden Banks but is most commonly observed in shallow tropical reefs of the Caribbean and is not expected to occur in the project area. The smalltooth

sawfish is a coastal species limited to shallow areas off the west coast of Florida and is not expected to occur in the project area.

Four Endangered mysticete whales (blue whale [*Balaenoptera musculus*], fin whale [*Balaenoptera physalus*], North Atlantic right whale [*Eubalaena glacialis*], and sei whale [*Balaenoptera borealis*]) have been reported from the Gulf of Mexico but are considered rare or extralimital (Würsig et al., 2000). These species are not included in the most recent NMFS stock assessment report (Hayes et al., 2020) nor in the most recent BOEM multisale EIS (BOEM, 2017a) as present in the Gulf of Mexico; therefore, they are not considered further in the EIA.

Seven Threatened coral species are known from the northern Gulf of Mexico: elkhorn coral (*Acropora palmata*), staghorn coral (*Acropora cervicornis*), lobed star coral (*Orbicella annularis*), mountainous star coral (*Orbicella faveolata*), boulder star coral (*Orbicella franksi*), pillar coral (*Dendrogyra cylindrus*), and rough cactus coral (*Mycetophyllia ferox*). None of these species are expected to be present in the project area (see **Section C.3.15**).

There are no other Threatened or Endangered species in the Gulf of Mexico that are reasonably likely to be affected by either routine or accidental events.

C.3.1 Sperm Whale (Endangered)

The only Endangered marine mammal likely to be present at or near the project area is the sperm whale. Resident populations of sperm whales occur within the Gulf of Mexico. Gulf of Mexico sperm whales are classified as an Endangered species and a “strategic stock” by NMFS (Waring et al., 2016). A “strategic stock” is defined by the MMPA as a marine mammal stock that meets the following criteria:

- The level of direct human-caused mortality exceeds the potential biological removal level;
- Based on the best available scientific information, is in decline and is likely to be listed as a Threatened species under the ESA within the foreseeable future; or
- Is listed as a Threatened or Endangered species under the ESA or is designated as depleted under the MMPA.

Current threats to sperm whale populations worldwide are discussed in a final recovery plan for the sperm whale published by NMFS (2010a). Threats are defined as “any factor that could represent an impediment to recovery,” and include fisheries interactions, anthropogenic noise, vessel interactions, contaminants and pollutants, disease, injury from marine debris, research, predation and natural mortality, direct harvest, competition for resources, loss of prey base due to climate change and ecosystem change, and cable laying. In the Gulf of Mexico, the impacts from many of these threats are identified as either low or unknown (BOEM, 2012a).

The distribution of sperm whales in the Gulf of Mexico is correlated with mesoscale physical features such as eddies associated with the Loop Current (Jochens et al., 2008). Sperm whale populations in the north-central Gulf of Mexico are present there throughout the year (Davis et al., 2000). Results of a multi-year tracking study show female sperm whales typically concentrated along the upper continental slope between the 656- and 3,280-foot (200- and 1,000-meter) depth contours (Jochens et al., 2008). Male sperm whales were more variable in their movements and were documented in water depths greater than 9,843 ft (3,000 m). Generally, groups of sperm whales sighted in the Gulf of Mexico during the MMS-funded Sperm Whale Seismic Study consisted of mixed-sex groups comprising adult females and

juveniles, and groups of bachelor males. Typical group size for mixed groups was 10 individuals (Jochens et al., 2008). A review of sighting reports from seismic mitigation surveys in the Gulf of Mexico conducted over a 6-year period found a mean group size for sperm whales of 2.5 individuals (Barkaszi et al., 2012).

In these mitigation surveys, sperm whales were the most common cetacean encountered. Results of the Sperm Whale Seismic Study showed that sperm whales transit through the vicinity of the project area. Movements of satellite-tracked individuals suggest that this area of the Gulf continental slope is within the home range of the Gulf of Mexico population (within the 95% utilization distribution) (Jochens et al., 2008).

IPFs that could potentially affect sperm whales include MODU presence, noise, and lights; support vessel and helicopter traffic; and both types of spill accidents: a small fuel spill and a large oil spill. Effluent discharges are likely to have negligible impacts on sperm whales due to rapid dispersion, the small area of ocean affected, the intermittent nature of the discharges, and the mobility of these marine mammals.

Though NMFS (2020a) stated marine debris as an IPF, compliance with BSEE NTL 2015-G03 and NMFS (2020a) Appendix B will minimize the potential for marine debris-related impacts on sperm whales. NMFS (2020a) estimates that no more than three sperm whales will be nonlethally taken, with one sperm whale lethally taken through the ingestion of marine debris over 50 years of proposed action. Therefore, marine debris is likely to have negligible impacts on sperm whales and is not further discussed (See **Table 2**).

Impacts of Mobile Offshore Drilling Unit Presence, Noise, and Lights

Some sounds produced by the MODU may be emitted at levels that could potentially disturb individual whales or mask the sounds animals would normally produce or hear. Noise associated with drilling is relatively weak in intensity, and an individual animal's noise exposure would be transient. As discussed in **Section A.1**, sound generated by an actively drilling MODU are maximum broadband (10 Hz to 10 kHz) source level of approximately 190 dB re 1 μ Pa m (Hildebrand, 2005).

NMFS (2018a) lists sperm whales in the same functional hearing group (i.e., mid frequency cetaceans) as most dolphins and other toothed whales, with an estimated hearing sensitivity from 150 Hz to 160 kHz. Therefore, vessel-related noise is likely to be heard by sperm whales. Frequencies <150 Hz produced by the drilling operations are not likely to be perceived with any significance by mid-frequency cetaceans. The sperm whale may possess better low frequency hearing than some of the other odontocetes, although not as low as many baleen whale species that primarily produce sounds between 30 Hz and 5 kHz (Wartzok and Ketten, 1999). Generally, most of the acoustic energy produced by sperm whales is present at frequencies below 10 kHz, although diffuse energy up to and past 20 kHz is common, with source levels up to 236 dB re 1 μ Pa m (Møhl et al., 2003).

It is expected that, due to the relatively stationary nature of the MODU operations, sperm whales would move away from the proposed operations area, and noise levels that could cause auditory injury would be avoided. Noise associated with proposed vessel operations may cause behavioral (disturbance) effects to sperm whales. Observations of sperm whales near offshore oil and gas operations suggest an inconsistent response to anthropogenic marine sound (Jochens et al., 2008). Most observations of behavioral responses of marine mammals to anthropogenic sounds,

in general, have been limited to short-term behavioral responses, which included the cessation of feeding, resting, or social interactions (NMFS, 2015a). Animals can determine the direction from which a sound arrives based on cues, such as differences in arrival times, sound levels, and phases at the two ears. Thus, an animal's directional hearing capabilities have a bearing on its ability to avoid noise sources (National Research Council, 2003b).

NMFS (2018a) presents criteria that are used to determine physiological (i.e., injury) thresholds for marine mammals. Behavioral disturbance thresholds have not been updated in the most recent acoustic guidance (NMFS, 2018a) and therefore, revert to thresholds established and published by NMFS in 70 *Federal Register (FR)* 1871. Behavioral disturbance thresholds for marine mammals and are applied equally across all functional hearing groups. Received SPL_{rms} of 120 dB re 1 μPa from a non-impulsive source are considered high enough to elicit a behavioral reaction in some marine mammal species. The 120-dB isopleth may extend tens to hundreds of kilometers from the source depending on the propagation environment. However, in the case of behavioral responses, received levels alone do not indicate a behavioral response and, more importantly, do not equate to biologically important responses (Southall et al., 2016, Ellison et al., 2012).

For mid frequency cetaceans exposed to a non-impulsive source (such as MODU operations), permanent threshold shifts are estimated to occur when the mammal has received a cumulative sound exposure level (SEL_{cum}) of 198 dB re 1 $\mu\text{Pa}^2 \text{ s}$ over a 24-hour period (NMFS, 2016a). Similarly, temporary threshold shifts are estimated to occur when the mammal has received a SEL_{cum} of 178 dB re 1 $\mu\text{Pa}^2 \text{ s}$ over a 24-hour period. Based on transmission loss calculations (Urlick, 1983), typical sources with DP thrusters are not expected to produce SPL_{rms} greater than 160 dB re 1 μPa beyond 105 ft (32 m) from the source. Due to the short propagation distance of above-threshold SPL_{rms}, the transient nature of sperm whales, and the stationary nature of the proposed activities, it is not expected that any sperm whales will receive exposure levels necessary for the onset of auditory threshold shifts.

The MODU will be located within a deepwater, open ocean environment. Sounds generated by drilling operations will be generally non-impulsive, with some variability in sound level. This analysis assumes that the continuous nature of sounds produced by the MODU will provide individual whales with cues relative to the direction and relative distance (sound intensity) of the sound source, and the fixed position of the MODU will allow for active avoidance of potential physical impacts. Drilling-related noise associated with this project will contribute to increases in the ambient noise environment of the Gulf of Mexico, but it is not expected to be in amplitudes sufficient enough to cause hearing effects to sperm whales.

MODU lighting and rig presence is not identified as an IPF for sperm whales (NMFS, 2007, 2015, 2020b, BOEM, 2016c, 2017a).

Impacts of Support Vessel and Helicopter Traffic

NMFS has found that support vessel traffic has the potential to disturb sperm whales and creates a risk of vessel strikes, which are identified as a threat in the recovery plan for this species (NMFS, 2010a). To reduce the potential for vessel strikes, BOEM issued NTL BOEM-2016-G01, which recommends protected species identification training and that vessel operators and crews maintain a vigilant watch for marine mammals and slow down or stop their vessel to avoid striking protected species and requires operators to report sightings of any injured or dead protected species. This NTL was reissued in June 2020 to address instances where guidance in the 2020

NMFS Biological Opinion (NMFS, 2020a). In addition, when sperm whales are sighted, vessel operators and crews are required to attempt to maintain a distance of 328 ft (100 m) or greater whenever possible (NTL BOEM 2016-G01 and NMFS, 2020a). Vessel operators are required to reduce vessel speed to 10 knots or less, as safety permits, when mother/calf pairs, pods, or large assemblages of cetaceans are observed near an underway vessel (NTL BOEM-2016-G01). When sperm whales are sighted while a vessel is underway, the vessel should take action (e.g., attempt to remain parallel to the whale's course, avoid excessive speed or abrupt changes in direction until the whale has left the area) as necessary to avoid violating the relevant separation distance. However, if the sperm whale is sighted within this distance, the vessel should reduce speed and shift the engine to neutral and not re-engage until the whale is outside of the separation area. This does not apply to any vessel towing gear (NMFS [2020a] Appendix C). Compliance with these mitigation measures will minimize the likelihood of vessel strikes as well as reduce the chance for disturbing sperm whales.

NMFS (2020a) analyzed the potential for vessel strikes and harassment of sperm whales in its Biological Opinion on the Federally Regulated Oil and Gas Program Activities in the Gulf of Mexico. NMFS concluded that the observed avoidance of passing vessels by sperm whales is an advantageous response to avoid a potential threat and is not expected to result in any significant effect on migration, breathing, nursing, breeding, feeding, or sheltering to individuals, or have any consequences at the level of the population. With the implementation of the NMFS vessel strike protocols listed in Appendix C of NMFS (2020a) in addition to the NTL BOEM-2016-G01, NMFS concluded that the likelihood of collisions between vessels and sperm whales would be reduced during daylight hours. During nighttime and during periods of poor visibility, it is assumed that vessel noise and sperm whale avoidance of moving vessels would reduce the chance of vessel strikes with this species. It is, however, likely that a collision between a sperm whale and a moving support vessel would result in severe injury or mortality of the stricken animal. The current Potential Biological Removal (PBR) level for the Gulf of Mexico stock of sperm whales is 1.1 (Hayes et al., 2019). The PBR level is defined by the MMPA as the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population. Mortality of a single sperm whale would constitute a significant impact to the local (Gulf of Mexico) stock of sperm whales but would not likely be significant at the species level.

Helicopter traffic also has the potential to disturb sperm whales. Smultea et al. (2008) documented responses of sperm whales offshore Hawaii to fixed wing aircraft flying at an altitude of 804 ft (245 m). A reaction to the initial pass of the aircraft was observed during 3 (12%) of 24 sightings. All three reactions consisted of a hasty dive and occurred at less than 1,180 ft (360 m) lateral distance from the aircraft. Additional reactions were seen when aircraft circled certain whales to make further observations. Based on other studies of cetacean responses to sound, the authors concluded that the observed reactions to brief overflights by the aircraft were short-term and limited to behavioral disturbances (Smultea et al., 2008).

Helicopters maintain altitudes above 700 ft (213 m) during transit to and from the offshore working area. In the event that a whale is seen during transit, the helicopter will not approach or circle the animal(s). In addition, guidelines and regulations issued by NMFS under the authority of the MMPA specify that helicopters maintain an altitude of 1,000 ft (305 m) within 328 ft (100 m) of marine mammals (BOEM, 2016a, 2017a, NMFS, 2020a). Although whales may respond to helicopters (Smultea et al., 2008), NMFS (2020a) concluded that this altitude would minimize the potential for disturbing sperm whales. Therefore, no significant impacts are expected.

Impacts of a Small Fuel Spill

Potential spill impacts on marine mammals including sperm whales are discussed by NMFS (2020a) and BOEM (2012a, 2015, 2016b, 2017a). Oil impacts on marine mammals are discussed by Geraci and St. Aubin (1990) and by the Marine Mammal Commission (MMC) (2011). For the EIA, there are no unique site-specific issues with respect to spill impacts on sperm whales that were not analyzed in the previous documents.

The probability of a fuel spill will be minimized by Shell's preventative measures during routine operations, including fuel transfer. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the potential for impacts on sperm whales. EP Section 9b provides detail on spill response measures. Given the open ocean location of the project area and the duration of a small spill, the opportunity for impacts to occur would be very brief.

A small fuel spill in offshore waters would produce a thin slick on the water surface and introduce concentrations of petroleum hydrocarbons and their degradation products. The extent and persistence of impacts would depend on the meteorological and oceanographic conditions at the time of the spill as well as the effectiveness of spill response measures. **Section A.9.1** discusses the likely fate of a small fuel spill and indicates that more than 90% would evaporate or disperse naturally within 24 hours. The area of diesel fuel on the sea surface would range from 1.2 to 12 ac (0.5 to 5 ha), depending on sea state and weather conditions.

Direct physical and physiological effects of exposure to diesel fuel could include skin irritation, inflammation, or necrosis; chemical burns of skin, eyes, and mucous membranes; inhalation of toxic fumes; ingestion of oil directly or via contaminated prey; and stress from the activities and noise of response vessels and aircraft (MMC, 2011). However, due to the limited areal extent and short duration of water quality impacts from a small fuel spill, as well as the mobility of sperm whales, no significant impacts are expected.

Impacts of a Large Oil Spill

Potential spill impacts on marine mammals including sperm whales are discussed by BOEM (2012a, 2015, 2016b, 2017a), and NMFS (2020a). Oil impacts on marine mammals are discussed by Geraci and St. Aubin (1990) and by the MMC (2011). For the EIA, there are no unique site-specific issues with respect to spill impacts on sperm whales.

Impacts of oil spills on sperm whales can include direct impacts from oil exposure as well as indirect impacts due to response activities and materials (e.g., vessel traffic, noise, dispersants) (MMC, 2011). Direct physical and physiological effects can include skin irritation, inflammation, or necrosis; chemical burns of skin, eyes, and mucous membranes; inhalation of toxic fumes; ingestion of oil (and dispersants) directly or via contaminated prey; and stress from the activities and noise of response vessels and aircraft. The level of impact of oil exposure depends on the amount, frequency, and duration of exposure; route of exposure; and type or condition of petroleum compounds or chemical dispersants (Waring et al., 2016). Complications of the above may lead to dysfunction of immune and reproductive systems, physiological stress, declining physical condition, and death. Behavioral responses can include displacement of animals from prime habitat, disruption of social structure, changing prey availability and foraging distribution and/or patterns, changing reproductive behavior/productivity, and changing movement patterns or migration (MMC, 2011). Ackleh et al. (2012) hypothesized that sperm whales may have temporarily relocated away from the vicinity of the *Deepwater Horizon* incident in 2010. However,

based on aerial surveys conducted in the aftermath of the spill, visibly oiled cetaceans (including several sperm whales) were identified within the footprint of the oil slick (Dias et al., 2017).

In the event of a large spill, the level of vessel and aircraft activity associated with spill response could disturb sperm whales and potentially result in vessel strikes, entanglement, or other injury or stress. Response vessels would operate in accordance with NTL BOEM-2016-G01 (see **Table 1**) to reduce the potential for striking or disturbing these animals.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the event of oil from a large spill contacting sperm whales, it is expected that impacts resulting in the injury or death of individual sperm whales would be adverse. Based on the current PBR level for the Gulf of Mexico stock of sperm whales (1.1), mortality of a single sperm whale would constitute a significant impact to the local (Gulf of Mexico) stock of sperm whales but would not likely be significant at the species level. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.3.2 Bryde's Whale (Endangered)

The Bryde's whale is the only year-round resident baleen whale in the northern Gulf of Mexico. The Bryde's whale is sighted most frequently in the waters over DeSoto Canyon between the 328 ft (100 m) and 3,280 ft (1,000 m) isobaths (Rosel et al., 2016, Hayes et al., 2019). Most sightings have been made in the DeSoto Canyon region and off western Florida, although there have been some in the west-central portion of the northeastern Gulf of Mexico. Based on the available data, it is possible that Bryde's whales could occur in the project area though unlikely.

In 2014, a petition was submitted to designate the northern Gulf of Mexico population as a DPS and list it as Endangered under the ESA (Natural Resources Defense Council, 2014). This petition received a 90-day positive finding by NMFS in 2015 and a proposed rule to list was published in 2016 (Hayes et al., 2019). On April 15, 2019, NMFS issued a final rule to list the Gulf of Mexico DPS of Bryde's whale as Endangered under the ESA. The listing was effective on May 15, 2019.

IPFs that could affect the Bryde's whales include MODU presence, noise, and lights; support vessel and helicopter traffic; and both types of spill accidents: a small fuel spill and a large oil spill. Effluent discharges are likely to have negligible impacts on Bryde's whales due to rapid dispersion, the small area of ocean affected, the intermittent nature of the discharges, and the mobility and low abundance of Bryde's whales in the Gulf of Mexico.

Though NMFS (2020a) stated marine debris as an IPF, compliance with BSEE NTL 2015-G03 and NMFS (2020a) Appendix B will minimize the potential for marine debris-related impacts on Bryde's whales. NMFS (2020a) estimated one sublethal take and no lethal takes of Bryde's whales from marine debris over 50 years of proposed action. Therefore, marine debris is likely to have negligible impacts on Bryde's whales and is not further discussed (See **Table 2**).

Impacts of Mobile Offshore Drilling Unit Presence, Noise, and Lights

Some sounds produced by the MODU may be emitted at levels that could potentially disturb individual whales or mask the sounds animals would normally produce or hear. Noise associated with drilling is relatively weak in intensity, and an individual animal's noise exposure would be

transient. As discussed in **Section A.1**, frequencies generated by an actively drilling MODU are maximum broadband (10 Hz to 10 kHz) with a root-mean-square source level of approximately 177 to 190 dB re 1 μPa m (Hildebrand, 2005).

NMFS (2018a) lists Bryde's whales in the functional hearing group of low frequency cetaceans (baleen whales), with an estimated hearing sensitivity from 7 Hz to 35 kHz. Therefore, vessel-related noise is likely to be heard by Bryde's whales. Frequencies <150 Hz produced by the drilling operations is more likely to be perceived by low-frequency cetaceans.

It is expected that, due to the relatively stationary nature of the MODU operations, Bryde's whales would move away from the proposed operations area, and noise levels that could cause auditory injury would be avoided. Noise associated with proposed vessel operations may cause behavioral (disturbance) effects to individual Bryde's whales. NMFS (2018a) presents criteria that are used to determine physiological (i.e., injury) thresholds for marine mammals. Behavioral disturbance thresholds have not been updated in the most recent acoustic guidance (NMFS, 2018a) and therefore, revert to thresholds established and published by NMFS in *70 Federal Register (FR)* 1871. Received SPL_{rms} of 120 dB re 1 μPa from a non-impulsive source are considered high enough to elicit a behavioral reaction in some marine mammal species. The 120-dB isopleth may extend tens to hundreds of kilometers from the source depending on the propagation environment. However, exposure to a SPL_{rms} of 120 dB re 1 μPa alone does not equate to a behavioral response or a biological consequence; rather it represents the level at which onset of a behavioral response may occur (Southall et al., 2016, Ellison et al., 2012).

For low frequency cetaceans, specifically the Bryde's whale, permanent and temporary threshold shift onset from non-impulsive sources is estimated to occur at SEL_{cum} of 199 dB re 1 μPa^2 s and 179 re 1 μPa^2 s, respectively. MODU operations and DP thrusters are not expected to reach permanent or temporary threshold shift values, and based on open water transmission loss calculations (Urick, 1983), noise produced by typical sources with DP thrusters in use during drilling, are not expected to propagate SPL_{rms} greater than the behavioral threshold of 120 dB re 1 μPa beyond 2,290 ft (700 m) from the source.

The MODU will be located within a deepwater, open ocean environment. Sounds generated by drilling operations will be generally non-impulsive, with some variability in sound level and frequency. This analysis assumes that the continuous nature of sounds produced by the MODU will provide individual whales with cues relative to the direction and relative distance (sound intensity) of the sound source, and the fixed position of the MODU will allow for active avoidance of potential physical impacts. Drilling-related noise associated with this project will contribute to increases in the ambient noise environment of the Gulf of Mexico, but it is not expected to be in amplitudes sufficient enough to cause hearing effects to Bryde's whales and due to the low density of Bryde's whales in the Gulf of Mexico, no significant impacts are expected.

Impacts of Support Vessel and Helicopter Traffic

Support vessel traffic has the potential to disturb Bryde's whales and creates a potential for vessel strikes. To reduce the potential for vessel strikes, BOEM has issued NTL BOEM-2016-G01, which recommends protected species identification training and that vessel operators and crews maintain a vigilant watch for marine mammals and slow down or stop their vessel to avoid striking protected species and requires operators to report sightings of any injured or dead protected

species. When whales are sighted, vessel operators and crews are required to attempt to maintain a distance of 1,640 ft (500 m) or greater whenever possible (NTL BOEM-2016-G01; NMFS, 2020a). Vessel operators are required to reduce vessel speed to 10 knots or less, as safety permits, when mother/calf pairs, pods, or large assemblages of cetaceans are observed near an underway vessel (NTL BOEM-2016-G01). When a Bryde's whale is sighted while a vessel is underway, the vessel should take action (e.g., attempt to remain parallel to the whale's course, avoid excessive speed or abrupt changes in direction until the whale has left the area) as necessary to avoid violating the relevant separation distance. However, if the whale is sighted within this distance, the vessel should reduce speed and shift the engine to neutral and not re-engage until the whale is outside of the separation area. This does not apply to any vessel towing gear (NMFS [2020a] Appendix C).

Compliance with these mitigation measures will minimize the likelihood of vessel strikes as well as reduce the chance for disturbing Bryde's whales. The current PBR level for the Gulf of Mexico stock of Bryde's whale is 0.03 (Hayes et al., 2019). Mortality of a single Bryde's whale would constitute a significant impact to the local (Gulf of Mexico) stock of Bryde's whales. However, it is very unlikely that Bryde's whale occur within the project area, including the transit corridor for support vessels; consequently, the probability of a vessel collision with this species is extremely low. Compliance with these mitigation measures will minimize the likelihood of vessel strikes as well as reduce the chance for disturbing Bryde's whales.

Helicopter traffic also has the potential to disturb Bryde's whales. Based on studies of cetacean responses to sound, the observed reactions to brief overflights by aircraft were short-term and limited to behavioral disturbances (Smultea et al., 2008). Helicopters maintain altitudes above 700 ft (213 m) during transit to and from the offshore working area. In the event that a whale is seen during transit, the helicopter will not approach or circle the animal(s). In addition, guidelines and regulations issued by NMFS under the authority of the MMPA specify that helicopters maintain an altitude of 1,000 ft (305 m) within 1,640 ft (500 m) of marine mammals (BOEM, 2016a, 2017a, NMFS, 2020a). Due to the brief potential for disturbance the low density of Bryde's whales thought to reside in the Gulf of Mexico, no significant impacts are expected.

Impacts of a Small Fuel Spill

Potential spill impacts on marine mammals are discussed by NMFS (2020a) and BOEM (2012a, 2015, 2016b, 2017a). Oil impacts on marine mammals are discussed by Geraci and St. Aubin (1990) and by the MMC (2011). The probability of a fuel spill will be minimized by Shell's preventative measures during routine operations, including fuel transfer. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the potential for impacts on Bryde's whales. EP Section 9b provides detail on spill response measures. Given the open ocean location of the project area and the duration of a small spill, the opportunity for impacts to occur would be very brief.

A small fuel spill in offshore waters would produce a thin slick on the water surface and introduce concentrations of petroleum hydrocarbons and their degradation products. The extent and persistence of impacts would depend on the meteorological and oceanographic conditions at the time of the spill as well as the effectiveness of spill response measures. **Section A.9.1** discusses the likely fate of a small fuel spill and indicates that more than 90% would evaporate or disperse naturally within 24 hours. The area of diesel fuel on the sea surface would range from 1.2 to 12 ac (0.5 to 5 ha), depending on sea state and weather conditions.

Direct physical and physiological effects of exposure to diesel fuel could include skin irritation, inflammation, or necrosis; chemical burns of skin, eyes, and mucous membranes; inhalation of toxic fumes; ingestion of oil directly or via contaminated prey; and stress from the activities and noise of response vessels and aircraft (MMC, 2011). However, due to the limited areal extent and short duration of water quality impacts from a small fuel spill, as well as the mobility of Bryde's whales and the unlikelihood of Bryde's whales in the project area, no significant impacts are expected.

Impacts of a Large Oil Spill

Potential spill impacts on marine mammals are discussed by BOEM (2012a, 2015, 2016b, 2017a), and NMFS (2020a). Oil impacts on marine mammals are discussed by Geraci and St. Aubin (1990) and by the MMC (2011).

Potential impacts of a large oil spill on Bryde's whales could include direct impacts from oil exposure as well as indirect impacts due to response activities and materials (e.g., vessel traffic, noise, dispersants) (MMC, 2011). Direct physical and physiological effects could include skin irritation, inflammation, or necrosis; chemical burns of skin, eyes, and mucous membranes; inhalation of toxic fumes; ingestion of oil (and dispersants) directly or via contaminated prey; and stress from the activities and noise of response vessels and aircraft. The level of impact of oil exposure depends on the amount, frequency, and duration of exposure; route of exposure; and type or condition of petroleum compounds or chemical dispersants (Hayes et al., 2019). Complications of the above may lead to dysfunction of immune and reproductive systems, physiological stress, declining physical condition, and death. Behavioral responses can include displacement of animals from prime habitat, disruption of social structure, changing prey availability and foraging distribution and/or patterns, changing reproductive behavior/productivity, and changing movement patterns or migration (MMC, 2011).

In the event of a large spill, the level of vessel and aircraft activity associated with spill response could disturb Bryde's whales and potentially result in vessel strikes, entanglement, or other injury or stress. Response vessels would operate in accordance with NTL BOEM-2016-G01 (see **Table 1**) to reduce the potential for striking or disturbing these animals.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the event of oil from a large spill contacting Bryde's whales, it is expected that impacts resulting in the injury or death of individual Bryde's whales would be significant based on the current PBR level for the Gulf of Mexico subspecies and stock (0.03). Mortality of a single Bryde's whale would constitute a significant impact to the local (Gulf of Mexico) stock of Bryde's whales. The core distribution area for Bryde's whales is within the eastern Gulf of Mexico OCS Planning Area; therefore, it is very unlikely that Bryde's whale occur within the project area and surrounding waters. Consequently, the probability of spilled oil from a project-related well blowout reaching Bryde's whales is extremely low.

C.3.3 West Indian Manatee (Threatened)

Most of the Gulf of Mexico West Indian manatee population is located in peninsular Florida (USFWS, 2001a). Critical habitat has been designated in southwest Florida in Manatee, Sarasota, Charlotte, Lee, Collier, and Monroe counties. Manatees regularly migrate farther west of Florida in the warmer months (Wilson, 2003) into Alabama and Louisiana coastal habitats, with some

individuals traveling as far west as Texas (Fertl et al., 2005). There have been three verified reports of Florida manatee sightings on the OCS during seismic mitigation surveys in mean water depths of over 1,969 ft (600 m) (Barkaszi and Kelly, 2019). One of these sightings resulted in a shutdown of airgun operations. A species description is presented in the recovery plan for this species (USFWS, 2001a).

IPFs that could potentially affect manatees include support vessel and helicopter traffic and a large oil spill. A small fuel spill in the project area would be unlikely to affect manatees because the project area is approximately 161 miles (259 km) from the nearest shoreline (Texas). As explained in **Section A.9.1**, a small fuel spill would not be expected to make landfall or reach coastal waters prior to dissipating. Compliance with NTL BSEE 2015-G013 (see **Table 1**) will minimize the potential for marine debris-related impacts on manatees. In certain cases, guidance in Appendix A of NMFS (2020a) replaces guidance in the NTL per the June 2020 reissued BSEE-NTL-2015-G03. Consistent with the analysis by BOEM (2016a), impacts of routine project-related activities on the manatee would be negligible.

Impacts of Support Vessel and Helicopter Traffic

Support vessel traffic associated with routine MODU operations has the potential to disturb manatees, and there is also a risk of vessel strikes, which are identified as a threat in the recovery plan for this species (USFWS, 2001a). Manatees are expected to be limited to inner shelf and coastal waters, and impacts are expected to be limited to transits of these vessels and helicopters through these waters. To reduce the potential for vessel strikes, BOEM has issued NTL BOEM-2016-G01, which recommends protected species identification training and that vessel operators and crews maintain a vigilant watch for marine mammals and slow down or stop their vessel to avoid striking protected species and requires operators to report sightings of any injured or dead protected species. Vessel strike avoidance measures described in NMFS (2020a) for the marine mammal species managed by that agency may also provide some additional indirect protections to manatees.

Compliance with NTL BOEM-2016-G01 will minimize the likelihood of vessel strikes, and no significant impacts on manatees are expected. The current PBR level for the Florida subspecies of Antillean manatee is 14 (USFWS, 2014). In the event of a vessel strike during support vessel transits, the mortality of a single manatee would constitute an adverse but insignificant impact to the subspecies.

Depending on flight altitude, helicopter traffic also has the potential to disturb manatees. Rathbun (1988) reported that manatees were disturbed more by helicopters than by fixed-wing aircraft; however, the helicopter was flown at relatively low altitudes of 66 to 525 ft (20 to 160 m). Helicopters used in support operations maintain a minimum altitude of 700 ft (213 m) while in transit offshore, 1,000 ft (305 m) over unpopulated areas or across coastlines, and 2,000 ft (610 m) over populated areas and sensitive habitats such as wildlife refuges and park properties. In addition, guidelines and regulations issued by NMFS under the authority of the MMPA specify that helicopters maintain an altitude of 1,000 ft (305 m) within 328 ft (100 m) of marine mammals (BOEM, 2012a,b, NMFS, 2020a). This mitigation measure will minimize the potential for disturbing manatees, and no significant impacts are expected.

Impacts of a Large Oil Spill

Based on the 30-day OSRA modeling (**Table 3**), coastal areas would not likely be affected within 3 to 10 days. Coastal areas between Cameron County, Texas, and Vermilion Parish, Louisiana, may be affected within 30 days of a spill (1% to 8% conditional probability). There is no manatee critical habitat designated in these areas, and the number of manatees potentially present is a small fraction of the population in peninsular Florida.

In the event that manatees were exposed to oil, effects could include direct impacts from oil exposure, as well as indirect impacts due to response activities and materials (e.g., vessel traffic, noise, dispersants) (MMC, 2011). Direct physical and physiological effects can include asphyxiation, acute poisoning, lowering of tolerance to other stress, nutritional stress, and inflammation infection (BOEM, 2017a). Indirect impacts include stress from the activities and noise of response vessels and aircraft (BOEM, 2017a). Complications of the above may lead to dysfunction of immune and reproductive systems, physiological stress, declining physical condition, and death. Behavioral responses can include displacement of animals from prime habitat, disruption of social structure, changing prey availability and foraging distribution and/or patterns, changing reproductive behavior/productivity, and changing movement patterns or migration (MMC, 2011).

In the event that a large spill reached coastal waters where manatees were present, the level of vessel and aircraft activity associated with spill response could disturb manatees and potentially result in vessel strikes, entanglement, or other injury or stress. Response vessels would operate in accordance with NTL BOEM-2016-G01 (see **Table 1**) to reduce the potential for striking or disturbing these animals.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the event of oil from a large spill enters areas inhabited by manatees, it is expected that impacts resulting in the injury or death of individual manatees could be significant at the population level. The current PBR level for the Florida subspecies of Antillean manatee is 14 (USFWS, 2014). It is not anticipated that groups of manatees would occur in coastal waters of the north central GOM; therefore, in the event of mortality of individual manatees from a large oil spill would constitute an adverse but insignificant impact to the subspecies. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.3.4 Non-Endangered Marine Mammals (Protected)

All marine mammal species are protected under the MMPA. In addition to the three Endangered species of marine mammals that were cited in **Sections C.3.1 to C.3.3**, 20 additional species of marine mammals may be found in the Gulf of Mexico. These include the dwarf and pygmy sperm whales (*Kogia sima* and *K. breviceps*, respectively), four species of beaked whales, and 14 species of delphinid whales and dolphins (see EP Section 6h). The minke whale (*Balaenoptera acutorostrata*) is considered rare in the Gulf of Mexico, and is therefore not considered further in the EIA (BOEM, 2012a). The most common non-endangered cetaceans in the deepwater environment are odontocetes (toothed whales and dolphins) such as the pantropical spotted dolphin (*Stenella attenuata*), spinner dolphin (*Stenella longirostris*), and Clymene dolphin (*Stenella clymene*). A brief summary is presented in this section, and additional information on these groups is presented by BOEM (2017a).

Dwarf and pygmy sperm whales. At sea, it is difficult to differentiate dwarf sperm whales from pygmy sperm whales, and sightings are often grouped together as *Kogia* spp. Both species have a worldwide distribution in temperate to tropical waters. In the Gulf of Mexico, both species occur primarily along the continental shelf edge and in deeper waters off the continental shelf (Mullin et al., 1991, Mullin, 2007, Hayes et al., 2019). Either species could occur in the project area.

Beaked whales. Four species of beaked whales are known from the Gulf of Mexico. They are Blainville's beaked whale (*Mesoplodon densirostris*), Sowerby's beaked whale (*Mesoplodon bidens*), Gervais' beaked whale (*Mesoplodon europaeus*), and Cuvier's beaked whale (*Ziphius cavirostris*). Stranding records (Würsig et al., 2000) as well as passive acoustic monitoring in the Gulf of Mexico (Hildebrand et al., 2015), suggest that Gervais' beaked whale and Cuvier's beaked whale are the most common species in the region. The Sowerby's beaked whale is considered extralimital, with one documented stranding reported in the Gulf of Mexico by Bonde and O'Shea (1989). There are a number of extralimital strandings and sightings reported beyond the recognized range of Sowerby's beaked whale (e.g., Canary Islands, Mediterranean Sea), including from the Gulf of Mexico side of Florida (Taylor et al., 2008). Blainville's beaked whales are rare, with only four documented strandings in the northern Gulf of Mexico (Würsig et al., 2000).

Due to the difficulties of at-sea identification, beaked whales in the Gulf of Mexico are identified either as Cuvier's beaked whales (*Ziphius* spp.) or grouped into an undifferentiated species complex (*Mesoplodon* spp.). In the northern Gulf of Mexico, they are broadly distributed in waters greater than 3,281 ft (1,000 m) over lower slope and abyssal landscapes (Davis et al., 2000). Any of these species could occur in the project area (Hayes et al., 2019).

Delphinids. Fourteen species of delphinids are known to occur in the Gulf of Mexico: Atlantic spotted dolphin (*Stenella frontalis*), bottlenose dolphin (*Tursiops truncatus*), Clymene dolphin, killer whale (*Orcinus orca*), false killer whale (*Pseudorca crassidens*), Fraser's dolphin (*Lagenodelphis hosei*), melon-headed whale (*Peponocephala electra*), pantropical spotted dolphin, pygmy killer whale (*Feresa attenuata*), short-finned pilot whale (*Globicephala macrorhynchus*), Risso's dolphin (*Grampus griseus*), rough-toothed dolphin (*Steno bredanensis*), spinner dolphin, and striped dolphin (*Stenella coeruleoalba*). The most common non-endangered cetaceans in the deepwater environment of the northern Gulf of Mexico are the pantropical spotted dolphin, spinner dolphin, and rough-toothed dolphin. However, any of these species could occur in the project area (Waring et al., 2016, Hayes et al., 2019).

The bottlenose dolphin is a common inhabitant of the northern Gulf of Mexico, particularly within continental shelf waters. There are two ecotypes of bottlenose dolphins, a coastal form and an offshore form, which are genetically isolated from each other (Waring et al., 2016). The offshore form of the bottlenose dolphin inhabits waters seaward from the 200-meter isobath and may occur within the project area. Inshore populations of coastal bottlenose dolphins in the northern Gulf of Mexico are separated by the NMFS into 31 geographically distinct population units, or stocks, for management purposes (Hayes et al., 2019).

Bottlenose dolphins in the Northern Gulf of Mexico are categorized into three stocks by NMFS (2016b): Bay, Sound, and Estuary; Continental Shelf; and Coastal and Oceanic. The Bay, Sound, and Estuary Stocks are considered to be strategic stocks. The strategic stock designation in this case was based primarily on the occurrence of an "unusual mortality event" of unprecedented

size and duration (from April 2010 through July 2014) (NOAA, 2016a) that affected these stocks. Carmichael et al. (2012) hypothesized that the unusual number of bottlenose dolphin strandings in the northern Gulf of Mexico during this time may have been associated with environmental perturbations, including sustained cold weather and the *Deepwater Horizon* incident in 2010 as well as large volumes of cold freshwater discharge in the early months of 2011. Carmichael et al. (2012) and Schwacke et al. (2014b) reported that 1 year after the *Deepwater Horizon* incident, many dolphins in Barataria Bay, Louisiana, showed evidence of disease conditions associated with petroleum exposure and toxicity. Venn-Watson et al. (2015) performed histological studies to examine contributing factors and causes of deaths for stranded common bottlenose dolphins from Louisiana, Mississippi, and Alabama and found that the dead dolphins from the “unusual mortality event” were more likely than those from other areas to have primary bacterial pneumonia and thin adrenal cortices. The adrenal gland and lung diseases were consistent with exposure to petroleum compounds, and the exposure to petroleum compounds during and after the *Deepwater Horizon* incident are proposed as a cause.

IPFs that could potentially affect non-endangered marine mammals include MODU presence, noise, and lights; support vessel and helicopter traffic; and two types of accidents (a small fuel spill and a large oil spill). Effluent discharges are likely to have negligible impacts on marine mammals due to rapid dispersion, the small area of ocean affected, the intermittent nature of the discharges, and the mobility of marine mammals. Compliance with NTL BSEE 2015-G013 (see **Table 1**) will minimize the potential for marine debris-related impacts on marine mammals.

Impacts of Mobile Offshore Drilling Unit Presence, Noise, and Lights

Noise from routine drilling activities has the potential to disturb marine mammals. Most odontocetes use higher frequency sounds than those produced by OCS drilling activities (Richardson et al., 1995). Three functional hearing groups are represented in the 20 non-endangered cetaceans found in the Gulf of Mexico (NMFS, 2018a). Eighteen of the 19 odontocete species are considered to be in the mid-frequency functional hearing group and two species (dwarf and pygmy sperm whales) are in the high frequency functional hearing group (NMFS, 2018a). Thruster and installation noise will affect each group differently depending on the frequency bandwidths produced by operations.

For mid frequency cetaceans exposed to a non-impulsive source (like drilling operations), permanent threshold shifts are estimated to occur when the mammal has received a SEL_{cum} of 198 dB re $1 \mu Pa^2 s$ over a 24-hour period. Similarly, temporary threshold shifts are estimated to occur when the mammal has received a SEL_{cum} of 178 dB re $1 \mu Pa^2 s$ over a 24-hour period. Based on transmission loss calculations (Urlick, 1983), open water propagation of noise produced by typical sources with intermittent use of DP thrusters during offshore operations, are not expected to produce SPL_{rms} greater than 160 dB re $1 \mu Pa$ beyond 105 ft (32 m) from the source. Due to the short propagation distance of above-threshold SPL_{rms} , the transient nature of marine mammals and the stationary nature of the proposed activities, it is not expected that any marine mammals will receive exposure levels necessary for the onset of auditory threshold shifts. NMFS (2018a) presents criteria that are used to determine physiological (i.e., injury) thresholds for marine mammals. Behavioral disturbance thresholds have not been updated in the most recent acoustic guidance (NMFS, 2018a) and therefore, revert to thresholds established and published by NMFS in 70 *Federal Register (FR)* 1871. Received SPL_{rms} of 120 dB re $1 \mu Pa$ from a non-impulsive source are considered high enough to elicit a behavioral reaction in some marine mammal species. The 120-dB isopleth may extend tens to hundreds of kilometers from the source depending on the

propagation environment. However, in the case of behavioral responses, received levels alone do not indicate a behavioral response and, more importantly, do not equate to biologically important responses (Southall et al., 2016, Ellison et al., 2012).

Some odontocetes have shown increased feeding activity around lighted platforms at night (Todd et al., 2009). Even temporary MODU present an attraction to pelagic food sources that may attract cetaceans (and sea turtles). Therefore, prey congregation could pose an attraction to protected species that would expose them to higher levels or longer durations of noise that might otherwise be avoided.

There are other OCS facilities and activities near the project area, and the region as a whole has a large number of similar sources. Due to the limited scope, timing, and geographic extent of drilling activities, this project would represent a small temporary contribution to the overall noise regime, and any short-term impacts are not expected to be biologically significant to marine mammal populations.

MODU lighting and presence is not identified as an IPF for marine mammals by BOEM (2016b, 2017a). Therefore, no significant impacts are expected from this IPF.

Impacts of Support Vessel and Helicopter Traffic

Support vessel traffic has the potential to disturb marine mammals, and there is also a risk of vessel strikes. Data concerning the frequency of vessel strikes are presented by BOEM (2017a). To reduce the potential for vessel strikes, BOEM has issued NTL BOEM-2016-G01 (see **Table 1**), which recommends protected species identification training and that vessel operators and crews maintain a vigilant watch for marine mammals and slow down or stop their vessel to avoid striking protected species and requires operators to report sightings of any injured or dead protected species. Vessel operators and crews are required to attempt to maintain a distance of 300 ft (91 m) or greater from whales and 148 ft (45 m) or greater from small cetaceans and sea turtles (NTL BOEM-2016-G01). When cetaceans are sighted while a vessel is underway, vessels must attempt to remain parallel to the animal's course and avoid excessive speed or abrupt changes in direction until the cetacean has left the area. Vessel operators are required to reduce vessel speed to 10 knots or less when mother/calf pairs, pods, or large assemblages of cetaceans are observed near an underway vessel, when safety permits. Although vessel strike avoidance measures described in NMFS (2020a) are only applicable to ESA-listed species, complying with them may provide additional indirect protections to non-listed species as well. Use of these measures will minimize the likelihood of vessel strikes as well as reduce the chance for disturbing marine mammals, and therefore no significant impacts are expected.

The current PBR level for several non-endangered cetacean species in the Gulf of Mexico are less than 3 individuals (e.g., rough-toothed dolphin = 2.5, Clymene dolphin = 0.6, killer whale = 0.1, pygmy killer whale = 0.8, dwarf and pygmy sperm whales = 0.9) (Hayes et al. 2019). Mortality of individuals equal to or in excess of their PBR level would constitute a significant impact to the local (Gulf of Mexico) stocks of these species.

Helicopter traffic also has the potential to disturb marine mammals (Würsig et al., 1998). However, while flying offshore, helicopters maintain altitudes above 700 ft (213 m) during transit to and from the working area. In addition, guidelines and regulations issued by NMFS under the authority of the MMPA specify that helicopters maintain an altitude of 1,000 ft (305 m) within

300 ft (91 m) of marine mammals (BOEM, 2017a, NMFS, 2020a). Maintaining this altitude will minimize the potential for disturbing marine mammals, and no significant impacts are expected.

Impacts of a Small Fuel Spill

Potential spill impacts on marine mammals are discussed by BOEM (2016b, 2017a), and oil impacts on marine mammals in general are discussed by Geraci and St. Aubin (1990). For the EIA, there are no unique site-specific issues with respect to spill impacts on these animals.

The probability of a fuel spill will be minimized by Shell's preventative measures, including fuel transfer. In the unlikely event of a spill, implementation of Shell's OSRP is expected to mitigate and reduce the potential for impacts on marine mammals. EP Section 9b provides detail on spill response measures. Given the open ocean location of the project area and the duration of a small spill, the opportunity for impacts to occur would be very brief.

A small fuel spill in offshore waters would produce a thin slick on the water surface and introduce the concentrations of petroleum hydrocarbons and their degradation products. The extent and persistence of impacts would depend on the meteorological and oceanographic conditions at the time and the effectiveness of spill response measures. **Section A.9.1** discusses the likely fate of a small fuel spill and indicates that over 90% would evaporate or disperse naturally within 24 hours. The area of diesel fuel on the sea surface would range from 1.2 to 12 ac (0.5 to 5 ha), depending on sea state and weather conditions.

Direct physical and physiological effects of exposure to diesel fuel could include skin irritation, inflammation, or necrosis; chemical burns of skin, eyes, and mucous membranes; inhalation of toxic fumes; ingestion of oil directly or via contaminated prey; and stress from the activities and noise of response vessels and aircraft (MMC, 2011). However, due to the limited areal extent and short duration of water quality impacts from a small fuel spill, as well as the mobility of marine mammals, no significant impacts would be expected.

Impacts of a Large Oil Spill

Potential spill impacts on marine mammals are discussed by BOEM (2016b, 2017a). For the EIA, there are no unique site-specific issues.

Impacts of oil spills on marine mammals can include direct impacts from oil exposure as well as indirect impacts due to response activities and materials (e.g., vessel traffic, noise, dispersants) (MMC, 2011). Direct physical and physiological effects can include skin irritation, inflammation, or necrosis; chemical burns of skin, eyes, and mucous membranes; inhalation of toxic fumes; ingestion of oil (and dispersants) directly or via contaminated prey; and stress from the activities and noise of response vessels and aircraft. Complications of the above may lead to dysfunction of immune and reproductive systems (DeGuise et al., 2017), physiological stress, declining physical condition, and death. Kellar et al. (2017) estimated reproductive success rates for two northern Gulf of Mexico stocks affected by oil were less than a third (19.4%) of those previously reported in other areas (64.7%) not impacted. Behavioral responses can include displacement of animals from prime habitat (McDonald et al., 2017a); disruption of social structure; changing prey availability and foraging distribution and/or patterns; changing reproductive behavior/productivity; and changing movement patterns or migration (MMC, 2011).

Data from the *Deepwater Horizon* incident, as analyzed and summarized by NOAA (2016b) indicate the scope of potential impacts from a large spill. Tens of thousands of marine mammals

were exposed to oil, where they likely inhaled, aspirated, ingested, physically contacted, and absorbed oil components (NOAA, 2016b, Takeshita et al., 2017). Nearly all of the marine mammal stocks in the northern Gulf of Mexico were affected. The oil's physical, chemical, and toxic effects damaged tissues and organs, leading to a constellation of adverse health effects, including reproductive failure, adrenal disease, lung disease, and poor body condition (NOAA, 2016b). According to the National Wildlife Federation (2016a), nearly all of the 20 species of dolphins and whales that live in the northern Gulf of Mexico had demonstrable, quantifiable injuries. Because of known low detection rates of carcasses (Williams et al., 2011), it is possible that the number of marine mammal deaths is underestimated. Also, necropsies to confirm the cause of death could not be conducted for many of these marine mammals, therefore some cause of deaths reported as unknown are likely attributable to oil interaction. Schwacke et al. (2014a) reported that 1 year after the spill, many dolphins in Barataria Bay, Louisiana, showed evidence of disease conditions associated with petroleum exposure and toxicity. Lane et al. (2015) noted a decline in pregnancy success rate among dolphins in the same region. BOEM (2012a) concluded that potential effects from a large spill could potentially contribute to more significant and longer-lasting impacts including mortality and longer-lasting chronic or sublethal effects than a small, but severe accidental spill.

In the event of a large spill, response activities that may impact marine mammals include increased vessel traffic, use of dispersants, and remediation activities (e.g., controlled burns, skimmers, boom) (BOEM, 2017a). The increased level of vessel and aircraft activity associated with spill response could disturb marine mammals, potentially resulting in behavioral changes. The large number of response vessels could result in vessel strikes, entanglement or other injury, or stress. Response vessels would operate in accordance with NTL BOEM-2016-G01 to reduce the potential for striking or disturbing these animals, and therefore no significant impacts are expected.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the event of oil from a large spill, it is expected that impacts resulting in the injury or death of individual marine mammals could be significant at the population level depending on the level of oiling and the species affected. Based on the current PBR level for several non-endangered cetacean species in the Gulf of Mexico that are less than 3 individuals (e.g., rough-toothed dolphin = 2.5, Clymene dolphin = 0.6, killer whale = 0.1, pygmy killer whale = 0.8, dwarf and pygmy sperm whales = 0.9) (Hayes et al., 2019), mortality of individuals equal to or in excess of their PBR level would constitute a significant impact to the local (Gulf of Mexico) stocks of these species. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.3.5 Sea Turtles (Endangered/Threatened)

As listed in EP Section 6h, five species of Endangered or Threatened sea turtles may be found near the project area. Endangered species are the leatherback, Kemp's ridley, and hawksbill turtles. As of May 6, 2016, the entire North Atlantic DPS of the green turtle is listed as Threatened (81 FR 20057). The DPS of loggerhead turtle that occurs in the Gulf of Mexico is listed as Threatened, although other DPSs are Endangered. Of the sea turtle species that may be found in the project area, only the Kemp's ridley relies on the Gulf of Mexico as its sole breeding ground. Species descriptions are presented by (BOEM, 2017a).

Critical habitat has been designated for the loggerhead turtle in the Gulf of Mexico as shown in **Figure 1**. Critical habitat in the northern Gulf of Mexico includes nesting beaches in Mississippi, Alabama, and the Florida Panhandle; nearshore reproductive habitat seaward from these beaches; and a large area of *Sargassum* habitat. The nearest designated nearshore reproductive critical habitat for loggerhead sea turtles is approximately 424 miles (682 km) from the project area.

Loggerhead turtles in the Gulf of Mexico are part of the Northwest Atlantic Ocean DPS (NMFS, 2014a). In July 2014, NMFS and the USFWS designated critical habitat for this DPS. The USFWS designation (79 FR 39756) includes nesting beaches in Jackson County, Mississippi; Baldwin County, Alabama; and Bay, Gulf, and Franklin Counties in the Florida Panhandle as well as several counties in southwest Florida and the Florida Keys (and other areas along the Atlantic coast). The NMFS designation (79 FR 39856) includes nearshore reproductive habitat within 1 mile (1.6 km) seaward of the mean high-water line along these same nesting beaches. NMFS also designated a large area of shelf and oceanic waters, termed *Sargassum* habitat, in the Gulf of Mexico (and Atlantic Ocean) as critical habitat. *Sargassum* is a genus of brown alga (Class Phaeophyceae) that has a pelagic existence. Rafts of *Sargassum* spp. serve as important foraging and developmental habitat for numerous fishes, and young sea turtles, including loggerhead turtles. NMFS also designated three other categories of critical habitat: of these, two (migratory habitat and overwintering habitat) are along the Atlantic coast, and the third (breeding habitat) is found in the Florida Keys and along the Florida east coast (NMFS, 2014a).

Leatherbacks and loggerheads are the species most likely to be present near the project area as adults. Green, hawksbill, and Kemp's ridley turtles are typically inner-shelf and nearshore species, unlikely to occur near the project area as adults. Female Kemp's ridley turtles may be found in the project area as they transit to and from nesting beaches. Hatchlings or juveniles of any of the sea turtle species may be present in deepwater areas, including the project area, where they may be associated with *Sargassum* spp. and other flotsam.

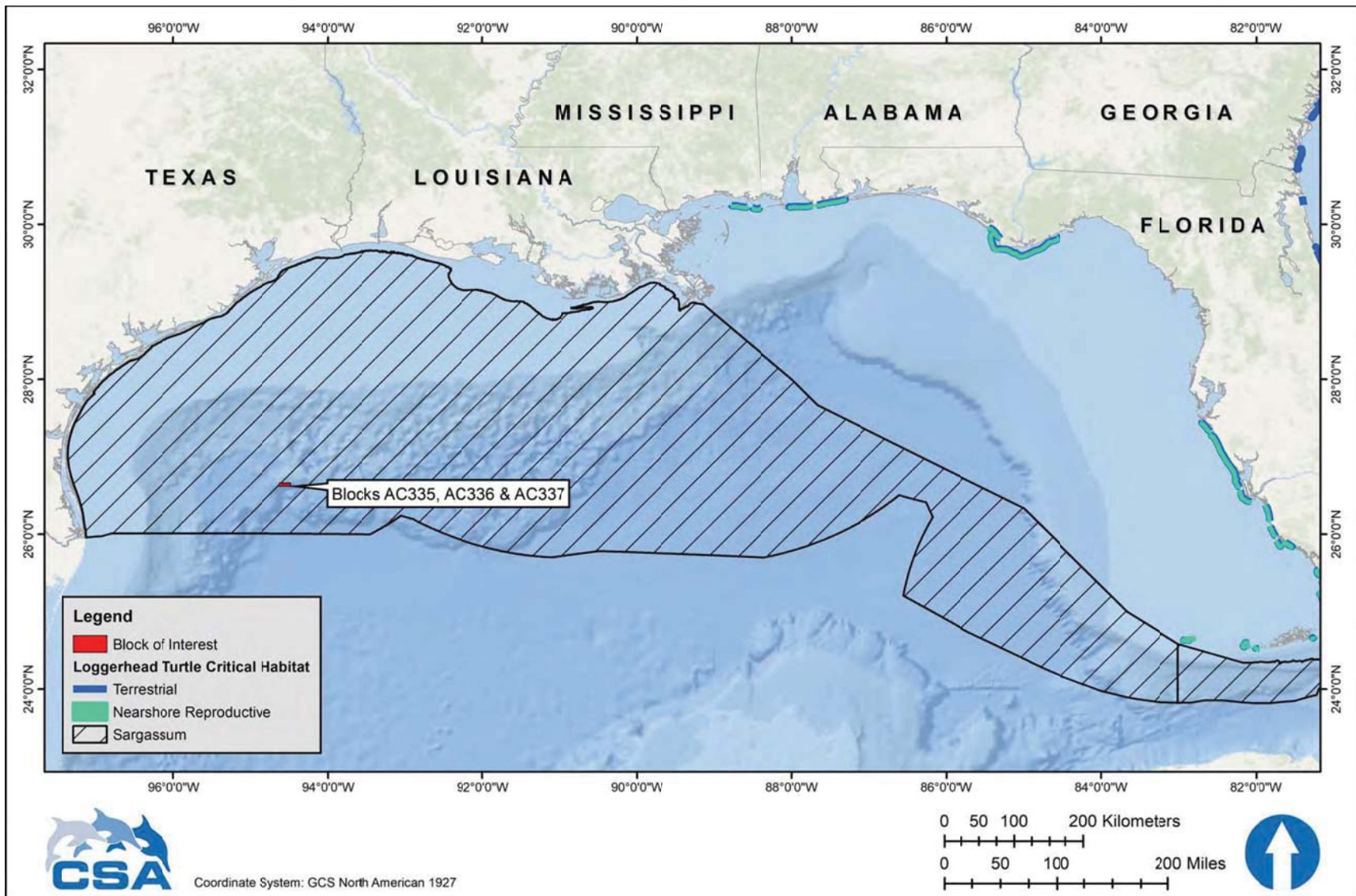


Figure 1. Location of loggerhead turtle critical habitat in the northern Gulf of Mexico in relation to the project area. The critical habitat includes terrestrial habitat (nesting beaches) and nearshore reproductive habitat in Mississippi, Alabama, and the Florida Panhandle as well as *Sargassum* habitat.

All five sea turtle species in the Gulf of Mexico are migratory and use different marine habitats according to their life stage. These habitats include high-energy beaches for nesting females and emerging hatchlings and pelagic convergence zones for hatchling and juvenile turtles. As adults, green, hawksbill, Kemp's ridley, and loggerhead turtles forage primarily in shallow benthic habitats. Leatherbacks are the most pelagic of the sea turtles, feeding primarily on jellyfish.

Sea turtle nesting in the northern Gulf of Mexico can be summarized by species as follows:

- Loggerhead turtles—loggerhead turtles nest in significant numbers along the Florida Panhandle (Florida Fish and Wildlife Conservation Commission, 2017a) and, to a lesser extent, from Texas through Alabama (NMFS and USFWS, 2008);
- Green and leatherback turtles—green and leatherback turtles infrequently nest on Florida Panhandle beaches (Florida Fish and Wildlife Conservation Commission, 2017b,c);
- Kemp's ridley turtles—The main nesting site is Rancho Nuevo beach in Tamaulipas, Mexico (NMFS et al., 2011). A total of 262 Kemp's ridley turtle nests have been counted on Texas beaches for the 2020 nesting season. This is an increase from 2019 but similar to 2018. A total of 190 Kemp's ridley turtle nests were counted on Texas beaches during the 2019 nesting season and a total of 250 Kemp's ridley turtle nests were counted on Texas beaches during the 2018 nesting season (Turtle Island Restoration Network, 2020). Padre Island National Seashore, along the coast of Willacy, Kenedy, and Kleberg Counties in southern Texas, is the most important nesting location for this species in the U.S.; and
- Hawksbill turtles—hawksbill turtles typically do not nest anywhere near the project area, with most nesting in the region located in the Caribbean Sea and on beaches of the Yucatán Peninsula (U.S. Fish and Wildlife Service, 2016).

IPFs that could potentially affect sea turtles include MODU presence, noise, and lights; support vessel and helicopter traffic; and two types of accidents (a small fuel spill and a large oil spill). Effluent discharges are likely to have negligible impacts on sea turtles due to rapid dispersion, the small area of ocean affected, and the intermittent nature of the discharges.

Though NMFS (2020a) stated marine debris as an IPF, compliance with NTL BSEE 2015-G03 (See **Table 1**) and NMFS (2020a) Appendix B will minimize the potential for marine debris-related impacts on sea turtles. NMFS (2020a) estimated a small proportion of individual sea turtles would be adversely affected from exposure to marine debris. Therefore, marine debris is likely to have negligible impacts on sea turtles and is not further discussed (See **Table 2**).

Impacts of Mobile Offshore Drilling Unit Presence, Noise, and Lights

Offshore drilling activities produce broadband sounds at frequencies and intensities that may be detected by sea turtles (Samuel et al., 2005, Popper et al., 2014). Potential impacts could include behavioral disruption and displacement from the area near the sound source. There is scarce information regarding hearing and acoustic thresholds for marine turtles. Sea turtles can hear low to mid-frequency sounds and they appear to hear best between 200 and 750 Hz and do not respond well to sounds above 1,000 Hz (Ketten and Bartol, 2005). The currently accepted hearing and response estimates are derived from fish hearing data rather than from marine mammal hearing data in combination with the limited experimental data available (Popper et al., 2014). NMFS Biological Opinion (NMFS, 2020a) lists the sea turtle underwater acoustic SPL_{rms} injury threshold as 207 dB re 1 µPa; Blackstock et al. (2018) identified the sea turtle underwater acoustic SPL_{rms} behavioral threshold as 175 dB re 1 µPa. No distinction is made between impulsive and non-impulsive sources for these thresholds. Based on transmission loss calculations (Urlick, 1983),

open water propagation of noise produced by typical sources with DP thrusters in use during drilling, are not expected to produce SPL_{rms} greater than 160 dB re 1 μ Pa beyond 105 ft (32 m) from the source. Certain sea turtles, especially loggerheads, may be attracted to offshore structures (Lohoefer et al., 1990, Gitschlag et al., 1997, Colman et al., 2020) and thus, may be more susceptible to impacts from sounds produced during routine drilling and completion activities. Helicopters and support vessels may also affect sea turtles because of machinery noise or visual disturbances. Any impacts would likely be short-term behavioral changes such as diving and evasive swimming, disruption of activities, or departure from the area. Because of the limited scope and short duration of drilling activities, these short-term impacts are not expected to be biologically significant to sea turtle populations.

Artificial lighting can disrupt the nocturnal orientation of sea turtle hatchlings (Tuxbury and Salmon, 2005, Berry et al., 2013, Simões et al., 2017). However, hatchlings may rely less on light cues when they are offshore than when they are emerging on the beach (Salmon and Wyneken, 1990). NMFS (2007) concluded that the effects of lighting from offshore structures on sea turtles are insignificant. Therefore, no significant impacts are expected.

NMFS (2020a) stated sea turtles have the potential to be entangled or entrapped in moon pools, and though many sea turtles could exit the moon pool under their own volition, sublethal effects could occur. Based on the moon pool entrapment cases of sea turtles reported and successful rescues and releases that have occurred, NMFS (2020a) estimated approximately about one sea turtle will be sub-lethally entrapped in moon pools every year. Therefore, no significant impacts are expected.

Impacts of Support Vessel and Helicopter Traffic

Support vessel traffic has the potential to disturb sea turtles, and there is also a risk of vessel strikes. Data show that vessel traffic is one cause of sea turtle mortality in the Gulf of Mexico (Lutcavage et al., 1997, NMFS, 2020a). While adult sea turtles are visible at the surface during the day and in clear weather, they can be difficult to spot from a moving vessel when resting below the water surface, during nighttime, or during periods of inclement weather. To reduce the potential for vessel strikes, BOEM issued NTL BOEM-2016-G01, which recommends protected species identification training and that vessel operators and crews maintain a vigilant watch for sea turtles and slow down or stop their vessel to avoid striking protected species and requires operators to report sightings of any injured or dead protected species. When sea turtles are sighted, vessel operators and crews are required to attempt to maintain a distance of 164 ft (50 m) or greater whenever possible (NMFS [2020a] Appendix C). Compliance with these mitigation measures will minimize the likelihood of vessel strikes as well as reduce the chance for disturbing sea turtles. Therefore, no significant impacts are expected.

Helicopter traffic also has the potential to disturb sea turtles. However, while flying offshore, helicopters maintain altitudes above 700 ft (213 m) during transit to and from the working area. This altitude will minimize the potential for disturbing sea turtles, and no significant impacts are expected (NMFS, 2020a, BOEM, 2012a).

Impacts of a Small Fuel Spill

Potential spill impacts on sea turtles are discussed by NMFS (2020a) and BOEM (2017a). For this EP, there are no unique site-specific issues with respect to spill impacts on sea turtles. **Section A.9.1** discusses the size and fate of a potential small diesel fuel spill as a result of Shell's

proposed activities. EP Section 9b provides detail on spill response measures. Given the open ocean location of the project area, the duration of a small spill and opportunity for impacts to occur would be very brief.

Direct physical and physiological effects of exposure to diesel fuel could include skin irritation, inflammation, or necrosis; chemical burns of skin, eyes, and mucous membranes; inhalation of toxic fumes; ingestion of oil directly or via contaminated prey; and stress from the activities and noise of response vessels and aircraft (NMFS, 2020b). As discussed in **Section A.9.1**, more than 90% of a small diesel spill in offshore waters would evaporate or disperse naturally within 24 hours. Therefore, due to the limited areal extent and short duration of water quality impacts from a small fuel spill, no significant impacts to sea turtles from direct or indirect exposure would be expected.

Loggerhead Critical Habitat – Nesting Beaches. A small fuel spill in the project area would be unlikely to affect sea turtle nesting beaches because the project area is 161 miles (259 km) from the nearest shoreline (Texas). Loggerhead turtle nesting beaches and nearshore reproductive habitat designated as critical habitat are located in Mississippi, Alabama, and the Florida Panhandle, at least 424 miles (682 km) from the project area. As explained in **Section A.9.1**, a small fuel spill would not be expected to make landfall or reach coastal waters prior to dissipating.

Loggerhead Critical Habitat – Sargassum Habitat. The project area is within the *Sargassum* portion of the loggerhead turtle critical habitat (**Figure 1**). Juvenile sea turtles could come into contact with or ingest oil, resulting in death, injury, or other sublethal effects. Impacts would be limited to the small area (1.2 to 12 ac [0.5 to 5 ha]) likely to be impacted by a small spill. A 12-ac (5-ha) impact would represent a negligible portion of the 96,776,959 ac (39,164,246 ha) designated *Sargassum* habitat for loggerhead turtles in the northern Gulf of Mexico.

Impacts of a Large Oil Spill

Impacts of oil spills on sea turtles can include direct impacts from oil exposure as well as indirect impacts due to response activities and materials (e.g., vessel traffic, noise, dispersants). Direct physical and physiological effects can include skin irritation, inflammation, or necrosis; chemical burns of skin, eyes, and mucous membranes; inhalation of toxic fumes and smoke (e.g., from *in situ* burning of oil); ingestion of oil (and dispersants) directly or via contaminated food; and stress from the activities and noise of response vessels and aircraft. Complications of the above may lead to dysfunction of immune and reproductive systems, physiological stress, declining physical condition, and death. Behavioral responses can include displacement of animals from prime habitat, disruption of social structure, change in food availability and foraging distribution and/or patterns, changing reproductive behavior/productivity, and changing movement patterns or migration (MMC, 2011, NMFS, 2014a). In the unlikely event of a spill, implementation of Shell's OSRP is expected to mitigate and reduce the potential for these types of impacts on sea turtles. EP Section 9b provides detail on spill response measures.

Studies of oil effects on loggerheads in a controlled setting (Lutcavage et al., 1995, NOAA, 2010) suggest that sea turtles show no avoidance behavior when they encounter an oil slick, and any sea turtle in an affected area would be expected to be exposed. Sea turtles' diving behaviors also put them at risk. Sea turtles rapidly inhale a large volume of air before diving and continually resurface over time, which may result in repeated exposure to volatile vapors and oiling (NMFS, 2020a).

Results of *Deepwater Horizon* incident studies provide an indication of potential effects of a large oil spill on sea turtles. NOAA (2016b) estimated that between 4,900 and 7,600 large juvenile and adult sea turtles (Kemp's ridleys, loggerheads, and hardshelled sea turtles not identified to species) and between 56,000 and 166,000 small juvenile sea turtles (Kemp's ridleys, green turtles, loggerheads, hawksbills, and hardshelled sea turtles not identified to species) were killed by the *Deepwater Horizon* incident. Nearly 35,000 hatchling sea turtles (loggerheads, Kemp's ridleys, and green turtles) were also injured by response activities (NOAA, 2016b). Evidence from (McDonald et al., 2017b) suggests 402,000 turtles were exposed to oil in the aftermath of the *Deepwater Horizon* incident, including 54,800 which were likely to have been heavily oiled.

Spill response activities could also kill sea turtles and interfere with nesting. NOAA (2016b) concluded that after the *Deepwater Horizon* incident, hundreds of sea turtles were likely killed by response activities such as increased boat traffic, dredging for berm construction, increased lighting at night near nesting beaches, and oil cleanup operations on nesting beaches. In addition, it is estimated that oil cleanup operations on Florida Panhandle beaches following the spill deterred adult female loggerheads from coming ashore and laying their eggs, resulting in a decrease of approximately 250 loggerhead nests or a reduction of 43.7% in 2010 (NOAA, 2016b, Lauritsen et al., 2017). Impacts from a large oil spill resulting in the death of individual listed sea turtles would be significant to local populations.

Loggerhead Critical Habitat – Nesting Beaches. Spilled oil reaching sea turtle nesting beaches could affect nesting sea turtles and egg development (NMFS, 2020a). An oiled beach could affect nest site selection or result in no nesting at all (e.g., false crawls). Upon hatching and successfully reaching the water, hatchlings would be subject to the same types of oil spill exposure hazards as adults. Hatchlings that contact oil residues while crossing a beach could exhibit a range of effects, from acute toxicity to impaired movement and normal bodily functions (NMFS, 2007).

Based on the 30-day OSRA modeling (**Table 3**), coastal areas would not likely be affected within 3 to 10 days. Coastal areas between Cameron County, Texas, and Vermilion Parish, Louisiana, may be affected within 30 days of a spill (1% to 8% conditional probability). The nearest nearshore reproductive critical habitat for loggerhead turtles is 424 miles (682 km) from the project area.

Loggerhead Critical Habitat – *Sargassum* Habitat. The project area is within the *Sargassum* habitat portion of the loggerhead turtle critical habitat (**Figure 1**). Due to the large area covered by the designated *Sargassum* habitat for loggerhead turtles, a large spill could result in oiling of a substantial part of the *Sargassum* habitat in the northern Gulf of Mexico. The *Deepwater Horizon* incident affected approximately one-third of the *Sargassum* habitat in the northern Gulf of Mexico (BOEM, 2016b). It is extremely unlikely that the entire *Sargassum* habitat would be affected by a large spill. Because *Sargassum* spp. are floating, pelagic species, it would only be affected by oil that is present near the surface.

The effects of oiling on *Sargassum* spp. vary with severity, but moderate to heavy oiling that could occur during a large spill could cause complete mortality to *Sargassum* spp. and its associated communities (BOEM, 2017a). *Sargassum* spp. also has the potential to sink during a large spill; thus temporarily removing the habitat and possibly being an additional pathway of exposure to the benthic environment (Powers et al., 2013). Lower levels of oiling may cause sublethal affects, including reduced growth, productivity, and recruitment of organisms associated with *Sargassum* spp. The *Sargassum* spp. algae itself could be less impacted by light to moderate oiling than associated organisms because of a waxy outer layer that might help protect it from oiling

(BOEM, 2016b). *Sargassum* spp. have a yearly seasonal cycle of growth and a yearly cycle of dispersal from the Gulf of Mexico to the western Atlantic. A large spill could affect a large portion of the annual crop of the algae; however, because of its ubiquitous distribution and seasonal cycle, recovery of the *Sargassum* spp. community would be expected to take one to two years (BOEM, 2017a).

Impacts to sea turtles from a large oil spill and associated cleanup activities would depend on spill extent, duration, and season (relative to turtle nesting season); the amount of oil reaching the shore; the importance of specific beaches to sea turtle nesting; and the level of cleanup vessel and beach crew activity required. A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the event of oil from a large spill, it is expected that impacts resulting in the injury or death of individual sea turtles would be adverse but not likely significant at the population level. In the unlikely event of a spill, implementation of Shell's OSRP would mitigate and reduce direct and indirect impacts to turtles from oil exposure and response activities and materials. EP Section 9b provides detail on spill response measures.

C.3.6 Piping Plover (Threatened)

The Piping Plover is a migratory shorebird that overwinters along the southeastern U.S. and Gulf of Mexico coasts. This Threatened species experienced declines in population as a result of hunting, habitat loss and modification, predation, and disease (USFWS, 2003). However, as a result of intensive conservation and management, populations of Piping Plover appear to have been increasing since 1991 throughout its range (Bird Life International, 2018). Critical overwintering habitat has been designated, including beaches in Texas, Louisiana, Mississippi, Alabama, and Florida (**Figure 2**). Piping Plovers inhabit coastal sandy beaches and mudflats, feeding by probing for invertebrates at or just below the surface. They use beaches adjacent to foraging areas for roosting and preening (USFWS, 2010). A species description is presented by BOEM (2017a).

A large oil spill is the only IPF that could potentially affect Piping Plovers. There are no IPFs associated with routine project activities that could affect these birds. A small fuel spill in the project area would be unlikely to affect Piping Plovers because a small fuel spill would not be expected to make landfall or reach coastal waters prior to dissipating (see explanation in **Section A.9.1**).

Impacts of a Large Oil Spill

The project area is 156 miles (251 km) from the nearest shoreline designated as Piping Plover critical habitat. The 30-day OSRA modeling (**Table 3**) predicts that Piping Plover critical habitat in Cameron Parish, Louisiana, would have a 3% conditional probability of contact within 30 days of a spill.

Piping Plovers could become externally oiled while foraging on oiled shores or become exposed internally through ingestion of oiled intertidal sediments and prey (BOEM, 2017a). They congregate and feed along tidally exposed banks and shorelines, following the tide out and foraging at the water's edge. It is possible that some deaths of Piping Plovers could occur, especially if spills occur during winter months when the birds are most common along the coastal Gulf or if spills contacted critical habitat. Impacts could also occur from vehicular traffic on beaches and other activities associated with spill cleanup. Shell has extensive resources available

to protect and rehabilitate wildlife in the event of a spill reaching the shoreline, as detailed in the OSRP.

However, a large spill that contacts shorelines would not necessarily impact Piping Plovers. In the aftermath of the *Deepwater Horizon* incident, Gibson et al. (2017) completed thorough surveys of coastal Piping Plover habitat in coastal Louisiana, Mississippi, and Alabama and found that only 0.89% of all observed Piping Plovers were visibly oiled, leaving the authors to conclude that the *Deepwater Horizon* incident did not substantially affect Piping Plover populations.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the event of oil from a large spill contacting beaches inhabited by Piping Plovers, it is expected that impacts resulting in the injury or death of individual Piping Plovers could be significant at the population level. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

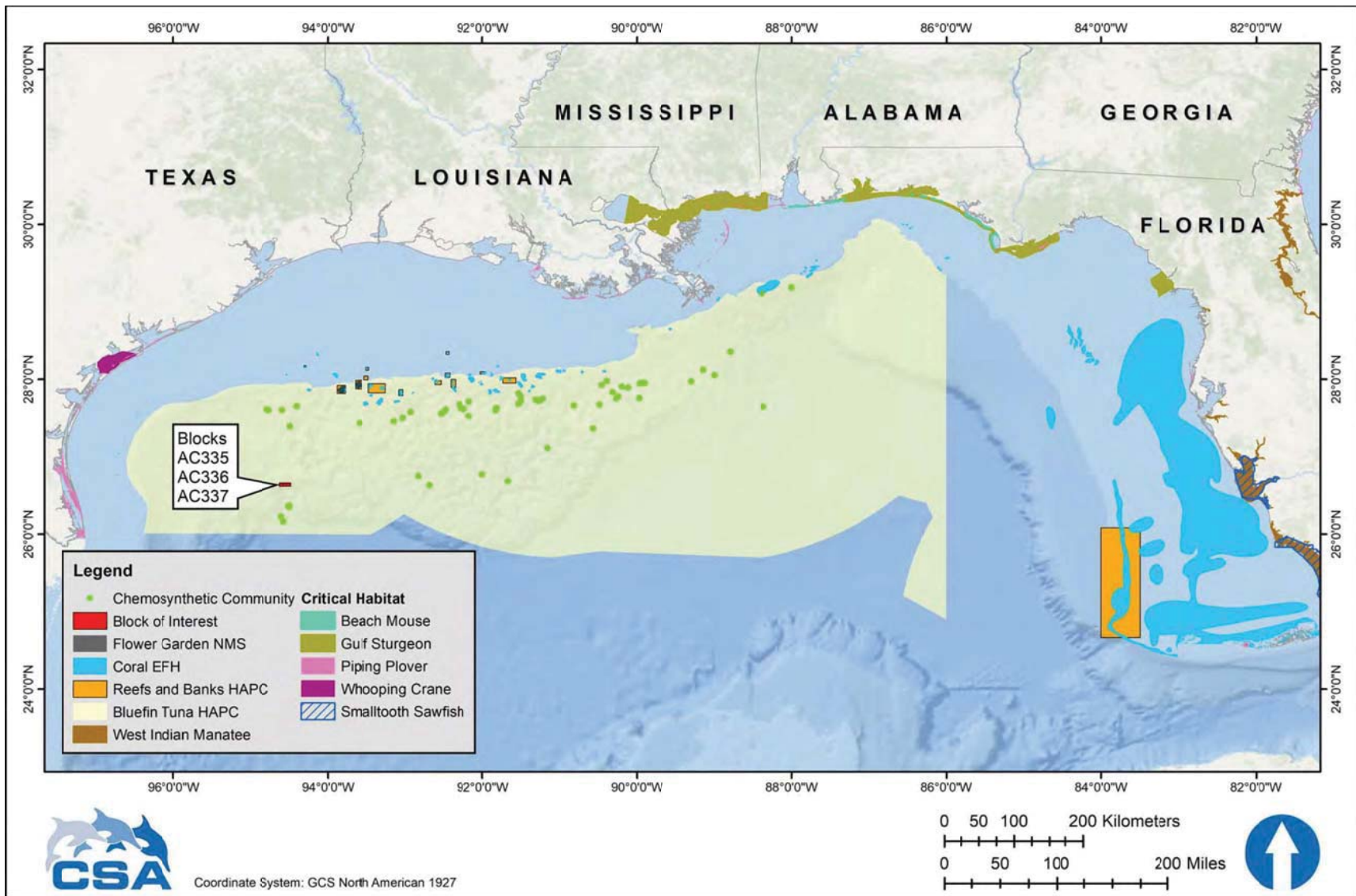


Figure 2. Location of selected environmental features in relation to the project area. EFH = Essential Fish Habitat; HAPC = Habitat Area of Particular Concern.

C.3.7 Whooping Crane (Endangered)

The Whooping Crane (*Grus americana*) is a large omnivorous wading bird and a federally listed Endangered species. Three wild populations live in North America (National Wildlife Federation, 2016b). One of these populations winters along the Texas coast at Aransas NWR and summers at Wood Buffalo National Park in Canada. This population represents the majority of the world's population of free-ranging Whooping Cranes, reaching an estimated population of 506 at Aransas NWR during the 2019 to 2020 winter (USFWS, 2020b). Another reintroduced population summers in Wisconsin and migrates to the southeastern U.S. for the winter (Whooping Crane Eastern Partnership, 2019). Whooping Cranes breed, migrate, winter, and forage in a variety of habitats, including coastal marshes and estuaries, inland marshes, lakes, ponds, wet meadows and rivers, and agricultural fields (USFWS, 2007). About 22,240 ac (9,000 ha) of salt flats in Aransas NWR and adjacent islands comprise the principal wintering grounds of the Whooping Crane. Aransas NWR is designated as critical habitat for the species (**Figure 2**). A species description is presented by BOEM (2012a).

A large oil spill is the only IPF that could potentially affect Whooping Cranes due to the distance of the project area from Aransas NWR.

Impacts of a Large Oil Spill

The 30-day OSRA modeling (**Table 3**) predicts up to a 4% chance of oil contacting Whooping Crane critical habitat (Calhoun or Aransas counties, Texas) within 30 days of a spill. The nearest Whooping Crane critical habitat is approximately 161 miles (259 km) from the project area.

In the event of oil exposure, Whooping Cranes could physically oil themselves while foraging in oiled areas or secondarily contaminate themselves through ingestion of contaminated shellfish, frogs, and fishes. It is possible that some deaths of Whooping Cranes could occur if the spill contacts their critical habitat in Aransas NWR, especially if spills occur during winter months when Whooping Cranes are most common along the Texas coast. Impacts could also occur from vehicular traffic on beaches and other activities associated with spill cleanup. Shell has extensive resources available to protect and rehabilitate wildlife in the event of a spill reaching the shoreline, as detailed in the OSRP. Impacts leading to the death of individual Whooping Cranes would be significant at a species level.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.3.8 Oceanic Whitetip Shark (Threatened)

The oceanic whitetip shark was listed as Threatened under the ESA in 2018 by NMFS (83 *FR* 4153). Oceanic whitetip sharks are found worldwide in offshore waters between approximately 30° N and 35° S latitude, and historically were one of the most widespread and abundant species of shark (Rigby et al., 2019) However, based on reported oceanic whitetip shark catches in several major long-line fisheries, the global population appears to have suffered substantial declines (Camhi et al., 2008) and the species is now only occasionally reported in the Gulf of Mexico (Rigby et al., 2019).

Oceanic whitetip shark management is complicated due to it being globally distributed, highly migratory, and overlapping in areas of high fishing; thus, leaving assessment of population trends on fishery dependent catch-and-effort data rather than scientific surveys (Young and Carlson, 2020). A comparison of historical shark catch rates in the Gulf of Mexico by Baum and Myers (2004) noted that most recent papers dismissed the oceanic whitetip shark as rare or absent in the Gulf of Mexico. NMFS (2018b) noted that there has been an 88% decline in abundance of the species in the Gulf of Mexico since the mid-1990s due to commercial fishing pressure.

IPFs that could affect the oceanic whitetip shark include MODU presence, noise, and lights, and a large oil spill. Though NMFS (2020a) lists a small diesel fuel spill as an IPF, in the project area, a small diesel fuel spill would be unlikely to affect oceanic whitetip sharks due to rapid natural dispersion of diesel fuel and the low density of oceanic whitetip sharks potentially present in the project area. Therefore, no significant impacts are expected from small diesel fuel spills and they are not further discussed (Table 2).

Impacts of Mobile Offshore Drilling Unit Presence, Noise, and Lights

Offshore drilling activities produce a broad array of sounds at frequencies and intensities that may be detected by elasmobranchs including the Threatened oceanic whitetip shark. The general frequency range for elasmobranch hearing is approximately between 20 Hz and 1 kHz (Ladich and Fay, 2013), which includes frequencies exhibited by individual species such as the nurse shark (*Ginglymostoma cirratum*; 300 and 600 Hz) and the lemon shark (*Negaprion brevirostris*; 20 Hz to 1 kHz) (Casper and Mann, 2006). These frequencies overlap with SPLs associated with drilling activities (typically 10 Hz to 10 kHz) (Hildebrand, 2005). Impacts from offshore drilling activities (i.e., non-impulsive sound) could include masking or behavioral change (Popper et al., 2014). However, because of the limited propagation distances of high SPLs from the drilling rig, impacts would be limited in geographic scope and no population level impacts on oceanic whitetip sharks are expected.

Impacts of a Large Oil Spill

Information regarding the direct effects of oil on elasmobranchs, including the oceanic whitetip shark are largely unknown. A study by Cave and Kajiura (2018) reported that when exposed to crude oil, the Atlantic stingray (*Hypanus sabinus*) experienced impaired olfactory function which could lead to decreased fitness. In the event of a large oil spill, oceanic whitetip sharks could be affected by direct ingestion, ingestion of oiled prey, or the absorption of dissolved petroleum products through the gills. Because oceanic whitetip sharks may be found in surface waters, they could be more likely to be impacted by floating oil than other species which only reside at depth.

It is possible that a large oil spill could affect individual oceanic whitetip sharks and result in injuries or deaths. However, due to the low density of oceanic whitetip sharks thought to exist in the Gulf of Mexico, it is unlikely that a large spill would result in population-level effects.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.3.9 Giant Manta Ray (Threatened)

The giant manta ray was listed as Threatened under the ESA in 2018 by NMFS (83 FR 2916). The species is a slow-growing, migratory, and planktivorous, inhabiting tropical, subtropical, and temperate bodies of water worldwide (NOAA, 2018a).

Commercial fishing is the primary threat to giant manta rays (NOAA, 2018a). The species is targeted and caught as bycatch in several global fisheries throughout its range. Although protected in U.S. waters, protection of populations is difficult as they are highly migratory with sparsely distributed and fragmented populations throughout the world. Some estimated regional population sizes are small (between 100 to 1,500 individuals) (Marshall et al., 2018, NOAA, 2018a). Stewart et al. (2018) recently reported evidence that the Flower Garden Banks serves as nursery habitat for aggregations of juvenile manta rays. At least 74 unique individuals have been positively identified at the Flower Garden Banks based on unique underbelly coloration (Flower Garden Banks National Marine Sanctuary, 2018). Genetic and photographic evidence in the Flower Garden Banks over 25 years of monitoring showed that 95% of identified giant manta ray male individuals were smaller than mature size (Stewart et al., 2018).

IPFs that may affect giant manta rays include MODU presence, noise, and lights, and a large oil spill. Though NMFS (2020a) lists a small diesel fuel spill as an IPF, in the project area a small diesel fuel spill would be unlikely to affect giant manta rays due to rapid natural dispersion of diesel fuel and the low density of giant manta rays potentially present in the project area. Therefore, no significant impacts are expected from small diesel fuel spills and they are not further discussed (See **Table 2**).

Impacts of Mobile Offshore Drilling Unit Presence, Noise, and Lights

Offshore drilling activities produce a broad array of sounds at frequencies and intensities that may be detected by elasmobranchs including the giant manta ray. The general frequency range for elasmobranch hearing is approximately between 20 Hz and 1 kHz (Ladich and Fay, 2013). Studies indicate that the most sensitive hearing ranges for individual species were 300 and 600 Hz (yellow stingray [*Urobatis jamaicensis*]) and 100 to 300 Hz (little skate [*Erinacea raja*]) (Casper et al., 2003, Casper and Mann, 2006). These frequencies overlap with SPLs associated with drilling activities (typically 10 Hz to 10 kHz) (Hildebrand, 2005). Impacts from offshore drilling activities (i.e., continuous sound) could include masking or behavioral change (Popper et al., 2014). However, because of the limited propagation distances of high SPLs from the drilling rig, impacts would be limited in geographic scope and no population level impacts on giant manta rays are expected.

Impacts of a Large Oil Spill

A large oil spill in the project area could reach coral reefs at the Flower Garden Banks which is the only known location of giant manta ray aggregations in the Gulf of Mexico; although, individuals may occur anywhere in the Gulf. Information regarding the direct effects of oil on elasmobranchs, including the giant manta ray, are largely unknown. In the unlikely event of a large oil spill impacting areas with giant manta rays, individual rays could be affected by direct ingestion of oil which could cover their gill filaments or gill rakers, or by ingestion of oiled plankton. A study by Cave and Kajiura (2018) reported that when exposed to the crude oil, the Atlantic stingray experienced impaired olfactory function which could lead to decreased fitness. Giant manta rays typically feed in shallow waters of less than 33 ft (10 m) depth (NOAA, 2018a). Because of this

shallow water feeding behavior, giant manta rays may be more likely to be impacted by floating oil than other species which only reside at depth.

In the event of a large oil spill, due to the distance between the project area and the Flower Garden Banks (approximately 100 miles [161 km]), it is unlikely that oil would impact the giant manta ray nursery habitat. It is possible that a large oil spill could contact individual giant manta rays, but due to the low density of individuals thought to occur in the Gulf of Mexico, there would not likely be any population-level effects.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.3.10 Gulf Sturgeon (Threatened)

The Gulf sturgeon is a Threatened fish species that inhabits major rivers and inner shelf waters from the Mississippi River to the Suwannee River, Florida (Barkuloo, 1988, Wakeford, 2001). The Gulf sturgeon is anadromous, migrating from the sea upstream into coastal rivers to spawn in freshwater. The historic range of the species extended from the Texas/Louisiana border to Tampa Bay, Florida (Pine and Martell, 2009). This range has contracted to encompass major rivers and inner shelf waters from the Lake Pontchartrain and the Pearl River system in Louisiana and Mississippi to the Suwannee River, Florida (NOAA, 2018b). Populations have been depleted or even extirpated throughout the species' historical range by fishing, shoreline development, dam construction, water quality changes, and other factors (Barkuloo, 1988, Wakeford, 2001). These declines prompted the listing of the Gulf sturgeon as a Threatened species in 1991. The best-known populations occur in the Apalachicola and Suwannee Rivers in Florida (Carr, 1996, Sulak and Clugston, 1998), the Choctawhatchee River in Alabama (Fox et al., 2000), and the Pearl River in Mississippi/Louisiana (Morrow et al., 1998). Rudd et al. (2014) reconfirmed the spatial distribution and movement patterns of Gulf Sturgeon by surgically implanting acoustic telemetry tags. Critical habitat in the Gulf extends from Lake Borgne, Louisiana (St. Bernard Parish), to Suwannee Sound, Florida (Levy County) (NMFS, 2014b) (**Figure 2**). Species descriptions are presented by (BOEM, 2012a) and in the recovery plan for this species (USFWS et al., 1995).

A large oil spill is the only IPF that could potentially affect Gulf sturgeon. There are no IPFs associated with routine project activities that could affect this species. A small fuel spill in the project area would be unlikely to affect Gulf sturgeon because a small fuel spill would not be expected to make landfall or reach coastal waters prior to dissipating (see explanation in **Section A.9.1**). Vessel strikes to Gulf sturgeon would be unlikely based on the location of the support vessel base and that NMFS (2020a) estimated one non-lethal Gulf sturgeon strike in the 50 years of proposed action. Due to the distance of the project area from the nearest Gulf Sturgeon critical habitat (407 miles [655 km]) and the support vessel base being in Port Fourchon, Louisiana, it is anticipated impacts from vessel strikes due to project activities will be negligible. The large oil spill IPF with potential impacts listed in **Table 2** is discussed below.

Impacts of a Large Oil Spill

Potential spill impacts on Gulf sturgeon are discussed by BOEM (2016b, 2017a) and NMFS (2007). For this EP, there are no unique site-specific issues with respect to this species.

The project area is approximately 407 miles (655 km) from the nearest Gulf sturgeon critical habitat. The 30-day OSRA modeling (**Table 3**) predicts that a spill in the project area has a <0.5% conditional probability of contacting any coastal areas containing Gulf sturgeon critical habitat within 30 days of a spill.

In the event of oil reaching Gulf sturgeon habitat, the fish could be affected by direct ingestion, ingestion of oiled prey, or the absorption of dissolved petroleum products through the gills. Based on the life history of this species, sub-adult and adult Gulf sturgeon would be most vulnerable to an estuarine or marine oil spill, and would be vulnerable primarily during winter months (from October through April) when this species is foraging in estuarine and marine habitats (NMFS, 2020a).

NOAA (2016b) estimated that 1,100 to 3,600 Gulf sturgeon were exposed to oil from the *Deepwater Horizon* incident. Overall, 63% of the Gulf sturgeon from six river populations were potentially exposed to the spill. Although the number of dead or injured Gulf sturgeon was not estimated, laboratory and field tests indicated that Gulf sturgeon exposed to oil displayed both genotoxicity and immunosuppression, which can lead to malignancies, cell death, susceptibility to disease, infections, and a decreased ability to heal (NOAA, 2016b).

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the event of oil from a large spill contacting waterways inhabited by Gulf sturgeon, it is expected that impacts resulting in the injury or death of individual sturgeon would be adverse but not likely significant at the population level. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. Shell has extensive resources available to protect coastal and estuarine wildlife and habitats in the event of a spill reaching the shoreline, as detailed in the OSRP. EP Section 9b provides detail on spill response measures.

C.3.11 Nassau Grouper (Threatened)

The Nassau grouper is a Threatened, long-lived reef fish typically associated with hard bottom structures such as natural and artificial reefs, rocks, and underwater ledges (NOAA, nd). Once one of the most common reef fish species in the coastal waters of the United States and Caribbean (Sadovy, 1997), the Nassau grouper has been subject to overfishing and is considered extinct in much of its historical range. Observations of current spawning aggregations compared with historical landings data suggest that the Nassau grouper population is substantially smaller than its historical size (NOAA, nd). The Nassau grouper was listed as Threatened under the ESA in 2016 (81 FR 42268).

Nassau groupers are found mainly in the shallow tropical and subtropical waters of eastern Florida (rare), the Florida Keys, Bermuda, the Yucatán Peninsula, and the Caribbean, including the U.S. Virgin Island and Puerto Rico (NOAA, nd). There has been one confirmed sighting of Nassau grouper from the Flower Garden Banks in the Gulf of Mexico at a water depth of 118 ft (36 m) (Foley et al., 2007). Three additional unconfirmed reports (i.e., lacking photographic evidence) of Nassau grouper have also been documented from mooring buoys and the coral cap region of the West Flower Garden flats (Foley et al., 2007).

There are no IPFs associated with routine project activities that could affect Nassau grouper. A small fuel spill would not affect Nassau grouper because the fuel would float and dissipate on

the sea surface and would not be expected to reach the Flower Garden Banks or the Florida Keys. A large oil spill is the only relevant IPF.

Impacts of a Large Oil Spill

Based on the 30-day OSRA modeling results (**Table 3**), a large oil spill would be unlikely (<0.5% probability) to reach Nassau grouper habitat in the Florida Keys (Monroe County, Florida). A spill would be unlikely to contact the Flower Garden Banks based on the distance between the project area and the Flower Garden Banks (approximately 100 miles [161 km]), and the difference in water depth between the project area (4,414 to 4,604 ft [1,345 to 1,403 m]) and the Banks (approximately 56 to 476 ft [17 to 145 m]). While on the surface, oil would not be expected to contact subsurface fish. Natural or chemical dispersion of oil could cause a subsurface plume which would have the possibility of contacting Nassau groupers.

If a subsurface plume were to occur, impacts to Nassau groupers on the Flower Garden Banks would be unlikely due to the low density of Nassau grouper present on the Banks, the distance between the project area and the Flower Garden Banks (approximately 100 miles [161 km]), and the shallow location of the coral cap of the Banks. Near-bottom currents in the region are predicted to flow along the isobaths (Nowlin et al., 2001) and typically would not carry a plume up onto the continental shelf edge. Valentine et al. (2014) observed the spatial distribution of excess hopane, a crude oil tracer from the *Deepwater Horizon* incident sediment core samples, to be in the deeper waters and not transported up the shelf, thus confirming that near-bottom currents flow along the isobaths.

In the unlikely event that an oil slick should reach Nassau grouper habitat, oil droplets or oiled sediment particles could come into contact with Nassau grouper present on the reefs. Potential impacts include the direct ingestion of oil which could cover their gill filaments or gill rakers, ingestion of oiled prey, or the absorption of dissolved petroleum products through the gills.

In the event of a large oil spill, due to the distance between the project area and the Flower Garden Banks, it is unlikely that oil would impact Nassau grouper habitats. It is possible that a large oil spill could contact individual Nassau grouper fish, but due to the low density of individuals thought to occur in the Gulf of Mexico, there would not likely be any population-level effects.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.3.12 Smalltooth Sawfish (Endangered)

The smalltooth sawfish, named after their flat, saw-like rostrum, is an elasmobranch ray which lives in shallow coastal tropical seas and estuaries where they feed on fish and invertebrates such as shrimp and crabs (NOAA Fisheries, nd). Once found along most of the northern Gulf of Mexico coast from Texas to Florida, their current range in Gulf of Mexico is restricted to areas primarily in southwest Florida (Brame et al., 2019) where several areas of critical habitat have been designated (**Figure 2**). A species description is presented in the recovery plan for this species (NMFS, 2009a).

Listed as Endangered under the ESA in 2003, population numbers have drastically declined over the past century primarily due to accidental bycatch (Seitz and Poulakis, 2006). Although there are

no reliable estimates for smalltooth sawfish population numbers throughout its range (NMFS, 2018c), data from 1989 to 2004 indicated a slight increasing trend in population numbers in Everglades National Park during that time period (Carlson et al., 2007). More recent data resulted in a similar conclusion, with indications that populations were stable or slightly increasing in southwest Florida (Carlson and Osborne, 2012).

There are no IPFs associated with routine project activities that could affect smalltooth sawfish. A small fuel spill would not affect smalltooth sawfish because the fuel would float and dissipate on the sea surface and would not be expected to reach smalltooth sawfish habitat in coastal areas (see **Section A.9.1**). A large oil spill is the only relevant IPF.

Impacts of a Large Oil Spill

The project area is approximately 844 miles (1,358 km) from the nearest smalltooth sawfish critical habitat in Charlotte County, Florida. Based on the 30-day OSRA modeling (**Table 3**), coastal areas containing smalltooth sawfish critical habitat are unlikely to be affected within 30 days of a spill (<0.5% conditional probability).

Information regarding the direct effects of oil on elasmobranchs, including the smalltooth sawfish are largely unknown. A study by Cave and Kajiura (2018) reported that when exposed to crude oil, the Atlantic stingray experienced impaired olfactory function which could lead to decreased fitness. In the event of oil reaching smalltooth sawfish habitats, the smalltooth sawfish could be affected by direct ingestion, ingestion of oiled prey, or the absorption of dissolved petroleum products through the gills. Based on the shallow, coastal habitats preferred by smalltooth sawfish, individuals in areas subject to coastal oiling could be more likely to be impacted than other species that reside at depth.

C.3.13 Beach Mouse (Endangered)

Four subspecies of Endangered beach mouse occur on the barrier islands of Alabama and the Florida Panhandle: the Alabama (*Peromyscus polionotus ammobates*), Choctawhatchee (*P. p. allopshys*), Perdido Key (*P. p. trissyllepsis*), and St. Andrew beach mouse (*P. p. peninsularis*). Critical habitat has been designated for all four subspecies and is shown combined in **Figure 2**. One additional species of beach mouse inhabiting dunes on the western Florida Panhandle, the Santa Rosa beach mouse (*P. p. leucocephalus*), is not listed under the ESA. Species descriptions are presented by (BOEM, 2017a).

A large oil spill is the only IPF that could potentially affect subspecies of beach mouse. There are no IPFs associated with routine project activities that could affect these animals due to the distance from shore and the lack of onshore support activities near their habitat.

Impacts of a Large Oil Spill

Potential spill impacts on Endangered beach mouse subspecies are discussed by BOEM (2016b, 2017a). For this EP, there are no unique site-specific issues with respect to these species.

The project area is approximately 462 miles (744 km) from the nearest beach mouse critical habitat. The 30-day OSRA modeling (**Table 3**) predicts that a spill in the project area has a <0.5% conditional probability of contacting any coastal areas containing beach mouse critical habitat within 30 days of a spill.

In the event of oil contacting these beaches, beach mice could experience several types of direct and indirect impacts. Contact with spilled oil could cause skin and eye irritation and subsequent infection; matting of fur; irritation of sweat glands, ear tissues, and throat tissues; disruption of sight and hearing; asphyxiation from inhalation of fumes; and toxicity from ingestion of oil and oiled food. Indirect impacts could include reduction of food supply, destruction of habitat, and fouling of nests. Impacts could also occur from vehicular traffic and other activities associated with spill cleanup (BOEM, 2017a).

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the event of oil from a large spill contacting beach mice habitat, it is expected that impacts resulting in the death of individual beach mice would be adverse and potentially significant at the population level. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.3.14 Florida Salt Marsh Vole (Endangered)

The Florida salt marsh vole (*Microtus pennsylvanicus dukecampbelli*) is a small, dark brown or black rodent found only in saltgrass (*Distichlis spicata*) meadows in the Big Bend region of Florida that was listed as Endangered under the ESA in 1991. Only two populations of Florida salt marsh vole are known to exist: one near Cedar Key in Levy County, Florida and one in the Lower Suwanee National Wildlife Refuge in Dixie County, Florida (Florida Fish and Wildlife Conservation Commission, nd). No critical habitat has been established for the Florida salt marsh vole in part due to concerns over illegal trapping or trespassing if the location of the populations were publicly disclosed (U.S. Fish and Wildlife Service, 2001b).

A large oil spill is the only IPF that potentially may affect the Florida salt marsh vole. There are no IPFs associated with routine project activities that could affect these animals due to the distance from the project area to their habitat and the lack of any onshore support activities near their habitat. A small fuel spill in the project area would not affect the Florida salt marsh vole because a small fuel spill would not be expected to reach their habitat prior to dissipating (see **Section A.9.1**).

Impacts of a Large Oil Spill

Florida salt marsh vole habitat in Levy and Dixie counties, Florida is approximately 799 miles (1,286 km) from the project area. The 30-day OSRA modeling (**Table 3**) predicts that a spill in the project area has <0.5% or less conditional probability of contacting any coastal areas containing Florida salt marsh voles within 30 days.

In the event of oil contacting beaches containing these animals, Florida salt marsh voles could experience several types of direct and indirect impacts. Contact with spilled oil could cause skin and eye irritation and subsequent infection; matting of fur; irritation of sweat glands, ear tissues, and throat tissues; disruption of sight and hearing; asphyxiation from inhalation of fumes; and toxicity from ingestion of oil and contaminated food. Indirect impacts could include reduction of food supply, destruction of habitat, and fouling of nests. Impacts could also occur from vehicular traffic and other activities associated with spill cleanup. Impacts associated with an extensive oiling of coastal habitat containing Florida salt marsh voles from a large oil spill are expected to be significant. Due to the extremely low population numbers, extensive oiling of Florida salt marsh vole habitat could result in the extinction of the species.

However, any such impacts are unlikely due to the distance from the project area to Florida salt marsh vole habitat and response actions that would occur in the event of a spill.

C.3.15 Threatened Coral Species

Seven Threatened coral species are known from the northern Gulf of Mexico: elkhorn coral, staghorn coral, lobed star coral, mountainous star coral, boulder star coral, pillar coral, and rough cactus coral. Elkhorn coral, lobed star coral, mountainous star coral, and boulder star coral have been reported from the coral cap region of the Flower Garden Banks (NOAA, 2014), but are unlikely to be present as regular residents in the northern Gulf of Mexico because they typically inhabit coral reefs in shallow, clear tropical, or subtropical waters. Staghorn coral, pillar coral, and rough cactus coral are not known to inhabit reefs of the Flower Garden Banks, but are present on reefs in the Florida Keys and Dry Tortugas (Florida Fish and Wildlife Conservation Commission, 2018). Other Caribbean coral species evaluated by NMFS in 2014 (79 FR 53852) either do not meet the criteria for ESA listing or are not known from the Flower Garden Banks, Florida Keys, or Dry Tortugas. Critical habitat has been designated for elkhorn coral and staghorn coral in the Florida Keys (Monroe County, Florida) and Dry Tortugas, but none has been designated for the other Threatened coral species included here.

There are no IPFs associated with routine project activities that could affect Threatened corals in the northern Gulf of Mexico. A small fuel spill would not affect Threatened coral species because the oil would float and dissipate on the sea surface. A large oil spill is the only relevant IPF (potential impacts listed in **Table 2**) and is discussed below.

Impacts of a Large Oil Spill

A large oil spill would be unlikely to reach coral reefs at the Flower Garden Banks or elkhorn coral critical habitat in the Florida Keys (Monroe County, Florida) or Dry Tortugas. The 30-day OSRA modeling (**Table 3**) predicts the conditional probability of oil contacting the Florida Keys is <0.5% within 30 days of a spill. A surface slick would not contact corals on the seafloor. If a subsurface plume were to occur, impacts on the Flower Garden Banks would be unlikely due to the distance and the difference in water depth.

Near-bottom currents in the region are predicted to flow along the isobaths (Nowlin et al., 2001) and typically would not carry a plume up onto the continental shelf edge. Valentine et al. (2014) observed the spatial distribution of excess hopane, a crude oil tracer from *Deepwater Horizon* incident sediment core samples, to be in the deeper waters and not transported up the shelf, thus confirming near-bottom currents flow along the isobaths.

In the unlikely event that an oil slick reached reefs at the Flower Garden Banks or other Gulf of Mexico reefs, oil droplets or oiled sediment particles could come into contact with reef organisms or corals. As discussed by BOEM (2017a) impacts could include loss of habitat, biodiversity, and live coral coverage; destruction of hard substrate; change in sediment characteristics; and reduction or loss of one or more commercial and recreational fishery habitats. Sublethal effects could be long-lasting and affect the resilience of coral colonies to natural disturbances (e.g., elevated water temperature, diseases) (BOEM, 2017a).

Due to the distance between the project area and coral habitats, there is a low chance of oil contacting Threatened coral habitat in the event of a spill and no significant impacts on Threatened coral species are expected.

C.4 Coastal and Marine Birds

C.4.1 Marine Birds

Marine birds include seabirds and other species that may occur in the pelagic environment of the project area (Clapp et al., 1982a,b, Clapp et al., 1983, Peake, 1996, Hess and Ribic, 2000). Seabirds spend much of their lives offshore over the open ocean, except during breeding season when they nest on islands and along the coast. Other waterbirds, such as waterfowl, marsh birds, and shorebirds may occasionally be present over open ocean areas. No Endangered or Threatened bird species are likely to occur at the project area. For a discussion of coastal birds, see **Section C.4.2**.

Marine birds of the northern Gulf of Mexico were surveyed from ships during the GulfCet II program (Davis et al., 2000). Davis et al. (2000) reported that terns, storm-petrels, shearwaters, and jaegers were the most frequently sighted seabirds in the deepwater area. From these surveys, four ecological categories of seabirds were documented in the deepwater areas of the Gulf: summer migrants (shearwaters, storm-petrels, boobies); summer residents that breed along the Gulf coast (Sooty Tern [*Onychoprion fuscatus*], Least Tern [*Sternula antillarum*], Sandwich Tern [*Thalasseus sandvicensis*], Magnificent Frigatebird [*Fregata magnificens*]); winter residents (gannets, gulls, jaegers); and permanent resident species (Laughing Gulls [*Leucophaeus atricilla*], Royal Terns [*Thalasseus maximus*], Bridled Terns [*Onychoprion anaethetus*]) (Davis et al., 2000). The GulfCet II study did not estimate bird densities; however, seabird densities over the open ocean have been estimated to be 0.62 birds mile⁻² (1.6 birds km⁻²) (Haney et al., 2014).

The distributions and relative densities of seabirds within the deepwater areas of the Gulf of Mexico, including the project area, vary temporally (i.e., seasonally) and spatially. In GulfCet II studies (Davis et al., 2000), species diversity and density varied by hydrographic environment and by the presence and relative location of mesoscale features such as Loop Current eddies that may enhance nutrient levels and productivity of surface waters where these seabird species forage (Davis et al., 2000).

Trans-Gulf migrant birds including shorebirds, wading birds, and terrestrial birds may also be present in the project area. Migrant birds may use offshore structures, including platforms and semisubmersibles for resting, feeding, or as temporary shelter from inclement weather (Ronconi et al., 2015). Some birds may be attracted to offshore structures because of the lights and the fish populations that aggregate around these structures.

IPFs that could potentially affect marine birds include MODU presence, noise, and lights; support vessel and helicopter traffic; and two types of accidents (a small fuel spill and a large oil spill). Effluent discharges permitted under the NPDES general permit are likely to have negligible impacts on the birds due to rapid dispersion, the small area of ocean affected, the intermittent nature of the discharges, and the mobility of these animals. Compliance with BSEE NTL 2015-G013 (See **Table 1**) will minimize the potential for marine debris-related impacts on birds.

Impacts of Mobile Offshore Drilling Unit Presence, Noise, and Lights

Marine birds migrating over water have been known to strike offshore structures, resulting in death or injury (Wiese et al., 2001, Russell, 2005). Mortality of migrant birds at tall towers and other land-based structures has been reviewed extensively, and the mechanisms involved in platform collisions appear to be similar. In some cases, migrants simply do not see a part of the platform until it is too late to avoid it. In other cases, navigation may be disrupted by noise or lighting (Russell, 2005, Ronconi et al., 2015). However, offshore structures may in some cases serve

as suitable stopover habitats for trans-Gulf migrant species, particularly in the spring (Russell, 2005, Ronconi et al., 2015).

Overall, potential negative impacts to marine birds from MODU lighting, potential collisions, or other adverse effects are highly localized, temporary in nature, and may be expected to affect only small numbers of birds during migration periods. Therefore, these potential impacts are not expected to affect birds at the population or species level and are not significant (BOEM, 2012a).

Impacts of Support Vessel and Helicopter Traffic

Support vessels and helicopters are unlikely to substantially disturb marine birds in open, offshore waters. Schwemmer et al. (2011) showed that several sea birds showed behavioral responses and altered distribution patterns in response to ship traffic, which could potentially cause loss of foraging time and resting habitat. However, it is likely that individual birds would experience, at most, only short-term behavioral disruption resulting from support vessel and helicopter traffic, and the impact would not be significant.

Impacts of a Small Fuel Spill

Potential spill impacts on marine birds are discussed by BOEM (2016b, 2017a). For this EP, there are no unique site-specific issues with respect to spill impacts on marine birds.

The probability of a fuel spill will be minimized by Shell's preventative measures implemented during routine operations, including fuel transfer. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the potential for impacts on marine birds. EP Section 9b provides detail on spill response measures. Given the open ocean location of the project area and the short duration of a small spill, the potential exposure for pelagic marine birds would be brief.

A small fuel spill in offshore waters would produce a thin slick on the water surface and introduce concentrations of petroleum hydrocarbons and their degradation products. The extent and persistence of impacts would depend on the meteorological and oceanographic conditions at the time and the effectiveness of spill response measures. **Section A.9.1** discusses the likely fate of a small fuel spill and indicates that more than 90% would evaporate or disperse naturally within 24 hours. The area of diesel fuel on the sea surface would range from 1.2 to 12 ac (0.5 to 5 ha), depending on sea state and weather conditions.

Birds exposed to oil on the sea surface could experience direct physical and physiological effects including skin irritation; chemical burns of skin, eyes, and mucous membranes; and inhalation of VOCs. Because of the limited areal extent and short duration of water quality impacts from a small fuel spill, secondary impacts due to ingestion of oil via contaminated prey or reductions in prey abundance are unlikely. Due to the low densities of birds in open ocean areas, the small area affected, and the brief duration of the surface slick, no significant impacts on marine birds are expected.

Impacts of a Large Oil Spill

Potential spill impacts on marine birds are discussed by BOEM (2016b, 2017a). For this EP, there are no unique site-specific issues with respect to spill impacts on marine birds.

Pelagic seabirds could be exposed to oil from a spill at the project area. Hess and Ribic (2000) reported that terns, storm-petrels, shearwaters, and jaegers were the most frequently sighted seabirds in the deepwater Gulf of Mexico (>200 m). Haney et al. (2014) estimated that seabird

densities over the open ocean are approximately 1.6 birds km⁻². The number of marine birds that could be affected in open, offshore waters would depend on the extent and persistence of the oil slick.

Data following the *Deepwater Horizon* incident provide relevant information about the species of marine birds that may be affected in the event of a large oil spill. Birds that have been treated for oiling include several pelagic species such as the Northern Gannet (*Morus bassanus*), Magnificent Frigatebird, and Masked Booby (*Sula dactylatra*) (USFWS, 2011). The Northern Gannet was among the species with the largest numbers of individuals affected by the spill. NOAA reported that at least 93 resident and migratory bird species across all five Gulf Coast states were exposed to oil from the *Deepwater Horizon* incident in multiple habitats, including offshore/open waters, island waterbird colonies, barrier islands, beaches, bays, and marshes (NOAA, 2016b). Exposure of marine birds to oil can result in adverse health with severity, depending on the level of oiling. Effects can range from plumage damage and loss of buoyancy for external oiling to more severe effects such as organ damage, immune suppression, endocrine imbalance, reduced aerobic capacity and death as a result of oil inhalation or ingestion (NOAA, 2016b).

However, a blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. It is expected that impacts to marine birds from a large oil spill resulting in the death of individual birds would be adverse but likely not significant at population levels. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.4.2 Coastal Birds

Threatened and Endangered bird species present in the Gulf of Mexico (Piping Plover and Whooping Crane) are discussed in **Section C.3**. Various species of non-endangered coastal birds are also found along the northern Gulf Coast, including diving birds, shorebirds, marsh birds, wading birds, and waterfowl. Gulf Coast marshes and beaches also provide important feeding grounds and nesting habitats. Species that nest on beaches, flats, dunes, bars, barrier islands, and similar coastal and nearshore habitats include the Sandwich Tern, Wilson's Plover (*Charadrius wilsonia*), Black Skimmer (*Rynchops niger*), Forster's Tern (*Sterna forsteri*), Gull-Billed Tern (*Gelochelidon nilotica*), Laughing Gull, Least Tern, and Royal Tern (USFWS, 2010). Additional information is presented by BOEM (2012a, 2017a).

The Brown Pelican was delisted from federal Endangered status in 2009 (USFWS, 2016) and was delisted from state species of special concern status by the State of Florida in 2017 (Florida Fish and Wildlife Conservation Commission, 2016) and Louisiana (Louisiana Wildlife & Fisheries, 2020). However, this species remains listed as endangered by Mississippi (Mississippi Natural Heritage Program, 2018). Brown Pelicans inhabit coastal habitats and forage within both coastal waters and waters of the inner continental shelf. Aerial and shipboard surveys, including GulfCet and GulfCet II (Davis et al., 2000) indicate that Brown Pelicans do not occur over deep offshore waters (Fritts and Reynolds, 1981, Peake, 1996). Nearly half the southeastern population of Brown Pelicans lives in the northern Gulf Coast, generally nesting on protected islands (USFWS, 2010).

The Bald Eagle was delisted from its federal Threatened status in 2007. However, this species is listed as endangered in Mississippi (Mississippi Natural Heritage Program, 2018). The Bald eagle is also listed as threatened in Texas (Texas Parks and Wildlife Department, 2017). The Bald Eagle still

receives protection under the Migratory Bird Treaty Act of 1918 and the Bald and Golden Eagle Protection Act of 1940 (USFWS, 2015). The Bald Eagle is a terrestrial raptor widely distributed across the southern U.S., including coastal habitats along the Gulf of Mexico. The Gulf Coast is inhabited by both wintering migrant and resident Bald Eagles (Buehler, 2000).

IPFs that could potentially affect coastal birds include support vessel and helicopter traffic and a large oil spill. As explained in **Section A.9.1**, a small fuel spill would not be expected to make landfall or reach coastal waters prior to dissipating. Compliance with NTL BSEE 2015-G013 will minimize the potential for marine debris-related impacts on shorebirds.

Impacts of Support Vessel and Helicopter Traffic

Support vessels and helicopters will transit coastal areas where coastal birds may be found. These activities could periodically disturb individuals or groups of birds within sensitive coastal habitats (e.g., wetlands that may support feeding, resting, or breeding birds).

Vessel traffic may disturb some foraging and resting birds. Flushing distances vary among species and individuals (Rodgers and Schwikert, 2002, Schwemmer et al., 2011, Mendel et al., 2019). The disturbances will be limited to flushing birds away from vessel pathways; known distances are from 65 to 160 ft (20 to 49 m) for personal watercraft and 75 to 190 ft (23 to 58 m) for outboard-powered boats (Rodgers and Schwikert, 2002). Flushing distances may be similar or less for the support vessels to be used for this project, and some species such as gulls are attracted to boats. Support vessels will not approach nesting or breeding areas on the shoreline, so nesting birds, eggs, and chicks will not be disturbed. Vessel operators will use designated navigation channels and comply with posted speed and wake restrictions while transiting sensitive inland waterways. Due to the limited scope, duration, and geographic extent of drilling activities, any short-term impacts are not expected to be significant to coastal bird populations.

Helicopter traffic can cause some disturbance to birds on shore and offshore. Responses highly depend on the type of aircraft, bird species, activities that animals were previously engaged in, and previous exposures to overflights (Efroymsen et al., 2001). Helicopters seem to cause the most intense responses over other human disturbances for some species (Bélanger and Bédard, 1989, Rojek et al., 2007, Fuller et al., 2018). However, Federal Aviation Administration Advisory Circular No. 91-36D recommends that pilots maintain a minimum altitude of 2,000 ft (610 m) when flying over noise-sensitive areas such as wildlife refuges, parks, and areas with wilderness characteristics. This is greater than the distance (slant range) at which aircraft overflights have been reported to cause behavioral effects on most species of birds studied in Efroymsen et al. (2001). With these guidelines in effect, it is likely that individual birds would experience, at most, only short-term behavioral disruption. The potential impacts are not expected to be significant to bird populations or species in the project area.

Impacts of Large Oil Spill

Coastal birds can be exposed to oil as they float on the water surface, dive during foraging, or wade in oiled coastal waters. The Brown Pelican and Bald Eagle could be impacted by the ingestion of contaminated fish or birds (BOEM, 2012a, 2016b). In the event of a large oil spill reaching coastal habitats, cleanup personnel and equipment could create short-term disturbances to coastal birds. Indirect effects could occur from restoration efforts, resulting in habitat loss, alteration, or fragmentation (BOEM, 2017a). Based on the 30-day OSRA results summarized in **Table 3**, coastal areas would not likely be affected within 3 to 10 days. Coastal areas between Cameron County,

Texas, and Vermilion Parish, Louisiana, may be affected within 30 days of a spill (1% to 8% conditional probability).

Studies concerning the *Deepwater Horizon* incident provide additional information regarding impacts on coastal birds that may be affected in the event that a large oil spill reaches coastal habitats. According to NOAA (2016b), an estimated 51,600 to 84,500 birds were killed by the spill, and the reproductive output lost as a result of breeding adult bird mortality was estimated to range from 4,600 to 17,900 fledglings that would have been produced in the absence of premature deaths of adult birds (NOAA, 2016b). Species with the largest numbers of estimated mortalities were American White Pelican (*Pelecanus erythrorhynchos*), Black Skimmer, Black Tern (*Chlidonias niger*), Brown Pelican, Laughing Gull, Least Tern, Northern Gannet, and Royal Tern (NOAA, 2016b). A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. However, if oil from a large spill reaches coastal bird habitats, significant injuries or mortalities to coastal birds are possible and could be significant at the population level. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.5 Fisheries Resources

C.5.1 Pelagic Communities and Ichthyoplankton

Biggs and Ressler (2000) reviewed the biology of pelagic communities in the deepwater environment of the northern Gulf of Mexico. The biological oceanography of the region is dominated by the influence of the Loop Current, whose surface waters are among the most oligotrophic in the world's oceans. Superimposed on this low-productivity condition are productive "hot spots" associated with entrainment of nutrient-rich Mississippi River water and mesoscale oceanographic features. Anticyclonic and cyclonic hydrographic features play an important role in determining biogeographic patterns and controlling primary productivity in the northern Gulf of Mexico (Biggs and Ressler, 2000).

Most fishes inhabiting shelf or oceanic waters of the Gulf of Mexico have planktonic eggs and larvae (Ditty, 1986, Ditty et al., 1988, Richards et al., 1989, Richards et al., 1993). A study by Ross et al. (2012) on midwater fauna to characterize vertical distribution of mesopelagic fishes in selected deepwater areas in the Gulf of Mexico substantiated high species richness, but the community was dominated by relatively few families and species.

IPFs that could potentially affect pelagic communities and ichthyoplankton include MODU presence, noise, and lights; effluent discharges; water intakes; and two types of accidents (a small fuel spill and a large oil spill).

Impacts of Mobile Offshore Drilling Unit Presence, Noise, and Lights

The MODU, as floating structure in the deepwater environment, will act as a fish-aggregating device (FAD). In oceanic waters, the FAD effect would be most pronounced for epipelagic fishes such as tunas, dolphin, billfishes, and jacks, which are commonly attracted to fixed and drifting surface structures (Holland, 1990, Higashi, 1994, Relini et al., 1994). Positive fish associations with offshore rigs and platforms in the Gulf of Mexico are well documented (Gallaway and Lewbel, 1982, Wilson et al., 2003, Wilson et al., 2006, Edwards and Sulak, 2006). The FAD effect could possibly enhance the feeding of epipelagic predators by attracting and concentrating smaller fish species.

MODU noise could potentially cause acoustic masking in fishes, thereby reducing their ability to hear biologically relevant sounds (Radford et al., 2014). The only defined acoustic threshold levels for continuous noise are given by Popper et al. (2014) and apply only to species of fish with swim bladders that provide some hearing (pressure detection) function. Popper et al. (2014) estimated threshold SPL_{rms} of 170 dB re 1 μPa accumulated over a 48-hour period for onset of recoverable injury and 158 dB re 1 μPa accumulated over a 12-hour period for onset temporary auditory threshold shifts. However, no consistent behavioral thresholds for fish have been established (Popper et al., 2014). Noise may also influence fish behaviors, such as predator-avoidance, foraging, reproduction, and intraspecific interactions (Picciulin et al., 2010, Brintjes and Radford, 2013, McLaughlin and Kunc, 2015). Because the MODU is a temporary structure, impacts on fish populations, whether beneficial or adverse, are not expected to be significant.

Few data exist regarding the impacts of noise on pelagic larvae and eggs. Generally, it is believed that larval fish will have similar hearing sensitivities as adults, but may be more susceptible to barotrauma injuries associated with impulsive noise (Popper et al., 2014). Larval fish were experimentally exposed to simulated impulsive sounds by Bolle et al. (2012). The controlled playbacks produced SEL_{cum} of 206 dB re 1 μPa² s but resulted in no increased mortality between the exposure and control groups. Non-impulsive noise sources (such as MODU operations) are expected to be far less injurious than impulsive noise. Based on transmission loss calculations (Urick, 1983), open water propagation of noise produced by typical sources with DP thrusters in use during drilling, are not expected to produce received SPL_{rms} greater than 160 dB re 1 μPa beyond 105 ft (32 m) from the source. Because of the limited propagation distances of above-threshold SPL_{rms} and the periodic and transient nature of ichthyoplankton, no impacts to these life stages are expected.

Impacts of Effluent Discharges

Discharges of treated WBM- and SBM-associated cuttings will produce temporary, localized increases in suspended solids in the water column around the MODU. In general, turbid water can be expected to extend between a few hundred meters and several kilometers down current from the discharge point (National Research Council, 1983, Neff, 1987). NPDES permit limits and requirements will be met.

WBM and cuttings will be released at the seafloor during the initial well intervals before the marine riser is set, that allows their return to the surface vessel. Excess cement slurry and BOP fluid will also be released at the seafloor. These discharges could smother or cover benthic communities in the vicinity of the discharge location. Impacts will be limited to the immediate area of the discharge, with little or no impact to fisheries resources.

Treated sanitary and domestic wastes may have little or no effect on the pelagic environment in the immediate vicinity of these discharges. These wastes may have elevated levels of nutrients, organic matter, and chlorine, but should dilute rapidly to undetectable levels within tens to hundreds of meters from the source. As a result of quick dilution, minimal impacts on water quality, plankton, and nekton are anticipated.

Deck drainage will have little or no impact on the pelagic environment in the immediate vicinity of these discharges. Deck drainage from oily areas will be passed through an oil-and-water separator prior to release, and discharges will be monitored for visible sheen. The discharges may have slightly elevated levels of hydrocarbons but should dilute rapidly to undetectable levels within tens

to hundreds of meters from the source. Minimal impacts on water quality, plankton, and nekton are anticipated.

Other effluent discharges from the MODU and support vessels are expected to include desalination unit discharge, non-contaminated well treatment and completion fluids, BOP fluid, ballast water, bilge water, cement slurry, fire water, hydrate inhibitor, and non-contact cooling water. The MODU and support vessel discharges are expected to be in compliance with NPDES permit and USCG regulations, as applicable, and are not expected to cause significant impacts on water quality (BOEM, 2012a).

Impacts of Water Intakes

Seawater will be drawn from several meters below the ocean surface for various services, including firewater and once-through non-contact cooling of machinery on the MODU (EP Table 7a). Section 316(b) of the Clean Water Act requires NPDES permits to ensure that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available to minimize adverse environmental impact from impingement and entrainment of aquatic organisms. The current general NPDES Permit No. GMG290103 specifies requirements for new facilities for which construction commenced after July 17, 2006, with a cooling water intake structure having a design intake capacity of greater than two million gallons of water per day, of which at least 25% is used for cooling purposes.

The MODU selected for this project meets the described applicability for new facilities, and the vessel's water intakes are expected to be in compliance with the design, monitoring, and recordkeeping requirements of the NPDES permit.

The intake of seawater for cooling water will entrain plankton. The low intake velocity should allow most strong-swimming juvenile fishes and smaller adults to escape entrainment or impingement. However, drifting plankton would not be able to escape entrainment except for a few fast-swimming larvae of certain taxonomic groups. Those organisms entrained may be stressed or killed, primarily through changes in water temperature during the route from cooling intake structure to discharge structure and mechanical damage (turbulence in pumps and condensers). Because of the limited scope and short duration of drilling activities, any short-term impacts of entrainment are not expected to be biologically significant to plankton or ichthyoplankton populations (BOEM, 2017a).

Impacts of a Small Fuel Spill

Potential spill impacts on fisheries resources are discussed by BOEM (2016b, 2017a). For this EP, there are no unique site-specific issues with respect to spill impacts.

The probability of a fuel spill will be minimized by Shell's preventative measures during routine operations, including fuel transfer. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the potential for impacts on pelagic communities, including ichthyoplankton. EP Section 9b provides detail on spill response measures. Given the open ocean location of the project area, the duration of a small spill and opportunity for impacts to occur would be very brief.

A small fuel spill in offshore waters would produce a thin slick on the water surface and introduce concentrations of petroleum hydrocarbons and their degradation products. The extent and

persistence of impacts would depend on the meteorological and oceanographic conditions at the time and the effectiveness of spill response measures. **Section A.9.1** discusses the likely fate of a small fuel spill and indicates that more than 90% would evaporate or disperse naturally within 24 hours. The area of diesel fuel on the sea surface would range from 1.2 to 12 ac (0.5 to 5 ha), depending on sea state and weather conditions.

A small fuel spill could have localized impacts on phytoplankton, zooplankton, ichthyoplankton, and nekton. Due to the limited areal extent and short duration of water quality impacts, a small fuel spill would be unlikely to produce detectable impacts on pelagic communities.

Impacts of a Large Oil Spill

Potential spill impacts on pelagic communities and ichthyoplankton are discussed by BOEM (2016b, 2017a). For this EP, there are no unique site-specific issues.

A large oil spill could directly affect water column biota including phytoplankton, zooplankton, ichthyoplankton, and nekton. A large spill that persisted for weeks or months would be more likely to affect these communities. While adult and juvenile fishes may actively avoid a large spill, planktonic eggs and larvae would be unable to avoid contact. Eggs and larvae of fishes in the upper layers of the water column are especially vulnerable to oiling; certain toxic fractions of spilled oil may be lethal to these life stages. Impacts would be potentially greater if local scale currents retained planktonic larval assemblages (and the floating oil slick) within the same water mass. Impacts to ichthyoplankton from a large spill would be greatest during spring and summer when concentrations of ichthyoplankton on the continental shelf peak (BOEM, 2014, 2015, 2016b).

Oil spill impacts to phytoplankton include changes in community structure and increases in biomass, which have been attributed to the effects of oil contamination and of decreased predation due to zooplankton mortality (Abbriano et al., 2011, Ozhan et al., 2014). Ozhan et al. (2014) reported that the formation of oil films on the water surface can limit gas exchange through the air-sea interface and can reduce light penetration into the water column which will limit phytoplankton photosynthesis. Determining the impact of a diesel spill on phytoplankton is a complex issue as some phytoplankton species are more tolerant of oil exposure than others while some species are more tolerant under low concentrations and some under high concentrations (Ozhan et al., 2014). Phytoplankton populations can change quickly on small temporal and spatial scales making it difficult to predict how a phytoplankton community as a whole will respond to an oil spill.

Mortality of zooplankton has been shown to be positively correlated with oil concentrations (Lennuk et al., 2015). Spills that are not immediately lethal can have short- or long-term impacts on biomass and community composition, behavior, reproduction, feeding, growth and development, immune response and respiration (Harvell et al., 1999, Wootton et al., 2003, Auffret et al., 2004, Hannam et al., 2010, Bellas et al., 2013, Blackburn et al., 2014). Zooplankton are especially vulnerable to acute oil pollution, showing increased mortality and sublethal changes in physiological activities (e.g., egg production, Moore and Dwyer, 1974, Linden, 1976, Lee et al., 1978, Suchanek, 1993). Zooplankton may also accumulate PAHs through diffusion from surrounding waters, direct ingestion of micro-droplets (e.g., Berrojalbiz et al., 2009, Lee et al., 2012, Lee, 2013), and by ingestion of droplets that are attached to phytoplankton (Almeda et al., 2013). Bioaccumulation of hydrocarbons can lead to additional impacts among those higher

trophic level consumers that rely on zooplankton as a food source (Almeda et al., 2013, Blackburn et al., 2014).

Planktonic communities have a high capacity for recovery from the effects of oil spill pollution due to their short life cycle and high reproductive capacity (Abbriano et al., 2011). Planktonic communities drift with water currents and recolonize from adjacent areas. Because of these attributes, plankton usually recover relatively rapidly to normal population levels following hydrocarbon spill events. Research in the aftermath of the *Deepwater Horizon* incident found that phytoplankton population recovered within weeks to months and zooplankton populations may have only been minimally affected (Abbriano et al., 2011).

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. It is expected that impacts to pelagic communities and ichthyoplankton from a large oil spill would be adverse but not significant at population levels. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.5.2 Essential Fish Habitat

Essential Fish Habitat (EFH) is defined as those waters and substrate necessary to fish for spawning, breeding, feeding, and growth to maturity. Under the Magnuson-Stevens Fishery Conservation and Management Act, as amended, federal agencies are required to consult on activities that may adversely affect EFH designated in Fishery Management Plans developed by the regional Fishery Management Councils.

The Gulf of Mexico Fishery Management Council (GMFMC) has prepared Fishery Management Plans for corals and coral reefs, shrimps, spiny lobster, reef fishes, coastal migratory pelagic fishes, and red drum (*Sciaenops ocellatus*). In 2005, the EFH for these managed species was redefined in Generic Amendment No. 3 to the various Fishery Management Plans (GMFMC, 2005). The EFH for most of these GMFMC-managed species is on the continental shelf in waters shallower than 600 ft (183 m). The shelf edge is the outer boundary for coastal migratory pelagic fishes, reef fishes, and shrimps. EFH for corals and coral reefs includes some shelf-edge topographic features located approximately 82 miles (132 km) from the project area.

EFH has been identified in the deepwater Gulf of Mexico for highly migratory pelagic fishes, which occur as transients in the project area. Species in this group, including tunas, swordfishes, billfishes, and sharks, are managed by NMFS. Highly migratory species with EFH within or near the project area include the following (NMFS, 2009b):

- Bigeye thresher shark (*Alopias superciliosus*) (all)
- Blue marlin (*Makaira nigricans*) (juveniles, adults)
- Bluefin tuna (*Thunnus thynnus*) (spawning, eggs, larvae, adults)
- Longbill spearfish (*Tetrapturus pfluegeri*) (juveniles, adults)
- Longfin mako shark (*Isurus paucus*) (all)
- Oceanic whitetip shark (all)
- Silky shark (*Carcharhinus falciformis*) (all)
- Skipjack tuna (*Carcharhinus falciformis*) (spawning, adults)
- Swordfish (*Xiphias gladius*) (larvae, juveniles, adults)
- White marlin (*Kajikia albidus*) (juveniles, adults)
- Yellowfin tuna (*Thunnus albacares*) (spawning, juveniles, adults)

- Sailfish (*Istiophorus albicans*) (juveniles, adults)

Research indicates the central and western Gulf of Mexico may be important spawning habitat for Atlantic bluefin tuna (Theo and Block, 2010), and NMFS (2009b) has designated a Habitat Area of Particular Concern (HAPC) for this species. The HAPC covers much of the deepwater Gulf of Mexico, including the project area (**Figure 2**). The areal extent of the HAPC is approximately 115,830 miles² (300,000 km²). Atlantic bluefin tuna follow an annual cycle of foraging in June through March off the eastern U.S. and Canadian coasts, followed by migration to the Gulf of Mexico to spawn in April, May, and June (NMFS, 2009b). The Atlantic bluefin tuna has also been designated as a species of concern (NMFS, 2011).

NTLs 2009-G39 and 2009-G40 provide guidance and clarification of regulations for biologically sensitive underwater features and areas and benthic communities that are considered EFH. As part of an agreement between BOEM and NMFS to complete a new programmatic EFH consultation for each new Five-Year Program, an EFH consultation was initiated between BOEM's Gulf of Mexico Region and NOAA's Southeastern Region during the preparation, distribution, and review of BOEM's 2017-2022 WPA/CPA Multisale EIS (BOEM, 2017a). The EFH assessment was completed and there is ongoing coordination among NMFS, BOEM, and BSEE, including discussions of mitigation (BOEM, 2016c).

Other HAPCs have been designated in the GMFMC (2005, 2010). These include the Florida Middle Grounds, Madison-Swanson Marine Reserve, Tortugas North and South Ecological Reserves, Pulley Ridge, and several other reefs and banks of the northwestern Gulf of Mexico (**Figure 2**). The nearest HAPC is West Flower Garden Bank, which is located approximately 87 miles (140 km) from the project area.

Routine IPFs that could potentially affect EFH and fisheries resources include MODU presence, noise, and lights; effluent discharges; and water intakes. In addition, two types of accidents (a small fuel spill and a large oil spill) may potentially affect EFH and fisheries resources.

Impacts of Mobile Offshore Drilling Unit Presence, Noise, and Lights

The MODU, as floating structure in the deepwater environment, will act as a FAD. In oceanic waters, the FAD effect would be most pronounced for epipelagic fishes such as tunas, dolphin, billfishes, and jacks, which are commonly attracted to fixed and drifting surface structures (Holland, 1990, Higashi, 1994, Relini et al., 1994, Gates et al., 2017). The FAD effect would possibly enhance feeding of epipelagic predators by attracting and concentrating smaller fish species.

MODU noise could potentially cause acoustic masking for fishes, thereby reducing their ability to hear biologically relevant sounds (Radford et al., 2014). Noise may also influence fish behaviors such as predator avoidance, foraging, reproduction, and intraspecific interactions (Picciulin et al., 2010, Brintjes and Radford, 2013, McLaughlin and Kunc, 2015, Nedelec et al., 2017). Further discussion on impact to fish from sound and injury criteria are discussed in **Section C.5.1**. Any impacts on EFH for highly migratory pelagic fishes are not expected to be significant.

Impacts of Effluent Discharges

Effluent discharges affecting EFH by diminishing ambient water quality include drilling muds and cuttings, treated sanitary and domestic wastes, deck drainage, and miscellaneous discharges such as desalination unit discharge, BOP fluid, non-contaminated well treatment and completion fluids, ballast water, bilge water, cement slurry, fire water, hydrate inhibitor, and cooling water. Impacts on EFH from effluent discharges are anticipated to be similar to those described in **Section C.5.1** for pelagic communities. No significant impacts on EFH for highly migratory pelagic fishes or coral are expected from these discharges.

Impacts of Water Intakes

As noted previously, cooling water intake will cause entrainment and impingement of plankton, including fish eggs and larvae (ichthyoplankton). Due to the limited scope, timing, and geographic extent of drilling activities, any short-term impacts on EFH for highly migratory pelagic fishes are not expected to be biologically significant.

Impacts of a Small Fuel Spill

Potential spill impacts on EFH are discussed by BOEM (2016b, 2017a). For this EP, there are no unique site-specific issues with respect to spill impacts.

The probability of a fuel spill will be minimized by Shell's preventative measures during routine operations, including fuel transfer. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the potential for impacts on EFH. EP Section 9b provides detail on spill response measures. Given the open ocean location of the project area, the duration of a small spill and opportunity for impacts to occur would be very brief.

A small fuel spill in offshore waters would produce a thin slick on the water surface and introduce concentrations of petroleum hydrocarbons and their degradation products. The extent and persistence of impacts would depend on the meteorological and oceanographic conditions at the time and the effectiveness of spill response measures. **Section A.9.1** discusses the likely fate of a small fuel spill and indicates that more than 90% would evaporate or disperse naturally within 24 hours. The area of diesel fuel on the sea surface would range from 1.2 to 12 ac (0.5 to 5 ha), depending on sea state and weather conditions.

A small fuel spill could have localized impacts on EFH for highly migratory pelagic fishes, including tunas, swordfishes, billfishes, and sharks. These species occur as transients in the project area. A spill would also produce short-term impact on surface and near-surface water quality in the HAPC for spawning Atlantic bluefin tuna, which covers much of the deepwater Gulf of Mexico. The affected area would represent a negligible portion of the HAPC, which covers approximately 115,830 miles² (300,000 km²) of the Gulf of Mexico. Therefore, no significant spill impacts on EFH for highly migratory pelagic fishes are expected.

A small fuel spill would not affect EFH for corals or coral reefs; the nearest of which is located approximately 82 miles (132 km) from the project area. A small fuel spill would float and dissipate on the sea surface and would not contact these seafloor features. Therefore, no significant spill impacts on EFH for corals and coral reefs are expected.

Impacts of a Large Oil Spill

Potential spill impacts on EFH are discussed by BOEM (2016b, 2017a). For this EP, there are no unique site-specific issues with respect to EFH.

An oil spill in offshore waters would temporarily increase hydrocarbon concentrations on the water surface and potentially the subsurface as well. Given the extent of EFH designations in the Gulf of Mexico (GMFMC, 2005, NMFS, 2009b), some impact on EFH would be unavoidable.

A large spill could affect the EFH for many managed species, including shrimps, spiny lobster, reef fishes, coastal migratory pelagic fishes, and red drum. It would result in adverse impacts on water quality and water column biota including phytoplankton, zooplankton, ichthyoplankton, and nekton. In coastal waters, sediments could be oiled and result in persistent degradation of the seafloor habitat for managed demersal fish and shellfish species.

The project area is within the HAPC for spawning bluefin tuna (NMFS, 2009b). A large spill could temporarily degrade the HAPC due to increased hydrocarbon concentrations in the water column, with the potential for lethal or sublethal impacts on spawning tuna. Potential impacts would depend in part on the timing of a spill, as this species migrates to the Gulf of Mexico to spawn in April, May, and June (NMFS, 2009b).

The nearest feature designated as EFH for corals is located 82 miles (132 km) from the project area. An accidental spill could reach or affect this feature, although near-bottom currents in the region are expected to flow along the isobaths (Nowlin et al., 2001, Valentine et al., 2014) and typically would not carry a plume up onto the continental shelf edge.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the event of oil from a large spill contacting EFH for managed species, it is expected that impacts could be significant but would likely be temporary and short-term. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.6 Archaeological Resources

C.6.1 Shipwreck Sites

In BOEM (2012a), information was presented that altered the impact conclusion for archaeological resources which came to light as a result of BOEM-sponsored studies and industry surveys. Evidence of damage to significant cultural resources (i.e., historic shipwrecks) has been shown to have occurred because of an incomplete knowledge of seafloor conditions in project areas >656 ft (200 m) water depth that have been exempted from high-resolution surveys. Since significant historic shipwrecks have recently been discovered outside the previously designated high-probability areas (some of which show evidence of impacts from permitted activities prior to their discovery), a survey is now required for exploration and development projects.

Based on NTL 2011-JOINT-G01, the project area is not on BOEM's list of archaeological survey blocks determined to have a high potential for containing archaeological properties (BOEM, 2011).

No archaeologically significant sonar contacts were identified within 2,000 ft (610 m) of the proposed wellsites during the archaeological assessment (Geoscience Earth & Marine Services, Inc., 2020b). No archaeological impacts are expected from routine activities in the project area.

Because no historic shipwreck sites are known to be present in the project area (see EP Section 6), there are no routine IPFs that are likely to affect these resources. A small fuel spill would not affect shipwrecks in adjoining blocks because the oil would float and dissipate on the sea surface. The only IPF considered would be the impact from a large oil spill that could contact shipwrecks in other blocks.

Impacts of a Large Oil Spill

BOEM (2012a) estimated that a severe subsurface blowout could resuspend and disperse sediments within a 984 ft (300 m) radius. Because there are no historic shipwrecks in the project area, this impact would not be relevant.

Beyond the seafloor blowout radius, there is the potential for impacts from oil, dispersants, and depleted oxygen levels (BOEM, 2017a). These impacts could include chemical contamination, alteration of the rates of microbial activity (BOEM, 2017a), and reduced biodiversity as shipwreck-associated sediment microbiomes (Hamdan et al., 2018). During the *Deepwater Horizon* incident, subsurface plumes were reported at a water depth of approximately 3,600 ft (1,100 m), extending at least 22 miles (35 km) from the wellsite and persisting for more than a month (Camilli et al., 2010). The subsurface plumes apparently resulted from the use of dispersants at the wellhead (NOAA, 2011b). While the behavior and impacts of subsurface plumes are not well known, a subsurface plume could contact shipwreck sites beyond the 984-foot (300-meter) radius estimated by BOEM (2012a), depending on its extent, trajectory, and persistence (Spier et al., 2013). If oil from a subsea spill should contact wooden shipwrecks on the seafloor, it could adversely affect their condition or preservation.

A spill entering shallow coastal waters could conceivably contaminate undiscovered or known historic shipwreck sites. Based on the 30-day OSRA modeling (**Table 3**), coastal areas would not likely be affected within 3 to 10 days. Coastal areas between Cameron County, Texas, and Vermilion Parish, Louisiana, may be affected within 30 days of a spill (1% to 8% conditional probability). If an oil spill contacted a coastal historic site, such as a fort or a lighthouse, the impacts may be temporary and reversible (BOEM, 2017a). Undiscovered shipwreck sites on or nearshore could also be impacted by foot or vehicle traffic during response and clean-up efforts in the aftermath of a spill.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.6.2 Prehistoric Archaeological Sites

With water depth estimates ranging from 4,414 to 4,604 ft (1,345 to 1,403 m), the project area is well beyond the 197 ft (60 m) depth contour used by BOEM as the seaward extent for prehistoric archaeological site potential in the Gulf of Mexico. Because prehistoric archaeological sites are not found in the project area, the only relevant IPF is a large oil spill that would reach coastal waters within the 197 ft (60 m) depth contour.

Impacts of a Large Oil Spill

Because of the water depth and the lack of prehistoric archaeological sites found in the project area, it is highly unlikely that any such resources would be affected by the physical effects of a subsea blowout. BOEM (2012a) estimates that a severe subsurface blowout could resuspend and disperse sediments within a 984 ft (300 m) radius.

Along the northern Gulf Coast, prehistoric sites occur frequently along the barrier islands and mainland coast and along the margins of bays and bayous (BOEM, 2012a). Based on the 30-day OSRA modeling (**Table 3**), coastal areas would not likely be affected within 3 to 10 days. Coastal areas between Cameron County, Texas, and Vermilion Parish, Louisiana, may be affected within 30 days of a spill (1% to 8% conditional probability). A spill reaching a prehistoric site along these shorelines could coat fragile artifacts or site features and compromise the potential for radiocarbon dating organic materials in a site (although other dating methods are available, and it is possible to decontaminate an oiled sample for radiocarbon dating). Coastal prehistoric sites could also be damaged by spill cleanup operations (e.g., by destroying fragile artifacts and disturbing the provenance of artifacts or site features). BOEM (2017a) notes that some unavoidable direct and indirect impacts on coastal historic resources could occur, resulting in the loss of information.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.7 Coastal Habitats and Protected Areas

Coastal habitats in the northern Gulf of Mexico that may be affected by oil and gas activities are described in previous EISs (BOEM, 2012a, 2013, 2014, 2015, 2016b, 2017a) and are tabulated in the OSRP. Coastal habitats inshore of the project area include coastal and barrier island beaches and dunes, wetlands, oyster reefs, and submerged seagrass beds. Most of the northern Gulf of Mexico is fringed by coastal and barrier island beaches, with wetlands, oyster reefs, and submerged seagrass beds occurring in sheltered areas behind the barrier islands and in estuaries.

Because of the distance from shore, the only IPF associated with routine activities in the project area that could affect beaches and dunes, wetlands, oyster reefs, seagrass beds, coastal wildlife refuges, wilderness areas, or any other managed or protected coastal area is support vessel traffic. The support bases at Port Fourchon and Galveston, Texas are not located in wildlife refuges or wilderness areas. Potential impacts of support vessel traffic are briefly addressed below.

A large oil spill is the only accidental IPF that could affect coastal habitats and protected areas. A small fuel spill in the project area would be unlikely to affect coastal habitats because the project area is 161 miles (259 km) from the nearest shoreline (Texas). As explained in **Section A.9.1**, a small fuel spill would not be expected to make landfall or reach coastal waters prior to natural dispersion.

Impacts of Support Vessel Traffic

Support operations, including the crew boats and supply boats as detailed in EP Section 14, may have a minor incremental impact on coastal and barrier island beaches, wetlands, oyster reefs, and protected habitats. Over time with a large number of vessel trips, vessel wakes can erode

shorelines along inlets, channels, and harbors, resulting in localized land loss. Impacts will be minimized by following the speed and wake restrictions in harbors and channels.

Support operations, including crew boats and supply boats are not anticipated to have a significant impact on submerged seagrass beds. While submerged seagrass beds have the potential to be uprooted, scarred, or lost due to direct contact from vessels, use of navigation channels and adherence to local requirements and implemented programs will decrease the likelihood of impacts to submerged seagrass beds BOEM (2017a, 2017c).

Impacts of a Large Oil Spill

Potential spill impacts on coastal habitats are discussed by BOEM (2016b, 2017a). Coastal habitats inshore of the project area include coastal and barrier island beaches, wetlands, oyster reefs, and submerged seagrass beds. For this EP, there are no unique site-specific issues with respect to coastal habitats.

Based on the 30-day OSRA modeling (**Table 3**), coastal areas would not likely be affected within 3 to 10 days. Coastal areas between Cameron County, Texas, and Vermilion Parish, Louisiana, may be affected within 30 days of a spill (1% to 8% conditional probability).

NWRs and other protected areas such as Wildlife Management Areas along the coast are discussed in the lease sale EIS (BOEM, 2017a) and Shell’s OSRP. Based on the 30-day OSRA, coastal and near-coastal wildlife refuges, wilderness areas, and state and national parks within the geographic range of the potential shoreline contacts within 30 days are listed in **Table 6**.

Table 6. Wildlife refuges, wilderness areas, and state and national parks and preserves within the geographic range of 1% or greater conditional probability of shoreline contacts within 30 days of a hypothetical spill from Launch Point 24 based on the 30-day Oil Spill Risk Analysis (OSRA) model.

County or Parish, State	Wildlife Refuge, Wilderness Area, or State/National Park
Cameron, Texas	Boca Chica State Park
	Brazos Island State Park
	Laguna Atascosa National Wildlife Refuge
	Laguna Madre Gulf Ecological Management Site
	Las Palomas Wildlife Management Area
	Lower Rio Grande Valley National Wildlife Refuge
Willacy, Texas	Laguna Atascosa National Wildlife Refuge
	Laguna Madre Gulf Ecological Management Site
	Padre Island National Seashore
Kenedy, Texas	Laguna Madre Gulf Ecological Management Site
	Padre Island National Seashore
Kleberg, Texas	Laguna Madre Gulf Ecological Management Site
	Padre Island National Seashore
Nueces, Texas	I.B. Magee Beach Park
	Laguna Madre Gulf Ecological Management Site
	Mission-Aransas National Estuarine Research Reserve
	Mustang Island State Park
	Port Aransas Nature Preserve
	Roberts Point Park

County or Parish, State	Wildlife Refuge, Wilderness Area, or State/National Park
Aransas, Texas	Aransas National Wildlife Refuge
	Goose Island State Park
	Lydia Ann Island Audubon Sanctuary
	Mission-Aransas National Estuarine Research Reserve
	Rattlesnake Island, Ayres Island, and Roddy Island Audubon Sanctuary
Calhoun, Texas	Redfish Bay State Scientific Area
	Aransas National Wildlife Refuge
	Chester Island Bird Sanctuary
	Guadalupe Delta Wildlife Management Area
	Matagorda Island Wildlife Management Area
Matagorda, Texas	Welder Flats Wildlife Management Area
	Big Boggy National Wildlife Refuge
	Matagorda Bay Nature Park
	Oyster Lake Park
	San Bernard National Wildlife Refuge
Brazoria, Texas	West Moring Dock Park
	Brazoria National Wildlife Refuge
	Christmas Bay Coastal Preserve
	Justin Hurst Wildlife Management Area
	San Bernard National Wildlife Refuge
Galveston, Texas	Anahuac National Wildlife Refuge
	Bolivar Flats Shorebird Sanctuary
	Fort Travis Seashore Park
	Galveston Island State Park
	Horseshoe Marsh Bird Sanctuary
	Mundy Marsh Bird Sanctuary
	R.A. Apffel Park
Seawolf Park	
Jefferson, Texas	McFaddin National Wildlife Refuge
	Sea Rim State Park
	Texas Point National Wildlife Refuge
Cameron, Louisiana	Peveto Woods Sanctuary
	Rockefeller State Wildlife Refuge and Game Preserve
	Sabine National Wildlife Refuge
Vermilion, Louisiana	Paul J. Rainey Wildlife Refuge and Game Preserve
	Rockefeller State Wildlife Refuge and Game Preserve
	State Wildlife Refuge

The level of impacts from oil spills on coastal habitats depends on many factors, including the oil characteristics, the geographic location of the landfall, and the weather and oceanographic conditions at the time of the spill (BOEM, 2017a). Oil that makes it to beaches may be liquid, weathered oil, an oil-and-water mousse, or tarballs. Oil is generally deposited on beaches in lines defined by wave action at the time of landfall. Oil that remains on the beach will thicken as its volatile components are lost. Thickened oil may form tarballs or aggregations that incorporate sand, shell, and other materials into its mass. Tar may be buried to varying depths under the sand. On warm days, both exposed and buried tarballs may liquefy and ooze. Oozing may also serve to expand the size of a mass as it incorporates beach materials. Oil on beaches may be cleaned up manually, mechanically, or both. Some oil can remain on the beach at varying depths and may persist for several years as it slowly biodegrades and volatilizes (BOEM, 2017a). Impacts associated with an extensive oiling of coastal and barrier island beaches from a large oil spill are expected to be adverse.

Coastal wetlands are highly sensitive to oiling and can be significantly impacted because of the inherent toxicity of hydrocarbon and non-hydrocarbon components of the spilled substances (Mendelssohn et al., 2012, Lin et al., 2016). Numerous variables such as oil concentration and chemical composition, vegetation type and density, season or weather, preexisting stress levels, soil types, and water levels may influence the impacts of oil exposure on wetlands. Light oiling could cause plant die-back, followed by recovery in a fairly short time. Vegetation exposed to oil that persists in wetlands could take years to recover (BOEM, 2017a). However, in a study in Barataria Bay, Louisiana, after the *Deepwater Horizon* spill, Silliman et al. (2012) reported that previously healthy marshes largely recovered to a pre-oiling state within 18 months. At 103 salt marsh locations that spanned 267 miles (430 km) of shoreline in Louisiana, Mississippi, and Alabama, Silliman et al. (2016) determined a threshold for oil impacts on marsh edge erosion with higher erosion rates occurring for approximately 1 to 2 years after the *Deepwater Horizon* spill at sites with the highest amounts of plant stem oiling (90% to 100%); thus, displaying a large-scale ecosystem loss. In addition to the direct impacts of oil, cleanup activities in marshes may accelerate rates of erosion and retard recovery rates (BOEM, 2017a). Impacts associated with an extensive oiling of coastal wetland habitat are expected to be significant.

In addition to the direct impacts of oil, cleanup activities in marshes may accelerate rates of erosion and retard recovery rates (BOEM, 2017a). A review of the literature and new studies indicated that oil spill impacts to seagrass beds are often limited and may be limited to when oil is in direct contact with these plants (Fonseca et al., 2017). Impacts associated with an extensive oiling of coastal wetland habitat are expected to be significant.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.8 Socioeconomic and Other Resources

C.8.1 Recreational and Commercial Fishing

Potential impacts to recreational and commercial fishing are analyzed by BOEM (2017a). The major species sought by commercial fishermen in federal waters of the Gulf of Mexico include shrimp, menhaden, red snapper (*Lutjanus campechanus*), tunas, and groupers (BOEM, 2017a). However, most of the fishing effort for these species is on the continental shelf in shallow waters. The main commercial fishing activity in deep waters of the northern Gulf of Mexico is pelagic longlining for tunas, swordfishes, and other billfishes (Continental Shelf Associates, 2002, Beerkircher et al., 2009). Pelagic longlining has occurred historically in the project area, primarily during spring and summer.

It is unlikely that any commercial fishing activity other than longlining will occur at or near the project area due to the water depth at the project area. Benthic species targeted by commercial fishers occur on the upper continental slope, well inshore of the project area. Royal red shrimp (*Pleoticus robustus*)

are caught by trawlers in water depths of approximately 820 to 1,804 ft (250 to 550 m) (Stiles et al., 2007). Tilefishes (primarily *Lopholatilus chamaeleonticeps*) are caught by bottom longlining in water depths from approximately 540 to 1,476 ft (165 to 450 m) (Continental Shelf Associates, 2002).

Most recreational fishing activity in the region occurs in water depths less than 656 ft (200 m) (Continental Shelf Associates, 1997, 2002, Keithly and Roberts, 2017). In deeper water, the main attraction to recreational fishers is petroleum rigs offshore Texas and Louisiana. Due to the project site's distance from shore, it is unlikely that recreational fishing activity is occurring in the project area.

The only routine IPF that could potentially affect fisheries (commercial and recreational) is MODU presence (including noise and lights). Two types of potential accidents are also addressed in this section: a small fuel spill and a large oil spill.

Impacts of Mobile Offshore Drilling Unit Presence, Noise, and Lights

There is a slight possibility of pelagic longlines becoming entangled in the MODU. For example, in January 1999, a portion of a pelagic longline snagged on the acoustic Doppler current profiler of a drillship working in the Gulf of Mexico (Continental Shelf Associates, 2002). The line was removed without incident. Generally, longline fishers use radar and are aware of offshore structures and ships when placing their sets. Therefore, little or no impact on pelagic longlining is expected.

No other adverse impacts on fishing activities are anticipated. The presence of the MODU would result in a limited area being unavailable for fishing activity, but this effect is considered negligible. Other factors such as effluent discharges are likely to have negligible impacts on commercial or recreational fisheries due to rapid dispersion, the small area of ocean affected, and the intermittent nature of the discharges.

Impacts of a Small Fuel Spill

The probability of a fuel spill will be minimized by Shell's preventative measures during routine operations, including fuel transfer. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the potential for impacts. EP Section 9b provides details on Shell's spill response measures. Given the open ocean location of the project area and the short duration of a small spill, the opportunity for impacts to occur would be very brief.

Pelagic longlining activities in the project area, if any, could be interrupted in the event of a small fuel spill. The area of diesel fuel on the sea surface would range from 1.2 to 12 ac (0.5 to 5 ha), depending on sea state and weather conditions. Fishing activities could be interrupted due to the activities of response vessels operating in the project area. A small fuel spill would not affect coastal water quality because the spill would not be expected to make landfall or reach coastal waters prior to dissipating (Section A.9.1).

Impacts of a Large Oil Spill

Potential spill impacts on fishing activities are discussed by BOEM (2016b, 2017a). For this EP, there are no unique site-specific issues with respect to this activity.

Pelagic longlining activities in the project area and other fishing activities in the northern Gulf of Mexico could be interrupted in the event of a large oil spill. A spill may or may not result in fishery closures, depending on the duration of the spill, the oceanographic and meteorological conditions at the time, and the effectiveness of spill response measures. Data from the *Deepwater Horizon* incident provide information about the maximum potential extent of fishery closures in the event of a large oil spill in the Gulf of Mexico (NMFS, 2010b). At its peak on 12 July 2010, closures encompassed 84,101 miles² (217,821 km²), or 34.8% of the U.S. Gulf of Mexico Exclusive Economic Zone. BOEM (2012a) notes that fisheries closures from a large spill event could have a negative effect on short-term fisheries catch and marketability.

According to BOEM (2012a, 2017a), the potential impacts on commercial and recreational fishing activities from an accidental oil spill are anticipated to be minimal because the potential for oil spills is very low; the most typical events are small and of short duration; and the effects are so localized that fishes are typically able to avoid the affected area. Fish populations may be affected by an oil spill event should it occur, but they would be primarily affected if the oil reaches the productive shelf and estuarine areas where many fishes spend a portion of their life cycle. However, most species of commercially valuable fish in the Gulf of Mexico have planktonic eggs or larvae which may be affected by a large oil spill in deep water (BOEM, 2017a). The probability of an offshore spill affecting these nearshore environments is also low.

Should a large oil spill occur, economic impacts on commercial and recreational fishing activities would likely occur, but are difficult to predict because impacts would differ by fishery and season (BOEM, 2017a, 2017c). Loss of consumer confidence and public health concerns can lead to the potential for economic loss since it is likely to result in seafood being withdrawn from the market. A loss of consumer confidence may also lead to price reductions or outright rejection of seafood products by commercial buyers and consumers. Quantifying financial loss due to loss in market confidence can be difficult, because it depends on reliable data being available to demonstrate both that sales have been lost and that prices have fallen as a direct consequence of the spill (International Tanker Owners Pollution Federation Limited, 2014). An analysis of the effects of the *Deepwater Horizon* incident on the seafood industry in the Gulf of Mexico estimated that the spill reduced total seafood sales by \$51.7 to \$952.9 million, with an estimated loss of 740 to 9,315 seafood related jobs (Carroll et al., 2016).

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the event of a large spill, impacts to recreational and commercial fishing are expected to be adverse, but likely temporary. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.8.2 Public Health and Safety

There are no IPFs associated with routine operations that are expected to affect public health and safety. A small fuel spill that is dissipated within a few days would have little or no impact on public health and safety, as the spill response would be completed entirely offshore, 161 miles (259 km) from the nearest shoreline (Texas). A large oil spill is the only IPF that has the potential to affect public health and safety.

Impacts of a Large Oil Spill

In the event of a large spill from a blowout, the main safety and health concerns are those of the offshore personnel involved in the incident and those responding to the spill. The proposed activities will be covered by the OSRP and, in addition, the MODU maintains a Shipboard Oil Pollution Emergency Plan as required under MARPOL 73/78.

Depending on the spill rate and duration, the physical and chemical characteristics of the oil, the meteorological and oceanographic conditions at the time, and the effectiveness of spill response measures, the public could be exposed to oil on the water and along the shoreline, through skin contact or inhalation of VOCs. Crude oil is a highly flammable material, and any smoke or vapors from a crude oil fire can cause irritation. Exposure to large quantities of crude oil may pose a health hazard.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures. No significant spill impacts on public health and safety are expected.

C.8.3 Employment and Infrastructure

There are no IPFs associated with routine operations that are expected to affect employment and infrastructure. The project involves drilling with support from existing shore-based facilities in Texas and Louisiana. No new or expanded facilities will be constructed, and no new employees are expected to move permanently into the area. The project will have a negligible impact on socioeconomic conditions such as local employment and existing offshore and coastal infrastructure (including major sources of supplies, services, energy, and water). A small fuel spill that is dissipated within a few days would have little or no economic impact, as the spill response would use existing facilities, resources, and personnel. A large oil spill is the only IPF that has the potential to affect employment and infrastructure.

Impacts of a Large Oil Spill

Potential socioeconomic impacts of an oil spill are discussed by BOEM (2016b, 2017a). For this EP, there are no unique site-specific issues with respect to employment and coastal infrastructure. A large spill could cause several types of economic impacts: extensive fishery closures could put fishermen out of work; temporary employment could increase as part of the response effort; adverse publicity could reduce employment in coastal recreation and tourism industries; and OCS drilling activities, including service and support operations that are an important part of local economies, could be suspended.

Nonmarket effects such as traffic congestion, strains on public services, shortages of commodities or services, and disruptions to the normal patterns of activities or expectations could also occur in the short term. These negative, short-term social and economic consequences of a spill are expected to be modest in terms of projected cleanup expenditures and the number of people employed in cleanup and remediation activities (BOEM, 2017a). Net employment impacts from a spill would not be expected to exceed 1% of baseline employment in any given year (BOEM, 2017a).

The project area is 161 miles (259 km) from the nearest shoreline (Texas). Based on the 30-day OSRA modeling (**Table 3**), coastal areas would not likely be affected within 3 to 10 days. Coastal areas between Cameron County, Texas, and Vermilion Parish, Louisiana, may be affected within 30 days of a spill (1% to 8% conditional probability).

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures. No significant spill impacts on employment and infrastructure are expected.

C.8.4 Recreation and Tourism

For this EP, there are no unique site-specific issues with respect to recreation and tourism. There are no known recreational or tourism uses in the project area. Recreational resources and tourism in coastal areas would not be affected by routine activities due to the distance from shore. Compliance with NTL BSEE-2015-G013 (See **Table 1**) will minimize the chance of trash or debris being lost overboard from the MODU and subsequently washing up on beaches. As explained in **Section A.9.1**, a small fuel spill would not be expected to make landfall or reach coastal waters prior to dissipating. Therefore, a small fuel spill in the project area would be unlikely to affect recreation and tourism. A large oil spill is the only IPF that has the potential to affect recreation and tourism.

Impacts of a Large Oil Spill

Potential impacts of an oil spill on recreation and tourism are discussed by BOEM (2017a). For this EP, there are no unique site-specific issues with respect to these impacts.

Impacts on recreation and tourism would vary depending on the duration of the spill and its fate including the effectiveness of response measures. A large spill that reached coastal waters and shorelines could adversely affect recreation and tourism by contaminating beaches and wetlands, resulting in negative publicity that encourages people to stay away. Loss of tourist confidence and public health concerns can then lead to the potential for economic loss. Media coverage of oil contamination, or word-of-mouth, can have implications on public perception of the incident. However, quantifying financial loss due to loss in confidence can be difficult because it depends on implementation of an effective response plan as well as a strategy to restore any loss of appeal to tourists that the area may have suffered.

Based on the 30-day OSRA modeling (**Table 3**), coastal areas would not likely be affected within 3 to 10 days. Coastal areas between Cameron County, Texas, and Vermilion Parish, Louisiana, may be affected within 30 days of a spill (1% to 8% conditional probability).

According to BOEM (2017a), should an oil spill occur and contact a beach area or other recreational resource, it would cause some disruption during the impact and cleanup phases of the spill. However, these effects are also likely to be small in scale and of short duration, in part because the probability of an offshore spill contacting most beaches is small. In the unlikely event that a spill occurs that is sufficiently large to affect large areas of the coast and, through public perception, have effects that reach beyond the damaged area, effects to recreation and tourism could be significant (BOEM, 2017a).

Impacts of the *Deepwater Horizon* incident on recreation and tourism provide some insight into the potential effects of a large spill. NOAA (2016b) estimated that the public lost 16,857,116 user-days of fishing, boating, and beach-going experiences as a result of the spill. The U.S. Travel Association has estimated the economic impact of the *Deepwater Horizon* incident on tourism across the Gulf Coast over a 3-year period at \$22.7 billion (Oxford Economics, 2010). Hotels and restaurants were the most affected tourism businesses, but charter fishing, marinas, and boat dealers and sellers were among the others affected (Eastern Research Group, 2014).

However, a blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the event of a large spill, impacts to recreation and tourism are expected to be adverse, but likely temporary. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.8.5 Land Use

Land use along the northern Gulf Coast is discussed by BOEM (2016b, 2017a). There are no routine IPFs potentially affecting land use. The project will use existing onshore support facilities in Louisiana. The land use at the existing shorebase sites is industrial. The project will not involve new construction or changes to existing land use and, therefore, will not have any impacts. Levels of boat and helicopter traffic as well as demand for goods and services, including scarce coastal resources, will represent a small fraction of the level of activity occurring at the shorebases.

A large oil spill is the only relevant accidental IPF. A small fuel spill would not have impacts on land use, as the response would be staged out of existing shorebases and facilities.

Impacts of a Large Oil Spill

The initial response for a large oil spill would be staged out of existing facilities, with no effect on land use. A large spill could have limited temporary impacts on land use along the coast if additional staging areas were needed. For example, during the *Deepwater Horizon* incident, 25 temporary staging areas were established in Louisiana, Mississippi, Alabama, and Florida for spill response and cleanup efforts (BOEM, 2012a). In the event of a large spill in the project area, similar temporary staging areas could be needed. These areas would eventually return to their original use as the response is demobilized.

An oil spill is not likely to significantly affect land use and coastal infrastructure in the region, in part because an offshore spill would have a small probability of contacting onshore resources. BOEM (2016b) states that landfill capacity would probably not be an issue at any phase of an oil spill event or the long-term recovery. In the case of the *Deepwater Horizon* incident and response, USEPA reported that existing landfills receiving oil spill waste had sufficient capacity to handle waste volumes; the wastes that were disposed of in landfills represented less than 7% of the total daily waste normally accepted at these landfills (USEPA, 2016).

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures. No significant spill impacts on land use are expected.

C.8.6 Other Marine Uses

The project area is not located within any USCG-designated fairway or shipping lane but is within the Military Warning Area W-602. Shell will comply with BOEM requirements and lease stipulations to avoid impacts on uses of the area by military vessels and aircrafts.

The shallow geohazard and archaeological assessments identified two sonar contacts within 2,000 ft (610 m) of proposed wellsite A. One sonar contact for proposed wellsite B and three sonar contacts each for proposed wellsites C and D were identified within 2,000 ft (610 m) (Geoscience Earth & Marine Services, Inc., 2020a,b). All sonar contacts were identified to be man-made debris and not recommended for archaeological avoidance.

No archaeological impacts are expected from routine activities in the project area. A large oil spill is the only relevant IPF. A small fuel spill would not have impacts on other marine uses because the spill and response activities would be mainly within the project area, and the duration would be brief.

Impacts of a Large Oil Spill

An accidental spill would be unlikely to significantly affect shipping or other marine uses. The lease blocks are not located within any USCG-designated fairway or shipping lane but are within the Military Warning Area W-602. In the event of a large spill requiring numerous response vessels, coordination would be required to manage the vessel traffic for safe operations.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures. No significant spill impacts on other marine uses are expected.

C.9 Cumulative Impacts

For purposes of NEPA, cumulative impact is defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR § 1508.7). Any single activity or action may have a negligible impact(s) by itself, but when combined with impacts from other activities in the same area and/or time period, substantial impacts may result.

Prior Studies. Prior to the lease sales, BOEM and its predecessors prepared multisale EISs to analyze the environmental impact of activities that might occur in the multisale area. BOEM and its predecessors also analyzed the cumulative impacts of OCS exploration activities similar to those planned in this EP in several documents. The level and types of activities planned in Shell's EP are within

the range of activities described and evaluated by BOEM (2012a,b, 2013, 2014, 2015, 2016a,b, 2017a). Past, present, and reasonably foreseeable activities were identified in the cumulative effects scenario of these documents, which are incorporated by reference. The proposed action will not result in any additional impacts beyond those evaluated in the multisale and Final EISs.

Description of Activities Reasonably Expected to Occur in the Vicinity of Project Area. Shell does not anticipate other projects in the vicinity of the project area beyond the types of projects analyzed in the lease sale and Supplemental EISs (BOEM, 2012a, 2013, 2014, 2015, 2016b, 2017a).

Cumulative Impacts of Activities in the Exploration Plan. The BOEM (2017a) Final EIS included a lengthy discussion of cumulative impacts, which analyzed the environmental and socioeconomic impacts from the incremental impact of the 10 proposed lease sales, in addition to all activities (including non-OCS activities) projected to occur from past, proposed, and future lease sales. The EISs considered exploration, delineation, and development wells; platform installation; service vessel trips; and oil spills. The EISs examined the potential cumulative effects on each specific resource for the entire Gulf of Mexico.

The EIA incorporates and builds on these analyses by examining the potential impacts on physical, biological, and socioeconomic resources from the work planned in this EP, in conjunction with the other reasonably foreseeable activities expected to occur in the Gulf of Mexico. Thus, for all impacts, the incremental contribution of Shell's proposed actions to the cumulative impacts analysis in these prior analyses is not significant.

C.9.1 Cumulative Impacts to Physical/Chemical Resources

The work planned in this EP is limited in geographic scope and the impacts on the physical/chemical environment will be correspondingly limited.

Air Quality. Emissions from pollutants into the atmosphere from activities are not projected to have significant effects on onshore air quality because of the distance from shore, the prevailing atmospheric conditions, emission rates and heights, and resulting pollutant concentrations. As BOEM found in the multisale EISs, the incremental contribution of activities similar to Shell's proposed activities to the cumulative impacts is not significant and will not cause or contribute to a violation of NAAQS (BOEM, 2012a, 2013, 2014, 2015, 2016b, 2017a). In addition, the cumulative contribution to visibility impairment is also very small. As mentioned in previous sections, projected emissions meet BOEM's exemption criteria and would not contribute to cumulative impacts on air quality.

Climate Change. CO₂ and CH₄ emissions from the project would constitute a negligible contribution to greenhouse gas emissions from all OCS activities. According to BOEM (2013), greenhouse gas emissions from all OCS oil and gas activities make up a very small portion of national CO₂ emissions, and BOEM does not believe that emissions directly attributable to OCS activities are a significant contributor to global greenhouse gas levels. Greenhouse gas emissions identified in this EP represent a negligible contribution to the total greenhouse gas emissions from reasonably foreseeable activities in the Gulf of Mexico area and would not significantly alter any of the climate change impacts evaluated in the previous EISs.

Water Quality. Shell's project may result in some minor water quality impacts due to the NPDES-permitted discharge of water based drilling fluids and associated cuttings, cuttings wetted with SBM, treated sanitary and domestic wastes, deck drainage, desalination unit discharge, BOP fluid, non-contaminated well treatment and completion fluids, ballast water, bilge water, hydrate inhibitor, excess cement slurry, fire water and non-contact cooling water. These effects are expected to be minor (localized to the area within a few hundred meters of the MODU) and temporary (lasting only hours longer than the disturbance or discharge). Any cumulative effects to water quality are expected to be negligible.

Archaeological Resources. The lease blocks are not on the list of archaeology survey blocks (BOEM, 2011). No known shipwrecks or other archaeological artifacts were identified during the shallow geohazards and archaeological assessment (Geoscience Earth & Marine Services, Inc., 2020a,b). The project area is well beyond the 197 ft (60 m) depth contour used by BOEM as the seaward extent for prehistoric archaeological site potential in the Gulf of Mexico. Therefore, Shell's operations will have no cumulative impacts on historic shipwrecks or prehistoric archaeological resources.

New Information. New information included in the most recent Programmatic, Supplemental, and Final EISs (BOEM, 2012a, 2013, 2014, 2015, 2016a,b, 2017a) has been incorporated into the EIA, where applicable.

C.9.2 Cumulative Impacts to Biological Resources

The work planned in this EP is limited in geographic scope and duration, and the impacts on biological resources will be correspondingly limited.

Seafloor Habitats and Biota. Effects on seafloor habitats and biota from discharges of drilling mud and cuttings are expected to be minor and limited to a small area. The shallow geohazards assessment did not identify any features that could support high-density deepwater benthic communities within 2,000 ft (610 m) of the proposed wellsite locations (Geoscience Earth & Marine Services, Inc., 2020a).

Areas that may support high-density deepwater benthic communities will be avoided as required by NTL 2009-G40. Soft bottom communities are ubiquitous along the northern Gulf of Mexico continental slope, and the extent of benthic impacts during this project is insignificant regionally. As noted in the multisale EISs, the incremental contributions of activities similar to Shell's proposed activities to the cumulative impacts is not determined to be significant (BOEM, 2012a,b, 2013, 2014, 2015, 2016b, 2017a).

Threatened, Endangered, and Protected Species. Threatened, Endangered, and protected species that could occur in the project area include the sperm whale, Bryde's whale, oceanic whitetip shark, giant manta ray, and five species of sea turtles. Potential impact sources include vessel presence including noise and lights, marine debris, and support vessel and helicopter traffic. Potential effects for these species would be limited and temporary and would be reduced by Shell's compliance with BOEM-required mitigation measures, including NTLs BSEE-2015-G013 and BOEM-2016-G01 and NMFS (2020a) Appendix B and C. No significant cumulative impacts are expected.

Coastal and Marine Birds. Birds may be exposed to contaminants, including air pollutants and routine discharges, but significant impacts are unlikely due to rapid dispersion. Shell's compliance with NTL BSEE-2015-G013 will minimize the likelihood of debris-related impacts on birds. Support vessel and helicopter traffic may disturb some foraging and resting birds; however, it is likely that individual birds would experience, at most, only short-term behavioral disruption.

Due to the limited scope, timing, and geographic extent of drilling activities, collisions or other adverse effects are unlikely, and no significant cumulative impacts are expected.

Fisheries Resources. Exploration and production structures occur in the vicinity of the project area. The additional effect of the proposed drilling activity would be negligible.

Coastal Habitats. Due to the distance of the wellsites from shore, routine activities are not expected to have any impacts on beaches and dunes, wetlands, seagrass beds, coastal wildlife refuges, wilderness areas, or any other managed or protected coastal area. The support bases are not in wildlife refuges or wilderness areas. Support operations, including the crew boat and supply boats, may have a minor incremental impact on coastal habitats. Over time with a large number of vessel trips, vessel wakes can erode shorelines along inlets, channels, and harbors. Impacts will be minimized by following the speed and wake restrictions in harbors and channels.

New Information. New information included in the most recent Programmatic, Supplemental, and Final EISs (BOEM, 2012a,b, 2013, 2014, 2015, 2016a,b, 2017a) has been incorporated into the EIA, where applicable.

C.9.3 Cumulative Impacts to Socioeconomic Resources

The work planned in this EP is limited in geographic scope and duration, and the impacts on socioeconomic resources will be correspondingly limited.

The multisale and Supplemental and Final EISs analyzed the cumulative impacts of oil and gas exploration and development in the project area, in combination with other impact-producing activities, on commercial fishing, recreational fishing, recreational resources, historical and archaeological resources, land use and coastal infrastructure, demographics, and environmental justice (BOEM, 2012a, 2013, 2014, 2015, 2016b, 2017a). BOEM also analyzed the economic impact of oil and gas activities on the Gulf States, finding only minor impacts in most of Texas, Mississippi, Alabama, and Florida, more significant impacts in parts of Texas, and substantial impacts on Louisiana.

Shell's proposed activities will have negligible cumulative impacts on socioeconomic resources. There are no IPFs associated with routine operations that are expected to affect public health and safety, employment and infrastructure, recreation and tourism, land use, or other marine uses. Due to the distance from shore, it is unlikely that any recreational fishing activity is occurring in the project area, and it is unlikely that any commercial fishing activity other than longlining occurs at or near the project area. The project will have negligible impacts on fishing activities.

New Information. New information included in the most recent Programmatic, Supplemental, and Final EISs (BOEM, 2012a,b, 2013, 2014, 2015, 2016a,b, 2017a) has been incorporated into the EIA, where applicable.

D. Environmental Hazards

D.1 Geologic Hazards

The shallow geohazards and archaeological assessment reports concluded that wellsite locations are suitable for the proposed exploratory drilling activities and no seafloor obstructions or conditions were found that would constrain the proposed project activities (Geoscience Earth & Marine Services, Inc., 2020a,b).

See EP Section 6a for supporting geological and geophysical information.

D.2 Severe Weather

Under most circumstances, weather is not expected to have any effect on the proposed activities. Extreme weather, including high winds, strong currents, and large waves, was considered in the design criteria for the MODU. High winds and limited visibility during a severe storm could disrupt communication and support activities (vessel and helicopter traffic) and make it necessary to suspend some activities on the MODU for safety reasons until the storm or weather event passes. In the event of a hurricane, procedures in Shell's Hurricane Evacuation Plan would be followed.

D.3 Currents and Waves

A rig-based acoustic Doppler current profiler will be used to continuously monitor the current beneath the MODU. Metocean conditions, such as sea state, wind speed, ocean currents, etc., will also be continuously monitored. Under most circumstances, physical oceanographic conditions are not

expected to have any effect on the proposed activities. Strong currents (caused by Loop Current eddies and intrusions) and large waves were considered in the design criteria for the MODU. High waves during a severe storm could disrupt support activities (i.e., vessel and helicopter traffic) and make it necessary to suspend some activities on the MODU for safety reasons until the storm or weather event passes.

E. Alternatives

No formal alternatives were evaluated in this EP. However, various technical and operational options, including the location of the wellsites and the selection of the MODU, were considered by Shell in developing the proposed action. There are no other reasonable alternatives to accomplish the goals of this project.

F. Mitigation Measures

The proposed action includes numerous mitigation measures required by laws, regulations, and BOEM lease stipulations and NTLs. The project will comply with applicable federal, state, and local requirements concerning air pollutant emissions, discharges to water, and solid waste disposal. Project activities will be conducted under Shell's OSRP and will include the measures described in EP Section 2j.

G. Consultation

No persons beyond those cited as Preparers (**Section H., Preparers**) or agencies were consulted regarding potential impacts associated with the proposed activities during the preparation of the EIA.

H. Preparers

The EIA was prepared for Shell Offshore Inc. by its contractor, CSA Ocean Sciences Inc. Contributors included the following:

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APPENDIX Q
ADMINISTRATIVE INFORMATION
(30 CFR Part 550.228 and 550.262)

A. Exempted Information Description (Public Information Copies only)

Excluded from the Public Information copies are the following:

- Proposed bottom hole location information
- Proposed total well depths (measured and true vertical depth)
- Production Rates and Life of Reserves
- New and Unusual Technologies
- Geological and Geophysical Attachments

B. Bibliography

The following documents were utilized in preparing this Plan:

Document	Author	Dated
Site Clearance Letter for Proposed Wellsite F, Block 337, Alaminos Canyon Area, Gulf of Mexico	Geoscience Earth & Marine Services, Inc., (GEMS)	2024
Shallow Hazards and Archaeological Assessment, Block 335 (OCS-G-36492) 336 (OCS-G-36102), and 337 (OCS-G-36103), Alaminos Canyon Area, Gulf of Mexico 2020.	Geoscience Earth & Marine Services, Inc., (GEMS)	2020
BOEMRE Environmental Impact Statement Report – No. 2009-053	Bureau of Ocean Energy Management, Regulation, and Enforcement	2009
Regional Oil Spill Response Plan	LLOG Exploration Offshore, L.L.C.	2022