UNITED STATES GOVERNMENT
MEMORANDUM

September 07, 2021

To: Public Information

From: Plan Coordinator, OLP, Plans Section (GM 235D)

Subject: Public Information copy of DOCD.

Control # - S-08053

Type - Supplemental Development Operations Coordinations Document

Lease(s) - OCS-G31534 Block - 940 Mississippi Canyon Area
RUE-OCS-G30379(Pending Approval) Block-939 Mississippi Canyon Area

Operator - Shell Offshore Inc.

Description – Drill/Complete subsea wells VA010,VA010-ALT,VA011,VA011-ALT,VA012,VA012-ALT and install new subsea manifold and Jumpers

Rig Type - Not Found

Attached is a copy of the subject plan.

It has been deemed submitted and is under review for approval.

Henry Emembolu
Plan Coordinator

Shell Offshore Inc
P. O. Box 61933
New Orleans, LA 70161-1933
United States of America
Tel +1 832 337 2168
Email robin.voosen@shell.com

PUBLIC INFORMATION COPY

July 7, 2021

Ms. Michelle Picou, Section Chief
Bureau of Ocean Energy Management
1201 Elmwood Park Boulevard
New Orleans, LA 70123-2394

Attn: Plans Group GM1053C

SUBJECT: Supplemental Development Operations Coordination Document (SDOCD)
Mississippi Canyon Blocks 939, 940, 941, and 984
RUE OCS-G 30379 (pending approval), 31534, 16661, & 22919
Unit Number 754312007
Offshore Louisiana

Dear Ms. Picou:

In compliance with 30 CFR 550.241 and NTLs 2008-G04, 2009-G27, and 2015-N01 and BOEM 2020-G01, giving DOCD guidelines, Shell Offshore Inc. (Shell) requests your approval of this Supplemental DOCD to drill/complete 6 new wells and install a new subsea manifold and associated jumpers. We are also covering future well work for all Vito wells.

This Plan consists of a series of attachments describing our intended operations. The attachments we desire to be exempted from disclosure under the Freedom of Information Act are marked "Confidential" and excluded from the Public Information Copies of this submittal.

A cost recovery fee is attached to the proprietary copy of the plan. Should you require additional information, please contact me as indicated above.

Sincerely,

Robin Voosen

Robin Voosen

Regulatory Specialist

SHELL OFFSHORE INC.

Supplemental Development Operations Coordination Document

for

Mississippi Canyon Blocks 939, 940, 941, and 984
OCS-G 30379 (RUE Pending Approval), 31534, 16661, & 22919
Offshore Louisiana & Alabama

Unit Number 754312007

PUBLIC INFORMATION

JULY 2021

PREPARED BY:

Robin Voosen
Regulatory Specialist

832.337.2168

robin.voosen@shell.com

REVISIONS TABLE

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SECTION 1: PLANS CONTENT

A. DESCRIPTION, OBJECTIVES & SCHEDULE

Plans Recap

The Initial DOCD N-10018 was approved March 14, 2019 to install a new Semi-submersible Floating Production System (FPS) and to produce from nine wells from one subsea drill center tied back to the host facility. It also included the setting of 12 Mud Mats on the seafloor to be used to store tension spacers and chain.

Revision No. 1 to the Initial DOCD was R-6842 approved June 13, 2019 to update schedule to pre-install the mooring piles for the host as soon as June 1, 2019, in lieu of 2020 as approved.

Revision No. 2 to the initial DOCD and R-6842 was R-6883 approved July 11, 2019 to change air emissions due to delays in the project - we needed additional time to complete the installation activity.

Revision No. 3 to the Initial DOCD and R-6883 was R-7000 was another update to the AQR and the Plan was updated for the March 13, 2020 Biological Opinion. It also covered the wells for future well work.

Revision No. 4 to the Initial DOCD and R-7000 was R-7077 and was another update to the AQR schedule allowing the pre-lay activity for ~November 2021.

The wells that have been drilled for production are as follows:

Well	API Number	Plan
OCS-G 31534 VA001	6081741384	S7858 DD
OCS-G 22919 VA002	6081741204	S7480 I - (OCS-G 31534 No. 2)
OCS-G 31534 VA003	6081741383	S7858 FF
OCS-G 31534 VA004	6081741379	S7858 JJ
OCS-G 31534 VA005	6081741388	S7858 BB
OCS-G 16661 VA006	6081741387	S7858 AA
OCS-G 31534 VA007	6081741378	S7858 CC
OCS-G 31534 VA008	6081741382	S7858 KK
OCS-G 31534 VA009	6081741388	S7858 GG

This Supplemental DOCD is for the drilling and completion of six new subsea wells and installation of a new manifold, jumpers and PLETs. We are including a contingency to pre-lay the mooring lines in 2022 if needed. This SDOCD will also allow future well work for the new wells and the previously drilled wells. The wells will be a subsea tie-back to the Vito Host, located in MC 939.

B. LOCATION

See attached BOEM forms.

C. RIG SAFETY AND POLLUTION FEATURES:

The rig will comply with the regulations of the American Bureau of Shipping (ABS), International Maritime Organization (IMO) and the United States Coast Guard (USCG). All drilling operations will be conducted under the provisions of 30 CFR, Part 250, Subpart D and other applicable regulations and notices, including those regarding the avoidance of potential drilling hazards and safety and pollution prevention control. Such measures as inflow detection and well control, monitoring for loss of circulation and seepage loss and casing design will be our primary safety measures. Primary pollution prevention measures are contaminated and non-contaminated drain system, mud drain system and oily water processing. The rig will have Operating Procedures and Job Safety Analysis for any fuel, base oil or SBM transfers. Below is a list of drains that are typical for rigs in Shell's fleet.

DRAIN SYSTEM POLLUTION FEATURES

Drains are provided on the rig in all spaces and on all decks where water or oil can accumulate. The drains are divided into two categories, non-contaminated and contaminated. All deck drains are fitted with a removable strainer plate to prevent debris entering the system.

Deck drainage from rainfall, rig washing, deck washing and runoff from curbs and gutters, including drip pans and work areas, are discharged depending on if it comes in contact with the contaminated or non-contaminated areas of the Rig.

1) Non-contaminated Drains

Non-contaminated drains are designated as drains that under normal circumstances do not contain hydrocarbons and are mostly located around the main deck and outboard in places where it is unlikely that hydrocarbons will be found. Non-Contaminated drains can be directed overboard or to Non-Hazardous storage tanks. Drains are normally directed to storage tanks and only sent overboard if static sheen test is completed.

All drains that have the ability to go overboard are plugged and labeled and are lined up to normally go into Hazardous and Non-Hazardous storage tanks. Any deviation from this requires a Request for Approval Drain Plug Removal Form to be filled out prior to any plug being pulled. The rig's drain plug program consists of a daily check of all deck drains leading to the sea to verify that their status is as designated.

In the event a leak or spill on deck, the event shall be contained as all drains are lined up to the holding tanks. Emergency spill kits are located around the vessel and kit deployment and notifications will be implemented as needed.

Rig personnel shall ensure that the perimeter kick-plates on weather decks are maintained and drain plugs are in place as needed to ensure a proper seal.

2) Contaminated Drains

Contaminated drains are designated as drains that may contain hydrocarbons, drains from likely zones (rig floor, active mud tanks, etc.) cannot be discharged overboard and are directed to hazardous storage tanks. Drains from zones less likely to be contaminated (BOP setback areas, well test deck, etc.) have the option to go overboard or to the hazardous storage tanks, drains are always directed to storage tank for this system. When oil-based mud is used for drilling it will be collected from decks via a mud vac system or pumped from storage tanks to portable tanks and sent to shore for processing.

3) Oily Water Processing

Oily water is collected in an oily water tank. It must be separated and cannot be pumped overboard until oil content is <15 ppm. The separated oil is pumped to a dirty oil tank and has to be sent ashore for disposal. On board the MODU an oil record log is kept according to instructions included in the log. All waste oil that is sent in to be disposed of is recorded in the MODU's oil log book.

All discharges will be in accordance with applicable NPDES permits. See Section 18, EIA.

4) Lower Hull Bilge System

- The main bilge system is designed to have drains directed to bilge pockets in lower machinery rooms or directly to the FWD and Aft bilge storage tanks. They are electrically driven, self-priming centrifugal pumps – forward and aft that automatically pump bilge pockets to storage tanks when high level is sensed.
- Bilge water is stored onboard and pumped overboard via the Oily Water Separator if below 15 PPM.

The Bilge pumps are manual/automatic type pumps. They are equipped with sensors that give a high and a high alarm. They are set to a point at which the water gets to a certain point they will automatically turn on to pump water out in order to keep flooding under control. The pumps are also capable of being put in manual mode in which they can be turned on by hand.

5) Emergency Bilge System

The Vessel has specific procedures for emergency bilge operations. It has emergency bilge pumps forward and aft for secondary response of de-watering vessel areas. For emergency purposes these overboard valves are kept open at all times. The pumps are manually controlled by the engine room operator in the Engine control room and all bilge pockets can be pumped and controlled from this area. In addition to this there is a third means of dewatering the vessel utilizing saltwater pumps and ballast pumps in various aft spaces. These valves must be manually operated in the affected machinery room.

6) Oily Water Drain/Separation System

Oily water/engine room bilge water is collected in an oily water tank. It must be separated and not pumped overboard until oil content is <15 ppm. The separated oil is pumped to a dirty oil tank and will to be sent ashore for disposal. On board all drilling Units, an oil record log is kept according to instructions included in the log.

The rig floor drains go to the hazardous or non-hazardous drain system. From there they are pumped through a 15ppm meter before going overboard or being diverted to a drain holding tank. Once the drain holding thank is full it is processed through a decanting and centrifugal separation system. The heavy solids that cannot pass are pumped to a tote and sent in for processing, the remaining fluid is either sent back to the holding tank or if under 15ppm it is diverted overboard.

7) Drain, Effluent and Waste Systems

- The rig's drainage system is designed in line with our environmental and single point discharge policies. Drains are either hazardous, i.e. from a hazardous area as depicted on the Area Classification drawings, or non-hazardous drains from nonhazardous areas.
- To prevent migration of hazardous materials and flammable gas from hazardous to non-hazardous areas, the drainage systems are segregated.
- The rig drainage systems tie into oily water separators that take out elements in the drainage that could harm the environment.

8) Rig Floor Drainage

The rig floor drains to the hazardous or non-hazardous drain system as described above. A dedicated mud vacuum system is also installed to remove any mud that may go down the drain.

9) Cement unit Drains

The drains in the containment for the mixing skid and chemical tanks are directed to a dedicated overboard line. This line is controlled by two gate valves for double isolation and is kept normally closed with locks.

10) Main Engine Rooms

The engine rooms have their own drainage and handling system. The engine rooms are outfitted with a dirty oil tank and the drainage in the tank is processed through the separator, the waste from the separator goes back to the dirty oil tank and the clean water (<15 ppm) goes overboard.

11) Helideck Drains

The helideck has a dedicated drainage system around its perimeter to drain heli-fuel from a helicopter incident. The fuel can be diverted to the designated heli fuel recovery tank which is located under the Helideck structure.

Operating configurations are as follows:

- The overboard piping valves and hydrocarbons take on valves are closed and locked. To unlock overboard or take on valves a permit or a Bulk Transfer Certificate must be filled out.
- The oily water separator continuously circulates the oily water collection tank. Waste oil is discharged into the waste oil tank and oily water is re-circulated back into the oily water collection tank. Clean water is pumped overboard, which is controlled/monitored by the oil content detector, set at 15 ppm.
- The solids control system is capable of being isolated for cuttings collection.

D. Storage Tanks – Transocean Proteus (or similar) Drillship

Type of Storage Tank	Tank Capacity (bbls)	Number of Tanks	Total Capacity (bbls)	Fluid Gravity (Specific)
Marine Oil	14788	1	14788	Marine oil (0.85 SG)
Marine Oil	14482	2	28964	Marine oil (0.85 SG)
Marine Oil settling tank	2338	2	4676	Marine oil (0.85 SG)
Marine Oil settling tank	1415	2	2830	Marine oil (0.85 SG)
Marine Oil settling tank	1145	2	2290	Marine oil (0.85 SG)
Lube oil	214	1	214	Lube Oil (.9 SG)
Lube oil	381	1	381	Lube Oil (.9 SG)
Lube oil	127	1	127	Lube Oil (.9 SG)
Lube Oil	169	1	169	Lube Oil (.9 SG)

Storage Tanks – Atwood Condor DP Semi-Submersible or similar:

Type of Storage Tank	Type of Facility	Tank Capacity (bbls)	Number of Tanks	Total Capacity (bbls)	Fluid Gravity (Specific)
Diesel Tank in stbd 1 80% fill in all hull tanks	Drilling Rig	3597	1		Marine Diesel (0.91 SG)
Diesel Tank in stbd 2	Drilling Rig	2713	1		Marine Diesel (0.91 SG)
Diesel Tank in stbd 3	Drilling Rig	3456	1		Marine Diesel (0.91 SG)
Diesel Tank in stbd 4	Drilling Rig	653	1		Marine Diesel (0.91 SG)
Diesel Tank in port 1	Drilling Rig	2090	1		Marine Diesel (0.91 SG)
Diesel Tank in port 2	Drilling Rig	1366	1		Marine Diesel (0.91 SG)
Diesel Tank in port 3	Drilling Rig	4787	1		Marine Diesel (0.91 SG)
Diesel Tank in port 4	Drilling Rig	3456	1		Marine Diesel (0.91 SG)
Diesel Settling Tanks	Drilling Rig	129	1		Marine Diesel (0.91 SG)
Diesel Settling Tanks	Drilling Rig	129	1		Marine Diesel (0.91 SG)
Diesel Settling Tanks	Drilling Rig	139	1		Marine Diesel (0.91 SG)
Diesel Settling Tanks	Drilling Rig	129	1		Marine Diesel (0.91 SG)
Diesel Day Tank	Drilling Rig	100	1		Marine Diesel (0.91 SG)
Diesel Day Tank	Drilling Rig	115	1		Marine Diesel (0.91 SG)
Diesel Day Tank	Drilling Rig	114	1		Marine Diesel (0.91 SG)
Diesel Day Tank	Drilling Rig	115	1		Marine Diesel (0.91 SG)
Lube Oil Tank	Drilling Rig	86.25	4	345	Lube Oil (0.91 SG)

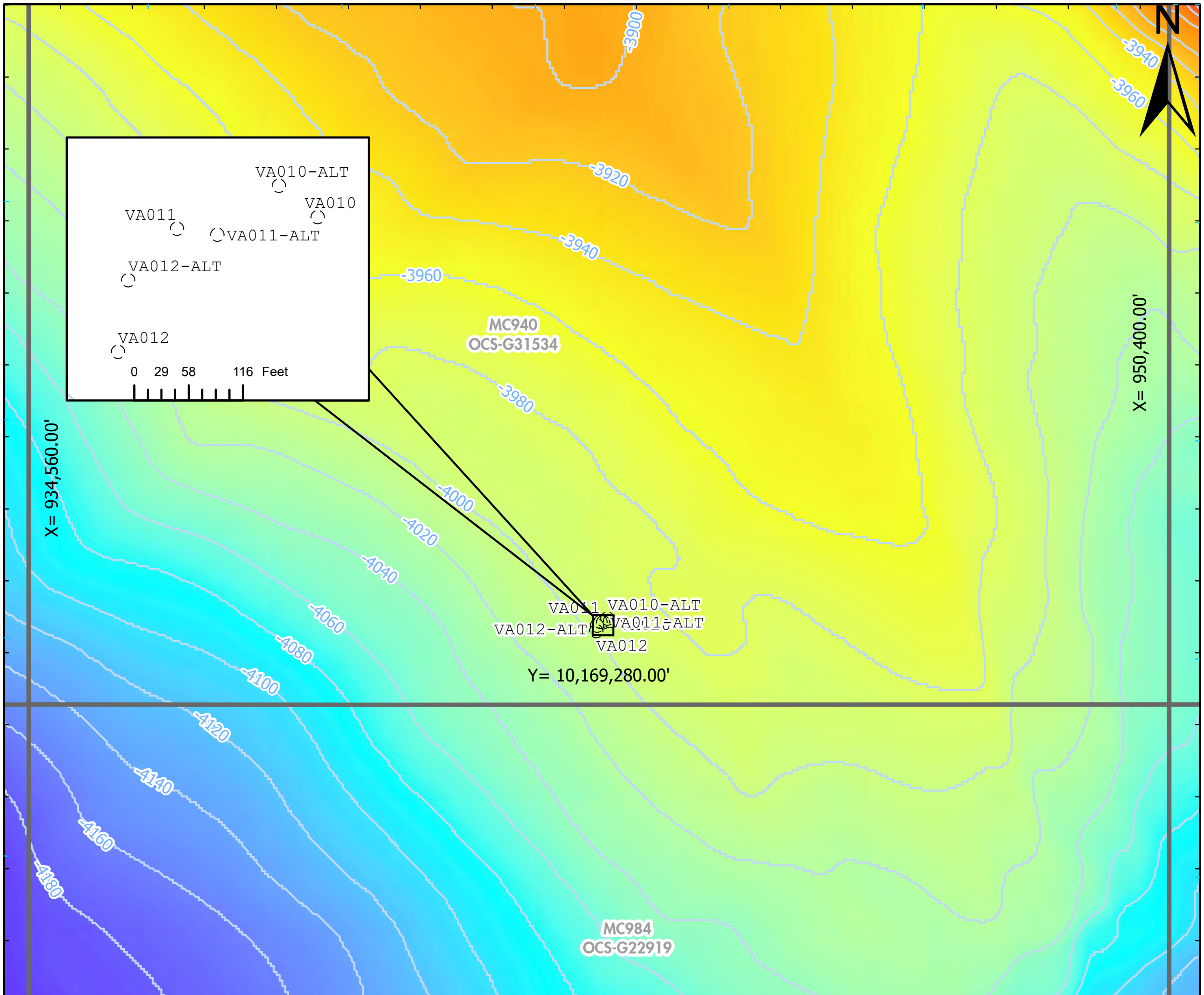
E. Pollution Prevention Measures

Pursuant to NTL 2008-G04 the proposed operations covered by this plan do not require Shell to specifically address the discharges of oils and greases from the rig during rainfall or routine operations. Nevertheless, Shell has provided this information as part of its response to 1(c) above.

F. Additional Measures

- Health, safety, and environment (HSE) are the primary topics in pre-tour and pre-job safety meetings. The discussion around no harm to people or environment is a key mindset. All personnel are reminded daily to inspect work areas for safety issues as well as potential pollution issues.
- All tools that come to and from the rig have their pollution pans inspected and cleaned, and plug installation confirmed prior to leaving the dock and prior to loading on the boat.
- Preventive maintenance of rig equipment includes visual inspection of hydraulic lines and reservoirs on a routine scheduled basis.
- All pollution pans on rig are inspected daily.
- Containment dikes are installed around all oil containment, drum storage areas, fuel vents, and fuel storage tanks.
- All used oil and fuel is collected and sent to shore for recycling.
- Direct overboard drains on the rig are checked regularly to verify drain plugs are installed.
- All trash containers are checked and emptied daily, and trash containers are kept covered. Trash is collected in a compactor and shipped to shore for disposal.
- The rig is involved in a recycling program for cardboard, plastic, paper, glass, and aluminum.
- Fuel hoses are changed on an annual basis.
- Spill prevention fittings are installed on all liquid take-on hoses.
- Shell has obtained International Organization for Standardization (ISO) 14001 certification.
- Shell will use low-sulfur fuel to reduce air pollutant impacts.

Attachment 1A - Bathymetry and Surface Locations



Well Name	X (ftUS)	Y (ftUS)	Latitude (DD)	Longitude (DD)	Block Calls	TVDSS
VA010	942,635	10,170,438	28.009381	-89.1629856	7765' FEL & 1158' FSL of BLK MC940	3992
VA010-ALT	942,599	10,170,472	28.0094727	-89.163099	7801' FEL & 1192' FSL of BLK MC940	3992
VA011	942,502	10,170,428	28.009347	-89.1633971	7898' FEL & 1148' FSL of BLK MC940	3395
VA011-ALT	942,540	10,170,421	28.0093296	-89.1632789	7860' FEL & 1141' FSL of BLK MC940	3395
VA012	942,444	10,170,298	28.0089867	-89.1635696	7884' FWL & 1018' FSL of BLK MC940	3998
VA012-ALT	942,455	10,170,374	28.0091962	-89.1635397	7895' FWL & 1094' FSL of BLK MC940	3998

MAP INFORMATION

Proposed Surface Locations

Lease Block

Bathymetry Contours ft.

BOEM bathy E (ft)

Value

-164

-11087

Graticule Grid Tick

Measured Grid Line

MAP SCALE

0 1,000 2,000 4,000

Feet

1:26,000

Print size: 8.5"x11" (ANSI A)

SHELL EXPLORATION & PRODUCTION COMPANY

Supplemental Exploration Plan

Mississippi Canyon Area
Offshore Louisiana

Vito Proposed Surface Locations

GEODETIC PARAMETERS

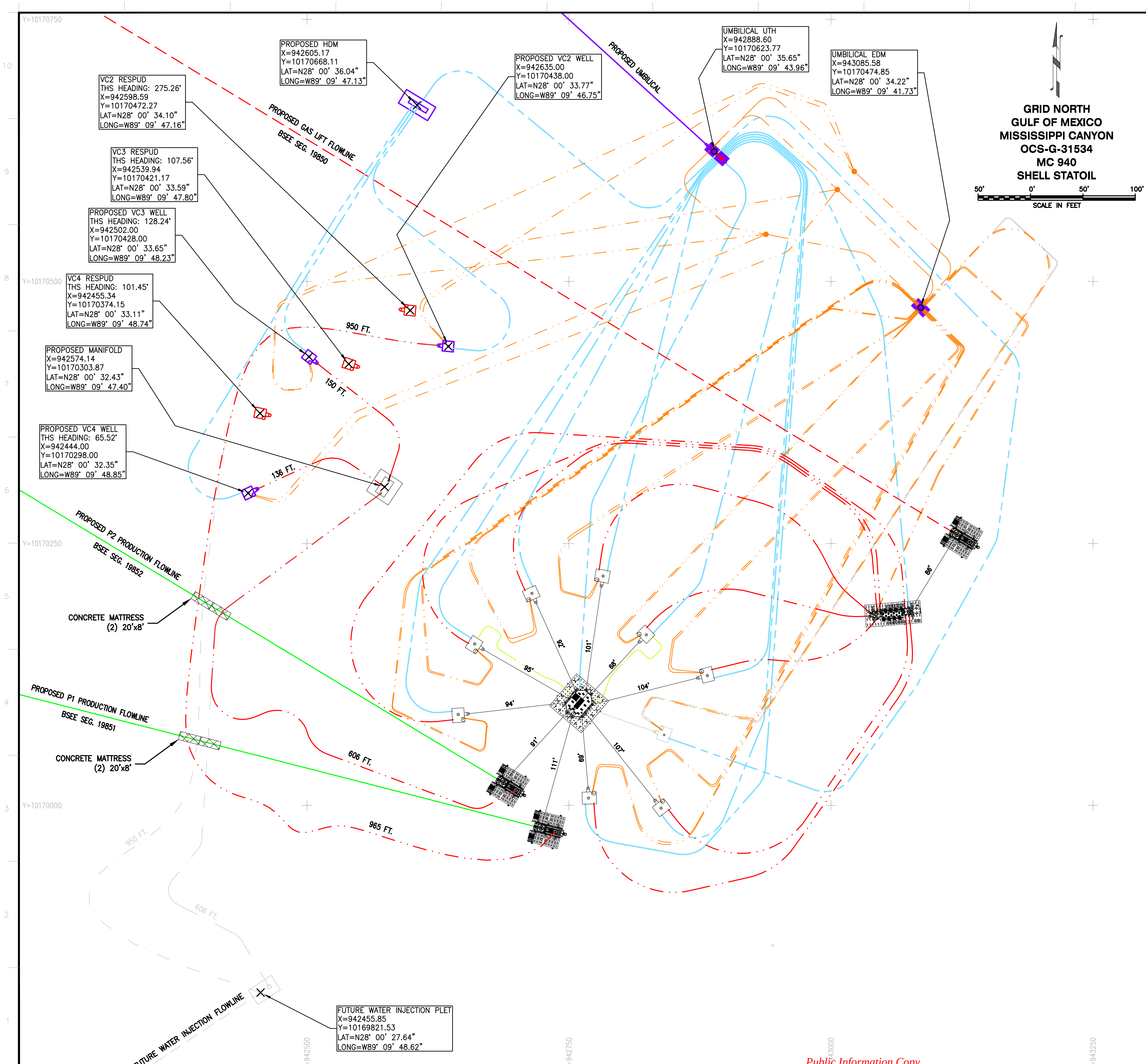
Horizontal Coordinate Reference System
CRS name (ESRI):
CRS name (Shell): NAD27 / UTM zone 16N (ftUS) [1241_32066]
CRS code (EPSG): 32066
Geodetic datum:
Projection name:
Horizontal units:

Author: J.Cooley	Date: 22 Mar 2021
Reviewed By: Tracy Albert	EP Catalog No.:

Document Path: C:\Users\janice.mollerson\AppData\Local\Temp\ArcGISProTemp29404\acd06443-915b-4b28-97a2-26ba0833bb7e\Untitled.aprx

Attachment 1B – Proposed Bottom Hole Locations

Proprietary Data



Subsea Phase 1 Equipment			
No.	Description	X	Y
	PRODUCTION MANIFOLD (AS-BUILT)	10170097.4500	942759.7100
	P1 PLET (AS-BUILT)	10169978.4218	942723.4834
	P2 PLET (AS-BUILT)	10170021.7803	942687.3714
	GAS LIFT MANIFOLD (AS-BUILT)	10170182.8200	943059.2300
	GAS LIFT PLET (AS-BUILT)	10170258.4428	943120.1533
QAY-8101	VA001 WELL (AS-BUILT)	10170086.8700	942644.4100
QAY-8102	VA 002 WELL (AS-BUILT)	10170007.1500	942768.7100
QAY-8103	VA 003 WELL (AS-BUILT)	10170154.0800	942660.0800
QAY-8104	VA 004 WELL (AS-BUILT)	10169997.4100	942837.8800
QAY-8105	VA 005 WELL (AS-BUILT)	10170202.3600	942714.7300
QAY-8106	VA 006 WELL (AS-BUILT)	10170123.8900	942882.1300
QAY-8107	VA007 WELL (AS-BUILT)	10170218.8400	942782.6400
QAY-8108	VA 008 WELL (AS-BUILT)	10170162.7900	942823.8700
QAY-8109	VA 009 WELL (AS-BUILT)	10170067.3100	942840.8000

LEGEND

- PRODUCTION FLOWLINE
- GAS LIFT FLOWLINE
- UMBILICAL
- LEAD – GAS LIFT JUMPER
- LEAD – SFL
- LEAD – EFL
- LEAD – HFL
- FUTURE EQUIPMENT

GEODETIC PARAMETERS

HORIZONTAL COORDINATE REFERENCE SYSTEM

CRS Name (EPSG):	NAD27/ BLM 16N (ftUS)
Alias:	NAD27/ UTM zone 16N (ftUS)
CRS Code (EPSG):	32066
TRANSFORMATION:	NAD27 to NAD83(1) [1241]
Map Units:	US survey feet

VERTICAL COORDINATE REFERENCE SYSTEM

Vertical Datum	Mean Sea Level
Elevation/Depth	Depth
Vertical Units:	Feet

REV	DATE	DESCRIPTION	DRAWN	CHK or TECH REP	DES ENG.	PROJ ENG.
A	2021-02-02	ISSUED FOR INTERNAL REVIEW	MGS			
032	2020-10-13	APPROVED	MGS	JS	JS	JS
031	2020-09-23	ISSUED FOR REVIEW	MGS	JS	JS	JS
030	2020-07-22	APPROVED	MGS	CDV	CDV	JS
029	2020-07-07	ISSUED FOR APPROVAL	MGS	CDV	CDV	JS
028	2020-05-06	APPROVED	MGS	CDV	JS	JS
27	2020-04-29	ISSUED FOR APPROVAL	MGS	CDV	JS	JS
026	2020-01-22	ISSUED FOR INFORMATION	MGS	CDV	JS	JS

SIEP SHELL INTERNATIONAL EXPLORATION AND PRODUCTION INC.- EP PROJECTS

VITO

VITO DRILL CENTER

VITO – MISSISSIPPI CANYON BLOCK 940

DRG No. VTO-500-UA-4180-2501001-002

REV. 32a

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OCS PLAN INFORMATION FORM 1D

General Information

Type of OCS Plan:		Exploration Plan (EP)	Development Operations Coordination Document (DOCD)	X

Company Name: Shell Offshore Inc.	BOEM Operator Number: 0689
Address: 701 Poydras St.	Contact Person: Robin Voosen/Tracy Albert
New Orleans, LA 70139	Phone Number: 832.337.2168/504.425.4652
	Email Address: robin.voosen@shell.com or tracy.albert@shell.com

If a service fee is required under 30 CFR 550.125(a) provide:	Amount Paid: $25,428	Receipt Nos. 26SCIKT6 & 26SCS6H1

Project and Worst Case Discharge (WCD) Information

Lease(s) OCS-G 22919	Area: MC	Block(s): 984	Project Name: Vito

Objectives(s):	X	Oil		Gas		Sulphur		Salt	Onshore Support Base(s) Fourchon & Houma

Platform/Well Name: 001 (Well H)	Total Volume of WCD: 314,000 BOPD	API Gravity: 25.9°

Distance to Closest Land (Miles): 67	Volume from uncontrolled blowout: 48 MMBBL

Have you previously provided information to verify the calculations and assumptions of your WCD?	x	Yes		No
If so, provide the Control Number of the EP or DOCD with which this information was provided	S-7480			
Do you propose to use new or unusual technology to conduct your activities?		Yes	X	No
Do you propose to use a vessel with anchors to install or modify a structure?		Yes	X	No
Do you propose any facility that will serve as a host facility for deep water subsea development?	X	Yes		No

Description of Proposed Activities and Tentative Schedule (Mark all that apply)

Proposed Activity	Start Date	End Date	No. of Days
Exploratory drilling			
Development drilling	2022	2025	270/yr.
Well completion	Included above		
Well test flaring (for more than 48 hours)			
Installation or modification of structure			
Installation of production facilities			
Installation of subsea wellheads and/or dry hole tree/manifolds	2022	2028	30/yr.
Installation of lease term pipelines	See attached for jumpers		
Commence production	2022	2025	
Other – Future well work – all wells	2022	2045	270/yr.

Description of Drilling Rig				Description of Structure			
	Jackup	X	Drillship		Caisson		Tension Leg Platform
	Gorilla Jackup		Platform rig		Fixed Platform		Compliant Tower
	Semisubmersible		Submersible		Spar Other		Guyed tower
X	DP Submersible		Other (attached descriptio)	X	Floating production system		Other (attached description)

Drilling Rig Name (If known): DW Proteus or similar Drillship//Atwood Condor or similar DP Submersible

Description of Lease Term Pipelines

From (Facility/Area/Block)	To (Facility/Area/Block)	Diameter (Inches)	Length (Feet)
See attached			

Note: The Vito Mooring Pre-lay scope is covered in DOCD R-7077 for 28 days in 2021. We are including contingency days in 2022 to give the project flexibility. See Section 8 AQR.

Proposed Activity	Start Date	End Date	~No. Days/year
Flowlines & SCR pre-lay	2021	2021	35
SDH & Flex Jumpers	2021	2021	25
Mooring Lines Pre-lay	2021	2021	28
Facility Installation	2022	2022	330
Facility Commissioning	2022	2022	100
Subsea Equipment Installation	2022	2022	105
Commence Production (Host)	2022		
Subsea Equipment Installation	2023	2023	35
Subsea Drilling new wells	2022	2025	270
Future well work	2022	2045	225
Host Production	2024	2045	365

Seafloor Equipment to be installed 2022-2028

From (Facility/Area/Block)	To (Facility/Area/Block)	Diameter (Inches)	Length (Feet)
MC 940 VA010 Jumper	MC 940 P1 PLET	16.7" OD	~1021'
MC 940 Manifold P2 Hub 3 Jumper	MC 940 P2 PLET	16.7" OD	~615'
MC 940 VA011 Jumper	MC 940 P2 Production Manifold Hub 1	16.7" OD	~150'
MC 940 VA012 Jumper	MC 940 Manifold Hub 2	16.7" OD	~136'
MC 940 VA009 Jumper	MC 940 P1 Production Manifold Hub	6.625" OD	~410'
MC 940 VA009 Jumper	MC 940 GL Manifold Hub	5.12" OD	~67'

Attachment 1E

Proposed Well/Structure Location

Well or Structure Name/Number (If renaming well or structure, reference previous name): Vito Semi-Submersible Floating Production System (FPS)	Previously reviewed under an approved EP or DOCD?		Yes	X	No

Is this an existing well or structure?		Yes	X	No	If this is an existing well or structure, list the Complex ID or API No.	N/A

Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?		Yes	X	No

WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day):	For structures, volume of all storage and pipelines (Bbls):	API Gravity of fluid	

	Surface Location	**Bottom-Hole Location (For Wells)**	**Completion (For multiple completions, enter separate lines)**	
Lease No.	RUE OCS-G 30379 (pending approval)	OCS	OCS	
Area Name	Mississippi Canyon			
Block No.	939			
Blockline Departures (in feet)	N/S Departure: 7244.48' FSL	N/S Departure F __ L	N/S Departure:	
	E/W Departure: 6736.62' FEL	E/W Departure F __ L	E/W Departure:	
Lambert X-Y coordinates	X: 927,823.38	X:	X:	
	Y: 10,176,524.48	Y:	Y:	
Latitude/ Longitude	Latitude 28° 01' 31.39"	Latitude	Latitude	
	Longitude -89° 12' 33.17"	Longitude	Longitude	
Water Depth (Feet): 4170'		MD (Feet):	TVD (Feet):	MD (Feet) / MD (Feet)
Anchor Radius (if applicable) in feet: 8,500' with 1000' buffer				

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**
ANCHOR 01	MC	939	933025.35	10182329.37	394'
ANCHOR 02	MC	939	933336.90	10182038.00	394'
ANCHOR 03	MC	939	933705.40	10181645.10	394'
ANCHOR 04	MC	939	933615.10	10171482.20	394'
ANCHOR 05	MC	939	933248.60	10171099.20	394'
ANCHOR 06	MC	939	932856.00	10170743.80	394'
ANCHOR 07	MC	939	922830.30	10170789.40	394'
ANCHOR 08	MC	939	922449.80	10171150.90	394'
ANCHOR 09	MC	939	922095.50	10171537.70	394'
ANCHOR 10	MC	939	921999.40	10181594.80	394'
ANCHOR 11	MC	939	922359.00	10181988.80	394'
ANCHOR 12	MC	939	922746.40	10182356.10	394'

Attachment 1F – Future well work

Proposed Well / Structure Location						
Well or Structure Name/Number (if renaming well or structure, reference previous name): VA001 (DD)		Previously reviewed under an approved EP or DOCD? S7858	X	Yes		No

Is this an existing well or structure?	X	Yes		No	If this is an existing well or structure, list the Complex ID or API Number:	6081741384

Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?	X	Yes		No

WCD Info	For wells, volume of uncontrolled Blowouts (bbls/day): 314,000 BOPD	For structures, volume of all storage and pipelines (bbls): NA	API Gravity of fluid	25.9°

	Surface Location		**Bottom Hole Location (for Wells)**		**Completion (for multiple enter separate lines)**	
Lease Number	OCS-G 31534		OCS-G 31534		OCS OCS	
Area Name	Mississippi Canyon		Mississippi Canyon			
Block No.	940		940			
Blockline Departure (in feet)	N/S Departure: 807' FSL				N/S Departure: N/S Departure:	
	E/W Departure 7756' FEL				E/W Departure: E/W Departure:	
Lambert X-Y Coord.	X: 942,644				X:	
	Y: 10,170,087				Y:	
Lat/Long	Latitude: 28° 00' 30.297"				Latitude	
	Longitude: -89° 09' 46.574"				Longitude	
Water Depth (Feet): 3,998'					MD (Feet)	TVD (Feet)

Anchor Radius (if applicable) in feet: NA

Anchor locations for drilling rig or construction barge (if anchor radius is 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=	

Attachment 1G – Future well work

Proposed Well/Structure Location							
Well or Structure Name/Number (If renaming well or structure, reference previous name): VA002 (984 No.00 2)			Previously reviewed under an approved EP or DOCD? S7480	X	Yes		No
Is this an existing well or structure?	x	Yes	No	If this is an existing well or structure, list the Complex ID or API No.	6081741204		
Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?				X	Yes		No

WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 314,000 BOPD	For structures, volume of all storage and pipelines (Bbls): NA	API Gravity of fluid	25.9°

	Surface Location	**Bottom-Hole Location (For Wells)**	**Completion (For multiple completions, enter separate lines)**	
Lease No.	OCS-G 31534	OCS-G 22919	OCS OCS	
Area Name	Mississippi Canyon	Mississippi Canyon		
Block No.	940	984		
Blockline Departures (in feet)	N/S Departure: 727 FSL		N/S Departure: N/S Departure:	
	E/W Departure: 7631' FEL		E/W Departure: E/W Departure:	
Lambert X-Y coordinates	X: 942,769		X:	
	Y: 10170007		Y:	
Latitude/ Longitude	Latitude: 28° 00' 29.53" N		Latitude	
	Longitude: 89°09' 45.172" W		Longitude	
Water Depth (Feet): 4,004'			MD (Feet)	MD (Feet)
Anchor Radius (if applicable) in 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:	

Attachment 1H – Future Well work

Proposed Well/Structure Location					
Well or Structure Name/Number (if renaming well or structure, reference previous name): VA003 (FF)	Previously reviewed under an approved EP or DOCD? S-7858	X	Yes		No

Is this an existing well or structure?	X	Yes		No	If this is an existing well or structure, list the Complex ID or API Number:	6081741383

Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?	X	Yes		No

WCD Info	For wells, volume of uncontrolled Blowouts (bbls/day): 314,000 BOPD	For structures, volume of all storage and pipelines (bbls): NA	API Gravity of fluid	25.9°

	Surface Location	**Bottom Hole Location (for Wells)**	**Completion (for multiple enter separate lines)**
Lease Number	OCS-G 31534	OCS-G 31534	OCS OCS
Area Name	Mississippi Canyon	Mississippi Canyon	
Block No.	940	940	
Blockline Departure (in feet)	N/S Departure: 874' FSL		N/S Departure: N/S Departure:
	E/W Departure 7738' FEL		E/W Departure: E/W Departure:
Lambert X-Y Coord.	X: 942,662		X:
	Y: 10,170,154		Y:
Lat/Long	Latitude: 28° 00' 30.9637"		Latitude
	Longitude: -89° 09' 46.3862"		Longitude

Water Depth (Feet): 4003'			MD (Feet)	TVD (Feet)

Anchor Radius (if applicable) in feet: NA

Anchor locations for drilling rig or construction barge (if anchor radius is 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=	

Attachment 1I – Future well work

Proposed Well/Structure Location						
Well or Structure Name/Number (if renaming well or structure, reference previous name): VA004 (JJ)			Previously reviewed under an approved EP or DOCD? S-7858	X	Yes	No
Is this an existing well or structure?	X Yes	No	If this is an existing well or structure, list the Complex ID or API Number:	6081741379		
Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?				X	Yes	No
WCD Info	For wells, volume of uncontrolled Blowouts (bbls/day): 314,000 BOPD	For structures, volume of all storage and pipelines (bbls): NA	API Gravity of fluid	25.9°		

	Surface Location	**Bottom Hole Location (for Wells)**	**Completion (for multiple enter separate lines)**
Lease Number	OCS-G 31534	OCS-G 31534	OCS OCS
Area Name	Mississippi Canyon	Mississippi Canyon	
Block No.	940	940	
Blockline Departure (in feet)	N/S Departure: 717' FSL		N/S Departure: N/S Departure:
	E/W Departure 7562' FEL		E/W Departure: E/W Departure:
Lambert X-Y Coord.	X: 942,838		X:
	Y: 10,169,997		Y:
Lat/Long	Latitude: 28° 00' 29.445		Latitude
	Longitude: -89.° 09' 44.398"		Longitude
Water Depth (Feet): 3,996'			MD (Feet) / TVD (Feet)
Anchor Radius (if applicable) in feet: NA			

Anchor locations for drilling rig or construction barge (if anchor radius is 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=	

Attachment 1J – Future well work

Proposed Well / Structure Location							
Well or Structure Name/Number (if renaming well or structure, reference previous name): VA005 (BB)				Previously reviewed under an approved EP or DOCD? S-7858	X	Yes	No
Is this an existing well or structure?	X	Yes	X	No	If this is an existing well or structure, list the Complex ID or API Number:		6081741388
Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?					X	Yes	No

WCD Info	For wells, volume of uncontrolled Blowouts (bbls/day): 314,000 BOPD	For structures, volume of all storage and pipelines (bbls): NA	API Gravity of fluid	25.9°
	Surface Location	**Bottom Hole Location (for Wells)**	**Completion (for multiple enter separate lines)**	
Lease Number	OCS-G 31534	OCS-G 31534	OCS OCS	
Area Name	Mississippi Canyon	Mississippi Canyon		
Block No.	940	940		
Blockline Departure (in feet)	N/S Departure: 922 FSL		N/S Departure: N/S Departure:	
	E/W Departure 7685' FEL		E/W Departure: E/W Departure:	
Lambert X-Y Coord.	X: 942,715		X:	
	Y: 10,170,202		Y:	
Lat/Long	Latitude: 28° 00' 31.453"		Latitude	
	Longitude: -89° 09' 45.812"		Longitude	
Water Depth (Feet): 3,991'			MD (Feet)	TVD (Feet)
Anchor Radius (if applicable) in feet: NA				

Anchor locations for drilling rig or construction barge (if anchor radius is 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=	

Attachment 1K – Future well work

Proposed Well / Structure Location						
Well or Structure Name/Number (if renaming well or structure, reference previous name): VA 006 (AA)		Previously reviewed under an approved EP or DOCD? S-7858	X	Yes		No
Is this an existing well or structure?	X	Yes		No	If this is an existing well or structure, list the Complex ID or API Number:	6081741387
Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?			X	Yes		No

WCD Info	For wells, volume of uncontrolled Blowouts (bbls/day): 314,000 BOPD	For structures, volume of all storage and pipelines (bbls): NA	API Gravity of fluid	25.9°

	Surface Location	Bottom Hole Location (for Wells)	Completion (for multiple enter separate lines)	
Lease Number	OCS-G 31534	OCS-G 16661	OCS OCS	
Area Name	Mississippi Canyon	Mississippi Canyon		
Block No.	940	941		
Blockline Departure (in feet)	N/S Departure: 844' FSL		N/S Departure: N/S Departure:	
	E/W Departure 7518' FEL		E/W Departure: E/W Departure:	
Lambert X-Y Coord.	X: 942,882		X:	
	Y: 10,170,124		Y:	
Lat/Long	Latitude: 28° 00' 30.706"		Latitude	
	Longitude: -89° 09' 43.930"		Longitude	
Water Depth (Feet): 3,993'			MD (Feet)	TVD(Feet)
Anchor Radius (if applicable) in feet: NA				

Anchor locations for drilling rig or construction barge (if anchor radius is 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=	

Attachment 1L – Future well work

Proposed Well/Structure Location					
Well or Structure Name/Number (if renaming well or structure, reference previous name): VA007 (CC)	Previously reviewed under an approved EP or DOCD? S-7858	X	Yes		No

Is this an existing well or structure?	X	Yes		No	If this is an existing well or structure, list the Complex ID or API Number:	6081741378

Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?	X	Yes		No

WCD Info	For wells, volume of uncontrolled Blowouts (bbls/day): 314,000 BOPD	For structures, volume of all storage and pipelines (bbls): NA	API Gravity of fluid	25.9°

	Surface Location	**Bottom Hole Location (for Wells)**	**Completion (for multiple enter separate lines)**
Lease Number	OCS-G 31534	OCS-G 31534	OCS OCS
Area Name	Mississippi Canyon	Mississippi Canyon	
Block No.	940	940	
Blockline Departure (in feet)	N/S Departure: 939 FSL		N/S Departure: N/S Departure:
	E/W Departure 7617' FEL		E/W Departure: E/W Departure:
Lambert X-Y Coord.	X: 942,783		X:
	Y: 10,170,219		Y:
Lat/Long	Latitude: 28° 00' 31.628"		Latitude
	Longitude: -89° 09' 45.058"		Longitude

Water Depth (Feet): 3,998'			MD (Feet)	TVD (Feet)

Anchor Radius (if applicable) in feet: NA

Anchor locations for drilling rig or construction barge (if anchor radius is 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=	

Attachment 1M – Future well work

Proposed Well/Structure Location								
Well or Structure Name/Number (if renaming well or structure, reference previous name): VA 008 (KK)				Previously reviewed under an approved EP or DOCD? S-7858	X	Yes		No
Is this an existing well or structure?	X	Yes		No	If this is an existing well or structure, list the Complex ID or API Number:			6081741382
Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?					X	Yes		No
WCD Info	For wells, volume of uncontrolled Blowouts (bbls/day): 314,000 BOPD	For structures, volume of all storage and pipelines (bbls): NA		API Gravity of fluid		25.9°		
	Surface Location	**Bottom Hole Location (for Wells)**		**Completion (for multiple enter separate lines)**				
Lease Number	OCS-G 31534	OCS-G 31534		OCS OCS				
Area Name	Mississippi Canyon	Mississippi Canyon						
Block No.	940	940						
Blockline Departure (in feet)	N/S Departure: 883' FSL			N/S Departure: N/S Departure:				
	E/W Departure 7576' FEL			E/W Departure: E/W Departure:				
Lambert X-Y Coord.	X: 942,824			X:				
	Y: 10,170,163			Y:				
Lat/Long	Latitude: 28° 00' 31.08"			Latitude				
	Longitude: -89° 09' 44.587"			Longitude				
Water Depth (Feet): 3,993'				MD (Feet)	TVD (Feet)			
Anchor Radius (if applicable) in feet: NA								

Anchor locations for drilling rig or construction barge (if anchor radius is 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=	

Attachment 1N – Future well work

Proposed Well / Structure Location					
Well or Structure Name/Number (if renaming well or structure, reference previous name): VA 009 (GG)	Previously reviewed under an approved EP or DOCD? S-7858	X	Yes		No

Is this an existing well or structure?	X	Yes		No	If this is an existing well or structure, list the Complex ID or API Number:	6081741385

Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?	X	Yes		No

WCD Info	For wells, volume of uncontrolled Blowouts (bbls/day): 314,000 BOPD	For structures, volume of all storage and pipelines (bbls): NA		API Gravity of fluid	25.9°
	Surface Location	**Bottom Hole Location (for Wells)**		**Completion (for multiple enter separate lines)**	
Lease Number	OCS-G 31534	OCS-G 31534		OCS OCS	
Area Name	Mississippi Canyon	Mississippi Canyon			
Block No.	940	940			
Blockline Departure (in feet)	N/S Departure: 787' FSL			N/S Departure: N/S Departure:	
	E/W Departure 7559' FEL			E/W Departure: E/W Departure:	
Lambert X-Y Coord.	X: 942,841			X:	
	Y: 10,170,067			Y:	
Lat/Long	Latitude: 28° 00' 30.138"			Latitude	
	Longitude: -89° 09' 44.379"			Longitude	
Water Depth (Feet): 3,994'				MD (Feet)	TVD (Feet)
Anchor Radius (if applicable) in feet: NA					

Anchor locations for drilling rig or construction barge (if anchor radius is 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=	

Attachment 1O – New Well

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<tr><th colspan="12">Proposed Well/Structure Location</th></tr>
<tr><td colspan="6">Well or Structure Name/Number (if renaming well or structure, reference previous name): VA 010</td><td colspan="2">Previously reviewed under an approved EP or DOCD?</td><td></td><td>Yes</td><td>X</td><td>No</td></tr>
<tr><td>Is this an existing well or structure?</td><td></td><td>Yes</td><td>X</td><td>No</td><td colspan="3">If this is an existing well or structure, list the Complex ID or API Number:</td><td colspan="4"></td></tr>
<tr><td colspan="8">Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?</td><td>X</td><td>Yes</td><td></td><td>No</td></tr>
<tr><td>WCD Info</td><td>For wells, volume of uncontrolled Blowouts (bbls/day): 314,000 BOPD</td><td colspan="4">For structures, volume of all storage and pipelines (bbls): NA</td><td colspan="2">API Gravity of fluid</td><td colspan="4">25.9°</td></tr>
<tr><td></td><td>Surface Location</td><td colspan="4">Bottom Hole Location (for Wells)</td><td colspan="6">Completion (for multiple enter separate lines)</td></tr>
<tr><td>Lease Number</td><td>OCS-G 31534</td><td colspan="4">OCS-G 31534</td><td colspan="6">OCS
OCS</td></tr>
<tr><td>Area Name</td><td>Mississippi Canyon</td><td colspan="4">Mississippi Canyon</td><td colspan="6"></td></tr>
<tr><td>Block No.</td><td>940</td><td colspan="4">940</td><td colspan="6"></td></tr>
<tr><td rowspan="2">Blockline Departure (in feet)</td><td>N/S Departure: 1158’ FSL</td><td colspan="4"></td><td colspan="6">N/S Departure:
N/S Departure:</td></tr>
<tr><td>E/W Departure 7765’ FEL</td><td colspan="4"></td><td colspan="6">E/W Departure:
E/W Departure:</td></tr>
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<tr><td>Y: 10,170,438</td><td colspan="4"></td><td colspan="6">Y:</td></tr>
<tr><td rowspan="2">Lat/Long</td><td>Latitude: 28.009381</td><td colspan="4"></td><td colspan="6">Latitude</td></tr>
<tr><td>Longitude: -89.1629856</td><td colspan="4"></td><td colspan="6">Longitude</td></tr>
<tr><td colspan="2">Water Depth (Feet): 3,996’</td><td colspan="2"></td><td colspan="2"></td><td colspan="3">MD (Feet)</td><td colspan="3">TVD (Feet)</td></tr>
<tr><td colspan="12">Anchor Radius (if applicable) in feet: NA</td></tr>
<tr><td colspan="12">Anchor locations for drilling rig or construction barge (if anchor radius is supplied above, not necessary)</td></tr>
<tr><td>Anchor Name or No.</td><td>Area</td><td>Block</td><td>X Coordinate</td><td>Y Coordinate</td><td colspan="7">Length of Anchor Chain on Seafloor</td></tr>
<tr><td></td><td></td><td></td><td>X=</td><td>Y=</td><td colspan="7"></td></tr>
<tr><td></td><td></td><td></td><td>X=</td><td>Y=</td><td colspan="7"></td></tr>
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Attachment 1P – New well

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<tr><td colspan="4">Well or Structure Name/Number (if renaming well or structure, reference previous name): VA 010 Alt</td><td colspan="2">Previously reviewed under an approved EP or DOCD?</td><td></td><td>Yes</td><td>X No</td></tr>
<tr><td colspan="2">Is this an existing well or structure?</td><td>Yes</td><td>X No</td><td colspan="3">If this is an existing well or structure, list the Complex ID or API Number:</td><td colspan="2"></td></tr>
<tr><td colspan="6">Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?</td><td>X</td><td>Yes</td><td>No</td></tr>
<tr><td>WCD Info</td><td>For wells, volume of uncontrolled Blowouts (bbls/day): 314,000 BOPD</td><td colspan="2">For structures, volume of all storage and pipelines (bbls): NA</td><td colspan="2">API Gravity of fluid</td><td colspan="3">25.9°</td></tr>
<tr><td></td><td>Surface Location</td><td colspan="2">Bottom Hole Location (for Wells)</td><td colspan="5">Completion (for multiple enter separate lines)</td></tr>
<tr><td>Lease Number</td><td>OCS-G 31534</td><td colspan="2">OCS-G 31534</td><td colspan="5">OCS
OCS</td></tr>
<tr><td>Area Name</td><td>Mississippi Canyon</td><td colspan="2">Mississippi Canyon</td><td colspan="5"></td></tr>
<tr><td>Block No.</td><td>940</td><td colspan="2">940</td><td colspan="5"></td></tr>
<tr><td rowspan="2">Blockline Departure (in feet)</td><td>N/S Departure: 1192’ FSL</td><td colspan="2"></td><td colspan="5">N/S Departure:
N/S Departure:</td></tr>
<tr><td>E/W Departure 7801’ FEL</td><td colspan="2"></td><td colspan="5">E/W Departure:
E/W Departure:</td></tr>
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<tr><td>Y: 10,170,472</td><td colspan="2"></td><td colspan="5">Y:</td></tr>
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<tr><td>Longitude: -89.163099</td><td colspan="2"></td><td colspan="5">Longitude</td></tr>
<tr><td colspan="2">Water Depth (Feet): 3,996’</td><td></td><td></td><td colspan="2">MD (Feet)</td><td colspan="3">TVD (Feet)</td></tr>
<tr><td colspan="9">Anchor Radius (if applicable) in feet: NA</td></tr>
</table>

Anchor locations for drilling rig or construction barge (if anchor radius is 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=	

Attachment 1Q – New Well

Proposed Well/Structure Location							
Well or Structure Name/Number (if renaming well or structure, reference previous name): VA 011				Previously reviewed under an approved EP or DOCD?		Yes	X No
Is this an existing well or structure?	Yes	X No	If this is an existing well or structure, list the Complex ID or API Number:				
Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?					X Yes		No
WCD Info	For wells, volume of uncontrolled Blowouts (bbls/day): 314,000 BOPD		For structures, volume of all storage and pipelines (bbls): NA	API Gravity of fluid	25.9°		
	Surface Location		**Bottom Hole Location (for Wells)**	**Completion (for multiple enter separate lines)**			
Lease Number	OCS-G 31534		OCS-G 31534	OCS OCS			
Area Name	Mississippi Canyon		Mississippi Canyon				
Block No.	940		940				
Blockline Departure (in feet)	N/S Departure: 1148' FSL			N/S Departure: N/S Departure:			
	E/W Departure 7898' FEL			E/W Departure: E/W Departure:			
Lambert X-Y Coord.	X: 942,502			X:			
	Y: 10,170,428			Y:			
Lat/Long	Latitude: 28.009347			Latitude			
	Longitude: -89.1633971			Longitude			
Water Depth (Feet): 3,996'				MD (Feet)	TVD (Feet)		
Anchor Radius (if applicable) in feet: NA							

Anchor locations for drilling rig or construction barge (if anchor radius is 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=	

Attachment 1R – New Well

Proposed Well/Structure Location						
Well or Structure Name/Number (if renaming well or structure, reference previous name): VA 011 Alt		Previously reviewed under an approved EP or DOCD?		Yes	X	No

Is this an existing well or structure?		Yes	X	No	If this is an existing well or structure, list the Complex ID or API Number:	

Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?	X	Yes		No

WCD Info	For wells, volume of uncontrolled Blowouts (bbls/day): 314,000 BOPD	For structures, volume of all storage and pipelines (bbls): NA	API Gravity of fluid	25.9°

	Surface Location	**Bottom Hole Location (for Wells)**	**Completion (for multiple enter separate lines)**
Lease Number	OCS-G 31534	OCS-G 31534	OCS OCS
Area Name	Mississippi Canyon	Mississippi Canyon	
Block No.	940	940	
Blockline Departure (in feet)	N/S Departure: 1141' FSL		N/S Departure: N/S Departure:
	E/W Departure 7860' FEL		E/W Departure: E/W Departure:
Lambert X-Y Coord.	X: 942,540		X:
	Y: 10,170,421		Y:
Lat/Long	Latitude: 28.0093296		Latitude
	Longitude: -89.1632789		Longitude

Water Depth (Feet): 3,996'			MD (Feet)	TVD (Feet)

Anchor Radius (if applicable) in feet: NA

Anchor locations for drilling rig or construction barge (if anchor radius is 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=	

Attachment 1S – New Well

Proposed Well/Structure Location

Well or Structure Name/Number (if renaming well or structure, reference previous name): VA 012	Previously reviewed under an approved EP or DOCD?		Yes	X No

Is this an existing well or structure?		Yes	X	No	If this is an existing well or structure, list the Complex ID or API Number:	

Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?	X	Yes		No

WCD Info	For wells, volume of uncontrolled Blowouts (bbls/day): 314,000 BOPD	For structures, volume of all storage and pipelines (bbls): NA	API Gravity of fluid	25.9°

	Surface Location	**Bottom Hole Location (for Wells)**	**Completion (for multiple enter separate lines)**
Lease Number	OCS-G 31534	OCS-G 31534	OCS OCS
Area Name	Mississippi Canyon	Mississippi Canyon	
Block No.	940	940	
Blockline Departure (in feet)	N/S Departure: 1018' FSL		N/S Departure: N/S Departure:
	E/W Departure 7884' FWL		E/W Departure: E/W Departure:
Lambert X-Y Coord.	X: 942,444		X:
	Y: 10,170,298		Y:
Lat/Long	Latitude: 28.0089867		Latitude
	Longitude: -89.1635696		Longitude

Water Depth (Feet): 3,996'			MD (Feet)	TVD (Feet)

Anchor Radius (if applicable) in feet: NA

Anchor locations for drilling rig or construction barge (if anchor radius is 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=	

Attachment 1T – New Well

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<tr><td colspan="4">Well or Structure Name/Number (if renaming well or structure, reference previous name): VA 012 Alt</td><td colspan="2">Previously reviewed under an approved EP or DOCD?</td><td>Yes</td><td>X No</td></tr>
<tr><td>Is this an existing well or structure?</td><td>Yes</td><td>X No</td><td colspan="3">If this is an existing well or structure, list the Complex ID or API Number:</td><td colspan="2"></td></tr>
<tr><td colspan="6">Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?</td><td>X Yes</td><td>No</td></tr>
<tr><td>WCD Info</td><td>For wells, volume of uncontrolled Blowouts (bbls/day): 314,000 BOPD</td><td colspan="2">For structures, volume of all storage and pipelines (bbls): NA</td><td colspan="2">API Gravity of fluid</td><td colspan="2">25.9°</td></tr>
<tr><td></td><td>Surface Location</td><td colspan="2">Bottom Hole Location (for Wells)</td><td colspan="4">Completion (for multiple enter separate lines)</td></tr>
<tr><td>Lease Number</td><td>OCS-G 31534</td><td colspan="2">OCS-G 31534</td><td colspan="4">OCS
OCS</td></tr>
<tr><td>Area Name</td><td>Mississippi Canyon</td><td colspan="2">Mississippi Canyon</td><td colspan="4"></td></tr>
<tr><td>Block No.</td><td>940</td><td colspan="2">940</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Blockline Departure (in feet)</td><td>N/S Departure: 1094’ FSL</td><td colspan="2"></td><td colspan="4">N/S Departure:
N/S Departure:</td></tr>
<tr><td>E/W Departure 7895’ FWL</td><td colspan="2"></td><td colspan="4">E/W Departure:
E/W Departure:</td></tr>
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<tr><td>Y: 10,170,374</td><td colspan="2"></td><td colspan="4">Y:</td></tr>
<tr><td rowspan="2">Lat/Long</td><td>Latitude: 28.0091962</td><td colspan="2"></td><td colspan="4">Latitude</td></tr>
<tr><td>Longitude: -89.1635397</td><td colspan="2"></td><td colspan="4">Longitude</td></tr>
<tr><td colspan="2">Water Depth (Feet): 3,996’</td><td></td><td></td><td colspan="2">MD (Feet)</td><td colspan="2">TVD (Feet)</td></tr>
<tr><td colspan="8">Anchor Radius (if applicable) in feet: NA</td></tr>
</table>

<table>
<tr><th colspan="6">Anchor locations for drilling rig or construction barge (if anchor radius is supplied above, not necessary)</th></tr>
<tr><td>Anchor Name or No.</td><td>Area</td><td>Block</td><td>X Coordinate</td><td>Y Coordinate</td><td>Length of Anchor Chain on Seafloor</td></tr>
<tr><td></td><td></td><td></td><td>X=</td><td>Y=</td><td></td></tr>
<tr><td></td><td></td><td></td><td>X=</td><td>Y=</td><td></td></tr>
<tr><td></td><td></td><td></td><td>X=</td><td>Y=</td><td></td></tr>
<tr><td></td><td></td><td></td><td>X=</td><td>Y=</td><td></td></tr>
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<tr><td></td><td></td><td></td><td>X=</td><td>Y=</td><td></td></tr>
<tr><td></td><td></td><td></td><td>X=</td><td>Y=</td><td></td></tr>
</table>

SECTION 2: GENERAL INFORMATION

A. Application and Permits

There are no individual or site-specific permits other than general NPDES Permit and rig move notification that need to be obtained. An approved Applications for permit to drill (APD) will be obtained from BSEE before rig activity takes place on a well.

B. Drilling Fluids (MODU)

See Section 7 of DOCD

C. Production

Type	Average Production Rate	Peak Production Rate	Life of Reservoir
Oil	Proprietary Data		
Gas			

D. Oil Characteristics

Provide the estimated chemical and physical characteristics of the oils that will be handled, stored, or transported on/by the facility.

Characteristic		Analytical Methodologies Should Be Compatible With:
1. Gravity (API)	15/27	ASTM D4052
2. Flash Point (ºC)	N/A	ASTM D93/IP 34
3. Pour Point (ºC)	-30°C	ASTM D97
4. Viscosity (Centipoise at 25 ˚C)	10cP @ 93°C/30 cP@ 54°C	ASTM D445
5. Wax Content (wt %)	2.4-5.5%	Precipitate with 2-butanon/dichloromethane (1 to 1 volume) at -10 ˚C
6. Asphaltene Content (wt %)	table below	IP-Method 143/84
7. Resin Content (wt %)	table below	Jokuty et al., 1996
8. Boiling point distribution including, for each fraction, the percent volume or weight and the boiling point range in ˚C		ASTM D2892 (TBP distillation) or ASTM D2887/5307

Fractions		Atmospheric Distillation									Vacuum Distillation			
IBP (°C)	Whole	C_5	65	100	150	200	250	300	350	370	370	475	525	565
FBP (°C)	Crude	65	100	150	200	250	300	350	370	+	475	525	565	+
Yield (% wt)		1.2	2.9	5.6	7.8	7.6	8.3	8.1	3.2	55.1	16.5	7.4	5.2	26.1
Yield (% vol)		1.6	3.7	6.7	8.9	8.4	8.9	8.4	3.2	49.6	16.1	7.0	4.9	21.7

9. Sulphur (wt %)	2.2-3%	ASTM D4294

Note: If the distillation information in Item No. 8 in the above table is not available, the GOMR may accept the following information in lieu of Items Nos. 5, 6, 7, and 8: weight percent total of saturates, aromatics, waxes, asphaltenes, and resins; and total BTEX (ppm) using analytical methods compatible with the Hydrocarbon Groups methodology found in Jokuty et al., 1996.

SARA (Topped Basis) All in wt %				
Well #	**Saturates**	**Aromatics**	**Resin**	**Asphaltenes**
MC984-2ST01BP01	27.12	50.09	12.01	10.79
MC940-2ST00BP00	42.5	43.4	9.3	4.77
MC984-1BP02	23.4	47.7	10.2	18.74
MC940-1ST01	25.8	49.9	11.1	13.18

Oil from one well	Oil from more than one well sampled on a facility	Oil from a pipeline system
·Area/Block- ·BOEM platform ·API Well No. ·Completion perforation interval ·BOEM's reservoir name ·Sample date ·Sample No.(if more than one is taken)	·Area/Block- - **See Tables Below** ·BOEM platform ID ·Field/Unit ·Sample date ·Sample No. (if more than one is taken) ·Listing of API Well Nos. ·Storage tank ID No. (if sampled at a storage tank)	·Pipeline segment number ·For each pipeline that feeds into the system, the ID codes for the closest upstream LACT units and/or facility measurement points ·Storage tank ID No. (if sampled at a storage tank)

Field/Unit	Vito	Vito
Area/Block	MC940	MC940
Well	MC940 - 2	MC940-2
API Well Number	608174120400	608174120400
Completion Perforations	Sample Depth: 31,355' MD	Sample Depth: 31,500' MD
BOEM Reservoir Name	VM80	VM80
Sample Date	May 13, 2012	May 9, 2012
Sample Number (if more than one)	NG-T-1957	NG-T-1986

E. New or Unusual Technology

None

F. Bonding

The bond requirement for the activities proposed in this plan are satisfied by an area-wide bond furnished and maintained according to 30 CFR Part 256, Subpart I-Bonding and NTL No. 2000-G16, "Guideline for General Lease Surety Bonds.

G. Oil Spill Financial Responsibility (OSFR)

Shell Offshore Inc. (Shell), BOEM Operator Number 0689, has demonstrated oil spill financial responsibility for the wells proposed in the DOCD according to 30 CFR Parts 250 and 253, and NTL No. 2008-N05, "Guidelines for Oil Spill Financial Responsibility for Covered Facilities."

H. Deepwater well control statement

Shell Offshore Inc (Shell), BOEM Operator Number 0689, has the financial capability to drill a relief well and conduct other emergency well control operations.

I. Suspension of Production

A Suspension of Production (SOP) was granted for the Vito Unit Agreement No. 754312007 by BSEE from March 14, 2021 through February 28, 2023.

J. Blowout Scenario

This section was previously accepted by BOEM in Plan Control No. S-7480 dated September 29, 2011 for MC 934, Well 001 (H). The wells proposed in this plan do not exceed the amount discussed in the data provided and accepted by BOEM.

This Section 2J was prepared by Shell pursuant to the guidance provided in the BOEM's NTL 2015-N01 with respect to blowout and worst case discharge (WCD) scenario descriptions. Shell intends to comply with all applicable laws, regulations, rules and Notices to Lessees.

Shell focuses on an integrated, three-pronged approach to a blowout, including prevention, intervention, containment, and recovery.

1. Shell believes that the best way to manage blowouts is to prevent them from happening. Significant effort goes into design and execution of wells and into building and maintaining staff competence. Shell continues to invest independently in research and development (R&D) to improve safety and reliability of our well systems.

2. Shell is a founding member of the MWCC, which provides robust well containment (shut-in and controlled flow) capabilities. Additionally, Shell is investing in research and development (R&D) to improve containment systems.

3. As outlined in Shell's OSRP, and detailed in EP Section 9, Shell has contracts with OSROs to provide the resources necessary to respond to this WCD scenario. The capabilities for on-water recovery, aerial and subsea dispersant application, in-situ burning, and nighttime monitoring and tracking have been significantly increased.

The Worst Case Discharge (WCD) blowout scenario for Vito is calculated for the MC 940 #1 ST3BP00 location based on the guidelines outlined in NTL No. 2015-N01 along with subsequent Frequently Asked Questions (FAQ). The WCD for MC 940 #1 ST3BP00, or a similarly targeted well, falls below the WCD exploratory scenario included in our Regional OSRP. In the unlikely event of a spill, Shell's Regional OSRP is designed to contain and respond to a spill that meets or exceeds this WCD. The WCD does not take into account potential flow mitigating factors such as well bridging, obstructions in the wellbore, reservoir barriers, or early intervention.

Uncontrolled blowout (volume first day)	314,000 bbl
Uncontrolled blowout rate (first 30-days average daily rate)	280,000 bopd
Duration of flow (days) based on relief well	185 days
Total volume of spill (bbls) for 185 days	48 MMBO

Table 1 Worst Case Discharge Summary

The Vito discovery is located approximately 62 miles from the nearest coastline in the Gulf of Mexico (GOM), in water depths of approximately 4100 feet (ft) across the discovery. To date, the Vito partnership has drilled four penetrations at Vito, the discovery well, MC984 #1 ST00 BP01 and 3 subsequent sidetracks; the MC984 #1 ST00 BP02, the MC940 #1 ST1 BP00, and the MC984 #1 ST2 BP00. All wells/sidetracks at Vito have been drilled from Surface Location H. The discovery well and the subsequent sidetracks were drilled in 2009 – 2010, with operations suspended in May 2010 due to the Drilling Moratorium. Additional WCD scenarios were evaluated for Vito, in which other sands and well locations were considered. However, the WCD numbers for these wells/sands are lower than the WCD number calculated for the NMP as these sands are thinner, of lower quality, and flowed at substantially lower rates than the NMP case represented for the WCD. These shallower sands will be cased off prior to the well path penetrating the NMP reservoir package.

1) Purpose

Pursuant to 30 CFR 250.213(g), 250.219, 250.250 and NTL No. 2015-N01, this document provides a blowout scenario description, further information regarding any potential oil spill, the assumptions and calculations used to determine the WCD and the measures taken to 1) enhance the ability to prevent a blowout and 2) respond and manage a blowout scenario if it were to occur. These calculations are based on best technical estimates of subsurface parameters that are derived from the 3D seismic and Shell's proprietary basin model. These parameters are better than or consistent with the estimates used by Shell to justify the investment. Therefore, these assumed parameters were used to calculate the WCD.

2) Background

This attachment has been developed to document the additional information requirements for EP's as requested by NTL No. 2015-N01 in response to the explosion and sinking of the Mobile Offshore Drilling Unit (MODU) Deepwater Horizon.

3) Information Requirements

a) Blowout scenario

All well and sidetrack locations addressed in this EP were assessed for WCD using the expected well path, the expected reservoir thickness, structural elevation, and rock/fluid properties for each. The MC940 #1 ST3 BP00 deviated well from the approved "H" surface location and a bottom hole location (BHL) on the Vito structure represented the well with the highest flow potential. The MC940 #1 ST3 BP00 well will be drilled through the reservoir as outlined in the Geological and Geophysical Information Section of the Revised Vito EP, using a subsea wellhead system, conductor, surface and intermediate casing program, and using a DP rig with a marine riser and subsea blowout preventer (BOP). A hydrocarbon influx and a well control event is modeled to occur from the reservoir. The simulated blowout modeled results in unrestricted flow from the well at the seafloor, which represents the WCD (no restrictions in wellbore, failure/loss of the subsea BOP, and a blowout to the seabed).

b) Estimated flow rate of the potential blowout

Category	EP
Type of Activity	Drilling
Facility Location (area/block)	MC 984
Facility Designation	DP
Distance to Nearest Shoreline (miles)	67 Statute miles
Uncontrolled blowout (volume first day)	314,000 bbl
Uncontrolled blowout rate (first 30-days average daily rate)	280,000 bopd

Table 2 Estimated Flow Rates of a Potential Blowout

c) Total volume and maximum duration of the potential blowout

Duration of flow (days)	185 days total duration to drill relief well (14 rig mob, 3 transit, 135 spud to top NMP, 33 ranging).
Total volume of spill (bbls)	48 MMBO based on 185 days flowing. Note: From CMG dynamic reservoir models

Table 3 Estimated Duration and Volume of a Potential Blowout

There is usually a decline in the discharge rate as time progresses, which is illustrated by the differences between the first 24-hour volume and 30-day average rate. At very short times, e.g. during the first 24 hours, the pressure profile in the reservoir changes from the moment when a well first starts flowing to a pseudo-steady state pressure profile with time, and as a result the rate declines. At somewhat longer time scales, effects such as reservoir voidage and the impact of boundaries can cause the rate to drop continuously with production. Simulation and material balance models can include these effects and form the basis of the NTL No. 2010-N06 estimates for 24-hour and 30-day rates as well as maximum duration volumes.

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

(**Proprietary – see original write-up**)

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 defined scenario where the formation is not supported by a cased and cemented wellbore, it is possible that the borehole may fail/collapse/bridge over within the span of a few days, significantly reducing the outflow rates. However, this WCD scenario does not include any bridging.

f) Likelihood for intervention to stop the blowout.

Safety of operations is our top priority. Maintaining well control at all times to prevent a blowout is the key focus of our operations. Our safe drilling record is based on our robust standards, conservative well design, prudent operations practices, competency of personnel, and strong HSE focus. Collectively, these constitute a robust system making blowouts extremely rare events.

Intervention Devices: Notwithstanding these facts, the main scenario for recovery from a blowout event is via intervention with the BOP attached to the well. There are built in redundancies in the BOP system to allow activation of selected components with the intent to seal off the well bore. As a minimum, the Shell contracted rig fleet in the GOM will have redundancies meeting the Interim Final Drilling Safety Rule with respect to Remotely Operated Vehicle (ROV) hot stab capabilities, a deadman system, and an autoshear system.

The rig that will be used to drill the well will be equipped with BOP stack that complies with Shell and BSEE standards.

Containment: The experience of gaining control over the Macondo well has resulted in a better understanding of the necessary equipment and systems for well containment. As a result, industry and government are better equipped and prepared today to contain an oil well blowout in deepwater. Shell is further analyzing these advances and incorporating them into its comprehensive approach to help prevent and, if needed, control another deepwater control incident.

Pursuant to NTL 2015-N01 Shell will provide additional information regarding our containment capabilities in a subsequent filing.

g) Availability of a rig to drill a relief well, rig package constraints and drilling from platform

Blowout intervention can be conducted from an ROV equipped vessel, the existing drilling rig or from another drilling rig. This location is not located near any existing platforms for relief well drilling. Shell has an active portfolio of well operations in the GOM which will be supported by a total of four to six MODU rigs in the 2018 – 2022 timeframe. The dynamically positioned rigs under contract will be the preferred rigs for blowout intervention work. However, moored rigs can also be used in some scenarios. Additionally, in the event of a blowout, there is the distinct possibility that other non-contracted rigs in the GOM could be utilized whether for increased expediency or better suitability. All efforts will be made at the time to secure the appropriate rig. Shell's current contracted rigs capable of operating at these water depths and reservoir depths without constraints are in the following table:

Rig Name	Rig Type
Deepwater Pontus	Dynamically positioned drillship
Noble Bully I	Dynamically positioned drillship
Noble Don Taylor	Dynamically positioned drillship

Table 2.4 Shell contracted rigs capable at Vito

Future modifications may change the rig's capability. Rig capabilities need to be assessed on a work scope specific basis.

h) Time taken to contract a rig, move it onsite, and drill a relief well

Relief well operations will immediately take priority and displace any activity from Shell's contracted rig fleet. The list of rigs capable of operating at Vito is tabled above. It is expected to take an average of 14 days to safely secure the well that the rig is working on up to the point the rig departs location, and an additional three days' transit to mobilize to the relief well site depending on distance to the site. The relief well will take approximately 135 days to drill down to the last casing string above the blowout zone, plus approximately 33 days for precision ranging activity to intersect the blowout well bore. The expected total time to mobilize and drill a relief well would be 185 days for Vito.

If a moored rig is chosen to conduct the relief well operations, anchor handlers would be prioritized to prepare mooring on the relief well site while the rig is being mobilized. This mooring activity is not expected to delay initiation of relief well drilling operations.

It is not possible to drill relief wells from any existing platforms (ATP's Titan Platform) due to rig capability limitations and a distance of over 4 miles to the Vito well.

i) Measures proposed to enhance ability to prevent blowout and to reduce likelihood of a blowout.

Shell believes that the best way to manage blowouts is to prevent them from happening. Detailed below are the measures employed by Shell with the goal of no harm to people or the environment. The Macondo incident has highlighted the importance of these practices. The lessons learned from the investigation are, and will continue to be, incorporated into our operations.

Standards: Shell's well design and operations adhere to internal corporate standards, the Code of Federal Regulations, and industry standards. A robust management of change process is in place to handle un-defined or exception situations. Ingrained in the Shell standards for well control is the philosophy of multiple barriers in the well design and operations on the well.

Risk Management: Shell believes that prevention of major incidents is best managed through the systematic identification and mitigation process (Safety Case). All Shell contracted rigs in the GOM have been operating with a Safety Case and will continue to do so. A Safety Case requires both the owner and contractors to systematically identify the risks in drilling operations and align plans to mitigate those risks; an alignment which is critical before drilling begins.

Well Design Workflow: The Well Delivery Process (WDP) is a rigorous internal assurance process with defined decision gates. The WDP leverages functional experts (internal and external) to examine the well design at the conceptual and detailed design stages for robustness before making a recommendation to the management review board. Shell's involvement in global deepwater drilling, starting in the GOM in the mid-1980's, provides a significant depth and breadth of internal drilling and operational expertise. Third party vendors and rig contractors are involved in all stages of the planning, providing their specific expertise. A Drill the Well on Paper (DWOP) exercise is conducted with rig personnel and vendors involved in execution of the well. This forum communicates the well plan, and solicits input as to the safety of the plan and procedures proposed.

Well and rig equipment qualification, certification, and quality assurance: All rigs will meet all applicable rules, regulations, and Notice to Lessees. Shell works closely with rig contractors to ensure proper upkeep of all rig equipment, which meets or exceeds the strictest of Shell, industry, or regulatory requirements. Well tangibles are governed by our internal quality assurance/control standards and industry standards.

MWD/LWD/PWD Tools: Shell intends to use these tools at Dover. The MWD/LWD/PWD tools are run on the drill string so that data on subsurface zones can be collected as the well advances in real time instead of waiting until the drill string is pulled to run wireline logs. Data from the tools are monitored and interpreted real time against prognosis to provide early warning of abnormal pressures to allow measures to be taken to progress the well safely.

Mud Logger: Mud-logging personnel continually monitor returning drilling fluids for indications of hydrocarbons, utilizing both a hot wire and a gas chromatograph. An abrupt increase in gas or oil carried in the returning fluid can be an indication of an impending kick. The mud logger also monitors drill cuttings returned to the surface in the drilling fluid for changes in lithology that can be an indicator that the well has penetrated or is about to penetrate a hydrocarbon-bearing interval. Mud logging instruments also monitor penetration rate to provide an early indication of drilling breaks that show the bit penetrating a zone that could contain hydrocarbons. The mud logging personnel are in close communication with both the offshore drilling foremen and onshore Shell representative(s) to report any observed anomalies so appropriate action can be taken.

Remote Monitoring: The Real Time Operating Center has been used by Shell to complement and support traditional rig-site monitoring since 2003. Well site operations are monitored 24/7 virtually by onshore teams consisting of geoscientists, petrophysicists, well engineers, and monitoring specialists. The same real time well control indicators monitored by the rig personnel are watched by the monitoring specialist for an added layer of redundancy.

Competency and Behavior: A structured training program for Well Engineers and Foremen is practiced, which includes internal professional examinations to verify competency. Other industry training in well control, such as by International Association of Drilling Contractors (IADC) and International Well Control Forum (IWCF) are also mandated. Progressions have elements of competency and Shell continues to have comprehensive internal training programs. The best systems and processes can be defeated by lack of knowledge and/or improper values. We believe that a combination of HSE tools (e.g. stop work, pre-job analysis, behavior based safety, DWOPs, audits), management HSE involvement and enforcement (e.g. compliance to life saving rules) have created a strong safety culture in our operations.

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

The response to a blowout is contained in our Well Control Contingency Plan (WCCP) which is a specific requirement of our internal well control standards. The WCCP in turn is part of the wider emergency response framework within Shell that addresses the overall organization response to an emergency situation. Resources are dedicated to these systems and drills are run frequently to test preparedness (security, medical, oil spill, and hurricane). This same framework is activated and tested during hurricane evacuations, thereby maintaining a fresh and responsive team.

The WCCP specifically addresses implementing actions at the emergency site that will ensure personnel safety, organizing personnel and their roles in the response, defining information requirements, establishing protocols to mobilize specialists, pre-selecting sources, and developing mobilization plans for personnel, material and services for well control procedures. The plan references individual activity checklists, a roster of equipment and services, initial information gathering forms, a generic description of relief well drilling, strategy and guidelines, intervention techniques and equipment, site safety management, exclusion zones, and re-boarding.

As set forth in 3f of this document, Shell is currently analyzing recent advances in containment technology and equipment and will incorporate them as they become available.

k) Arrangements for drilling a relief well

The size of the Shell contracted rig fleet in the GOM ensures that there is adequate well equipment (e.g. casing and wellhead) available for relief wells. Rigs and personnel will also be readily available within Shell, diverted from their active roles elsewhere. Resources from other operators can also be leveraged should the need arise. Generally, relief well plans will mirror the blowout well, incorporating any learning on well design based on root cause analysis of the blowout. A generic relief well description is outlined in the WCCP.

l) Assumptions and calculations used in Regional OSRP

Shell has designed a response program (Regional OSRP) based upon a regional capability of responding to a range of spill volumes, from small operational spills up to and including the WCD from a well blowout. Shell's program is developed to fully satisfy federal oil spill planning regulations. The Regional 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.

SECTION 3: GEOLOGICAL & GEOPHYSICAL INFORMATION

Proprietary Data

A. Geological Description

B. Structure Contour Maps

C. Interpreted Two-dimension (2-D) and/or Three Dimensional (3-D) Seismic Lines

D. Geological Structure Cross-Sections

E. Shallow Hazards Report

See Section 6 for the list of reports used for this plan.

F. Shallow Hazards Assessment

See Section 6 for assessment of activities proposed in this plan.

G. High-Resolution Seismic Lines

H and I Stratigraphic Column with Time vs Depth

Not required for DOCDs.

J. Geochemical Information

Not required for DOCDs in GoM.

SECTION 4: HYDROGEN SULFIDE

A. Concentration

< 20 ppm

B. Classification

Based on CFR 250.490, Shell requests that the Regional Supervisor, Field Operations, determine the zones in the proposed operations in this plan to be classified as an area where the absence of H_2S has been confirmed.

C. H_2S Contingency Plan

Shell is not required to file an H_2S Contingency Plan for this facility, prepared according to 30 CFR 250.490, before conducting the proposed development activities.

D. Modeling Report

Not applicable.

SECTION 5: MINERALS RESOURCE CONSERVATION

Proprietary Data

A. Technology and reservoir engineering practices and procedures

B. Technology and recovery practices and procedures

C. Reservoir Development

SECTION 6: BIOLOGICAL, PHYSICAL AND SOCIOECONOMIC INFORMATION

A. Well Clearance

Shell Offshore Inc. (Shell) is submitting a supplemental DOCD to previously approved Initial DOCD N-10018 for the Vito Field Development in Mississippi Canyon Block 940. Shell is seeking clearance to continue its development of the Vito field by adding production wells and seafloor equipment in Mississippi Canyon block MC 940.

This document addresses seafloor conditions specific to the following proposed operations and complies with BOEM NTL 2008-G05 (Shallow Hazards Program), NTL 2008-G04 (Information Requirements for EPs and DOCDs), NTL 2009-G40 (Deepwater Benthic Communities), and NTL 2005-G07 and Joint 2011-G01 (Archaeological Resource Surveys and Reports).

Seafloor conditions appear favorable within the vicinity of the proposed surface locations. There are no potential sites for deepwater benthic communities within 2,000 ft and no sonar targets of archaeological significance were identified in the vicinity of any of the proposed wellsite's. There is some potential for encountering overpressured sands within the limit of investigation based on the stratigraphy and the drilling history in the area. There is generally a low potential for significant shallow gas at the proposed locations based on seismic attributes and amplitude analysis

The assessments listed below address the seafloor conditions around the proposed production wellsites and the proposed seafloor equipment installation area. All activities fall within the 2000 ft. radial clearance of proposed production wellsite's.

Geohazards and Archaeological Assessment. The following summary of the geohazards and archaeological assessment is based on the findings provided within the following detailed reports, which were submitted concurrently with this development plan and previously submitted exploration plans:

- "Geologic, Stratigraphic, and Archaeological Assessment of Blocks 940(Open), 984(OCSG-22919), and 985(OCSG-22920) Mississippi Canyon Area Gulf of Mexico". GEMS Project No. 0507-1331 Dated October, 22, 2007.
- Side Scan Sonar Contact Assessment Blocks 895 (OCS-G-33764), 896 (OCS-G-35642), 939 (OCS-G-35348), and 940 (OCS-G-31534), Mississippi Canyon Area, Oceaneering, OII Project No. 185506, Dec. 13, 2017.
- Geohazards and Archaeological Assessment of the Western Portions of Block 939 and 983 Mississippi Canyon Area, Gulf of Mexico, GEMS, Project No. 0513-2248
- Vito Field Development Anchor Fault Zone Avoidance Mapping, 408024-00422-SS-REP-0002, IntecSea Worley Parsons Group, April 1, 2015

.

Available Data. Assessments are based on the analysis of the data from AUV (Autonomous Underwater Vehicle) geophysical survey data (sub-bottom profiler, side-scan sonar and multi-beam echo-sounder), and 3D seismic data volumes. The power spectrum analysis shows that the 3D seismic data used for this study has a bandwidth of approximately 13-52 Hz, which meets the regulatory requirement. Fig. Vito-Spec.jpg.

Existing Infrastructure and Shipping Activity. No portion of the block MC 940 is in a shipping fairway or in known dump site, however adjacent to proposed operation area is a designated BOEM Chemical Dumpsite. Any debris identified in the area of operation from dumping will follow protocols as defined in the Waste Barrel Avoidance and Release Response document. Previous drilled and wells and development equipment is located within 2000 ft. of the proposed production wellsite's and installation area. Operations will be conducted using state of the art DGP for positioning to depict all existing pipelines, wells, and other equipment located within 500 ft. of proposed wellsite's and installation area to ensure safe operations.

<u>Proposed Wellsite's VA010, VA010-ALT, VA011, VA011-ALT, VA012, VA012-ALT and Proposed Seafloor Equipment in Mississippi Canyon block 940 (OCS-G-31534)</u>

<u>Wellsites</u>

The proposed production wellsite's are located in the southern central area of MC 940. The primary proposed wellsite's VA010, VA011, VA012 and the alternate proposed wellsite's are located within 500 ft of each and will be addressed together. Seafloor and subsurface conditions are approximately equivalent.

Seafloor Equipment

Shell proposes to install a 5.12" OD Flexible Jumper from VA009 to Gas Lift Manifold Hub at a length of 66.75 ft. Shell proposes to install a 6.625" OD Jumper from VA009 Production Well to Production Manifold Hub at a length of 409.71 ft. Shell proposes to install a 16.7" OD Flexible Jumper from proposed production well VA010(VC2) at a length of 1020.26 ft. to Proposed P1 PLET. Shell proposes to install a 16.7" OD Flexible Jumper from proposed production well VA011(VC3) at a length of 150.37 ft. to Proposed Manifold Hub – 1. Shell proposes to install a 16.7" OD Flexible Jumper from Proposed Manifold Hub -3 to Proposed P2 PLET with an additional 614.47 ft. of jumper. Shell also proposes to install a 135.58 ft. 16.7" OD Flexible Jumper from VA012(VC4) to Proposed Manifold Hub – 2.

Table A-1. Proposed Production Wellsite Surface Location Coordinates

	Proposed Drill Center MC 940 and Production Wells	
Name	**Spheroid & Datum: Clarke 1866 NAD27 Projection: UTM Zone 16 North**	
Proposed Wellsite Name		
VA010(VC2)	X: 942,635 ft	Y: 10,170,438 ft.
VA010-ALT	X: 942,598.59 ft.	Y: 10,170,472.27 ft.
VA011(VC3)	X: 942,502 ft.	Y: 10,170,428 ft.
VA011-ALT	X: 942,539.94 ft.	Y: 10,170,421.17 ft.
VA012(VC4)	X: 942,444 ft	Y: 10,170,298 ft.
VA012-ALT	X: 942,455.34 ft	Y: 10,170,374.15 ft.
Proposed HDM	X: 942,605.17 ft.	Y: 10,170,668.11 ft
Proposed Manifold	X: 942,552.53 ft.	Y: 10,170,333.30 ft
P1 PLET	X: 942,723.48 ft.	Y: 10,169,978.42 ft

Shell will drill the proposed well using a dynamically positioned drilling vessel. This assessment addresses the seafloor conditions within a 2,000-ft radius around the proposed production wellsite's and encompasses the seafloor equipment installation area.

Water Depth and Seafloor Conditions. Based on the AUV multibeam bathymetry data, the water depth at the proposed location is -3,996 ft. and the water depths range from -3970 to -4040 ft. within the 2000 ft. clearing radius. The seafloor slopes down to the southwest with average slope of 1.4 degrees.

To the north and east of the proposed production wellsite's and installation area is a series of minor northwest-southeast trending seafloor faults which are parallel/sub-parallel to the arcuate seafloor fault trend. These seafloor faults are within 2000 ft of the proposed production wellsite's and the seafloor installation area however they are not within 250 ft. of the proposed wellsite's and installation area. The faults are over 700 ft. to the northeast. See Figure Vito-ESR.

Deepwater High-Density Deepwater Benthic Communities. The seafloor amplitudes from 3D seismic data and the AUV sonar, all show ambient amplitudes or backscatter at the seabed with no indications of hardground or fluid expulsion features. There is no evidence that the faults are conduits for gas or fluid migration at the seabed. In addition, no hardgrounds, were defined on the sonar therefore the potential for high-density deepwater benthic communities is very low or negligible. No geologic features or seafloor conditions were identified within the 2,000 ft. radial clearance of the proposed production wellsite's and installation area that indicate potential for high-density benthic communities. There are no water bottom anomaly as defined by the BOEM (BOEM, 2021) within the 2,000 ft. radial clearance.

Stratigraphy. Stratigraphic conditions from the seabed to the top of the orange unit are shown on the Top-Hole Prognosis Chart. The subsurface stratigraphy in the area is divided into five stratigraphic units, with Unit 3 divided into two sub-units. The sub-surface conditions for primary proposed production wellsite, VA011, are similar for all the proposed production well sites. See figure Vito-Tophole.

Unit-1 (Seafloor(H00) to Horizon A(H10)). Unit-1 at the proposed production wellsite is 793 ft thick. Unit- 1 is characterized by soft hemipelagic silty mud with a thin mud drape. No anomalous amplitudes are seen within 250 ft radius of the proposed production wellsite.

Unit-2 (Horizon A(H10) to Horizon B(H20)). This unit is defined as the Top of the Blue Unit. Unit-2 consists of approximately 780 ft of predominantly mud rich sequence. Mostly consisting of mass transport deposits (MTD). No anomalous amplitudes are seen within 250 ft radius of the proposed production wellsite.

Unit-3A (Horizon B(H20) to Horizon H25). This unit is defined as the Intra-Blue Unit. Unit-3A is approximately 421 ft. thick and is predominantly mud rock. There is a possibility of sub-seismic sands could be present in this unit. No amplitude anomaly is noted within a 250 ft radius of the proposed production wellsite.

Unit-3B (Horizon H25 to Horizon C(H30)). This unit is defined as the Base of Blue Unit. This unit is 740 ft thick and consist of interbedded sand and mudrocks. The sands are laterally extensive with basin floor fan facies. Sub-seismic sand could be present throughout this unit.

Unit-4 (Horizon C(H30) to Horizon E11(H40)). This unit is defined as the Sub-Blue Unit and is a relatively thin. This unit is 286 ft thick and consist of interbedded sand and mudrocks. The sands are laterally extensive with basin floor fan facies. Sub-seismic sand could be present throughout this unit. No amplitude anomaly is noted within 250 ft radius of the proposed production wellsite.

Unit-5 (Horizon E11(H40) to Horizon F(H50)). This unit reflects the Top of Orange Unit. Unit 5 is 1391 ft thick and is mudrock interbedded with sand and silt. Sub-seismic sands can be present throughout this unit. There are no amplitude anomaly is noted within 250 ft. of the proposed production wellsite.

Faults. There aren't any mapped faults beneath the proposed production wellsite.

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 to be at 1,476 ft BML. However, sediments above the BGHSZ are predominantly shale with limited sand presence or other permeable formations for gas hydrate to gather. Therefore, the **potential for significant gas hydrate accumulations is assessed to be negligible.**

Shallow Gas. There is little significant accumulation of shallow hydrocarbons. There are no high-amplitude anomalies indicative of shallow gas in the predominantly shale-rich sediment directly below the proposed production wellsite; therefore, the **potential for encountering significant shallow gas is assessed to be low**.

Shallow Water Flow. The proposed well is in a region with relatively high sedimentation rates. Shallow water flow potential is generally much higher in Mississippi Canyon. In Unit 1 the potential for shallow water flow is low. Units 2 and 3A have a moderately low potential for shallow water flow as this is the top of the Blue Unit. Unit 3B has the highest potential for shallow water flow. Whereas the Unit below 3B, Unit 4, has a moderately high potential for shallow water flow. The last unit, Unit 5, has a moderately low potential for shallow water flow. The potential for encountering shallow water flow below the proposed production wellsite is **assessed to be Low to High**.

Archaeological Assessment. Sonar contacts in the Vito area were recently re-evaluated. An ROV survey was also conducted over a sampling of sonar contacts for identification. Due to the outcome of the evaluation some of the targets were re-classified, Oceaneering, 2017. There are 12 sonar targets identified within the 2,000 ft. radial clearance. None of these sonar targets were identified to be of archaeological significance and are likely modern debris, geologic in origin or industrial waste barrels. A 100' avoidance is recommended for 4 of the sonar targets that are considered debris or geologic in origin. Contact Numbers: V4, V15, V19, and V21. There are 8 sonar targets considered industrial waste barrels and have the BOEM accepted 33 ft. avoidance as described in the Waster Barrel Avoidance Release and Response document. Contact Numbers: V12, V17, V18, V23, V24, V25, A22, and A23. Further details about contacts can be found in Oceaneering, 2017 report. See figure Vito-ESR.jpg

Proposed Production Wellsites and Seafloor Equipment, Concluding Remarks. Seafloor conditions appear favorable at the vicinity of the proposed production wellsites. There are no potential sites for deepwater benthic communities within the 2,000 ft. radial clearance and no sonar targets of archaeological significance were identified. Shell will design its operations to avoid seafloor hazards. (See Shallow Hazards and Archaeological reports for details.)

B - F

Pursuant to NTL No. 2008-G04 the proposed operations covered by this DOCD do not involve operations impacting the following: Topographic features map, Topographic features statement (shunting), Live bottoms, (Pinnacle Trend) map, Live bottoms (low relief) map, or potentially sensitive biological features map.

G. Remotely Operated Vehicle (ROV) Monitoring Plan

Information no longer required by BOEM.

H. Threatened and Endangered Species Information

Under Section 7 of the Endangered Species Act (ESA) all federal agencies must ensure that any actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of a listed species, or destroy or adversely modify its designated critical habitat.

In accordance with 30 CFR 250, Subpart B, effective May 14, 2007 and further outlined in Notice to Lessees (NTL) 2008-G04, and the Biological Opinion on the National Marine Fisheries Service. 2020. Endangered Species Act, Section 7 Consultation – Biological Opinion on the Federally Regulated Oil and Gas Program Activities in the Gulf of Mexico. U.S. Department of Commerce, National Oceanic and Atmospheric Administration. St. Petersburg, FL. (NMFS 2020 Endangered Species Act, Section 7 Consultation – Biological Opinion), lessees/operators are required to address site-specific information on the presence of federally listed threatened or endangered species and critical habitat designated under the ESA, and marine mammals protected under the Marine Mammal Protection Act (MMPA) in the area of proposed activities under this plan.

Currently the only designated critical habitat is *Sargassum* habitat for the Loggerhead sea turtle in the proposed project area; however, it is possible that this species and one or more of the other listed species could be seen in the area of our operations. The following table reflects the Federally-listed endangered and threatened species in the lease area and along the northern Gulf coast:

Common Name	Scientific Name	T/E Status
Hawksbill Turtle	*Eretmochelys imbricata*	E
Green Turtle	*Chelonia mydas*	T/E
Kemp's Ridley Turtle	*Lepidochelys kempii*	E
Leatherback Turtle	*Dermochelys coriacea*	E
Loggerhead Turtle	*Caretta caretta*	T

Table 6.1 – Threatened and Endangered Sea Turtles

The green sea turtle is threatened, except for the Florida breeding population, which is listed as endangered.

There are 29 species of marine mammals that may be found in the Gulf of Mexico (see Table 6.7 below). Of the species listed as Endangered, only the Sperm whale is commonly found in the project area. No critical habitat for these species has been designated in the Gulf of Mexico.

Common Name	**Scientific Name**	**T/E Status**
Atlantic Spotted Dolphin	*Stenella frontalis*	
Blainville's Beaked Whale	*Mesoplodon densirostris*	
Blue Whale	*Balaenoptera musculus*	E
Bottlenose Dolphin	*Tursiops truncatus*	
Bryde's Whale	*Balaenoptera edeni*	E
Clymene Dolphin	*Stenella clymene*	
Cuvier's Beaked Whale	*Ziphius cavirostris*	
Dwarf Sperm Whale	*Kogia simus*	
False Killer Whale	*Pseudorca crassidens*	
Fin Whale	*Balaenoptera physalus*	E
Fraser's Dolphin	*Lagenodelphis hosei*	
Gervais' Beaked Whale	*Mesoplodon europaeus*	
Humpback Whale	*Megaptera novaeangliae*	E
Killer Whale	*Orcinus orca*	
Melon-headed Whale	*Peponocephala electra*	
Minke Whale	*Balaenoptera acutorostrata*	
North Atlantic Right Whale	*Eubalaena glacialis*	E
Pantropical Spotted Dolphin	*Stenella attenuata*	
Pygmy Killer Whale	*Feresa attenuata*	
Pygmy Sperm Whale	*Kogia breviceps*	
Risso's Dolphin	*Grampus griseus*	
Rough-toothed Dolphin	*Steno bredanensis*	
Sei Whale	*Balaenoptera borealis*	E
Short-finned Pilot Whale	*Globicephala macrorhynchus*	
Sowerby's Beaked Whale	*Mesoplodon bidens*	
Sperm Whale	*Physeter macrocephalus*	E
Spinner Dolphin (Long-snouted)	*Stenella longirostris*	
Striped Dolphin	*Stenella coeruleoalba*	
Florida manatee	*Trichechus manatus*	E

Table 6.2 Threatened and Endangered Marine Mammals

The blue, fin, humpback, North Atlantic right and sei whales are rare or extralimital in the Gulf of Mexico and are unlikely to be present in the lease area. The Environmental Impact Analysis found in Section 18 discusses potential impacts and mitigation measures related to threatened and endangered species.

There are also listed species of birds, fishes, invertebrates and terrestrial mammals in the Gulf of Mexico waters and coastal environments. Of these, it is possible that Giant manta ray may be present in the lease area, but it is highly unlikely that any other birds, fish species and terrestrial mammals, given their coastal ranges, will be present in the lease area. The presence of invertebrates is identified through different lease operations, as biologically sensitive habitat features that must be avoided per BOEM NTL 2009-G40.

Birds		
Piping Plover	*Charadrius melodus*	T
Whooping Crane	*Grus americana*	E
Fishes		
Oceanic whitetip shark	*Carcharhinus longimanus*	T
Giant manta ray	*Mobula birostris*	T
Gulf sturgeon	*Acipenser oxyrinchus desotoi*	T
Nassau grouper	*Epinephelus striatus*	T
Smalltooth sawfish	*Pristis pectinata*	E
Invertebrates		
Elkhorn coral	*Acropora palmata*	T
Staghorn coral	*Acropora cervicornis*	T
Pillar coral	*Dendrogyra cylindrus*	T
Rough cactus coral	*Mycetophyllia ferox*	T
Lobed star coral	*Orbicella annularis*	T
Mountainous star coral	*Orbicella faveolata*	T
Boulder star coral	*Orbicella franksi*	T
Terrestrial Mammals		
Beach mice (Alabama, Choctawhatchee, Perdido Key, St. Andrew)	*Peromyscus polionotus*	E
Florida salt marsh vole	*Microtus pennsylvanicus dukecampbelli*	E

Table 6.3– Birds, fishes, invertebrates and terrestrial mammals

I. <u>Archaeological Report</u>

See Section 6A above.

J. <u>Air and Water Quality Information</u>

Pursuant to NTL 2008-G04 the proposed operations covered by this DOCD do not require Shell to provide additional information relating to air and water quality information. For specific information relating to air and water quality information please refer to Section 18 of this plan.

K. <u>Socioeconomic Information</u>

Pursuant to NTL 2008-G04 the proposed operations covered by this DOCD do not require Shell to provide additional information relating to air and water quality information. For specific information relating to socioeconomic information please refer to Section 18 of this plan.

L. Waste Barrel Avoidance and Release Response

See the following for Waste Barrel Avoidance Document for the Mississippi Canyon Area.

Shell Exploration & Production

Waste Barrel Avoidance and Release Response in the Mississippi Canyon Area

Document Title	Waste Barrel Avoidance and Release Response in the Mississippi Canyon Area
Document Number	MRB-100-HX-0505-0000002-000
Document Revision	REV 5
Version Code	Not Applicable
Document Status	Issued for Review
EIS Discipline / Document Type	Hazard Analysis Report
Originator / Author	Joshua O'Brien
Classification	Restricted
ECCN	EAR 99
Issue Date	4/01/19

Revision History is shown on next page

Purpose

This document provides expectations and guidance for avoiding, and responding to a release of the contents of, a seafloor waste barrel. The procedures below describe Shell's expectations for routine barrel avoidance, data management, and response to inadvertent release of barrel contents.

Applicability

This document applies to all ROV, anchor and other operations which could cause a seafloor barrel rupture.

Changes to this procedure must be approved by BOEM.[1]

Revision History

Date	Person	Revision
12/16/08	RBKuehn	Incorporated comments from MMS[1] and issued as final.
8/16/10	RBKuehn	Incorporated comment from BOEMRE[2] to include New Orleans District manager in the notification of Step 2 of the section ***Barrel Impact Reporting***. Also revised all relevant references to MMS as BOEMRE
10/20/10	RBKuehn	➢ In Background, added in summary of suspected materials disposed at the site, based on research of the site in public records. ➢ In section on Equipment Decontamination- **Decon Procedure:** o clarified what types of detergents are preferred/allowed, using the NPDES Vessel General Permit as a guide. o Expanded on appropriate PPE and other personnel precautions o Noted a need for secondary containment as appropriate Significant changes to the text are shown in yellow shade. ➢ Added page numbers and cleaned up format. ➢ Issued as REV 2
05/19/17	BMontchanin	➢ Deleted Mars B reference to generalize procedure to all projects in the MC area ➢ Changed BOEMRE to BOEM ➢ Changed name of duty phone ➢ Changed Shell contact focal point to Joshua O'Brien
10/01/18	Andy Englande	➢ Revised "Barrel Impact Reporting Section" in the event Shell disrupted a barrel causing a release.
4/01/19	Andy Englande	➢ Changed originator/author from Bertrand Montchanin to Joshua O'Brien.

Background

Various projects will be carried out in an area of the Mississippi Canyon known to contain barrels of chemical waste.

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[1] Per MMS approval of West Boreas Supplemental Exploration Plan, MS 5231 December 16, 2008
Control No. S-07273, Lease(s) OCS-G07957, Block 762, Mississippi Canyon Area OCS-G07962, Block 806, Mississippi Canyon Area

[2] Per BOEM approval of the Supplement to the Conceptual DWOP for Mars B project, 8/12/10, MS 5220

- The barrels were discharged in this area in the 1970's under government approved permits.

- The content, and its toxicity, of each individual barrel is not known. However, there are records of a wide range of industrial waste materials that were disposed in the barrels including chlorinated hydrocarbons and liquid metal salts. Below is a summary of the barrel contents based on available records.

    1. Metallic sodium and calcium; calcium oxide, sodium oxide, and inert salts.[3]

    2. 80-90% dichlorobutene, 20% organic high-boilers, and 1% quaternary ammonium salts. "Other wastes produced from the manufacture of fungicides and herbicides".[4]

- Within the area there are/could be many hundreds of waste barrels. Many of the barrels may have released their contents over time. However, an unknown number of barrels still look intact, and they may or may not still contain their original content. Also, as some of the barrels contained metal based solid waste, some of the barrels that no longer look intact may still contain some waste.

- Extensive sonar surveys of the area exist and are available for planning purposes.

Potential Hazards

Although there are no records of any issues regarding the barrels during the many years of Oil and Gas operations in the Mississippi Canyon area, the following potential hazards exist:

- Personnel exposure or equipment damage due to adherence of waste chemicals to recovered subsea equipment
- Equipment damage from sodium exposure to water (very vigorous reaction).

Normal Operations

For normal operations, all contractors and Shell employees must meet the following expectations:

1. Shell's over-arching policy is to avoid barrel contact.

2. Press releases making any reference to the chemical waste or barrels, or any incidents involving any chemical waste or barrels, will require the express written permission from Shell.

3. All recorded video material is confidential and the property of Shell (standard contract provision).

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[3] EPA Permit Application No. 730D009E from Ethyl Corp. March 1, 1977, Public Notice April 20, 1977.

[4] Chapter 5 "Ocean Discharge" in the book Assessing Potential Ocean Pollutants, A Report of the Study Panel on Assessing Potential Ocean Pollutants. National Academy of Sciences, Washington DC, 438 pp. This document details DuPont's application to dispose of the following at the ocean disposal site

If during normal ROV operations there is a discovery of any potential archaeological resource (i.e., cannot be definitively identified as waste barrel/barrel remnant, modern debris, or refuse), any seafloor-disturbing activities in its proximity, must be stopped, the discovery must be reported to Dr. Chris Horrell at 504-736-2796, and further instructions must be obtained before proceeding.

4. Equipment Placement/Stand-off Distance
   4.1. A safe stand-off distance from the waste barrels is considered 10m (33ft). Care must be taken that flexible components (e.g. ROV tether, anchor lines, seismic cables) are controlled as well (e.g. don't drag through a barrel field).
   4.2. If a seafloor action will generate cuttings or debris, increase the stand-off distance as needed to avoid debris contact with nearby barrels.
   4.3. Do not investigate any barrels or remainders of barrels. Remain the minimum stand-off of 10m (33ft) at all times.
   4.4. Survey the anchor/pile/export locations with an ROV to ensure barrel avoidance.
   4.5. Record the (approximate) location of any chemical waste barrel seen, if feasible, without getting closer than the 10m (33ft) stand-off distance.

5. Contact the Shell GOM Environmental Duty Phone for any questions or concerns. 1-504-390-1330.

6. Decontamination of Equipment: In the event of contact with a barrel contents decontaminate equipment per **Decontamination of Equipment** below.

7. Make reports of barrel contact/rupture per **Barrel Release Reporting** below.

Decontamination of Equipment

1. **General**

   In the unlikely case that contact is suspected or has been made with any wastes from a barrel, appropriate action needs to be taken to guarantee the topside safety of personnel handling the equipment (e.g. ROV, anchor lines, etc).

   It is left solely to the judgment of the Person-in-Charge of the equipment/vessel to determine if it is necessary to abandon all or part of the equipment on the sea floor.

2. Decon Procedure

Based on various factors[5], Shell recommends the following:

2.1. Use the ocean to "wash" the equipment (e.g. fly an ROV for at least an hour at depth high enough above sea floor to prevent umbilical dragging or other disturbance of the sea floor). For other equipment, provide any movement through the water column that's possible, again avoiding seafloor dragging.

2.2. Retrieve the equipment to the surface, but do not bring onboard if feasible.

2.3. Hose the equipment off before retrieving onto the vessel. Use as high a water flow as is available/safe. **CAUTION-** detergent/soap may be used BUT in as low a quantity as practicable to minimize foam. Only non-toxic and phosphate free cleaners and detergents may be used. Furthermore, cleaners and detergents should not be caustic or only minimally caustic and should be biodegradable[6].

2.4. Avoid physical contact with the equipment and keep the equipment off the vessel at this point.

2.5. Dunk the equipment back in the sea and "wash" the equipment for approximately 15 minutes.

2.6. Retrieve the equipment to the surface. Before recovering, visually inspect the equipment, umbilical, cable surfaces with binoculars for signs of corrosion, discoloration, air reaction such as fuming/smoking, or any other signs of chemical contact. Rewash and dunk the equipment as needed.

2.7. Retrieve the equipment onto the back deck. Monitor the equipment and surrounding storage area for indications of chemical contamination (corrosion, discoloration, air reaction such as fuming/smoking, etc.). Establish secondary containment as necessary to collect any potentially contaminated drips.

2.8. Only essential personnel should be allowed near the equipment, once retrieved on the back deck.

2.9. While performing cleaning operations on the equipment, involving contact with potentially contaminated surfaces, personal protective equipment must be worn including, but not limited to: safety eye goggles, safety clothing such as coverall and aprons, Nitrile type chemical resistant industrial-safety gloves, and PVC boots.

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[5] Shell assumes, for purposes of this decontamination guidance, that:

- The most toxic material identified in the disposal area's permits and other available documents is involved. However, Shell cannot guarantee there are not other toxic materials present than those identified in the permits and other documents.
- It is assumed that the materials do not chemically interact with the materials of the ROV, its tools and equipment.

[6] The NPDES General Permit for Discharges Incidental to the Normal Operation of a Vessel provides insight into managing any washing. Also, EPA provides the following definitions:
"Non-toxic" soaps, cleaners, and detergents mean these materials which do not exhibit potentially harmful characteristics as defined by the Consumer Product Safety Commission regulations found at 16 CFR Chapter II, Subchapter C, Part 1500.
"Phosphate Free" soaps, cleaners, and detergents means these materials which contain, by weight, 0.5% or less of phosphates or derivatives of phosphates.

2.10. Wash hands thoroughly and take a shower after performing cleaning operations on the equipment.

2.11. Avoid drinking liquids or eating food in the work area.

2.12. If contamination is still suspected, consult with the Shell representatives/management for further actions including additional washing, abandonment on the seafloor, segregated storage on the boat, wrapping the equipment partially or fully in plastic sheeting, etc.

2.13. Document all actions and results in a log.

Barrel Impact Reporting

1. Initial reporting:

    1.1. Equipment opera tor is to inform the Shell onsite representative and the Shell operations supervisor on duty.

    1.2 The Shell onsite representative or the Shell operations supervisor will call the Environmental Duty Phone 504-390-1330 with an estimate of chemical and volume released.

    1.3 The Shell onsite representative or the Shell operations supervisor should contact Regulatory Affairs (Sylvia Bellone or Tracy Albert) via email or phone listed in GAL.

2. The SEPCo Regulatory Affairs person will contact

    2.1 BSEE's Environmental Enforcement Branch Chief, T. J. Broussard at 504-736-3245

    2.2 BSEE New Orleans District Manager

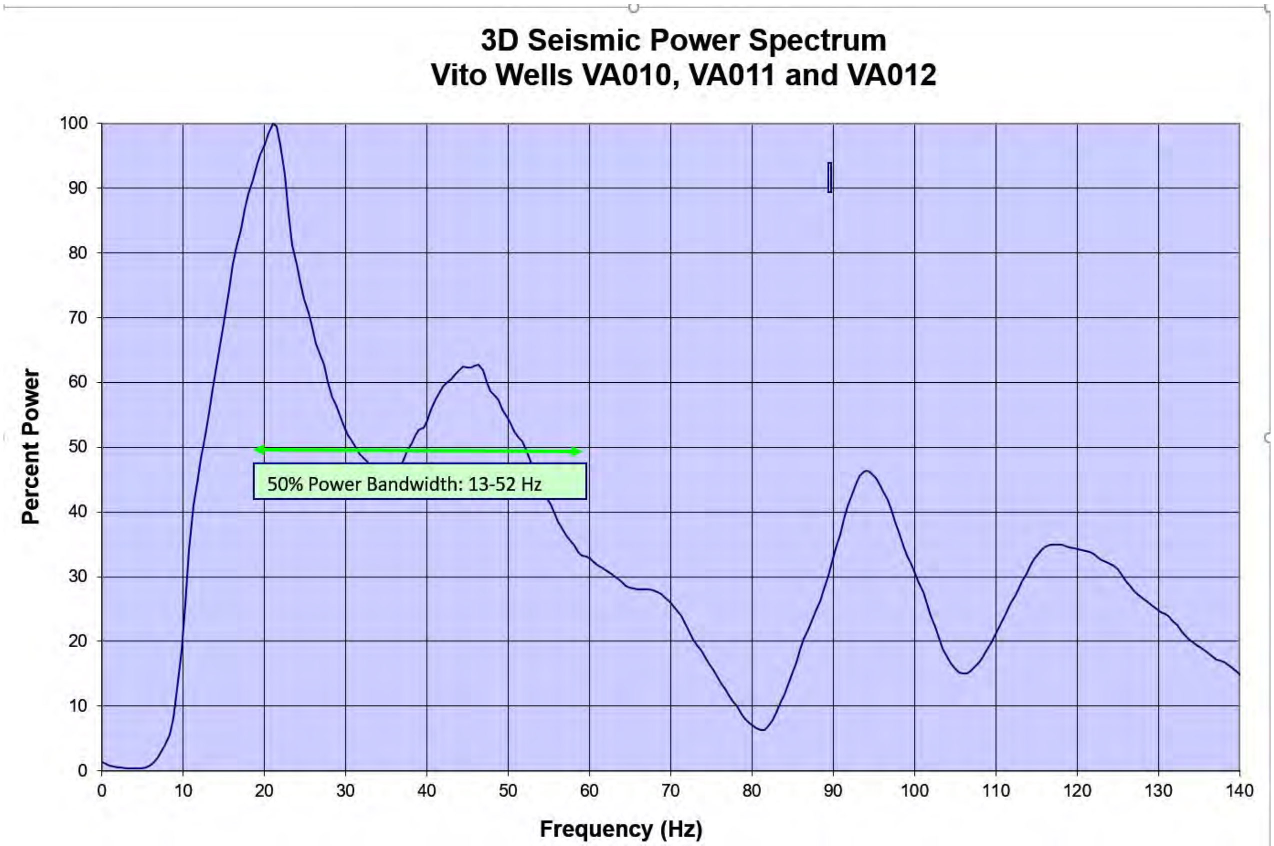
    to report the event. The call should include the lat/long, estimate of release if any (chemical or liquid hydrocarbon) and any circumstances of note.

3. Follow-up Reporting

    SEPCo Regulatory Affairs will follow up with an email to the Environment Enforcement Branch Chief T. J. Broussard with the details of the ruptured barrel.

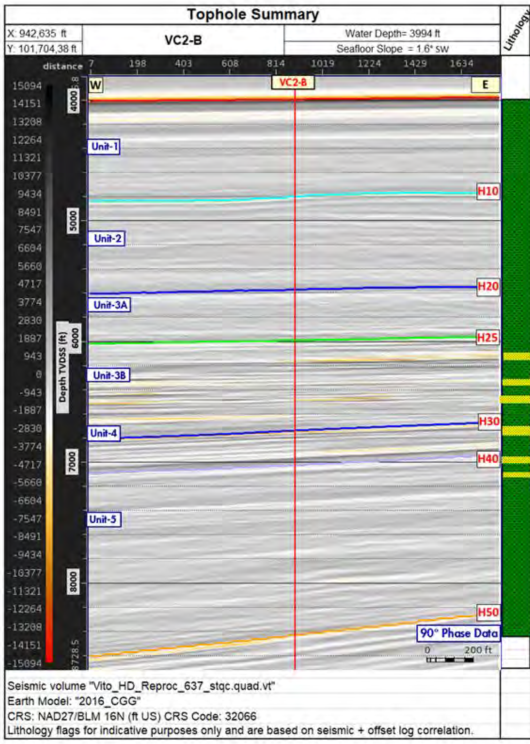
    BSEE have requested submission of a copy of whatever relevant video is available for the event period. *No dedicated* video survey is required for a barrel rupture (i.e. just be prepared to submit whatever video was obtained as normal part of the activities). BOEM has agreed we can submit any video after the project is completed.

Attachment 6B



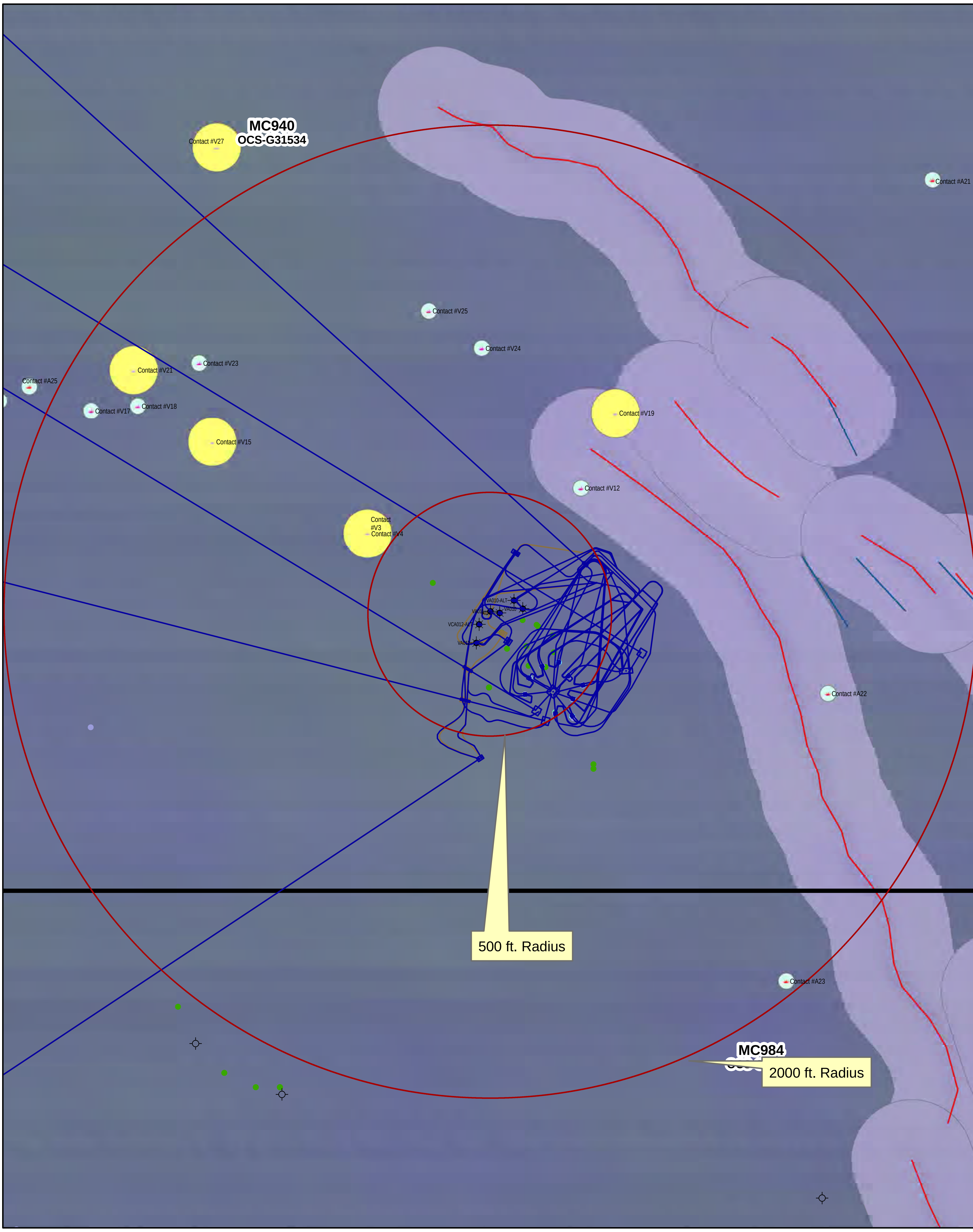
Attachment 6C

Wellsites VA010, VA011, and VA012



Event	Unit	Depth BML (ft)	Depth SS (ft)	TWTT SS (ms)	Unit Thickness (ft)	Predicted Lithology and Potential of Geohazard Occurrence	SWF	Shallow gas
H00 (Seafloor)		0	3996	1627				
H10 (A)	1	803	4799	1939	803	Soft hemipelagic silty mud with thin mud drape.	Low	Low
H20 (B; Top Blue)	2	1575	5571	2217	772	Predominantly mud rich sequence, mostly consisting of mass transport deposit (MTD)	Mod. Low	Low
H25 (Intra Blue)	3A	1996	5992	2358	421	Predominantly mud rock, sub-seismic sands could be present, Pleistocene canyon overbank facies.	Mod. Low	Low
H30 (C; Base Blue)	3B	2741	6737	2602	745	Interbedded sand and mudrocks. Sands are laterally extensive. Basin floor fan facies. Sub sesimic sand could be present throughout this unit. Sands: 6142-6193, 6317-6377, 6455-6508.	High	Low
H40 (E11; Sub Blue)	4	3029	7025	2694	288	Interbedded sand and mudrocks. Basin floor fan facies. Sands: 6791-6841,6938 -	Mod. High	Low
H50 (F; Top Orange)	5	4434	8430	3126	1405	Mudrock interbedded with sand and silt. Deepwater turbidites. Sub-seismic sands could be present throughout this unit. Sands: 7037-7085.	Mod. Low	Low

Chance of Occurrence	Low	Moderately Low	Moderate	Moderately High	High
	<10%	10-20%	20-30%	30-40%	>40%



Legend

VTO-500-UA-4180-2501001-002	ID	VA010, VA010-ALT, VA011, VA011-ALT, VA012, VCA012-ALT
GOM3_Leases	**Sonar-Contact**	Indust-Waste-Barrel-Buffer(10m)
Gas Pipelines	**Feature Description**	Seafloor_Faults
Oil Pipelines	Sonar contact (Job 072657-072954)	Seafloor-Faults-Buffer
Other Pipelines	Additional sonar contact (Job 072657-072954)	Sonar-Contact-Buffer(100ft.)
Umbilicals	Sonar contact (Job 100420)	
	Additional sonar contact (Job 100420)	
	Sonar contact (2014 Fugro survey)	

GEODETIC PARAMETERS

Horizontal Coordinate Reference System
CRS name (ESRI): NAD 1927 BLM Zone 16N
CRS name (Shell): [CLICK TO UPDATE]
CRS code (EPSG): 32066
Geodetic datum: North American 1927
Projection name: Transverse Mercator
Horizontal units: Foot US
Vertical Coordinate Reference System
Vertical datum: Mean Sea Level
Elevation/Depth: Elevation
Vertical units: feet

MAP SCALE

0 0.05 0.1 0.2
Nautical Miles

MAP INFORMATION
1:5,028

Graticule Grid Tick
Measured Grid Line

N

Print size: 11"x17" (ANSI B)

Public Information Copy

SHELL EXPLORATION & PRODUCTION COMPANY

SECURITY CLASSIFICATION

UA Geomatics

Amplitude Seafloor Rendering w/ Features
Vito Wells - VA10, VA-11, and VA-12
Mississippi Canyon Area

MC 940

Author: Update Document Properties
Date: 09 Mar 2021
Reviewed By:
Map Status:

TABLE 7A: WASTES YOU WILL GENERATE, TREAT AND DOWNHOLE DISPOSE OR DISCHARGE TO THE GOM

Note: Please specify if the amount reported is a total or per well amount

Projected generated waste			Projected ocean discharges		Projected Downhole Disposal
Type of Waste and Composition	**Composition**	**Projected Amount**	**Discharge rate**	**Discharge Method**	**Answer yes or no**
Will drilling occur ? If yes, you should list muds and cuttings					
EXAMPLE: Cuttings wetted with ynthetic based fluid	*Cuttings generated while using synthetic based drilling fluid.*	*X bbl/well*	*X bbl/day*	*discharge pipe*	*No*
Water-based drilling fluid (Drillship/MODU)	barite, additives, mud	85000 bbls/well	17000 bbls/day	Overboard and seafloor discharge prior to marine riser installation	No
Cuttings wetted with water-based fluid (Drillship/MODU)	Cuttings coated with water based drilling mud	11520 bbls/well	768 bbls/day	Seafloor prior to marine riser installation	No
Cuttings wetted with synthetic-based fluid (Drillship/MODU)	Cuttings generated while using synthetic based drilling fluid.	16360 bbls/well	409 bbls/day	Overboard discharge line below the water level	No
Synthetic based drilling fluid adhering to washed drill cuttings (Drillship/MODU)	Synthetic based drilling fluid adhering to washed drill cuttings	280 bbls/well	7 bbls/day	Overboard discharge line below the water level	No
Spent drilling fluids - synthetic (Drillship/MODU)	Synthetic-based drilling mud	0 bbls / well	0 bbls/day	Overboard discharge line below the water level	No
Spent drilling fluids - water based (Drillship/MODU)	Synthetic-based drilling mud	0 bbls / well	0 bbls/day	Overboard discharge line below the water level	No
Chemical product waste (Drillship/MODU)	Chemical product waste	0 bbls / well	0 bbls/day	Treated to meet NPDES limits and discharged overboard	No
Brine (Drillship/MODU)	brine	N/A	N/A	N/A	No
Will humans be there? If yes, expect conventional waste					
EXAMPLE: Sanitary waste water		*X liter/person/day*	*NA*	*chlorinate and discharge*	*No*
Domestic waste (Vito FPS)	Gray water (laundry, galley, lavatory)	110 liters/person/day	**N/A**	Ground to less than 25 mm mesh size and discharged overboard	No
Sanitary waste (Vito FPS)	Black water (treated human body waste fro	75 liters/person/day	**N/A**	Treated in the MSD** prior to discharge to meet NPDES limits	No
Domestic waste (kitchen water, shower water) (Drillship/MODU)	grey water	18000 bbls/well	200 bbls/day/well	Ground to less than 25 mm mesh size and discharge overboard	No
Sanitary waste (toilet water) (Drillship/MODU)	treated sanitary waste	13500 bbls/well	150 bbls/day/well	Treated in the MSD** prior to discharge to meet NPDES limits	No
Is there a deck? If yes, there will be Deck Drainage					
Production Deck Drainage (Vito FPS)	Rainwater/washwater	32,850 bbls/year	90 bbls/day	Drained overboard through E-Sump	No
Deck Drainage (Drillship/MODU)	Wash and rainwater	1800 bbls/well	20 bbls/day	Drained overboard through deck scuppers	No
Will you conduct well treatment, completion, or workover?					
No well treatment activity will occur on host.					
well treatment fluids (Drillship/MODU)	Linear Frac Gel Flush Fluids, Crosslinked Frac Fluids carrying ceramic proppant and acidic breaker fluid	300 bbls/well	10 bbls/day	Overboard discharge line below the water level if oil and greese free.	No
well completion fluids (Drillship/MODU)	Completion brine contaminated with WBDM and displacement spacers	450 bbls/well	15 bbls/day	Overboard discharge line below the water level if oil and greese free.	No
workover fluids (Drillship/MODU)	Linear Frac Gel Flush Fluids, Crosslinked Frac Fluids carrying ceramic proppant.	450 bbls/well	15 bbls/day	NA	No
Miscellaneous discharges. If yes, only fill in those associated with your activity.					
Desalinization unit discharge (Vito FPS)	Reject water from watermaker unit		400 bbls per day	RO Desalination Unit Discharge Line, Directly Overboard	No
Ballast water (Vito FPS)	treated seawater		2692 bbls/day	Overboard discharge line	No
Bilge water (Vito FPS)	Bilge and drainage water will be treated to MARPOL standards (< 15ppm oil in water).		1000 bbls/day	Bilge and drainage water will be treated to MARPOL standards (< 15ppm oil in water).	No
Firewater (Vito FPS)	treated seawater		2,000 bbls/month	Discharged overboard below waterline	No
Cooling water (Vito FPS)	hypochlorite-treated seawater		456,343 bbl/day/well	Discharged overboard 77' below waterline	No
Untreated or treated seawater (Vito FPS)	Treated Seawater		300 gpm	Discharged at seafloor.	No
Hydrate Inhibitor (Vito FPS)	Hydrate Inhibitor		300 gpm	Discharged at seafloor.	No
Utility Seawater (Vito FPS)	hypochlorite-treated seawater		300 gal/min	Discharged overboard 77' below waterline	No
Desalinization unit discharge (Drillship/MODU)	Rejected water from watermaker unit	36000 bbls/well	400 bbls/day/well	RO Desalinization Unit Discharge Line below waterline	No
Blowout preventer fluid (Drillship/MODU)	Water based	18 bbls/well	0 bbls/day	Discharge Line @ Subsea BOP @ seafloor	No
Ballast water (Drillship/MODU)	Uncontaminated seawater	294840 bbls/well	3276 bbls/day	Discharge line overboard just above water line	No
Bilge water (Drillship/MODU)	Bilge and drainage water will be treated to MARPOL standards (< 15ppm oil in water).	138870 bbls/well	1543 bbls/day	to MARPOL standards (< 15ppm oil in water).	No
Excess cement at seafloor (Drillship/MODU)	Cement slurry	planned 100% excess is discharged)	200 bbls/day	Discharged at seafloor.	No
Fire water (Drillship/MODU)	Treated seawater	6000 bbls/well	2000 bbls/month	Discharged below waterline	No
Cooling water (Drillship/MODU)	Treated seawater	41070870 bbls/well	456343 bbls/day/well	Discharged below waterline	No
Untreated or treated seawater	Treated Seawater	2300 bbls / flowline	300 gpm	Discharged at seafloor.	No
Hydrate Inhibitor (Drillship/MODU)	Hydrate Inhibitor	20 bbl glycol plug / flowline 15 bbl methanol / well	300 gpm	Discharged at seafloor.	No
Sub sea Production Control Fluid	Water-based	72 bbls/year	72 bbls/year	Discharged at seafloor.	No
Will you produce hydrocarbons? If yes fill in for produced water.					
Produced water (Vito FPS)	treated formation water	10,000 bbls/day	NA	Discharged overboard below waterline	NA
Will you be covered by an individual or general NPDES permit ?			**GENERAL PERMIT**	GMG290103	

TABLE 7B: WASTES YOU WILL TRANSPORT AND /OR DISPOSE OF ONSHORE

Note: Please specify whether the amount reported is a total or per well

Projected generated waste		Solid and Liquid Wastes transportation	Waste Disposal		
Type of Waste	**Composition**	**Transport Method**	**Name/Location of Facility**	**Amount**	**Disposal Method**
Will drilling occur ? If yes, fill in the muds and cuttings.					
EXAMPLE: Oil-based drilling fluid or mud	*NA*	*NA*	*NA*	*NA*	*NA*
No Drilling Activities will occur on Vito host					
Synthetic-based drilling fluid or mud (Drillship/MODU)	used SBF and additives	Drums/tanks on supply boat/barges	Halliburton Drilling Fluids, MiSwaco, Newpark Drilling Fluids - Fourchon, LA; R360 Environmental Solutions (Fourchon, LA),	6,500 bbls/well	Recycled/Reconditioned; Deep Well Injection
Cuttings wetted with Water-based fluid (Drillship/MODU)	NA	NA	NA	NA	NA
Cuttings wetted with Synthetic-based fluid (Drillship/MODU)	Drill cuttings from synthetic based interval.	storage tank on supply boat.	R360 Environmental Solutions (Fourchon, LA),	300 bbls / well	Deep Well Injection, or landfarm
Cuttings wetted with oil-based fluids (Drillship/MODU)	NA	NA	NA	NA	NA
Completion Fluids (Drillship/MODU)	Completion and treatment fluids	Storage tank on supply boat	Halliburton, Baker Hughes, Newpark, or Tetra - Fourchon, LA; R360 Environmental Solutions - Fourchon, LA	4,000 bbls/well	Recycled/Reconditioned; Deep Well Injection
Salvage Hydrocarbons (Drillship/MODU)	Well completion fluids, formation water, formation solids, and hydrocarbon	Barge or vessel tank	PSC Industrial Outsourcing, Inc. (Jeanerette, LA)	<8000 bbl./well	Recycled or Injection
Will you produce hydrocarbons? If yes fill in for produced sand.					
Produced sand- NORM (Naturally Occuring Radioactive Material) (Vito FPS)	produced sands/sludges/scales	DOT rated containers on OSV	Trinity Environmental Liberty TX, or LOTUS-Andrews TX	150 bbls per yr.	Deep Well Injection
Produced sand and/or NORM (Naturally Occurring Radioactive Material) (Drillship/MODU)	Sand Produced from formation, sludges and scales	Drums/tanks on supply boat	Trinity Environmental (Liberty, TX) or LOTUS (Andrews, TX); or R360 Environmental Solutions (Fourchon, La.)	200 bbls/year	Disposal or Deep Well Injection
Will you have additional wastes that are not permitted for discharge? If yes, fill in the appropriate rows.					
EXAMPLE: trash and debris	***cardboard, aluminum,***	***barged in a storage bin***	***shorebase***	***z tons total***	***recycle***
Non Hazardous Industrial waste- Recycled (Vito FPS)	oily rags, filters, plastics, rope, empty buckets, etc.	DOT rated containers on OSV	Omega Waste Management, Patterson, LA	10 tons/year	Recycle-Waste to Energy
Non-Hazardous Industrial Waste-Disposal (Vito FPS)	spent blasting grit, other misc solid industrial wastes	DOT rated containers on OSV	Waste Mangement Woodside Landfill- Walker, LA	20 tons/year	RCRA Subtitle D Landfill
Used oil and glycol (Vito FPS)	used lube oils, cooking oil, glycols	DOT rated containers on OSV	Omega Waste Management, Patterson, LA	8 tons/year	Recycle-Waste to Energy
Non-Hazardous Chemical product wastes (Vito FPS)	unused chemicals or used chemicals	DOT rated containers on OSV	Waste Mangement Woodside Landfill- Walker, LA	6000 gal/year	RCRA Subtitle D Landfill
Exploration & Productiion Waste (Vito FPS)	RCRA exempt production waste	DOT rated containers on OSV	R360 Port Fourchon, or Clean Waste Port Fourchon,	500 bbl/yr	Deep well injection
Hazardous Waste (Vito FPS)	paints, solvents, chemicals, drain cleanouts	DOT rated containers on OSV	Chemical Waste Management, Sulphur LA	6 tons/year	Recycle, treatment, incineration, Subtitle C Landfill
Universal Waste Items (Vito FPS)	Batteries, lamps, electronics, mercury containing devices	DOT rated containers on OSV	Chemical Waste Management, Sulphur LA	10 tons/year	Recycle
General Trash (Vito FPS)	Domestic trash and debis	DOT rated containers on OSV	Jefferson Parish Landfill (Riverbirch) Avondale, LA.	360 cubic yards/year	Landfill
Trash and debris - recyclables (Drillship/MODU)	trash and debris	various storage containers on supply boat	Omega Waste Management, Patterson, LA	200 lbs/month	Recycle
Trash and debris - non-recyclables (Drillship/MO	trash and debris	various storage containers on supply boat	Riverbirch Landfill, Avondale, LA	400 lbs/month	Landfill
E&P Wastes (Drillship/MODU)	Completion, treatment, and production wastes	various storage containers on supply boat	R360 Environmental Solutions, Fourchon, LA; Clean Waste, Fourchon, LA	200 bbls / well	Deep Well Injection, or landfarm
Used oil and glycol (Drillship/MODU)	used oil, oily rags and pads, empty drums and cooking oil	various storage containers on supply boat	Omega Waste Management, Patterson, LA; Chemical Waste Management, Sulphur, LA	20 bbls/month	Recycle or RCRA Subtitle C landfill
Non-Hazardous Waste (Drillship/MODU)	paints, insulation, chemicals, completion and treatment fluids	various storage containers on supply boat	Waste Management Woodside Landfill Walker, La.	60 bbls/mo	RCRA Subtitle D landfill
Non-Hazardous Oilfield Waste (Drillship/MODU)	Chemicals, completion and treatment fluids	various storage containers on supply boat	Chemical Waste Management Sulphur, LA; Clean Harbors, Colfax, LA	60 bbls/mo	Deep Well Injected
Hazardous Waste (Drillship/MODU)	paints, solvents, chemicals, pyrotechnics, completion and treatment, commissioning fluids	various storage containers on supply boat	Chemical Waste Management Sulphur, LA; Clean Harbors, Colfax, LA	60 bbls/mo	Recycle, treatment, incineration, or RCRA Subtitle C landfill
Universal Waste Items (Drillship/MODU)	Batteries, lamps, glass, and mercury-contaminated waste	various storage containers on supply boat	Chemical Waste Management Sulphur, LA	50 bbls/mo	Recycle, treatment, incineration, or landfill

SECTION 8: AIR EMISSIONS

A. Emissions Worksheet and Screening Questions

Screening Questions for DOCD's	Yes	No
Is any calculated Complex Total (CT) Emission amount (in tons) associated with your proposed development and production 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	
Do your emission calculations include any emission reduction measures or modified emission factors?	X	
Does or will the facility complex associated with your proposed development and production activities process production from eight or more wells?	X	
Do you expect to encounter H_2S at concentrations greater than 20 parts per million (ppm)?		X
Do you propose to flare or vent natural gas in excess of the criteria set forth under 250.1160(a)(4) or (7)?	X	
Do you propose to burn produced hydrocarbon liquids?		X
Are your proposed development and production activities located within 25 miles from shore?		X
Are your proposed development and production activities located within 200 kilometers of the Breton Wilderness Area?	X	

***Note: The following AQR is using fuel limitations and Shell will perform fuel monitoring for this project.**

B. If you answer *no* to <u>all</u> of the above screening questions from the appropriate table, provide:

(1) Summary information regarding the peak year emissions for both Plan Emissions and Complex Total Emissions, if applicable. This information is compiled on the summary form of the two sets of worksheets. You can submit either these summary forms or use the format below. You do not need to include the entire set of worksheets.

Note: There are no collocated wells, activities or facilitates associated with this plan. The complex total is the same as Plan Emissions.

Air Pollutant		Plan Emission Amounts (tons)	Calculated Exemption Amounts (tons)		Calculated Complex Total Emission Amounts (tons)
PM					
SO_x					
NOx					
VOC					
CO					

(1) Contact: Damonica Pierson, (504) 425-9065, Damonica.Pierson@Shell.com; Josh O'Brien, (504) 425-9097, Joshua.E.Obrien@shell.com

C. Worksheets

See attached. The schedule in Form BOEM-0137 will not match the days presented in the AQR, as the AQR contains extra days for contingency delays.

Note: The air emissions in this plan were previously approved in Plan N-10018 on March 14 and April 26, 2019, Plan R-6842 on June 13, 2019, Plan R-7000 on September 25, 2020, and R-7077 which was filed on March 10, 2021 (pending approval) and do change by the operations proposed in this revised plan.

D. Emissions Reduction Measures

Vito FPS (MC-939)

Emission Source	Reduction Control Method	Amount of Reduction	Monitoring System
None			

Well Work, Drill Center 1 (MC-940)

Emission Source	Reduction Control Method	Activity Year(s)	Amount of Reduction	Monitoring System	Annual Fuel Limit, gal
VESSELS- Drilling - Propulsion Engine - Diesel	Actual fuel consumption	2022-2025	2,190.27 tons NOx/year	Fuel log	5,443,200
VESSELS - Well Stimulation	Actual fuel consumption	2022-2025	41.56 tons NOx/year	Fuel log	210,000
VESSELS- Drilling - Propulsion Engine - Diesel	Actual fuel consumption	2026-2045	1,825.23 tons NOx/year	Fuel log	4,536,000
VESSELS - Well Stimulation	Actual fuel consumption	2026-2045	24.94 tons NOx/year	Fuel log	126,000

COMPANY	Shell Offshore Inc.
AREA	Mississippi Canyon
BLOCK	939
LEASE	OCS-G 30379 (RUE Pending)
FACILITY	Vito Floating Production System (FPS)
WELL	Wells VA001,VA002, VA003, VA004, VA005, VA006, VA007, VA008, VA009, VA010, VA011, VA012
COMPANY CONTACT	DaMonica Pierson
TELEPHONE NO.	(504) 425-9065
REMARKS	The following equipment utilize non-default emission factors and are presented on the FACTORS tab: - Cold Vent (VOC) - Natural Gas Turbine - Mars 100 (NOx, VOC, CO) - Dual Fuel Turbine - Taurus 70, Diesel (NOx, VOC, CO) - Dual Fuel Turbine - Taurus 70, Nat Gas (NOx, VOC, CO) No emission reduction measures are included in this AQR. Vito-AQR-DOCD Mod 0621vFINAL-Ramboll.xlsx

LEASE TERM PIPELINE CONSTRUCTION INFORMATION:

YEAR	NUMBER OF PIPELINES	TOTAL NUMBER OF CONSTRUCTION DAYS
2021	20	90
2022	4	45
2023	6	25
2024		
2025		
2026		
2027		
2028		
2029		
2030		

AIR EMISSIONS COMPUTATION FACTORS

Fuel Usage Conversion Factors	Natural Gas Turbines		Natural Gas Engines		Diesel Recip. Engine		Diesel Turbines	
	SCF/hp-hr	7.508	SCF/hp-hr	5.631	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/ttn/chief/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://www3.epa.gov/ttnchie1/ap42/ch01/final/c01s03.pdf 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 NEI;TSP refer to Diesel Recip. > 600 hp reference	3/19	
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 NEI;TSP refer to Diesel Recip. > 600 hp reference	3/19	https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-data
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 NEI;TSP (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 NEI;TSP 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 https://cfpub.epa.gov/webfire/
Combustion Flare (no smoke)	lbs/MMscf	0.00	0.00	0.00	0.01	90.58	300.47	N/A	412.92	N/A	AP42 13.5-1, 13.5-2	2/18	
Combustion Flare (light smoke)	lbs/MMscf	2.66	2.66	2.66	0.01	90.58	300.47	N/A	412.9	N/A	AP42 13.5-1, 13.5-2	2/18	
Combustion Flare (medium smoke)	lbs/MMscf	13.32	13.32	13.32	0.01	90.58	300.47	N/A	412.9	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 (heavy smoke)	lbs/MMscf	26.64	26.64	26.64	0.01	90.58	300.47	N/A	412.9	N/A	AP42 13.5-1, 13.5-2	2/18	
Liquid Flaring	lbs/bbl	0.42	0.0966	0.0651	20.15832	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.apiwebstore.org/publications/item.cgi?9879d38a-8bc0-4abe-bb5c-9b623870125d
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	
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	https://www.epa.gov/moves/nonroad2008a-installation-and-updates
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 NEI;TSP refer to Diesel Recip. > 600 hp reference	3/19	https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-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 NEI;TSP refer to Diesel Recip. > 600 hp reference	3/19	

Sulfur Content Source	Value	Units
Fuel Gas	3.38	ppm
Diesel Fuel (6)	0.0015	% weight
Diesel Fuel (7)	0.05	% 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	1,332	MMBtu/MMscf

Natural Gas Flare Parameters	Value	Units
VOC Content of Flare Gas	5.7	lb VOC/lb-mol gas
Natural Gas Flare Efficiency	98	%

Properties of Natural Gas		
VOC Concentration	108,188	ppmv
MW	22.10	MW

**Non-Default Emissions Factors (Solar Turbines)		PM	SOx	NOx	VOC	CO			Notes
Distillate Turbines	lb/MMBtu	0.01	0.0015	0.88	0.0004	0.003	AP42 3.2-1& 3.	04/00	2
Distillate Turbines (Taurus70)	gms/hp-hr			4.81	0.118	0.420	SOLAR	7/18	3, (gas turbine shaft pwr)
Taurus70 SAC - Gas Fueled	gms/hp-hr			3.08	0.115	0.399	SOLAR	7/18	3, (gas turbine shaft pwr)
Mars100 - Gas Fueled	gms/hp-hr			3.43	0.118	0.416	SOLAR	7/18	3
Diesel Recip. > 600 hp - Installation Vessels	gms/hp-hr		0.1835				AP42 3.4-1	10/96	7

365	days/yr - FLAG 2010 Guidance	0.138	mmBtu/gal, Diesel, Distallate #2, 40C
2000	lb/ton conversion factor	73.97	mmbtu/hr, Diesel, SOLAR T70
454	g/lb conversion factor	1434.1	btu/scf (LHV, design value)
0.0004	BTU/hp-hr conversion	77.98	mmbtu/hr, Gas, SOLAR T70
1000	SCF/MSCF conversion factor	112.61	mmbtu/hr, Gas, SOLAR M100
1.341	hp/kW conversion factor		
1000	kW/MW conversion factor		

Notes

1. Factors are not used in this spreadsheet calculation.
2. Emission factors are derived from the appropriate USEPA developed AP-42 document.
3. NOx Emissions from the SAC Power Generating Turbines (Taurus70) and Mars 100 Fuel Gas Compressors are based on emission factors provided by the vendor as these estimates are great than the BOEM default factor for NOx. For all other pollutants, the BOEM default factor is employed.
4. The BOEM default factor is employed for each constituent. SOx emissions are based on the BOEM default factor calculation but adjusted to reflect sulfur content.
5 -Reserved
6.Per 40 CFR Part 80 Subpart I, as of June 1, 2012, nonroad, locomotive, and marine (NRLM) diesel fuel is subject to a 15 ppm maximum sulfur content,which is considered ultra-low sulfur diesel (ULSD). BOEM has indicated that use of low sulfur fuel content on the AQRs will not result in mitigations in Plan approval documents.
7. Note that installation vessels may utilize diesel fuels with low sulfur content levels (0.05%). All other emission factors are aligned with BOEM default factors.
8. H2S levels represented here are consistent with BOEM default values but can be adjusted to be consitent with Vito H2S contigency plan (if it is required under BSEE regs).

COMPANY	AREA		BLOCK	LEASE	FACILITY	WELL	CONTACT	PHONE	REMARKS
Shell Offshore Inc.	Mississippi Canyon		939	OCS-G30379 (RUE Pending)	Vito Floating Production System (FPS)	Wells VA001,VA002, VA003, VA004, VA005, VA006, VA007, VA008, VA009, VA010, VA011, VA012	DaMonica Pierson	(504) 425-9065	The following equipment utilize non-default emission factors and are presented on the FACTORS tab: - Cold Vent (VOC) - Natural Gas Turbine - Mars 100 (NOx, VOC, CO) - Dual Fuel Turbine - Taurus 70, Diesel (NOx, VOC, CO) - Dual Fuel Turbine - Taurus 70, Nat Gas (NOx, VOC, CO) No emission reduction measures are included in this AQR. Vito-AQR-DOCD Mod 0621vFINAL-Ramboll.xlsx

OPERATIONS	EQUIPMENT	EQUIPMENT ID	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR									ESTIMATED TONS								
	Diesel Engines		HP	GAL/HR	GAL/D																				
	Nat. Gas Engines		HP	SCF/HR	SCF/D																				
	Burners		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
SUBSEA EQUIP	VESSELS - Flowlines & SCR Pre-Lay, Diesel		30173	1552.28	37254.72	24	35	21.29	12.84	12.46	0.31	510.01	14.66	0.00	79.99	0.15	8.94	5.39	5.23	0.13	214.20	6.16	0.00	33.60	0.06
INSTALLATION	VESSELS - SDH & Flex Jumpers, Diesel		26069	1341.15	32187.50	24	25	18.39	11.10	10.76	0.27	440.64	12.67	0.00	69.11	0.13	5.52	3.33	3.23	0.08	132.19	3.80	0.00	20.73	0.04
	VESSELS - Flowline Jumper Installation		21389	1100.38	26409.08	24	15	15.09	9.10	8.83	0.22	361.53	10.39	0.00	56.71	0.11	2.72	1.64	1.59	0.04	65.08	1.87	0.00	10.21	0.02
FACILITY	VESSELS - Mooring Lines Pre-Lay		16961	872.58	20941.81	24	28	11.97	7.22	7.00	0.17	286.69	8.24	0.00	44.97	0.08	4.02	2.43	2.35	0.06	96.33	2.77	0.00	15.11	0.03
INSTALLATION	VESSELS - FPS at Site, Install Mooring Lines #1, Diesel		32792	1687.02	40488.41	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
2021 Facility Total Emissions								**66.73**	**40.26**	**39.05**	**0.97**	**1,598.86**	**45.97**	**0.00**	**250.78**	**0.47**	**21.19**	**12.79**	**12.40**	**0.31**	**507.80**	**14.60**	**0.00**	**79.65**	**0.15**
EXEMPTION CALCULATION	**DISTANCE FROM LAND IN MILES**																**2,064.60**	**2,064.60**	**2,064.60**	**2,064.60**	**2,064.60**	**2,064.60**	**2,064.60**	**53,260.68**	**2064.60**
	62.0																								
SUBSEA EQUIP	VESSELS - Interim Well Monitoring, Diesel		21389	1100.3785	26409.08	24	10	15.09	9.10	8.83	0.22	361.53	10.39	0.00	56.71	0.11	1.81	1.09	1.06	0.03	43.38	1.25	0.00	6.80	0.01
INSTALLATION	VESSELS - Flowlines & SCR Pre-Lay OSV, Diesel		10728	551.91	13245.90	24	15	7.57	4.57	4.43	0.11	181.33	5.21	0.00	28.44	0.05	1.36	0.82	0.80	0.02	32.64	0.94	0.00	5.12	0.01
	VESSELS - LCV (URF Pre-FPS Survey Activities), Diesel		13290	683.72	16409.22	24	10	9.38	5.66	5.49	0.14	224.64	6.46	0.00	35.23	0.07	1.13	0.68	0.66	0.02	26.96	0.78	0.00	4.23	0.01
FACILITY	VESSELS - LCV (URF Post-FPS Survey Activities), Diesel		13290	683.72	16409.22	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
INSTALLATION	VESSELS - Infield SCR's Keelhaul, Hang-off, Umbilical Lay OSV		10728	551.91	13245.90	24	10	7.57	4.57	4.43	0.11	181.33	5.21	0.00	28.44	0.05	0.91	0.55	0.53	0.01	21.76	0.63	0.00	3.41	0.01
FACILITY	VESSELS - Hookup Support (OSV)		11900	612.21	14692.98	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
COMMISSIONING	VESSELS - INTERIM WELL MONITORING OSV, Diesel		21389	1100.38	26409.08	24	10	15.09	9.10	8.83	0.22	361.53	10.39	0.00	56.71	0.11	1.81	1.09	1.06	0.03	43.38	1.25	0.00	6.80	0.01
2021 Non-Facility Total Emissions								**54.69**	**33.00**	**32.01**	**0.80**	**1,310.36**	**37.68**	**0.00**	**205.53**	**0.38**	**7.02**	**4.23**	**4.11**	**0.10**	**168.12**	**4.83**	**0.00**	**26.37**	**0.05**

COMPANY	AREA		BLOCK	LEASE	FACILITY	WELL	CONTACT	PHONE	REMARKS
Shell Offshore Inc.	Mississippi Canyon		939	OCS-G30379 (RUE Pending)	Vito Floating Production System (FPS)	Wells VA001,VA002, VA003, VA004, VA005, VA006, VA007, VA008, VA009, VA010, VA011, VA012	DaMonica Pierson	(504) 425-9065	The following equipment utilize non-default emission factors and are presented on the FACTORS tab: - Cold Vent (VOC) - Natural Gas Turbine - Mars 100 (NOx, VOC, CO) - Dual Fuel Turbine - Taurus 70, Diesel (NOx, VOC, CO) - Dual Fuel Turbine - Taurus 70, Nat Gas (NOx, VOC, CO) No emission reduction measures are included in this AQR. Vito-AQR-DOCD Mod 0621vFINAL-Ramboll.xlsx

OPERATIONS	EQUIPMENT	EQUIPMENT ID	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR									ESTIMATED TONS								
	Diesel Engines		HP	GAL/HR	GAL/D																				
	Nat. Gas Engines		HP	SCF/HR	SCF/D																				
	Burners		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
SUBSEA EQUIP INSTALLATION	VESSELS - Flowlines & SCR Pre-Lay, Diesel		30173	1552.28	37254.72	24	35	21.29	12.84	12.46	0.31	510.01	14.66	0.00	79.99	0.15	8.94	5.39	5.23	0.13	214.20	6.16	0.00	33.60	0.06
	VESSELS - SDH & Flex Jumpers, Diesel		26069	1341.15	32187.50	24	50	18.39	11.10	10.76	0.27	440.64	12.67	0.00	69.11	0.13	11.03	6.66	6.46	0.16	264.38	7.60	0.00	41.47	0.08
	VESSELS - Flowline Jumper Installation		21389	1100.38	26409.08	24	30	15.09	9.10	8.83	0.22	361.53	10.39	0.00	56.71	0.11	5.43	3.28	3.18	0.08	130.15	3.74	0.00	20.41	0.04
FACILITY INSTALLATION	VESSELS - Mooring Lines Pre-Lay		16961	872.58	20941.81	24	28	11.97	7.22	7.00	0.17	286.69	8.24	0.00	44.97	0.08	4.02	2.43	2.35	0.06	96.33	2.77	0.00	15.11	0.03
	VESSELS - FPS at Site, Install Mooring Lines #1, Diesel		32792	1687.02	40488.41	24	28	23.13	13.96	13.54	0.34	554.27	15.94	0.00	86.94	0.16	7.77	4.69	4.55	0.11	186.24	5.35	0.00	29.21	0.05
	VESSELS - FPS at Site, Install Mooring Lines #2, Diesel		32600	1677.14	40251.35	24	28	23.00	13.88	13.46	0.33	551.03	15.84	0.00	86.43	0.16	7.73	4.66	4.52	0.11	185.15	5.32	0.00	29.04	0.05
	VESSELS - Infield SCR's Keelhaul, Hang-off, Umbilical Lay		30173	1552.28	37254.72	24	45	21.29	12.84	12.46	0.31	510.01	14.66	0.00	79.99	0.15	11.49	6.93	6.73	0.17	275.40	7.92	0.00	43.20	0.08
	VESSELS - Station Keeping #1 Diesel		12500	643.08	15433.80	24	14	8.82	5.32	5.16	0.13	211.28	6.07	0.00	33.14	0.06	1.48	0.89	0.87	0.02	35.50	1.02	0.00	5.57	0.01
	VESSELS - Station Keeping #2 Diesel		12500	643.08	15433.80	24	14	8.82	5.32	5.16	0.13	211.28	6.07	0.00	33.14	0.06	1.48	0.89	0.87	0.02	35.50	1.02	0.00	5.57	0.01
	VESSELS - Station Keeping #3 Diesel		12500	643.08	15433.80	24	14	8.82	5.32	5.16	0.13	211.28	6.07	0.00	33.14	0.06	1.48	0.89	0.87	0.02	35.50	1.02	0.00	5.57	0.01
	VESSELS - Station Keeping #4 Diesel		12500	643.08	15433.80	24	14	8.82	5.32	5.16	0.13	211.28	6.07	0.00	33.14	0.06	1.48	0.89	0.87	0.02	35.50	1.02	0.00	5.57	0.01
	VESSELS - Diving Campaign		26069	1341.15	32187.50	24	25	18.39	11.10	10.76	0.27	440.64	12.67	0.00	69.11	0.13	5.52	3.33	3.23	0.08	132.19	3.80	0.00	20.73	0.04
	RECIP.<600hp Diesel - Linear Winch HPU		540	27.78	666.74	18	30	1.19	1.19	1.19	0.03	16.79	1.24	--	3.61	--	0.32	0.32	0.32	0.01	4.53	0.33	--	0.97	--
	RECIP.<600hp Diesel - Linear Winch HPU		540	27.78	666.74	18	30	1.19	1.19	1.19	0.03	16.79	1.24	--	3.61	--	0.32	0.32	0.32	0.01	4.53	0.33	--	0.97	--
	RECIP.<600hp Diesel - Steering Winch HPU		270	13.89	333.37	18	30	0.60	0.60	0.60	0.02	8.39	0.62	--	1.80	--	0.16	0.16	0.16	0.00	2.27	0.17	--	0.49	--
	RECIP.<600hp Diesel - Steering Winch HPU		270	13.89	333.37	18	30	0.60	0.60	0.60	0.02	8.39	0.62	--	1.80	--	0.16	0.16	0.16	0.00	2.27	0.17	--	0.49	--
FACILITY COMMISSIONING	FLOWLINE FLOODING, PIGGING & HYDROTEST EQUIP diesel		2250	115.75	2778.08	20	40	1.59	0.90	0.88	0.03	54.07	1.44	--	12.40	--	0.63	0.36	0.35	0.01	21.63	0.58	--	4.96	--
	FLOWLINES DEWATERING EQUIP diesel		16750	861.72	20681.29	18	10	11.82	6.72	6.57	0.20	402.51	10.71	--	92.32	--	1.06	0.60	0.59	0.02	36.23	0.96	--	8.31	--
	VESSELS - FLOWLINE FLOODING, PIGGING & HYDROTEST, diesel		21389	1100.38	26409.08	20	40	15.09	9.10	8.83	0.22	361.53	10.39	0.00	56.71	0.11	6.04	3.64	3.53	0.09	144.61	4.16	0.00	22.68	0.04
	VESSELS - FLOWLINES DEWATERING diesel		21389	1100.38	26409.08	24	10	15.09	9.10	8.83	0.22	361.53	10.39	0.00	56.71	0.11	1.81	1.09	1.06	0.03	43.38	1.25	0.00	6.80	0.01
PRODUCTION	RECIP.<600hp Diesel - Misc Small Temp Equipment		600	30.87	740.82	18	365	1.32	1.32	1.32	0.04	18.65	1.38	--	4.01	--	4.35	4.35	4.35	0.12	61.27	4.52	--	13.17	--
	RECIP.>600hp Diesel - Misc Large Temp Equipment		1000	51.45	1234.70	18	365	0.71	0.40	0.39	0.01	24.03	0.64	--	5.51	--	2.32	1.32	1.29	0.04	78.94	2.10	--	18.11	--
	RECIP Diesel Fire Pump #1		1064	54.74	1313.73	1	61	0.75	0.43	0.42	0.01	25.57	0.68	--	5.86	--	0.02	0.01	0.01	0.00	0.78	0.02	--	0.18	--
	RECIP Diesel Fire Pump #2		1064	54.74	1313.73	1	61	0.75	0.43	0.42	0.01	25.57	0.68	--	5.86	--	0.02	0.01	0.01	0.00	0.78	0.02	--	0.18	--
	DIESEL CRANE ENGINE #1		540	27.78	666.74	24	183	0.38	0.22	0.21	0.01	12.98	0.35	--	2.98	--	0.84	0.48	0.47	0.01	28.50	0.76	--	6.54	--
	DIESEL CRANE ENGINE #2		540	27.78	666.74	24	183	0.38	0.22	0.21	0.01	12.98	0.35	--	2.98	--	0.84	0.48	0.47	0.01	28.50	0.76	--	6.54	--
	RECIP Emergency Generator - Diesel		2252	115.86	2780.55	1	61	1.59	0.90	0.88	0.03	54.12	1.44	--	12.41	--	0.05	0.03	0.03	0.00	1.65	0.04	--	0.38	--
	LIFE BOATS - Diesel		428	22.02	528.45	1	61	0.30	0.17	0.17	0.01	10.29	0.27	--	2.36	--	0.01	0.01	0.01	0.00	0.31	0.01	--	0.07	--
	Natural Gas Turbine - Mars 100 #1		14124	106036.036	2544864.86	24	61	0.00	0.27	0.27	0.08	106.79	3.69	--	12.97	--	--	0.20	0.20	0.06	78.17	2.70	--	9.49	--
	Natural Gas Turbine - Mars 100 #2		14124	106036.036	2544864.86	24	61	--	0.27	0.27	0.08	106.79	3.69	--	12.97	--	--	0.20	0.20	0.06	78.17	2.70	--	9.49	--
	Dual Fuel Turbine - Taurus 70 #1, Diesel		9369	536.01	12864.35	24	122	0.79	0.28	0.28	0.10	99.30	2.45	0.00	8.67	--	1.15	0.41	0.41	0.15	145.37	3.58	0.00	12.69	--
	Dual Fuel Turbine - Taurus 70 #1, Nat Gas		9369	70337.84	1688108.11	24	61	--	0.18	0.18	0.05	63.63	2.38	--	8.25	--	--	0.13	0.13	0.04	46.58	1.74	--	6.04	--
	Dual Fuel Turbine - Taurus 70 #2, Diesel		9369	536.01	12864.35	1	61	0.79	0.28	0.28	0.10	99.30	2.45	0.00	8.67	--	0.02	0.01	0.01	0.00	3.03	0.07	0.00	0.26	--
	Dual Fuel Turbine - Taurus 70 #2, Nat Gas		9369	70337.84	1688108.11	23	61	--	0.18	0.18	0.05	63.63	2.38	--	8.25	--	--	0.12	0.12	0.04	44.64	1.67	--	5.79	--
	Dual Fuel Turbine - Taurus 70 #3, Diesel		9369	536.01	12864.35	1	61	0.79	0.28	0.28	0.10	99.30	2.45	0.00	8.67	--	0.02	0.01	0.01	0.00	3.03	0.07	0.00	0.26	--
	Dual Fuel Turbine - Taurus 70 #3, Nat Gas		9369	70337.84	1688108.11	23	61	--	0.18	0.18	0.05	63.63	2.38	--	8.25	--	--	0.12	0.12	0.04	44.64	1.67	--	5.79	--
	Dual Fuel Turbine - Taurus 70 #4, Diesel		9369	536.01	12864.35	1	61	0.79	0.28	0.28	0.10	99.30	2.45	0.00	8.67	--	0.02	0.01	0.01	0.00	3.03	0.07	0.00	0.26	--
	Dual Fuel Turbine - Taurus 70 #4, Nat Gas		9369	70337.84	1688108.11	23	61	--	0.18	0.18	0.05	63.63	2.38	--	8.25	--	--	0.12	0.12	0.04	44.64	1.67	--	5.79	--
	MISC.		**BPD**	**SCF/HR**	**COUNT**																				
	STORAGE TANK				0	0	0	--	--	--	--	--	#DIV/0!	--	--	--	--	--	--	--	--	0.00	--	--	--
	COMBUSTION FLARE - no smoke			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	0.00	0.00	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			950000		24	61	12.65	12.65	12.65	0.01	86.05	285.45	--	392.27	--	9.26	9.26	9.26	0.01	62.99	208.95	--	287.14	--
	COMBUSTION FLARE - heavy smoke			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	--
	COLD VENT - Routine				1	24	61	--	--	--	--	--	61.13	--	--	--	--	--	--	--	--	44.75	--	--	--
	COLD VENT - Intermittent				22800000	24	10	--	--	--	--	--	1544.12	--	--	--	--	--	--	--	--	185.29	--	--	--
	FUGITIVES				11420	24	61	--	--	--	--	--	5.71	--	--	--	--	--	--	--	--	5.71	--	--	--
2022 Facility Total Emissions								**256.96**	**161.83**	**157.66**	**4.40**	**6,865.46**	**#DIV/0!**	**0.02**	**1,462.62**	**1.52**	**97.30**	**64.88**	**63.44**	**1.78**	**2,640.47**	**523.58**	**0.01**	**688.89**	**0.53**
EXEMPTION CALCULATION	**DISTANCE FROM LAND IN MILES**																**2,064.60**	**2,064.60**	**2,064.60**	**2,064.60**	**2,064.60**	**2,064.60**	**2,064.60**	**53,260.68**	**2064.60**
	62.0																								
SUBSEA EQUIP INSTALLATION (PRE-FPS ARRIVAL)	VESSELS - Interim Well Monitoring, Diesel		21389	1100.3785	26409.08	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 - Flowlines & SCR Pre-Lay OSV, Diesel		10728	551.91	13245.90	24	45	7.57	4.57	4.43	0.11	181.33	5.21	0.00	28.44	0.05	4.09	2.47	2.39	0.06	97.92	2.82	0.00	15.36	0.03
	VESSELS - Flowline Jumper Metrology, Diesel		21389	1100.38	26409.08	24	10	15.09	9.10	8.83	0.22	361.53	10.39	0.00	56.71	0.11	1.81	1.09	1.06	0.03	43.38	1.25	0.00	6.80	0.01
	VESSELS - Flowline Jumper Interim Well Monitoring OSV		10728	551.91	13245.90	24	15	7.57	4.57	4.43	0.11	181.33	5.21	0.00	28.44	0.05	1.36	0.82	0.80	0.02	32.64	0.94	0.00	5.12	0.01
	VESSELS - Jumper Stand Up Test, Diesel		21389	1100.38	26409.08	24	20	15.09	9.10	8.83	0.22	361.53	10.39	0.00	56.71	0.11	3.62	2.18	2.12	0.05	86.77	2.49	0.00	13.61	0.03
	VESSELS - LCV (URF Pre-FPS Survey Activities), Diesel		13290	683.72	16409.22	24	10	9.38	5.66	5.49	0.14	224.64	6.46	0.00	35.23	0.07	1.13	0.68	0.66	0.02	26.96	0.78	0.00	4.23	0.01
FACILITY INSTALLATION	VESSELS - LCV (URF Post-FPS Survey Activities), Diesel		13290	683.72	16409.22	24	10	9.38	5.66	5.49	0.14	224.64	6.46	0.00	35.23	0.07	1.13	0.68	0.66	0.02	26.96	0.78	0.00	4.23	0.01
	VESSELS - Infield SCR's Keelhaul, Hang-off, Umbilical Lay OSV		10728	551.91	13245.90	24	10	7.57	4.57	4.43	0.11	181.33	5.21	0.00	28.44	0.05	0.91	0.55	0.53	0.01	21.76	0.63	0.00	3.41	0.01
FACILITY COMMISSIONING	VESSELS - Hookup Support (OSV)		11900	612.21	14692.98	24	90	8.40	5.07	4.91	0.12	201.14	5.78	0.00	31.55	0.06	9.07	5.47	5.31	0.13	217.23	6.25	0.00	34.07	0.06
	VESSELS - FLOWLINE FLOODING, PIGGING & HYDROTEST OSV Diesel		10728	551.91	13245.90	24	6	7.57	4.57	4.43	0.11	181.33	5.21	0.00	28.44	0.05	0.54	0.33	0.32	0.01	13.06	0.38	0.00	2.05	0.00
	VESSELS - FLOWLINES DEWATERING diesel (OSV)		10728	551.91	13245.90	24	20	7.57	4.57	4.43	0.11	181.33	5.21	0.00	28.44	0.05	1.82	1.10	1.06	0.03	43.52	1.25	0.00	6.83	0.01
	VESSELS - SUBSEA COMMISSIONING SUPPORT Diesel		21389	1100.38	26409.08	24	25	15.09	9.10	8.83	0.22	361.53	10.39	0.00	56.71	0.11	4.53	2.73	2.65	0.07	108.46	3.12	0.00	17.01	0.03
	VESSELS - INTERIM WELL MONITORING OSV, Diesel		21389	1100.38	26409.08	24	10	15.09	9.10	8.83	0.22	361.53	10.39	0.00	56.71	0.11	1.81	1.09	1.06	0.03	43.38	1.25	0.00	6.80	0.01
PRODUCTION	VESSELS - Support Vessel - Diesel		10100	519.60	12470.51	24	150	7.13	4.30	4.17	0.10	170.72	4.91	0.00	26.78	0.05	12.83	7.74	7.51	0.19	307.29	8.84	0.00	48.20	0.09
	VESSELS - Support Vessel - Diesel		10100	519.60	12470.51	24	150	7.13	4.30	4.17	0.10	170.72	4.91	0.00	26.78	0.05	12.83	7.74	7.51	0.19	307.29	8.84	0.00	48.20	0.09
	VESSELS - Crew Vessel - Diesel		8000	411.57	9877.63	24	30	5.64	3.41	3.30	0.08	135.22	3.89	0.00	21.21	0.04	2.03	1.23	1.19	0.03	48.68	1.40	0.00	7.64	0.01
	VESSELS - Flotel - Diesel		17500	900.31	21607.32	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
2022 Non-Facility Total Emissions								**145.24**	**87.63**	**85.00**	**2.11**	**3,479.86**	**100.05**	**0.01**	**545.81**	**1.02**	**59.49**	**35.89**	**34.81**	**0.87**	**1,425.30**	**40.98**	**0.00**	**223.55**	**0.42**

COMPANY	AREA	BLOCK	LEASE	FACILITY	WELL	CONTACT	PHONE	REMARKS
Shell Offshore Inc.	Mississippi Canyon	939	OCS-G30379 (RUE Pending)	Vito Floating Production System (FPS)	Wells VA001,VA002, VA003, VA004, VA005, VA006, VA007, VA008, VA009, VA010, VA011, VA012	DaMonica Pierson	(504) 425-9065	The following equipment utilize non-default emission factors and are presented on the FACTORS tab: - Cold Vent (VOC) - Natural Gas Turbine - Mars 100 (NOx, VOC, CO) - Dual Fuel Turbine - Taurus 70, Diesel (NOx, VOC, CO) - Dual Fuel Turbine - Taurus 70, Nat Gas (NOx, VOC, CO) No emission reduction measures are included in this AQR. Vito-AQR-DOCD Mod 0621vFINAL-Ramboll.xlsx

OPERATIONS	EQUIPMENT	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR									ESTIMATED TONS								
	Diesel Engines	HP	GAL/HR	GAL/D																				
	Nat. Gas Engines	HP	SCF/HR	SCF/D																				
	Burners	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
SUBSEA EQUIP	VESSELS - SDH & Flex Jumpers, Diesel	26069	1341.15	32187.50	24	10	18.39	11.10	10.76	0.27	440.64	12.67	0.00	69.11	0.13	2.21	1.33	1.29	0.03	52.88	1.52	0.00	8.29	0.02
INSTALLATION	VESSELS - Flowline Jumper Installation	21389	1100.38	26409.08	24	35	15.09	9.10	8.83	0.22	361.53	10.39	0.00	56.71	0.11	6.34	3.82	3.71	0.09	151.84	4.37	0.00	23.82	0.04
PRODUCTION	RECIP.<600hp Diesel - Misc Small Temp Equipment	600	30.87	740.82	18	365	1.32	1.32	1.32	0.04	18.65	1.38	--	4.01	--	4.35	4.35	4.35	0.12	61.27	4.52	--	13.17	--
	RECIP.>600hp Diesel - Misc Large Temp Equipment	1000	51.45	1234.70	18	365	0.71	0.40	0.39	0.01	24.03	0.64	--	5.51	--	2.32	1.32	1.29	0.04	78.94	2.10	--	18.11	--
	RECIP Diesel Fire Pump #1	1064	54.74	1313.73	1	52	0.75	0.43	0.42	0.01	25.57	0.68	--	5.86	--	0.02	0.01	0.01	0.00	0.66	0.02	--	0.15	--
	RECIP Diesel Fire Pump #2	1064	54.74	1313.73	1	52	0.75	0.43	0.42	0.01	25.57	0.68	--	5.86	--	0.02	0.01	0.01	0.00	0.66	0.02	--	0.15	--
	DIESEL CRANE ENGINE #1	540	27.78	666.74	24	365	0.38	0.22	0.21	0.01	12.98	0.35	--	2.98	--	1.67	0.95	0.93	0.03	56.84	1.51	--	13.04	--
	DIESEL CRANE ENGINE #2	540	27.78	666.74	24	365	0.38	0.22	0.21	0.01	12.98	0.35	--	2.98	--	1.67	0.95	0.93	0.03	56.84	1.51	--	13.04	--
	RECIP Emergency Generator - Diesel	2252	115.86	2780.55	1	52	1.59	0.90	0.88	0.03	54.12	1.44	--	12.41	--	0.04	0.02	0.02	0.00	1.41	0.04	--	0.32	--
	LIFE BOATS - Diesel	428	22.02	528.45	1	52	0.30	0.17	0.17	0.01	10.29	0.27	--	2.36	--	0.01	0.00	0.00	0.00	0.27	0.01	--	0.06	--
	Natural Gas Turbine - Mars 100 #1	14124	106036.04	2544864.86	24	365	0.00	0.27	0.27	0.08	106.79	3.69	--	12.97	--	--	1.18	1.18	0.35	467.73	16.16	--	56.79	--
	Natural Gas Turbine - Mars 100 #2	14124	106036.04	2544864.86	24	365	--	0.27	0.27	0.08	106.79	3.69	--	12.97	--	--	1.18	1.18	0.35	467.73	16.16	--	56.79	--
	Dual Fuel Turbine - Taurus 70 #1, Diesel	9369	536.01	12864.35	1	365	0.79	0.28	0.28	0.10	99.30	2.45	0.00	8.67	--	0.14	0.05	0.05	0.02	18.12	0.45	0.00	1.58	--
	Dual Fuel Turbine - Taurus 70 #1, Nat Gas	9369	70337.84	1688108.11	23	365	--	0.18	0.18	0.05	63.63	2.38	--	8.25	--	--	0.75	0.75	0.22	267.10	9.98	--	34.64	--
	Dual Fuel Turbine - Taurus 70 #2, Diesel	9369	536.01	12864.35	1	365	0.79	0.28	0.28	0.10	99.30	2.45	0.00	8.67	--	0.14	0.05	0.05	0.02	18.12	0.45	0.00	1.58	--
	Dual Fuel Turbine - Taurus 70 #2, Nat Gas	9369	70337.84	1688108.11	23	365	--	0.18	0.18	0.05	63.63	2.38	--	8.25	--	--	0.75	0.75	0.22	267.10	9.98	--	34.64	--
	Dual Fuel Turbine - Taurus 70 #3, Diesel	9369	536.01	12864.35	1	365	0.79	0.28	0.28	0.10	99.30	2.45	0.00	8.67	--	0.14	0.05	0.05	0.02	18.12	0.45	0.00	1.58	--
	Dual Fuel Turbine - Taurus 70 #3, Nat Gas	9369	70337.84	1688108.11	23	365	--	0.18	0.18	0.05	63.63	2.38	--	8.25	--	--	0.75	0.75	0.22	267.10	9.98	--	34.64	--
	Dual Fuel Turbine - Taurus 70 #4, Diesel	9369	536.01	12864.35	1	365	0.79	0.18	0.28	0.10	99.30	2.45	0.00	8.67	--	0.14	0.03	0.05	0.02	18.12	0.45	0.00	1.58	--
	Dual Fuel Turbine - Taurus 70 #4, Nat Gas	9369	70337.84	1688108.11	23	365	--	0.18	0.18	0.05	63.63	2.38	--	8.25	--	--	0.75	0.75	0.22	267.10	9.98	--	34.64	--
	MISC.	**BPD**	**SCF/HR**	**COUNT**																				
	COMBUSTION FLARE - no smoke		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	0.00	0.00	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		950000		24	365	12.65	12.65	12.65	0.01	86.05	285.45	--	392.27	--	55.42	55.42	55.42	0.04	376.89	1250.27	--	1718.16	--
	COMBUSTION FLARE - heavy smoke		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	--
	COLD VENT - Routine			1	24	365	--	--	--	--	--	10.22	--	--	--	--	--	--	--	--	44.75	--	--	--
	COLD VENT - Intermittent			22800000	24	10	--	--	--	--	--	1544.12	--	--	--	--	--	--	--	--	185.29	--	--	--
	FUGITIVES			11420	24	365	--	--	--	--	--	5.71	--	--	--	--	--	--	--	--	5.71	--	--	--
2023	**Facility Total Emissions**						**55.46**	**39.21**	**38.65**	**1.38**	**1,937.69**	**1,901.02**	**0.01**	**653.69**	**0.23**	**74.63**	**73.72**	**73.51**	**2.04**	**2,914.86**	**1,575.66**	**0.00**	**2,066.76**	**0.06**
EXEMPTION CALCULATION	**DISTANCE FROM LAND IN MILES**															**2,064.60**	**2,064.60**	**2,064.60**	**2,064.60**	**2,064.60**	**2,064.60**	**2,064.60**	**53,260.68**	**2064.60**
	62.0																							
PRODUCTION	VESSELS - Support Vessel - Diesel	10100	519.60	12470.51	24	180	7.13	4.30	4.17	0.10	170.72	4.91	0.00	26.78	0.05	15.39	9.29	9.01	0.22	368.75	10.60	0.00	57.84	0.11
	VESSELS - Support Vessel - Diesel	10100	519.60	12470.51	24	180	7.13	4.30	4.17	0.10	170.72	4.91	0.00	26.78	0.05	15.39	9.29	9.01	0.22	368.75	10.60	0.00	57.84	0.11
	VESSELS - Well Jumper Metrology - Diesel	21389	1100.38	26409.08	24	180	15.09	9.10	8.83	0.22	361.53	10.39	0.00	56.71	0.11	32.59	19.66	19.07	0.47	780.91	22.45	0.00	122.48	0.23
	VESSELS - Crew Vessel - Diesel	8000	411.57	9877.63	24	60	5.64	3.41	3.30	0.08	135.22	3.89	0.00	21.21	0.04	4.06	2.45	2.38	0.06	97.36	2.80	0.00	15.27	0.03
	VESSELS - Flotel - Diesel	17500	900.31	21607.32	24	90	12.35	7.45	7.23	0.18	295.80	8.50	0.00	46.40	0.09	13.33	8.04	7.80	0.19	319.46	9.19	0.00	50.11	0.09
	VESSELS - Commissioning Support Vessel - Diesel	21389	1100.38	26409.08	24	35	15.09	9.10	8.83	0.22	361.53	10.39	0.00	56.71	0.11	6.34	3.82	3.71	0.09	151.84	4.37	0.00	23.82	0.04
2023	**Non-Facility Total Emissions**						**62.42**	**37.66**	**36.53**	**0.91**	**1,495.52**	**43.00**	**0.00**	**234.57**	**0.44**	**87.11**	**52.56**	**50.98**	**1.27**	**2,087.07**	**60.01**	**0.01**	**327.35**	**0.61**

COMPANY	AREA	BLOCK	LEASE	FACILITY	WELL	CONTACT	PHONE	REMARKS
Shell Offshore Inc.	Mississippi Canyon	939	OCS-G30379 (RUE Pending)	Vito Floating Production System (FPS)	Wells VA001,VA002, VA003, VA004, VA005, VA006, VA007, VA008, VA009, VA010, VA011, VA012	DaMonica Pierson	(504) 425-9065	The following equipment utilize non-default emission factors and are presented on the FACTORS tab: - Cold Vent (VOC) - Natural Gas Turbine - Mars 100 (NOx, VOC, CO) - Dual Fuel Turbine - Taurus 70, Diesel (NOx, VOC, CO) - Dual Fuel Turbine - Taurus 70, Nat Gas (NOx, VOC, CO) No emission reduction measures are included in this AQR. Vito-AQR-DOCD Mod 0621vFINAL-Ramboll.xlsx

OPERATIONS	EQUIPMENT	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR									ESTIMATED TONS								
	Diesel Engines	HP	GAL/HR	GAL/D																				
	Nat. Gas Engines	HP	SCF/HR	SCF/D																				
	Burners	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
PRODUCTION	RECIP.<600hp Diesel - Misc Small Temp Equipment	600	30.87	740.82	18	365	1.32	1.32	1.32	0.04	18.65	1.38	--	4.01	--	4.35	4.35	4.35	0.12	61.27	4.52	--	13.17	--
	RECIP.>600hp Diesel - Misc Large Temp Equipment	1000	51.45	1234.70	18	365	0.71	0.40	0.39	0.01	24.03	0.64	--	5.51	--	2.32	1.32	1.29	0.04	78.94	2.10	--	18.11	--
	RECIP Diesel Fire Pump #1	1064	54.74	1313.73	1	52	0.75	0.43	0.42	0.01	25.57	0.68	--	5.86	--	0.02	0.01	0.01	0.00	0.66	0.02	--	0.15	--
	RECIP Diesel Fire Pump #2	1064	54.74	1313.73	1	52	0.75	0.43	0.42	0.01	25.57	0.68	--	5.86	--	0.02	0.01	0.01	0.00	0.66	0.02	--	0.15	--
	DIESEL CRANE ENGINE #1	540	27.78	666.74	24	365	0.38	0.22	0.21	0.01	12.98	0.35	--	2.98	--	1.67	0.95	0.93	0.03	56.84	1.51	--	13.04	--
	DIESEL CRANE ENGINE #2	540	27.78	666.74	24	365	0.38	0.22	0.21	0.01	12.98	0.35	--	2.98	--	1.67	0.95	0.93	0.03	56.84	1.51	--	13.04	--
	RECIP Emergency Generator - Diesel	2252	115.86	2780.55	1	52	1.59	0.90	0.88	0.03	54.12	1.44	--	12.41	--	0.04	0.02	0.02	0.00	1.41	0.04	--	0.32	--
	LIFE BOATS - Diesel	428	22.02	528.45	1	52	0.30	0.17	0.17	0.01	10.29	0.27	--	2.36	--	0.01	0.00	0.00	0.00	0.27	0.01	--	0.06	--
	Natural Gas Turbine - Mars 100 #1	14124	106036.036	2544864.86	24	365	0.00	0.27	0.27	0.08	106.79	3.69	--	12.97	--	--	1.18	1.18	0.35	467.73	16.16	--	56.79	--
	Natural Gas Turbine - Mars 100 #2	14124	106036.036	2544864.86	24	365	--	0.27	0.27	0.08	106.79	3.69	--	12.97	--	--	1.18	1.18	0.35	467.73	16.16	--	56.79	--
	Dual Fuel Turbine - Taurus 70 #1, Diesel	9369	536.01	12864.35	1	365	0.79	0.28	0.28	0.10	99.30	2.45	0.00	8.67	--	0.14	0.05	0.05	0.02	18.12	0.45	0.00	1.58	--
	Dual Fuel Turbine - Taurus 70 #1, Nat Gas	9369	70337.84	1688108.11	23	365	--	0.18	0.18	0.05	63.63	2.38	--	8.25	--	--	0.75	0.75	0.22	267.10	9.98	--	34.64	--
	Dual Fuel Turbine - Taurus 70 #2, Diesel	9369	536.01	12864.35	1	365	0.79	0.28	0.28	0.10	99.30	2.45	0.00	8.67	--	0.14	0.05	0.05	0.02	18.12	0.45	0.00	1.58	--
	Dual Fuel Turbine - Taurus 70 #2, Nat Gas	9369	70337.84	1688108.11	23	365	--	0.18	0.18	0.05	63.63	2.38	--	8.25	--	--	0.75	0.75	0.22	267.10	9.98	--	34.64	--
	Dual Fuel Turbine - Taurus 70 #3, Diesel	9369	536.01	12864.35	1	365	0.79	0.28	0.28	0.10	99.30	2.45	0.00	8.67	--	0.14	0.05	0.05	0.02	18.12	0.45	0.00	1.58	--
	Dual Fuel Turbine - Taurus 70 #3, Nat Gas	9369	70337.84	1688108.11	23	365	--	0.18	0.18	0.05	63.63	2.38	--	8.25	--	--	0.75	0.75	0.22	267.10	9.98	--	34.64	--
	Dual Fuel Turbine - Taurus 70 #4, Diesel	9369	536.01	12864.35	1	365	0.79	0.18	0.28	0.10	99.30	2.45	0.00	8.67	--	0.14	0.03	0.05	0.02	18.12	0.45	0.00	1.58	--
	Dual Fuel Turbine - Taurus 70 #4, Nat Gas	9369	70337.84	1688108.11	23	365	--	0.18	0.18	0.05	63.63	2.38	--	8.25	--	--	0.75	0.75	0.22	267.10	9.98	--	34.64	--
	MISC.	**BPD**	**SCF/HR**	**COUNT**																				
	COMBUSTION FLARE - no smoke		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	0.00	0.00	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		950000		24	365	12.65	12.65	12.65	0.01	86.05	285.45	--	392.27	--	55.42	55.42	55.42	0.04	376.89	1250.27	--	1718.16	--
	COMBUSTION FLARE - heavy smoke		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	--
	COLD VENT - Routine			1	24	365	--	--	--	--	--	10.22	--	--	--	--	--	--	--	--	44.75	--	--	--
	COLD VENT - Intermittent			22800000	24	10	--	--	--	--	--	1544.12	--	--	--	--	--	--	--	--	185.29	--	--	--
	FUGITIVES			11420	24	365	--	--	--	--	--	5.71	--	--	--	--	--	--	--	--	5.71	--	--	--
2024-2045	**Annual Facility Total Emissions**						**21.98**	**19.01**	**19.06**	**0.90**	**1,135.52**	**1,877.95**	**0.00**	**527.87**	**0.00**	**66.09**	**68.56**	**68.51**	**1.92**	**2,710.14**	**1,569.78**	**0.00**	**2,034.65**	**0.00**
EXEMPTION CALCULATION	**DISTANCE FROM LAND IN MILES**															**2,064.60**	**2,064.60**	**2,064.60**	**2,064.60**	**2,064.60**	**2,064.60**	**2,064.60**	**53,260.68**	**2064.60**
	62.0																							
PRODUCTION	VESSELS - Support Vessel - Diesel	10100	519.60	12470.51	24	180	7.13	4.30	4.17	0.10	170.72	4.91	0.00	26.78	0.05	15.39	9.29	9.01	0.22	368.75	10.60	0.00	57.84	0.11
	VESSELS - Support Vessel - Diesel	10100	519.60	12470.51	24	180	7.13	4.30	4.17	0.10	170.72	4.91	0.00	26.78	0.05	15.39	9.29	9.01	0.22	368.75	10.60	0.00	57.84	0.11
	VESSELS - Crew Vessel - Diesel	8000	411.57	9877.63	24	60	5.64	3.41	3.30	0.08	135.22	3.89	0.00	21.21	0.04	4.06	2.45	2.38	0.06	97.36	2.80	0.00	15.27	0.03
	VESSELS - Flotel - Diesel	17500	900.31	21607.32	24	90	12.35	7.45	7.23	0.18	295.80	8.50	0.00	46.40	0.09	13.33	8.04	7.80	0.19	319.46	9.19	0.00	50.11	0.09
2024-2045	**Annual Non-Facility Total Emissions**						**32.24**	**19.45**	**18.87**	**0.47**	**772.45**	**22.21**	**0.00**	**121.16**	**0.23**	**48.18**	**29.07**	**28.20**	**0.70**	**1,154.32**	**33.19**	**0.00**	**181.05**	**0.34**

Vito Host Summary

COMPANY	AREA	BLOCK	LEASE	FACILITY	WELL			
Shell Offshore Inc.	Mississippi Canyon	939	OCS-G30379 (RUE Pending)	Vito Floating Production System (FPS)	Wells VA001,VA002, VA003, VA004, VA005, VA006, VA007, VA008, VA009, VA010, VA011, VA012			

Year	Facility Emitted Substance								
	TSP	PM10	PM2.5	SOx	NOx	VOC	Pb	CO	NH3
2021	21.19	12.79	12.40	0.31	507.80	14.60	0.00	79.65	0.15
2022	97.30	64.88	63.44	1.78	2640.47	523.58	0.01	688.89	0.53
2023	74.63	73.72	73.51	2.04	2914.86	1575.66	0.00	2066.76	0.06
2024-2045	66.09	68.56	68.51	1.92	2710.14	1569.78	0.00	2034.65	0.00
Allowable	2064.60	2064.60	2064.60	2064.60	2064.60	2064.60	2064.60	53260.68	2064.60

Solar Turbines
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PREDICTED EMISSION PERFORMANCE

Customer **Shell Vito**	Engine Model **TAURUS 70-10801 Axial** **GSC STANDARD**
Job ID	
Inquiry Number	Fuel Type: **SD NATURAL GAS** — Water Injection: **NO**
Run By: **Randall G Carroll** — Date Run: **18-Jul-18**	Engine Emissions Data **REV. 0.2**

1	7698 kW	100.0% Load	Elev. 100 ft	Rel. Humidity 60.0%	Temperature 59.0 Deg. F

	NOx EMISSIONS	CO EMISSIONS	UHC EMISSIONS
PPMvd at 15% O2	235.00	50.00	25.00
ton/yr	320.80	41.55	11.90
lbm/MMBtu (Fuel LHV)	0.936	0.121	0.035
lbm/(MW-hr) (gas turbine shaft pwr)	9.09	1.18	0.34
lbm/hr	73.24	9.49	2.72

2	7663 kW	100.0% Load	Elev. 100 ft	Rel. Humidity 60.0%	Temperature 60.0 Deg. F

	NOx EMISSIONS	CO EMISSIONS	UHC EMISSIONS
PPMvd at 15% O2	235.00	50.00	25.00
ton/yr	319.68	41.41	11.86
lbm/MMBtu (Fuel LHV)	0.936	0.121	0.035
lbm/(MW-hr) (gas turbine shaft pwr)	9.10	1.18	0.34
lbm/hr	72.99	9.45	2.71

3	7169 kW	100.0% Load	Elev. 100 ft	Rel. Humidity 60.0%	Temperature 75.0 Deg. F

	NOx EMISSIONS	CO EMISSIONS	UHC EMISSIONS
PPMvd at 15% O2	235.00	50.00	25.00
ton/yr	303.15	39.27	11.25
lbm/MMBtu (Fuel LHV)	0.932	0.121	0.035
lbm/(MW-hr) (gas turbine shaft pwr)	9.22	1.19	0.34
lbm/hr	69.21	8.97	2.57

Notes

1. For short-term emission limits such as lbs/hr., Solar recommends using "worst case" anticipated operating conditions specific to the application and the site conditions. Worst case for one pollutant is not necessarily the same for another.
2. Solar's typical SoLoNOx warranty, for ppm values, is available for greater than 0 deg F or -20 deg C, and between 50% and 100% load for gas, fuel, and between 65% and 100% load for liquid fuel (except f or the Centaur 40). An emission warranty for non-SoLoNOx equipment is available for greater than 0 deg F or -20 deg C and betwee
3. Fuel must meet Solar standard fuel specification ES 9-98. Emissions are based on the attached fuel composition, or, San Diego natural gas or equivalent.
4. If needed, Solar can provide Product Information Letters to address turbine operation outside typical warranty ranges, as well as non-warranted emissions of SO2, PM10/2.5, VOC, and formaldehyde.
5. Solar can provide factory testing in San Diego to ensure the actual unit(s) meet the above values within the tolerances quoted. Pricing and schedule impact will be provided upon request.
6. Any emissions warranty is applicable only for steady-state conditions and does not apply during start-up, shut-down, malfunction, or transient event.

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PREDICTED EMISSION PERFORMANCE

Customer **Shell Vito**		Engine Model **TAURUS 70-10801 Axial** **GSC STANDARD**	
Job ID			
Inquiry Number		Fuel Type **SD NATURAL GAS**	Water Injection **NO**
Run By **Randall G Carroll**	Date Run **18-Jul-18**	Engine Emissions Data **REV. 0.2**	

	NOx EMISSIONS	CO EMISSIONS	UHC EMISSIONS
4 — 6998 kW, 100.0% Load, Elev. 100 ft, Rel. Humidity 60.0%, Temperature 80.0 Deg. F			
PPMvd at 15% O2	235.00	50.00	25.00
ton/yr	297.48	38.53	11.04
lbm/MMBtu (Fuel LHV)	0.930	0.120	0.034
lbm/(MW-hr) (gas turbine shaft pwr)	9.27	1.20	0.34
lbm/hr	67.92	8.80	2.52
5 — 6816 kW, 100.0% Load, Elev. 100 ft, Rel. Humidity 60.0%, Temperature 85.0 Deg. F			
PPMvd at 15% O2	235.00	50.00	25.00
ton/yr	291.86	37.81	10.83
lbm/MMBtu (Fuel LHV)	0.928	0.120	0.034
lbm/(MW-hr) (gas turbine shaft pwr)	9.34	1.21	0.35
lbm/hr	66.64	8.63	2.47
6 — 6640 kW, 100.0% Load, Elev. 100 ft, Rel. Humidity 60.0%, Temperature 90.0 Deg. F			
PPMvd at 15% O2	235.00	50.00	25.00
ton/yr	286.36	37.09	10.62
lbm/MMBtu (Fuel LHV)	0.925	0.120	0.034
lbm/(MW-hr) (gas turbine shaft pwr)	9.41	1.22	0.35
lbm/hr	65.38	8.47	2.43

Notes

1. For short-term emission limits such as lbs/hr., Solar recommends using "worst case" anticipated operating conditions specific to the application and the site conditions. Worst case for one pollutant is not necessarily the same for another.
2. Solar's typical SoLoNOx warranty, for ppm values, is available for greater than 0 deg F or -20 deg C, and between 50% and 100% load for gas, fuel, and between 65% and 100% load for liquid fuel (except f or the Centaur 40). An emission warranty for non-SoLoNOx equipment is available for greater than 0 deg F or -20 deg C and betwee
3. Fuel must meet Solar standard fuel specification ES 9-98. Emissions are based on the attached fuel composition, or, San Diego natural gas or equivalent.
4. If needed, Solar can provide Product Information Letters to address turbine operation outside typical warranty ranges, as well as non-warranted emissions of SO2, PM10/2.5, VOC, and formaldehyde.
5. Solar can provide factory testing in San Diego to ensure the actual unit(s) meet the above values within the tolerances quoted. Pricing and schedule impact will be provided upon request.
6. Any emissions warranty is applicable only for steady-state conditions and does not apply during start-up, shut-down, malfunction, or transient event.

Solar Turbines
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PREDICTED ENGINE PERFORMANCE

Customer: **Shell Vito**	Model: **TAURUS 70-10801 Axial**
	Package Type: **GSC**
Job ID:	Match: **STANDARD**
Run By: **Randall G Carroll** / Date Run: **18-Jul-18**	Fuel System: **DUAL**
Engine Performance Code: **REV. 4.20.1.22.12** / Engine Performance Data: **REV. 1.0**	Fuel Type: **SD NATURAL GAS**

DATA FOR NOMINAL PERFORMANCE

Elevation	feet	100
Inlet Loss	in H2O	4.0
Exhaust Loss	in H2O	10.0

		1	2	3	4	5	6
Engine Inlet Temperature	deg F	59.0	60.0	75.0	80.0	85.0	90.0
Relative Humidity	%	60.0	60.0	60.0	60.0	60.0	60.0
Gearbox Efficiency		0.9850	0.9850	0.9850	0.9850	0.9850	0.9850
Generator Efficiency		0.9700	0.9700	0.9700	0.9700	0.9700	0.9700
Based On 1.0 Power Factor							
Specified Load*	kW	FULL	FULL	FULL	FULL	FULL	FULL
Net Output Power*	kW	7698	7663	7169	6998	6816	6640
Fuel Flow	mmBtu/hr	78.24	77.98	74.29	73.04	71.83	70.67
Heat Rate*	Btu/kW-hr	10164	10176	10362	10438	10538	10642
Therm Eff*	%	33.572	33.530	32.930	32.689	32.379	32.062
Engine Exhaust Flow	lbm/hr	210490	209924	201381	198371	195351	192342
PT Exit Temperature	deg F	956	957	969	974	980	986
Exhaust Temperature	deg F	956	957	969	974	980	986

Fuel Gas Composition (Volume Percent)

Methane (CH4)	92.79
Ethane (C2H6)	4.16
Propane (C3H8)	0.84
N-Butane (C4H10)	0.18
N-Pentane (C5H12)	0.04
Hexane (C6H14)	0.04
Carbon Dioxide (CO2)	0.44
Hydrogen Sulfide (H2S)	0.0001
Nitrogen (N2)	1.51

Fuel Gas Properties

LHV (Btu/Scf)	939.2	Specific Gravity	0.5970	Wobbe Index at 60F	1215.6

**Electric power measured at the generator terminals.*

This performance was calculated with a basic inlet and exhaust system. Special equipment such as low noise silencers, special filters, heat recovery systems or cooling devices will affect engine performance. Performance shown is "Expected" performance at the pressure drops stated, not guaranteed.

Solar Turbines
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PREDICTED EMISSION PERFORMANCE

Customer **Shell**	Engine Model **MARS 100-16000** **CS/MD HIGH AMBIENT**
Job ID	
Inquiry Number	Fuel Type: **SD NATURAL GAS** — Water Injection: **NO**
Run By: **Randall G Carroll** — Date Run: **19-Jul-18**	Engine Emissions Data **REV. 1.0**

	NOx EMISSIONS	CO EMISSIONS	UHC EMISSIONS
1 — 15336 HP, 100.0% Load, Elev. 100 ft, Rel. Humidity 60.0%, Temperature 59.0 Deg. F			
PPMvd at 15% O2	250.00	50.00	25.00
ton/yr	505.52	61.55	17.63
lbm/MMBtu (Fuel LHV)	0.996	0.121	0.035
lbm/(MW-hr) (gas turbine shaft pwr)	10.09	1.23	0.35
lbm/hr	115.42	14.05	4.02
2 — 15299 HP, 100.0% Load, Elev. 100 ft, Rel. Humidity 60.0%, Temperature 60.0 Deg. F			
PPMvd at 15% O2	250.00	50.00	25.00
ton/yr	504.45	61.42	17.59
lbm/MMBtu (Fuel LHV)	0.996	0.121	0.035
lbm/(MW-hr) (gas turbine shaft pwr)	10.10	1.23	0.35
lbm/hr	115.17	14.02	4.02
3 — 14774 HP, 100.0% Load, Elev. 100 ft, Rel. Humidity 60.0%, Temperature 75.0 Deg. F			
PPMvd at 15% O2	250.00	50.00	25.00
ton/yr	488.98	59.54	17.05
lbm/MMBtu (Fuel LHV)	0.991	0.121	0.035
lbm/(MW-hr) (gas turbine shaft pwr)	10.13	1.23	0.35
lbm/hr	111.64	13.59	3.89

Notes

1. For short-term emission limits such as lbs/hr., Solar recommends using "worst case" anticipated operating conditions specific to the application and the site conditions. Worst case for one pollutant is not necessarily the same for another.
2. Solar's typical SoLoNOx warranty, for ppm values, is available for greater than 0 deg F or -20 deg C, and between 50% and 100% load for gas, fuel, and between 65% and 100% load for liquid fuel (except f or the Centaur 40). An emission warranty for non-SoLoNOx equipment is available for greater than 0 deg F or -20 deg C and betwee
3. Fuel must meet Solar standard fuel specification ES 9-98. Emissions are based on the attached fuel composition, or, San Diego natural gas or equivalent.
4. If needed, Solar can provide Product Information Letters to address turbine operation outside typical warranty ranges, as well as non-warranted emissions of SO2, PM10/2.5, VOC, and formaldehyde.
5. Solar can provide factory testing in San Diego to ensure the actual unit(s) meet the above values within the tolerances quoted. Pricing and schedule impact will be provided upon request.
6. Any emissions warranty is applicable only for steady-state conditions and does not apply during start-up, shut-down, malfunction, or transient event.

Solar Turbines
A Caterpillar Company

PREDICTED EMISSION PERFORMANCE

Customer **Shell**	Engine Model **MARS 100-16000 CS/MD HIGH AMBIENT**
Job ID	
Inquiry Number	Fuel Type: **SD NATURAL GAS** Water Injection: **NO**
Run By: **Randall G Carroll** Date Run: **19-Jul-18**	Engine Emissions Data **REV. 1.0**

	NOx EMISSIONS	CO EMISSIONS	UHC EMISSIONS
4 — 14584 HP, 100.0% Load, Elev. 100 ft, Rel. Humidity 60.0%, Temperature 80.0 Deg. F			
PPMvd at 15% O2	250.00	50.00	25.00
ton/yr	483.35	58.85	16.85
lbm/MMBtu (Fuel LHV)	0.989	0.120	0.035
lbm/(MW-hr) (gas turbine shaft pwr)	10.15	1.24	0.35
lbm/hr	110.35	13.44	3.85
5 — 14352 HP, 100.0% Load, Elev. 100 ft, Rel. Humidity 60.0%, Temperature 85.0 Deg. F			
PPMvd at 15% O2	250.00	50.00	25.00
ton/yr	476.80	58.06	16.63
lbm/MMBtu (Fuel LHV)	0.987	0.120	0.034
lbm/(MW-hr) (gas turbine shaft pwr)	10.17	1.24	0.35
lbm/hr	108.86	13.25	3.80
6 — 14110 HP, 100.0% Load, Elev. 100 ft, Rel. Humidity 60.0%, Temperature 90.0 Deg. F			
PPMvd at 15% O2	250.00	50.00	25.00
ton/yr	470.01	57.23	16.39
lbm/MMBtu (Fuel LHV)	0.985	0.120	0.034
lbm/(MW-hr) (gas turbine shaft pwr)	10.20	1.24	0.36
lbm/hr	107.31	13.07	3.74

Notes

1. For short-term emission limits such as lbs/hr., Solar recommends using "worst case" anticipated operating conditions specific to the application and the site conditions. Worst case for one pollutant is not necessarily the same for another.
2. Solar's typical SoLoNOx warranty, for ppm values, is available for greater than 0 deg F or -20 deg C, and between 50% and 100% load for gas, fuel, and between 65% and 100% load for liquid fuel (except f or the Centaur 40). An emission warranty for non-SoLoNOx equipment is available for greater than 0 deg F or -20 deg C and betwee
3. Fuel must meet Solar standard fuel specification ES 9-98. Emissions are based on the attached fuel composition, or, San Diego natural gas or equivalent.
4. If needed, Solar can provide Product Information Letters to address turbine operation outside typical warranty ranges, as well as non-warranted emissions of SO2, PM10/2.5, VOC, and formaldehyde.
5. Solar can provide factory testing in San Diego to ensure the actual unit(s) meet the above values within the tolerances quoted. Pricing and schedule impact will be provided upon request.
6. Any emissions warranty is applicable only for steady-state conditions and does not apply during start-up, shut-down, malfunction, or transient event.

Solar Turbines
A Caterpillar Company

PREDICTED ENGINE PERFORMANCE

Customer: **Shell**		Model: **MARS 100-16000**	
		Package Type: **CS/MD**	
Job ID:		Match: **HIGH AMBIENT**	
Run By: **Randall G Carroll**	Date Run: **19-Jul-18**	Fuel System: **GAS**	
Engine Performance Code: **REV. 4.20.1.22.12**	Engine Performance Data: **REV. 1.1**	Fuel Type: **SD NATURAL GAS**	

DATA FOR NOMINAL PERFORMANCE

Elevation	feet	100
Inlet Loss	in H2O	4.0
Exhaust Loss	in H2O	4.0
Accessory on GP Shaft	HP	27.8

		1	2	3	4	5	6
Engine Inlet Temperature	deg F	59.0	60.0	75.0	80.0	85.0	90.0
Relative Humidity	%	60.0	60.0	60.0	60.0	60.0	60.0
Driven Equipment Speed	RPM	9021	9020	9012	9005	8990	8972
Specified Load	HP	FULL	FULL	FULL	FULL	FULL	FULL
Net Output Power	HP	15336	15299	14774	14584	14352	14110
Fuel Flow	mmBtu/hr	115.87	115.65	112.61	111.53	110.27	109.00
Heat Rate	Btu/HP-hr	7555	7559	7622	7648	7684	7725
Therm Eff	%	33.677	33.661	33.384	33.271	33.115	32.938
Engine Exhaust Flow	lbm/hr	337824	337186	327563	324185	320600	316847
PT Exit Temperature	deg F	901	901	911	914	918	922
Exhaust Temperature	deg F	901	901	911	914	918	922

Fuel Gas Composition (Volume Percent)

Methane (CH4)	92.79
Ethane (C2H6)	4.16
Propane (C3H8)	0.84
N-Butane (C4H10)	0.18
N-Pentane (C5H12)	0.04
Hexane (C6H14)	0.04
Carbon Dioxide (CO2)	0.44
Hydrogen Sulfide (H2S)	0.0001
Nitrogen (N2)	1.51

Fuel Gas Properties

LHV (Btu/Scf)	939.2	Specific Gravity	0.5970	Wobbe Index at 60F	1215.6

This performance was calculated with a basic inlet and exhaust system. Special equipment such as low noise silencers, special filters, heat recovery systems or cooling devices will affect engine performance. Performance shown is "Expected" performance at the pressure drops stated, not guaranteed.

Solar Turbines
A Caterpillar Company

PREDICTED EMISSION PERFORMANCE

Customer **Shell Vito**	Engine Model **TAURUS 70-10801 Axial GSC STANDARD**
Job ID	
Inquiry Number	Fuel Type: **DIESEL 2-D** — Water Injection: **NO**
Run By: **Randall G Carroll** — Date Run: **18-Jul-18**	Engine Emissions Data **REV. 0.2**

	NOx EMISSIONS	CO EMISSIONS	UHC EMISSIONS
1 — 7155 kW, 100.0% Load, Elev. 100 ft, Rel. Humidity 60.0%, Temperature 59.0 Deg. F			
PPMvd at 15% O2	350.00	50.00	25.00
ton/yr	465.25	40.46	11.59
lbm/MMBtu (Fuel LHV)	1.431	0.124	0.036
lbm/(MW-hr) (gas turbine shaft pwr)	14.18	1.23	0.35
lbm/hr	106.22	9.24	2.65
2 — 7122 kW, 100.0% Load, Elev. 100 ft, Rel. Humidity 60.0%, Temperature 60.0 Deg. F			
PPMvd at 15% O2	350.00	50.00	25.00
ton/yr	463.67	40.33	11.55
lbm/MMBtu (Fuel LHV)	1.431	0.124	0.036
lbm/(MW-hr) (gas turbine shaft pwr)	14.20	1.24	0.35
lbm/hr	105.86	9.21	2.64
3 — 6641 kW, 100.0% Load, Elev. 100 ft, Rel. Humidity 60.0%, Temperature 75.0 Deg. F			
PPMvd at 15% O2	350.00	50.00	25.00
ton/yr	439.79	38.25	10.95
lbm/MMBtu (Fuel LHV)	1.425	0.124	0.035
lbm/(MW-hr) (gas turbine shaft pwr)	14.45	1.26	0.36
lbm/hr	100.41	8.73	2.50

Notes

1. For short-term emission limits such as lbs/hr., Solar recommends using "worst case" anticipated operating conditions specific to the application and the site conditions. Worst case for one pollutant is not necessarily the same for another.
2. Solar's typical SoLoNOx warranty, for ppm values, is available for greater than 0 deg F or -20 deg C, and between 50% and 100% load for gas, fuel, and between 65% and 100% load for liquid fuel (except f or the Centaur 40). An emission warranty for non-SoLoNOx equipment is available for greater than 0 deg F or -20 deg C and betwee
3. Fuel must meet Solar standard fuel specification ES 9-98. Emissions are based on the attached fuel composition, or, San Diego natural gas or equivalent.
4. If needed, Solar can provide Product Information Letters to address turbine operation outside typical warranty ranges, as well as non-warranted emissions of SO2, PM10/2.5, VOC, and formaldehyde.
5. Solar can provide factory testing in San Diego to ensure the actual unit(s) meet the above values within the tolerances quoted. Pricing and schedule impact will be provided upon request.
6. Any emissions warranty is applicable only for steady-state conditions and does not apply during start-up, shut-down, malfunction, or transient event.

Solar Turbines
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PREDICTED EMISSION PERFORMANCE

Customer		Engine Model	
Shell Vito		**TAURUS 70-10801 Axial GSC STANDARD**	
Job ID			
Inquiry Number		Fuel Type	Water Injection
		DIESEL 2-D	**NO**
Run By	Date Run	Engine Emissions Data	
Randall G Carroll	**18-Jul-18**	**REV. 0.2**	

	NOx EMISSIONS	CO EMISSIONS	UHC EMISSIONS
4 — 6474 kW, 100.0% Load, Elev. 100 ft, Rel. Humidity 60.0%, Temperature 80.0 Deg. F			
PPMvd at 15% O2	350.00	50.00	25.00
ton/yr	431.73	37.55	10.75
lbm/MMBtu (Fuel LHV)	1.422	0.124	0.035
lbm/(MW-hr) (gas turbine shaft pwr)	14.55	1.27	0.36
lbm/hr	98.57	8.57	2.46
5 — 6295 kW, 100.0% Load, Elev. 100 ft, Rel. Humidity 60.0%, Temperature 85.0 Deg. F			
PPMvd at 15% O2	350.00	50.00	25.00
ton/yr	423.55	36.84	10.55
lbm/MMBtu (Fuel LHV)	1.418	0.123	0.035
lbm/(MW-hr) (gas turbine shaft pwr)	14.68	1.28	0.37
lbm/hr	96.70	8.41	2.41
6 — 6124 kW, 100.0% Load, Elev. 100 ft, Rel. Humidity 60.0%, Temperature 90.0 Deg. F			
PPMvd at 15% O2	350.00	50.00	25.00
ton/yr	415.53	36.14	10.35
lbm/MMBtu (Fuel LHV)	1.415	0.123	0.035
lbm/(MW-hr) (gas turbine shaft pwr)	14.80	1.29	0.37
lbm/hr	94.87	8.25	2.36

Notes

1. For short-term emission limits such as lbs/hr., Solar recommends using "worst case" anticipated operating conditions specific to the application and the site conditions. Worst case for one pollutant is not necessarily the same for another.
2. Solar's typical SoLoNOx warranty, for ppm values, is available for greater than 0 deg F or -20 deg C, and between 50% and 100% load for gas, fuel, and between 65% and 100% load for liquid fuel (except f or the Centaur 40). An emission warranty for non-SoLoNOx equipment is available for greater than 0 deg F or -20 deg C and betwee
3. Fuel must meet Solar standard fuel specification ES 9-98. Emissions are based on the attached fuel composition, or, San Diego natural gas or equivalent.
4. If needed, Solar can provide Product Information Letters to address turbine operation outside typical warranty ranges, as well as non-warranted emissions of SO2, PM10/2.5, VOC, and formaldehyde.
5. Solar can provide factory testing in San Diego to ensure the actual unit(s) meet the above values within the tolerances quoted. Pricing and schedule impact will be provided upon request.
6. Any emissions warranty is applicable only for steady-state conditions and does not apply during start-up, shut-down, malfunction, or transient event.

Solar Turbines
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PREDICTED ENGINE PERFORMANCE

Customer: Shell Vito	Model: TAURUS 70-10801 Axial
	Package Type: GSC
Job ID:	Match: STANDARD
Run By: Randall G Carroll; Date Run: 18-Jul-18	Fuel System: DUAL
Engine Performance Code: REV. 4.20.1.22.12; Engine Performance Data: REV. 1.0	Fuel Type: DIESEL 2-D

DATA FOR NOMINAL PERFORMANCE

Specific Gravity of Fuel		0.850
Elevation	feet	100
Inlet Loss	in H2O	4.0
Exhaust Loss	in H2O	10.0

		1	2	3	4	5	6
Engine Inlet Temperature	deg F	59.0	60.0	75.0	80.0	85.0	90.0
Relative Humidity	%	60.0	60.0	60.0	60.0	60.0	60.0
Gearbox Efficiency		0.9850	0.9850	0.9850	0.9850	0.9850	0.9850
Generator Efficiency		0.9700	0.9700	0.9700	0.9700	0.9700	0.9700
Based On 1.0 Power Factor							
Specified Load*	kW	FULL	FULL	FULL	FULL	FULL	FULL
Net Output Power*	kW	7155	7122	6641	6474	6295	6124
Fuel Flow	mmBtu/hr	74.21	73.97	70.48	69.33	68.17	67.06
Heat Rate*	Btu/kW-hr	10371	10386	10613	10708	10829	10950
Therm Eff*	%	32.901	32.854	32.151	31.866	31.508	31.160
Engine Exhaust Flow	lbm/hr	210909	210354	201898	198908	195887	192882
PT Exit Temperature	deg F	927	928	941	947	953	959
Exhaust Temperature	deg F	927	928	941	947	953	959

**Electric power measured at the generator terminals.*

This performance was calculated with a basic inlet and exhaust system. Special equipment such as low noise silencers, special filters, heat recovery systems or cooling devices will affect engine performance. Performance shown is "Expected" performance at the pressure drops stated, not guaranteed.

Solar Turbines
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PREDICTED EMISSION PERFORMANCE

Customer **Shell**	Engine Model **MARS 100-16000** **CS/MD HIGH AMBIENT**
Job ID	
Inquiry Number	Fuel Type: **SD NATURAL GAS** — Water Injection: **NO**
Run By: **Randall G Carroll** — Date Run: **19-Jul-18**	Engine Emissions Data **REV. 1.0**

	NOx EMISSIONS	CO EMISSIONS	UHC EMISSIONS
1 — 15336 HP, 100.0% Load, Elev. 100 ft, Rel. Humidity 60.0%, Temperature 59.0 Deg. F			
PPMvd at 15% O2	250.00	50.00	25.00
ton/yr	505.52	61.55	17.63
lbm/MMBtu (Fuel LHV)	0.996	0.121	0.035
lbm/(MW-hr) (gas turbine shaft pwr)	10.09	1.23	0.35
lbm/hr	115.42	14.05	4.02
2 — 15299 HP, 100.0% Load, Elev. 100 ft, Rel. Humidity 60.0%, Temperature 60.0 Deg. F			
PPMvd at 15% O2	250.00	50.00	25.00
ton/yr	504.45	61.42	17.59
lbm/MMBtu (Fuel LHV)	0.996	0.121	0.035
lbm/(MW-hr) (gas turbine shaft pwr)	10.10	1.23	0.35
lbm/hr	115.17	14.02	4.02
3 — 14774 HP, 100.0% Load, Elev. 100 ft, Rel. Humidity 60.0%, Temperature 75.0 Deg. F			
PPMvd at 15% O2	250.00	50.00	25.00
ton/yr	488.98	59.54	17.05
lbm/MMBtu (Fuel LHV)	0.991	0.121	0.035
lbm/(MW-hr) (gas turbine shaft pwr)	10.13	1.23	0.35
lbm/hr	111.64	13.59	3.89

Notes

1. For short-term emission limits such as lbs/hr., Solar recommends using "worst case" anticipated operating conditions specific to the application and the site conditions. Worst case for one pollutant is not necessarily the same for another.
2. Solar's typical SoLoNOx warranty, for ppm values, is available for greater than 0 deg F or -20 deg C, and between 50% and 100% load for gas, fuel, and between 65% and 100% load for liquid fuel (except f or the Centaur 40). An emission warranty for non-SoLoNOx equipment is available for greater than 0 deg F or -20 deg C and betwee
3. Fuel must meet Solar standard fuel specification ES 9-98. Emissions are based on the attached fuel composition, or, San Diego natural gas or equivalent.
4. If needed, Solar can provide Product Information Letters to address turbine operation outside typical warranty ranges, as well as non-warranted emissions of SO2, PM10/2.5, VOC, and formaldehyde.
5. Solar can provide factory testing in San Diego to ensure the actual unit(s) meet the above values within the tolerances quoted. Pricing and schedule impact will be provided upon request.
6. Any emissions warranty is applicable only for steady-state conditions and does not apply during start-up, shut-down, malfunction, or transient event.

Solar Turbines
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PREDICTED EMISSION PERFORMANCE

Customer **Shell**	Engine Model **MARS 100-16000** **CS/MD HIGH AMBIENT**
Job ID	Fuel Type: **SD NATURAL GAS** / Water Injection: **NO**
Inquiry Number	Engine Emissions Data **REV. 1.0**
Run By: **Randall G Carroll** / Date Run: **19-Jul-18**	

	NOx EMISSIONS	CO EMISSIONS	UHC EMISSIONS
4 — 14584 HP, 100.0% Load, Elev. 100 ft, Rel. Humidity 60.0%, Temperature 80.0 Deg. F			
PPMvd at 15% O2	250.00	50.00	25.00
ton/yr	483.35	58.85	16.85
lbm/MMBtu (Fuel LHV)	0.989	0.120	0.035
lbm/(MW-hr) (gas turbine shaft pwr)	10.15	1.24	0.35
lbm/hr	110.35	13.44	3.85
5 — 14352 HP, 100.0% Load, Elev. 100 ft, Rel. Humidity 60.0%, Temperature 85.0 Deg. F			
PPMvd at 15% O2	250.00	50.00	25.00
ton/yr	476.80	58.06	16.63
lbm/MMBtu (Fuel LHV)	0.987	0.120	0.034
lbm/(MW-hr) (gas turbine shaft pwr)	10.17	1.24	0.35
lbm/hr	108.86	13.25	3.80
6 — 14110 HP, 100.0% Load, Elev. 100 ft, Rel. Humidity 60.0%, Temperature 90.0 Deg. F			
PPMvd at 15% O2	250.00	50.00	25.00
ton/yr	470.01	57.23	16.39
lbm/MMBtu (Fuel LHV)	0.985	0.120	0.034
lbm/(MW-hr) (gas turbine shaft pwr)	10.20	1.24	0.36
lbm/hr	107.31	13.07	3.74

Notes

1. For short-term emission limits such as lbs/hr., Solar recommends using "worst case" anticipated operating conditions specific to the application and the site conditions. Worst case for one pollutant is not necessarily the same for another.
2. Solar's typical SoLoNOx warranty, for ppm values, is available for greater than 0 deg F or -20 deg C, and between 50% and 100% load for gas, fuel, and between 65% and 100% load for liquid fuel (except f or the Centaur 40). An emission warranty for non-SoLoNOx equipment is available for greater than 0 deg F or -20 deg C and betwee
3. Fuel must meet Solar standard fuel specification ES 9-98. Emissions are based on the attached fuel composition, or, San Diego natural gas or equivalent.
4. If needed, Solar can provide Product Information Letters to address turbine operation outside typical warranty ranges, as well as non-warranted emissions of SO2, PM10/2.5, VOC, and formaldehyde.
5. Solar can provide factory testing in San Diego to ensure the actual unit(s) meet the above values within the tolerances quoted. Pricing and schedule impact will be provided upon request.
6. Any emissions warranty is applicable only for steady-state conditions and does not apply during start-up, shut-down, malfunction, or transient event.

Solar Turbines
A Caterpillar Company

PREDICTED ENGINE PERFORMANCE

Customer *Shell*	Model **MARS 100-16000**
	Package Type **CS/MD**
Job ID	Match **HIGH AMBIENT**
Run By: **Randall G Carroll** — Date Run: **19-Jul-18**	Fuel System **GAS**
Engine Performance Code: **REV. 4.20.1.22.12** — Engine Performance Data: **REV. 1.1**	Fuel Type **SD NATURAL GAS**

DATA FOR NOMINAL PERFORMANCE

Elevation	feet	100
Inlet Loss	in H2O	4.0
Exhaust Loss	in H2O	4.0
Accessory on GP Shaft	HP	27.8

		1	2	3	4	5	6
Engine Inlet Temperature	deg F	59.0	60.0	75.0	80.0	85.0	90.0
Relative Humidity	%	60.0	60.0	60.0	60.0	60.0	60.0
Driven Equipment Speed	RPM	9021	9020	9012	9005	8990	8972
Specified Load	HP	FULL	FULL	FULL	FULL	FULL	FULL
Net Output Power	HP	15336	15299	14774	14584	14352	14110
Fuel Flow	mmBtu/hr	115.87	115.65	112.61	111.53	110.27	109.00
Heat Rate	Btu/HP-hr	7555	7559	7622	7648	7684	7725
Therm Eff	%	33.677	33.661	33.384	33.271	33.115	32.938
Engine Exhaust Flow	lbm/hr	337824	337186	327563	324185	320600	316847
PT Exit Temperature	deg F	901	901	911	914	918	922
Exhaust Temperature	deg F	901	901	911	914	918	922

Fuel Gas Composition (Volume Percent)

Methane (CH4)	92.79
Ethane (C2H6)	4.16
Propane (C3H8)	0.84
N-Butane (C4H10)	0.18
N-Pentane (C5H12)	0.04
Hexane (C6H14)	0.04
Carbon Dioxide (CO2)	0.44
Hydrogen Sulfide (H2S)	0.0001
Nitrogen (N2)	1.51

Fuel Gas Properties

LHV (Btu/Scf)	939.2	Specific Gravity	0.5970	Wobbe Index at 60F	1215.6

This performance was calculated with a basic inlet and exhaust system. Special equipment such as low noise silencers, special filters, heat recovery systems or cooling devices will affect engine performance. Performance shown is "Expected" performance at the pressure drops stated, not guaranteed.

Solar Turbines
A Caterpillar Company

PREDICTED EMISSION PERFORMANCE

Customer: **Shell Vito**	Engine Model: **TAURUS 70-10801 Axial GSC STANDARD**
Job ID:	
Inquiry Number:	Fuel Type: **DIESEL 2-D** / Water Injection: **NO**
Run By: **Randall G Carroll** / Date Run: **18-Jul-18**	Engine Emissions Data: **REV. 0.2**

	NOx EMISSIONS	CO EMISSIONS	UHC EMISSIONS
1 — 7155 kW, 100.0% Load, Elev. 100 ft, Rel. Humidity 60.0%, Temperature 59.0 Deg. F			
PPMvd at 15% O2	350.00	50.00	25.00
ton/yr	465.25	40.46	11.59
lbm/MMBtu (Fuel LHV)	1.431	0.124	0.036
lbm/(MW-hr) (gas turbine shaft pwr)	14.18	1.23	0.35
lbm/hr	106.22	9.24	2.65
2 — 7122 kW, 100.0% Load, Elev. 100 ft, Rel. Humidity 60.0%, Temperature 60.0 Deg. F			
PPMvd at 15% O2	350.00	50.00	25.00
ton/yr	463.67	40.33	11.55
lbm/MMBtu (Fuel LHV)	1.431	0.124	0.036
lbm/(MW-hr) (gas turbine shaft pwr)	14.20	1.24	0.35
lbm/hr	105.86	9.21	2.64
3 — 6641 kW, 100.0% Load, Elev. 100 ft, Rel. Humidity 60.0%, Temperature 75.0 Deg. F			
PPMvd at 15% O2	350.00	50.00	25.00
ton/yr	439.79	38.25	10.95
lbm/MMBtu (Fuel LHV)	1.425	0.124	0.035
lbm/(MW-hr) (gas turbine shaft pwr)	14.45	1.26	0.36
lbm/hr	100.41	8.73	2.50

Notes

1. For short-term emission limits such as lbs/hr., Solar recommends using "worst case" anticipated operating conditions specific to the application and the site conditions. Worst case for one pollutant is not necessarily the same for another.
2. Solar's typical SoLoNOx warranty, for ppm values, is available for greater than 0 deg F or -20 deg C, and between 50% and 100% load for gas, fuel, and between 65% and 100% load for liquid fuel (except f or the Centaur 40). An emission warranty for non-SoLoNOx equipment is available for greater than 0 deg F or -20 deg C and betwee
3. Fuel must meet Solar standard fuel specification ES 9-98. Emissions are based on the attached fuel composition, or, San Diego natural gas or equivalent.
4. If needed, Solar can provide Product Information Letters to address turbine operation outside typical warranty ranges, as well as non-warranted emissions of SO2, PM10/2.5, VOC, and formaldehyde.
5. Solar can provide factory testing in San Diego to ensure the actual unit(s) meet the above values within the tolerances quoted. Pricing and schedule impact will be provided upon request.
6. Any emissions warranty is applicable only for steady-state conditions and does not apply during start-up, shut-down, malfunction, or transient event.

Solar Turbines
A Caterpillar Company

PREDICTED EMISSION PERFORMANCE

Customer **Shell Vito**	Engine Model **TAURUS 70-10801 Axial** **GSC STANDARD**
Job ID	
Inquiry Number	Fuel Type: **DIESEL 2-D** — Water Injection: **NO**
Run By: **Randall G Carroll** — Date Run: **18-Jul-18**	Engine Emissions Data **REV. 0.2**

	NOx EMISSIONS	CO EMISSIONS	UHC EMISSIONS
4 — 6474 kW, 100.0% Load, Elev. 100 ft, Rel. Humidity 60.0%, Temperature 80.0 Deg. F			
PPMvd at 15% O2	350.00	50.00	25.00
ton/yr	431.73	37.55	10.75
lbm/MMBtu (Fuel LHV)	1.422	0.124	0.035
lbm/(MW-hr) (gas turbine shaft pwr)	14.55	1.27	0.36
lbm/hr	98.57	8.57	2.46
5 — 6295 kW, 100.0% Load, Elev. 100 ft, Rel. Humidity 60.0%, Temperature 85.0 Deg. F			
PPMvd at 15% O2	350.00	50.00	25.00
ton/yr	423.55	36.84	10.55
lbm/MMBtu (Fuel LHV)	1.418	0.123	0.035
lbm/(MW-hr) (gas turbine shaft pwr)	14.68	1.28	0.37
lbm/hr	96.70	8.41	2.41
6 — 6124 kW, 100.0% Load, Elev. 100 ft, Rel. Humidity 60.0%, Temperature 90.0 Deg. F			
PPMvd at 15% O2	350.00	50.00	25.00
ton/yr	415.53	36.14	10.35
lbm/MMBtu (Fuel LHV)	1.415	0.123	0.035
lbm/(MW-hr) (gas turbine shaft pwr)	14.80	1.29	0.37
lbm/hr	94.87	8.25	2.36

Notes

1. For short-term emission limits such as lbs/hr., Solar recommends using "worst case" anticipated operating conditions specific to the application and the site conditions. Worst case for one pollutant is not necessarily the same for another.
2. Solar's typical SoLoNOx warranty, for ppm values, is available for greater than 0 deg F or -20 deg C, and between 50% and 100% load for gas, fuel, and between 65% and 100% load for liquid fuel (except f or the Centaur 40). An emission warranty for non-SoLoNOx equipment is available for greater than 0 deg F or -20 deg C and betwee
3. Fuel must meet Solar standard fuel specification ES 9-98. Emissions are based on the attached fuel composition, or, San Diego natural gas or equivalent.
4. If needed, Solar can provide Product Information Letters to address turbine operation outside typical warranty ranges, as well as non-warranted emissions of SO2, PM10/2.5, VOC, and formaldehyde.
5. Solar can provide factory testing in San Diego to ensure the actual unit(s) meet the above values within the tolerances quoted. Pricing and schedule impact will be provided upon request.
6. Any emissions warranty is applicable only for steady-state conditions and does not apply during start-up, shut-down, malfunction, or transient event.

Solar Turbines
A Caterpillar Company

PREDICTED ENGINE PERFORMANCE

Customer: **Shell Vito**	Model: **TAURUS 70-10801 Axial**
Job ID:	Package Type: **GSC**
Run By: **Randall G Carroll**	Match: **STANDARD**
Date Run: **18-Jul-18**	Fuel System: **DUAL**
Engine Performance Code: **REV. 4.20.1.22.12**	Fuel Type: **DIESEL 2-D**
Engine Performance Data: **REV. 1.0**	

DATA FOR NOMINAL PERFORMANCE

Specific Gravity of Fuel		0.850
Elevation	feet	100
Inlet Loss	in H2O	4.0
Exhaust Loss	in H2O	10.0

		1	2	3	4	5	6
Engine Inlet Temperature	deg F	59.0	60.0	75.0	80.0	85.0	90.0
Relative Humidity	%	60.0	60.0	60.0	60.0	60.0	60.0
Gearbox Efficiency		0.9850	0.9850	0.9850	0.9850	0.9850	0.9850
Generator Efficiency		0.9700	0.9700	0.9700	0.9700	0.9700	0.9700
Based On 1.0 Power Factor							
Specified Load*	kW	FULL	FULL	FULL	FULL	FULL	FULL
Net Output Power*	kW	7155	7122	6641	6474	6295	6124
Fuel Flow	mmBtu/hr	74.21	73.97	70.48	69.33	68.17	67.06
Heat Rate*	Btu/kW-hr	10371	10386	10613	10708	10829	10950
Therm Eff*	%	32.901	32.854	32.151	31.866	31.508	31.160
Engine Exhaust Flow	lbm/hr	210909	210354	201898	198908	195887	192882
PT Exit Temperature	deg F	927	928	941	947	953	959
Exhaust Temperature	deg F	927	928	941	947	953	959

**Electric power measured at the generator terminals.*

This performance was calculated with a basic inlet and exhaust system. Special equipment such as low noise silencers, special filters, heat recovery systems or cooling devices will affect engine performance. Performance shown is "Expected" performance at the pressure drops stated, not guaranteed.

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A Caterpillar Company

PREDICTED EMISSION PERFORMANCE

Customer **Shell Vito**	Engine Model **TAURUS 70-10801 Axial** **GSC STANDARD**
Job ID	
Inquiry Number	Fuel Type: **SD NATURAL GAS** — Water Injection: **NO**
Run By: **Randall G Carroll** — Date Run: **18-Jul-18**	Engine Emissions Data **REV. 0.2**

1 — 7698 kW, 100.0% Load, Elev. 100 ft, Rel. Humidity 60.0%, Temperature 59.0 Deg. F

	NOx EMISSIONS	CO EMISSIONS	UHC EMISSIONS
PPMvd at 15% O2	235.00	50.00	25.00
ton/yr	320.80	41.55	11.90
lbm/MMBtu (Fuel LHV)	0.936	0.121	0.035
lbm/(MW-hr) (gas turbine shaft pwr)	9.09	1.18	0.34
lbm/hr	73.24	9.49	2.72

2 — 7663 kW, 100.0% Load, Elev. 100 ft, Rel. Humidity 60.0%, Temperature 60.0 Deg. F

	NOx EMISSIONS	CO EMISSIONS	UHC EMISSIONS
PPMvd at 15% O2	235.00	50.00	25.00
ton/yr	319.68	41.41	11.86
lbm/MMBtu (Fuel LHV)	0.936	0.121	0.035
lbm/(MW-hr) (gas turbine shaft pwr)	9.10	1.18	0.34
lbm/hr	72.99	9.45	2.71

3 — 7169 kW, 100.0% Load, Elev. 100 ft, Rel. Humidity 60.0%, Temperature 75.0 Deg. F

	NOx EMISSIONS	CO EMISSIONS	UHC EMISSIONS
PPMvd at 15% O2	235.00	50.00	25.00
ton/yr	303.15	39.27	11.25
lbm/MMBtu (Fuel LHV)	0.932	0.121	0.035
lbm/(MW-hr) (gas turbine shaft pwr)	9.22	1.19	0.34
lbm/hr	69.21	8.97	2.57

Notes

1. For short-term emission limits such as lbs/hr., Solar recommends using "worst case" anticipated operating conditions specific to the application and the site conditions. Worst case for one pollutant is not necessarily the same for another.
2. Solar's typical SoLoNOx warranty, for ppm values, is available for greater than 0 deg F or -20 deg C, and between 50% and 100% load for gas, fuel, and between 65% and 100% load for liquid fuel (except f or the Centaur 40). An emission warranty for non-SoLoNOx equipment is available for greater than 0 deg F or -20 deg C and betwee
3. Fuel must meet Solar standard fuel specification ES 9-98. Emissions are based on the attached fuel composition, or, San Diego natural gas or equivalent.
4. If needed, Solar can provide Product Information Letters to address turbine operation outside typical warranty ranges, as well as non-warranted emissions of SO2, PM10/2.5, VOC, and formaldehyde.
5. Solar can provide factory testing in San Diego to ensure the actual unit(s) meet the above values within the tolerances quoted. Pricing and schedule impact will be provided upon request.
6. Any emissions warranty is applicable only for steady-state conditions and does not apply during start-up, shut-down, malfunction, or transient event.

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PREDICTED EMISSION PERFORMANCE

Customer **Shell Vito**	Engine Model **TAURUS 70-10801 Axial** **GSC STANDARD**
Job ID	
Inquiry Number	Fuel Type: **SD NATURAL GAS** — Water Injection: **NO**
Run By: **Randall G Carroll** — Date Run: **18-Jul-18**	Engine Emissions Data **REV. 0.2**

4	6998 kW	100.0% Load	Elev. 100 ft	Rel. Humidity 60.0%	Temperature 80.0 Deg. F

	NOx EMISSIONS	CO EMISSIONS	UHC EMISSIONS
PPMvd at 15% O2	235.00	50.00	25.00
ton/yr	297.48	38.53	11.04
lbm/MMBtu (Fuel LHV)	0.930	0.120	0.034
lbm/(MW-hr)	9.27	1.20	0.34
(gas turbine shaft pwr) lbm/hr	67.92	8.80	2.52

5	6816 kW	100.0% Load	Elev. 100 ft	Rel. Humidity 60.0%	Temperature 85.0 Deg. F

	NOx EMISSIONS	CO EMISSIONS	UHC EMISSIONS
PPMvd at 15% O2	235.00	50.00	25.00
ton/yr	291.86	37.81	10.83
lbm/MMBtu (Fuel LHV)	0.928	0.120	0.034
lbm/(MW-hr)	9.34	1.21	0.35
(gas turbine shaft pwr) lbm/hr	66.64	8.63	2.47

6	6640 kW	100.0% Load	Elev. 100 ft	Rel. Humidity 60.0%	Temperature 90.0 Deg. F

	NOx EMISSIONS	CO EMISSIONS	UHC EMISSIONS
PPMvd at 15% O2	235.00	50.00	25.00
ton/yr	286.36	37.09	10.62
lbm/MMBtu (Fuel LHV)	0.925	0.120	0.034
lbm/(MW-hr)	9.41	1.22	0.35
(gas turbine shaft pwr) lbm/hr	65.38	8.47	2.43

Notes

1. For short-term emission limits such as lbs/hr., Solar recommends using "worst case" anticipated operating conditions specific to the application and the site conditions. Worst case for one pollutant is not necessarily the same for another.
2. Solar's typical SoLoNOx warranty, for ppm values, is available for greater than 0 deg F or -20 deg C, and between 50% and 100% load for gas, fuel, and between 65% and 100% load for liquid fuel (except f or the Centaur 40). An emission warranty for non-SoLoNOx equipment is available for greater than 0 deg F or -20 deg C and betwee
3. Fuel must meet Solar standard fuel specification ES 9-98. Emissions are based on the attached fuel composition, or, San Diego natural gas or equivalent.
4. If needed, Solar can provide Product Information Letters to address turbine operation outside typical warranty ranges, as well as non-warranted emissions of SO2, PM10/2.5, VOC, and formaldehyde.
5. Solar can provide factory testing in San Diego to ensure the actual unit(s) meet the above values within the tolerances quoted. Pricing and schedule impact will be provided upon request.
6. Any emissions warranty is applicable only for steady-state conditions and does not apply during start-up, shut-down, malfunction, or transient event.

Solar Turbines
A Caterpillar Company

PREDICTED ENGINE PERFORMANCE

Customer		Model
Shell Vito		TAURUS 70-10801 Axial
		Package Type: GSC
Job ID:		Match: STANDARD
Run By: Randall G Carroll	Date Run: 18-Jul-18	Fuel System: DUAL
Engine Performance Code: REV. 4.20.1.22.12	Engine Performance Data: REV. 1.0	Fuel Type: SD NATURAL GAS

DATA FOR NOMINAL PERFORMANCE

Elevation	feet	100
Inlet Loss	in H2O	4.0
Exhaust Loss	in H2O	10.0

		1	2	3	4	5	6
Engine Inlet Temperature	deg F	59.0	60.0	75.0	80.0	85.0	90.0
Relative Humidity	%	60.0	60.0	60.0	60.0	60.0	60.0
Gearbox Efficiency		0.9850	0.9850	0.9850	0.9850	0.9850	0.9850
Generator Efficiency		0.9700	0.9700	0.9700	0.9700	0.9700	0.9700
Based On 1.0 Power Factor							
Specified Load*	kW	FULL	FULL	FULL	FULL	FULL	FULL
Net Output Power*	kW	7698	7663	7169	6998	6816	6640
Fuel Flow	mmBtu/hr	78.24	77.98	74.29	73.04	71.83	70.67
Heat Rate*	Btu/kW-hr	10164	10176	10362	10438	10538	10642
Therm Eff*	%	33.572	33.530	32.930	32.689	32.379	32.062
Engine Exhaust Flow	lbm/hr	210490	209924	201381	198371	195351	192342
PT Exit Temperature	deg F	956	957	969	974	980	986
Exhaust Temperature	deg F	956	957	969	974	980	986

Fuel Gas Composition (Volume Percent)

Methane (CH4)	92.79
Ethane (C2H6)	4.16
Propane (C3H8)	0.84
N-Butane (C4H10)	0.18
N-Pentane (C5H12)	0.04
Hexane (C6H14)	0.04
Carbon Dioxide (CO2)	0.44
Hydrogen Sulfide (H2S)	0.0001
Nitrogen (N2)	1.51

Fuel Gas Properties

LHV (Btu/Scf)	939.2	Specific Gravity	0.5970	Wobbe Index at 60F	1215.6

**Electric power measured at the generator terminals.*

This performance was calculated with a basic inlet and exhaust system. Special equipment such as low noise silencers, special filters, heat recovery systems or cooling devices will affect engine performance. Performance shown is "Expected" performance at the pressure drops stated, not guaranteed.

Date:
July 2021

Prepared for:
Shell International Exploration & Production, Inc.

Prepared by:
Ramboll US Consulting, Inc.
Lynnwood, Washington

Project Number:
1690022424

DOCD DISPERSION MODELING REPORT

PROJECT VITO HOST

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FIGURES

TABLES

APPENDICES

Acronyms and Abbreviations

AERMOD	American Meteorological Society/Environmental Protection Agency regulatory model
BOEM	Bureau of Ocean Energy Management
CALPUFF	Puff-based dispersion model, originally developed for California Air Resources Board
CALMET	Meteorological pre-processor from the CALPUFF modeling system
CALPOST	Post-processor program from the CALPUFF modeling system
CAA	Clean Air Act
DOCD	Development Operations Coordination Document
EET	Emissions Exemption Threshold
EP	Exploration Plan
EPA	Environmental Protection Agency
GOMR	Gulf of Mexico Region
km	kilometers
MMIF	Mesoscale Model Interface Program
NAAQS	National Ambient Air Quality Standard
OCD	Offshore and Coastal Dispersion Model
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
PSD	Prevention of Significant Deterioration (an EPA program)
SL	Significance Level
WRF	Weather Research and Forecasting model

1. INTRODUCTION

Shell International Exploration & Production, Inc. (Shell) engaged Ramboll US Consulting, Inc. (Ramboll) to perform modeling analyses in support of a Development Operations Coordination Document (DOCD) for the project named “Vito”. Project Vito is an offshore platform located in the western Gulf of Mexico, with the “host” in lease block MC939 and wells in lease blocks MC940, MC941, and MC984.

Shell provided Ramboll with emissions estimates for both installation years (2021, 2022, and 2023) and operational years (2024-2045). Maximum emission rates are from the installation year 2023 (see Section 2 of this report for an emission summary). Maximum emission rates of total suspended particulate (TSP) and sulfur dioxide (SO_2) are each less than their respective Emission Exemptions Threshold (EET), but maximum emission rates for nitrogen oxides (NOx) are greater than its EET, indicating that a modeling assessment is required for NOx. This report presents the required modeling analysis based on the year of highest emissions, 2023, in support of a DOCD.

The regulatory background on Bureau of Ocean and Energy Management (BOEM) modeling requirements is discussed in the remainder of this section. Section 2 presents EET screening analyses. Section 3 presents Ramboll’s dispersion modeling, with a summary of modeled emission rates and stack parameters followed by model settings, input data sources, and general modeling approach. Finally, Section 4 of this report summarizes the modeling results.

1.1 Regulatory Background

As required by BOEM, assessments of proposed emissions are required in both Exploration Plans (EPs) and DOCDs and should incorporate detail pertinent to the requirements of 30 CFR §550. Specifically: air emissions (30 CFR §550.218 and 550.249), environmental impact assessment (30 CFR §550.227 and 550.261), support vessel and aircraft (30 CFR §550.224 and 550.257), and onshore support facilities (30 CFR §550.225 and 550.258.)

Pursuant to requirements of 30 CFR §550.218 and 550.249 an EP or DOCD must include projected emissions of SO_2, particulate matter (PM_{10} and $PM_{2.5}$), NOx, carbon monoxide (CO), volatile organic compounds (VOC), and TSP that will be generated by the proposed installation activities. Further, the project must also include measures taken to reduce emissions, a description of processes, equipment, fuels and combustibles, and the distance to shore.

30 CFR §550.303 provides Pollution Prevention and Control requirements for new and revised plans and lists formulas to determine if the proposed activities emissions exceed an initial screening. The lessee shall compare the projected annual-total emissions, in tons per year (TPY), from the facility for each pollutant to their respective EET, calculated using the following equations defined at §550.303(d), where “D” is the distance of the proposed facility from the closest onshore area of a State, expressed in statute miles:

CO:	$EET = 3400 \times D^{2/3}$
TSP, SO_2, NOx, and VOC:	$EET = 33.3 \times D$

If the amount of the projected emissions of all pollutants is less than or equal to their respective EETs, then the facility is exempt from further air quality review requirements in 30 CFR §550.303 and no dispersion modeling is required.

If the facility emissions exceed an EET, the lessee must perform air dispersion modeling to determine whether the projected facility emissions result in an onshore ambient air concentration above the significance levels (SLs) listed in 30 CFR §550.303(e)(1), which are summarized in Table 1. The SL for VOC is equivalent to its EET. If a facility's TSP emissions exceed its EET, PM_{10} and $PM_{2.5}$ emissions should be modeled and compared to their respective SLs, as instructed by 30 CFR §550.303(e)(2). If no SL is listed in 30 CFR §550.303(e)(1) for a pollutant (such as 1-hour NO_2) for which a NAAQS has been established, NTL-2020-G02[1] §8.c instructs the lessee to compare maximum modeled design value added to the background concentration with the appropriate NAAQS for that averaging period.

Table 1. BOEM Class II Significance Levels -- Air Pollutant Concentrations (µg/m³)

Air Pollutant	Averaging Period				
	Annual	24 hour	8 hour	3 hour	1 hour
SO_2	1	5	--	25	--
PM_{10}	1	5	--	--	--
$PM_{2.5}$	0.3	1.2	--	--	--
NO_2	1	--	--	--	--
CO	--	--	500	--	2000

Only facility emissions are included in the comparison to the EET, and in further modeling (if required). *Facility*, as used in 30 CFR §550.302 is defined as the following:

> [A]ll installations or devices permanently or temporarily attached to the seabed. They include mobile offshore drilling units (MODUs), even while operating in the "tender assist" mode (i.e., with skid-off drilling units) or other vessels engaged in drilling or downhole operations. They are used for exploration, development, and production activities for oil, gas, or Sulphur and emit or have the potential to emit any air pollutant from one or more sources. They include all floating production systems (FPSs), including column-stabilized-units (CSUs); floating production, storage and offloading facilities (FPSOs); tension-leg platforms (TLPs); spars, etc. During production, multiple installations or devices are a single facility if the installations or devices are at a single site. Any vessel used to transfer production from an offshore facility is part of the facility while it is physically attached to the facility.

Facility emissions do not include mobile support craft (MSC) unless physically attached to the facility. As explained in the preamble to the June 2020 rulemaking,[2] section 5(a)(8) of the Outer Continental Shelf Lands Act (OCSLA) does not require BOEM to consider vessel traffic to and from Outer Continental Shelf (OCS) facilities in order to determine modeling and control requirements. While BOEM has traditionally maintained that the proposed framework for attributing MSC emissions was permissible under section 5(a)(8) of OCSLA, the Solicitor's Office has pointed out that the Secretary's statutory authority under OCSLA is distinct from that of the U.S. Environmental Protection Agency (EPA) under the Clean Air Act (CAA). OCSLA does not require considering attributed emissions from vessels in order to determine modeling and control obligations (Fed. Reg. Vol. 85 No. 109 Pg. 34927).

[1] Notice to Lessees (NTL) and Operators of Federal Oil, Gas, and Sulfur Leases in the Outer Continental Shelf, Gulf of Mexico OCS Region number 2020-G02, available at https://www.boem.gov/sites/default/files/documents/about-boem/NTL-2020-G02.pdf

[2] See https://www.boem.gov/sites/default/files/documents/about-boem/85-FR-34912.pdf

NTL-2020-N02[3] cites 30 CFR §550.218(e) and §550.249(e) and explains that applicants must adhere to 40 CFR 51 Appendix W, the *Guideline on Air Quality Models*. NTL-2020-N02 further explains that BOEM has approved CALPUFF version 5.8.5 for sources more than 50 kilometers (km) from shore and AERMOD v19191 for sources less than 50 km from shore, for use in satisfying the air modeling requirements.

Any facility for which the projected facility emissions result in onshore ambient air concentrations above the SLs is considered to significantly affect the air quality of the onshore area for that pollutant and must control their emissions using Best Available Control Technology (BACT). Additional controls or the purchase of offsets would be required if a nonattainment area were to be significantly impacted by pollutants other than VOC.[4]

2. SCREENING ANALYSES

2.1 Emissions Exemptions Screening

Calculations of emissions of all criteria pollutants were performed using BOEM's emission spreadsheet. As shown in Table 2, only NOx exceeded its EET and is thus the only pollutant required to be evaluated further, pursuant to 30 CFR §550.303. Details on the NOx emissions can be found in Appendix A.

Table 2. EET Screening

	TSP (ton/year)	SOx (ton/year)	NOx (ton/year)	VOC (ton/year)	CO (ton/year)
Total	74.63	2.04	2914.86	1575.66	2066.76
EET(1)	2064.6	2064.6	2064.6	2064.6	53260.7
Exceed EET?	No	No	**Yes**	No	No

(1) EET was calculated using the equations shown in Section 1.1. The distance from shore was 62 miles.

3. DISPERSION MODELING ANALYSIS

To fulfill the requirements of 30 CFR §550.303 outlined in Section 1.1 above, Ramboll performed a dispersion modeling analysis of NOx emitted by the facility's sources. The dispersion modeling followed EPA guidance, including 40 CFR 51 Appendix W (the *Guideline*) as well as NTL-2020-G02 (October 1, 2020) which supersedes BOEM's August 2019 Air Dispersion Modeling Guidelines for the Gulf of Mexico.

3.1 Stack Parameters and Emission Rates

3.1.1 Operational Scenario Stack Parameters and Emission Rates

Stack parameters and emission rates are given in Appendix A. Source parameters are provided in Table A-1 and emission rates are provided in Table . If specific stack parameters are not available, they are represented using pseudo point sources. Pseudo point sources use highly conservative parameters to account for the variety of possible vessel configurations. All equipment was modeled in the most conservative location of lease block MC939. This location was chosen because it is closest to the shoreline which is the worst-case location.

3 Notice to Lessees (NTL) and Operators of Federal Oil, Gas, and Sulfur Leases in the Outer Continental Shelf, Gulf of Mexico OCS Region number 2020-NO2, available at https://www.boem.gov/sites/default/files/documents/about-boem/NTL-2020-N02.pdf.

4 30 CFR 550.303(g)(1)

3.1.2 Dispersion Model Selection

Ramboll used the CALPUFF modeling system to estimate impacts of air pollutants at discrete receptors placed along the States' shoreline areas, because the Vito project is more than 50 km from shore.

On April 15, 2003, EPA adopted the CALPUFF modeling system as the EPA's preferred model for long-range transport assessments and for evaluating potential impacts including CALPUFF in Appendix A of the Guideline. The 2017 revisions to the Guideline removed CALPUFF from Appendix A, but the preamble made it clear that other agencies (e.g. BOEM, FWS) could still choose to use CALPUFF. Features of the CALPUFF modeling system include the ability to consider: secondary aerosol formation; gaseous and particle deposition; wet and dry deposition processes; complex three-dimensional wind regimes; and the effects of humidity on regional visibility. CALPUFF Version 5.8.5 (release date December 14, 2015) and CALPOST version 6.292 (release date April 6, 2011) were used[5].

In April of 2012, the BOEM director first approved the use of CALPUFF for sources greater than 50 km from shore. NTL-2020-N02 clarified that CALPUFF version 5.8.5 should be used, and that AERMOD v19191 should be used for sources less than 50 km from shore.

NTL-2020-G02 §3 explains that lessees may use BOEM's recent meteorological dataset for dispersion modeling. For BOEM's Air Quality Modeling in the Gulf of Mexico Region study[6], Ramboll ran a 5-year (2010-2014) WRF simulation with 4 km horizontal resolution. Alpine Geophysics used the Mesoscale Model Interface Program (MMIF[7]) version 3.2 to extract three sub-domains of the full WRF domain. Although these MMIF extractions were originally intended for a different use, they have been made publicly available[8]. Ramboll used the "central" domain, shown in **Error! Reference source not found.** by the blue box. For the sake of simplicity, the full MMIF domain was used as the CALPUFF modeling domain.

3.1.3 Building Downwash (Prime Algorithm)

Building downwash is the effect of nearby structures on the flow of emissions from their respective sources. However, Ramboll did not account for building downwash effects as part of the modeling approach because downwash effects are negligible at large source-receptor distances.

The details of stack exit velocity or temperature at various engine loads also have an insignificant effect at these source-receptor distances, and only the magnitude of emissions has a significant effect on predicted concentrations.

3.1.4 Averaging Periods

CALPUFF-predicted hourly pollutant concentrations were averaged for comparison with applicable 1-hour NO_2 NAAQS and annual NO_2 SL. In all instances, comparisons with regulatory criteria were based on the highest model prediction of the five-year simulation for the averaging period, which is more conservative than the maximum *design value* called for in NTL-2020-G02 §8.c.

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[5] See http://www.src.com/

[6] See https://espis.boem.gov/final%20reports/BOEM_2019-057.PDF

[7] See https://www.epa.gov/scram/air-quality-dispersion-modeling-related-model-support-programs#mmif

[8] See https://boem.gcoos.org/

3.1.5 Chemical Transformations

The NOx chemistry in CALPUFF was turned off because EPA has never approved CALPUFF's chemistry algorithms. It is conservatively assumed that 100 percent of NOx is converted to NO_2. NTL-2020-G02 does not offer guidance on the use of NOx chemistry.

3.1.6 Domain and Receptors

The domain for the CALPUFF simulations is shown in Figure 1. The CALPUFF computational grid was taken to be the full MMIF v3.2 grid, using points 1 to 239 in the X direction (East) and points 1 to 200 in the Y direction (North). The domain includes a 50+ km buffer past the receptors, and a 100+ km buffer around the lease block to allow for re-circulation of puffs. A Lambert Conformal Conic Coordinate system was used for the coordinates, inherited from the WRF projection because MMIF does not interpolate or re-project datasets.

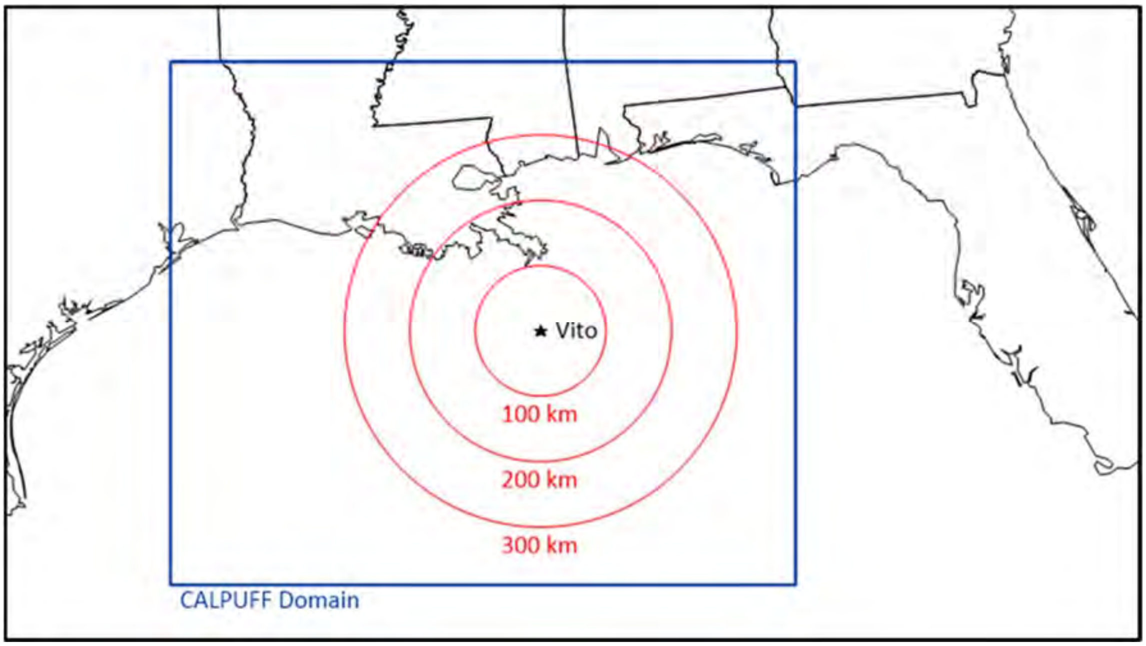


Figure 1. Vito Location, Modeling Domain (blue)

Class II discrete receptors were placed at 4 km intervals along the line defining the shore [according to United States Geological survey (USGS) Geographic Information System (GIS) information downloaded from the Internet.] Gridded receptors were turned off in the CALPUFF runs to make the runtimes more reasonable.

4. RESULTS

The results of the modeling simulations using the MMIF v3.2 meteorological data set are presented in Table 3 below.

Table 3. Vito DOCD Modeling Results

Receptor Class	Standard	Receptor Set	Vito (µg/m³)	Threshold (µg/m³)	Criteria	Pass?
Class II	NO_2 1-hr	Shoreline	90[(1)]	188	NAAQS	Yes

	NO_2 Annual	Shoreline	0.076	1	SL	Yes
(1) Background added using EPA 2018-2020 NO_2 Design Value (DV) at Kenner, LA, 36 ppb (67.7 μg/m^3)						

NOx has been assumed to be 100% NO_2, following NTL-2020-G02 §8.e.

Following NTL-2020-G02 §8.c, the model-predicted 1-hour concentration was added to the EPA's published 2020 Design Value[9] for the Kenner site and compared to the 1-hr NO_2 NAAQS. For this analysis, the maximum predicted hourly value (H1H) rather than the maximum design value (H8H max daily) was used (a conservative simplification). As shown in Table 3 above, the total 1-hour NO_2 concentration is below the NAAQS; therefore, compliance has been demonstrated.

As shown, model-predicted maximum annual concentrations are below the annual NO_2 SL; therefore, annual NAAQS modeling is not required.

This analysis demonstrates that emissions from activities at Vito will not significantly affect the air quality of an onshore area or a State, in accordance with 30 CFR 550.303(f). Therefore, no further analysis is required.

[9] EPA's published design values can be found at https://www.epa.gov/air-trends/air-quality-design-values#report

APPENDIX A
VITO STACK PARAMETERS & EMISSION RATES

Table A-1. Point Source Stack Parameters Used in CALPUFF Modeling Analysis

Source	Source ID	X-Coord (km)	Y-Coord (km)	Exit Height (m)	Exit Diameter (m)	Exit Velocity (m/s)	Exit Temp (K)
VESSELS - SDH & Flex Jumpers, Diesel	VSFD	770.112	- 1295.888	6.1	0.001	0.001	533
VESSELS - Flowline Jumper Installation	VFJI	770.112	- 1295.888	6.1	0.001	0.001	533
RECIP.<600hp Diesel - Misc Small Temp Equipment	RCP1	770.112	- 1295.888	36.1	0.001	0.001	533
RECIP.>600hp Diesel - Misc Large Temp Equipment	RCP2	770.112	- 1295.888	36.1	0.001	0.001	533
RECIP Diesel Fire Pump #1	DFP1	770.112	- 1295.888	4.307	0.2	0.001	533
RECIP Diesel Fire Pump #2	DFP2	770.112	- 1295.888	4.3	0.2	0.001	533
DIESEL CRANE ENGINE #1	DCE 1	770.112	- 1295.888	15.65	0.1	0.001	533
DIESEL CRANE ENGINE #2	DCE2	770.112	- 1295.888	15.65	0.1	0.001	533
RECIP Emergency Generator - Diesel	EGEN	770.112	- 1295.888	5.12	0.45	0.001	533
LIFE BOATS - Diesel	LB	770.112	- 1295.888	6.1	0.001	0.001	533
Natural Gas Turbine - Mars 100 #1	MARS1	770.112	- 1295.888	13.89	2.3	0.001	533
Natural Gas Turbine - Mars 100 #2	MARS2	770.112	- 1295.888	13.89	2.3	0.001	533
Dual Fuel Turbine - Taurus 70 #1, Diesel	DFT1	770.112	- 1295.888	13.112	1.89	0.001	533
Dual Fuel Turbine - Taurus 70 #1, Nat Gas	DFT2	770.112	- 1295.888	13.112	1.89	0.001	533
Dual Fuel Turbine - Taurus 70 #2, Diesel	DFT3	770.112	- 1295.888	13.112	1.89	0.001	533

Source	Source ID	X-Coord (km)	Y-Coord (km)	Exit Height (m)	Exit Diameter (m)	Exit Velocity (m/s)	Exit Temp (K)
Dual Fuel Turbine - Taurus 70 #2, Nat Gas	DFT4	770.112	- 1295.888	13.112	1.89	0.001	533
Dual Fuel Turbine - Taurus 70 #3, Diesel	DFT5	770.112	- 1295.888	13.112	1.89	0.001	533
Dual Fuel Turbine - Taurus 70 #3, Nat Gas	DFT6	770.112	- 1295.888	13.112	1.89	0.001	533
Dual Fuel Turbine - Taurus 70 #4, Diesel	DFT7	770.112	- 1295.888	13.112	1.89	0.001	533
Dual Fuel Turbine - Taurus 70 #4, Nat Gas	DFT8	770.112	- 1295.888	13.112	1.89	0.001	533
COMBUSTION FLARE - no smoke	CF1	770.112	- 1295.888	54.39	1.75	20	1273
COMBUSTION FLARE - medium smoke	CF3	770.112	- 1295.888	54.39	1.75	20	1273

Table A-2. Emission Rates from Stacks Used in the Modeling Analysis

Source ID	NOx	
	lb/hr	TPY
VSFD	440.64	52.88
VFJI	361.53	151.84
RCP1	18.65	61.27
RCP2	24.03	78.94
DFP1	25.57	0.66
DFP2	25.57	0.66
DCE 1	12.98	56.84
DCE2	12.98	56.84
EGEN	54.12	1.41
LB	10.29	0.27
MARS1	106.79	467.73
MARS2	106.79	467.73
DFT1	99.30	18.12
DFT2	63.63	267.10
DFT3	99.30	18.12
DFT4	63.63	267.10
DFT5	99.30	18.12
DFT6	63.63	267.10
DFT7	99.30	18.12
DFT8	63.63	267.10
CF1	0.03	0.00
CF3	86.05	376.89
Total		**2914.86**
EET		**2064.60**
Exceed EET?		**Yes**

COMPANY	Shell Offshore Inc.
AREA	Mississippi Canyon
BLOCK	940
LEASE	OCS-G31534
FACILITY	Vito Subsea Field (tieback to Vito Platfom, MC-939, ID TBD)
WELL	VA001,VA002, VA003, VA004, VA005, VA006, VA007, VA008, VA009, VA010, VA010-ALT, VA011, VA011-ALT, VA012, VA012-ALT
COMPANY CONTACT	Josh O'Brien
TELEPHONE NO.	504-425-9097
REMARKS	Revised DOCD MODU (Drillship or DP Semi-sub) Subsea Installation, well work (incl. workover for all Vito wells) No non-default emission factors were used in this AQR. Emission reduction measures are included in this AQR for VESSELS- Drilling - Propulsion Engine - Diesel and VESSELS - Well Stimulation. For vessels listed under "Pipeline Installation" section of Emissions tab see Footnote (1) on emissions tab for description of activities covered by General Service Vessels. "VESSELS - Well Stimulation" listed under "Production" section of Emissions tab will occur at the subsea drill center. Some activities associated with these sources, specifically Service Vessels, are not currently planned but are included as a contingency, per BOEM guidance, AIR EMISSIONS CALCULATIONS INSTRUCTIONS FOR DPPs/DOCDs and PRA Statement, https://www.boem.gov/sites/default/files/documents/newsroom/BOEM-0139-Instructions-July-2020.pdf. Therefore, the schedule in Form BOEM-0137 will not match the days presented in the AQR. Vito DOCD AQR DC WW INST MODU 20210526-BOEM.xlsx

LEASE TERM PIPELINE CONSTRUCTION INFORMATION:

YEAR	NUMBER OF PIPELINES	TOTAL NUMBER OF CONSTRUCTION DAYS
2022		
2023		
2024		
2025		
2026		
2027		
2028		
2029		
2030		
2031		

Fuel Limit Basis

Purpose

Shell has reviewed engine information for its GOM fleet of Drillship and DP semi-sub MODUs. Of the proposed MODUs, the highest fuel consumption is Shell's contracted Transocean Deepwater MODUs, which has six, main engines of 9,387 hp/engine. (Shell's contracted Noble MODUs have lower total horsepower and fuel consumption.) The projected fuel usages presented below would therefore be conservative across the fleet of Drillships and DP Semi-subs.

Step 1 - Determine Typical Operating Loads

Description	Value	Notes
Actual average daily fuel use (gal/day)	13,006	Based on daily fuel records for the Deepwater Thalassa from January 1, 2016 to December 31, 2016.
Contingency factor	1.55	The contingency factor is used to allow for more usage if need be.
Proposed MODU Campaign Average Daily Fuel Use (gal/day)	20,160	Calculated Value - PTE fuel use * Proposed Operating Load and rounded up to nearest thousand (for additional conservatism). This represents total fuel use on the MODU and is allocated equally amongst the six prime movers.
2022-2025 Annual Fuel Limits, MMGals	5,443,200	Calculated Value - Campaign Average Daily Fuel Use * Campaign Days
2026-2045 Annual Fuel Limits, MMGals	4,536,000	Calculated Value - Campaign Average Daily Fuel Use * Campaign Days

Step 2 - Determine Typical Frac Vessel Operating Loads

Description	Value	Notes
Actual average daily fuel use (gal/day)	8,356	Based on available daily fuel records for the Shell contracted Fracturing/Stimulation Vessels at subsea assets from January 1, 2020 to December 31, 2020.
Contingency factor	2.50	The contingency factor is used to allow for more usage if need be.
Proposed MODU Campaign Average Daily Fuel Use (gal/day)	21,000	Calculated Value - PTE fuel use * Proposed Operating Load and rounded up to nearest thousand (for additional conservatism). This represents total fuel use on the MODU and is allocated equally amongst the six prime movers.
2022-2025 Annual Fuel Limits, MMGals	210,000	Calculated Value - Campaign Average Daily Fuel Use * Campaign Days
2026-2045 Annual Fuel Limits, MMGals	126,000	Calculated Value - Campaign Average Daily Fuel Use * Campaign Days

Additional Notes

1 - Operating loads are campaign specific and may change in future AQRs depending on the future fuel usage tracking. Fuel levels depicted in this AQR does not restrict Shell from using a different value in future AQRs.

2 - If tracked fuel usage associated with this activity indicates emissions may exceed the approved emissions, Shell will submit revised AQR calculations.

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	0.0001	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/ch01/final/c01s03.pdf https://cfpub.epa.gov/webfire/
Diesel Turbine	g/hp-hr	0.0381	0.0137	0.0137	0.0048	2.7941	0.0013	0.0000	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	0.0000	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	0.0000	1.2025	0.0022	USEPA 2017 NEI;TSP refer to Diesel Recip. > 600 hp reference	3/19	
Vessels – Drilling Prime Engine, Auxiliary	g/hp-hr	0.320	0.1931	0.1873	0.0047	7.6669	0.2204	0.0000	1.2025	0.0022	USEPA 2017 NEI;TSP refer to Diesel Recip. > 600 hp reference	3/19	https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-data
Vessels – Diesel Boiler	g/hp-hr	0.0466	0.1491	0.1417	0.4400	1.4914	0.0820	0.0000	0.1491	0.0003	USEPA 2017 NEI;TSP (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	0.0000	1.2025	0.0022	USEPA 2017 NEI;TSP 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	0.00	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 https://cfpub.epa.gov/webfire/
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	0.0001	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-gulfwid emission-inventory
Fugitives	lbs/hr/component						0.0005				API Study	12/93	https://www.apiwebstore.org/publications/item.cgi?9879d38a-8bc0-4abe bb5c-9b623870125d
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-gulfwid 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-gulfwid 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_N oom/Library/Publications/2014-1001.pdf
Vessels - Ice Management Diesel	g/hp-hr	0.320	0.1931	0.1873	0.0047	7.6669	0.2204	0.0000	1.2025	0.0022	USEPA 2017 NEI;TSP refer to Diesel Recip. > 600 hp reference	3/19	https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-data
Vessels - Hovercraft Diesel	g/hp-hr	0.320	0.1931	0.1873	0.0047	7.6669	0.2204	0.0000	1.2025	0.0022	USEPA 2017 NEI;TSP 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 CALCULATIONS - 2022-2025

COMPANY	AREA		BLOCK	LEASE	FACILITY	WELL	CONTACT	PHONE	REMARKS
Shell Offshore Inc.	Mississippi Canyon		940	OCS-G31534	Vito Subsea Field (tieback to Vito Platfom, MC-939, ID TBD)	VA001,VA002, VA003, VA004, VA005, VA006, VA007, VA008, VA009, VA010, VA010-ALT, VA011, VA011-ALT, VA012, VA012-ALT	Josh O'Brien	504-425-9097	Revised DOCD MODU (Drillship or DP Semi-sub) Subsea Installation, well work (incl. workover for all Vito wells) No non-default emission factors were used in this AQR. Emission reduction measures are included in this AQR for VESSELS- Drilling - Propulsion Engine - Diesel and VESSELS - Well Stimulation. For vessels listed under "Pipeline Installation" section of Emissions tab see Footnote (1) on emissions tab for description of activities covered by General Service Vessels. "VESSELS - Well Stimulation" listed under "Production" section of Emissions tab will occur at the subsea drill center. Some activities associated with these sources, specifically Service Vessels, are not currently planned but are included as a contingency, per BOEM guidance, AIR EMISSIONS CALCULATIONS INSTRUCTIONS FOR DPPs/DOCDs and PRA Statement, https://www.boem.gov/sites/default/files/documents/newsroom/BOEM-0139-Instructions-July-2020.pdf. Therefore, the schedule in Form BOEM-0137 will not match the days presented in the AQR. Vito DOCD AQR DC WW INST MODU 20210526-BOEM.xlsx

OPERATIONS	EQUIPMENT	EQUIPMENT ID	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR									ESTIMATED TONS								
	Diesel Engines		HP	GAL/HR	GAL/D																				
	Nat. Gas Engines		HP	SCF/HR	SCF/D																				
	Burners		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, WELL WORK, INSTALLATION	VESSELS- Drilling - Propulsion Engine - Diesel		9387	482.92	3360.00	24	270	6.62	4.00	3.88	0.10	158.67	4.56	0.00	24.89	0.05	6.22	3.75	3.64	0.09	149.03	4.28	0.00	23.38	0.04
	VESSELS- Drilling - Propulsion Engine - Diesel		9387	482.92	3360.00	24	270	6.62	4.00	3.88	0.10	158.67	4.56	0.00	24.89	0.05	6.22	3.75	3.64	0.09	149.03	4.28	0.00	23.38	0.04
	VESSELS- Drilling - Propulsion Engine - Diesel		9387	482.92	3360.00	24	270	6.62	4.00	3.88	0.10	158.67	4.56	0.00	24.89	0.05	6.22	3.75	3.64	0.09	149.03	4.28	0.00	23.38	0.04
	VESSELS- Drilling - Propulsion Engine - Diesel		9387	482.92	3360.00	24	270	6.62	4.00	3.88	0.10	158.67	4.56	0.00	24.89	0.05	6.22	3.75	3.64	0.09	149.03	4.28	0.00	23.38	0.04
	VESSELS- Drilling - Propulsion Engine - Diesel		9387	482.92	3360.00	24	270	6.62	4.00	3.88	0.10	158.67	4.56	0.00	24.89	0.05	6.22	3.75	3.64	0.09	149.03	4.28	0.00	23.38	0.04
	VESSELS- Drilling - Propulsion Engine - Diesel		9387	482.92	3360.00	24	270	6.62	4.00	3.88	0.10	158.67	4.56	0.00	24.89	0.05	6.22	3.75	3.64	0.09	149.03	4.28	0.00	23.38	0.04
	RECIP.<600hp Diesel	Emergency Air C	2547	131.03	3144.79	1	270	5.62	5.62	5.62	0.16	79.17	5.84	--	17.01	--	0.76	0.76	0.76	0.02	10.69	0.79	--	2.30	--
	RECIP.>600hp Diesel	Emergency Gene	26	1.34	32.10	1	270	0.02	0.01	0.01	0.00	0.62	0.02	--	0.14	--	0.00	0.00	0.00	0.00	0.08	0.00	--	0.02	--
PIPELINE INSTALLATION	VESSELS - General Service (MPSV) - Diesel (1)		45000	2315.07	55561.68	24	30	31.75	19.15	18.58	0.46	760.62	21.87	0.00	119.30	0.22	11.43	6.90	6.69	0.17	273.82	7.87	0.00	42.95	0.08
	VESSELS - General Service (MPSV) - Diesel (1)		17025	875.87	21020.84	24	40	12.01	7.25	7.03	0.17	287.77	8.27	0.00	45.14	0.08	5.77	3.48	3.37	0.08	138.13	3.97	0.00	21.67	0.04
PRODUCTION	VESSELS - Well Stimulation		37500	1929.23	21000.00	24	10	26.46	15.96	15.48	0.39	633.85	18.22	0.00	99.42	0.18	1.44	0.87	0.84	0.02	34.50	0.99	0.00	5.41	0.01
2022-2025	**Facility Total Emissions**							**115.58**	**71.96**	**69.97**	**1.76**	**2,714.03**	**81.60**	**0.01**	**430.33**	**0.77**	**56.72**	**34.52**	**33.51**	**0.84**	**1,351.41**	**39.34**	**0.00**	**212.59**	**0.39**
EXEMPTION CALCULATION	**DISTANCE FROM LAND IN MILES**																**2,231.10**			**2,231.10**	**2,231.10**	**2,231.10**		**56,086.99**	
	67.0																								
DRILLING	VESSELS- Fastl/Crew Diesel		8000	411.57	9877.63	24	135	5.64	3.41	3.30	0.08	135.22	3.89	0.00	21.21	0.04	18.29	11.03	10.70	0.27	438.12	12.60	0.00	68.72	0.13
	VESSELS - Supply Diesel		10100	519.60	12470.51	24	270	7.13	4.30	4.17	0.10	170.72	4.91	0.00	26.78	0.05	23.09	13.93	13.51	0.34	553.12	15.90	0.00	86.76	0.16
	VESSELS - Supply Diesel		10100	519.60	12470.51	24	81	7.13	4.30	4.17	0.10	170.72	4.91	0.00	26.78	0.05	6.93	4.18	4.05	0.10	165.94	4.77	0.00	26.03	0.05
	VESSELS - Supply Diesel		10100	519.60	12470.51	24	81	7.13	4.30	4.17	0.10	170.72	4.91	0.00	26.78	0.05	6.93	4.18	4.05	0.10	165.94	4.77	0.00	26.03	0.05
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 - Supply Diesel		12605	648.48	15563.44	24	20	8.89	5.37	5.20	0.13	213.06	6.13	0.00	33.42	0.06	2.13	1.29	1.25	0.03	51.13	1.47	0.00	8.02	0.01
2022-2025	**Non-Facility Total Emissions**							**35.91**	**21.67**	**21.02**	**0.52**	**860.43**	**24.74**	**0.00**	**134.96**	**0.25**	**57.36**	**34.61**	**33.57**	**0.83**	**1,374.25**	**39.51**	**0.00**	**215.55**	**0.40**

(1) VESSELS - General Service (MPSV) - Diesel: The days allocated per year will be for temporary activities of installation/maintenance of flowline, jumpers, flying leads, etc., inspections, equipment maintenance, stimulations, or other service needs; some of which may not occur in any given year and are yet to be planned.

AIR EMISSIONS CALCULATIONS - 2026-2045

COMPANY	AREA	BLOCK	LEASE	FACILITY	WELL	CONTACT	PHONE	REMARKS
Shell Offshore Inc.	Mississippi Canyon	940	OCS-G31534	Vito Subsea Field (tieback to Vito Platfom, MC-939, ID TBD)	VA001,VA002, VA003, VA004, VA005, VA006, VA007, VA008, VA009, VA010, VA010-ALT, VA011, VA011-ALT, VA012, VA012-ALT	Josh O'Brien	504-425-9097	Revised DOCD MODU (Drillship or DP Semi-sub) Subsea Installation, well work (incl. workover for all Vito wells) No non-default emission factors were used in this AQR. Emission reduction measures are included in this AQR for VESSELS- Drilling - Propulsion Engine - Diesel and VESSELS - Well Stimulation. For vessels listed under "Pipeline Installation" section of Emissions tab see Footnote (1) on emissions tab for description of activities covered by General Service Vessels. "VESSELS - Well Stimulation" listed under "Production" section of Emissions tab will occur at the subsea drill center. Some activities associated with these sources, specifically Service Vessels, are not currently planned but are included as a contingency, per BOEM guidance, AIR EMISSIONS CALCULATIONS INSTRUCTIONS FOR DPPs/DOCDs and PRA Statement, https://www.boem.gov/sites/default/files/documents/newsroom/BOEM-0139-Instructions-July-2020.pdf. Therefore, the schedule in Form BOEM-0137 will not match the days presented in the AQR. Vito DOCD AQR DC WW INST MODU 20210526-BOEM.xlsx

OPERATIONS	EQUIPMENT	EQUIPMENT ID	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR									ESTIMATED TONS								
	Diesel Engines		HP	GAL/HR	GAL/D																				
	Nat. Gas Engines		HP	SCF/HR	SCF/D																				
	Burners		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, WELL WORK, INSTALLATION	VESSELS- Drilling - Propulsion Engine - Diesel		9387	482.92	3360.00	24	225	6.62	4.00	3.88	0.10	158.67	4.56	0.00	24.89	0.05	5.18	3.13	3.03	0.08	124.19	3.57	0.00	19.48	0.04
	VESSELS- Drilling - Propulsion Engine - Diesel		9387	482.92	3360.00	24	225	6.62	4.00	3.88	0.10	158.67	4.56	0.00	24.89	0.05	5.18	3.13	3.03	0.08	124.19	3.57	0.00	19.48	0.04
	VESSELS- Drilling - Propulsion Engine - Diesel		9387	482.92	3360.00	24	225	6.62	4.00	3.88	0.10	158.67	4.56	0.00	24.89	0.05	5.18	3.13	3.03	0.08	124.19	3.57	0.00	19.48	0.04
	VESSELS- Drilling - Propulsion Engine - Diesel		9387	482.92	3360.00	24	225	6.62	4.00	3.88	0.10	158.67	4.56	0.00	24.89	0.05	5.18	3.13	3.03	0.08	124.19	3.57	0.00	19.48	0.04
	VESSELS- Drilling - Propulsion Engine - Diesel		9387	482.92	3360.00	24	225	6.62	4.00	3.88	0.10	158.67	4.56	0.00	24.89	0.05	5.18	3.13	3.03	0.08	124.19	3.57	0.00	19.48	0.04
	VESSELS- Drilling - Propulsion Engine - Diesel		9387	482.92	3360.00	24	225	6.62	4.00	3.88	0.10	158.67	4.56	0.00	24.89	0.05	5.18	3.13	3.03	0.08	124.19	3.57	0.00	19.48	0.04
	Vessels - Diesel Boiler		0	[redacted]	[redacted]	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.<600hp Diesel	Emergency Air C	2547	131.03	3144.79	1	225	5.62	5.62	5.62	0.16	79.17	5.84	--	17.01	--	0.63	0.63	0.63	0.02	8.91	0.66	--	1.91	--
	RECIP.>600hp Diesel	Emergency Gene	26	1.34	32.10	1	225	0.02	0.01	0.01	0.00	0.62	0.02	--	0.14	--	0.00	0.00	0.00	0.00	0.07	0.00	--	0.02	--
PIPELINE INSTALLATION	VESSELS - General Service (MPSV) - Diesel (1)		45000	2315.07	55561.68	24	30	31.75	19.15	18.58	0.46	760.62	21.87	0.00	119.30	0.22	11.43	6.90	6.69	0.17	273.82	7.87	0.00	42.95	0.08
	VESSELS - General Service (MPSV) - Diesel (1)		17025	875.87	21020.84	24	40	12.01	7.25	7.03	0.17	287.77	8.27	0.00	45.14	0.08	5.77	3.48	3.37	0.08	138.13	3.97	0.00	21.67	0.04
PRODUCTION	VESSELS - Well Stimulation		37500	1929.23	21000.00	24	6	26.46	15.96	15.48	0.39	633.85	18.22	0.00	99.42	0.18	0.86	0.52	0.51	0.01	20.70	0.60	0.00	3.25	0.01
	MISC.		BPD	SCF/HR	COUNT																				
2026-2045	Facility Total Emissions							115.58	71.96	69.97	1.76	2,714.03	81.60	0.01	430.33	0.77	49.79	30.29	29.40	0.73	1,186.79	34.52	0.00	186.67	0.34
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES																2,231.10			2,231.10	2,231.10	2,231.10		56,086.99	
	67.0																								
DRILLING	VESSELS- Fastl/Crew Diesel		8000	411.57	9877.63	24	112.5	5.64	3.41	3.30	0.08	135.22	3.89	0.00	21.21	0.04	15.24	9.19	8.92	0.22	365.10	10.50	0.00	57.26	0.11
	VESSELS - Supply Diesel		10100	519.60	12470.51	24	225	7.13	4.30	4.17	0.10	170.72	4.91	0.00	26.78	0.05	19.24	11.61	11.26	0.28	460.94	13.25	0.00	72.30	0.13
	VESSELS - Supply Diesel		10100	519.60	12470.51	24	68	7.13	4.30	4.17	0.10	170.72	4.91	0.00	26.78	0.05	5.77	3.48	3.38	0.08	138.28	3.98	0.00	21.69	0.04
	VESSELS - Supply Diesel		10100	519.60	12470.51	24	68	7.13	4.30	4.17	0.10	170.72	4.91	0.00	26.78	0.05	5.77	3.48	3.38	0.08	138.28	3.98	0.00	21.69	0.04
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 - Supply Diesel		12605	648.48	15563.44	24	20	8.89	5.37	5.20	0.13	213.06	6.13	0.00	33.42	0.06	2.13	1.29	1.25	0.03	51.13	1.47	0.00	8.02	0.01
2026-2045	Non-Facility Total Emissions							35.91	21.67	21.02	0.52	860.43	24.74	0.00	134.96	0.25	48.15	29.05	28.18	0.70	1,153.73	33.17	0.00	180.96	0.34

(1) VESSELS - General Service (MPSV) - Diesel: The days allocated per year will be for temporary activities of installation/maintenance of flowline, jumpers, flying leads, etc., inspections, equipment maintenance, stimulations, or other service needs; some of which may not occur in any given year and are yet to be planned.

Vito MODU AIR EMISSIONS CALCULATIONS Summary

COMPANY	AREA	BLOCK	LEASE	FACILITY	WELL
Shell Offshore Inc.	Mississippi Canyon	940	OCS-G31534	Vito Subsea Field (tieback to Vito Platfom, MC-939, ID TBD)	VA001,VA002, VA003, VA004, VA005, VA006, VA007, VA008, VA009, VA010, VA010-ALT, VA011, VA011-ALT, VA012, VA012-ALT

Year	Facility Emitted Substance								
	TSP	PM10	PM2.5	SOx	NOx	VOC	Pb	CO	NH3
2022-2025	56.72	34.52	33.51	0.84	1351.41	39.34	0.00	212.59	0.39
2026-2045	49.79	30.29	29.40	0.73	1186.79	34.52	0.00	186.67	0.34
Allowable	2231.10			2231.10	2231.10	2231.10		56086.99	

SECTION 9: OIL SPILL RESPONSE PLANNING

All the proposed activities and facilities in this plan will be covered by the Regional OSRP filed by Shell Offshore Inc. (0689) in accordance with 30 CFR 254.47 and NTL 2013-N02. Shell's regional OSRP was approved by BSEE in June 2017, the bi-annual review was found to be in compliance November 22, 2019. Updates were found to be in compliance March 23, 2020.

Spill Response Sites:

Primary Response Equipment Locations	Preplanned Staging Location(s)
Ingleside, TX; Galveston, TX; Venice, LA; Ft Jackson, LA; Harvey, LA; Stennis, MS; Pascagoula, MS; Theodore, AL; Tampa, FL	Galveston, TX; Port Fourchon; Venice, LA; Pascagoula, MS ; Mobile, AL; Tampa, FL

OSRO Information:

The names of the oil spill removal organizations (OSRO's) under contract include Clean Gulf Associates (CGA), Marine Spill Response Company (MSRC) and Oil Spill Response Limited (OSRL). These OSRO's provide equipment and will in some cases provide trained personnel to operate their response equipment (OSRVs, etc.) and Shell also has the option to pull from their trained personnel as needed for assistance/expertise in the Command Post and in the field.

Worst Case Scenario Determination:

	Drilling		Production	
Category	**Regional OSRP**	**DOCD**	**Regional OSRP**	**DOCD**
Type of Activity	Subsea Drilling	Vito Subsea	Production >10 miles to shore	Vito FPS
Facility Location (area/block)	MC 812	MC 984	MC 812	MC 984
Facility Designation	Subsea well B◊	Subsea Well 001◊◊	Subsea Well B◊	Subsea Well 001◊◊
Distance to Nearest Shoreline (miles)	59	67	59	67
Volume Storage tanks (total) Flowlines (on facility) Pipelines Uncontrolled blowout (volume per day) Total Volume	N/A N/A N/A 468,000 BOPD* 468,000 BOPD	NA NA NA 314,000 BOPD** 314,000 BOPD	16,600 Bbls 100 Bbls 27,428 Bbls 468,000 BOPD* 512,128❖	4,298 Bbls 100 Bbls 2,789 Bbls 314,000 BOPD** 321,187
Type of Oil(s) - (crude oil, condensate, diesel)	Crude oil	Crude oil	Crude oil	Crude oil
API Gravity(s)	31°	25.9°	31°	25.9°

***24 hour rate (432,000 BOPD 30-day average) **24 hour rate (280,000 BOPD 30-day average)**

◊This well was reviewed and accepted by BOEM in plan N-9840. ❖This new number was accepted by BOEM in plan N-9989.

◊◊This well was reviewed and accepted by BOEM in Plan S-7480.

Certification:

Shell Offshore Inc. has the capability to respond to the appropriate worst-case spill scenario included in its Regional OSRP, approved by BSEE June 2017. The bi-annual review was found to be in compliance November 22, 2019. Updates were found to be in compliance March 23, 2020. I hereby certify that Shell Offshore Inc. 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 our plan.

Modeling:

Based on the requirement per NTL 2008-G04 and the outcome of the OSRAM Model, Shell Offshore Inc. determined no additional modeling was needed for potential oil or hazardous substance spill for operations proposed in this exploration plan, as the current, approved OSRP adequately meets the necessary response capabilities.

B. <u>Oil Spill Response Discussion</u>

1. Volume of the Worst Case Discharge

Please refer to Section 2j and 9(iv) of this DOCD.

2. Trajectory Analysis

Trajectories of a spill and the probability of it impacting a land segment have been projected utilizing information in the BSEE Oil Spill Risk Analysis Model (OSRAM) for the Central and Western Gulf of Mexico available on the BSEE website using 30 day impact. Offshore areas along the trajectory between the source and land segment contact could be impacted. The land segment contact probabilities are shown in Table 9.C.1.

Area/Block	OCS-G	Launch Area	Land Segment Contact	%
MC 984		58	Galveston, TX	1
			Jefferson, TX	1
			Cameron, LA	3
			Vermillion, LA	2
			Iberia, LA	1
			Terrebonne, LA	3
			LaFourche, LA	3
			Jefferson, LA	1
			Plaquemines, LA	**8**
			St. Bernard, LA	1
			Okaloosa, FL	1

Table 9.C.1 Probability of Land Segment Impact

C. <u>Resource Identification</u>

The locations identified in Table 9.C.1 are the highest probable land segments to be impacted using the BSEE Oil Spill Risk Analysis Model (OSRAM). The environmental sensitivities are identified using the appropriate National Oceanic and Atmospheric Administration (NOAA) Environmental Sensitivity Index (ESI) maps for the given land segment. ESI maps provide a concise summary of coastal resources that are at risk if an oil spill occurs nearby. Examples of at-risk resources include biological resources (such as birds and shellfish beds), sensitive shorelines (such as marshes and tidal flats), and human-use resources (such as public beaches and parks).

In the event an oil spill occurs, ESI maps can help responders meet one of the main response objectives: reducing the environmental consequences of the spill and the cleanup efforts. Additionally, ESI maps can be used by planners to identify vulnerable locations, establish protection priorities, and identify cleanup strategies.

The following is a list of resources of special economic or environmental importance that potentially could be impacted by the Mississippi Canyon 939 WCD scenario.

Onshore/Nearshore: Plaquemines Parish has been identified as the most probable impacted Parish within the Gulf of Mexico for the Greater than 10 Mile Worst Case Discharge and the Exploratory Worst Case Discharge. Plaquemines Parish has a total area of 2,429 square miles of which, 845 square miles of it is land and 1,584 square miles is water. Plaquemines Parish includes two National Wildlife Refuges: Breton National Wildlife Refuge and Delta National Wildlife Refuge. This area is also a nesting ground for the brown pelican, an endangered species. Examples of Environmental Sensitivity maps for Plaquemines Parish are detailed in the following pages. Key ESI maps for Plaquemines Parish and the legend are shown in Figures 9.C.1 through 9.C.5.

Offshore: An offshore spill may require an Essential Fishing Habitat (EFH) Assessment. This assessment would include a description of the spill, analysis of the potential adverse effects on EFH and the managed species; conclusions regarding the effects on the EFH; and proposed mitigation, if applicable.

Significant pre-planning of joint response efforts was undertaken in response to provisions of the National Contingency Plan (NCP). Area Contingency Plans (ACPs) were developed to provide a well coordinated response to oil discharges and other hazardous releases. The One Gulf Plan is specific to the Gulf of Mexico to advance the unity of policy and effort in each of the Gulf Coast ACPs. Strategies used for the response to an oil spill regarding protection of identified resources are detailed in the One Gulf Plan and relevant Gulf Coast ACP.

D. Worst Case Discharge Response

Shell will make every effort to respond to the MC939 Worst Case Discharge as effectively as possible. Below is a table outlining the applicable evaporation and surface dispersion quantity:

	Mississippi Canyon Block 939	**Calculations (BBLS)**
i.	**TOTAL WCD (based on 30 day average (per day))**	**280,300**
ii.	Approximate loss of volume of oil to natural surface dispersion and evaporation base (approximate bbls per day)* (13% Natural surface evaporation and dispersion in 24 hrs)	-36,400
	APPROXIMATE TOTAL REMAINING	**~243,900**

Table 9.D.1 Oil Remaining After Surface Dispersion

Shell has contracted OSROs to provide equipment, personnel, materials and support vessels as well as temporary storage equipment to be considered in order to cope with a WCD spill. Under adverse weather conditions, major response vessels and Transrec skimmers are still effective and safe in sea states of 6-8 ft. If sea conditions prohibit safe mechanical recovery efforts, then natural dispersion and airborne chemical dispersant application (visibility & wind conditions permitting) may be the only safe and viable recovery option.

MSRC OSRV	8 foot seas
VOSS System	4 foot seas
Expandi Boom	6 foot seas, 20 knot winds
Dispersants	Winds more than 25 knots, Visibility less than 3 nautical miles, or Ceiling less than 1,000 feet.

Table 9.D.2 Operational Limitations of Response Equipment

Upon notification of the spill, Shell would request a partial or full mobilization of contracted resources, including, but not limited to, skimming vessels, oil storage vessels, dispersant aircraft, subsea dispersant, shoreline protection, wildlife protection, and containment equipment. Following is a list of the contracted resources including de-rated recovery capacity, personnel, and estimated response times (procurement, load out, travel time to the site, and deployment). The Incident Commander or designee may contact other service companies if the Unified Command deems such services necessary to the response efforts.

Based on the anticipated worst case discharge scenario, Shell can be onsite with dedicated, contracted on water oil spill recovery equipment with adequate response capacity to contain and recover surface oil, and prevent land impact, within approximately 46 hours (based on the equipment's Estimated Daily Response Capacity (EDRC) and storage capacity). Shell will continue to ramp up additional on-water mechanical recovery resources as well as apply dispersants and in-situ burning as needed and as approved under the supervision of the USCG Captain of the Port (COTP) and the Regional Response Team (RRT).

Subsea Control and Containment: Shell, as a founding member of the MWCC, will have access to the IRCS that can be rapidly deployed through the MWCC. The IRCS is designed to contain oil flow in the unlikely event of an underwater well blowout, and is designed, constructed, tested, and available for rapid response. Shell's specific containment response for MC 939 will be addressed in Shell's NTL 2010-N10 submission at the time the APD is submitted.

Table 9.D.9 Control, Containment, and Subsea Dispersant Package Activation List

Mechanical Recovery (skimming): Response strategies include skimming utilizing available OSROs Oil Spill Response Vessels (OSRVs), Oil Spill Response Barges (OSRBs), ID Boats, and Quick Strike OSRVs. There is a combined de-rated recovery rate capability of approximately 975,000 barrels/day. Temporary storage associated with the identified skimming and temporary storage equipment equals approximately 861,000 barrels.

	De-rated Recovery Rate (bopd)	Storage (bbls)
Offshore Recovery and Storage	628,677	845,829
Nearshore Recovery and Storage	346,415	15,679
Total	975,092	861,508

Table 9.D.3 Mechanical Recovery Combined De-Rated Capability

Table 9.D.4 Offshore On-Water Recovery and Storage Activation List
Table 9.D.5 Nearshore On-Water Recovery and Storage 5ctivation List

Oil Storage: The strategy for transferring, storing and disposing of oil collected in these recovery zones is to utilize two 150,000-160,000 ton (dead weight) tankers mobilized by Shell (or any other tanker immediately available). The recovered oil would be transferred to Motiva's Norco, LA storage and refining facility, or would be stored at Delta Commodities, Inc. Harvey, LA facility.

Aerial Surveillance: Aircraft can be mobilized to detect, monitor, and target response to oil spills. Aircraft and spotters can be mobilized within hours of an event.

Table 9.D.6 Aerial Surveillance Activation List

Aerial Dispersant: Depending on proximity to shore and water depth, dispersants may be a viable response option. If appropriate and approved, 4 to 5 sorties from three DC-3's can be made within the first 12 hour operating day of the response. These aerial systems could disperse approximately 7,704 to 9,630 barrels of oil per day. Additionally, 3 to 4 sorties from the BE90 King Air and 3 to 4 sorties from the Hercules C-130A within the first 12 hour operating day of the response could disperse 4,600 to 6,100 barrels of oil per day. For continuing dispersant operations, the CCA's Aerial Dispersant Delivery System (ADDS) would be mobilized. The ADDS has a dispersant spray capability of 5,000 gallons per sortie.

Table 9.D.7 Offshore Aerial Dispersant Activation List

Vessel Dispersant: Vessel dispersant application is another available response option. If appropriate, vessel spray systems can be installed on offshore vessels of opportunity using inductor nozzles (installed on fire-water monitors), skid mounted systems, or purpose-built boom arm spray systems. Vessels can apply dispersant within the first 12-24 hours of the response and continually as directed.

Table 9.D.8 Offshore Boat Spray Dispersant Activation List

Subsea Dispersant: Shell has contracted with Wild Well Control for a subsea dispersant package. Subsea dispersant application has been found to be highly effective at reducing the amount of oil reaching the surface. Additional data collection, laboratory tests and field tests will help in facilitating the optimal application rate and effectiveness numbers. For planning purposes, the system has the potential to disperse approximately 24,500 to 34,000 barrels of oil per day.

Table 9.D.9 Control, Containment, and Subsea Dispersant Package Activation List

In-Situ Burning: Open-water in-situ burning (ISB) also may be used as a response strategy, depending on the circumstances of the release. ISB services may be provided by the primary OSRO contractors. If appropriate conditions exist and approvals are granted, one or multiple ISB task forces could be deployed offshore. Task forces typically consist of two to four fire teams, each with two vessels capable of towing fire boom, guide boom or tow line with either a handheld or aerially-deployed oil ignition system. At least one support/safety boat would be present during active burning operations to provide logistics, safety and monitoring support. Depending upon a number of factors, up to 4 burns per 12-hour day could be completed per ISB fire team. Most fire boom systems can be used for approximately 8-12 burns before being replaced. Fire intensity and weather will be the main determining factors for actual burns per system. Although the actual amount of oil that will be removed per burn is dependent on many factors, recent data suggests that a typical burn might eliminate approximately 750 barrels. For planning purposes and based on the above assumptions, a single task force of four fire teams with the appropriate weather and safety conditions could complete four burns per day and remove up to ~12,000 bbls/day. In-situ burning nearshore and along shorelines may be a possible option based on several conditions and with appropriate approvals, as outlined in Section 19, In-situ Burn Plan (OSRP). In-situ burning along certain types of shorelines may be used to minimize physical damage where access is limited or if it is determined that mechanical/manual removal may cause a substantial negative impact on the environment. All safety considerations will be evaluated. In addition, Shell will assess the situation and can make notification within 48 hours of the initial spill to begin ramping up fire boom production through contracted OSRO(s). There are potential limitations that need to be assessed prior to ISB operations. Some limitations include atmospheric and sea conditions; oil weathering; air quality impacts; safety of response workers; and risk of secondary fires.

Table 9.D.10 In-Situ Burn Equipment Activation List

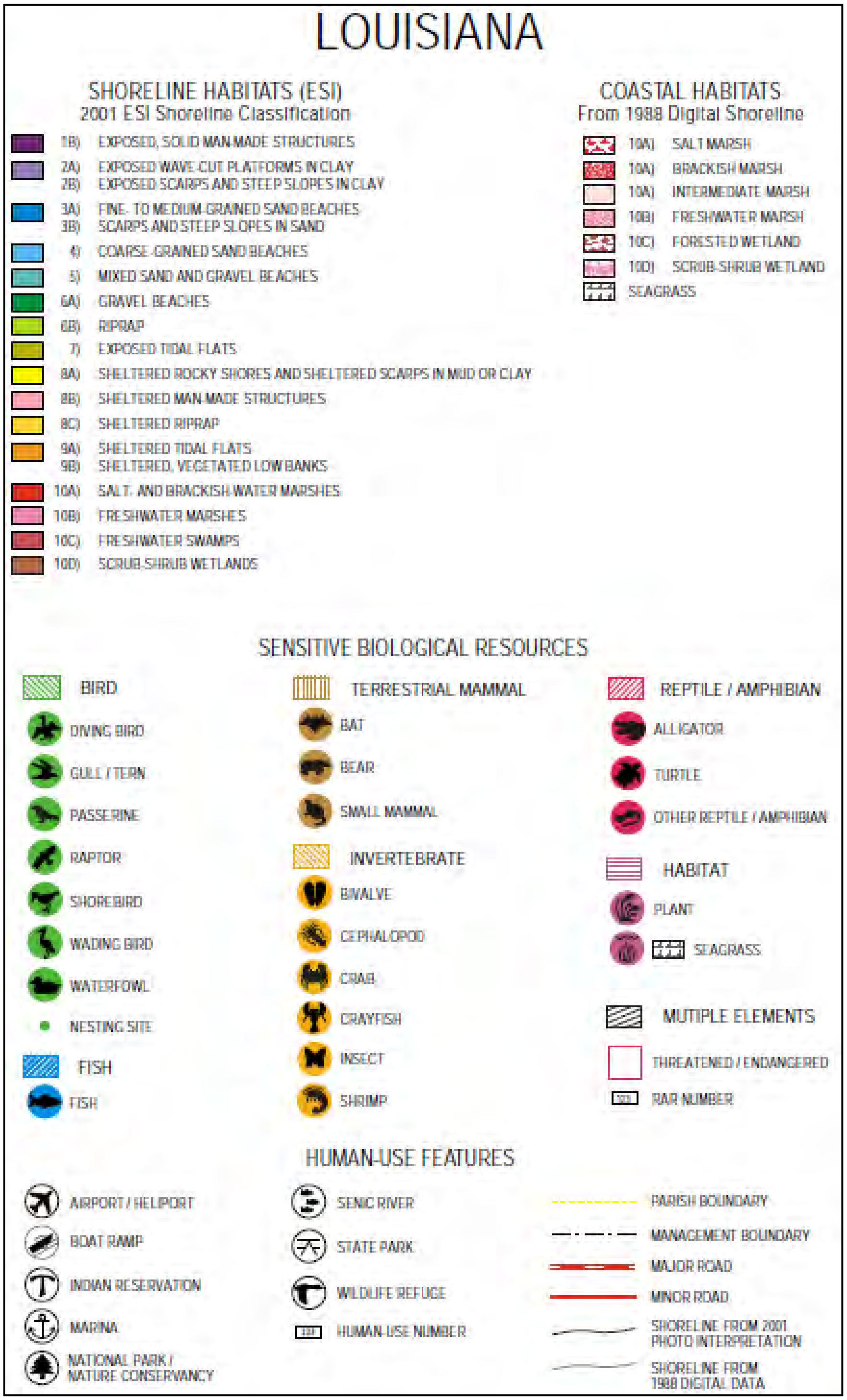
Shoreline Protection: If the spill went unabated, shoreline impact in Plaquemines Parish, LA would depend upon existing environmental conditions. Nearshore response may include the deployment of shoreline boom on beach areas, or protection and sorbent boom on vegetated areas. Strategies would be based upon surveillance and real time trajectories provided by The Response Group that depict areas of potential impact given actual sea and weather conditions. Strategies from the New Orleans, Louisiana Area Contingency Plan, Unified Command would be consulted to ensure that environmental and special economic resources would be correctly identified and prioritized to ensure optimal protection. Shell has access to shoreline response guides that depict the protection response modes applicable for oil spill clean-up operations. Each response mode is schematically represented to show optimum deployment and operation of the equipment in areas of environmental concern. Supervisory personnel have the option to modify the deployment and operation of equipment allowing a more effective response to site-specific circumstances.

Table 9.D.11 Shoreline Protection and Wildlife Support List

Wildlife Protection: If wildlife is threatened due to a spill, the contracted OSRO's have resources available to Shell, which can be utilized to protect and/or rehabilitate wildlife. The resources under contract for the protection and rehabilitation of affected wildlife are in Table 9.D.11.

New or unusual technology in regards to spill, prevention, control and clean-up:

Shell will use our normal well design and construction processes with multiple barrier approach as well as new stipulations mandated by NTL 2008-N05. Response techniques will utilize new learnings from Macondo response to include in-situ burning and subsea dispersant application. Mechanical recovery advancements are continuing to be made to incorporate utilization of Koseq arms outfitted on barges, conversion of Platform Support Vessels for Oil Spill Response, and inclusion of nighttime spill detection radar to improve tracking capabilities (X-Band radar, Infrared sensing, etc.). In addition, new response technologies/techniques are continuing to be considered by Shell and the appropriate government organizations for incorporation into our planned response. Any additional response technologies/techniques presented at the time of response will be used at the discretion of the Unified Command and USCG.



LOUISIANA
SHORELINE HABITATS (ESI)
2001 ESI Shoreline Classification
1B) EXPOSED, SOLID MAN-MADE STRUCTURES
2A) EXPOSED WAVE-CUT PLATFORMS IN CLAY
2B) EXPOSED SCARPS AND STEEP SLOPES IN CLAY
3A) FINE- TO MEDIUM-GRAINED SAND BEACHES
3B) SCARPS AND STEEP SLOPES IN SAND
4) COARSE-GRAINED SAND BEACHES
5) MIXED SAND AND GRAVEL BEACHES
6A) GRAVEL BEACHES
6B) RIPRAP
7) EXPOSED TIDAL FLATS
8A) SHELTERED ROCKY SHORES AND SHELTERED SCARPS IN MUD OR CLAY
8B) SHELTERED MAN-MADE STRUCTURES
8C) SHELTERED RIPRAP
9A) SHELTERED TIDAL FLATS
9B) SHELTERED, VEGETATED LOW BANKS
10A) SALT- AND BRACKISH-WATER MARSHES
10B) FRESHWATER MARSHES
10C) FRESHWATER SWAMPS
10D) SCRUB-SHRUB WETLANDS
COASTAL HABITATS
From 1988 Digital Shoreline
10A) SALT MARSH
10A) BRACKISH MARSH
10A) INTERMEDIATE MARSH
10B) FRESHWATER MARSH
10C) FORESTED WETLAND
10D) SCRUB-SHRUB WETLAND
SEAGRASS
SENSITIVE BIOLOGICAL RESOURCES
BIRD
DIVING BIRD
GULL / TERN
PASSERINE
RAPTOR
SHOREBIRD
WADING BIRD
WATERFOWL
NESTING SITE
FISH
FISH
TERRESTRIAL MAMMAL
BAT
BEAR
SMALL MAMMAL
INVERTEBRATE
BIVALVE
CEPHALOPOD
CRAB
CRAYFISH
INSECT
SHRIMP
REPTILE / AMPHIBIAN
ALLIGATOR
TURTLE
OTHER REPTILE / AMPHIBIAN
HABITAT
PLANT
SEAGRASS
MUTIPLE ELEMENTS
THREATENED / ENDANGERED
RAR NUMBER
HUMAN-USE FEATURES
AIRPORT / HELIPORT
BOAT RAMP
INDIAN RESERVATION
MARINA
NATIONAL PARK / NATURE CONSERVANCY
SENIC RIVER
STATE PARK
WILDLIFE REFUGE
HUMAN-USE NUMBER
PARISH BOUNDARY
MANAGEMENT BOUNDARY
MAJOR ROAD
MINOR ROAD
SHORELINE FROM 2001 PHOTO INTERPRETATION
SHORELINE FROM 1988 DIGITAL DATA

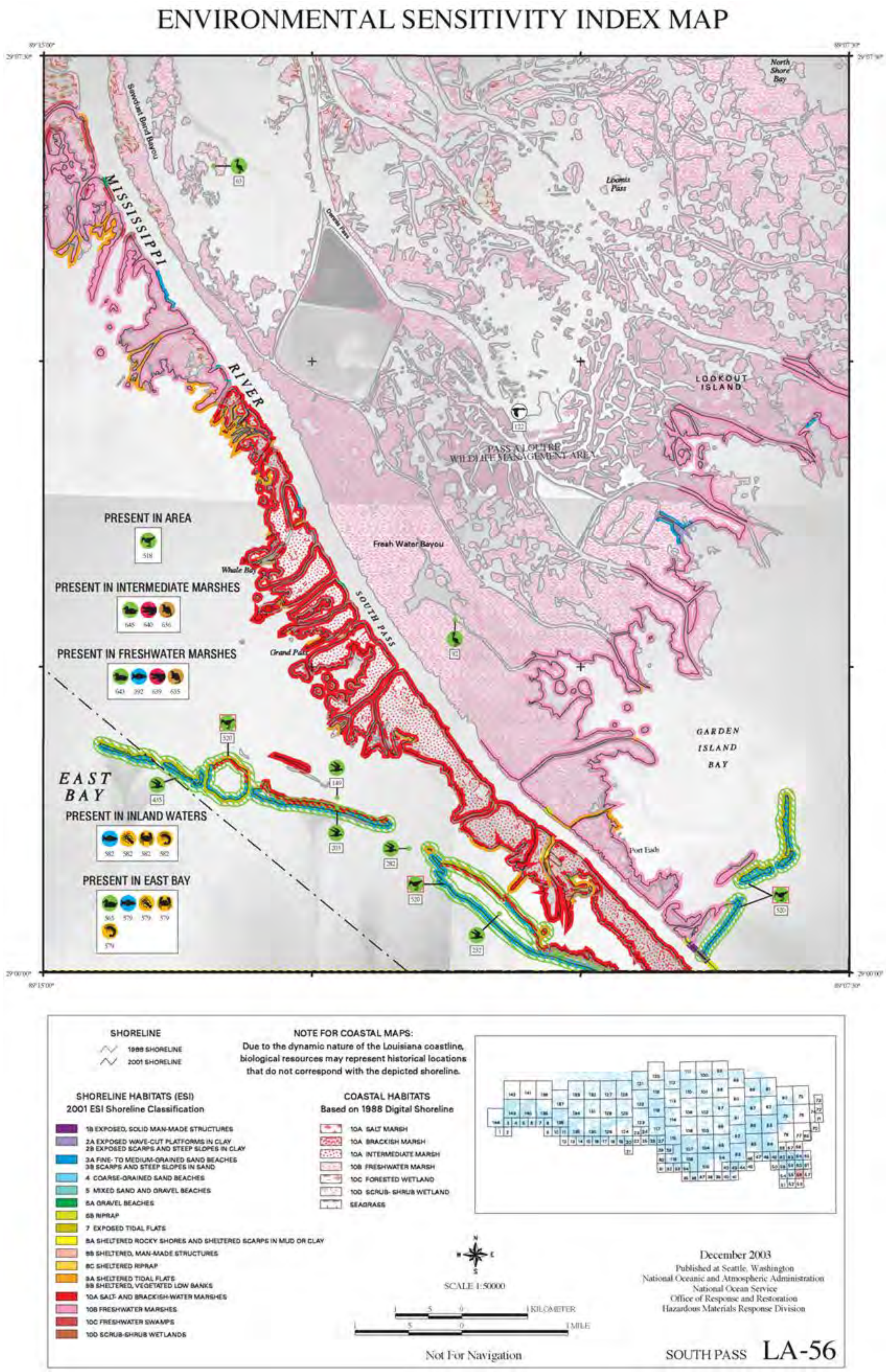


Figure 9.C.2 South Pass ESI Map

ENVIRONMENTAL SENSITIVITY INDEX MAP

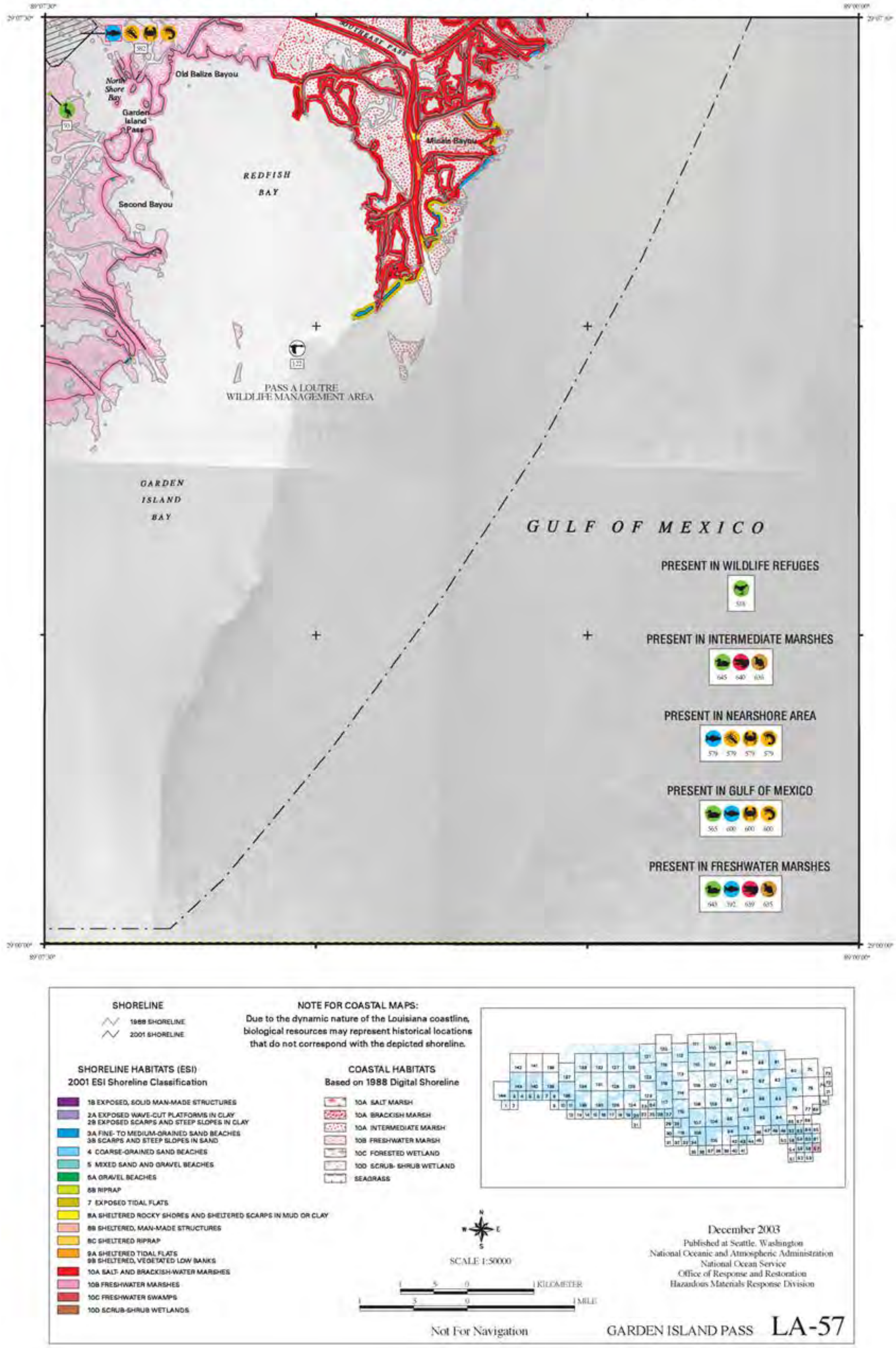


Figure 9.C.3 Garden Island Pass ESI Map

ENVIRONMENTAL SENSITIVITY INDEX MAP

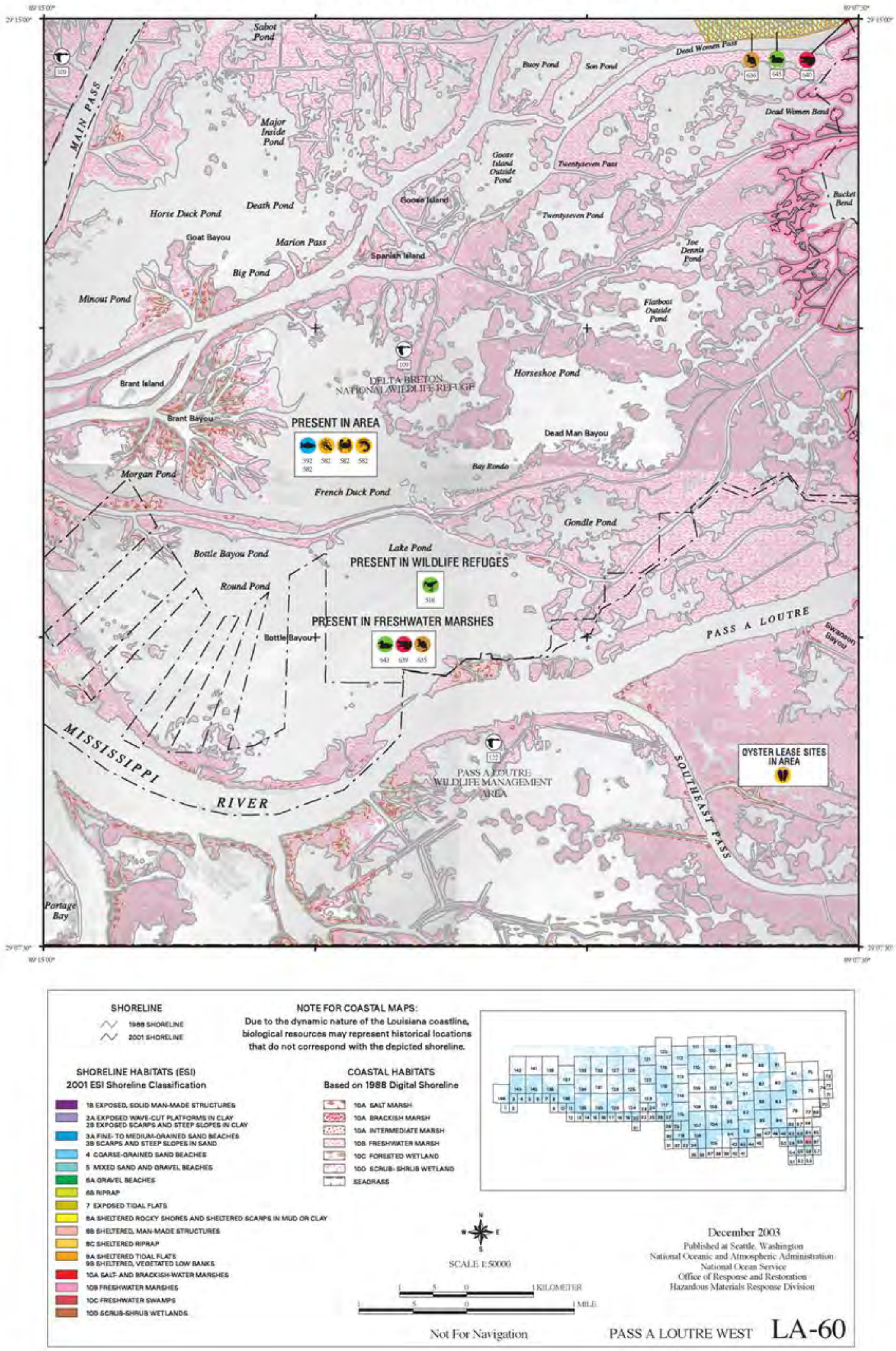


Figure 9.C.4 Pass a Loutre West ESI Map

ENVIRONMENTAL SENSITIVITY INDEX MAP

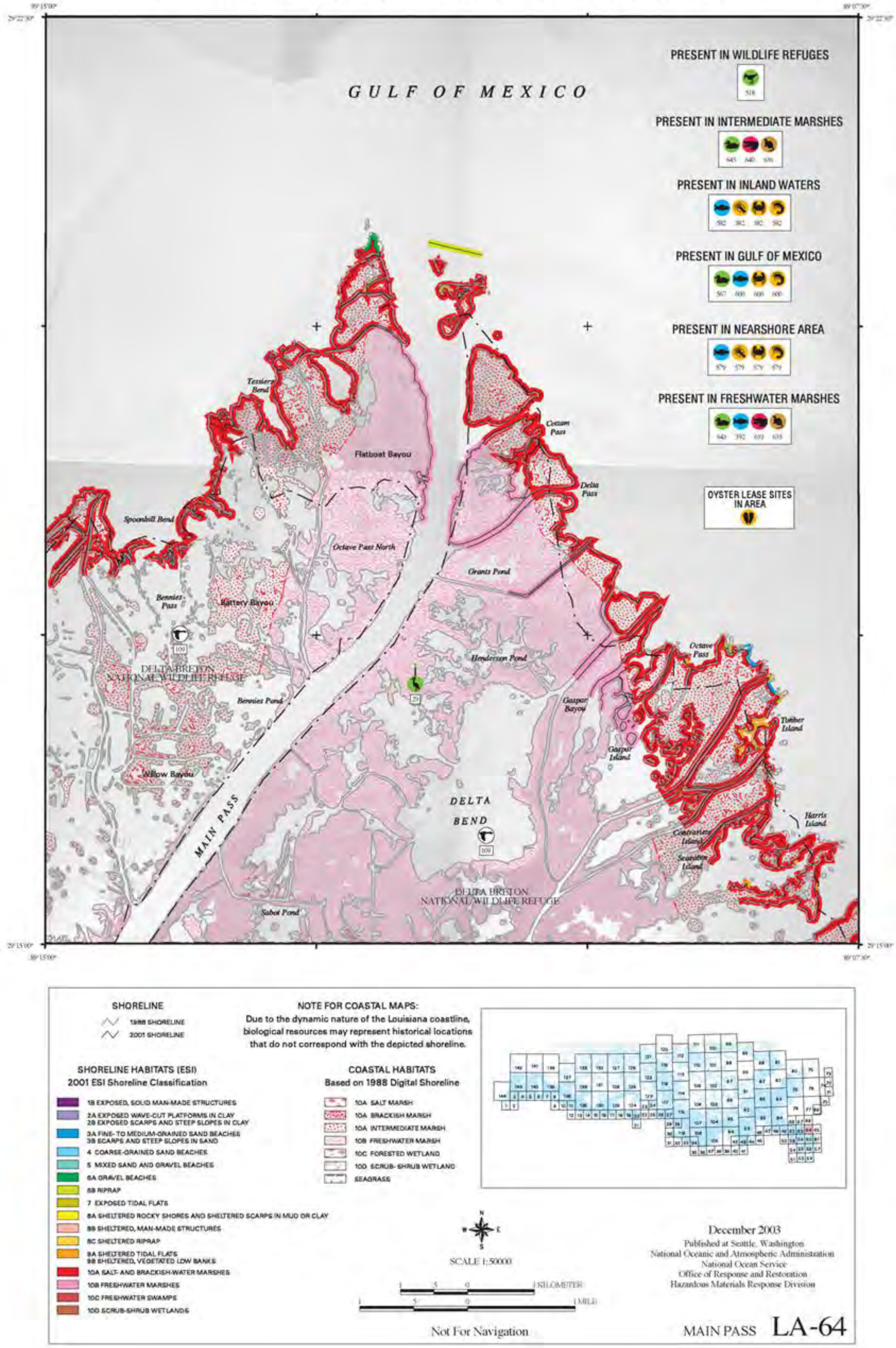


Figure 9.C.5 Main Pass ESI Map

Mississippi Canyon 984 - Drilling > 10 Miles
Sample Offshore On-Water Recovery & Storage Activation List

** - These components are additional operational requirements that must be procured in addition to the system identified.*
*** - These components are additional operational requirements for the packages to be used in an enhanced skimming deployment.*
**** - Specific Barge names may vary.*

Skimming System	Supplier & Phone	Warehouse	Skimming Package	Quantity	Effective Daily Recovery Capacity (EDRC in Bbls/Day)	Storage (Barrels)	Staging Area	Distance to Site from Staging (Miles)	Response Times (Hours): Staging ETA	Loadout Time	ETA to Site	Deployment Time	Total ETA
FRV Breton Island	CGA (888) 242-2007	Venice, LA	Lamor Brush Skimmer	2	22,885	249	Venice, LA	98	2	3	5.5	1	8
			38" Boom	84									
			95' Vessel	1									
			X Band Radar	1									
			Personnel	8									
FRV JL D'Bien	CGA (888) 242-2007	Leeville, LA	Lamor Brush Skimmer	2	22,885	249	Leeville, LA	112	2	3	6.5	1	10
			38" Boom	84									
			95' Vessel	1									
			X Band Radar	1									
			Personnel	8									
Deep Blue Responder LFF 100 Brush	MSRC (800) OIL-SPIL	Port Fourchon, LA	LFF 100 Brush Skimmer	1	18,086	4,000	Port Fourchon, LA	102	2	1	7.5	1	12
			Backup- Stress 1 Skimmer	1									
			67" Pressure Inflatable Boom	2640'									
			210' Vessel	1									
			Personnel	10									
			32' Support Boat	1									
			X Band Radar	1									
			Infrared Camera	1									
			FAES #4 "Buster"	1									
Louisiana Responder Transrec 350	MSRC (800) OIL-SPIL	Fort Jackson, LA	Transrec	1	10,567	4,000	Fort Jackson, LA	105	2	1	7.5	1	12
			Backup- Stress 1 Skimmer	1									
			67" Pressure Inflatable Boom	2640'									
			210' Vessel	1									
			Personnel	10									
			32' Support Boat	1									
			X Band Radar	1									
			Infrared Camera	1									
			FAES #4 "Buster"	1									
Stress 1	MSRC (800) OIL-SPIL	Belle Chasse, LA	Offshore Skimmer	1	15,840	0	Venice, LA	96	4	1	7	1	13
			67" Pressure Inflatable Boom "Louisiana Responder"	330'									
			Personnel	5									
			*Appropriate Vessel	2									
			*Temporary Storage	1		500							
FOILEX 250	MSRC (800) OIL-SPIL	Belle Chasse, LA	Offshore Skimmer	1	3,977	0	Venice, LA	96	4	1	7	1	13
			67" Pressure Inflatable Boom "Louisiana Responder"	330'									
			Personnel	5									
			*Appropriate Vessel	2									
			*Temporary Storage	1		500							
FOILEX 200	MSRC (800) OIL-SPIL	Belle Chasse, LA	Offshore Skimmer	1	1,989	0	Venice, LA	96	4	1	7	1	13
			67" Pressure Inflatable Boom "Louisiana Responder"	330'									
			Personnel	5									
			*Appropriate Vessel	2									
			*Temporary Storage	1		500							
GT-185	MSRC (800) OIL-SPIL	Belle Chasse, LA	Offshore Skimmer	1	1,371	0	Venice, LA	96	4	1	7	1	13
			67" Pressure Inflatable Boom "Louisiana Responder"	330'									
			Personnel	5									
			*Appropriate Vessel	2									
			*Temporary Storage	1		500							
Walosep W-4	MSRC (800) OIL-SPIL	Belle Chasse, LA	Offshore Skimmer	1	3,017	0	Venice, LA	96	4	1	7	1	13
			67" Pressure Inflatable Boom "Deep Blue Responder"	330'									
			Personnel	5									
			*Appropriate Vessel	2									
			*Temporary Storage	1		500							
Stress 1	MSRC (800) OIL-SPIL	Port Fourchon, LA	Offshore Skimmer	1	15,840	0	Venice, LA	96	5.75	1	7	1	15
			67" Pressure Inflatable Boom "Deep Blue Responder"	330'									
			Personnel	5									
			*Appropriate Vessel	2									
			*Temporary Storage	1		500							
Stress 1	MSRC (800) OIL-SPIL	Pascagoula, MS	Offshore Skimmer	1	15,840	0	Venice, LA	96	5.5	1	7	1	15
			67" Pressure Inflatable Boom	330'									
			Personnel	5									
			*Appropriate Vessel	2									
			*Temporary Storage	1		500							

Table 9.D.4 Offshore On-Water Recovery Storage Activation List

Mississippi Canyon 984 - Drilling > 10 Miles
Sample Offshore On-Water Recovery & Storage Activation List

** - These components are additional operational requirements that must be procured in addition to the system identified.*
*** - These components are additional operational requirements for the packages to be used in an enhanced skimming deployment.*
**** - Specific Barge names may vary.*

Skimming System	Supplier & Phone	Warehouse	Skimming Package	Quantity	Effective Daily Recovery Capacity (EDRC in Bbls/Day)	Storage (Barrels)	Staging Area	Distance to Site from Staging (Miles)	Response Times (Hours): Staging ETA	Loadout Time	ETA to Site	Deployment Time	Total ETA
Stress 2	MSRC (800) OIL-SPIL	Pascagoula, MS	Offshore Skimmer	1	5,017	0	Venice, LA	96	5.5	1	7	1	16
			67" Pressure Inflatable Boom	330'									
			Personnel	5									
			*Appropriate Vessel	2									
			*Temporary Storage	1		500							
WP-1	MSRC (800) OIL-SPIL	Pascagoula, MS	Offshore Skimmer	1	3,017	0	Venice, LA	96	5.5	1	7	1	16
			67" Pressure Inflatable Boom	110'									
			Personnel	5									
			*Appropriate Vessel	2									
			*Temporary Storage	1		500							
Stress 1	MSRC (800) OIL-SPIL	Lake Charles, LA	Offshore Skimmer	1	15,840	0	Venice, LA	96	7	1	7	1	18
			67" Pressure Inflatable Boom	330'									
			Personnel	5									
			*Appropriate Vessel	2									
			*Temporary Storage	1		500							
FOILEX 250	MSRC (800) OIL-SPIL	Lake Charles, LA	Offshore Skimmer	1	3,977	0	Venice, LA	96	7	1	7	1	18
			67" Pressure Inflatable Boom "Deep Blue Responder"	330'									
			Personnel	5									
			*Appropriate Vessel	2									
			*Temporary Storage	1		500							
DESMI OCEAN	MSRC (800) OIL-SPIL	Lake Charles, LA	Offshore Skimmer	1	3,017	0	Venice, LA	96	7	1	7	1	18
			67" Pressure Inflatable Boom "Deep Blue Responder"	330'									
			Personnel	5									
			*Appropriate Vessel	2									
			*Temporary Storage	1		500							
FRU 3.0 - Foilex 150 TDS	CGA (888) 242-2007	Harvey, LA	Weir Skimmer	1	1,131	0	Venice, LA	96	4	1	9.5	1	18
			Personnel	4									
			* Utility Boat (<100')	1									
			50 bbl Portable tank	1		50							
PT 150 Aquaguard Skimmer (2)	CGA (888) 242-2007	Harvey, LA	Brush skimmer	1	22,323	0	Venice, LA	96	4	1	9.5	1	18
			Personnel	4									
			* Offshore Utility Boat	1									
			* Add'l Storage	2		1,000							
Fast Response Unit "FRU" 1.0	CGA (888) 242-2007	Venice, LA	Foilex 250 Skimmer	1	4,251	100	Venice, LA	96	4	2	9.5	1	17
			Personnel	4									
			Utility Boat	1									
			53" Skimming Boom	75'									
			** 67" Sea Sentry	440'									
			** Crew Boat	1									
			** Add'l Storage	1		100							
Fast Response Unit "FRU" 1.0	CGA (888) 242-2007	Venice, LA	Foilex 250 Skimmer	1	4,251	100	Venice, LA	96	4	2	9.5	1	17
			Personnel	4									
			Utility Boat	1									
			53" Skimming Boom	75'									
			** 67" Sea Sentry	440'									
			** Crew Boat	1									
			** Add'l Storage	1		100							
Mississippi Responder Transrec-350	MSRC (800) OIL-SPIL	Pascagoula, MS	Transrec Skimmer	1	10,567	4,000	Pascagoula, MS	176	3	1	12.5	1	17
			Backup- Stress 1 Skimmer	1									
			67" Pressure Inflatable Boom	2640'									
			210' Vessel	1									
			Personnel	10									
			32' Support Boat	1									
			X Band Radar	1									
			Infrared Camera	1									
			FAES #4 "Buster"	1									
QT-185	MSRC (800) OIL-SPIL	Port Arthur, TX	Offshore Skimmer	1	1,371	0	Venice, LA	96	8	1	7	1	17
			67" Pressure Inflatable Boom "Mississippi Responder"	330'									
			Personnel	5									
			*Appropriate Vessel	2									
			*Temporary Storage	1		500							

Table 9.D.4 Offshore On-Water Recovery Storage Activation List (continued)

Mississippi Canyon 984 - Drilling > 10 Miles
Sample Offshore On-Water Recovery & Storage Activation List

Skimming System	Supplier & Phone	Warehouse	Skimming Package	Quantity	Effective Daily Recovery Capacity (EDRC in Bbls/Day)	Storage (Barrels)	Staging Area	Distance to Site from Staging (Miles)	Response Times (Hours): Staging ETA	Loadout Time	ETA to Site	Deployment Time	Total ETA
** - These components are additional operational requirements that must be procured in addition to the system identified. ** - These components are additional operational requirements for the packages to be used in an enhanced skimming deployment. *** - Specific Barge names may vary.*													
MSRC-452 Offshore Barge	MSRC (800) OIL-SPIL	Fort Jackson, LA	Offshore Barge 67" Pressure Inflatable Boom Crucial Disc Skimmer Desmi Ocean *Appropriate Vessel Personnel * Offshore Tug X Band Radar Infrared Camera	1 2640' 1 1 1 9 2 1 1	14,159	45,000	Fort Jackson, LA	105	4	1	11.5	1	**18**
Fast Response Unit "FRU" 1.0	CGA (888) 242-2007	Morgan City, LA	Foilex 250 Skimmer Personnel Utility Boat 53" Skimming Boom ** 67" Sea Sentry ** Crew Boat ** Add'l Storage	1 4 1 75' 440' 1 1	4,251	100 100	Venice, LA	98	5	2	9.5	1	**18**
Fast Response Unit "FRU" 1.0	CGA (888) 242-2007	Leeville, LA	Foilex 250 Skimmer Personnel Utility Boat 53" Skimming Boom ** 67" Sea Sentry ** Crew Boat ** Add'l Storage	1 4 1 75' 440' 1 1	4,251	100 100	Venice, LA	98	5.5	2	9.5	1	**18**
Fast Response Unit "FRU" 1.0	CGA (888) 242-2007	Leeville, LA	Foilex 250 Skimmer Personnel Utility Boat 53" Skimming Boom ** 67" Sea Sentry ** Crew Boat ** Add'l Storage	1 4 1 75' 440' 1 1	4,251	100 100	Venice, LA	98	5.5	2	9.5	1	**18**
Fast Response Unit "FRU" 1.0	CGA (888) 242-2007	Vermilion, LA	Foilex 250 Skimmer Personnel Utility Boat 53" Skimming Boom ** 67" Sea Sentry ** Crew Boat	1 4 1 75' 440' 1	4,251	100	Venice, LA	98	6.25	2	9.5	1	**19**
Walosep W-4	MSRC (800) OIL-SPIL	Galveston, TX	Offshore Skimmer 67" Pressure Inflatable Boom * Personnel *Appropriate Vessel *Temporary Storage	1 330' 5 2 1	3,017	0 500	Venice, LA	98	9.5	1	7	1	**19**
FRV H.I. Rich	CGA (888) 242-2007	Vermilion, LA	Lamor Brush Skimmer 38" Boom 95' Vessel X Band Radar Personnel	2 84 1 1 8	22,885	249	Vermilion, LA	265	3	0	15.5	1	**20**
Fast Response Unit "FRU" 1.0	CGA (888) 242-2007	Lake Charles, LA	Foilex 250 Skimmer Personnel Utility Boat 53" Skimming Boom ** 67" Sea Sentry ** Crew Boat ** Add'l Storage	1 4 1 75' 440' 1 1	4,251	100 100	Venice, LA	98	7	2	9.5	1	**20**
Stress 1	MSRC (800) OIL-SPIL	Ingleside, TX	Offshore Skimmer 67" Pressure Inflatable Boom Personnel *Appropriate Vessel *Temporary Storage	1 330' 5 2 1	15,840	0 500	Venice, LA	98	12.25	1	7	1	**22**
FRV Galveston Island	CGA (888) 242-2007	Galveston, TX	Lamor Brush Skimmer 38" Boom 95' Vessel X Band Radar Personnel	2 84 1 1 8	22,885	249	Galveston, TX	356	2	0	21	1	**24**
Fast Response Unit "FRU" 1.0	CGA (888) 242-2007	Aransas Pass, TX	Foilex 250 Skimmer Personnel * 100-140' Utility Boat 53" Skimming Boom ** 67" Sea Sentry ** Crew Boat ** Add'l Storage	1 4 1 75' 440' 1 1	4,251	100 100	Venice, LA	98	12.25	2	9.5	1	**25**

Table 9.D.4 Offshore On-Water Recovery Storage Activation List (continued)

Mississippi Canyon 984 - Drilling > 10 Miles
Sample Offshore On-Water Recovery & Storage Activation List

* - These components are additional operational requirements that must be procured in addition to the system identified.
** - These components are additional operational requirements for the packages to be used in an enhanced skimming deployment.
*** - Specific Barge names may vary.

Skimming System	Supplier & Phone	Warehouse	Skimming Package	Quantity	Effective Daily Recovery Capacity (EDRC in Bbls/Day)	Storage (Barrels)	Staging Area	Distance to Site from Staging (Miles)	Response Times (Hours): Staging ETA	Loadout Time	ETA to Site	Deployment Time	Total ETA
Stress 1	MSRC (800) OIL-SPIL	Miami, FL	Offshore Skimmer	1	15,840	0	Venice, LA	80	18	1	7	1	26
			67" Pressure Inflatable Boom	330'									
			Personnel	5									
			*Appropriate Vessel	2									
			*Temporary Storage	1		500							
MSRC-402 Offshore Barge	MSRC (800) OIL-SPIL	Pascagoula, MS	Offshore Barge	1	22,244	40,300	Pascagoula, MS	176	4	1	19.5	1	26
			67" Pressure Inflatable Boom	2640'									
			Crucial Disc Skimmer	2									
			*Appropriate Vessel	1									
			Personnel	9									
			* Offshore Tug	2									
			X Band Radar	1									
			Infrared Camera	1									
Gulf Coast Responder Transrec-350	MSRC (800) OIL-SPIL	Lake Charles, LA	Transrec Skimmer	1	10,567	4,000	Lake Charles, LA	306	2	1	22	1	26
			Backup - Stress 1 Skimmer	1									
			67" Pressure Inflatable Boom	2640'									
			210' Vessel	1									
			Personnel	10									
			32' Support Boat	1									
			X Band Radar	1									
			Infrared Camera	1									
			FAES #4 "Buster"	1									
CGA-200 HOSS Barge (OSRB)	CGA (888) 242-2007	Harvey, LA	Marco Skimmer	4	76,285	4,000	Harvey, LA	158	0	4	24	1	29
			67" Sea Sentry	2640'									
			Personnel	12									
			* Tug - 1,200 HP	2									
			X Band Radar	1									
			* Tug - 1,800 HP	1									
Texas Responder Transrec-350	MSRC (800) OIL-SPIL	Galveston, TX	Transrec Skimmer	1	10,567	4,000	Galveston, TX	356	2	1	25.5	1	30
			Backup - Stress 1 Skimmer	1									
			67" Pressure Inflatable Boom	2640'									
			210' Vessel	1									
			Personnel	10									
			32' Support Boat	1									
			X Band Radar	1									
			Infrared Camera	1									
			FAES #4 "Buster"	1									
PSV-VOO Skimming System (Brush)	MSRC (800) OIL-SPIL	Port Fourchon, LA	Lamor Brush Skimmer	1	18,086	0	Port Fourchon, LA	102	24	1	7.5	1	34
			67" Pressure Inflatable Boom	1320'									
			* PSV-VOO	1									
			Personnel	9									
			Thermal Infrared Camera	1									
			*Appropriate Vessel	1									
			* Marine Portable Tank	2		1,000							
PSV-VOO Skimming System (Brush)	MSRC (800) OIL-SPIL	Port Fourchon, LA	Lamor Brush Skimmer	1	18,086	0	Port Fourchon, LA	102	24	1	7.5	1	34
			67" Pressure Inflatable Boom	1320'									
			* PSV-VOO	1									
			Personnel	9									
			Thermal Infrared Camera	1									
			*Appropriate Vessel	1									
			* Marine Portable Tank	2		1,000							
Koseq Skimming Arms (6) (Meriflex Weir)	CGA (888) 242-2007	Harvey, LA	15m rigid skimming arm	2	36,326	0	Port Fourchon, LA	102	4	24	10	1	39
			Personnel	5									
			* Offshore vessel (>200')	1									
			* 30T crane	1									
			* 500 bbl Portable tank	4		2,000							
Koseq Skimming Arms (7) (Meriflex Weir)	CGA (888) 242-2007	Harvey, LA	15m rigid skimming arm	2	36,326	0	Port Fourchon, LA	102	4	24	10	1	39
			Personnel	5									
			* Offshore vessel (>200')	1									
			* 30T crane	1									
			* 500 bbl Portable tank	4		2,000							
Koseq Skimming Arms (8) (Meriflex Weir)	CGA (888) 242-2007	Harvey, LA	15m rigid skimming arm	2	36,326	0	Port Fourchon, LA	102	4	24	10	1	39
			Personnel	5									
			* Offshore vessel (>200')	1									
			* 30T crane	1									
			* 500 bbl Portable tank	4		2,000							

Table 9.D.4 Offshore On-Water Recovery Storage Activation List (continued)

Mississippi Canyon 984 - Drilling > 10 Miles
Sample Offshore On-Water Recovery & Storage Activation List

Skimming System	Supplier & Phone	Warehouse	Skimming Package	Quantity	Effective Daily Recovery Capacity (EDRC in Bbls/Day)	Storage (Barrels)	Staging Area	Distance to Site from Staging (Miles)	Response Times (Hours): Staging ETA	Loadout Time	ETA to Site	Deployment Time	Total ETA
*- These components are additional operational requirements that must be procured in addition to the system identified. ** - These components are additional operational requirements for the packages to be used in an enhanced skimming deployment. *** - Specific Barge names may vary.													
Koseq Skimming Arms (9) (Lamor Brush)	CGA (888) 242-2007	Harvey, LA	15m rigid skimming arm	2	45,770	0	Port Fourchon, LA	102	4	24	10	1	38
			Personnel	5									
			* Offshore vessel (>200')	1									
			* 30T crane	1									
			* 500 bbl Portable tank	4		2,000							
Southern Responder Transrec-350	MSRC (800) OIL-SPIL	Ingleside, TX	Transrec Skimmer	1	10,567	4,000	Ingleside, TX	497	2	1	39.5	1	40
			Backup - Stress 1 Skimmer	1									
			67" Pressure Inflatable Boom	2640'									
			210' Vessel	1									
			Personnel	10									
			32' Support Boat	1									
			X Band Radar	1									
			Infrared Camera	1									
			FAES #4 "Buster"	1									
MSRC-570 Offshore Barge	MSRC (800) OIL-SPIL	Galveston, TX	Offshore Barge	1	22,244	56,900	Galveston, TX	256	4	1	39.5	1	46
			67" Pressure Inflatable Boom	2640'									
			Crucial Disc Skimmer	2									
			*Appropriate Vessel	1									
			Personnel	8									
			* Offshore Tug	2									
			X Band Radar	1									
			Infrared Camera	1									
***Moran/ Long Island	CGA (888) 242-2007	Houma, LA	Offshore Barge	1	N/A	83,382	Houma, LA	155	24-72	0	19.5	1	45 to 93
			Personnel	4									
			Offshore Tug	1									
***Moran/ Tennessee	CGA (888) 242-2007	Houma, LA	Offshore Barge	1	N/A	83,000	Houma, LA	155	24-72	0	19.5	1	45 to 93
			Personnel	4									
			Offshore Tug	1									
***K-Sea DBL 101 Offshore Barge	CGA (888) 242-2007	Belle Chasse, LA	Offshore Barge	1	N/A	107,285	Houma, LA	155	24-72	0	19.5	1	45 to 93
			Personnel	10									
			* Offshore Tug	1									
***K-Sea DBL 102 Offshore Barge	CGA (888) 242-2007	Belle Chasse, LA	Offshore Barge	1	N/A	107,285	Houma, LA	155	24-72	0	19.5	1	45 to 93
			Personnel	10									
			* Offshore Tug	1									
***Moran/ Massachusetts	CGA (888) 242-2007	Houma, LA	Offshore Barge	1	N/A	137,123	Houma, LA	155	24-72	0	19.5	1	45 to 93
			Personnel	4									
			Offshore Tug	1									
***Moran/ Georgia	CGA (888) 242-2007	Houma, LA	Offshore Barge	1	N/A	118,794	Houma, LA	155	24-72	0	19.5	1	45 to 93
			Personnel	4									
			Offshore Tug	1									

DERATED RECOVERY RATE (BBLS/DAY)	668,565
STORAGE CAPACITY INCLUDING SKIMMING VESSELS (BARRELS)	807,237

Table 9.D.4 Offshore On-Water Recovery Storage Activation List (continued)

Mississippi Canyon 984 - Drilling > 10 Miles
Sample Nearshore On-Water Recovery Activation List

Skimming System	Supplier & Phone	Warehouse	Skimming Package	Quantity	Effective Daily Recovery Capacity (EDRC in Bbls/Day)	Storage (Barrels)	Staging Area	Distance to Nearshore Environment (Miles)	Response Times (Hours): Staging ETA	Loadout Time	ETA to Nearshore Environment	Deployment Time	Total ETA
* - These components are additional operational requirements that must be procured in addition to the system identified.													
SWS CGA-77 FRV	CGA (888) 242-2007	Venice, LA	Lori Brush Skimmer	2	22,885	249	Venice, LA	96	2	0	5.5	1	9
			36" Boom	150									
			60' Vessel	1									
			X Band Radar	1									
			Personnel	4									
FRV M/V Grand Bay	CGA (888) 242-2007	Venice, LA	Lori Brush Skimmer	2	15,257	65	Venice, LA	96	2	0	5.5	1	9
			36" Boom	46'									
			46' Vessel	1									
			Personnel	4									
SWS CGA-76 FRV	CGA (888) 242-2007	Leeville, LA	Lori Brush Skimmer	2	22,885	249	Leeville, LA	112	2	0	6.5	1	10
			36" Boom	150									
			60' Vessel	1									
			X Band Radar	1									
			Personnel	4									
SWS CGA-52 MARCO Shallow Water Skimmer	CGA (888) 242-2007	Venice, LA	Marco Belt Skimmer	1	3,588	34	Venice, LA	96	4	1	5.5	1	12
			* 18" Boom (contractor)	100'									
			Personnel	3									
			36' Skimming Vessel	1									
			Shallow Water Barge	1		249							
SWS CGA-53 MARCO Shallow Water Skimmer	CGA (888) 242-2007	Leeville, LA	Marco Belt Skimmer	1	3,588	34	Venice, LA	96	5.5	1	5.5	1	13
			* 18" Boom (contractor)	100'									
			Personnel	3									
			38' Skimming Vessel	1									
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Belle Chasse, LA	Skimmer	1	905	400	Venice, LA	96	4	1	7	1	13
			18" Boom	50'									
			Personnel	4									
			Non-self-propelled barge	1									
			Push Boat	1									
MSRC "Kvichak"	MSRC (800) OIL-SPIL	Belle Chasse, LA	Marco I Skimmer	1	3,588	24	Venice, LA	96	4	1	7	1	13
			Personnel	2									
			30' Shallow Water Vessel	1									
SBS w/ GT-185 w/adapter	MSRC (800) OIL-SPIL	Baton Rouge, LA	Skimmer	1	1,371	400	Venice, LA	96	5	1	7	1	14
			18" Boom	50'									
			Personnel	4									
			Non-self-propelled barge	1									
			Push Boat	1									
MSRC "Kvichak"	MSRC (800) OIL-SPIL	Pascagoula, MS	Marco I Skimmer	1	3,588	24	Venice, LA	96	5.5	1	7	1	15
			Personnel	2									
			30' Shallow Water Vessel	1									
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Pascagoula, MS	Skimmer	1	905	400	Venice, LA	96	5.5	1	7	1	15
			18" Boom	50'									
			Personnel	4									
			Non-self-propelled barge	1									
			Push Boat	1									
SBS w/ AardVAC	MSRC (800) OIL-SPIL	Pascagoula, MS	Skimmer	1	3,840	400	Venice, LA	96	5.5	1	7	1	15
			18" Boom	50'									
			Personnel	4									
			Self-propelled barge	1									
GT-185	MSRC (800) OIL-SPIL	Pascagoula, MS	Skimmer	1	1,371	*500	Venice, LA	96	6	1	7	1	15
			18" Boom	50'									
			Personnel	5									
			*Appropriate Vessel	2									
FRV M/V RW Armstrong	CGA (888) 242-2007	Morgan City, LA	Lori Brush Skimmer	2	15,257	65	Morgan City, LA	194	2	0	11.5	1	15
			36" Boom	46'									
			46' Vessel	1									
			Personnel	4									
SW CGA-72 FRV	CGA (888) 242-2007	Morgan City, LA	Marco Belt Skimmer	2	21,500	249	Morgan City, LA	194	2	0	11.5	1	15
			36" Auto Boom	150'									
			Personnel	4									
			56' SWS Vessel	1									
			* 14'-16' Alum. Flatboat	2									

Table 9.D.5 Nearshore On-Water Recovery Activation List

Mississippi Canyon 984 - Drilling > 10 Miles
Sample Nearshore On-Water Recovery Activation List

Skimming System	Supplier & Phone	Warehouse	Skimming Package	Quantity	Effective Daily Recovery Capacity (EDRC in Bbls/Day)	Storage (Barrels)	Staging Area	Distance to Nearshore Environment (Miles)	Response Times (Hours): Staging ETA	Loadout Time	ETA to Nearshore Environment	Deployment Time	Total ETA
* - These components are additional operational requirements that must be procured in addition to the system identified.													
SWS CGA-51 MARCO Shallow Water Skimmer	CGA (888) 242-2007	Lake Charles, LA	Marco Belt Skimmer * 18" Boom (contractor) Personnel 34' Skimming Vessel Shallow Water Barge	1 100' 3 1 1	3,588	20 249	Venice, LA	96	7	1	5.5	1	15
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Lake Charles, LA	Skimmer 18" Boom Personnel Non-self-propelled barge Push Boat	1 50' 4 1 1	905	400	Venice, LA	96	7	1	7	1	16
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Lake Charles, LA	Skimmer 18" Boom Personnel Non-self-propelled barge Push Boat	1 50' 4 1 1	905	400	Venice, LA	96	7	1	7	1	16
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Lake Charles, LA	Skimmer 18" Boom Personnel Non-self-propelled barge Push Boat	1 50' 4 1 1	905	400	Venice, LA	96	7	1	7	1	16
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Lake Charles, LA	Skimmer 18" Boom Personnel Self-propelled barge	1 50' 4 1	905	400	Venice, LA	96	7	1	7	1	16
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Lake Charles, LA	Skimmer 18" Boom Personnel Self-propelled barge	1 50' 4 1	905	400	Venice, LA	96	7	1	7	1	16
MSRC "Kvichak"	MSRC (800) OIL-SPIL	Galveston, TX	Marco I Skimmer Personnel 30' Shallow Water Vessel	1 2 1	3,588	24	Venice, LA	96	9.5	1	7	1	19
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Galveston, TX	Skimmer 18" Boom Personnel Non-self-propelled barge Push Boat	1 50' 4 1 1	905	400	Venice, LA	96	9.5	1	7	1	19
SBS w/ GT-185 w/adapter	MSRC (800) OIL-SPIL	Galveston, TX	Skimmer 18" Boom Personnel Non-self-propelled barge Push Boat	1 50' 4 1 1	1,371	400	Venice, LA	96	9.5	1	7	1	19
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Memphis, TN	Skimmer 18" Boom Personnel Non-self-propelled barge Push Boat	1 60' 4 1 1	905	400	Venice, LA	96	9.5	1	7	1	19
SW CGA-74 FRV	CGA (888) 242-2007	Vermilion, LA	Marco Belt Skimmer 36" Auto Boom Personnel 56' SW Vessel * 14'-16' Alum. Flatboat	2 150' 4 1 2	21,500	249	Vermilion, LA	265	2	0	15.5	1	19
GT-185	MSRC (800) OIL-SPIL	Jacksonville, FL	Skimmer 18" Boom Personnel *Appropriate Vessel *Temporary Storage	1 60' 5 2 1	1,371	500	Venice, LA	96	12	1	7	1	21
SWS CGA-55 Egmopol Shallow Water Skimmer	CGA (888) 242-2007	Morgan City, LA	Marco Skimmer * 18" Boom (contractor) Personnel 38' Skimming Vessel Shallow Water Barge	1 100' 3 1 1	1,810	100 249	Venice, LA	96	5	1	13.5	1	21

Table 9.D.5 Nearshore On-Water Recovery Activation List (continued)

Mississippi Canyon 984 - Drilling > 10 Miles
Sample Nearshore On-Water Recovery Activation List

Skimming System	Supplier & Phone	Warehouse	Skimming Package	Quantity	Effective Daily Recovery Capacity (EDRC in Bbls/Day)	Storage (Barrels)	Staging Area	Distance to Nearshore Environment (Miles)	Response Times (Hours) Staging ETA	Loadout Time	ETA to Nearshore Environment	Deployment Time	Total ETA
* - These components are additional operational requirements that must be procured in addition to the system identified.													
FRV M/V Bastian Bay	CGA (888) 242-2007	Lake Charles, LA	Lori Brush Skimmer	2	15,257	65	Lake Charles, LA	306	2	0	18	1	21
			36" Boom	46'									
			46' Vessel	1									
			Personnel	4									
SW CGA-73 FRV	CGA (888) 242-2007	Lake Charles, LA	Marco Belt Skimmer	2	21,500	249	Lake Charles, LA	306	2	0	18	1	21
			36" Auto Boom	150'									
			Personnel	5									
			56' SWS Vessel	1									
			* 14'-16' Alum. Flatboat	2									
MSRC "Kvichak"	MSRC (800) OIL-SPIL	Ingleside, TX	Marco I Skimmer	1	3,588	24	Venice, LA	96	12.25	1	7	1	22
			Personnel	2									
			30' Shallow Water Vessel	1									
SBS w/ GT-185 w/adapter	MSRC (800) OIL-SPIL	Ingleside, TX	Skimmer	1	1,371	400	Venice, LA	96	12.25	1	7	1	22
			18" Boom	50'									
			Personnel	4									
			Self-propelled barge	1									
MSRC "Kvichak"	MSRC (800) OIL-SPIL	Savannah, GA	Marco I Skimmer	1	3,588	24	Venice, LA	96	13.5	1	7	1	23
			Personnel	2									
			30' Shallow Water Vessel	1									
GT-185	MSRC (800) OIL-SPIL	Tampa, FL	Skimmer	1	1,371		Venice, LA	96	13	1	7	1	22
			18" Boom	50'									
			Personnel	5									
			*Appropriate Vessel	2									
			*Temporary Storage	1		500							
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Roxana, IL	Skimmer	1	905	400	Venice, LA	96	14	1	7	1	23
			18" Boom	50'									
			Personnel	4									
			Non-self-propelled barge	1									
			Push Boat	1									
SWS CGA-75 FRV	CGA (888) 242-2007	Galveston, TX	Lori Brush Skimmer	2	22,885	249	Galveston, TX	356	2	0	21	1	24
			36" Boom	150									
			60' Vessel	1									
			X Band Radar	1									
			Personnel	4									
CGA-54 Egmopol Shallow Water Skimmer	CGA (888) 242-2007	Galveston, TX	Marco Belt Skimmer	1	1,810	100	Venice, LA	96	10	1	13.5	1	25
			* 18" Boom (contractor)	100'									
			Personnel	3									
			34' Skimming Vessel	1									
			Shallow Water Barge	1		249							
WP-1	MSRC (800) OIL-SPIL	Miami, FL	Skimmer	1	3,017		Venice, LA	96	16	1	7	1	25
			18" Boom	50'									
			Personnel	5									
			*Appropriate Vessel	2									
			*Temporary Storage	1		500							
AARDVAC	MSRC (800) OIL-SPIL	Miami, FL	Skimmer	1	3,840		Venice, LA	96	16	1	7	1	25
			18" Boom	50'									
			Personnel	5									
			* Appropriate Vessel	2									
			*Temporary Storage	1		500							
AARDVAC	MSRC (800) OIL-SPIL	Miami, FL	Skimmer	1	3,840		Venice, LA	96	16	1	7	1	25
			18" Boom	50'									
			Personnel	5									
			* Appropriate Vessel	2									
			*Temporary Storage	1		500							
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Whiting, IN	Skimmer	1	905	400	Venice, LA	96	17.25	1	7	1	27
			18" Boom	60'									
			Personnel	4									
			Non-self-propelled barge	1									
			Push Boat	1									
SW CGA-71 FRV	CGA (888) 242-2007	Aransas Pass, TX	Marco Belt Skimmer	2	21,500	249	Galveston, TX	356	6	0	21	1	28
			36" Auto Boom	150'									
			Personnel	5									
			56' SWS Vessel	1									
			* 14'-16' Alum. Flatboat	2									

Table 9.D.5 Nearshore On-Water Recovery Activation List (continued)

Mississippi Canyon 984 - Drilling > 10 Miles
Sample Nearshore On-Water Recovery Activation List

Skimming System	Supplier & Phone	Warehouse	Skimming Package	Quantity	Effective Daily Recovery Capacity (EDRC in Bbls/Day)	Storage (Barrels)	Staging Area	Distance to Nearshore Environment (Miles)	Response Times (Hours): Staging ETA	Loadout Time	ETA to Nearshore Environment	Deployment Time	Total ETA
* - These components are additional operational requirements that must be procured in addition to the system identified.													
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Toledo, OH	Skimmer 18" Boom Personnel Non-self-propelled barge Push Boat	1 50' 4 1 1	905	400	Venice, LA	96	18.5	1	7	1	28
SBS w/ AardVAC	MSRC (800) OIL-SPIL	Virginia Beach, VA	Skimmer 18" Boom Personnel Self-propelled barge	1 50' 4 1	3,840	400	Venice, LA	96	20	1	7	1	29
MSRC "Quick Strike"	MSRC (800) OIL-SPIL	Lake Charles, LA	LORI Brush Skimmer Personnel 47' Fast Response Boat	2 3 1	5,000	50	Lake Charles, LA	306	2	1	22	1	26
SBS w/ Stress 1	MSRC (800) OIL-SPIL	Chesapeake City, MD	Skimmer 18" Boom Personnel Non-self-propelled barge Push Boat	1 50' 4 1 1	15,840	400	Venice, LA	96	21.25	1	7	1	31
SBS w/ Stress 1	MSRC (800) OIL-SPIL	Edison/Perth Amboy, NJ	Skimmer 18" Boom Personnel Self-propelled barge	1 50' 4 1	15,840	400	Venice, LA	96	23	1	7	1	32
MSRC "Kvichak"	MSRC (800) OIL-SPIL	Edison/Perth Amboy, NJ	Marco I Skimmer Personnel 30' Shallow Water Vessel	1 2 1	3,588	24	Venice, LA	96	22.75	1	7	1	32
MSRC "Kvichak"	MSRC (800) OIL-SPIL	Edison/Perth Amboy, NJ	Marco I Skimmer Personnel 30' Shallow Water Vessel	1 2 1	3,588	24	Venice, LA	96	22.75	1	7	1	32
SBS w/ GT-185	MSRC (800) OIL-SPIL	Bayonne, NJ	Skimmer 18" Curtain Internal Foam Personnel Non-self-propelled barge *Appropriate Vessel	1 60' 4 1 1	1,371	400	Venice, LA	96	22.75	1	7	1	32
FRV CGA 58 Timbalier Bay	CGA (888) 242-2007	Aransas Pass, TX	Lori Brush Skimmer 36" Boom 46' Vessel Personnel	2 46' 1 4	15,257	65	Aransas Pass, TX	490	2	0	29	1	32
MSRC "Lightning"	MSRC (800) OIL-SPIL	Tampa, FL	LORI Brush Skimmer Personnel 47' Fast Response Boat	2 3 1	5,000	50	Tampa, FL	419	2	1	30	1	34
SBS w/ GT-185	MSRC (800) OIL-SPIL	Providence, RI	Skimmer 18" Curtain Internal Foam Personnel Non-self-propelled barge Push Boat	1 60' 4 1 1	1,371	400	Venice, LA	96	26	1	7	1	35
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Everett, MA	Skimmer 18" Boom Personnel Non-self-propelled barge Push Boat	1 50' 4 1 1	905	400	Venice, LA	96	26	1	7	1	35
MSRC "Kvichak"	MSRC (800) OIL-SPIL	Portland, ME	Marco I Skimmer Personnel 30' Shallow Water Vessel	1 2 1	3,588	24	Venice, LA	96	28	1	7	1	37
SBS w/ WP-1	MSRC (800) OIL-SPIL	Portland, ME	Skimmer 18" Boom Personnel Self-propelled barge	1 50' 4 1	3,017	400	Venice, LA	96	28	1	7	1	37
DERATED RECOVERY RATE (BBLS/DAY)											344,578		
SKIMMING VESSEL STORAGE CAPACITY (BARRELS)											15,279		

Table 9.D.5 Nearshore On-Water Recovery Activation List (continued)

Mississippi Canyon 984 - Drilling > 10 Miles Sample Aerial Surveillance Activation List											
Aerial Surveillance System	Supplier & Phone	Airport/City, State	Aerial Surveillance Package	Quantity	Staging Location	Distance to Site from Staging (nautical miles)	Response Times (Hours)			
							Staging ETA	Loadout Time	ETA to Site	Total ETA
* - These components are additional operational requirements that must be procured in addition to the system identified.										
Twin Commander Air Speed - 260 Knots	Airborne Support (985) 851-6391	Houma, LA	Surveillance Aircraft	1	Houma, LA	142	1	0.25	0.47	1.75
			Spotter Personnel	2						
			Crew - Pilots	1						
Aztec Piper Air Speed - 150 Knots	Airborne Support (985) 851-6391	Houma, LA	Surveillance Aircraft	1	Houma, LA	142	1	0.25	0.83	2.10
			Spotter Personnel	2						
			Crew - Pilots	1						
Eurocopter EC-135 Helicopter Air Speed - 141 knots	PHI (800) 235-2452	Houma, LA	Surveillance Aircraft	1	Houma, LA	142	1	0.25	0.88	2.15
			Spotter Personnel	2						
			Crew - Pilots	1						
Sikorsky S-76 Helicopter Air Speed - 141 knots	PHI (800) 235-2452	Houma, LA	Surveillance Aircraft	1	Houma, LA	142	1	0.25	0.88	2.15
			Spotter Personnel	2						
			Crew - Pilots	1						

Table 9.D.6 Aerial Surveillance Activation List

Mississippi Canyon 984 - Drilling > 10 Miles
Sample Offshore Aerial Dispersant Activation List

Aerial Dispersant System	Supplier & Phone	Airport/ City, State	Aerial Dispersant Package	Quantity	Staging Location	Distance to Site from Staging (Miles)	Response Times (Hours): Staging ETA	Response Times (Hours): Loadout Time	Response Times (Hours): ETA to Site	Response Times (Hours): Deployment Time	Response Times (Hours): Total ETA
NOTE: *Planholder has access to additional dispersant assets.*											
** - These components are additional operational requirements that must be procured in addition to the system(s) identified.*											
*** The second flight times listed are to demonstrate subsequent sortie and application timeframes.*											
**** The dispersants listed is for gallon capacity only not amount stored at each location.*											
Twin Commander Air Speed - 300 MPH	CGA/Airborne Support (985) 851-6391	Houma, LA	Aero Commander	1	Houma, LA	142	1	0	0.47	0	1.60
			Spotter Personnel	2							
			Crew - Pilots	1							
BT-67 (DC-3 Turboprop) Aircraft Air Speed - 194 MPH	CGA/Airborne Support (985) 851-6391	Houma, LA	DC-3 Dispersant Aircraft	1	Houma, LA 1st Flight	142	2	0.5	0.73	0.5	3.76
			Dispersant - Gallons	2000							
			Spotter Aircraft	1							
			Spotter Personnel	2	Houma, LA 2nd Flight	142	0.73	0.5	0.73	0.3	2.30
			Crew - Pilots	2							
DC-3 Aircraft Air Speed - 150 MPH	CGA/Airborne Support (985) 851-6391	Houma, LA	DC-3 Dispersant Aircraft	1	Houma, LA 1st Flight	142	2	0.5	0.95	0.5	3.86
			Dispersant - Gallons	1200							
			Spotter Aircraft	1							
			Spotter Personnel	2	Houma, LA 2nd Flight	142	0.95	0.5	0.95	0.3	2.70
			Crew - Pilots	2							
DC-3 Aircraft Air Speed - 150 MPH	CGA/Airborne Support (985) 851-6391	Houma, LA	DC-3 Dispersant Aircraft	1	Houma, LA 1st Flight	142	2	0.5	0.95	0.5	3.86
			Dispersant - Gallons	1200							
			Spotter Aircraft	1							
			Spotter Personnel	2	Houma, LA 2nd Flight	142	0.95	0.5	0.95	0.3	2.70
			Crew - Pilots	2							
BE-90 King Air Aircraft Air Speed - 213 MPH	MSRC (800) OIL-SPIL	Kiln, MS	BE-90 Dispersant Aircraft	1	Stennis INTL., MS 1st Flight	165	3	0.00	0.78	0.20	4.00
			Dispersant - Gallons	250							
			* Spotter Aircraft	1							
			*Spotter Personnel	2	Stennis INTL., MS 2nd Flight	165	0.78	0.20	0.78	0.20	2.00
			Crew - Pilots	2							
C130-A Aircraft Air Speed - 342 MPH	MSRC (800) OIL-SPIL	Kiln, MS	C130-A Disp Aircraft	1	Stennis INTL., MS 1st Flight	165	3	0.0	0.48	0.5	4.00
			Dispersant - Gallons	4125							
			*Spotter Aircraft	1							
			*Spotter Personnel	2	Stennis INTL., MS 2nd Flight	165	0.50	0.3	0.48	0.5	1.86
			Crew - Pilots	2							
C130-A Aircraft Air Speed - 342 MPH	MSRC (800) OIL-SPIL	Mesa, AZ	C130-A Disp. Aircraft	1	Stennis INTL., MS 1st Flight	165	7	0.3	0.48	0.5	8.36
			Dispersant - Gallons	4125							
			*Spotter Aircraft	1							
			*Spotter Personnel	2	Stennis INTL., MS 2nd Flight	165	0.50	0.3	0.48	0.5	1.86
			Crew - Pilots	2							

Table 9.D.7 Offshore Aerial Dispersant Activation List

Boat Spray Dispersant System	Supplier & Phone	Warehouse	Boat Spray Dispersant Package	Quantity	Staging Area	Distance to Site from Staging (Miles)	Response Times (Hours): Staging ETA	Loadout Time	ETA to Site	Deployment Time	Total ETA
NOTE: Planholder has access to additional dispersant assets. ** - These components are additional operational requirements that must be procured by OSROs in addition to the system(s) identified.*											
Fire Monitor Induction Dispersant Spray System	AMPOL (800) 482-6765	Port Fourchon, LA	Dispersant Spray System	1	Venice, LA	96	5.75	0.5	7	1	14.25
			Dispersant (Gallons)	500							
			Personnel	4							
			* 110' Utility Boat	1							
			* Crew Boat	1							
USCG SMART Team	USCG	Mobile, AL	Personnel	4	Venice, LA	96	6	1	7	0.5	14.5
			* Crew Boat	1							
Vessel Based Dispersant Spray System	CGA (888) 242-2007	Harvey, LA	Dispersant Spray System	1	Venice, LA	96	4	0.5	9.5	1	15
			Dispersant (Gallons)	330							
			Personnel	4							
			* Utility Boat	1							
Fire Monitor Induction Dispersant Spray System	AMPOL (800) 482-6765	Cameron, LA	Dispersant Spray System	1	Venice, LA	96	7.75	0.5	7	1	16.25
			Dispersant (Gallons)	500							
			Personnel	4							
			* 110' Utility Boat	1							
			* Crew Boat	1							
Vessel Based Dispersant Spray System	CGA (888) 242-2007	Aransas Pass, TX	Dispersant Spray System	1	Venice, LA	96	12.25	0.5	9.5	1	23.25
			Dispersant (Gallons)	330							
			Personnel	4							
			* Utility Boat	1							

Table 9.D.8 Offshore Boat Spray Dispersant Activation List

Containment System	Supplier & Phone	Warehouse	Package	Quantity	Staging Area	Distance to Site from Staging (Miles)	Response Times (Days): Staging ETA	Loadout Time	ETA to Site	Deployment Time	Total ETA
** - Response time may vary depending on Drill Ship's operations and location at the time of deployment.*											
Site Assessment and Surveillance	BP	Port Fourchon, LA	Multi-Service Vessel	1	Port Fourchon, LA	102	0	1.5	7.5	0.5	9.5
			ROV's	2							
Subsea Dispersant Application	BP / MWCC	Port Fourchon, LA	Multi-Service Vessel	1	Port Fourchon, LA	102	1.5	1.5	7.5	2	12.5
			ROV's	2							
			Coil Tubing Unit	1							
		Houston, TX	Dispersant	200,000 gal							
			Manifold	1							
			Subsea Dispersant Injection System	1							
Capping Stack	BP / MWCC	Port Fourchon, LA	Anchor Handling Tug Supply Vessel	1	Port Fourchon, LA	102	2*	1.5	7.5	3	14*
			ROV's	1							
		Houston, TX	Hydraulic System	1							
			Capping Stack	1							
"Top Hat" Unit	BP / MWCC	Port Fourchon, LA	Anchor Handling Tug Supply Vessel	1	Port Fourchon, LA	102	13*	1	7.5	3	25*
			ROV's	2							
			Multi-Purpose Supply Vessel	1							
			Drill Ship (Processing Vessel)	1							
		Houston, TX	"Top Hat"	1							
			Containment Chamber	1							
			Shuttle Barge	1							

Table 9.D.9 Subsea Control, Containment, and Subsea Dispersant Package Activation List

Mississippi Canyon 984 - Drilling > 10 Miles
Sample In-Situ Burn Equipment Activation List

Skimming System	Supplier & Phone	Warehouse	Skimming Package	Quantity	Staging Area	Distance to Site from Staging (Miles)	Response Times (Hours): Staging ETA	Loadout Time	ETA to Site	Deployment Time	Total ETA
NOTE: Planholder has access to additional ISB assets. * - These components are additional operational requirements that must be procured in addition to the system identified. ** - Teams will deploy in sections of 500' at any given time											
ISB Fire-Fighting Team	TBD	TBD	* Offshore Firefighting Vessels	2	Venice, LA	96	4	1	7	1	13
			* Cranes	2							
			* Roll-off Boxes	2							
			Personnel	8							
			* Air Monitoring Equipment	2							
SMART In-Situ Burn Monitoring Team	USCG	Mobile, AL	* Air Monitoring Equipment	1	Venice, LA	96	4	1	7	1	13
			* Offshore Vessel	1							
			Personnel	4							
Safety Monitoring Team	TBD	TBD	* Air Monitoring Equipment	1	Venice, LA	96	4	1	7	1	13
			* Offshore Vessel	1							
			Personnel	4							
Wildlife Monitoring Team	TBD	TBD	* Air Monitoring Equipment	1	Venice, LA	96	4	1	7	1	13
			* Offshore Vessel	1							
			Personnel	4							
Aerial Spotting Team (per 2 ISB Task Forces)	TBD	TBD	Fixed Wing Aircraft	1	Venice, LA	96	4	1	7	1	13
			Trained ISB Spotter	2							
			ISB Documenter	1							
Fire Team (In-Situ Burn Fire System)	MSRC (800) OIL-SPIL	Lake Charles, LA	**Fire Boom (ft)	2,000	Venice, LA	96	7	1	7	1	16
			Tow Line (ft)	600							
			* Appropriate Vessel	2							
			Personnel	2							
			Ignition Device	25							
Fire Team (In-Situ Burn Fire System)	MSRC (800) OIL-SPIL	Houston, TX	**Fire Boom (ft)	16,000	Venice, LA	96	9	1	7	1	18
			Tow Line (ft)	600							
			* Appropriate Vessel	2							
			Personnel	2							
			Ignition Device	155							
Fire Team (In-Situ Burn Fire System)	MSRC (800) OIL-SPIL	Galveston, TX	**Fire Boom (ft)	1,000	Venice, LA	96	9.5	1	7	1	18.5
			Tow Line (ft)	600							
			* Appropriate Vessel	2							
			Personnel	2							
			Ignition Device	10							
Supply Team (Supply Vessel System)	MSRC (800) OIL-SPIL	Venice, LA	*Offshore Vessel 110' - 310'	1	Venice, LA	96	4	1	19	1	25
			Personnel	6							
Fire Team (In-Situ Burn Fire System)	MSRC (800) OIL-SPIL	Portland, ME	**Fire Boom (ft)	1,000	Venice, LA	96	28	1	7	1	37
			Tow Line (ft)	600							
			* Appropriate Vessel	2							
			Personnel	2							
			Ignition Device	10							
Fire Team (In-Situ Burn Fire System)	CGA (888) 242-2007	Harvey, LA	Fire Boom (ft)	500	Venice, LA	96	4	24	9.5	1	38.5
			Guide Boom/Tow Line (ft)	400							
			* Offshore Vessel (0.5 kt capability)	3							
			Personnel	20							
			Ignition Device	10							
Fire Team (In-Situ Burn Fire System)	CGA (888) 242-2007	Harvey, LA	Fire Boom (ft)	500	Venice, LA	96	4	24	9.5	1	38.5
			Guide Boom/Tow Line (ft)	400							
			* Offshore Vessel (0.5 kt capability)	3							
			Personnel	20							
			Ignition Device	10							
TOTAL FIRE BOOM AVAILABLE (FEET)										21,000	

Table 9.D.10 In-Situ Burn Equipment Activation List

Mississippi Canyon 984 - Drilling > 10 Miles
Sample Shoreline Protection & Wildlife Support List

Supplier & Phone	Warehouse	Equipment Listing	Quantity	Staging Area	Response Times (Hours)			
					Staging ETA	Loadout Time	Deployment Time	Total ETA
AMPOL (800) 482-6765	Harvey, LA	Containment Boom - 18" to 24"	8,000'	Venice, LA	4	1	1	6
		Containment Boom - 6" to 10"	3,000'					
AMPOL (800) 482-6765	Venice, LA	Containment Boom - 18" to 24"	2,250'	Venice, LA	4	1	1	6
		Response Boats - 14' to 20'	2					
		Response Boats - 21' to 36'	1					
		Portable Skimmers	2					
ES&H Environmental (877) 437-2634	Belle Chasse, LA	Containment Boom - 10"	1,500'	Venice, LA	4	1	1	6
		Containment Boom - 18"	15,500'					
		Containment Boom - 24"	5,000'					
		Jon Boat - 12' to 16'	4					
		Response Boats - 18' to 21'	1					
		Response Boats - 22' to 25'	1					
		Response Boats - 26' to 29'	3					
		Portable Skimmers	10					
		Wildlife Hazing Cannon	50					
ES&H Environmental (877) 437-2634	Venice, LA	Containment Boom - 10"	2,000'	Venice, LA	4	1	1	6
		Containment Boom - 18"	13,000'					
		Containment Boom - 24"	10,000					
		Jon Boat - 12' to 16'	4					
		Response Boats - 22' to 25'	1					
		Response Boats - 26' to 29'	2					
		Portable Skimmers	5					
		Wildlife Hazing Cannon	25					
OMI (800) 645-6671	Belle Chasse, LA	Containment Boom - 18" to 24"	4,500'	Venice, LA	4	1	1	6
		Containment Boom - 6" to 10"	500'					
		Response Boats - 20'	1					
		Response Boats - 25' to 28'	2					
		Portable Skimmers	12					
		Shallow Water Skimmers	1					
		Bird Scare Cannons	12					
		Response Personnel	24					
OMI (800) 645-6671	Venice, LA	Containment Boom - 18" to 24"	1,500'	Venice, LA	4	1	1	6
		Response Boats - 16'	4					
		Response Boats (Barge) - 25' to 33'	1					
		Response Boats - 25' to 28'	2					
		Response Boats - (Cabin Boat) 27' to 30'	1					
		Shallow Water Skimmers	3					
		Portable Skimmers	2					
USES Environmental (888) 279-9930	Meraux, LA	Containment Boom - 18"	6,000'	Venice, LA	4	1	1	6
		Containment Boom - 10"	1,000'					
		Response Boats - 16'	23					
		Response Boats - 18'	1					
		Response Boats - 24'	1					
		Response Boats - 26'	2					
		Response Boats - 28'	1					
		Portable Skimmers	2					
USES Environmental (888) 279-9930	Marrero, LA	Containment Boom - 18"	600'	Venice, LA	4	1	1	6
USES Environmental (888) 279-9930	Venice, LA	Containment Boom - 18"	10,000'	Venice, LA	4	1	1	6
		Response Boats - 16'	15					
		Response Boats - 26'	2					
		Response Boats - 30'	1					
		Portable Skimmers	2					
		Shallow Water Skimmers	1					
CGA (888) 242-2007	Harvey, LA	Wildlife Rehab Trailer	1	Venice, LA	4	1	1	6
		Wildlife Husbandry Trailer	1					
		Support Trailer	3					
		Bird Scare Cannons	120					
		Contract Truck (Third Party)	3					
		Personnel (Responder/Mechanic)	4					

Table 9.D.11 Shoreline Protection and Wildlife Support List

Mississippi Canyon 984 - Drilling > 10 Miles
Sample Shoreline Protection & Wildlife Support List

Supplier & Phone	Warehouse	Equipment Listing	Quantity	Staging Area	Response Times (Hours): Staging ETA	Loadout Time	Deployment Time	Total ETA
USES Environmental (888) 534-2744	Geismar, LA	Containment Boom - 18"	1,000'	Venice, LA	4.75	1	1	7
		Response Boats - 16'	2					
		Portable Skimmers	1					
USES Environmental (888) 279-9930	Hahnville, LA	Containment Boom - 18"	500'	Venice, LA	4.25	1	1	7
USES Environmental (888) 279-9930	Amelia, LA	Containment Boom - 18"	500'	Venice, LA	5	1	1	7
USES Environmental (888) 279-9930	Lafitte, LA	Containment Boom - 18"	1,000'	Venice, LA	4.25	1	1	7
		Response Boats - 18'	2					
OMI (800) 645-6671	Galliano, LA	Containment Boom - 18" to 24"	2,000'	Venice, LA	5	1	1	7
		Containment Boom - 6" to 10"	500'					
		Response Boats - 16'	1					
		Response Boats (Barge) - 25' to 33'	1					
		Response Boats - 25' to 28'	1					
		Portable Skimmers	3					
Lawson Environmental Service (985) 876-0420	Houma, LA	Containment Boom - 18"	30,000'	Venice, LA	4.75	1	1	7
		Containment Boom - 12"	2,000'					
		Containment Boom - 10"	9,500'					
		Response Boats - 14'	10					
		Response Boats - 16'	6					
		Response Boats - 20'	5					
		Response Boats - 24'	8					
		Response Boats - 26'	4					
		Response Boats - 28'	7					
		Response Boats - 32'	4					
		Portable Skimmers	6					
OMI (800) 645-6671	Port Allen, LA	Containment Boom - 18" to 24"	2500'	Venice, LA	5	1	1	7
		Containment Boom - 6" to 10"	500'					
		Response Boats - 16'	2					
		Response Boats - 25 to 33'	1					
		Shallow Water Skimmers	1					
		Response Personnel	6					
OMI (800) 645-6671	Morgan City, LA	Containment Boom - 18" to 24"	2,500	Venice, LA	5	1	1	7
		Containment Boom - 6" to 10"	400'					
		Response Boats - 16'	2					
		Response Boats - 25' to 28'	1					
		Portable Skimmers	3					
		Response Personnel	3					
OMI (985) 798-1005	Houma, LA	Containment Boom - 18" to 24"	2,000'	Venice, LA	4.75	1	1	7
		Containment Boom - 6" to 10"	500'					
		Response Boats - 16'	2					
		Response Boats - 25' to 28'	1					
		Response Boats - (Cabin Boat) 27' to 30'	1					
		Shallow Water Skimmers	3					
Clean Harbors (800) 645-8265	Baton Rouge, LA	Containment Boom - 18" to 24"	14,000'	Venice, LA	5	1	1	7
		Response Boats - 14' to 20'	1					
		Portable Skimmers	3					
		Response Personnel	13					
ES&H Environmental (877) 437-2634	Houma, LA	Containment Boom - 10"	2,000'	Venice, LA	4.75	1	1	7
		Containment Boom - 18"	20,000'					
		Containment Boom - 24"	5,000'					
		Jon Boat - 12' to 16'	30					
		Response Boats - 22' to 25'	2					
		Response Boats - 26' to 29'	4					
		Portable Skimmers	23					
		Shallow Water Skimmers	2					
		Wildlife Hazing Cannon	57					

Table 9.D.11 Shoreline Protection and Wildlife Support List (cont.)

Mississippi Canyon 984 - Drilling > 10 Miles
Sample Shoreline Protection & Wildlife Support List

Supplier & Phone	Warehouse	Equipment Listing	Quantity	Staging Area	Response Times (Hours)			
					Staging ETA	Loadout Time	Deployment Time	Total ETA
ES&H Environmental (877) 437-2634	Morgan City, LA	Containment Boom - 10"	2,000'	Venice, LA	5	1	1	7
		Containment Boom - 18"	500'					
		Jon Boat - 12' to 16'	3					
		Response Boats - 18' to 21'	2					
		Response Boats - 22' to 25'	1					
		Portable Skimmers	2					
		Wildlife Hazing Cannon	12					
SWS Environmental (877) 742-4215	Baton Rouge, LA	Containment Boom - 18"	1,000'	Venice, LA	5	1	1	7
		Response Boats - 25' to 42'	2					
		Shallow Water Skimmers	1					
		Response Personnel	6					
USES Environmental (888) 279-9930	Biloxi, MS	Containment Boom - 18"	2,000'	Venice, LA	5	1	1	7
		Response Boats - 16'	1					
Wildlife Ctr. of Texas (713) 861-9453	Baton Rouge, LA	Wildlife Specialist - Personnel	6 to 20	Venice, LA	5	1	1	7
USES Environmental (888) 279-9930	Mobile, AL	Containment Boom - 10"	800'	Venice, LA	6	1	1	8
		Containment Boom - 18"	5,000'					
		Response Boats - 16'	1					
		Response Boats - 18'	1					
		Response Boats - 20'	1					
		Response Boats - 26'	1					
		Portable Skimmers	2					
ES&H Environmental (877) 437-2634	Port Fourchon, LA	Containment Boom - 18"	1000'	Venice, LA	5.75	1	1	8
		Response Boats - 22' to 25'	1					
		Portable Skimmers	1					
AMPOL (800) 482-6765	New Iberia, LA	Containment Boom - 6" to 10"	4,150'	Venice, LA	6	1	1	8
		Containment Boom - 18" to 24"	34,050'					
		Response Boats - 14' to 20'	3					
		Response Boats - 21' to 36'	3					
		Portable Skimmers	27					
Clean Harbors (800) 645-8265	New Iberia, LA	Containment Boom - 18" to 24"	33,800'	Venice, LA	6	1	1	8
		Containment Boom - 6" to 10"	500'					
		Response Boats - 21' to 36'	4					
ES&H Environmental (877) 437-2634	Golden Meadow, LA	Containment Boom - 10"	1,000'	Venice, LA	5.25	1	1	8
		Containment Boom - 18"	13,000					
		Jon Boat - 12' to 16'	2					
		Response Boats - 18' to 21'	1					
		Response Boats - 22' to 25'	1					
		Response Boats - 26' to 29'	1					
		Portable Skimmers	5					
		Wildlife Hazing Cannon	12					
ES&H Environmental (877) 437-2634	Lafayette, LA	Containment Boom - 10"	500'	Venice, LA	6	1	1	8
		Containment Boom - 18"	13,000'					
		Jon Boat - 12' to 16'	3					
		Response Boats - 18' to 21'	1					
		Response Boats - 22' to 25'	1					
		Response Boats - 26' to 29'	1					
		Portable Skimmers	4					
		Wildlife Hazing Cannon	12					
OMI (800) 645-6671	New Iberia, LA	Containment Boom - 18" to 24"	12,000'	Venice, LA	6	1	1	8
		Containment Boom - 6" to 10"	300'					
		Response Boats - 16'	3					
		Response Boats (Barge) - 25' to 33'	1					
		Response Boats - 25' to 28'	1					
		Portable Skimmers	8					
		Response Personnel	8					

Table 9.D.11 Shoreline Protection and Wildlife Support List (cont.)

Mississippi Canyon 984 - Drilling > 10 Miles
Sample Shoreline Protection & Wildlife Support List

Supplier & Phone	Warehouse	Equipment Listing	Quantity	Staging Area	Response Times (Hours)			
					Staging ETA	Loadout Time	Deployment Time	Total ETA
USES Environmental (888) 279-9930	Lake Charles, LA	Containment Boom - 10"	100'	Venice, LA	7	1	1	9
		Containment Boom - 18"	7,700'					
		Response Boats - 16'	3					
		Response Boats - 27'	1					
		Response Boats - 37'	1					
ES&H Environmental (877) 437-2634	Lake Charles, LA	Containment Boom - 10"	500'	Venice, LA	7	1	1	9
		Containment Boom - 18"	15,000'					
		Containment Boom - 24"	5,000'					
		Jon Boat - 12' to 16'	3					
		Response Boats - 18' to 21'	2					
		Response Boats - 26' to 29'	2					
		Portable Skimmers	13					
		Wildlife Hazing Cannon	40					
Miller Env. Services (800) 929-7227	Sulphur, LA	Containment Boom - 10"	600'	Venice, LA	7	1	1	9
		Containment Boom - 18"	14,000'					
		Jon Boats - 14' to 16'	2					
		Jon Boats - 16' w/25hp HP Outboard Motor	2					
		Air Boat - 18'	1					
		Work Boat - 18'	2					
		Response Boats - 24' - 28'	4					
		Portable Skimmers	5					
		Shallow Water Skimmers	1					
		Response Personnel	49					
SWS Environmental (877) 742-4215	Pensacola, FL	Containment Boom - 18"	2,500'	Venice, LA	6.75	1	1	9
		Response Boats - 16' to 25'	2					
		Shallow Water Skimmers	1					
		Response Personnel	2					
USES Environmental (888) 279-9930	Jackson, MS	Containment Boom - 10"	400'	Venice, LA	6.5	1	1	9
		Containment Boom - 18"	2,000'					
		Response Boats - 12'	3					
		Response Boats - 14'	1					
		Response Boats - 16'	1					
		Response Boats - 18'	1					
		Response Boats - 20'	1					
		Portable Skimmers	2					
AMPOL (800) 482-6765	Port Arthur, TX	Containment Boom - 18" to 24"	16,000'	Venice, LA	8	1	1	10
		Response Boats - 14' to 20'	2					
		Response Boats - 21' to 36'	1					
		Portable Skimmers	3					
Clean Harbors (800) 645-8265	Port Arthur, TX	Containment Boom - 18" to 24"	3,000'	Venice, LA	8	1	1	10
		Response Boats - 21' to 36'	2					
		Portable Skimmers	2					
		Response Personnel	54					
Garner Environmental (800) 424-1716	Port Arthur, TX	Containment Boom - 6"	22,000'	Venice, LA	8	1	1	10
		Response Boats - 14' to 20'	8					
		Response Boats - 21' to 36'	1					
		Portable Skimmers	3					
Miller Env. Services (800) 929-7227	Beaumont, TX	Containment Boom - 18"	14,000'	Venice, LA	7.75	1	1	10
		Response Boats - 18'	2					
		Response Boats - 24'	2					
		Shallow Water Skimmers	1					
		Response Personnel	47					
OMI (800) 645-6671	Port Arthur, TX	Containment Boom - 18" to 24"	4000'	Venice, LA	8	1	1	10
		Response Boats - 14' to 20'	6					
		Response Boats - 21' to 36'	2					
		Shallow Water Skimmers	1					
Wildlife Ctr. of Texas (713) 861-9453	Houston, TX	Wildlife Specialist - Personnel	6 to 20	Venice, LA	9	1	1	11

Table 9.D.11 Shoreline Protection and Wildlife Support List (cont.)

Mississippi Canyon 984 - Drilling > 10 Miles Sample Shoreline Protection & Wildlife Support List								
					Response Times (Hours)			
Supplier & Phone	Warehouse	Equipment Listing	Quantity	Staging Area	Staging ETA	Loadout Time	Deployment Time	Total ETA
OMI (800) 645-6671	Houston, TX	Containment Boom - 18" to 24"	4000'	Venice, LA	9	1	1	11
		Response Boats - 16'	3					
		Response Boats - 25' to 28'	1					
		Portable Skimmers	1					
Miller Env. Services (800) 929-7227	Houston, TX	Containment Boom - 18"	12,000'	Venice, LA	9	1	1	11
		Shallow Water Skimmers	1					
		Response Boats - 28'	1					
		Responder Personnel	38					
Clean Harbors (800) 645-8265	Houston, TX	Containment Boom - 18" to 24"	4,500'	Venice, LA	9	1	1	11
		Response Boats - 14' to 20'	2					
		Response Boats - 21' to 36'	3					
		Portable Skimmers	1					
		Response Personnel	14					
ES&H Environmental (877) 437-2634	Houston, TX	Containment Boom - 10"	500'	Venice, LA	9	1	1	11
		Containment Boom - 18"	13,000'					
		Containment Boom - 24"	5,000'					
		Jon Boat - 12' to 16'	2					
		Response Boats - 26' to 29'	2					
		Portable Skimmers	2					
		Wildlife Hazing Cannon	12					
Garner Environmental (800) 424-1716	Deer Park, TX	Containment Boom - 6"	18,900'	Venice, LA	8.75	1	1	11
		Response Boats - 12'	2					
		Response Boats - 16' to 20'	5					
		Respons Boats - 30'	2					
		Portable Skimmers	25					
		Shallow Water Skimmers	3					
SWS Environmental (877) 742-4215	Panama City, FL	Containment Boom - 18"	7,000'	Venice, LA	8.75	1	1	11
		Response Boats - 16' to 25'	3					
		Response Boats - 25' to 42'	1					
		Portable Skimmers	6					
		Response Personnel	10					
SWS Environmental (877) 742-4215	Houston, TX	Containment Boom - 18"	20,000'	Venice, LA	9	1	1	11
		Response Boats - 16' to 25'	1					
		Response Boats - 25' to 42'	2					
		Portable Skimmers	2					
		Response Personnel	19					
USES Environmental (888) 279-9930	Houston, TX	Containment Boom - 6"	500'	Venice, LA	9	1	1	11
		Containment Boom - 20"	10,000'					
		Response Boats - 16'	4					
		Response Boats - 26'	1					
		Portable Skimmers	1					
Phoenix Pollution Control & Environmental Services (281) 838-3400	Baytown, TX	Containment Boom - 18"	13,000'	Venice, LA	8.75	1	1	11
		Containment Boom - 10"	1,150'					
		Response Boats - 16'	6					
		Response Boats - 20'	3					
		Response Boats - 24'	1					
		Response Boats - 35'	2					
		Portable Skimmers	24					
USES Environmental (888) 279-9930	Shreveport, LA	Containment Boom - 6"	500'	Venice, LA	8.5	1	1	11
		Containment Boom - 18"	2,000'					
		Response Boats - 16'	1					
		Response Boats - 24'	1					
		Shallow Water Skimmers	1					

Table 9.D.11 Shoreline Protection and Wildlife Support List (cont.)

Mississippi Canyon 984 - Drilling > 10 Miles
Sample Shoreline Protection & Wildlife Support List

Supplier & Phone	Warehouse	Equipment Listing	Quantity	Staging Area	Response Times (Hours)			
					Staging ETA	Loadout Time	Deployment Time	Total ETA
USES Environmental (888) 279-9930	Memphis, TN	Containment Boom - 6"	850'	Venice, LA	9.5	1	1	12
		Containment Boom - 12"	300'					
		Containment Boom - 18"	5,000'					
		Response Boats - 12'	3					
		Response Boats - 14'	5					
		Response Boats - 16'	2					
		Response Boats - 24'	1					
		Response Boats - 28'	1					
		Portable Skimmers	2					
Garner Environmental (800) 424-1716	La Marque, TX	Containment Boom - 6"	9,500'	Venice, LA	9.25	1	1	12
		Response Boats - 16'	5					
		Response Boats - 24'	1					
		Portable Skimmers	7					
SWS Environmental (877) 742-4215	Memphis, TN	Containment Boom - 6"	100'	Venice, LA	9.5	1	1	12
		Containment Boom - 12"	800'					
		Containment Boom - 18"	800'					
		Response Boats - 25' to 42'	1					
		Shallow Water Skimmers	1					
		Response Personnel	9					
SWS Environmental (877) 742-4215	Jacksonville, FL	Containment Boom - 18"	1,500'	Venice, LA	11.75	1	1	14
		Response Boats - 16' to 25'	2					
		Shallow Water Skimmers	1					
		Response Personnel	8					
Miller Env. Services (800) 929-7227	Corpus Christi, TX	Containment Boom - 10"	2,000'	Venice, LA	12.25	1	1	15
		Containment Boom - 18"	30,000'					
		Jon Boats - 14' to 16' w/25hp motor	4					
		Jon Boats - 16' to 18' w/Outboard motor	4					
		Air Boat - 14'	1					
		Response Boats - 24' to 26'	4					
		Portable Skimmers	6					
		Shallow Water Skimmers	2					
		Response Personnel	142					
SWS Environmental (877) 742-4215	Tampa, FL	Containment Boom - 18"	2,000'	Venice, LA	13	1	1	15
		Response Boats - 16' to 25'	2					
		Response Boats - 25' to 42'	1					
		Portable Skimmers	1					
		Response Personnel	10					
SWS Environmental (877) 742-4215	Tampa, FL	Containment Boom - 18"	2,000'	Venice, LA	13	1	1	15
		Response Boats - 16' to 25'	2					
		Response Boats - 25' to 42'	1					
		Shallow Water Skimmers	1					
		Response Personnel	10					
SWS Environmental (877) 742-4215	St. Petersburg, FL	Containment Boom - 18"	10,800	Venice, LA	13.5	1	1	16
		Response Boats - 16' to 25'	1					
		Response Boats - 25' to 42'	1					
		Portable Skimmers	1					
		Response Personnel	8					
SWS Environmental (877) 742-4215	Savannah, GA	Containment Boom - 18"	1,400'	Venice, LA	13.5	1	1	16
		Response Boats - 16' to 25'	3					
		Shallow Water Skimmers	1					
		Response Personnel	7					
SWS Environmental (877) 742-4215	Fort Lauderdale, FL	Containment Boom - 18"	1,000'	Venice, LA	15.75	1	1	18
		Response Boats - 16' to 25'	2					
		Response Boats - 25' to 42'	1					
		Shallow Water Skimmers	1					
		Response Personnel	8					
Tri-State Bird Rescue & Research, Inc. (800) 261-0980	Newark, DE	Wildlife Specialist - Personnel	6 to 12	Venice, LA	21	1	1	23

Table 9.D.11 Shoreline Protection and Wildlife Support List (cont.)

SECTION 10: ENVIRONMENTAL MONITORING INFORMATION

A. Monitoring Systems

A rig based Acoustic Doppler Current Profiler (ADCP) is used to continuously monitor the current beneath the Rig. Metocean conditions such as sea states, wind speed, ocean currents, etc. will also be continuously monitored. Shell will comply with NTL 2015-G04.

B. Incidental Takes

Although marine mammals and other protected marine species may be seen in the area, Shell does not believe that its operations proposed under this EP will result in any incidental takes. Shell implements the mitigation measures and monitors for incidental takes of protected species according to the following notices to lessees and operators from the BOEM/BSEE:

NTL 2015-BSEE-G03 "Marine Trash and Debris Awareness and Elimination"
NTL 2016-BOEM-G01 "Vessel Strike Avoidance and Injured/Dead Protected Species Reporting"
NTL 2016-BOEM-G02 "Implementation of Seismic Survey Mitigation Measures & Protected Species Observer Program"

Additionally, the NMFS 2020 Endangered Species Act, Section 7 Consultation – Biological Opinion discusses the potential for entrapment or entanglement of listed marine species from proposed operations, and specifically references the use of areas commonly called "moon pools." Shell provides the following information regarding the use of moon pools on vessels supporting the proposed operations:

- The area that may be referred to as a "moon pool" on a DP semi-submersible rig is an open area under the rig and is not enclosed and poses no risk to marine life.

- The typical drillship MODUs that may be used to conduct the operations stated in this plan will be selected from our common fleet and the sizes of the moonpools range from approximately 82 x 41 ft to 111 x 36 ft.

- Regardless of which MODU will be used, all moon pool/open areas for these operations will be used for deploying casing and well heads, tools supporting drilling, blow-out preventers, and riser system components. The moon pool will not be used to deploy remote-operated vehicles (ROVs).

- Moon pools on MODUs intended to be used do not have doors. Some MODUs have wave breakers, but these will not be used during drilling operations. All MODUs have flexible lines, which are drape hoses, to support drilling operations, see image below. By definition, drape hoses have a U-shaped bend or 'drape' in the line that allows for relative movement between the inner barrel of the telescopic joint and the outer barrel of the telescopic joint as the MODU moves (ISO 13624-1:2009 Petroleum and Natural Gas Industries). The purpose of the flexible lines is to connect a choke, kill, or auxiliary line (e.g. hydraulic) terminal fitting on the telescopic joint to the appropriate piping on the drilling structure (API Specification 16Q). These drape hoses do not present a potential entanglement or entrapment threat to listed species.

Figure 1 - Moon Pool on Transocean MODU

Specific to monitoring of the moon pool during operations, there is a minimum of one camera monitoring each moon pool 24/7. During operations there are generally two or more personnel monitoring the drilling unit and overseeing the moon pool.

At the time of this submission, the MODU contractor is not selected. Once this is determined, the following mitigations will be adhered to. Shell is committed to protecting marine life and will mitigate the potential for entrapment of endangered marine species in a moon pool area specific to these activities as follows:

1. The presence of Endangered Species Act listed marine species (listed species) in moon pools will be documented in MODU daily reports and logs. If a listed species is observed, rig/vessel personnel will follow actions listed in Bullet 3.

2. MODU personnel will take steps to avoid the presence or use of multiple flexible lines or ropes and/or nettings in the moon pool in a way that potentially may result in the entrapment or entanglement of a listed species. In the event critical operational and/or safety lines, ropes or nettings will be present, camera monitoring of the moon pool area as specified below will be in place. As stated above, drape hoses are not considered a type of flexible line that potentially may result in the entanglement or entrapment of listed species.

3. Cameras will monitor the moon pool area for the presence of listed species. Camera footage will be transmitted to the control room where personnel will monitor for presence of listed species. The occurrence of sea turtles or other listed species in a moon pool will be documented in operations daily report logs and personnel will alert our environmental lead on duty, who will immediately contact NMFS at nmfs.psoreview@noaa.gov and BSEE at 985-722-7902 and protectedspecies@bsee.gov for additional guidance on any operation restrictions, continued monitoring requirements, recovery assistance needs (if required), and incidental report information.

a. If a listed species is observed in the moon pool prior to the start of operations, appropriate rig/vessel personnel will be notified by the control room before operations will be allowed to begin.
b. If operations have not commenced and conditions within the moonpool are such that visibility is limited to visually detect a listed species, rig/vessel personnel will monitor the moon pool for 30 minutes prior to start of activities in the moon pool. If operations are ongoing and conditions within the moonpool are such that visibility is limited, rig/vessel personnel will continue to monitor the moon pool and adjust operations (e.g., deploy or retrieve equipment) when it is safe to do so to minimize any potential interaction with an undetected listed species.
c. If any listed species is detected in the moon pool, personnel will assess whether ongoing operations have the potential to entangle or entrap the listed species:
   - If ongoing operations in the moon pool pose no potential threat of entrapment or entanglement to the listed species (e.g. drill pipe), operations will proceed and monitoring by rig/vessel operations personnel will continue.
   - If personnel determine that a potential threat exists, operations will pause until the threat is eliminated (e.g., the animal exits the moon pool on its own).
   - If pausing operations cannot eliminate the threat (e.g., the animal cannot or will not exit the moon pool within a reasonable time on its own volition) and/or the animal is dead, in distress, or injured, personnel will alert our environmental lead on duty, who will immediately contact NMFS at nmfs.psoreview@noaa.gov and BSEE at 985-722-7902 and protectedspecies@bsee.gov for additional guidance on any operation restrictions, continued monitoring requirements, recovery assistance needs (if required), and incidental report information.

C. Flower Garden Banks National Marine Sanctuary

The operations proposed in this DOCD will not be conducted within the Protective Zones of the Flower Garden Banks and Stetson Bank.

SECTION 11: LEASE STIPULATIONS INFORMATION

Vito Unit number 754312007 – consists of Mississippi Canyon Blocks 940 (G31534), 941 (G16661), 984 (G22919) & 985 (G22920).

Mississippi Canyon Block 940, OCS-G 31534
This lease was part of Lease Sale #205 held October 2007. Shell Offshore became operator in November 2009. This lease is part of the Unit Contract No. 754312007.

This lease is not part of a biological sensitive area, known chemosynthetic area, or shipping fairway. See Section 6 of this plan for site specific archeological information.

The following stipulations are associated with this lease:

Stipulation No. 8 – Protected Species
This Stipulation is addressed in the following sections of this plan:
Section 6, Threatened or endangered species, critical habitat and marine mammal information
Section 10, Environmental Monitoring Information, Incidental takes
Section 12, Environmental Mitigation Measures Information, Incidental takes
Section 18, Environmental Impact Assessment

Mississippi Canyon Block 941, OCS-G 16661
This lease was part of Lease Sale #157 help April 1996. In March 2015 Shell became operation of MC 941 from depths below 18,000' subsea down to 50,000' subsea. This lease is part of Unit Contract No. 754312007.

There were no stipulations associated with this lease.

This lease is not part of a biological sensitive area, known chemosynthetic area, or shipping fairway. See Section 6 of this plan for site specific archeological information.

Mississippi Canyon Block 984, OCS-G 22919
This lease was part of Lease Sale 178-1 in March 2001. Shell Offshore became operator in September 2009. This lease is part of Unit Contract No. 754312007.

There were no stipulations associated with this lease.

This lease is not part of a biological sensitive area, known chemosynthetic area, or shipping fairway. See Section 6 of this plan for site specific archeological information.

Mississippi Canyon Block 985, OCS-G 22920
This lease was part of Lease Sale 178-1 in March 2001. Shell Offshore became operator in September 2009. This lease is part of Unit Contract No. 754312007.

There were no stipulations associated with this lease.

This lease is not part of a biological sensitive area, known chemosynthetic area, or shipping fairway. See Section 6 of this plan for site specific archeological information.

Mississippi Canyon Block 939, OCS-G 35348 (Expired 5/31/2021)
RUE OCS-G 30379 has been submitted to BOEM to retain the anchor clearance of the MC939 Vito Host.

This lease is not part of a biological sensitive area, known chemosynthetic area, or shipping fairway. See Section 6 of this plan for site specific archeological information.

SECTION 12: ENVIRONMENTAL MITIGATION MEASURE INFORMATION

A. Impacts to Marine and coastal environments

The proposed action will implement mitigation measures required by laws and regulations, including all applicable Federal & State requirements concerning air emissions, discharges to water, and solid waste disposal, as well as any additional permit requirements and Shell policies. Project activities will be conducted in accordance with the Regional Oil Spill Response Plan. The EIA attached as Section 18 to this plan discusses impacts and mitigation measures including Coastal Habitats and Protected Areas.

B. Incidental Takes

We do not anticipate any incidental takes related to the proposed operations. Shell implements the mitigation measures and monitors for incidental takes of protected species according to the following notices to lessees and operators from the BOEM/BSEE:

NTL 2015-BSEE-G03	"Marine Trash and Debris Awareness and Elimination"
NTL 2016-BOEM-G01	"Vessel Strike Avoidance and Injured/Dead Protected Species Reporting"
NTL 2016-BOEM-G02	"Implementation of Seismic Survey Mitigation Measures & Protected Species Observer Program"

SECTION 13: RELATED FACILITIES AND OPERATIONS INFORMATION

The following is from the Vito Initial DOCD N10018 and does not change for the activities proposed in this plan.

The host will be a new-build four-column semi-submersible Floating Production System (FPS), located in MC Block 939. The FPS will have the capability to accept additional subsea tiebacks, by pre-installing riser porches and umbilical pull tubes. Payload of 100 tonnes and space is reserved on the topsides to accommodate this, but in general, the tiebacks will fill ullage available from Vito wells' decline over time. Gas lift can be supplied to tiebacks from a new riser hangoff or by subsea connection at the Vito drill center.

Vito will be developed with subsea wells from a single drill center, offset from the new host location sufficiently for pipeline and umbilical routing, and to create a prudent buffer between the host and drill rig operations.

Eight subsea development wells are planned for the expected reservoir case, with fewer or additional wells depending on development drilling findings. There will be a single drill center in MC Block 940, tied back to the host with dual production flowlines, one gas lift riser and flowline, and one supporting umbilical. The flowlines are roughly 4 miles long and will connect to the respective production or gas lift manifolds via rigid jumpers. The DOCD also contains one back up well.

Production of crude:

The crude will produce from eight subsea wells connected to a single production manifold through 8 well jumpers (6" diameter 70-110' length) (Block MC 940) to a four column semi-submersible host (Block MC 939) via two production flowlines (12" diameter 13,000' length) and risers (10" diameter, 6000' length) with a maximum rate of 60,000 BOPD per production flowline.

The shut-in time in the event of a leak is based on CROC the leak detection system. CROC will allow 60 minutes for the operator to act and then it will shut the field down. If there is a break in the line the shut-in time is 2 minutes 45 seconds.

Enhancement of ultimate Recovery (gas lift service):

From the four column semi-submersible host (Block MC 939) gas lift gas will be transported to a gas lift manifold which distributes the gas to the 8 subsea wells via gas lift jumpers (Block MC 940) via a gas lift flowline/riser (10" diameter 19,300' length) with a maximum of 100 MMscfd rate to enhance ultimate recovery.

Flow Assurance risk treatment and control hydraulics (utilities to treat HC and support controls):

To treat the fluid from flow assurance risks and provide hydraulics to control the system, a 14-tube umbilical will be connected from the four column semi-submersible host (Block MC 939) to the subsea drill center (Block MC 940) via an umbilical (18,222' length). Two 0.5" umbilical tubes will service H_2S Scavenger treating H_2S, two 0.5" umbilical tubes will service Corrosion Inhibitor treating Corrosion, two 1" tubes will service Methanol managing Hydrates and one 1" tube will service Asphaltene solvent and in the future Halite solvent managing Asphaltenes and Halite. There is one spare 1" and one spare 0.5" tube. Finally, there are two 0.5" LP and two 1" HP lines to provide power and control to the subsea system.

(13b) Transportation System

Oil Export

Vito will have a bi-directional oil export pipeline. Although it will be operated as an export only line, it will be used as bi-directional during commissioning. The oil export riser will be an un-insulated 14 inch OD carbon steel pipe Steel Catenary Riser (SCR). The oil export pipeline will be an 18 inch OD carbon steel pipe tied into an existing subsea tie-in to the Olympus Oil lateral line at West Delta 143 C jacket approximately 52 miles away.

The oil export pipeline and riser will be designed in accordance with ANSI B31.4 for a Maximum Allowable Operating Pressure of 2500 psig (ANSI 1500#) and a Maximum Allowable Operating Temperature of 150° F at the top of the riser.

From WD 143 oil will be custoday tranfered and transported via a 24" pipeline to Clovelly, LA.

Gas Export

Vito will have a bi-directional gas pipeline to function for both gas export and import during gas lift operations. The gas export riser will be an un-insulated 10.75 inch OD carbon steel pipe. The gas export line will be a 10.75 inch OD carbon steel pipe and will be tied in at the existing subsea wye sled on the Olympus Gas Lateral in MC 718 approximately 19 miles away. This wye also routes to WD 143C. The gas pipeline will be configured for export during normal operations. Gas buy-back from Olympus and Gas import from the Mississippi Canyon System will require Olympus Gas Lateral to be bi-directional as well.

The gas export pipeline and riser will be designed in accordance with ANSI B31.4 for a Maximum Allowable Operating Pressure of 2220 psig (ANSI 900#) and a Maximum Allowable Operating Temperature of 150° F at the top of the riser.

Gas from WD 143 C will be transported via a 30" pipeline to the Targa Gas Plant in Venice, LA.

(13c) Produced liquid hydrocarbons transportation vessels

Transport Method	Vessel Capacity	Average Volume to be loaded (per transfer)	No. of Transfers (Yearly Average)
NA			

SECTION 14: SUPPORT VESSELS AND AIRCRAFT INFORMATION

A. General

Type	Maximum Fuel Tank Storage Capacity (Gals)	Maximum No. In Area at Any Time	Trip Frequency or Duration
Offshore Construction Phases: Host Mooring Installation			
Pile Installation Vessel	374,000	1	32
Host hook up Vessel	565,374	1	46
Positioning tugs	242,900	4	5
Umbilical Riser Flowline Installation			
Pipelay Vessel	1,154,960	1	43
Diving & Umbilical & SDH Installation Vessel	979,286	1	72
Light Construction/Survey Vessel (LCV)	242,335	1	16
Offshore Supply Vessel (OSV)	236,318	1	24
Jumper Installation			
Multi-Service Vessel (MSV)	316,000	1	13
OSV	236,318	1	13
Pre-Commissioning/Commissioning			
OSV for N_2 spread	236,318	1	11
LCV for Subsea support (hydro)	122,047	1	25
LCV for Subsea support (comm)	122,047	1	18
General Offshore Support			
Offshore Support Vessel	254,000	1	86
Offshore Fast Supply Vessels	254,000	1	49
Helicopter Flights	1,050	1	1 per day
During Producing Operations:			
Offshore Support Vessels	254,000	1	1 per week
Helicopter	1050	1-2	1 per week

B. Diesel Oil Supply Vessels

Size of Fuel Supply Vessel	Capacity of Fuel Supply Vessel (Gallons)	Frequency of Fuel Transfers	Route Fuel Supply Vessel Will Take
280 foot length	135,000	Every 5 days during construction, every 3 months during production operaitons	Port Fourchon to MC 939 (host)

C. Drilling Fluids Transportation

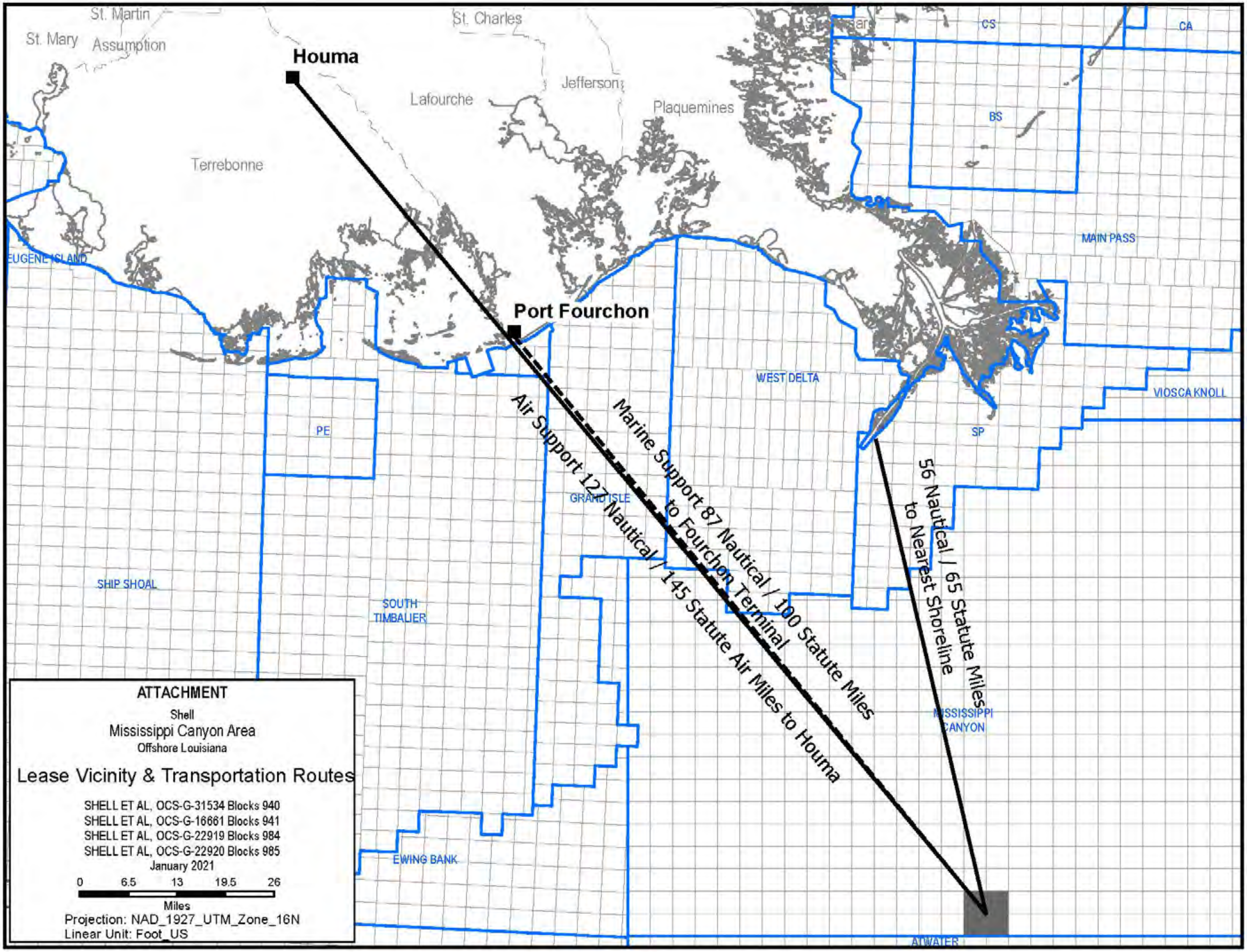
This information is only required for operations offshore Florida.

D. Solid and Liquid Wastes Transportation

See Section 7, Tables 7A & 7B for this information.

E. Vicinity Map

See attached


St. Martin
St. Mary
Assumption
St. Charles
Houma
Jefferson
Lafourche
Plaquemines
Terrebonne
CS
CA
BS
MAIN PASS
EUGENE ISLAND
Port Fourchon
WEST DELTA
VIOSCA KNOLL
PE
SP
Air Support 127 Nautical / 145 Statute Air Miles to Houma
Marine Support 87 Nautical / 100 Statute Miles to Fourchon Terminal
56 Nautical / 65 Statute Miles to Nearest Shoreline
GRAND ISLE
SHIP SHOAL
SOUTH TIMBALIER
MISSISSIPPI CANYON
EWING BANK
ATWATER
ATTACHMENT
Shell
Mississippi Canyon Area
Offshore Louisiana
Lease Vicinity & Transportation Routes
SHELL ET AL, OCS-G-31534 Blocks 940
SHELL ET AL, OCS-G-16661 Blocks 941
SHELL ET AL, OCS-G-22919 Blocks 984
SHELL ET AL, OCS-G-22920 Blocks 985
January 2021
0 6.5 13 19.5 26
Miles
Projection: NAD_1927_UTM_Zone_16N
Linear Unit: Foot_US

SECTION 15: ONSHORE SUPPORT FACILITIES INFORMATION

A. General

Name	Location	Existing / New / Modified
Fourchon	Port Fourchon, LA	Existing
PHI Heliport	Houma, LA	Existing

The onshore support bases for water and air transportation will be the existing terminals in Houma and Fourchon, Louisiana. The Fourchon boat facility is operated by Shell and is located on Bayou Lafourche, south of Leeville, LA approximately 3 miles from the Gulf of Mexico. The existing onshore air support base in Houma, LA is located at 3550 Taxi Rd., Houma, LA 70363.

Support Base Construction or Expansion

None planned.

Support Base Construction or Expansion Timetable

NA

B. Waste Disposal

See Section 7, Tables 7A and 7B.

C. Air emissions

Not required by BOEM GOM.

D. Unusual solid and liquid wastes

Not required by BOEM GOM.

SECTION 16: SULPHUR OPERATIONS INFORMATION

Information regarding Sulphur Operations is not included in this plan as we are not proposing to conduct sulphur operations.

SECTION 17: COASTAL ZONE MANAGEMENT ACT (CZMA) INFORMATION

Louisiana and Texas CZM concurrence was obtained in Vito's Initial DOCD N10018 and is not required for Supplemental DOCD's.

SECTION 18: Environmental Impact Analysis

Supplemental Development Operations Coordination Document (DOCD)

RUE OCS-G 30379, Mississippi Canyon Block 939
OCS-G 31534, Mississippi Canyon Block 940

Offshore Louisiana

July 2021

Prepared for:

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

Prepared by:

CSA Ocean Sciences Inc.
8502 SW Kansas Avenue
Stuart, Florida 34997
Telephone: (772) 219-3000

Acronyms and Abbreviations

ac	acre
ADIOS	Automated Data Inquiry for Oil Spills
AQR	Air Quality Emissions Report
AUV	autonomous underwater vehicle
bbl	barrel
BOEM	Bureau of Ocean Energy Management
BOEMRE	Bureau of Ocean Energy Management, Regulation and Enforcement
BOP	blowout preventer
BOPD	barrels of oil per day
BSEE	Bureau of Safety and Environmental Enforcement
CFR	Code of Federal Regulations
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
dB	decibel
DOCD	Development Operations Coordination Document
DP	dynamically positioned
DPS	distinct population segment
EFH	Essential Fish Habitat
EIA	Environmental Impact Analysis
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FAD	fish aggregating device
FPS	Floating Production System
FR	Federal Register
GMFMC	Gulf of Mexico Fishery Management Council
H_2S	hydrogen sulfide
ha	hectare
HAPC	Habitat Area of Particular Concern
Hz	hertz
IPF	impact-producing factor
kHz	kilohertz
MARPOL	International Convention for the Prevention of Pollution from Ships
MC	Mississippi Canyon
MMC	Marine Mammal Commission
MMPA	Marine Mammal Protection Act
MODU	mobile offshore drilling unit
MWCC	Marine Well Containment Company
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRC	National Research Council
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
PAH	polycyclic aromatic hydrocarbon
PM	particulate matter
re 1 μPa	relative to one micropascal
re 1 μPa m	relative to one micropascal meter
re 1 $\mu Pa^2 \cdot s$	relative to one micropascal squared second
SBM	synthetic-based mud
Shell	Shell Offshore Inc.
SO_x	sulfur oxides
USCG	U.S. Coast Guard
USDOI	U.S. Department of the Interior
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound
WBM	water-based mud
WCD	worst case discharge
WMA	Wildlife Management Area

Introduction

Project Summary

Shell Offshore Inc. (Shell) is submitting a Supplemental Development Operations Coordination Document (DOCD) for the installation and operation of a drill center and connected flowlines located in Mississippi Canyon (MC) MC 940, approximately 7,000 ft (2,134 m) away from the Floating Production System (FPS). Additionally, this SDOCD covers the drilling, completion, treatment, and workover for six wells (designated VA010, VA010-ALT, VA011, VA01-ALT, VA012, VA012-ALT). A DOCD was previously submitted and approved for the FPS. This initial DOCD was approved by BOEM in 2019 as Plan N-10018. Plan N-10018 covers the installation and commissioning of the FPS, which will include 12 mooring lines and mud mats in MC 939. This Environmental Impact Analysis (EIA) provides information on potential impacts on environmental resources that could be affected by Shell's proposed activities in the project area. Environmental impacts associated with drilling and completion of nine wells at MC 940 were previously evaluated in Supplemental Exploration Plan No. S-7858, approved August 18, 2017.

The project area is in the Central Planning Area, 65 miles (105 km) from the nearest shoreline (Louisiana), 100 miles (161 km) from the onshore support base at Port Fourchon, Louisiana, and 145 miles (233 km) from the helicopter base at Houma, Louisiana. All miles in the EIA are statute miles. Water depth at the project area ranges from 3,970 to 4,040 ft (1,210 to 1,231 m).

Subsea equipment installation will be accomplished with a dynamically positioned (DP) installation vessel. For the proposed wellsite drilling, completion, and workover, a DP mobile offshore drilling unit (MODU) will be used, as detailed in DOCD Section 14. Subsea equipment installation is estimated to be conducted between 2022 and 2023 with production commencing in 2023 and continuing until approximately 2045. Three wells are proposed to be drilled/completed from 2022 to 2023 with the three remaining wells in 2023. The MODU is expected to be on site for up to 270 days per year from 2022 to 2025 and up to 225 days per year from 2026 to 2045 for completion and well work 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 (U.S.C.) §§ 1331-1356, and Bureau of Ocean Energy Management (BOEM) regulations including 30 Code of Federal Regulations (CFR) § 550.242(s) and § 550.261. The EIA is a project- and site-specific analysis of Shell's planned activities under this DOCD.

The EIA presents data, analyses, and conclusions to support 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 the 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 (PEIS) for the Outer Continental Shelf (OCS) Oil and Gas Leasing Program (BOEM, 2016a) and in multisale Environmental Impact Statements (EISs) for the Western and Central Gulf of Mexico Planning Areas (BOEM, 2012a, b, 2013, 2014, 2015, 2016b, 2017a).

The most recent multisale EISs updated environmental baseline information in light of the Macondo (*Deepwater Horizon*) incident and addressed 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-Macondo 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-Macondo incident studies, where applicable, to provide BOEM and other regulatory agencies with the necessary information to evaluate Shell's DOCD and ensure that oil and gas exploration activities are performed in an environmentally sound manner, with minimal impacts on the environment.

OCS Regulatory Framework

The regulatory framework for OCS activities in the Gulf of Mexico is summarized by 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 govern 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 establish consultation and coordination processes with federal, state, and local agencies (e.g., the ESA, MMPA, Coastal Zone Management Act of 1972, and the Magnuson-Stevens Fishery Conservation and Management Act). 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 a regulation or standard. **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).

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.

Table 1. (Continued).

NTL	Title	Summary
BOEM-2016-G01	Vessel Strike Avoidance and Injured/Dead Protected Species Reporting	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. 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.
BSEE-2015-G03	Marine Trash and Debris Awareness and Elimination	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.
BOEM 2015-N02	Elimination of Expiration Dates on Certain Notice to Lessees and Operators Pending Review and Reissuance	Eliminates the expiration dates on past or upcoming expiration dates from NTLs currently posted on the Bureau of Ocean Energy Management website.
BOEM 2015-N01	Information Requirements for Exploration Plans, Development and Production Plans, and Development Operations Coordination Documents on the OCS for Worst Case Discharge Blowout Scenarios	Provides guidance regarding information required in worst case discharge (WCD) descriptions and blowout scenarios. Supersedes NTL 2010-N06.
BOEM-2014-G04	Military Warning and Water Test Areas	Provides contact links to individual command headquarters for the military warning and water test areas in the Gulf of Mexico.
BSEE-2012-N06	Guidance to Owners and Operators of Offshore Facilities Seaward of the Coast Line Concerning Regional Oil Spill Response Plans	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.

Table 1. (Continued).

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 blowout preventers (BOPs) or surface BOPs 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 *Federal Register* [FR] 63346). Informs operators that the BOEM 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 Benthic Communities	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 Outer Continental Shelf.
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 ESA and MMPA.
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. Reissued in June 2020 to comply with Executive Order 13891 of October 9, 2019 and to rescind NTL 2011-JOINT-G01.

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 subsea equipment installation and exploration program that certifies Shell's capability to respond to the maximum extent practicable to a WCD (30 CFR 254.2) (see DOCD Section 9). The OSRP demonstrates Shell's capability to rapidly and effectively manage oil spills that may result from drilling operations, subsea/topside installation or producing 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 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 including 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.

EIA Organization

The EIA is organized into **Sections A** through **I** corresponding to the organization found in NTL 2008-G04 (as extended by NTL 2015-N02 and partially amended by 2020-G01), 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.

- Vessel 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.

Environmental Resources	Impact-producing Factors									
	Vessel Presence (incl. noise & lights)	Physical Disturbance to Seafloor	Air Pollutant Emissions	Effluent Discharges	Water Intake	Onshore Waste Disposal	Marine Debris	Support Vessel/Helicopter Traffic	Accidents: Small Fuel Spill	Accidents: 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)

X = potential impact; dash (--) = no impact or negligible impact; Numbers in parentheses refer to table footnotes on the following page.

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 of 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-d) are applicable. The lease is not within the given ranges (buffer zone) of any marine sanctuary, topographic feature, or no-activity zone. There are no submarine banks in the lease block.

(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 BOEM as being in water depths 300 m or greater.*
   - No impacts on high-density deepwater benthic communities are anticipated. Geohazards and wellsite assessments found no features indicative of high-density chemosynthetic communities or coral communities within 9,000 ft (2,743 m) of the proposed mooring radius and buffer of the subsea field and within 2,000 ft (610 m) of the proposed wellsites with associated subsea installation (Geoscience Earth & Marine Services, 2007a, 2013, IntecSea Worley Parsons Group, 2015, Oceaneering International Inc, 2017).

(5) *Exploration or production activities where hydrogen sulfide (H_2S) concentrations greater than 500 ppm might be encountered.*
   - DOCD Section 4 contains Shell's request for classification of MC 939 and MC 940 as H_2S "present (less than 10 ppm)". Shell will submit an H_2S Contingency Plan prepared according to 30 CFR 250.490 before commencing the proposed exploration and development activities.

(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 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 your 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. Water depths at the project area are well beyond the 60-m (197 ft) depth contour used by BOEM as the seaward extent for prehistoric archaeological site potential in the Gulf of Mexico. As discussed in **Section C.6**, the geohazards and wellsite assessments identified multiple sonar contacts within the project area, but none of the sonar contacts within 9,000 ft (2,743 m) of the proposed mooring radius and buffer of the subsea field and within 2,000 ft (610 m) of the proposed wellsites with associated subsea installation were interpreted to be archeologically significant (Geoscience Earth & Marine Services, 2007a, 2013, IntecSea Worley Parsons Group, 2015, Oceaneering International Inc, 2017).

(8) *All activities that you determine 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 Vessel 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 Vessel Presence (including noise and lights)

Subsea installations will be conducted by a DP installation vessel. Drilling, completion, and well work will be conducted by a MODU, either a DP drillship or a DP semisubmersible drilling rig. DP installation vessels and DP MODUs are self-propelled and maintain 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 subsea equipment installation and MODU presence include the physical presence of the MODU, installation vessel, and support vessels in the ocean, increased light from working and safety lighting on the vessels, and noise audible above and below the water surface. The potential impacts resulting from the use of anchors are addressed in **Section C.2.1**.

The physical presence of the installation vessel and MODU in the ocean will attract pelagic fishes and other marine life. The MODU will 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 installation vessel and MODU will maintain exterior lighting for working at night and navigational and aviation safety in accordance with federal 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**.

MODUs and installation vessels can be expected to produce noise from station keeping, drilling (MODU only), 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 site meteorological conditions and operational requirements. Representative source levels for vessels in DP mode range from 184 to 190 decibels (dB) relative to one micropascal (re 1 µPa), with a primary frequency below 600 hertz (Hz) (Blackwell and Greene Jr., 2003, McKenna et al., 2012, Kyhn et al., 2014). Production activities can generate source levels as high as 195 dB re 1 µPa m with peak frequencies at 40 to 100 Hz (Hildebrand, 2005). BOEM (2012a) stated that source levels from oil and gas production platforms are low, with a frequency range of 50 to 500 Hz. Zykov (2016) characterized a noisier MODU thruster at 190 to 195 dB re 1 µPa at 1 m 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 sound that includes strong tonal components at low frequencies (Minerals Management Service, 2000). When drilling, the drill string represents a long vertical sound source (McCauley, 1998). Sound associated with drilling activities have a maximum broadband (10 Hz to 10 kHz) source levels of approximately 190 dB re 1 µPa m (Hildebrand, 2005; Kyhn et al., 2014). Based on available data, underwater sound generated from MODU during drilling and in the absence of thrusters can be expected to range between 154 and 176 dB re 1 µPa m (Nedwell et al., 2001). The use of thrusters, whether drilling or not, can elevate source levels from a drillship or semisubmersible to approximately 188 dB re 1 µPa m (Gales, 1982; Nedwell and Howell, 2004; Kyhn et al., 2014).

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). Source levels for the vessel-mounted transceiver are estimated to be >200 dB re 1 µPa m expressed as SPL, with energy focused toward the seafloor (Equinor, 2019). However, 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, 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 installation vessels will not use anchors to install the seafloor mooring equipment. There will be minimal disturbance to the seafloor and soft bottom communities during positioning of the subsea equipment. Physical disturbance of the seafloor will be limited to the proximal area where the subsea equipment is placed on the substrate.

BOEM (2012a) estimated an area of seafloor disturbance between 1.2 ac (0.5 ha) and 2.5 ac (1.0 ha) per kilometer of pipeline or flowline installation. Due to the water depth in the project area, it is anticipated that the subsea equipment and flowlines will not be buried by trenching, but instead will be placed on the seafloor, decreasing the area of impact.

The six 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 (BOP). 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 DOCD Section 8. Offshore air pollutant emissions will result from operations of the installation vessel and MODU as well as service vessels and helicopters. These emissions occur mainly from combustion of natural gas and diesel fuel. Primary air pollutants typically associated with OCS activities are suspended particulate matter ($PM_{2.5}$ and PM_{10}), sulfur oxides (SO_x), nitrogen oxides (NO_x), volatile organic compounds (VOCs), carbon monoxide (CO), (Reşitoğlu et al., 2015) and ammonia (NH_3), and lead (Pb) (NTL 2020-G01).

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 DOCD Section 8) prepared in accordance with BOEM requirements provided in 30 CFR 550 Subpart C. The AQR shows that the projected emissions associated with the proposed activities meet BOEM's exemption criteria with the exception of NO_x emissions for the FPS. Based on calculated emissions, dispersion modeling of the NO_x emissions, and the location of the project area relative to shore, it can be concluded that project emissions will not significantly affect onshore air quality for any of the criteria pollutants. No further analysis or control measures are required.

A.4 Effluent Discharges

Effluent discharges from the installation vessel and MODU are summarized in DOCD Section 7. Discharges from the installation vessel and MODU are required to comply with the National Pollutant Discharge Elimination System (NPDES) General Permit for oil and gas activities (GMG290000). The support vessels' 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 DOCD Section 7.

Other effluent discharges from installation vessel, MODU, and support vessels are expected to include non-contact cooling water, treated sanitary and domestic wastes, deck drainage, desalination unit discharge, uncontaminated fire water, utility seawater, non-contaminated well treatment and completion fluids, workover fluids, treated seawater, hydrate inhibitor, bilge water, subsea production control fluid, excess cement, BOP fluid, and ballast water. The installation vessel, MODU, and support vessel discharges are expected to be in accordance with NPDES permit and/or USCG regulations, as applicable, and therefore are not expected to cause significant impacts on water quality.

A.5 Water Intake

Seawater will be drawn from approximately 11-meters below the ocean surface for various services, including ballast, firewater, utility water, and once-through non-contact cooling of machinery on the MODU (DOCD 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 NPDES General Permit No. GMG290000 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 2 million gallons of water per day, of which at least 25% is used for cooling purposes.

The installation vessel and 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 DOCD Section 7. Used SBMs and additives will be transported to Halliburton Drilling Fluids, M-I SWACO, Newpark Drilling Fluids, or R360 Environmental Solutions, in Port Fourchon, Louisiana, for recycling, reconditioning, or deep well injection. Cuttings wetted with SBMs will be transported to R360 Environmental Solutions, in Port Fourchon, Louisiana, for deep well injection or landfarm. Completion fluids will be transported to Haliburton, Baker Hughes, Newpark, Tetra, or R360 Environmental Solutions in Port Fourchon, Louisiana, for recycling or deep well injection. Salvage hydrocarbons will be transported to shore for recycling or deep well injection at PSC Industrial Outsourcing, Inc. in Jeanerette, Louisiana. Produced sand and NORM (Naturally Occurring Radioactive Material) will be transported to shore for disposal or deep well injection at Trinity Environmental in Liberty, Texas, LOTUS in Andrews, Texas, or R360 Environmental Solutions in Port Fourchon, Louisiana. Exploration and production wastes will be transported to R360 Environmental Solutions or Clean Waste in Port Fourchon, Louisiana.

Recyclable trash and debris generated during the proposed project will be recycled at Omega Waste Management in Patterson, Louisiana, or at a similarly permitted facility. Non-recyclable trash and debris will be transported to the Jefferson Parish landfill (Riverbirch) in Avondale, Louisiana; or to a similarly permitted facility. Non-hazardous waste including industrial and chemical product wastes will be transported to Waste Management Woodside Landfill in Walker, Louisiana. Used oil and glycol will be transported to Omega Waste Management in Patterson, Louisiana or Chemical Waste Management in Sulphur, Louisiana. Non-hazardous Oilfield Waste and hazardous waste will be transported to Chemical Waste Management in Sulphur, Louisiana, or Clean Harbors in Colfax, Louisiana, or to a similarly permitted facility. Universal waste items such as batteries, lamps, glass, and mercury contaminated waste will be sent to Chemical Waste Management in Sulphur, Louisiana, for processing. Wastes will be recycled or disposed of 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 30 CFR 250.300(a) and (b)(6) prohibit operators from deliberately discharging containers and other similar materials (e.g., trash and debris) into the marine environment. 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, posting informational placards, 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 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 Houma, Louisiana 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. The project will be supported by installation vessels, MODUs, tugboats, supply vessels, and helicopters. There will likely be always at least one vessel in the field during installation and production 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 (Laist et al., 2001; Jensen and Silber, 2004; Hazel et al., 2007; Vanderlaan and Taggart, 2007; Conn and Silber, 2013; 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 Houma, Louisiana, 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 µPa 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 underwater SPLs of 109 dB re 1 µPa 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 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 DOCD Section 2j.

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

The lease sale EISs (BOEM, 2012a, 2013, 2014, 2015, 2016b) analyzed five other types of accidents: loss of well control, pipeline failures, vessel collisions, chemical and drilling fluid spills, and hydrogen sulfide (H_2S) release.

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 hydrogen sulfide (H_2S) 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.

<u>Loss of Well Control</u>. 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 releases of gas, condensate, oil, sand, or water, the loss of well control can also suspend and disperse bottom sediments (BOEM, 2012a, b, 2013, 2017b). 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 DOCD 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 DOCD Sections 2j and 9b for further information.

<u>Pipeline Failures</u>. 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, 2003, 2007b, Berger Geosciences, 2015, C&C Technologies, 2015).

<u>Vessel Collisions</u>. BSEE data show that there were 181 OCS-related collisions between 2007 and 2019 (BSEE, 2019). 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 (2017b), 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 Spill. Chemicals are stored and used for pipeline hydrostatic testing, during drilling, and in well completion operations. The relative quantities of their use are reflected in the largest volumes spilled (BOEM, 2017b). Completion, workover, and treatment fluids are the largest volume 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).

H_2S Release. Based on 30 CFR 250.490 (b), Shell has requested MC 939 and MC 940 to be classified as H_2S "present (less than 10 ppm)". Shell will submit an H_2S Contingency Plan before commencing the proposed exploration activities. See DOCD Section 4 for more details.

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 duration of impacts 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. 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). Adherence to suspended sediments is not be 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) model (NOAA, 2016a). This model uses a database of the physical properties of oils 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. 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.

The ADIOS results, coupled with spill trajectory information discussed in the next section regarding large spills, indicate that a small fuel spill would not affect coastal or shoreline resources (NOAA, 2016a). The project area is 65 miles (105 km) from the nearest shoreline (Louisiana). Slicks from 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. DOCD Section 9b provides a detailed discussion of Shell's oil spill response.

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 DOCD 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 barrels. 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 DOCD using the requirements prescribed by NTL 2015-N01 as 314,000 barrels of oil per day (BOPD) for the initial release and 280,000 BOPD 30-day average with a total potential spill volume of 48 million barrels. The detailed analysis of this calculation can be found in DOCD Section 2j. The WCD scenario for this DOCD has a low probability of being realized. Some of the factors that are likely to reduce rates and volumes, which are not included 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 designed 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 DOCD Sections 2j and 9b. Shell will also comply with NTL 2010-N10 and the Final Drilling Safety Rule, 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.

The OSRA model results for Launch Area C058 (the launch area which includes the project area) are presented in **Table 3**. The 30-day OSRA model does not predict shoreline contact within the first 3 days following a spill. After 10 days, the model predicts a 1% chance of shoreline contact in Terrebonne Parish, Louisiana; a 2% chance of shoreline contact in Lafourche Parish, Louisiana; and a 4% chance of shoreline contact in Plaquemines Parish, Louisiana. After 30 days, shorelines in two Texas counties, eight Louisiana parishes, and one Florida county are predicted to have a 3% or less probability of contact with the exception of Plaquemines Parish, Louisiana. Plaquemines Parish, Louisiana, is predicted to have an 8% probability of being contacted within 30 days.

Table 3. Conditional probabilities of a spill in the project area 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 C058) 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
C10	Galveston, TX	--	--	1
C12	Jefferson, TX	--	--	1
C13	Cameron, LA	--	--	3
C14	Vermilion, LA	--	--	2
C15	Iberia, LA	--	--	1
C17	Terrebonne, LA	--	1	3
C18	Lafourche, LA	--	2	3
C19	Jefferson, LA	--	--	1
C20	Plaquemines, LA	--	4	8
C21	St. Bernard, LA	--	--	1
C28	Okaloosa, FL	--	--	1

[1] Conditional probability refers to the probability of contact within the stated time period, assuming that a spill has occurred. -- indicates less than 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 are lost rapidly by evaporation and dissolution from the oil 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 the equipment and services available to Shell through MWCC's near-term containment capabilities and other industry response resources. 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, all 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 ft × 20 ft 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 3,500-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 response 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 accessible 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 DOCD Section 9b for a detailed description of spill response measures.

B. Affected Environment

The project area is in the Central Planning Area of the Gulf of Mexico, 65 miles (105 km) from the nearest shoreline, 100 miles (161 km) from the onshore support base at Port Fourchon, Louisiana, and 145 miles (233 km) from the helicopter base at Houma, Louisiana. Water depth in the project area ranges from 3,970 to 4,040 ft (1,210 to 1,231 m).

The seafloor at MC 939 and MC 940 slopes down to the southwest on a slope of approximately 1.3 to 1.4 degrees and contains a series of ridges and valleys that trend from north to south along the western border of the area. A series of minor northwest to southeast trending seafloor faults are within 2,000 ft (610 m) of the proposed wellsites and associated subsea installation; however, these faults are not within 250 ft (76 m). No seafloor anomalies were identified within 9,000 ft (2,743 m) of the proposed mooring radius and buffer of the subsea field and within 2,000 ft (610 m) of the proposed wellsites with associated subsea installation that could indicate potential for chemosynthetic or high-density deepwater benthic communities (Geoscience Earth & Marine Services, 2007a, 2013, IntecSea Worley Parsons Group, 2015, Oceaneering International Inc, 2017).

A detailed description of the regional affected environment is provided by BOEM (2012a, 2013, 2014, 2015, 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 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 not classified because there is no provision in the Clean Air Act for classification of areas outside state waters (BOEM, 2012a).

In general, ambient air quality in coastal counties along the Gulf of Mexico is relatively good (BOEM, 2012a). As of May 2021, Mississippi, Alabama, and Florida Panhandle coastal counties are in attainment of the National Ambient Air Quality Standards (NAAQS) for all criteria pollutants (USEPA, 2021). 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, 2021).

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 and both types of accidents: a small fuel spill and a large oil spill.

Impacts of Air Pollutant Emissions

Air pollutant emissions are the only routine IPFs anticipated to affect air quality. Offshore air pollutant emissions will result from the operation of the installation and service vessels, MODU, and helicopters, 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, SO_x, NO_x, VOCs, CO, NH_3, and Pb.

Due to the distance from shore and dispersion modeling of the NO_x emissions, routine operations in the project area are not expected to impact air quality along the coast. As noted in the lease sale EISs (BOEM, 2012a, 2013, 2014, 2015, 2016b, 2017a), 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.

MC 939 and MC 940 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 550 Subpart C. The Air Quality Emissions Report (see DOCD Section 8), prepared in accordance with BOEM requirements, shows that the projected emissions from emission sources associated with the proposed activities meet BOEM exemption criteria with the exception of NO_x emissions. Based on calculated emissions, dispersion modeling of the NO_x emissions, and the location of the project area relative to shore, it can be concluded that project emissions will not significantly affect onshore air quality for any of the criteria pollutants. Therefore, this DOCD 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 97 miles (156 km) from the Breton Wilderness Area. Shell will comply with emissions requirements as directed by BOEM. Based on the Class I Air Quality Related Values (AQRV) analysis results, it can be concluded that project emissions will not significantly affect onshore air quality for any of the criteria pollutants. 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, Chassahowitzka Wilderness Area in Hernando County, and Everglades National Park in Monroe, Miami-Dade, and Collier Counties. The project area is approximately 312 miles (502 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 (CO_2) and methane (CH_4) emissions from the project would constitute a very small incremental contribution to greenhouse gas emissions from all OCS activities. According to Programmatic and OCS lease sale EISs (BOEM, 2017a), estimated CO_2 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). The probability of a small spill would 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 impacts. DOCD Section 9b provides detail on spill response measures.

A small fuel spill would likely affect air quality near the spill site by introducing VOCs through evaporation. The ADIOS 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 from a small spill would not be significant.

A small fuel spill would not affect coastal air quality because the spill will be expected to break up 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 predictions (**Table 3**), Plaquemines Parish in Louisiana is the coastal area most likely to be affected (4% probability within 10 days, and 8% probability within 30 days). Eight Louisiana parishes, two Texas counties, and one Florida county have a 1% to 8% probability of shoreline contact within 30 days of a spill.

A large oil spill resulting from a blowout 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 DOCD Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. DOCD Section 9b provides detail on spill response measures. Based on OSRA modeling, and the low likelihood of a large oil spill event, significant spill impacts on coastal air quality are not expected.

C.1.2 Water Quality

There are no site-specific 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 GMG290000 establishes permit limits and monitoring requirements for effluent discharges from the installation vessel, MODU, and support vessels. Shell will meet NPDES permit limits and requirements, and little or no impact on water quality is anticipated.

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 installation vessel, 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 installation vessel and MODU will flow overboard without treatment. However, rainwater that falls on the installation vessel and MODU areas that may be contaminated with oil or chemicals, such as chemical storage areas and 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 installation vessel, MODU, and support vessels are expected to include non-contact cooling water, treated sanitary and domestic wastes, deck drainage, desalination unit discharge, uncontaminated fire water, utility seawater, non-contaminated well treatment and completion fluids, workover fluids, treated seawater, hydrate inhibitor, bilge water, subsea production control fluid, excess cement, BOP fluid, and ballast water. The installation vessel, MODU, and support vessel discharges are expected to be in accordance with NPDES permit and/or 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). The probability of a small spill would 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 impacts. DOCD 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, 2017). It is possible for diesel oil that is dispersed by wave action to form droplets that are small enough be kept in suspension and moved by the currents.

Diesel oil 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 oil spill would evaporate or disperse within 24 hours (**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, 2006). 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 (see **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). 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 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 an entire set of water 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, the 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 dilute the constituents and microbial degradation which removes 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 CH_4 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 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 predictions (**Table 3**), the nearshore waters and embayments of Plaquemines Parish in Louisiana are the coastal areas most likely to be affected, with a 4% probability of shoreline contact within 10 days and 8% probability of shoreline contact within 30 days.

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 DOCD Section 2j. In the event of a large spill, water quality would be temporarily affected, but no long-term detectable impacts are expected. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce any resultant impacts. DOCD Section 9b provides detail on spill response measures.

C.2 Seafloor Habitats and Biota

Water depth at the project area ranges from 3,970 to 4,040 ft (1,210 to 1,231 m). See DOCD 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; hard bottom communities are rare. Geoscience Earth & Marine Services (2007a, 2013), IntecSea Worley Parsons Group (2015), Oceaneering International Inc (2017) conducted shallow hazard assessment surveys of MC 939 and MC 940. No features or areas that could support significant, high-density benthic communities were found within 9,000 ft (2,743 m) of the proposed mooring radius and buffer of the subsea field and within 2,000 ft (610 m) of the proposed wellsites with associated subsea installation. As a result, proposed activities are not expected to have an impact on regionally present high-density deepwater benthic communities.

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 that have been conducted to regionally characterized 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 the vicinity of the proposed activities. **Table 4** summarizes data from two stations in the vicinity of the proposed activities. Sediments at these two stations were similar, predominantly clay (54% at Station MT3 and 46% at Station MT4) and silt (43% at Station MT3 and 46% at Station MT4) (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)	Density		
			Meiofauna (individuals m^{-2})	Macroinfauna (individuals m^{-2})	Megafauna (individuals ha^{-1})
MT3	19 mi (31 km) NNW	996	885,995	4,924	1,034
MT4	12 mi (19 km) SSW	1,403	246,058	3,262	1,548

Densities of meiofauna (animals that pass through a 0.5-mm sieve but are retained on a 0.062-mm sieve) in sediments collected at water depths representative of the project area ranged from approximately 246,000 to 886,000 individuals m^{-2} (Rowe and Kennicutt, 2009). Nematodes, nauplii, and harpacticoid copepods were the three dominant groups in the meiofauna, accounting for about 90% of total abundance.

The benthic macroinfauna was characterized by small mean individual sizes and low densities, both of which reflect the intrinsically low primary production in Gulf of Mexico surface waters (Wei, 2006). Benthic macroinfaunal density decreased exponentially with water depth (Carvalho et al., 2013). Based on an equation presented by Wei (2006), macroinfaunal densities in the water depth of the project area are expected to range from 2,533 to 2,841 individuals m^{-2}; however, actual densities are unknown and often highly variable. Macroinfaunal densities at nearby stations are estimated between 3,200 and 4,900 individuals m^{-2}.

Polychaetes are typically the most abundant macroinfaunal group on the northern Gulf of Mexico continental slope, followed by amphipods, tanaids, bivalves, and isopods. Carvalho et al. (2013) found that polychaete abundance was higher in the central region 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 in Zone 2E. Zone 2E consists of stations ranging in depth from 2,050 to 5,998 ft (625 to 1,828 m) and extends from the Texas-Louisiana slope to the west Florida terrace. The most abundant species in this zone were the polychaetes *Aricidea suecica*, *Litocorsa antennata*, *Paralacydonia paradoxa*, and *Tharyx marioni*; and the bivalve *Heterodonta* sp. D. (Wei, 2006, Wei et al., 2010).

Megafaunal density from nearby stations ranged from 1,034 to 1,548 individuals ha^{-1} (**Table 4**). Common megafauna included motile groups such as decapods, ophiuroids, holothurians, and demersal fishes, as well as sessile groups such as sponges and anemones (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 about 1 to 2 grams of carbon per square meter (g C m^{-2}) in the top 6 in. (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 from the sea surface.

Impacts of Physical Disturbance to the Seafloor

BOEM (2012a) estimated an area of seafloor disturbance between 1.2 ac (0.5 ha) and 2.5 ac (1.0 ha) per kilometer of pipeline or flowline installation. Due to the water depth in the project area, it is anticipated that the subsea equipment and flowlines will not be buried by trenching, but instead will be placed on the seafloor, decreasing the area of impact.

In water depths such as those that are encountered in the project area, DP MODUs 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 is relatively 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 have no significant impact on soft bottom benthic communities on a regional basis.

Impacts of Effluent Discharges

Drilling muds 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 drill sites. 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 H_2S 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 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) estimates that a severe subsurface blowout could resuspend and disperse sediments within a 984-ft (300-m) radius. While 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 resuspended for more than 30 days and dispersed over a much wider area. Rowe and Kennicutt (2009) characterized surface sediments at the sampling station near the project area as predominantly clay and silt.

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 miles^2 (24 km^2). 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 miles^2 (148 km^2). NOAA (2016b) documented a footprint of over 772 miles^2 (2,000 km^2) of impacts to benthic habitats surrounding the *Deepwater Horizon* incident site. The analysis also identified a larger area of approximately 3,552 miles^2 (9,200 km^2) of potential exposure and uncertain impacts to benthic communities (NOAA, 2016b). Stout and Payne (2017) also noted that SBM released as a result of the blowout covered an area of 2.5 miles^2 (6.5 km^2).

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 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 DOCD Section 2j.

In the unlikely event of a spill, implementation of Shell's OSRP will minimize potential impacts. DOCD Section 9b provides detail on spill response measures. A large oil spill could have impacts on soft bottom communities but significant impacts on a regional basis are not 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 authigenic carbonates created by chemosynthetic communities, and on shipwrecks. The nearest known high-density deepwater benthic community is located approximately 40 miles (64 km) west-southwest of the project area in MC 969.

High-resolution geophysical surveys using autonomous underwater vehicle (AUV) side scan sonar, sub-bottom profilers, and multi-beam echo-sounders, re-processed 3-D seismic data volumes, have been conducted in the project area as part of the archaeological resources and shallow hazards assessments. Based on these surveys, features or areas that could support high-density chemosynthetic or other benthic communities are not anticipated in the project area (Geoscience Earth & Marine Services, 2007a, 2013, IntecSea Worley Parsons Group, 2015, Oceaneering International Inc, 2017).

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 disturbance and effluent discharge 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, 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. 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 a water depth 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, 2016b, 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 a few patches of habitats 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 lesser impacts. Effects to deepwater coral communities could be temporary (e.g., lack of feeding and loss of tissue mass) or long lasting and affect the resilience of coral colonies to natural disturbances (e.g., elevated water temperature and diseases) (BOEM, 2012a, 2015, 2016b, 2017a). The impact of a spill affecting 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 an area measuring approximately 50 by 130 ft (15 by 40 m) was covered by a brown flocculent material (Bureau of Ocean Energy Management, Regulation, and Enforcement [BOEMRE], 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 corals at this location showed signs of tissue damage that were 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. (2014a) 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., 2014b).

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 DOCD Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. DOCD 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 West Delta Block 147, located 42 miles (68 km) northwest of the project area. There are no IPFs associated with either routine operations or accidents that could cause impacts to designated topographic features due to the 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 defined in NTL 2009-G39. The nearest pinnacle trend stipulation blocks are located about 90 miles (145 km) north-northeast of the project area in Main Pass Block 290. 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 reefs 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 123 miles (198 km) northeast of 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. To provide reference for potential impacts to Threatened, Endangered, and protected species, the following sections include discussions of individual- (i.e., effect on single individual), population- (i.e., effect on localized population of individuals) and species-level (i.e., effect on entire species as a whole) impacts for select species. It is understood that contact with potential IPFs, particularly large oil spills, does not necessarily result in mortality. However, the size of the population, along with its status as Threatened, Endangered, or protected were considered when determining if potential individual mortality may result in impacts at the individual, population, or species level.

Endangered, Threatened, or species of concern that may occur in the project area or along the northern and eastern 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[1]	*Balaenoptera edeni*	E	X	--	None
Sperm whale	*Physeter macrocephalus*	E	X	--	None
West Indian manatee	*Trichechus manatus*[2]	T	--	X	Florida (Peninsular)
Sea Turtles					
Loggerhead turtle	*Caretta caretta*	T,E[3]	X	X	Nesting beaches and nearshore reproductive habitat in Mississippi, Alabama, and Florida; *Sargassum* habitat including most of the central & western Gulf of Mexico.
Green turtle	*Chelonia mydas*	T	X	X	None
Leatherback turtle	*Dermochelys coriacea*	E	X	X	None
Hawksbill turtle	*Eretmochelys imbricata*	E	X	X	None
Kemp's ridley turtle	*Lepidochelys kempii*	E	X	X	None
Birds					
Piping Plover	*Charadrius melodus*	T	--	X	Coastal Texas, Louisiana, Mississippi, Alabama, and Florida
Whooping Crane	*Grus americana*	E	--	X	Coastal Texas (Aransas National Wildlife Refuge)
Fishes					
Oceanic whitetip shark	*Carcharhinus longimanus*	T	X	--	None
Giant manta ray	*Mobula birostris*	T	X	X	None
Gulf sturgeon	*Acipenser oxyrinchus desotoi*	T	--	X	Coastal Louisiana, Mississippi, Alabama, and Florida
Nassau grouper	*Epinephelus striatus*	T	--	X	None
Smalltooth sawfish	*Pristis pectinata*	E	--	X	Southwest Florida
Invertebrates					
Elkhorn coral	*Acropora palmata*	T	--	X	Florida Keys and the Dry Tortugas
Staghorn coral	*Acropora cervicornis*	T	--	X	Florida Keys and the Dry Tortugas
Pillar coral	*Dendrogyra cylindrus*	T	--	X	None
Rough cactus coral	*Mycetophyllia ferox*	T	--	X	None
Lobed star coral	*Orbicella annularis*	T	--	X	None
Mountainous star coral	*Orbicella faveolata*	T	--	X	None
Boulder star coral	*Orbicella franksi*	T	--	X	None
Terrestrial Mammals					
Beach mice (Alabama, Choctawhatchee, Perdido Key, St. Andrew)	*Peromyscus polionotus*	E	--	X	Alabama and Florida (Panhandle) beaches
Florida salt marsh vole	*Microtus pennsylvanicus dukecampbelli*	E	--	X	None

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

1 In 2021, NMFS recognized that what had previously been accepted as a subspecies of the Bryde's whale is actually a separate species. The reclassification is currently undergoing the legal process to be formally recognized.

2 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.

3 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 pectinata*), 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 Bryde's whale (*Balaenoptera edeni)*, sperm whale (*Physeter macrocephalus*), oceanic whitetip shark (*Carcharhinus longimanus*), and giant manta ray (*Mobula birostris*) are the only Endangered or Threatened species that could potentially 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, 2017); no critical habitat has been designated for the sperm whale. The Bryde's whale 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 species is severely restricted in range, being found only in the northeastern Gulf in the waters of the DeSoto Canyon (Waring et al., 2016, Rosel et al., 2021) and is therefore not likely to occur within the project area. The giant manta ray 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 cervicronis*), 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 likely to be affected by either routine or accidental events associated with project activities.

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 Minerals Management Service-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 vessel presence, noise, and lights; support vessel and helicopter traffic noise; support vessel strikes; 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) identified marine debris as an IPF for sperm whales, 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 Vessel Presence, Noise, and Lights

Subsea installation process may produce sound levels that could potentially disturb individual whales or mask the sounds animals would normally produce or hear. Noise associated with the project activities is relatively weak in intensity, and an individual animal's noise exposure would be transient. 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 µPa m (Møhl et al., 2003).

It is expected that, due to the relatively stationary nature of the installation vessel and 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, 2015b). 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 µPa^2 s over a 24-hour period (NMFS, 2016). Similarly, temporary threshold shifts are estimated to occur when the mammal has received a SEL_{cum} of 178 dB re 1 µPa^2 s over a 24-hour period. Based on transmission loss calculations (Urick, 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 activites, it is not expected that any sperm whales will receive exposure levels necessary for the onset of auditory threshold shifts.

The installation vessel and MODU will be located within a deepwater, open ocean environment. Sounds generated by project operations will be generally non-impulsive, with some variability in sound level. This analysis assumes that the continuous nature of sounds produced by the installation vessel and 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 installation vessel and MODU will allow for active avoidance of potential physical impacts. Subsea installation-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.

Vessel lighting and presence are not identified as IPFs for sperm whales (NMFS, 2007, 2015a, 2020b, BOEM, 2012a, 2013, 2014, 2015, 2016b, 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 was updated (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. Based on its Endangered status, mortality of a single sperm whale would constitute a significant impact to the local (Gulf of Mexico) population 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 800 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 BOEM (2012a, 2015, 2016b, 2017a) and NMFS (2020a). Oil impacts on marine mammals are discussed by Geraci and St. Aubin (1990) and by the Marine Mammal Commission (MMC) (2011). For this DOCD, 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 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. DOCD 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 slick on the water surface and increase 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 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 (Marine Mammal Commission [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 MMC (2011). For this DOCD, 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 (Hayes et al., 2017). Complications related to 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 areas near 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-G01to 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 DOCD 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) population of sperm whales but would not be significant at species level. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. DOCD Section 9b provides detail on spill response measures.

C.3.2 Bryde's Whale (Endangered)

A recent study by Rosel et al. (2021), identified the genetically distinct Northern Gulf of Mexico Bryde's whale stock as a new species of baleen whale named the Rice's whale (*Balaenoptera ricei*) through DNA analysis. The reclassification is currently undergoing the legal process within applicable United States agencies to be formally recognized. Until it is made official this species of whales will be referred to as the Bryde's whale as it was formerly known. The proposed Rice's whale distribution area as presented by NMFS is presented in **Figure 2** for reference.

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 vessel presence, marine sound, and lights; support vessel and helicopter traffic; and both types of spill accidents: a small fuel spill and a large oil spill. It is unlikely that the Bryde's whales could occur in the project area. 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 Rice'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 Vessel Presence, Noise, and Lights

Some sounds produced by the installation vessel and 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 source levels of approximately 177 to 190 dB re 1 μPa m expressed as SPL (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 installation vessel and MODU operations, Bryde's whales would move away from the proposed operations area, and sound 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 *FR* 1871. Received SPL 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 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_{24h} 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 theshold shift values, and based on open water transmission loss calculations (Urick, 1983), sound produced by typical sources with DP thrusters in use during drilling, are not expected to propagate SPL_{24h} greater than the behavioral threshold of 120 dB re 1 μPa beyond 2,290 ft (700 m) from the source.

The installation vessel and MODU will be located within a deepwater, open ocean environment. This analysis assumes that the continuous nature of sounds produced by the installation vessel and 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 installation vessel and MODU will allow for active avoidance of potential physical impacts. Subsea installation-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 whales 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. DOCD 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 DOCD 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 population- and species-level impact to this subspecies 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 (Endangered)

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 65 miles (105 km) from the nearest shoreline (Louisiana). 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 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 and installation activities including subsea equipment, 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, the 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

The 30-day OSRA results summarized in **Table 3** predict that shorelines in Terrebonne, Lafourche, and Plaquemines Parishes, Louisiana, could be contacted by a large oil spill within 10 days. Other Texas, Louisiana, and Florida panhandle shorelines could be contacted by a large oil spill within 30 days. There is no 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, and 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 (or contaminated vegetation, in the case of manatees); and stress from the activities and noise of response vessels and aircraft (BOEM, 2017a). Complications related to 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 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 DOCD 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 Gulf of

Mexico; therefore, in the event of mortality of individual manatees from a large oil spill would constitute an adverse but insignificant impact at the population level to the subspecies. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. DOCD 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 *Kogia breviceps*, respectively), four species of beaked whales, and 14 species of delphinid whales and dolphins (see DOCD 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, Waring et al., 2016). 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 only one documented stranding in the Gulf of Mexico (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 or are 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., 2000a). Any of these species could occur in the project area (Hayes et al., 2019).

Delphinids. Fourteen species of delphinids are known from the Gulf of Mexico, including Atlantic spotted dolphin (*Stenella frontalis*), bottlenose dolphin (*Tursiops truncatus*), Clymene dolphin, false killer whale (*Pseudorca crassidens*), Fraser's dolphin (*Lagenodelphis hosei*), killer whale (*Orcinus orca*), melon-headed whale (*Peponocephala electra*), pantropical spotted dolphin (*Stenella attenuata*), pygmy killer whale (*Feresa attenuata*), short-finned pilot whale (*Globicephala macrorhynchus*), Risso's dolphin (*Grampus griseus*), rough-toothed dolphin (*Steno bredanensis*), spinner dolphin (*Stenella longirostris*), and striped dolphin (*Stenella coeruleoalba*). The most common non-endangered cetaceans in the deepwater environment 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, 2016c) 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 vessel 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 and Vessel Presence, Noise, and Lights

Noise from routine drilling and installation 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 bandwiths 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_{24h} of 198 dB re 1 μPa^2 s. Simlarly, temporary threshold shifts are estimated to occur when the mammal has received a SEL_{24h} of 178 dB re 1 μPa^2 s. Due to the short propagation distance of above-threshold SEL_{24h}, the transient nature of marine mammals and the stationary nature of the proposed activites, 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 *FR* 1871. Received SPL 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).

BOEM (2012a) stated the source level from oil and gas production platforms are low with a frequency range of 50 to 500 Hz. It is expected that marine mammals within or near the project area would be able to detect the presence of the installation vessel and MODU and avoid exposure to higher energy sounds, particularly within an open ocean environment.

Some odontocetes have shown increased feeding activity around lighted platforms at night (Todd et al., 2009). Even temporary offshore structures present an attraction to pelagic food sources that may attract cetaceans. Therefore, prey congregation could pose an attraction to protected species that exposes 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 installation and 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.

Vessel lighting and presence are not identified as IPFs for marine mammals by BOEM (2016b, 2017a). Installation vessel and MODU characteristics are expected to be similar to a drilling rig in terms of lighting and presence. Therefore, no significant impacts are expected.

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 at a population level 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 specify that helicopters maintain an altitude of 1,000 ft (305 m) within 300 ft (91 m) of marine mammals (BOEM, 2017a; NMFS, 2020a). 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 this DOCD, 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. DOCD 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 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), and Geraci and St. Aubin (1990). For this DOCD, 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 related to 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 causes 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 DOCD 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 at the population level 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. DOCD Section 9b provides detail on spill response measures.

C.3.5 Sea Turtles (Endangered/Threatened)

As listed in DOCD Section 6h, five species of Endangered or Threatened sea turtles may be found near the project area. Endangered species include 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).

The critically Endangered Kemp's ridley turtle nests almost exclusively on a 16 mile (26 km) stretch of coastline near Rancho Nuevo in the Mexican state of Tamaulipas. A much smaller, but growing, population nests in Padre Island National Seashore, mostly as a result of reintroduction efforts (NMFS et al., 2011). Sporadic nesting takes place elsewhere along the southern Texas and northern Mexican coasts. 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.

Loggerhead turtles in the Gulf of Mexico are part of the Northwest Atlantic Ocean DPS (NMFS, 2014a). Effective August 11, 2014, NMFS and the USFWS designated critical habitat for this DPS, as shown in **Figure 1**. The USFWS designation (79 FR 39755) 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 39855) includes nearshore reproductive habitat within 0.99 miles (1.6 km) seaward of the mean high-water line along these same nesting beaches. NMFS also designated large areas of shelf and oceanic waters, termed *Sargassum* habitat in the Gulf of Mexico (and Atlantic Ocean) as critical habitats. *Sargassum* is a genus of brown algae (Class Phaeophyceae) that has a pelagic existence. Rafts of Sargassum serve as important foraging and developmental habitat for numerous fishes, and young sea turtles, including loggerhead turtles. Additionally, NMFS 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.

The nearest designated nearshore reproductive critical habitat for loggerhead sea turtles is approximately 152 miles (245 km) north of the project area. The lease block is located in the designated *Sargassum* critical habitat for loggerhead sea turtles (**Figure 1**).

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 turtles may be present in deepwater areas, including the project area, where they may be associated with *Sargassum* and other flotsam. 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.

1. 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);
2. Green and leatherback turtles—green and leatherback turtles infrequently nest on Florida Panhandle beaches (Florida Fish and Wildlife Conservation Commission, 2017b, c);
3. Kemp's ridley turtles—the main nesting site is Rancho Nuevo beach in Tamaulipas, Mexico (NMFS et al., 2011). As of early June 2021, a total of 95 Kemp's ridley turtle nests have been counted on Texas beaches for the 2021 nesting season. A total of 262 Kemp's ridley turtle nests were counted on Texas beaches during the 2020 nesting season. This was an increase from 2019 (190 nests), but similar to 2018 (250 nests) (Turtle Island Restoration Network, 2021). 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
4. 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 (USFWS, 2016).

IPFs that could potentially affect sea turtles include vessel 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.

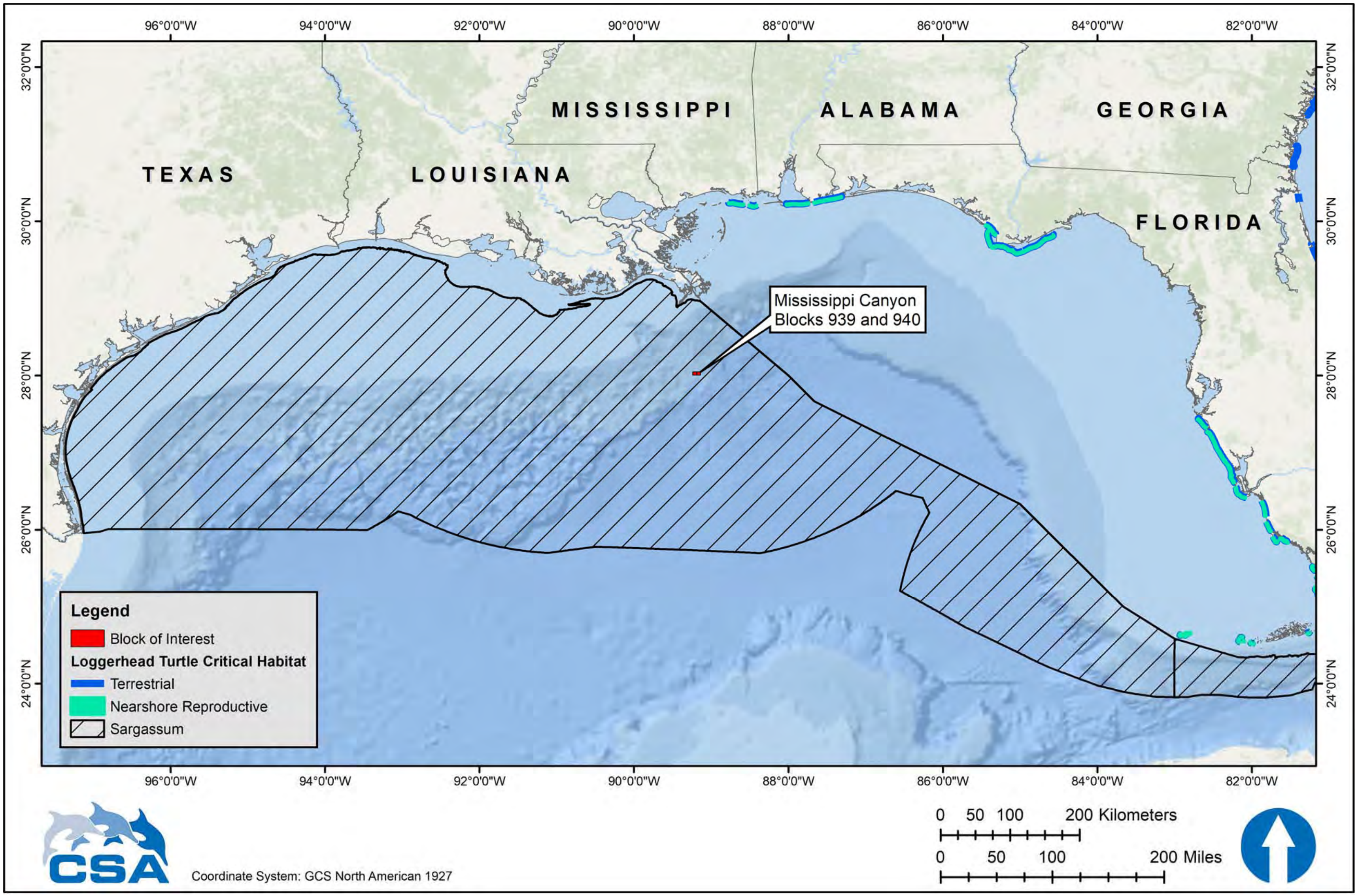


Figure 1. Location of loggerhead turtle designated critical habitat in relation to the project area.

Though NMFS (2020a) stated marine debris as an IPF, compliance with NTL BSEE 2015-G013 (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 Vessel Presence, Noise, and Lights

Offshore 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 injury threshold as 207 dB re 1 μPa; Blackstock et al. (2018) identified the sea turtle underwater acoustic SPL 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 (Urick, 1983), open water propagation of sound produced by typical sources with DP thrusters in use during installation activities, are not expected to produce SPL greater than 160 dB re 1 μPa beyond 105 ft (32 m) from the source. Certain sea turtles, especially loggerheads, may be attracted to offshore structures (Lohoefener 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 installation 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. Due to the limited scope, timing, and geographic extent of MODU and subsea equipment installation activities, these short-term impacts are not expected to be biologically significant to sea turtle populations.

BOEM (2012a) stated the source level from oil and gas production platforms are low with a frequency range of 50 to 500 Hz. This noise will be of variable duration and intensity, depending on the type of machinery used.

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 one sea turtle will be sub-lethally entrapped in moon pools every year. Therefore, no significant impacts are expected.

Sea turtles have the potential for entanglement with the mooring lines; though, they are anticipated to be rigid and will pose little or no risk.

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 (BOEM, 2012a; NMFS, 2020a).

Impacts of a Small Fuel Spill

Potential spill impacts on sea turtles are discussed by BOEM (2016b, 2017a) and NMFS (2020). For this DOCD, 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. DOCD 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.

Effects of a small spill on *Sargassum* critical habitat for loggerhead turtles would be limited to the small area (0.5 to 5 ha [1.2 to 12 ac]) likely to be impacted by a small spill. A 5-ha (12-ac) impact would represent a negligible portion of the 39,164,246 ha (96,776,959 ac) designated *Sargassum* critical habitat for loggerhead turtles in the northern Gulf of Mexico.

A small fuel spill in the project area would be unlikely to affect sea turtle nesting beaches because the project area is 65 miles (105 km) from the nearest shoreline (Louisiana), 152 miles (245 km) from the nearest designated loggerhead nearshore reproductive critical habitat, and approximately 504 miles (811 km) from Padre Island National Seashore, which is the primary Kemp's ridley nesting beach in the U.S. A small fuel spill would not be expected to make landfall or reach coastal waters prior to breaking up.

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, and beach cleanup activities). 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 related to 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 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. DOCD 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 the *Deepwater Horizon* incident provide an indication of the effects of a large oil spill on sea turtles. NOAA (2016b) estimates that between 4,900 and up to 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, of which 54,800 were likely 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.

The nearest terrestrial and nearshore reproductive critical habitat for loggerhead turtles is Horn Island, Mississippi, while for Kemp's ridley turtles is Padre Island National Seashore. The 30-day OSRA results summarized in **Table 3** predict a <0.5% probability of contact to any terrestrial or nearshore reproductive critical habitat for the loggerhead sea turtle or the Padre Island National Seashore within 30 days of a spill. 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 are subject to the same types of oil spill exposure hazards as adults. Hatchlings that contact oil residues while crossing a beach can exhibit a range of effects, from acute toxicity to impaired movement and normal bodily functions (NMFS, 2020a).

Due to the large area designated as *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 catastrophic 2010 *Deepwater Horizon* incident affected approximately one-third of the *Sargassum* habitat in the northern Gulf of Mexico (BOEM, 2016b). Although the project area is located within the *Sargassum* habitat, it is unlikely that the entire *Sargassum* critical habitat would be affected by a large spill.

The effects of oiling on *Sargassum* vary with severity, but moderate to heavy oiling that could occur during a large spill could cause complete mortality to *Sargassum* and its associated communities (BOEM, 2017a). *Sargassum* also has the potential to sink during a large spill; thus temporarily removing the habitat and possibly being an additional pathway of oil 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.* The *Sargassum* 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* has 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* community would be expected to occur within a short time period (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 DOCD Section 2j. 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. DOCD 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 is in decline 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 (BirdLife 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 it would not be expected to make landfall or reach coastal waters prior to breaking up (see explanation in **Section A.9.1**).

Impacts of a Large Oil Spill

The project area is 65 miles (105 km) from the nearest shoreline designated as Piping Plover critical habitat. The 30-day OSRA results summarized in **Table 3** predict that Louisiana shorelines designated as critical habitats for the wintering Piping Plover could be contacted by a spill within 10 days (Plaquemines, Terrebonne, and Lafourche Parishes) or 30 days (Cameron, Vermilion, Terrebonne, Lafourche, Jefferson, Plaquemines, and St. Bernard Parishes).

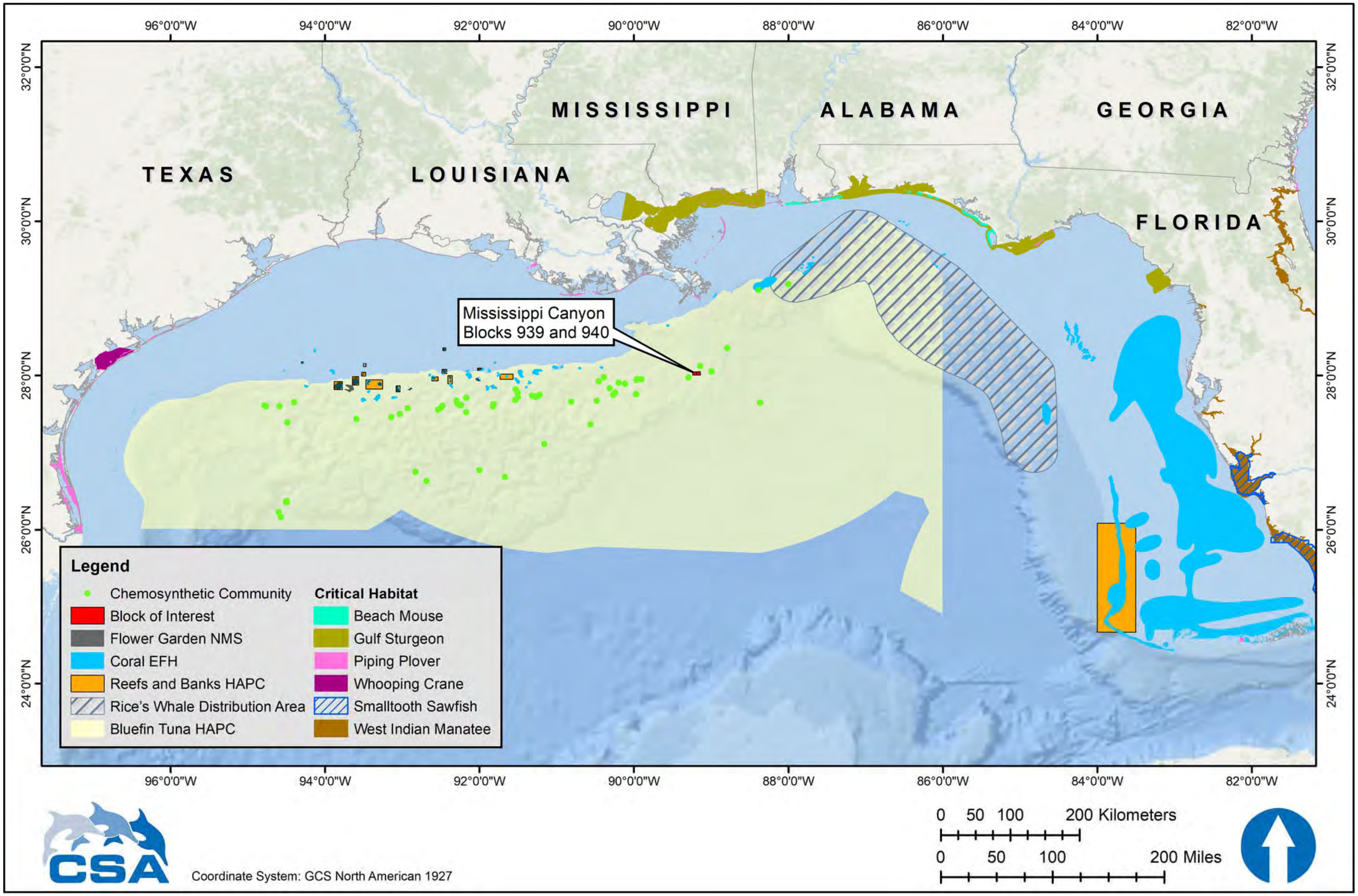


Figure 2. Location of selected environmental features in relation to the project area. (EFH = Essential Fish Habitat; HAPC = Habitat Area of Particular Concern.)

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 DOCD 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. DOCD Section 9b provides detail on spill response measures.

C.3.7 Whooping Crane (Endangered)

The Whooping Crane is a large omnivorous wading bird listed as an 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 from Aransas NWR.

Impacts of a Large Oil Spill

The 30-day OSRA results summarized in **Table 3** predict that a large oil spill has a less than 0.5% probability of reaching Whooping Crane critical habitat in the Aransas NWR located in Aransas and Calhoun Counties in Texas. The nearest Whooping Crane critical habitat is approximately 441 miles (710 km) from the project area.

In the event of oil exposure, Whooping Cranes could become externally oiled while foraging in oiled areas or internally exposed to oil through ingestion of contaminated crustaceans, shellfish, frogs, and fishes. It is possible that some death of Whooping Cranes could occur. 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 population and species levels.

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 DOCD Section 2j.

In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. DOCD 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 vessel 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 Vessel Presence, Noise, and Lights

Offshore drilling and installation 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 production activities (195 dB re 1 µPa m with peak frequencies at 40 to 100 Hz) (Hildebrand, 2005). Impacts from offshore activities (i.e., non-impulsive sound from MODU and vessel activities) could include masking or behavioral change (Popper et al., 2014). However, because of the limited propagation distances of high SPLs from the MODU and installation vessel 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 recent 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. 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 come in contact with oceanic whitetip sharks. However, if contact resulted in individual mortality, regional population-level effects on the species could be observed.

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 DOCD Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. DOCD 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. Approximately 100 unique individuals have been positively identified at the Flower Garden Banks based on unique underbelly coloration (Belter et al., 2020). 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 vessel 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 Vessel Presence, Noise, and Lights

Offshore drilling and installation 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 production activities (195 dB re 1 μPa m with peak frequencies at 40 to 100 Hz) (Hildebrand, 2005). Impacts from offshore drilling activities (i.e., non-impulsive sounds from MODU and vessel activities) could include masking or behavioral change (Popper et al., 2014). However, because of the limited propagation distances of high SPLs from the MODU and installation vessel, 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 recent study by Cave and Kajiura (2018) reported that when exposed 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, 2018). 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 264 miles [425 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 likely be regional population-level effects on the species if mortality is observed.

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 DOCD Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. DOCD 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 breaking up (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 (147 miles [237 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 (2020a). For this DOCD, there are no unique site-specific issues with respect to this species.

The project area is approximately 147 miles (237 km) from the nearest Gulf sturgeon critical habitat. The 30-day OSRA modeling (**Table 3**) predicts that a spill in the project area would have a 1% or lower probability of contacting Gulf sturgeon critical habitats in St. Bernard Parish in Louisiana or Okaloosa County in Florida 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 DOCD 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 the significant at the population level. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce 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. DOCD 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 264 miles [425 km]), and the difference in water depth between the project area (3,970 to 4,040 ft [1,210 to 1,231 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 264 miles [425 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. Due to the low density of individuals thought to occur in the Gulf of Mexico, there is a very low probability for Nassau groupers to be exposed to oil from the spill. Impacts to Nassau grouper from a large oil spill would be considered at an individual level and very unlikely at a population 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 DOCD Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. DOCD Section 9b provides detail on spill response measures.

C.3.12 Smalltooth Sawfish (Endangered)

The smalltooth sawfish, named due to 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 432 miles (695 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 the 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. Due to its Endangered status, a large oil spill with death to individuals could have impacts to smalltooth sawfish at population and species levels.

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. allophrys*), 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 in habiting 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 beach mouse subspecies are discussed by BOEM (2016b, 2017a). For this DOCD, there are no unique site-specific issues with respect to these species.

The project area is approximately 164 miles (264 km) from the nearest beach mouse critical habitat. The 30-day OSRA results summarized in **Table 3** predicts less than a 0.5% chance that a spill in the project area would contact beach mouse critical habitat in Baldwin County, Alabama, Escambia, Bay, Walton, and Okaloosa counties, Florida, 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 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 (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 DOCD 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 due to its Endangered status potentially significant at the population and species levels. In the unlikely event of a spill, implementation of Shell’s OSRP will mitigate and reduce the impacts. DOCD 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 (USFWS, 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 356 miles (576 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.

In November 2020, NMFS proposed to designate critical habitat for the boulder star coral, lobed star coral, mountainous star coral, pillar coral, and rough cactus coral in the Atlantic Ocean, Gulf of Mexico, and Caribbean Sea. For the areas in the Gulf of Mexico this includes the Flower Garden Banks and the waters near Miami-Dade and Monroe counties, Florida, and the Dry Tortugas.

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). The 30-day OSRA modeling (**Table 3**) predicts the conditional probability of oil contacting the Florida Keys is less than 0.5%. The nearest coral HAPC is approximately 45 miles (72 km) northwest of the lease block. 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 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 and 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 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 vessel 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 Vessel Presence, Noise, and Lights

Birds that frequent platforms may be exposed to contaminants including air pollutants and routine discharges, but significant impacts are unlikely due to rapid dispersion of effluents and air pollutants. 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. In other cases, navigation may be disrupted by noise or lighting (Russell, 2005, Ronconi et al., 2015). Conversely, offshore structures are suitable stopover habitats for most trans-Gulf migrant species, and most of the migrants that stop over on platforms probably benefit from their stay, particularly in spring (Russell, 2005, Ronconi et al., 2015).

Overall, potential negative impacts to birds from vessel lighting, potential collisions, or other adverse effects are highly localized, and may be expected to affect only small numbers of birds during migration periods. Therefore, these potential impacts may be adverse, but are not expected to affect birds at the population or species level and are not significant (BOEM, 2012a). Any impacts on populations of marine and pelagic birds are not expected to be significant.

Impacts of Support Vessel and Helicopter Traffic

Support vessels associated with routine MODU operations and installation activities including subsea equipment, and helicopters are unlikely to significantly disturb pelagic 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 DOCD, there are no unique site-specific issues with respect to spill impacts on marine and pelagic birds.

A small fuel spill in offshore waters would produce a slick on the water surface and increase 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 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 fuel 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 and pelagic birds would be expected.

Impacts of a Large Oil Spill

Potential spill impacts on marine and pelagic birds are discussed by BOEM (2012a, 2013, 2014, 2015, 2016b, 2017a). For this DOCD, there are no unique site-specific issues with respect to spill impacts on marine and pelagic 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. Haney et al. (2014) estimated that seabird densities over the open ocean are approximately 1.6 birds km^{-2}. The number of pelagic birds that could be affected in open, offshore waters would depend on the extent and persistence of the surface oil.

Data following the *Deepwater Horizon* incident provide relevant information about the species of pelagic 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 from 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 DOCD 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. DOCD 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 breaking up. 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 associated with routine MODU operations and installation activities including subsea equipment, and helicopters will transit coastal areas near Port Fourchon and Houma, Louisiana, where shorebirds and coastal nesting 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 MODU and subsea installation 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 are highly dependent on the type of aircraft, bird species, activities that animals were previously engaged in, and previous exposures to overflights (Efroymson 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 Efroymson 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). The 30-day OSRA modeling results summarized in **Table 3** predict that Terrebonne, Lafourche, and Plaquemines Parishes could be contacted within 10 days; and shorelines of Texas, Louisiana, and Florida that include habitat for shorebirds and coastal nesting birds could be affected within 30 days.

Studies concerning the *Deepwater Horizon* incident provide additional information regarding impacts on shorebirds and coastal nesting birds that may be affected in the event 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, Black Skimmer, Black Tern, 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 DOCD 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. DOCD 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). Pelagic eggs and larvae become part of the planktonic community for various lengths of time (10 to 100 days, depending on the species) (BOEM, 2012a). 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 revealed high species richness, but numerical abundance was dominated by relatively few families and species.

IPFs that could potentially affect pelagic communities and ichthyoplankton include vessel presence, noise, and lights; effluent discharges; water intakes; and two types of accidents (a small fuel spill; and a large oil spill).

Impacts of Vessel Presence, Noise, and Lights

The installation vessel and MODU, as floating structures 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. Installation vessel and 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, Bruintjes and Radford, 2013, McLaughlin and Kunc, 2015). Because the MODU and installation vessels are a temporary structure, impacts on fish populations, whether beneficial or adverse, are not expected to be significant.

Limited 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_{24h} of 206 dB re 1 μPa^2 s but resulted in no increased mortality between the exposure and control groups. Non-impulsive sound sources (such as MODU operations) are expected to be far less injurious than impulsive sounds. Because of the limited propagation distances of above-threshold SEL_{24h} and the periodic and transient nature of ichthyoplankton, no impacts to these life stages are expected.

Impacts of Effluent Discharges

Effluents discharged during the course of subsea equipment installation activities and well work activities are not expected to have a significant impact on water column biota. All NPDES permit limits and requirements for effluent discharges will be met.

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 a slight 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 will dilute rapidly to undetectable levels within tens to hundreds of meters from the source. Minimal impacts on water quality, plankton, and nekton are anticipated.

Deck drainage may have a slight effect on the pelagic environment in the immediate vicinity of these discharges. Deck drainage from contaminated 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 will dilute rapidly to undetectable levels within tens to hundreds of meters from the source. Minimal impacts on water quality, plankton, and nekton are anticipated.

Produced water and process effluents, including well treatment and completion fluids, will be discharged overboard. Other discharges in accordance with the NPDES permit, such as non-contact cooling water, desalination unit discharge, uncontaminated fire water, utility seawater, workover fluids, treated seawater, hydrate inhibitor, bilge water, subsea production control fluid, excess cement, BOP fluid, and ballast water, are expected to dilute rapidly and have little or no impact on water column biota. The MODU, installation, and support vessel discharges are expected to be in accordance with NPDES permit and USCG regulations, as applicable, and therefore are not expected to cause significant impacts on water quality (BOEM, 2012a).

Impacts of Water Intakes

Seawater will be drawn from approximately 11-meters below the ocean surface for various services including firewater and once-through non-contact cooling of machinery on the installation vessel and MODU (DOCD 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. GMG290000 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 installation vessel and 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 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 DOCD, there are no unique site-specific issues with respect to spill impacts.

A small fuel spill in offshore waters would produce a slick on the water surface and increase 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 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).

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 DOCD 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. DOCD 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 on the Texas-Louisiana OCS, the nearest of which is located 45 miles (72 km) northwest of 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 at or near the project area include the following (NMFS, 2009b):

- Bigeye thresher shark (*Alopias superciliosus*) (all);
- Bigeye tuna (*Thunnus obesus*) (juveniles);
- 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 (*Carcharhinus longimanus*) (all);
- Sailfish (*Istiophorus albicans*) (juveniles, adults);
- Skipjack tuna (*Carcharhinus falciformis*) (spawning, adult);
- Swordfish (*Xiphias gladius*) (larvae, juveniles, adults);
- White marlin (*Kajikia albidus*) (juveniles, adults); and
- Yellowfin tuna (*Thunnus albacares*) (spawning, juveniles, adults).

Research indicates the central and western Gulf of Mexico may be important spawning habitat for Atlantic bluefin tuna, 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 miles^2 (300,000 km^2). The prevailing assumption is that Atlantic bluefin tuna follow an annual cycle of foraging in June through March off the eastern United States 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 identified in the Gulf of Mexico by the GMFMC (2005), including the Florida Middle Grounds, Madison-Swanson Marine Reserve, Tortugas North and South Ecological Reserves, Pulley Ridge, and several individual reefs and banks of the northwestern Gulf of Mexico (**Figure 2**). The GMFMC is currently considering options on protecting deep-sea corals to add to the HAPCs previously identified (Fisheries Leadership and Sustainability Forum, 2015). The nearest of these is Jakkula Bank, located 142 miles (229 km) west of the project area.

Routine IPFs that could potentially affect EFH and fisheries resources include vessel 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 Vessel Presence, Noise, and Lights

The installation vessel and MODU, as floating structures in the deepwater environment, will act as an FAD. In oceanic waters, the FAD effect would be most pronounced for epipelagic fishes such as tunas, dolphin, billfishes, and jacks that are commonly attracted to fixed and drifting surface structures (Holland, 1990, Higashi, 1994, Relini et al., 1994, Gates et al., 2017). This FAD effect would possibly enhance feeding of epipelagic predators by attracting and concentrating smaller fish species.

Installation vessel and 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, Bruintjes 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

Other effluent discharges affecting EFH by diminishing ambient water quality include treated sanitary and domestic wastes, deck drainage, and miscellaneous discharges such as desalination unit brine and non-contact cooling water, fire water, workover fluids, subsea production control fluid, excess cement, BOP fluid, and ballast 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 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 significant.

Impacts of a Small Fuel Spill

Potential spill impacts on EFH are discussed by BOEM (2016b, 2017a). For this DOCD, 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. DOCD 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 slick on the water surface and increase 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 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 near-surface and 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 miles^2 (300,000 km^2) 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 coral EFH is located 45 miles (72 km) northwest of the project area. A small fuel spill would float and dissipate on the sea surface and would not contact these 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 DOCD, 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 Atlantic 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 and their offspring. 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 45 miles (72 km) northwest of the project area. An accidental spill would be unlikely to reach or affect this feature. 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 DOCD 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 the duration of these impacts would likely be short-term. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. DOCD 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 >200 m (656 ft) 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.

Forty-nine sonar targets were detected within 9,000 ft (2,743 m) of the proposed mooring radius and buffer of the subsea field and 12 sonar targets were detected within 2,000 ft (610 m) of the proposed wellsites and associated subsea installations; however, they were not identified as archaeologically significant (Geoscience Earth & Marine Services, 2007a, 2013, IntecSea Worley Parsons Group, 2015, Oceaneering International Inc, 2017). Shell will observe a 100-ft (30-m) avoidance area around 11 of the sonar targets and 32.8-ft (10-m) avoidance area around 50 of the sonar targets. These sonar contacts were identified as modern debris, man-made debris (industrial waste barrels) or geologic in origin and not recommended for archaeological avoidance. If the sonar contacts are confirmed as waste barrels during operations, Shell will follow its Waste Barrel Avoidance and Release Response in the Mississippi Canyon Area document, including offset distances. 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 DOCD 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 known 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 and *in situ* preservation.

There are no known historic shipwrecks in the project area. A spill entering shallow coastal waters could conceivably contaminate undiscovered or known historic shipwreck sites. The 30-day OSRA modeling summarized in **Table 3** predicts that Terrebonne, Lafourche, and Plaquemines Parishes, Louisiana could be contacted within 10 days of a spill and other Texas, Louisiana, and Florida shorelines could be contacted by a spill within 30 days. If an oil spill contacted a coastal historic site, such as a fort or a lighthouse, the major impact would be a temporary, reversible visual impact from oil contact of the site and its environment (BOEM, 2012a). However, more recent studies suggest that the impacts could be longer term and not easily reversible (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 DOCD Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. DOCD Section 9b provides detail on spill response measures. Therefore, no significant spill impacts on historic shipwrecks are expected.

C.6.2 Prehistoric Archaeological Sites

With a water depth ranging from 3,970 to 4,040 ft (1,210 to 1,231 m), the project area is well beyond the 197 ft (60 m) depth contour used by the 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). The 30-day OSRA modeling summarized in **Table 3** predicts Terrebonne, Lafourche, and Plaquemines Parishes, Louisiana, could be contacted within 10 days of a spill, and other Texas, Louisiana, and Florida shorelines could be contacted by a spill within 30 days. 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 DOCD Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. DOCD 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. Generally, most of the northern Gulf of Mexico is fringed by coastal and barrier island beaches, with wetlands, oyster reefs, and/or submerged seagrass beds occurring in sheltered areas behind the barrier islands and in estuaries.

Due to the distance from shore, there are no IPFs associated with routine activities occurring in the project area that are likely to affect beaches and dunes, wetlands, seagrass beds, coastal wildlife refuges, wilderness areas, or any other managed or protected coastal area. The support bases are not located in wildlife refuges or a wilderness areas. Potential impacts of support vessel traffic are briefly addressed in this section.

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 65 miles (105 km) from the nearest shoreline (Louisiana). 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

For OCS activities in general, support operations, including the crew boat and supply boats, and vessels supporting subsea installation and production activities 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. Support operations, including the crew boat and supply boats as detailed in DOCD Section 14, may have a minor incremental impact on coastal habitats, seagrass beds, wetlands, or protected areas. Impacts will be minimized by following the speed and wake restrictions in harbors and channels.

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 and dunes, wetlands, oyster reefs, and submerged seagrass beds. For this DOCD, there are no unique site-specific issues with respect to coastal habitats.

NWRs and other protected areas such as Wildlife Management Areas (WMAs) 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**.

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 (BOEM, 2017a). Oil that makes it to beaches may be either liquid weathered oil, an oil-and-water mousse, or tarballs (BOEM, 2012a, 2017a). 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 significant.

Table 6. Wildlife refuges, wilderness areas, and state and national parks and preserves within the geographic range of the potential shoreline contacts within 30 days based on OSRA modeling.

County or Parish, State	Wildlife Refuge, Wilderness Area, or State/National Park
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	Sabine National Wildlife Refuge
	Rockefeller State Wildlife Refuge and Game Preserve
	Peveto Woods Sanctuary
Vermilion, Louisiana	Paul J. Rainey Wildlife Refuge and Game Preserve
	Rockefeller State Wildlife Refuge and Game Preserve
	State Wildlife Refuge
Iberia, Louisiana	Marsh Island Wildlife Refuge
	Shell Key National Wildlife Refuge
Terrebonne, Louisiana	Isles Dernieres Barrier Islands Refuge
	Pointe-aux-Chenes Wildlife Management Area
Lafourche, Louisiana	East Timbalier Island National Wildlife Refuge
	Pointe-aux-Chenes Wildlife Management Area
	Wisner Wildlife Management Area (including Picciola Tract)
Jefferson, Louisiana	Grand Isle State Park
Plaquemines, Louisiana	Breton National Wildlife Refuge
	Delta National Wildlife Refuge
	Pass-a-Loutre Wildlife Management Area
St. Bernard, Louisiana	Biloxi National Wildlife Refuge
	Breton National Wildlife Refuge
	Saint Bernard State Park
Okaloosa, Florida	Eglin Beach Park
	Fred Gannon Rocky Bayou State Park
	Gulf Islands National Seashore
	Henderson Beach State Park
	Rocky Bayou Aquatic Preserve
	Yellow River Wildlife Management Area

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 (Beazley et al., 2012, Lin and Mendelssohn, 2012, 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). 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).

In addition to the direct impacts of oil, cleanup activities in marshes may accelerate rates of erosion and retard recovery rates (BOEM, 2017a). A recent 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 DOCD Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. DOCD 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 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 occurs at or near 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 about 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 about 540 to 1,476 ft (165 to 450 m) (Continental Shelf Associates, 2002). The water depth at the proposed project area ranges from 3,970 to 4,040 ft (1,210 to 1,231 m). No conflict with commercial fishing activity other than longlining is expected to occur.

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 would be petroleum platforms in offshore waters of Texas and Louisiana. A limited number of recreational anglers target tunas and billfishes as well as bottom fishes such as tilefishes and groupers (Continental Shelf Associates, 2002).

The only routine IPF that could potentially affect fisheries (commercial and recreational) is vessel 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 Vessel Presence

There is a slight possibility of pelagic longlines becoming entangled in the installation vessel and 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. 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. DOCD 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.

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 breaking up (see **Section A.9.1**).

Impacts of a Large Oil Spill

Potential spill impacts on fishing activities are discussed by BOEM (2016b, 2017a). For this DOCD, 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, 2010a). At its peak on 12 July 2010, closures encompassed 84,101 miles^2 (217,821 km^2), or 34.8% of the U.S. Gulf of Mexico EEZ. 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 DOCD Section 2j. In the event of a large spill, impacts to recreational and commercial fishing are expected to be significantly adverse for up to several years. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. DOCD 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. 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 installation vessel and 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 DOCD Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. DOCD Section 9b provides detail on spill response measures. Therefore, 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 subsea installation activities, drilling, and well work activities with support from existing shore-based facilities in Louisiana.

The project will have a negligible adverse impact on socioeconomic conditions such as local employment, 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 DOCD, 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 and infrastructure installation 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).

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 DOCD Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. DOCD Section 9b provides detail on spill response measures. Therefore, no significant spill impacts on employment and infrastructure are expected.

C.8.4 Recreation and Tourism

There are no known recreational uses of 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 will minimize the chance of trash or debris being lost overboard from the installation vessel and MODU and subsequently washing up on beaches. There are no known recreational or tourism activities occurring in the project area, and as explained in **Section A.9.1**, a small fuel spill would not be expected to make landfall or reach coastal waters prior to breaking up. 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 DOCD, 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. The 30-day OSRA results summarized in **Table 3** predict that Terrebonne, Lafourche, and Plaquemines Parishes, Louisiana, could be contacted within 10 days of a spill, and other Texas, Louisiana, and Florida shorelines could be contacted by a spill within 30 days. Nearshore waters and embayments of Plaquemines Parish in Louisiana have the highest probability of contact within 10 days (4% probability) and 30 days (8% probability).

According to BOEM, 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 to affect 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. 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).

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 DOCD 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. DOCD 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 accident 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 DOCD Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. DOCD 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, shipping lane, or military warning area. Shell will comply with BOEM requirements and lease stipulations to avoid impacts on uses of the area by military vessels and aircraft.

There are no IPFs from routine project activities that are likely to affect shipping or other marine uses. A large oil spill is the only relevant accident IPF. A small fuel spill would not have impacts on other marine uses, as 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. In the event of a large spill requiring numerous response vessels, coordination would be required to manage the vessel traffic for safe operations. Shell will comply with BOEM requirements and lease stipulations to avoid impacts on uses of the area by military vessels and aircraft.

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 DOCD Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. DOCD 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 DOCD in several documents. The level and types of activities planned in Shell's DOCD are within the range of activities described and evaluated by BOEM (2012a, 2012b, 2013, 2014, 2015, 2016a, 2016b, 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. Other exploration and development activities may occur in the vicinity of lease blocks MC 939 and MC 940. 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 DOCD. 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 level and type of activity proposed in Shell's DOCD are within the range of activities described and evaluated in the recent lease sale EISs. 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 DOCD, 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 DOCD is limited in geographic scope and duration, 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 the BOEM exemption criteria with the exception of NO_x emissions; however, modeled results demonstrate NO_x would not contribute to cumulative impacts on air quality.

Climate Change. CO_2 and CH_4 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 CO_2 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 DOCD 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 non-contact cooling water, treated sanitary and domestic wastes, deck drainage, desalination unit discharge, uncontaminated fire water, utility seawater, non-contaminated well treatment and completion fluids, treated seawater, hydrate inhibitor, bilge water, workover fluids, subsea production control fluid, excess cement, BOP fluid, and ballast water. These effects are expected to be minor (localized to the area within a few hundred meters of the MODU, installation vessel, and support vessels), 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 geohazard, wellsite clearance, and archaeological assessments did not identify any known shipwrecks or other archaeological artifacts in the project area (Geoscience Earth & Marine Services, 2007a, 2013, IntecSea Worley Parsons Group, 2015, Oceaneering International Inc, 2017). The project area is well beyond the 60-m (197-ft) depth contour used by the 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 DOCD 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 bottom disturbance associated with installation activities are expected to be minor and limited to a small area. As described previously, the geophysical surveys did not identify any features that could support high-density deepwater benthic communities in the project area (Geoscience Earth & Marine Services, 2007a, 2013, IntecSea Worley Parsons Group, 2015, Oceaneering International Inc, 2017).

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 were 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 installation 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 installation activity would be negligible.

Coastal Habitats. Due to the distance 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 at Port Fourchon and Houma, Louisiana, are not in wildlife refuge 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 DOCD 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

Based on the results of high-resolution geophysical surveys consisting of AUV, side scan sonar, sub-bottom profilers, and multi-beam, pre-processed 3-D seismic data volumes, the subsea equipment installation and proposed wellsites with associated subsea installation appear suitable for the planned activities (Geoscience Earth & Marine Services, 2007a, 2013, IntecSea Worley Parsons Group, 2015, Oceaneering International Inc, 2017).

See DOCD 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 installation vessel and 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 installation vessel and MODU for safety reasons until the storm or weather event passes. In the event of a hurricane, procedures in Shell's Hurricane Evacuation Plan will be followed.

D.3 Currents and Waves

An FPS-based acoustic Doppler current profiler and a horizontal acoustic Doppler Current profiler will be used to continuously monitor the current beneath the FPS. Metocean conditions such as sea states, 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 FPS, installation vessel, and 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 FPS, installation vessel, and MODU for safety reasons until the storm or weather event passes.

E. Alternatives

No formal alternatives were evaluated in this DOCD. However, various technical and operational options, including the location of the subsea equipment and proposed wellsites, installation vessel, and 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 DOCD Section 2f.

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:

- Kathleen Gifford (Project Scientist, CSA Ocean Sciences Inc.);
- John Tiggelaar (Project Scientist, CSA Ocean Sciences Inc.);
- Dustin Myers (GIS Specialist, CSA Ocean Sciences Inc.);
- Tracy Albert (Regulatory Specialist, Shell Exploration & Production Co.);
- Carlos Andre Nunes E Silva (Regulatory Specialist, Shell Exploration & Production Co.);
- DaMonica Pierson (Senior Environmental Engineer, Shell Exploration & Production Co.);
- Eirik Sorgard (Project BOM, Shell Exploration & Production Co.);
- Saurabh Limaye (Well/Drilling Engineer, Shell International Exploration & Production);
- Byron Russert (Completion Engineer, Shell Exploration & Production Co.);
- Stacey Fresquez (Project Lead, Shell International Exploration & Production);
- Legna Mendoza (Staff Petrophysical Engineer, Shell Exploration & Production Co.);
- Carolina Isaza-Londono (Geologist, Shell Exploration & Production Co.);
- Matt Silbernagel (Geophysicist, Shell Exploration & Production Co.);
- Guangri Xue (Reservoir Engineer, Shell Exploration & Production Co.);
- Marisa Rydzy (Petrophysicist, Shell International Exploration & Production);
- John Smiley (Subsea Engineer, Shell International Exploration & Production);
- Ian Penny (Health and Safety Manager, Shell International Exploration & Production);
- Yury Gorbunov (Shallow Hazard Specialist, Shell International Exploration & Production);
- Stacey Maysonave (Geophysical Technician, Shell Exploration & Production Co.);
- Joshua O'Brien (Environmental Engineer, Shell Exploration & Production Co.); and
- Tim Langford (Emergency Response Advisor, Shell Exploration & Production Co.).

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SECTION 19: ADMINISTRATIVE INFORMATION

A. Exempted Information Description (Public Information Copies Only)

The following attachments were excluded from the public information copies of this plan:

1b. OCS Plan Information form – Bottom hole locations & proposed total depth
2c. Production Information
2j. Worst Case Discharge Information (Proprietary attachments)
4b. H_2S Classification Information
5. Mineral Resource Conservation information – proposed formation information

B. Bibliography

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Shell OSRP

CSA EIA July 2021

Vito DOCD N-10018, R-6842, R-6883, R-7000 & R-7077.