UNITED STATES GOVERNMENT November 4, 2020
MEMORANDUM

To: Public Information (MS 5030)
From: Plan Coordinator, FO, Plans Section (MS 5231)

Subject: Public Information copy of plan

Control #	-	S-08020
Type	-	Supplemental Development Operations Coordinations Document
Lease(s)	-	OCS-G19939 Block - 348 Mississippi Canyon Area OCS-G26252 Block - 391 Mississippi Canyon Area OCS-G26253 Block - 392 Mississippi Canyon Area OCS-G26254 Block - 393 Mississippi Canyon Area OCS- Block - 437 Mississippi Canyon Area
Operator	-	Shell Offshore Inc.
Description	-	Wells, Platform Appomattox, Drill Centers
Rig Type	-	Drillship

Attached is a copy of the subject plan.

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

Chiquita Hill
Plan Coordinator

Site Type/Name	**Botm Lse/Area/Blk**	**Surface Location**	**Surf Lse/Area/Blk**
FPSO/A-APPOMA		4759 FNL, 5744 FEL	/MC/437
????/AC		2014 FNL, 6011 FWL	G26253/MC/392
????/AE		3017 FNL, 5811 FEL	G26253/MC/392
????/AW		3858 FNL, 3484 FEL	G26252/MC/391
FPSO/FPS		4759 FNL, 5744 FEL	G33733/MC/437
????/IE		7323 FNL, 4462 FEL	G26253/MC/392
????/IW		4676 FSL, 969 FEL	G26252/MC/391
????/VX		5714 FNL, 743 FEL	G26254/MC/393
WELL/AC001	G19939/MC/348	1964 FNL, 6118 FWL	G26253/MC/392
WELL/AC001	G26253/MC/392	1964 FNL, 6118 FWL	G26253/MC/392
WELL/AC001ST1	G26253/MC/392	1964 FNL, 6118 FWL	G26253/MC/392
WELL/AC002	G26253/MC/392	1931 FNL, 5922 FWL	G26253/MC/392

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PUBLIC INFORMATION COPY

August 20, 2020

Ms. Michelle Picou, Section Chief
Bureau of Ocean Energy Management
1201 Elmwood Park Boulevard
New Orleans, LA 70123-2394333

SUBJECT: Supplemental Development Operations Coordination Document (DOCD)
OCS-G 30380 (RUE Pending) Mississippi Canyon Block 437 (Host Location)
OCS-G 19939, Mississippi Canyon Block 348
OCS-G 26252, Mississippi Canyon Block 391
OCS-G 26253, Mississippi Canyon Block 392
OCS-G 26254, Mississippi Canyon Block 393
Unit Contract No. 754312009 Appomattox MC 392
Unit Contract No. 754314008 Vicksburg MC 393
Offshore Alabama

Dear Ms. Picou:

In compliance with 30 CFR 550.211 and NTLs 2008-G04, 2009-G27, and 2015-N01, giving DOCD guidelines, Shell Offshore Inc. (Shell) requests your approval of this Supplemental DOCD to produce from or inject into thirteen additional wells from six subsea drill centers tied back to the Appomattox Host Facility. The additional wells are OCS-G 26252, MC 391, AW007, IW001, IW001 Alt, IW005; OCS-G 26253, MC 392, AW007 Alt, AC002, IW004, AE003, AE002, IE002, IE002 Alt; and OCS-G 26254 VX001, VX001 Alt. The wells that start with an "I" are the proposed injection wells. The Initial DOCD for this facility was approved October 6, 2017, Plan Control No. N-9969.

The drilling of the proposed wells was approved in Exploration Plan S-07996 July 31, 2020.

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.

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

Sincerely,

Tracy Albert
Sr. Regulatory Specialist

SHELL OFFSHORE INC.

Supplemenl Development Operations Coordination Document

for

OCS-G 30380 (RUE Pending), Mississippi Canyon Block 437 (Host)
OCS-G 19939, Mississippi Canyon Block 348
OCS-G 26252, Mississippi Canyon Block 391
OCS-G 26253, Mississippi Canyon Block 392
OCS-G 26254, Mississippi Canyon Block 393
Offshore Alabama

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PREPARED BY:

Tracy Albert
Sr. Regulatory Specialist

504.425.4652

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REVISIONS TABLE

Date Requested	Plan Section	What Changed	Date Resubmitted
9/1/2020	Section 1 Section 13	Well AC1 BH Block corrected Adding Host moonpool info	9/2/2020 & 9/3/2020
10/7/2020	Various	Added “RUE Pending for expired lease MC437	10/7/2020
10/27/2020	Provided final copy of plan		

TABLE OF CONTENTS

<u>SECTION 1: PLANS CONTENT</u>

History of Development to Date

The Appomattox host facility is a semi-submersible Floating Production System (FPS) centered in Mississippi Canyon Block 437 with 16 mooring lines. The Appomattox FPS provides processing capabilities, including primary oil and gas separation, oil conditioning, gas compression, produced water treating, and water injection. The Host began producing May 29, 2019.

There is no drilling rig located on the FPS. All wells will be drilled by dynamically positioned drilling rigs (MODUs) and will have subsea wellheads and trees. The subsea wells are proosed to be drilled from four (4) production and two (2) injection drill centers above the Appomattox and Vicksburg reservoir structures located between 3 and 7 miles away from the FPS.

The wells drilled to date in the MC 392 and 393 Units are as follows:

Plan Number	Date Approved	MC 348	MC 391	MC 392	MC 393	DC 353	API Number/Wells Drilled (to date)
S-7761	1/14/2016			✓			OCS-G 26253 AC001 6081741361
S-7761	1/14/2016			✓			OCS-G 26253 AC006 6081741339
S-7761	1/14/2016			✓			OCS-G 26253 AE001 6081741334
S-7761	1/14/2016			✓			OCS-G 26253 AE005 6081741335
S-7761	1/14/2016			✓			OCS-G 26253 AE006 6081741336
S-7761	1/14/2016		✓				OCS-G 26252 AW001 6081741340
S-7761	1/14/2016		✓				OCS-G 26252 AW006 6081741342
S-7761	1/14/2016			✓			OCS-G 26253 IE003 6081741397
S-7761	1/14/2016			✓			OCS-G 26253 IE004 6081741393
S-7761	1/14/2016		✓				OCS-G 26252 IW002 6081741396
S-7761	1/14/2016				✓		OCS-G 26254 VX002 6081741333
S-7761	1/14/2016		✓				OCS-G 26252 AW005 6081741423
S-7761	1/14/2016		✓				OCS-G 26252 IW001 6081741425
S-7761	1/14/2016				✓		OCS-G 26254 VX003 6081741422
S-7761	1/14/2016			✓			OCS-G 26253 AC003 6081741424
S-7761	1/14/2016				✓		OCS-G 26254 VX006 6081741421

Supplemental EP S-7761, approved January 14, 2016, provides for the drilling and completion of 28 subsea wells: 2 exploration, 7 injectors and 19 development wells. To date 16 development wells have been spudded, AC001, AC003, AC006, AE001BP1, AE005, AE006BP1, AW001BP1, AW005, AW006, VX002, VX003, VX006 and 4 injection wells, IE003, IE004, IW001, IW002, were spudded. Three of the wells were lost due to shallow hole problems. Supplemental EP S-7996 was approved July 31, 2020 for thirteen additional back up wells.

This supplemental DOCD is for the thirteen additional well locations (7 producers and 6 injectors). The injection wells (beginning with the letter I) are replacements and backup wells for the two wells that were lost. The wells will be batch set, deepened, completed and suspend under the Exploration Plans. Installation, tie-in to the Appomattox Host, and production/injection of the wells will be covered in this SDOCD. The additional wells are OCS-G 26252, MC 391, AW007, IW001, IW001 Alt, IW005; OCS-G 26253, MC 392, AW007 Alt, AC002, IW004, AE003, AE002, IE002, IE002 Alt; and OCS-G 26254 VX001, VX001 Alt. The wells that start with an "I" are the proposed injection wells.

The subsea architecture consists of wells clustered at individual drill centers. For the production system, subsea manifolds will gather multiphase production from subsea trees via individual jumpers and route these fluids to the FPS via dual, looped flowlines. The flowlines transition to steel catenary risers (SCRs) that carry the fluids up to the FPS. Water injection is routed similarly from the FPS down to wells clustered around subsea injection manifolds. However, each injection drill center is supported by a single flowline and SCR.

The Appomattox and Vicksburg wells feature shut-in pressure conditions at the seafloor of approximately 12 kpsi, and flowing temperatures at the seafloor that may exceed 350°F temperature. Pressure conditions up to 15 kpsi are well-known and currently operated in the Gulf of Mexico with rated and proven equipment and technology. Temperature conditions exceeding 350°F have been operated safely onshore and in shallow offshore environments for years.

The lease area is 72 statute miles from the nearest shoreline, 142 statute miles from the onshore support base at Port Fourchon, Louisiana and 181 statute miles from the helicopter base at Houma, Louisiana. Water depths at the well sites range from 7,081′ to 7,404′ (See Section 14.E).

Shell, through its parent and affiliate corporations, has extensive experience safely developing for oil and gas in the Gulf of Mexico. Shell will draw upon this experience in organizing and carrying out its planned MC 437 development program. Shell believes that the best way to manage blowouts is to prevent them from happening. Significant effort goes into the design and execution of wells and into building and maintaining staff competence. In the unlikely event of a spill, Shell's Regional Oil Spill Response Plan (OSRP) is designed to contain and respond to a spill that meets or exceeds the WCD detailed in Section 9 of this DOCD. The worst case discharge (WCD) does not take into account potential flow mitigating factors such as well bridging, obstructions in wellbore, reservoir barriers, or early intervention. Shell continues to invest in Research and Development (R&D) to improve safety and 6reliability of our well systems. All operations will be conducted in accordance with applicable federal and state laws, regulations, and lease and permit requirements. Shell will have trained personnel and monitoring programs in place to ensure such compliance.

A. & B. Plan Information Forms and Location

- See attached Location plats (SL & BHL)
- See attached Subsea layout drawings
- See attached BOEM 137 Plans Forms

C. SAFETY AND POLLUTION FEATURES

The rig to be used for future well work (Atwood Condor or similar DP semi-submersible or Transocean Deepwater Proteus or similar Drill Ship) 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 following drain items 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 from 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.

A. 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 (or similar) DP Semi-Submersible

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	3597	Marine Diesel (0.91 SG)
Diesel Tank in stbd 2	Drilling Rig	2,713	1	2713	Marine Diesel (0.91 SG)
Diesel Tank in stbd 3	Drilling Rig	3,456	1	3456	Marine Diesel (0.91 SG)
Diesel Tank in stbd 4	Drilling Rig	653	1	653	Marine Diesel (0.91 SG)
Diesel Tank in port 1	Drilling Rig	2,090	1	2090	Marine Diesel (0.91 SG)
Diesel Tank in port 2	Drilling Rig	1,366	1	1366	Marine Diesel (0.91 SG)
Diesel Tank in port 3	Drilling Rig	4,787	1	4787	Marine Diesel (0.91 SG)
Diesel Tank in port 4	Drilling Rig	3,456	1	3456	Marine Diesel (0.91 SG)
Total storage hull tanks	Drilling Rig			22,118	Marine Diesel (0.91 SG)
Diesel Settling Tanks	Drilling Rig	129	3	387	Marine Diesel (0.91 SG)
Diesel Settling Tanks	Drilling Rig	139	1	139	Marine Diesel (0.91 SG)

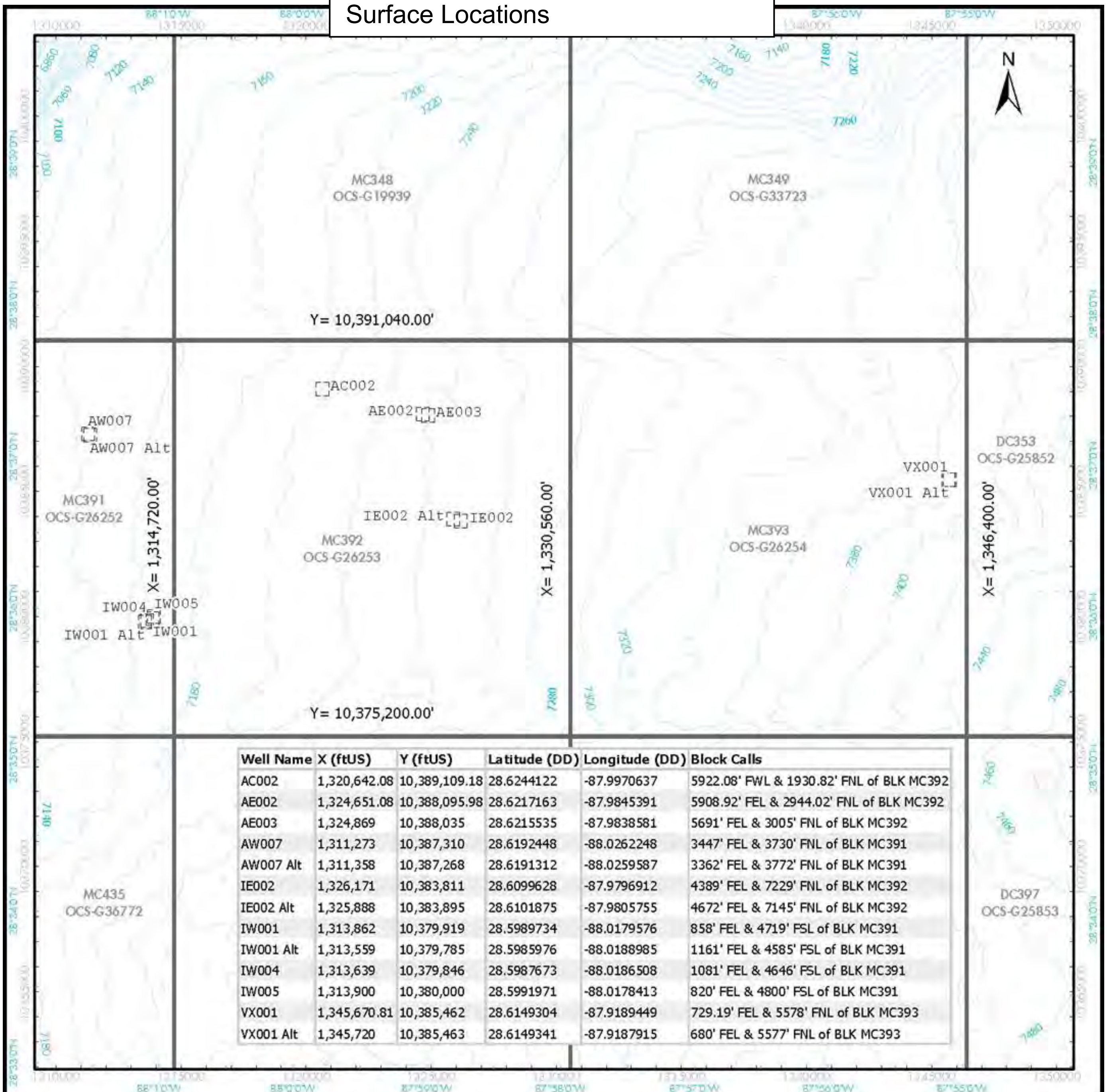
B. Pollution Prevention Measures

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

C. Additional Measures

- HSE (health safety and environment) 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, cleaned and confirmation of plugs installed prior to leaving dock and prior to loading on the boat.
- Preventive maintenance of rig equipment includes visual inspection of hydraulic lines and reservoirs on 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 in for recycling.
- Every drain on the rig is assigned a number. The number is logged when plug is removed and replaced.
- All trash containers are checked and emptied daily. The trash containers are kept covered. Trash is disposed of in a compactor and shipped in via boat.
- Fuel hoses and SBM are changed on annual basis.
- TODO or (KLAW) spill prevention fittings are installed on all liquid take on hoses.
- Waste paint thinner is collected and sent ashore for disposal.
- Shell has obtained ISO14001 certification.
- Shell uses low sulfur fuel.

Attachment 1A – Bathymetry and Surface Locations



Well Name	X (ftUS)	Y (ftUS)	Latitude (DD)	Longitude (DD)	Block Calls
AC002	1,320,642.08	10,389,109.18	28.6244122	-87.9970637	5922.08' FWL & 1930.82' FNL of BLK MC392
AE002	1,324,651.08	10,388,095.98	28.6217163	-87.9845391	5908.92' FEL & 2944.02' FNL of BLK MC392
AE003	1,324,869	10,388,035	28.6215535	-87.9838581	5691' FEL & 3005' FNL of BLK MC392
AW007	1,311,273	10,387,310	28.6192448	-88.0262248	3447' FEL & 3730' FNL of BLK MC391
AW007 Alt	1,311,358	10,387,268	28.6191312	-88.0259587	3362' FEL & 3772' FNL of BLK MC391
IE002	1,326,171	10,383,811	28.6099628	-87.9796912	4389' FEL & 7229' FNL of BLK MC392
IE002 Alt	1,325,888	10,383,895	28.6101875	-87.9805755	4672' FEL & 7145' FNL of BLK MC392
IW001	1,313,862	10,379,919	28.5989734	-88.0179576	858' FEL & 4719' FSL of BLK MC391
IW001 Alt	1,313,559	10,379,785	28.5985976	-88.0188985	1161' FEL & 4585' FSL of BLK MC391
IW004	1,313,639	10,379,846	28.5987673	-88.0186508	1081' FEL & 4646' FSL of BLK MC391
IW005	1,313,900	10,380,000	28.5991971	-88.0178413	820' FEL & 4800' FSL of BLK MC391
VX001	1,345,670.81	10,385,462	28.6149304	-87.9189449	729.19' FEL & 5578' FNL of BLK MC393
VX001 Alt	1,345,720	10,385,463	28.6149341	-87.9187915	680' FEL & 5577' FNL of BLK MC393

MAP INFORMATION

- Proposed Surface Locations
- Structure Depth Contour (ft)
- Lease Block

MAP SCALE

0 1,000 2,000 4,000
Feet

1:65,000
Print size: 8.5"x11" (ANSI A)

SHELL EXPLORATION & PRODUCTION COMPANY

ATTACHMENT

Mississippi Canyon Area
Offshore Alabama

Proposed Surface Locations Exploration Plan

GEODETIC PARAMETERS

Horizontal Coordinate Reference System
CRS name (ESRI): NAD 1927 BLM Zone 16N
CRS name (Shell): NAD27 / UTM zone 16N (ftUS) [1241_32066]
CRS code (EPSG): 32066
Geodetic datum: North American 1927
Projection name: Transverse Mercator
Horizontal units: Foot US

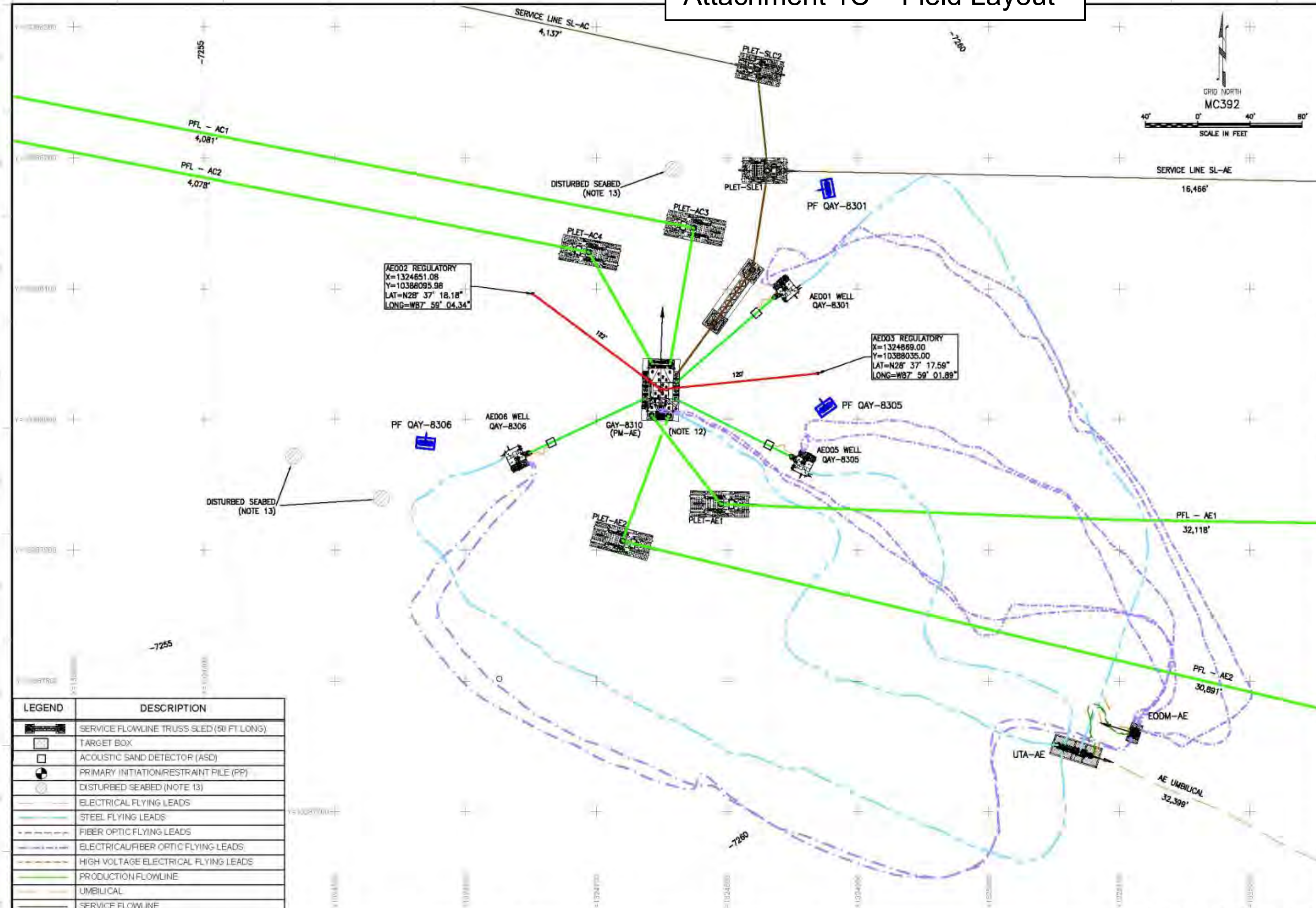
Author: G. Cai	Date: 14 Jan 2020
Reviewed By: S. W. Bridges	EP Catalog No.: EP201912200644

Document Path: G:\30_Project\United_States\GOM_PROD\Projects\Exploration Plan Map.aprx

Attachment 1B – BHL Plat

Omitted from PI Copies

Attachment 1C – Field Layout



LEGEND	DESCRIPTION
	SERVICE FLOWLINE TRUSS SLED (50 FT LONG)
	TARGET BOX
	ACOUSTIC SAND DETECTOR (ASD)
	PRIMARY INITIATION/RESTRAINT PILE (PP)
	DISTURBED SEABED (NOTE 13)
	ELECTRICAL FLYING LEADS
	STEEL FLYING LEADS
	FIBER OPTIC FLYING LEADS
	ELECTRICAL/FIBER OPTIC FLYING LEADS
	HIGH VOLTAGE ELECTRICAL FLYING LEADS
	PRODUCTION FLOWLINE
	UMBILICAL
	SERVICE FLOWLINE

FLYING LEAD INFORMATION

Item	Length	Status	Item	Length	Status
QAY-8301-SFL	560'	AB	QAY-8306-SFL	720'	AB
QAY-8301-EOFL-A	700'	AB	QAY-8306-EOFL-A	900'	AB
QAY-8301-EOFL-B	700'	AB	QAY-8306-EOFL-B	900'	AB
QAY-8302-SFL	905'		AE-UTH-EODM-OFL-FO1B	100'	AB
QAY-8302-EOFL-A	1076'		AE-UTH-EODM-OFL-FO2B	100'	AB
QAY-8302-EOFL-B	1076'		AE-UTH-EODM-EFL-Q1	100'	AB
QAY-8303-SFL	414'		AE-UTH-EODM-EFL-Q2	100'	AB
QAY-8303-EOFL-A	470'		GAY-8310-SFL	480'	AB
QAY-8303-EOFL-B	477'		GAY-8310-EOFL-A	550'	AB
QAY-8304-SFL	864'		GAY-8310-EOFL-B	550'	AB
QAY-8304-EOFL-A	975'				
QAY-8304-EOFL-B	974'				
QAY-8305-SFL	380'	AB			
QAY-8305-EOFL-A	450'	AB			
QAY-8305-EOFL-B	450'	AB			

FUTURE

WELL COORDINATE SUMMARY **(NOTE 10)**

Item	Easting	Northing	Latitude	Longitude	Depth	Heading	Status
QAY-8301	1324844.18	10388099.90	N28° 37' 18.23"	W87° 59' 02.17"	-7260.26	230.7°	AB
QAY-8302	1324651.08	10388095.98	N28° 37' 18.18"	W87° 59' 04.34"	-7257.89	130.45°	P
QAY-8303	1324869.27	10388035.46	N28° 37' 17.60"	W87° 59' 01.89"	-7260.54	266.97°	P
QAY-8304	1324628.63	10388034.59	N28° 37' 17.57"	W87° 59' 04.59"	-7257.61	86.08°	P
QAY-8305	1324858.23	10387966.88	N28° 37' 16.92"	W87° 59' 02.00"	-7260.38	298.50°	AB
QAY-8306	1324639.27	10387969.91	N28° 37' 16.93"	W87° 59' 04.46"	-7257.69	61.70°	AB

SUBSEA EQUIPMENT SUMMARY

Item	Easting	Northing	Latitude	Longitude	Depth	Heading	Status
AE-TJ-N	1324819.22	10388114.15	N28° 37' 18.37"	W87° 59' 02.46"	-7259.96	216.39°	AB
AE-TJ-S	1324790.07	10388073.52	N28° 37' 17.97"	W87° 59' 02.78"	-7259.58	216.39°	AB
CP-AE1	1324418.13	10387940.40	N28° 37' 16.62"	W87° 59' 06.94"	-7255.05		
CP-AE2	1324412.12	10387983.84	N28° 37' 17.05"	W87° 59' 07.04	-7255.03		
CP-SL-AE	1324697.26	10388192.15	N28° 37' 19.13"	W87° 59' 03.65"	-7258.50		
EODM-AE	1325111.50	10387760.09	N28° 37' 14.89"	W87° 58' 59.14"	-7262.36	286.95°	AB
GAY-8310	1324749.14	10388022.54	N28° 37' 17.46"	W87° 59' 03.23"	-7259.06	001.3°	AB
GAY-8310 PILE	1324749.13	10388022.07	N28° 37' 17.45"	W87° 59' 03.23"	-7259.06		AB
PF QAY-8301	1324876.98	10388176.50	N28° 37' 18.99"	W87° 59' 01.81"	-7260.05	259.29°	AB
PF QAY-8305	1324875.49	10388009.07	N28° 37' 17.34"	W87° 59' 01.81"	-7260.61	324.62°	AB
PF QAY-8306	1324569.23	10387981.73	N28° 37' 17.04"	W87° 59' 05.25"	-7256.88	5.89°	AB
PLET-AC3	1324774.61	10388146.36	N28° 37' 18.69"	W87° 59' 02.96"	-7259.42	281.12°	AB
PLET-AC4	1324694.26	10388127.75	N28° 37' 18.50"	W87° 59' 03.86"	-7258.43	281.01°	AB
PLET-AE1	1324794.95	10387935.24	N28° 37' 16.60"	W87° 59' 02.71"	-7259.59	91.14°	AB
PLET-AE2	1324719.83	10387907.03	N28° 37' 16.31"	W87° 59' 03.55"	-7258.66	104.36°	AB
PLET-SLC2	1324822.76	10388267.71	N28° 37' 19.89"	W87° 59' 02.43"	-7259.54	282.29°	AB
PLET-SLE1 (CTR)	1324830.76	10388190.15	N28° 37' 19.13"	W87° 59' 02.33"	-7259.88	90.88°	AB
PLET-SLE1 (STEM)	1324842.43	10388189.97	N28° 37' 19.13"	W87° 59' 02.20"	-7259.91	90.88°	AB
PP-AE1	1324535.45	10387938.60	N28° 37' 16.62"	W87° 59' 05.62"	-7256.46		
PP-AE2	1324458.30	10387971.70	N28° 37' 16.93"	W87° 59' 06.38	-7255.69		
PP-SL-AE	1324758.32	10388191.27	N28° 37' 19.13"	W87° 59' 03.15"	-7259.24		
UTA-AE	1325072.00	10387744.79	N28° 37' 14.74"	W87° 58' 59.56"	-7262.32	107.3°	AB

AB	AS-BUILT
P	PROPOSED

REFERENCE EVERGREEN DRAWING:
APX-500-UA-4182-2501001-001, REV. 01Z

NOTES:

1. DRILL CENTER LOCATION CENTERED ON PRODUCTION MANIFOLD.
2. DELETED
3. PRODUCTION MANIFOLD SITS ON SUCTION ANCHOR FOUNDATION.
4. DELETED
5. FLYING LEAD LENGTHS SHOWN ARE MANUFACTURED LENGTHS. ROUTES DRAWN REFLECT THE ACTUAL LENGTHS.
6. EXCEPT WHERE NOTED, EFLs, OFLs AND EOFLs ARE INSTALLED OVER SFLs.
7. DELETED
8. CONNECTOR ORIENTATIONS ARE NOTIONAL. DETAILS ARE IN JUMPER SPECIFIC GA's.
9. DELETED
10. THS HEADINGS ARE THE SAME AS THE WELL HEADINGS.
11. DELETED
12. FLOWLINE JUMPER TO PLET-AE1 IS ON TOP.
13. DISTURBED SEABED FROM 13' DIAMETER, 60' PENETRATION TEMPORARY INITIATION/RESTRAINT PILE.

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

UMBILICAL STRUCTURE INSTALLATION:

POSITION REFERENCE FOR EODM, PF, AND LTDF: GEOMETRICAL CENTER OF MUDMAT
POSITION REFERENCE FOR UTA MUDMAT: GEOMETRICAL CENTER OF UTH FUNNEL
HEADING REFERENCE FOR EODM, PF, AND LTDF: BLACK LINE ON MUDMAT POINTS AWAY FROM STRUCTURE CENTER ON DEFINED HEADING
HEADING REFERENCE FOR UTA MUDMAT: ARROW ON MUDMAT POINTS TOWARDS UMBILICAL ON DEFINED HEADING

REV	DATE	DESCRIPTION	DRAWN	CHK or TECH REP	DES ENG.	PROJ ENG.
A	2020-05-14	ISSUED FOR INTERNAL REVIEW	MGS	JD	JD	JD

SIEP Projects & Technology
Upstream Major Projects - Americas

APPO EAST (AE) DRILL CENTER
SUBSEA LAYOUT

APPOMATTOX
MC392

DRG No. APX-503-UA-4182-2501101-001 REV. A

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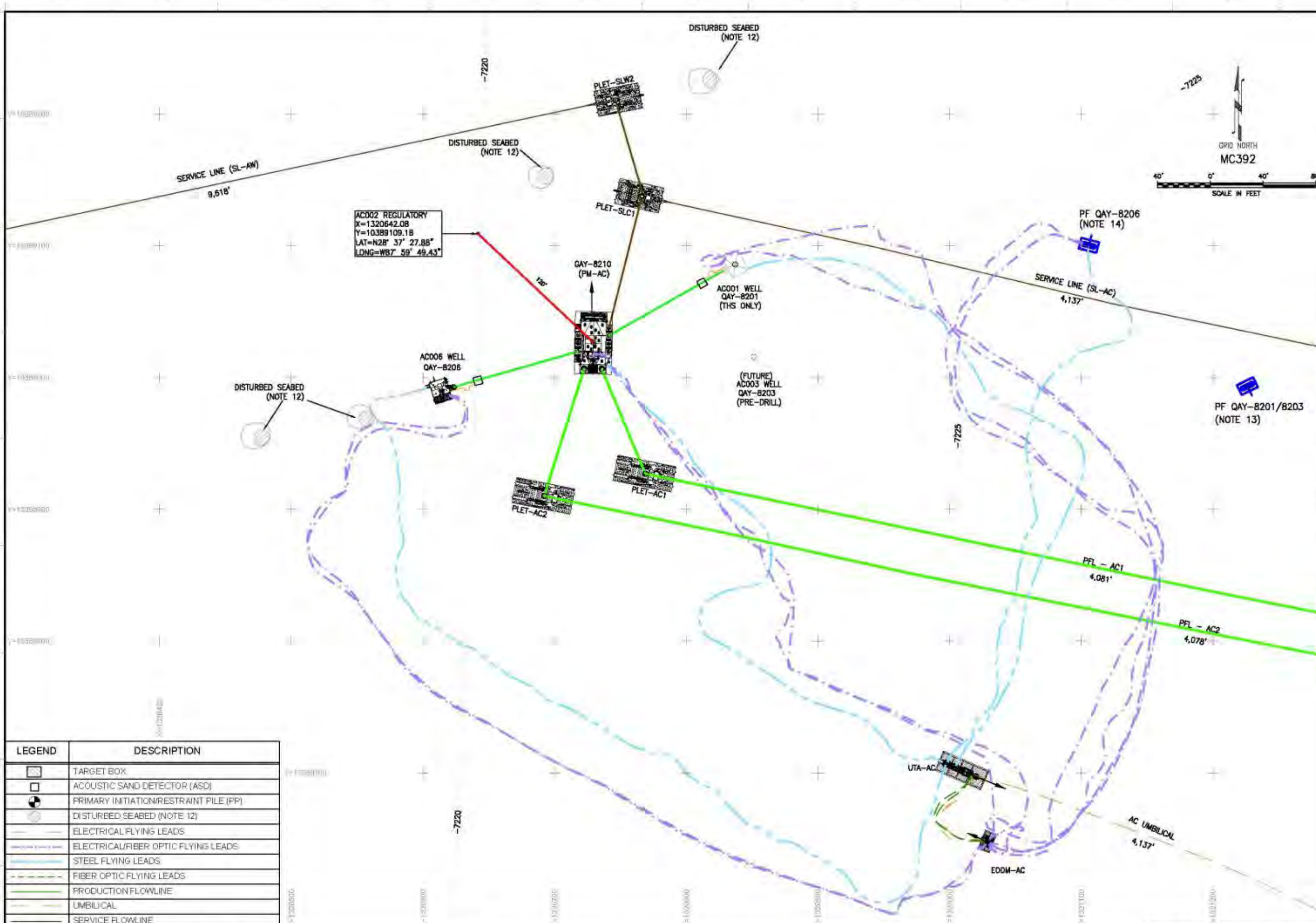
Attachment 1D – AC Drill Center



LEGEND	DESCRIPTION
	TARGET BOX
	ACOUSTIC SAND DETECTOR (ASD)
	PRIMARY INITIATION/RESTRAINT PILE (PP)
	DISTURBED SEABED (NOTE 12)
	ELECTRICAL FLYING LEADS
	ELECTRICAL/FIBER OPTIC FLYING LEADS
	STEEL FLYING LEADS
	FIBER OPTIC FLYING LEADS
	PRODUCTION FLOWLINE
	UMBILICAL
	SERVICE FLOWLINE

FLYING LEAD INFORMATION

Item	Length	Status	Item	Length	Status
QAY-8201-SFL	580'	AB	QAY-8205-EOFL-A	564'	
QAY-8201-EOFL-A	800'	AB	QAY-8205-EOFL-B	564'	
QAY-8201-EOFL-B	800'	AB	QAY-8206-SFL	760'	AB
QAY-8202-SFL	960'	P	QAY-8206-EOFL-A	850'	AB
QAY-8202-EOFL-A	1000'	P	QAY-8206-EOFL-B	850'	AB
QAY-8202-EOFL-B	1000'	P	AC-UTH-EODM-EFL-01	100'	AB
QAY-8203-SFL	460'	AB	AC-UTH-EODM-EFL-02	100'	AB
QAY-8203-EOFL-A	700'	AB	AC-UTH-EODM-OFL-FO1B	100'	AB
QAY-8203-EOFL-B	700'	AB	AC-UTH-EODM-OFL-FO2B	100'	AB
QAY-8204-SFL	864'		GAY-8210-SFL	500'	AB
QAY-8204-EOFL-A	890'		GAY-8210-EOFL-A	600'	AB
QAY-8204-EOFL-B	890'		GAY-8210-EOFL-B	600'	AB
QAY-8205-SFL	344'				

FUTURE

WELL COORDINATE SUMMARY (NOTE 10)

Item	Easting	Northing	Latitude	Longitude	Depth	Heading	Status
QAY-8201	1320837.23	10389085.87	N28° 37' 27.67"	W87° 59' 47.24"	-7222.65	241.50°	AB
QAY-8202	1320642.08	10389109.18	N28° 37' 27.88"	W87° 59' 49.43"	-7219.97	148.12°	P
QAY-8203	1320851.53	10389015.71	N28° 37' 26.96"	W87° 59' 47.07"	-7222.87	275.13°	P
QAY-8204	1320613.49	10389053.29	N28° 37' 27.33"	W87° 59' 49.74"	-7219.62	109.42°	P
QAY-8205	1320825.91	10388948.88	N28° 37' 26.31"	W87° 59' 47.35"	-7222.54	314.76°	P
QAY-8206	1320614.19	10388989.92	N28° 37' 26.70"	W87° 59' 49.73"	-7219.66	72.68°	AB

SUBSEA EQUIPMENT SUMMARY

Item	Easting	Northing	Latitude	Longitude	Depth	Heading	Status
EODM-AC	1321026.80	10388648.03	N28° 37' 23.35"	W87° 59' 45.05"	-7225.27	291.99°	AB
GAY-8210	1320729.71	10389026.28	N28° 37' 27.07"	W87° 59' 48.44"	-7221.20	001°	AB
GAY-8210 PILE	1320729.70	10389025.81	N28° 37' 27.07"	W87° 59' 48.44"	-7221.20		AB
PF QAY-8201/8203	1321226.30	10388993.55	N28° 37' 26.79"	W87° 59' 42.86"	-7226.74	154°	AB
PF QAY-8206	1321105.95	10389100.39	N28° 37' 27.84"	W87° 59' 44.22"	-7225.80	14°	AB
PLET-AC1	1320769.21	10388927.03	N28° 37' 26.09"	W87° 59' 47.99"	-7221.77	101.15°	AB
PLET-AC2	1320692.37	10388910.12	N28° 37' 25.92"	W87° 59' 48.85"	-7220.73	101.26°	AB
PLET-SLC1 (CTR)	1320766.50	10389137.54	N28° 37' 28.18"	W87° 59' 48.04"	-7221.66	102.19°	AB
PLET-SLC1 (STEM)	1320777.85	10389135.10	N28° 37' 28.15"	W87° 59' 47.91"	-7221.82	102.19°	AB
PLET-SLW2	1320746.43	10389210.52	N28° 37' 28.90"	W87° 59' 48.27"	-7221.37	259.17°	AB
UTA-AC	1321014.59	10388699.74	N28° 37' 23.86"	W87° 59' 45.21"	-7225.07	113.57°	AB

AB	AS-BUILT
P	PROPOSED

NOTES:
1. DRILL CENTER LOCATION CENTERED ON PRODUCTION MANIFOLD.
2. PRODUCTION MANIFOLD SITS ON SUCTION ANCHOR FOUNDATION.
3. DELETED
4. DELETED
5. FLYING LEAD LENGTHS SHOWN ARE MANUFACTURED LENGTHS. ROUTES DRAWN REFLECT THE ACTUAL LENGTHS.
6. EXCEPT WHERE NOTED, EFLs, OFLs AND EOFLs ARE INSTALLED OVER SFLs.
7. DELETED
8. CONNECTOR ORIENTATIONS ARE NOTIONAL. DETAILS ARE IN JUMPER SPECIFIC GA's.
9. DELETED
10. THS HEADINGS ARE THE SAME AS THE WELL HEADINGS.
11. DELETED
12. DISTURBED SEABED FROM 13' DIAMETER, 60' PENETRATION TEMPORARY INITIATION/RESTRAINT PILE.
13. SAFETY INFO - REMOVE LOOSE SADDLE, NET 25kg, THAT IS ON TOP OF PF BEFORE RECOVERY.
14. FLYING LEADS DESIGNATED FOR AC003 WELL (QAY-8203) ARE PARKED ON PF QAY-8206.

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

UMBILICAL STRUCTURE INSTALLATION:

POSITION REFERENCE FOR EODM, PF, AND LTDF: GEOMETRICAL CENTER OF MUDMAT
POSITION REFERENCE FOR UTA MUDMAT: GEOMETRICAL CENTER OF UTH FUNNEL
HEADING REFERENCE FOR EODM, PF, AND LTDF: BLACK LINE ON MUDMAT POINTS AWAY FROM STRUCTURE CENTER ON DEFINED HEADING
HEADING REFERENCE FOR UTA MUDMAT: ARROW ON MUDMAT POINTS TOWARDS UMBILICAL ON DEFINED HEADING

REV	DATE	DESCRIPTION	DRAWN	CHK or TECH REP	DES ENG.	PROJ ENG.
A	2020-05-14	ISSUED FOR INTERNAL REVIEW	MGS	JD	JD	JD

SIEP Projects & Technology
Upstream Major Projects - Americas

APPO CENTRAL (AC) DRILL CENTER
SUBSEA LAYOUT

APPOMATTOX
MC392

DRG No. APX-503-UA-4182-2501102-001 REV. A

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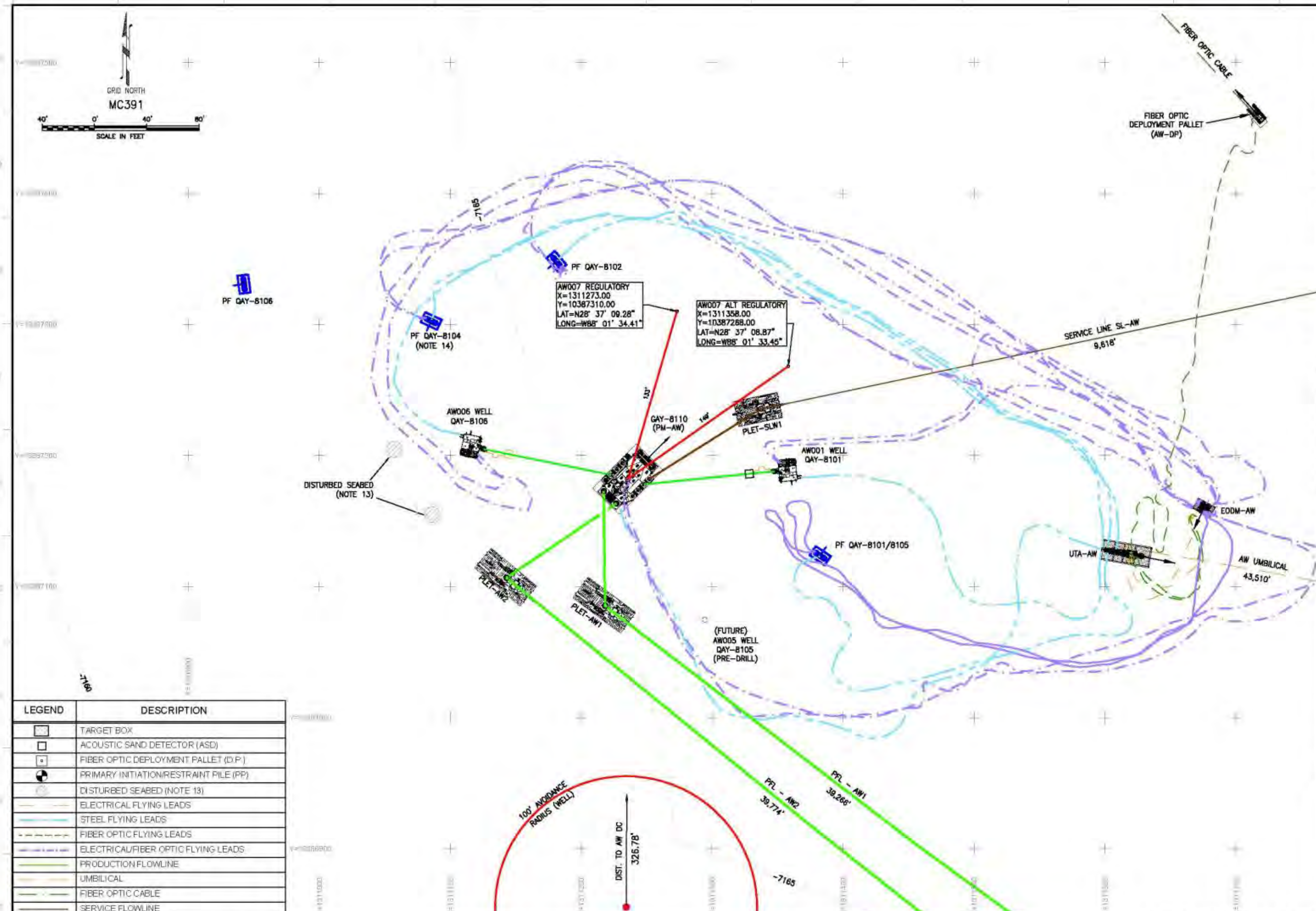
Attachment 1E – AW Drill Center



LEGEND	DESCRIPTION
	TARGET BOX
	ACOUSTIC SAND DETECTOR (ASD)
	FIBER OPTIC DEPLOYMENT PALLET (D.P.)
	PRIMARY INITIATION/RESTRAINT PILE (PP)
	DISTURBED SEABED (NOTE 13)
	ELECTRICAL FLYING LEADS
	STEEL FLYING LEADS
	FIBER OPTIC FLYING LEADS
	ELECTRICAL/FIBER OPTIC FLYING LEADS
	PRODUCTION FLOWLINE
	UMBILICAL
	FIBER OPTIC CABLE
	SERVICE FLOWLINE

FLYING LEAD INFORMATION

Item	Length	Status	Item	Length	Status
QAY-8101-SFL	360'	AB	QAY-8106-SFL	800'	AB
QAY-8101-EOFL-A	500'	AB	QAY-8106-EOFL-A	1000'	AB
QAY-8101-EOFL-B	500'	AB	QAY-8106-EOFL-B	1000'	AB
QAY-8102-SFL	560'	AB	AW-UTH-EODM-OFL-FO1B	150'	AB
QAY-8102-EOFL-A	700'	AB	AW-UTH-EODM-OFL-FO2B	150'	AB
QAY-8102-EOFL-B	700'	AB	AW-UTH-EODM-EFL-Q1	150'	AB
QAY-8103-SFL	321'	FUTURE	AW-UTH-EODM-EFL-Q2	150'	AB
QAY-8103-EOFL-A	522'		GAY-8110-SFL	580'	AB
QAY-8103-EOFL-B	522'		GAY-8110-EOFL-A	800'	AB
QAY-8104-SFL	700'	AB	GAY-8110-EOFL-B	800'	AB
QAY-8104-EOFL-A	850'	AB	AW-UTH-DP-OFL-FO1A	500'	AB
QAY-8104-EOFL-B	850'	AB			
QAY-8105-SFL	440'	AB			
QAY-8105-EOFL-A	550'	AB			
QAY-8105-EOFL-B	550'	AB			

WELL COORDINATE SUMMARY (NOTE 10)

Item	Easting	Northing	Latitude	Longitude	Depth	Heading	Status
QAY-8101	1311357.16	10387188.87	N28° 37' 08.09"	W88° 01' 33.45"	-7166.55	264.25°	AB
QAY-8102	1311231.96	10387303.70	N28° 37' 09.22"	W88° 01' 34.67"	-7165.78	185.75°	P
QAY-8103	1311341.58	10387124.01	N28° 37' 07.45"	W88° 01' 33.62"	-7166.19	303.85°	P
QAY-8104	1311158.20	10387274.58	N28° 37' 08.92"	W88° 01' 35.69"	-7165.00	136.86°	P
QAY-8105	1311294.36	10387074.56	N28° 37' 06.95"	W88° 01' 34.15"	-7165.58	329.83°	P
QAY-8106	1311116.15	10387206.90	N28° 37' 08.25"	W88° 01' 36.16"	-7164.32	91.38°	AB

SUBSEA EQUIPMENT SUMMARY

Item	Easting	Northing	Latitude	Longitude	Depth	Heading	Status
ALM-AW	1311019.56	10387092.60	N28° 37' 07.11"	W88° 01' 37.23"	-7162.73		
AW-DP	1311715.13	10387461.48	N28° 37' 10.82"	W88° 01' 29.46"	-7168.84	318°	AB
EODM-AW	1311675.63	10387160.04	N28° 37' 07.83"	W88° 01' 29.88"	-7168.69	208.43°	AB
GAY-8110	1311235.62	10387181.94	N28° 37' 08.01"	W88° 01' 34.82"	-7165.40	44.4°	AB
GAY-8110 PILE	1311235.29	10387181.60	N28° 37' 08.01"	W88° 01' 34.82"	-7165.40	318°	AB
PF QAY-8101/8105	1311382.45	10387123.48	N28° 37' 07.44"	W88° 01' 33.16"	-7166.60	33.89°	AB
PF QAY-8102	1311181.13	10387348.07	N28° 37' 09.65"	W88° 01' 35.44"	-7165.46	229.89°	AB
PF QAY-8104	1311085.44	10387302.64	N28° 37' 09.19"	W88° 01' 36.51"	-7164.27	204.91°	AB
PF QAY-8106	1310942.51	10387330.74	N28° 37' 09.46"	W88° 01' 38.12"	-7162.58	262.89°	AB
PLET-AW1	1311219.22	10387085.32	N28° 37' 07.05"	W88° 01' 35.00"	-7164.92	126.41°	AB
PLET-AW2	1311142.94	10387106.68	N28° 37' 07.26"	W88° 01' 35.85"	-7164.30	130.0°	AB
PLET-SLW1	1311337.04	10387235.50	N28° 37' 08.55"	W88° 01' 33.68"	-3.12	78.42°	AB
UTA-AW	1311616.19	10387125.17	N28° 37' 07.48"	W88° 01' 30.54"	-7168.29	99.72°	AB
UTA-AW-ALM	1311571.81	10386991.81	N28° 37' 06.16"	W88° 01' 31.03"	-7167.84		

AB	AS-BUILT
P	PROPOSED

NOTES:
1. DRILL CENTER LOCATION CENTERED ON PRODUCTION MANIFOLD
2. DELETED
3. PRODUCTION MANIFOLD SITS ON SUCTION ANCHOR FOUNDATION
4. DELETED
5. FLYING LEAD LENGTHS SHOWN ARE MANUFACTURED LENGTHS. ROUTES DRAWN REFLECT THE ACTUAL LENGTHS.
6. EXCEPT WHERE NOTED, EFLs, OFLs AND EOFLs ARE INSTALLED OVER SFLs.
7. DELETED
8. CONNECTOR ORIENTATIONS ARE NOTIONAL. DETAILS ARE IN JUMPER SPECIFIC GA's.
9. DELETED
10. THS HEADINGS ARE THE SAME AS THE WELL HEADINGS.
11. DELETED
12. FLOWLINE JUMPER TO PLET-AW1 IS ON TOP.
13. DISTURBED SEABED FROM 13' DIAMETER, 60' PENETRATION TEMPORARY INITIATION/RESTRAINT PILE.
14. SAFETY INFO - REMOVE LOOSE SADDLE, NET 25kg, THAT IS ON TOP OF PF BEFORE RECOVERY.

GEODETIC PARAMETERS

HORIZONTAL COORDINATE REFERENCE SYSTEM

CRS Name (EPSG):	NAD27/ BLM 16N (ftUS)
Alias:	NAD27/ U TM 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

UMBILICAL STRUCTURE INSTALLATION:

POSITION REFERENCE FOR EODM, DP, PF, AND LTDF: GEOMETRICAL CENTER OF MUDMAT
POSITION REFERENCE FOR UTA MUDMAT: GEOMETRICAL CENTER OF UTH FUNNEL
HEADING REFERENCE FOR EODM, PF, AND LTDF: BLACK LINE ON MUDMAT POINTS AWAY FROM STRUCTURE CENTER ON DEFINED HEADING
HEADING REFERENCE FOR UTA MUDMAT: ARROW ON MUDMAT POINTS TOWARDS UMBILICAL ON DEFINED HEADING
HEADING REFERENCE FOR DP: LONGITUDINAL LINE OF OPTICAL BODY TOWARDS CABLE

REV	DATE	DESCRIPTION	DRAWN	CHK or TECH REP	DES ENG.	PROJ ENG.
A	2020-05-14	ISSUED FOR INTERNAL REVIEW	MGS	JD	JD	JD

SIEP Projects & Technology
Upstream Major Projects - Americas

APPO WEST (AW) DRILL CENTER
SUBSEA LAYOUT

APPOMATTOX
MC391

DRG. No. APX-503-UA-4182-2501103-001
REV. A

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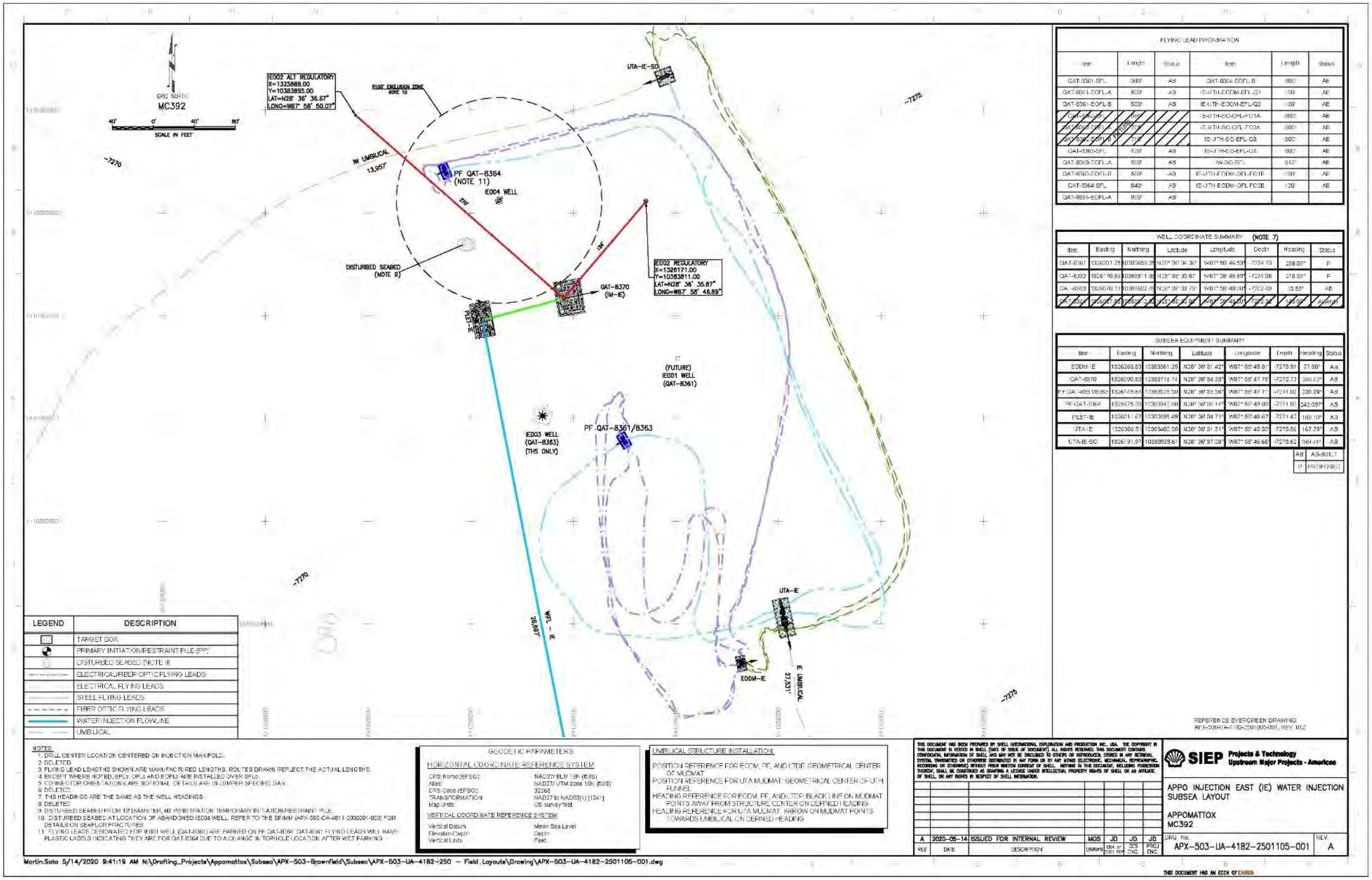
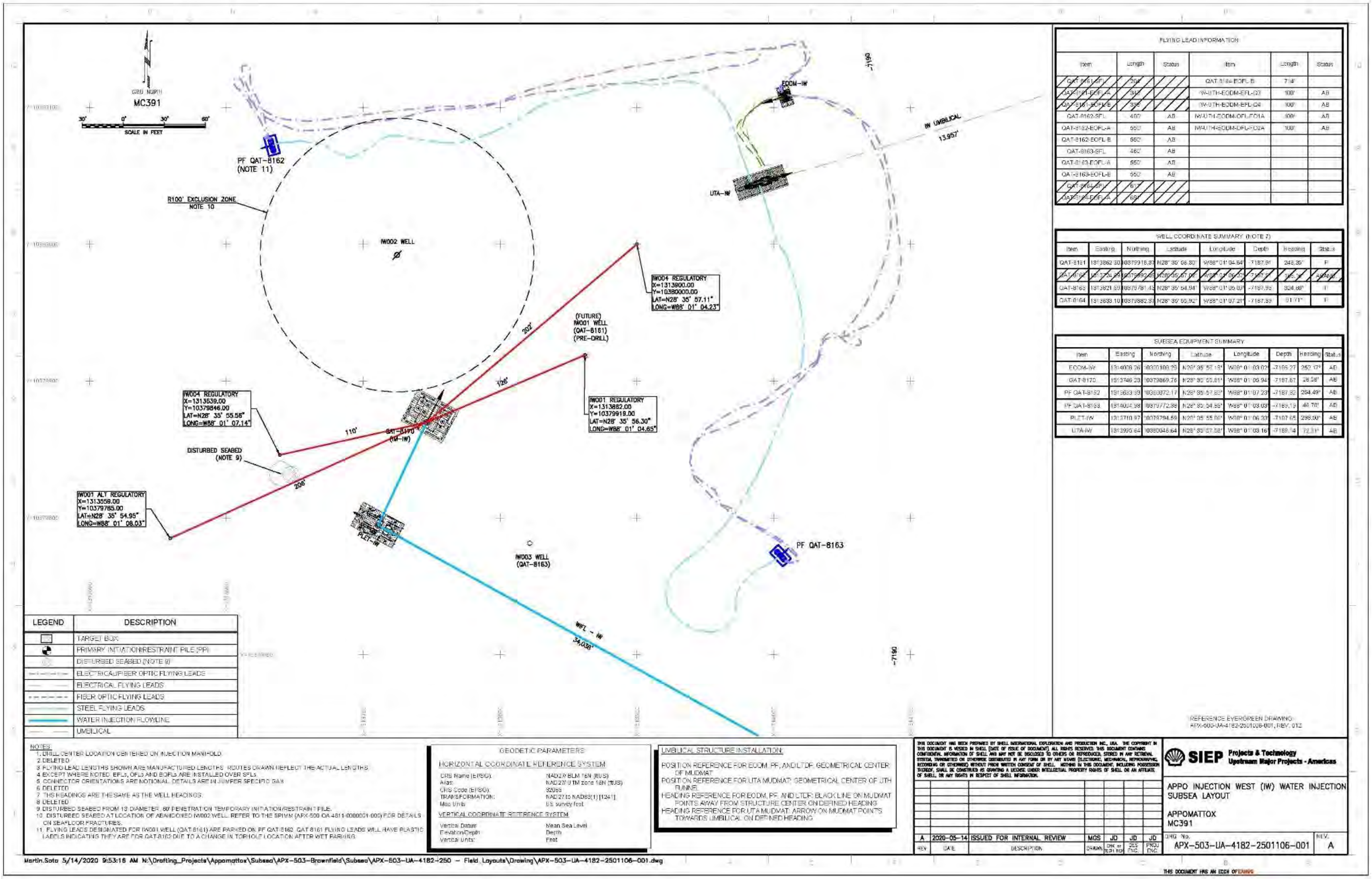
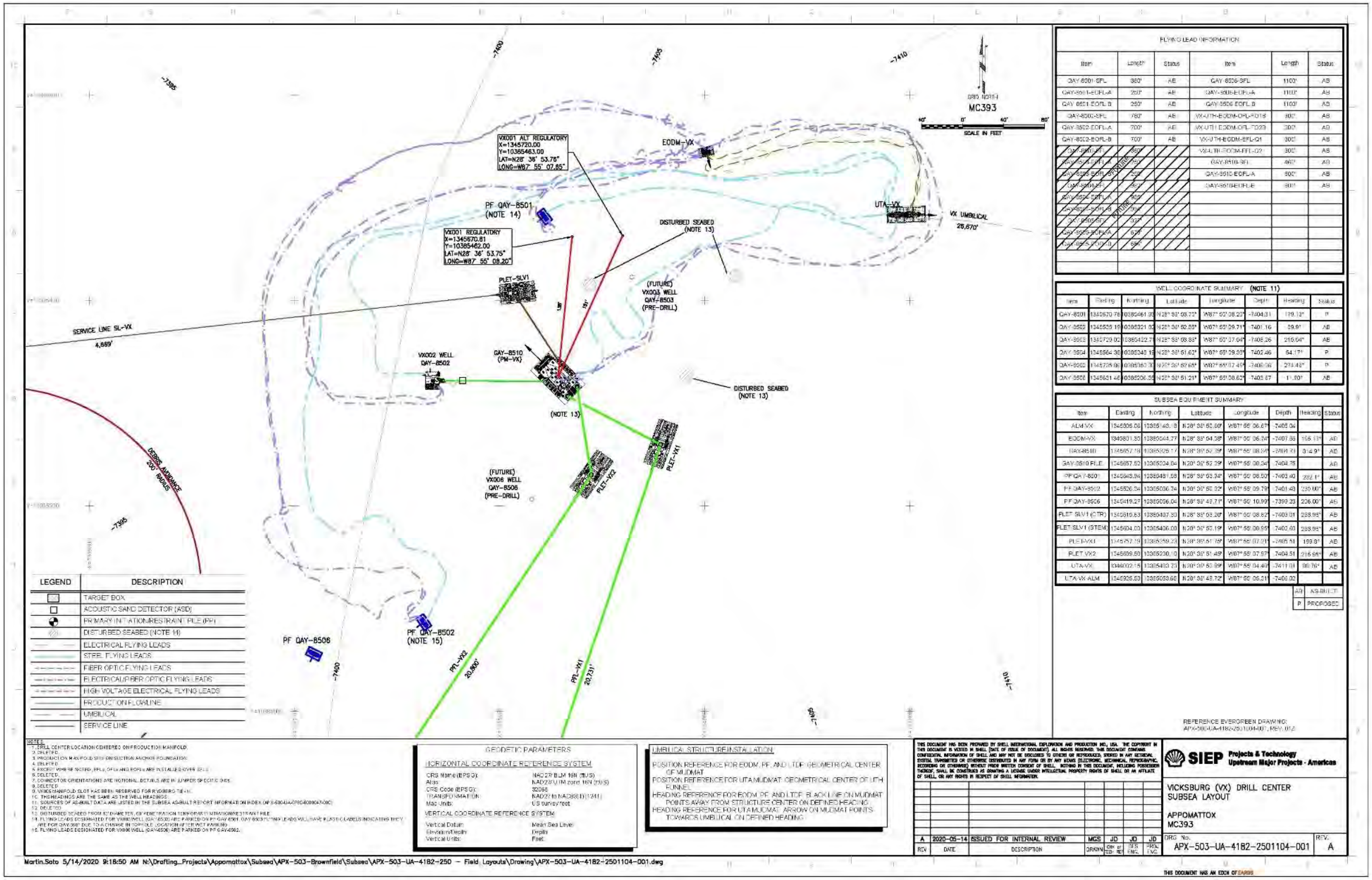
Attachment 1F – IE Drill Center



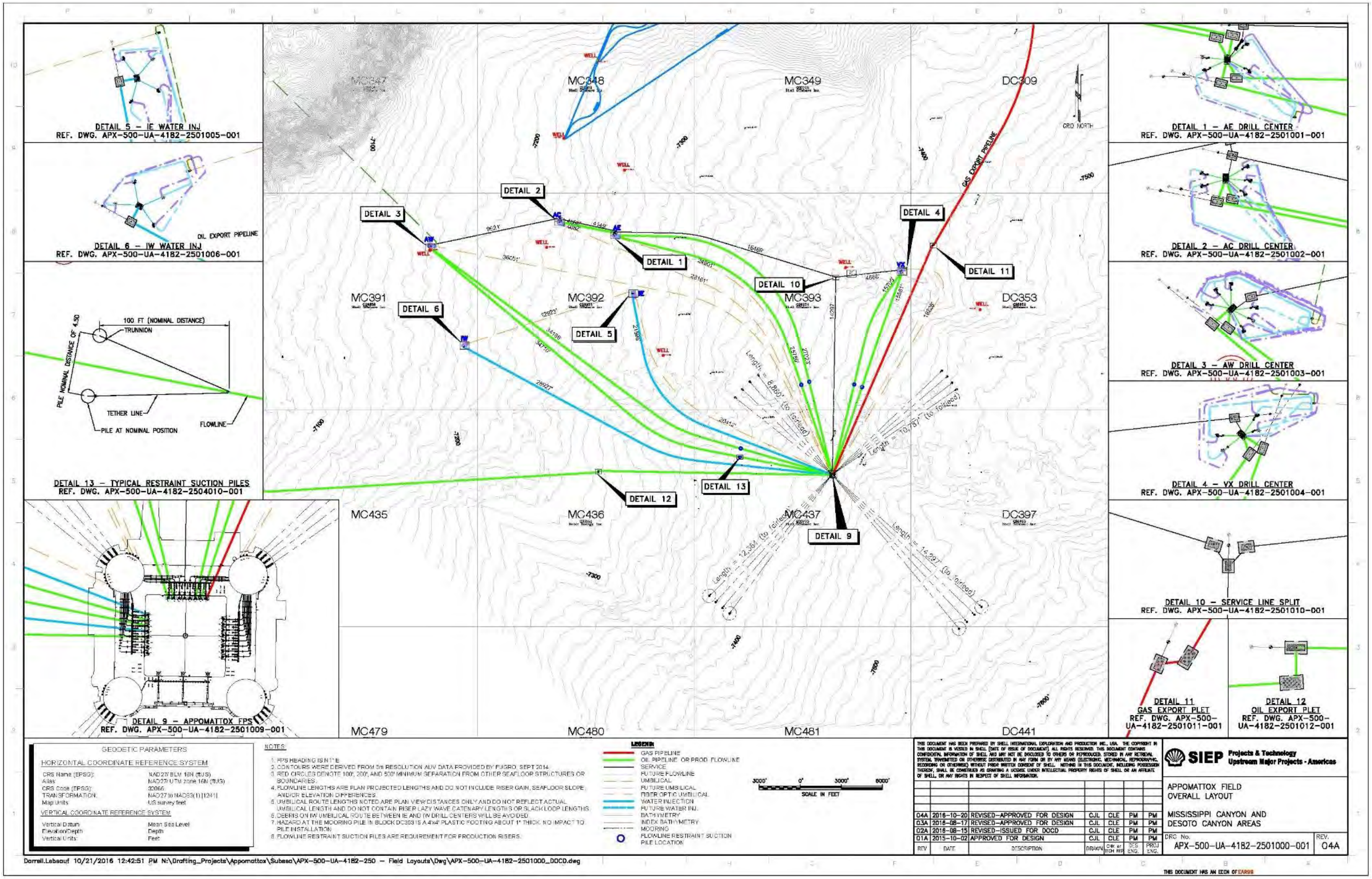
Attachment 1G - IW Drill Center



Attachment 1H – VX Drill Center



Attachment 1I – Overall Field Layout



Department of the Interior	OMB Control Number: 1010-0151
Bureau of Ocean Energy Management	OMB Approval Expires: 12/31/14

OCS PLAN INFORMATION FORM 1J

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: Sylvia Bellone/Tracy Albert
New Orleans, LA 70131	Phone Number: 504.425.7215/504.425.4652
	Email Address: Sylvia.bellone@shell.com & tracy.albert@shell.com

If a service fee is required under 30 CFR 550.125(a) provide:	Amount Paid: $ 55,094	Receipt Nos. 26PNLM94, 26PNPS7U, 26PNU6SO

Project and Worst Case Discharge (WCD) Information

Lease(s): OCS-G 26252	Area: MC	Block(s): 391	Project Name: Appomattox

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

Platform/Well Name: C	Total Volume of WCD: 416,414	API Gravity: 37.5

Distance to Closest Land (Miles): 72 (WCD)	Volume from uncontrolled blowout: 44 MMBO

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	EP S-07444			
Do you propose to use new or unusual technology to conduct your activities?	X	Yes		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 deepwater 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			
Well completion			
Well test flaring (for more than 48 hours)			
Installation or modification of structure			
Installation of production facilities			
Installation of subsea wellheads and/or dry hole tree/manifolds			
Installation of lease term pipelines	2021	2057	30/yr
Commence production/injection	2021	2057	10/yr
Other (Specify and attach description) Well Work	2021	2057	365/89//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
	DP Submersible		Other (attached descriptio)	X	Floating production system		Other (attached description)

Drilling Rig Name (If known): Transocean Proteus or similar drillship

Description of Lease Term Pipelines

From (Facility/Area/Block)	To (Facility/Area/Block)	Diameter (Inches)	Length (Feet)
Well	AW, IW, AC, AE, IE or VX manifold	8.625”	100-270’

Form BOEM-0137 December 2011 – Supersedes all previous editions of this form which may not be used.)

Attachment 1J

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

Proposed Well/Structure Location

Well or Structure Name/Number (If renaming well or structure, reference previous name): Appomattox 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.	2623	
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.	OCS-G 30380 (RUE Pending)	OCS	OCS OCS
Area Name	Mississippi Canyon		
Block No.	437 FPSO		
Blockline Departures (in feet)	N/S Departure: 4759"N	N/S Departure F __ L	N/S Departure F __ L N/S Departure F __ L N/S Departure F __ L
	E/W Departure: 5744' E	E/W Departure F __ L	E/W Departure F __ L E/W Departure F __ L E/W Departure F __ L
Lambert X-Y coordinates	X: 1340656	X:	X: X: X:
	Y: 10370441	Y:	Y: Y: Y:
Latitude/ Longitude	Latitude 28° 34' 24.601"	Latitude	Latitude Latitude Latitude
	Longitude -87° 56' 03.166"	Longitude	Longitude Longitude Longitude

Water Depth (Feet): 7422	MD (Feet):	TVD (Feet):	MD (Feet): MD (Feet): MD (Feet):	TVD (Feet): TVD (Feet): TVD (Feet):
Anchor Radius (if applicable) in feet: 16,500'				

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 L01	DC	353	1348656	10378061	200'
ANCHOR L02	DC	353	1349043	10377632	200'
ANCHOR L03	DC	353	1349400	10377179	200'
ANCHOR L04	DC	353	1349734	10376709	200'
ANCHOR L05	DC	397	1351547	10360804	200'
ANCHOR L06	DC	397	1351030	10360246	200'
ANCHOR L07	DC	397	1350483	10359718	200'
ANCHOR L08	DC	441	1349908	10359221	200'
ANCHOR L09	MC	437	1333144	10360328	200'
ANCHOR L10	MC	437	1332622	10360730	200'
ANCHOR L11	MC	437	1332123	10361161	200'
ANCHOR L12	MC	437	1331649	10361618	200'
ANCHOR L13	MC	393	1333547	10376115	200'
ANCHOR L14	MC	393	1334062	10376706	200'
ANCHOR L15	MC	393	1334620	10377258	200'
ANCHOR L16	MC	393	1335229	10377752	200'

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

Attachment 1K

Proposed Well/Structure Location							
Well Name/Number: **Drill Center Appo Central (AC)**		Previously reviewed under an approved EP or DOCD? EP S-07444		X	Yes		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.	NA		
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?				X	Yes		No

WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414	For structures, volume of all storage and pipelines (Bbls):NA	API Gravity of fluid	37.5

	Surface Location	**Bottom-Hole Location (For Wells)**	**Completion (For multiple completions, enter separate lines)**
Lease No.	OCS-G 26253		
Area Name	Mississippi Canyon		
Block No.	392		
Blockline Departures (in feet)	N/S Departure: 2,014' FNL		
	E/W Departure: 6,011' FWL		
Lambert X-Y coordinates	X: 1,320,731		
	Y: 10,389,026		
Latitude/ Longitude	Latitude: 28.62418544		
	Longitude : -87.99678433		

Water Depth (Feet): 7,220'	MD (Feet):	TVD (Feet):		
Anchor Radius (if applicable) in feet:	NA			

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:	

Form BOEM- 0137 (December 2011 – Supersedes all previous editions of this form which may not be used.)

Attachment 1L

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

Proposed Well/Structure Location							
Well Name/Number: AC001				Previously reviewed under an approved EP or DOCD ? EP S-07444	X	Yes	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.	6081741361		
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?					X	Yes	No
WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414			For structures, volume of all storage and pipelines (Bbls):NA	API Gravity of fluid	37.5	
	Surface Location			**Bottom-Hole Location (For Wells)**	**Completion (For multiple completions, enter separate lines)**		
Lease No.	OCS-G 26253			OCS-G 26253			
Area Name	Mississippi Canyon			Mississippi Canyon			
Block No.	392			392			
Blockline Departures (in feet)	N/S Departure: 1,964' FNL						
	E/W Departure: 6,118' FWL						
Lambert X-Y coordinates	X: 1,320,838						
	Y: 10,389,076						
Latitude/ Longitude	Latitude 28.62456599						
	Longitude -87.99644032						
Water Depth (Feet): 7,220'							
Anchor Radius (if applicable) in feet:				NA			

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:	

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Attachment 1M

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

Proposed Well/Structure Location							
Well Name/Number: AC001 ST			Previously reviewed under an approved EP or DOCD? EP S-07444	X	Yes		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.	6081741361			
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?				X	Yes		No
WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414		For structures, volume of all storage and pipelines (Bbls):NA	API Gravity of fluid	37.5		
	Surface Location		**Bottom-Hole Location (For Wells)**	**Completion (For multiple completions, enter separate lines)**			
Lease No.	OCS-G 26253		OCS-G 26253				
Area Name	Mississippi Canyon		Mississippi Canyon				
Block No.	392		392				
Blockline Departures (in feet)	N/S Departure: 1,964' FNL						
	E/W Departure: 6,118' FWL						
Lambert X-Y coordinates	X: 1,320,838						
	Y: 10,389,076						
Latitude/ Longitude	Latitude 28.62456599						
	Longitude -87.99644032						
Water Depth (Feet): 7,220'							
Anchor Radius (if applicable) in feet:			NA				

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:	

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Attachment 1N

Proposed Well/Structure Location								
Well Name/Number: AC002				Previously reviewed under an approved EP or DOCD? S-7996	X	Yes		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.	NA		
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?					X	Yes		No

WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414	For structures, volume of all storage and pipelines (Bbls):NA	API Gravity of fluid	37.5

	Surface Location	Bottom-Hole Location (For Wells)	Completion (For multiple completions, enter separate lines)
Lease No.	OCS-G 26253	OCS-G 26253	
Area Name	Mississippi Canyon	Mississippi Canyon	
Block No.	MC 392	MC 392	
Blockline Departures (in feet)	N/S Departure: 1931' FNL		
	E/W Departure: 5922' FWL		
Lambert X-Y coordinates	X: 1,320,642		
	Y: 10,389,109		
Latitude/ Longitude	Latitude 28.6244122		
	Longitude -87.9970637		

Water Depth (Feet): 7,200'				
Anchor Radius (if applicable) in feet:	NA			

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:	

Attachment 1O

Proposed Well/Structure Location								
Well Name/Number: AC003				Previously reviewed under an approved EP or DOCD? EP S-07444	X	Yes		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.	NA		
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?					X	Yes		No
WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414		For structures, volume of all storage and pipelines (Bbls):NA		API Gravity of fluid	37.5		
	Surface Location		Bottom-Hole Location (For Wells)		Completion (For multiple completions, enter separate lines)			
Lease No.	OCS-G 26253		OCS-G 26253					
Area Name	Mississippi Canyon		Mississippi Canyon					
Block No.	MC 392		MC 392					
Blockline Departures (in feet)	N/S Departure: 2,037' FNL							
	E/W Departure: 6,129' FWL							
Lambert X-Y coordinates	X: 1,320,849							
	Y: 10,389,003							
Latitude/ Longitude	Latitude 28.62436543							
	Longitude -87.99640413							
Water Depth (Feet): 7,220'								
Anchor Radius (if applicable) in feet:		NA						

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:	

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Attachment 1P

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

Proposed Well/Structure Location							
Well Name/Number: AC004			Previously reviewed under an approved EP or DOCD? EP S-07444	X	Yes		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.	NA		
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?				X	Yes		No
WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414		For structures, volume of all storage and pipelines (Bbls):NA	API Gravity of fluid	37.5		
	Surface Location		**Bottom-Hole Location (For Wells)**	**Completion (For multiple completions, enter separate lines)**			
Lease No.	OCS-G 26253		OCS-G 26253				
Area Name	Mississippi Canyon		Mississippi Canyon				
Block No.	MC 392		MC 392				
Blockline Departures (in feet)	N/S Departure: 1,985' FNL						
	E/W Departure: 5,897' FWL						
Lambert X-Y coordinates	X: 1,320,617						
	Y: 10,389,055						
Latitude/ Longitude	Latitude 28.62450316						
	Longitude -87.9971288						
Water Depth (Feet): 7,220'							
Anchor Radius (if applicable) in feet:		NA					

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:	

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Attachment 1Q

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

Proposed Well/Structure Location							
Well Name/Number: AC005			Previously reviewed under an approved EP or DOCD? EP S-07444	X	Yes		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.	NA		
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?				X	Yes		No
WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414	For structures, volume of all storage and pipelines (Bbls):NA		API Gravity of fluid	37.5		
	Surface Location	**Bottom-Hole Location (For Wells)**		**Completion (For multiple completions, enter separate lines)**			
Lease No.	OCS-G 26253	OCS-G 26253					
Area Name	Mississippi Canyon	Mississippi Canyon					
Block No.	MC 392	MC 392					
Blockline Departures (in feet)	N/S Departure: 2,103' FNL						
	E/W Departure: 6,097' FWL						
Lambert X-Y coordinates	X: 1,320,817						
	Y: 10,388,937						
Latitude/ Longitude	Latitude 28.62418314						
	Longitude -87.99650218						
Water Depth (Feet): 7,220'							
Anchor Radius (if applicable) in feet:		NA					

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:	

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Attachment 1R

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

Proposed Well/Structure Location							
Well Name/Number: AC005 ST				Previously reviewed under an approved EP or DOCD? EP S-07444	X	Yes	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.	NA		
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?					X	Yes	No

WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414	For structures, volume of all storage and pipelines (Bbls):NA	API Gravity of fluid	37.5

	Surface Location	**Bottom-Hole Location (For Wells)**	**Completion (For multiple completions, enter separate lines)**
Lease No.	OCS-G 26253	OCS-G 19939	
Area Name	Mississippi Canyon	Mississippi Canyon	
Block No.	MC 392	MC 348	
Blockline Departures (in feet)	N/S Departure: 2,103' FNL		
	E/W Departure: 6,097' FWL		
Lambert X-Y coordinates	X: 1,320,817		
	Y: 10,388,937		
Latitude/ Longitude	Latitude 28.62418314		
	Longitude -87.99650218		
Water Depth (Feet): 7,220'			
Anchor Radius (if applicable) in feet:	NA		

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:	

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Attachment 1S

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

Proposed Well/Structure Location							
Well Name/Number: AC006			Previously reviewed under an approved EP or DOCD? EP S-07444	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.	608174133900			
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?				X	Yes		No
WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414		For structures, volume of all storage and pipelines (Bbls):NA	API Gravity of fluid	37.5		
	Surface Location		**Bottom-Hole Location (For Wells)**	**Completion (For multiple completions, enter separate lines)**			
Lease No.	OCS-G 26253		OCS-G 26253				
Area Name	Mississippi Canyon		Mississippi Canyon				
Block No.	MC 392		MC 392				
Blockline Departures (in feet)	N/S Departure: 2,050' FNL						
	E/W Departure: 5,894' FWL						
Lambert X-Y coordinates	X: 1,320,614						
	Y: 10,388,990						
Latitude/ Longitude	Latitude 28° 37" 26.701'						
	Longitude -87° 59' 49.731"						
Water Depth (Feet): 7,220'							
Anchor Radius (if applicable) in feet:	NA						

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:	

Anchor Locations for Drilling Rig or Construction Barge (If anchor radius supplied above, not necessary)

Form BOEM- 0137 (December 2011 – Supersedes all previous editions of this form which may not be used.)

Attachment 1T

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

Proposed Well/Structure Location							
Well Name/Number: **Drill Center Appo East (AE)**				Previously reviewed under an approved EP or DOCD? EP S-07444	X	Yes	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.	NA		
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?					X	Yes	No

WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414	For structures, volume of all storage and pipelines (Bbls):NA	API Gravity of fluid	37.5

	Surface Location	**Bottom-Hole Location (For Wells)**	**Completion (For multiple completions, enter separate lines)**
Lease No.	OCS-G 26253		
Area Name	Mississippi Canyon		
Block No.	MC 392		
Blockline Departures (in feet)	N/S Departure: 3,017' FNL		
	E/W Departure: 5,811' FEL		
Lambert X-Y coordinates	X: 1,324,749		
	Y: 10,388,023		
Latitude/ Longitude	Latitude: 28.62151777		
	Longitude: -87.98423194		

Water Depth (Feet): 7,255'	MD (Feet):	TVD (Feet):		
Anchor Radius (if applicable) in feet:	NA			

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:	

Form BOEM- 0137 (December 2011 – Supersedes all previous editions of this form which may not be used.)

Attachment 1U

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

<table>
<tr><td colspan="8">Proposed Well/Structure Location</td></tr>
<tr><td colspan="3">Well Name/Number: AE001</td><td colspan="2">Previously reviewed under an approved EP or DOCD? EP S-07444</td><td>X</td><td>Yes</td><td>No</td></tr>
<tr><td colspan="2">Is this an existing well or structure? X Yes No</td><td colspan="3">If this is an existing well or structure, list the Complex ID or API No.</td><td colspan="3">608174133400</td></tr>
<tr><td colspan="5">Do you plan to use a subsea BOP/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 blowout (Bbls/Day): 416,414</td><td colspan="2">For structures, volume of all storage and pipelines (Bbls):NA</td><td>API Gravity of fluid</td><td colspan="3">37.5</td></tr>
<tr><td></td><td>Surface Location</td><td colspan="2">Bottom-Hole Location (For Wells)</td><td colspan="4">Completion (For multiple completions, enter separate lines)</td></tr>
<tr><td>Lease No.</td><td>OCS-G 26253</td><td colspan="2">OCS-G 26253</td><td colspan="4"></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>MC 392</td><td colspan="2">MC 392</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Blockline Departures (in feet)</td><td>N/S Departure: 2,940’ FNL</td><td colspan="2"></td><td colspan="4"></td></tr>
<tr><td>E/W Departure: 5,716’ FEL</td><td colspan="2"></td><td colspan="4"></td></tr>
<tr><td rowspan="2">Lambert X-Y coordinates</td><td>X: 1,324,844</td><td colspan="2"></td><td colspan="4"></td></tr>
<tr><td>Y: 10,388,100</td><td colspan="2"></td><td colspan="4"></td></tr>
<tr><td rowspan="2">Latitude/ Longitude</td><td>Latitude
28° 37’ 19.100”</td><td colspan="2"></td><td colspan="4"></td></tr>
<tr><td>Longitude
-87° 59’ 02.174”</td><td colspan="2"></td><td colspan="4"></td></tr>
<tr><td colspan="2">Water Depth (Feet): 7,255’</td><td></td><td></td><td colspan="2" rowspan="2"></td><td colspan="2" rowspan="2"></td></tr>
<tr><td colspan="2">Anchor Radius (if applicable) in feet:</td><td colspan="2">NA</td></tr>
</table>

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:	

Form BOEM- 0137 (December 2011 – Supersedes all previous editions of this form which may not be used.)

Attachment 1V

Proposed Well/Structure Location								
Well Name/Number: AE002				Previously reviewed under an approved EP or DOCD? S-7996	X	Yes		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.	NA			
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?					X	Yes		No
WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414		For structures, volume of all storage and pipelines (Bbls):NA		API Gravity of fluid		37.5	
	Surface Location		Bottom-Hole Location (For Wells)		Completion (For multiple completions, enter separate lines)			
Lease No.	OCS-G 26253		OCS-G 26253					
Area Name	Mississippi Canyon		Mississippi Canyon					
Block No.	MC 392		MC 392					
Blockline Departures (in feet)	N/S Departure: 2944' FNL							
	E/W Departure: 5909' FEL							
Lambert X-Y coordinates	X: 1,324,651							
	Y: 10,388,096							
Latitude/ Longitude	Latitude 28.6217163							
	Longitude -87.9845391							
Water Depth (Feet): 7,255'								
Anchor Radius (if applicable) in feet:			NA					

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:	

Proposed Well/Structure Location							
Well Name/Number: AE003			Previously reviewed under an approved EP or DOCD? S-7996	X	Yes		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.	NA			
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?				X	Yes		No
WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414		For structures, volume of all storage and pipelines (Bbls):NA	API Gravity of fluid	37.5		
	Surface Location		Bottom-Hole Location (For Wells)	Completion (For multiple completions, enter separate lines)			
Lease No.	OCS-G 26253		OCS-G 26253				
Area Name	Mississippi Canyon		Mississippi Canyon				
Block No.	MC 392		MC 392				
Blockline Departures (in feet)	N/S Departure: 3005' FNL						
	E/W Departure: 5691' FEL						
Lambert X-Y coordinates	X: 1,324,869						
	Y: 10,388,035						
Latitude/ Longitude	Latitude 28.6215535						
	Longitude -87.9838581						
Water Depth (Feet): 7,255'							
Anchor Radius (if applicable) in feet:			NA				

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:	

Attachment 1X

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

<table>
<tr><td colspan="10">Proposed Well/Structure Location</td></tr>
<tr><td colspan="4">Well Name/Number: AE004</td><td colspan="2">Previously reviewed under an approved EP or DOCD? EP S-07444</td><td>X</td><td>Yes</td><td></td><td>No</td></tr>
<tr><td colspan="2">Is this an existing well or structure?</td><td></td><td>Yes</td><td>X</td><td>No</td><td colspan="2">If this is an existing well or structure, list the Complex ID or API No.</td><td colspan="2">NA</td></tr>
<tr><td colspan="6">Do you plan to use a subsea BOP/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 colspan="2">For wells, volume of uncontrolled blowout (Bbls/Day): 416,414</td><td colspan="3">For structures, volume of all storage and pipelines (Bbls):NA</td><td colspan="2">API Gravity of fluid</td><td colspan="2">37.5</td></tr>
<tr><td></td><td colspan="2">Surface Location</td><td colspan="3">Bottom-Hole Location (For Wells)</td><td colspan="4">Completion (For multiple completions, enter separate lines)</td></tr>
<tr><td>Lease No.</td><td colspan="2">OCS-G 26253</td><td colspan="3">OCS-G 26253</td><td colspan="4"></td></tr>
<tr><td>Area Name</td><td colspan="2">Mississippi Canyon</td><td colspan="3">Mississippi Canyon</td><td colspan="4"></td></tr>
<tr><td>Block No.</td><td colspan="2">MC 392</td><td colspan="3">MC 392</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Blockline Departures (in feet)</td><td colspan="2">N/S Departure: 3,013’ FNL</td><td colspan="3"></td><td colspan="4"></td></tr>
<tr><td colspan="2">E/W Departure: 5,930’ FEL</td><td colspan="3"></td><td colspan="4"></td></tr>
<tr><td rowspan="2">Lambert X-Y coordinates</td><td colspan="2">X: 1,324,630</td><td colspan="3"></td><td colspan="4"></td></tr>
<tr><td colspan="2">Y: 10,388,027</td><td colspan="3"></td><td colspan="4"></td></tr>
<tr><td rowspan="2">Latitude/ Longitude</td><td colspan="2">Latitude
28.62176675</td><td colspan="3"></td><td colspan="4"></td></tr>
<tr><td colspan="2">Longitude
-87.98459082</td><td colspan="3"></td><td colspan="4"></td></tr>
<tr><td colspan="3">Water Depth (Feet): 7,255’</td><td colspan="2"></td><td></td><td colspan="2" rowspan="2"></td><td colspan="2" rowspan="2"></td></tr>
<tr><td colspan="4">Anchor Radius (if applicable) in feet:</td><td colspan="2">NA</td></tr>
</table>

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:	

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Attachment 1Y

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

Proposed Well/Structure Location							
Well Name/Number: **AE005**			Previously reviewed under an approved EP or DOCD? EP S-07444	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.	608174133500			
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?				X	Yes		No
WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414	For structures, volume of all storage and pipelines (Bbls):NA		API Gravity of fluid	37.5		

	Surface Location	**Bottom-Hole Location (For Wells)**	**Completion (For multiple completions, enter separate lines)**
Lease No.	OCS-G 26253	OCS-G 26253	
Area Name	Mississippi Canyon	Mississippi Canyon	
Block No.	MC 392	MC 392	
Blockline Departures (in feet)	N/S Departure: 3,073’ FNL		
	E/W Departure: 5,702’ FEL		
Lambert X-Y coordinates	X: 1,324,858		
	Y: 10,387,967		
Latitude/ Longitude	Latitude 28° 37’ 16.917”		
	Longitude -87° 59’ 02.004”		
Water Depth (Feet): 7,255’			
Anchor Radius (if applicable) in feet:	NA		

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:	

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Attachment 1Z

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

Proposed Well/Structure Location							
Well Name/Number: **AE006**				Previously reviewed under an approved EP or DOCD? EP S-07444	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.	608174133600		
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?					X	Yes	No

WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414	For structures, volume of all storage and pipelines (Bbls):NA	API Gravity of fluid	37.5

	Surface Location	**Bottom-Hole Location (For Wells)**	**Completion (For multiple completions, enter separate lines)**
Lease No.	OCS-G 26253	OCS-G 26253	
Area Name	Mississippi Canyon	Mississippi Canyon	
Block No.	MC 392	MC 392	
Blockline Departures (in feet)	N/S Departure: 3,070' FNL		
	E/W Departure: 5,921' FEL		
Lambert X-Y coordinates	X: 1,324,639		
	Y: 10,387,970		
Latitude/ Longitude	Latitude 28° 37' 16.929"		
	Longitude -87° 59' 04.462"		
Water Depth (Feet): 7,255'			
Anchor Radius (if applicable) in feet:	NA		

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:	

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Attachment 1AA

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

Proposed Well/Structure Location							
Well Name/Number: **Drill Center Appo West (AW)**				Previously reviewed under an approved EP or DOCD? EP S-07444	X	Yes		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.	NA		
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?					X	Yes		No

WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414	For structures, volume of all storage and pipelines (Bbls):NA	API Gravity of fluid	37.5

	Surface Location	**Bottom-Hole Location (For Wells)**	**Completion (For multiple completions, enter separate lines)**
Lease No.	OCS-G 26252		
Area Name	Mississippi Canyon		
Block No.	MC391		
Blockline Departures (in feet)	N/S Departure: 3,858' FNL		
	E/W Departure: 3,484' FEL		
Lambert X-Y coordinates	X: 1,311,236		
	Y: 10,387,182		
Latitude/ Longitude	Latitude: 28.61889176		
	Longitude : -88.02633668		

Water Depth (Feet): 7,166’	MD (Feet):	TVD (Feet):		
Anchor Radius (if applicable) in feet:	NA			

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:	

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Attachment 1BB

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

Proposed Well/Structure Location							
Well Name/Number: **AW001**				Previously reviewed under an approved EP or DOCD? EP S-07444	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.	608174134000		
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?					X	Yes		No

WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414	For structures, volume of all storage and pipelines (Bbls):NA	API Gravity of fluid	37.5

	Surface Location	**Bottom-Hole Location (For Wells)**	**Completion (For multiple completions, enter separate lines)**
Lease No.	OCS-G 26252	OCS-G 26252	
Area Name	Mississippi Canyon	Mississippi Canyon	
Block No.	MC 391	MC391	
Blockline Departures (in feet)	N/S Departure: 3,851' FNL		
	E/W Departure: 3,363' FEL		
Lambert X-Y coordinates	X: 1,311,357		
	Y: 10,387,189		
Latitude/ Longitude	Latitude 28° 37' 08.089"		
	Longitude -88° 01" 33.415"		
Water Depth (Feet): 7,166'			
Anchor Radius (if applicable) in feet:	NA		

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:	
	0		X:	Y:	
			X:	Y:	

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Attachment 1CC

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

<table>
<tr><th colspan="8">Proposed Well/Structure Location</th></tr>
<tr><td colspan="3">Well Name/Number: AW002</td><td colspan="2">Previously reviewed under an approved EP or DOCD? EP S-07444</td><td>X</td><td>Yes</td><td>No</td></tr>
<tr><td>Is this an existing well or structure?</td><td>Yes</td><td>X No</td><td colspan="2">If this is an existing well or structure, list the Complex ID or API No.</td><td colspan="3">NA</td></tr>
<tr><td colspan="5">Do you plan to use a subsea BOP/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 colspan="2">For wells, volume of uncontrolled blowout (Bbls/Day): 416,414</td><td colspan="2">For structures, volume of all storage and pipelines (Bbls):NA</td><td>API Gravity of fluid</td><td colspan="2">37.5</td></tr>
<tr><td></td><td colspan="2">Surface Location</td><td colspan="2">Bottom-Hole Location (For Wells)</td><td colspan="3">Completion (For multiple completions, enter separate lines)</td></tr>
<tr><td>Lease No.</td><td colspan="2">OCS-G 26252</td><td colspan="2">OCS-G 26253</td><td colspan="3"></td></tr>
<tr><td>Area Name</td><td colspan="2">Mississippi Canyon</td><td colspan="2">Mississippi Canyon</td><td colspan="3"></td></tr>
<tr><td>Block No.</td><td colspan="2">MC 391</td><td colspan="2">MC 392</td><td colspan="3"></td></tr>
<tr><td rowspan="2">Blockline Departures (in feet)</td><td colspan="2">N/S Departure: 3,742’ FNL</td><td colspan="2"></td><td colspan="3"></td></tr>
<tr><td colspan="2">E/W Departure: 3,481’ FEL</td><td colspan="2"></td><td colspan="3"></td></tr>
<tr><td rowspan="2">Lambert X-Y coordinates</td><td colspan="2">X: 1,311,239</td><td colspan="2"></td><td colspan="3"></td></tr>
<tr><td colspan="2">Y: 10,387,298</td><td colspan="2"></td><td colspan="3"></td></tr>
<tr><td rowspan="2">Latitude/ Longitude</td><td colspan="2">Latitude
28.61945158</td><td colspan="2"></td><td colspan="3"></td></tr>
<tr><td colspan="2">Longitude
-88.02631989</td><td colspan="2"></td><td colspan="3"></td></tr>
<tr><td colspan="3">Water Depth (Feet): 7,166’</td><td></td><td></td><td colspan="2" rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td colspan="3">Anchor Radius (if applicable) in feet:</td><td colspan="2">NA</td></tr>
</table>

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:	

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Attachment 1DD

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

Proposed Well/Structure Location								
Well Name/Number: **AW003**				Previously reviewed under an approved EP or DOCD? EP S-07444	X	Yes		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.	NA		
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?					X	Yes		No

WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414	For structures, volume of all storage and pipelines (Bbls):NA	API Gravity of fluid	37.5

	Surface Location	**Bottom-Hole Location (For Wells)**	**Completion (For multiple completions, enter separate lines)**
Lease No.	OCS-G 26252	OCS-G 26253	
Area Name	Mississippi Canyon	Mississippi Canyon	
Block No.	MC 391		
Blockline Departures (in feet)	N/S Departure: 3,931' FNL		
	E/W Departure: 3,391' FEL		
Lambert X-Y coordinates	X: 1,311,329		
	Y: 10,387,109		
Latitude/ Longitude	Latitude 28.61893379		
	Longitude -88.02603424		
Water Depth (Feet): 7,166'			
Anchor Radius (if applicable) in feet:	NA		

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:	

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Attachment 1EE

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

Proposed Well/Structure Location							
Well Name/Number: **AW004**			Previously reviewed under an approved EP or DOCD? EP S-07444	X	Yes		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.	NA			
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?				X	Yes		No
WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414	For structures, volume of all storage and pipelines (Bbls):NA		API Gravity of fluid	37.5		
	Surface Location	**Bottom-Hole Location (For Wells)**		**Completion (For multiple completions, enter separate lines)**			
Lease No.	OCS-G 26252	OCS-G 26252					
Area Name	Mississippi Canyon	Mississippi Canyon					
Block No.	MC 391	MC 391					
Blockline Departures (in feet)	N/S Departure: 3,774' FNL						
	E/W Departure: 3,568' FEL						
Lambert X-Y coordinates	X: 1,311,152						
	Y: 10,387,266						
Latitude/ Longitude	Latitude 28.6193615						
	Longitude -88.02659026						
Water Depth (Feet): 7,166'							
Anchor Radius (if applicable) in feet:		NA					

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:	

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Attachment 1FF

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

Proposed Well/Structure Location						
Well Name/Number: **AW005**		Previously reviewed under an approved EP or DOCD? EP S-07444	X	Yes		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.	NA		
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?			X	Yes		No
WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414	For structures, volume of all storage and pipelines (Bbls):NA	API Gravity of fluid	37.5		

	Surface Location	**Bottom-Hole Location (For Wells)**	**Completion (For multiple completions, enter separate lines)**
Lease No.	OCS-G 26252	OCS-G 26252	
Area Name	Mississippi Canyon	Mississippi Canyon	
Block No.	MC 391	MC 391	
Blockline Departures (in feet)	N/S Departure: 3,975' FNL		
	E/W Departure: 3,448' FEL		
Lambert X-Y coordinates	X: 1,311,272		
	Y: 10,387,065		
Latitude/ Longitude	Latitude 28.61881141		
	Longitude -88.02621077		
Water Depth (Feet): 7,166'			
Anchor Radius (if applicable) in feet:	NA		

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:	

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Attachment 1GG

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

Proposed Well/Structure Location							
Well Name/Number: **AW006**			Previously reviewed under an approved EP or DOCD? EP S-07444	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.	608174134200			
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?				X	Yes		No
WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414		For structures, volume of all storage and pipelines (Bbls):NA	API Gravity of fluid	37.5		
	Surface Location		**Bottom-Hole Location (For Wells)**	**Completion (For multiple completions, enter separate lines)**			
Lease No.	OCS-G 26252		OCS-G 26252				
Area Name	Mississippi Canyon		Mississippi Canyon				
Block No.	MC 391						
Blockline Departures (in feet)	N/S Departure: 3,833' FNL						
	E/W Departure: 3,604' FEL						
Lambert X-Y coordinates	X: 1,311,116'						
	Y: 10,387,207'						
Latitude/ Longitude	Latitude 28° 37" 08.247"						
	Longitude -88° 01' 35.159"						
Water Depth (Feet): 7,166'							
Anchor Radius (if applicable) in feet:			NA				

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:	

Form BOEM- 0137 (December 2011 – Supersedes all previous editions of this form which may not be used.)

Attachment 1HH

Proposed Well/Structure Location									
Well Name/Number: AW007				Previously reviewed under an approved EP or DOCD? S-7996		X	Yes		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.	NA			
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?						X	Yes		No
WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414		For structures, volume of all storage and pipelines (Bbls):NA			API Gravity of fluid		37.5	
	Surface Location		Bottom-Hole Location (For Wells)			Completion (For multiple completions, enter separate lines)			
Lease No.	OCS-G 26252		OCS-G 26252						
Area Name	Mississippi Canyon		Mississippi Canyon						
Block No.	391		391						
Blockline Departures (in feet)	N/S Departure: 3730' FNL								
	E/W Departure: 3447 FEL								
Lambert X-Y coordinates	X: 1,311,273								
	Y: 10,387,310								
Latitude/ Longitude	Latitude 28.6192448								
	Longitude -88.0262248								
Water Depth (Feet): 7,158'									
Anchor Radius (if applicable) in feet:			NA						

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:	

Proposed Well/Structure Location

Well Name/Number: AW007 Alt	Previously reviewed under an approved EP or DOCD? S-7996	X	Yes		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.	NA

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

WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414	For structures, volume of all storage and pipelines (Bbls):NA	API Gravity of fluid	37.5

	Surface Location	Bottom-Hole Location (For Wells)	Completion (For multiple completions, enter separate lines)
Lease No.	OCS-G 26252	OCS-G 26253	
Area Name	Mississippi Canyon	Mississippi Canyon	
Block No.	391	392	
Blockline Departures (in feet)	N/S Departure: 3772′ FNL		
	E/W Departure: 3362 FEL		
Lambert X-Y coordinates	X: 1,311,358		
	Y: 10,387,268		
Latitude/ Longitude	Latitude 28.6191312		
	Longitude -88.0259587		
Water Depth (Feet): 7,166′			
Anchor Radius (if applicable) in feet:	NA		

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:	

Atttachment 1JJ

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

Proposed Well/Structure Location							
Well Name/Number: **Drill Center Appo SE Injector (IE)**			Previously reviewed under an approved EP or DOCD? EP S-07444	X	Yes		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.	NA			
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?				X	Yes		No
WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414	For structures, volume of all storage and pipelines (Bbls):NA		API Gravity of fluid	37.5		
	Surface Location	**Bottom-Hole Location (For Wells)**		**Completion (For multiple completions, enter separate lines)**			
Lease No.	OCS-G 26253						
Area Name	Mississippi Canyon						
Block No.	MC 392						
Blockline Departures (in feet)	N/S Departure: 7,323' FNL						
	E/W Departure: 4,462' FEL						
Lambert X-Y coordinates	X: 1,326,098						
	Y: 10,383,717						
Latitude/ Longitude	Latitude: 28.60970253						
	Longitude: -87.97991638						
Water Depth (Feet): 7,272’		MD (Feet):	TVD (Feet):				
Anchor Radius (if applicable) in feet:		NA					

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:	

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

Attachment 1KK

Proposed Well/Structure Location							
Well Name/Number: **IE001**			Previously reviewed under an approved EP or DOCD? EP S-07444	X	Yes		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.	NA			
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?				X	Yes		No
WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414	For structures, volume of all storage and pipelines (Bbls):NA		API Gravity of fluid	37.5		
	Surface Location	**Bottom-Hole Location (For Wells)**		**Completion (For multiple completions, enter separate lines)**			
Lease No.	OCS-G 26253	OCS-G 26253					
Area Name	Mississippi Canyon	Mississippi Canyon					
Block No.	MC 392	MC 392					
Blockline Departures (in feet)	N/S Departure: 7,382’ FNL						
	E/W Departure: 4,358’ FEL						
Lambert X-Y coordinates	X: 1,326,202						
	Y: 10,383,658						
Latitude/ Longitude	Latitude 28.60978363						
	Longitude -87.97957813						
Water Depth (Feet): 7,272’							
Anchor Radius (if applicable) in feet:		NA					

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:	

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Proposed Well/Structure Location							
Well Name/Number: IE002			Previously reviewed under an approved EP or DOCD? S-7996	X	Yes		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.	NA		
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?				X	Yes		No
WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414		For structures, volume of all storage and pipelines (Bbls):NA	API Gravity of fluid	37.5		
	Surface Location		Bottom-Hole Location (For Wells)	Completion (For multiple completions, enter separate lines)			
Lease No.	OCS-G 26253		OCS-G 26253				
Area Name	Mississippi Canyon		Mississippi Canyon				
Block No.	MC 392		MC 392				
Blockline Departures (in feet)	N/S Departure: 7229' FNL						
	E/W Departure: 4389' FEL						
Lambert X-Y coordinates	X: 1,326,171						
	Y: 10,383,811						
Latitude/ Longitude	Latitude 28.6099628						
	Longitude -87.9796912						
Water Depth (Feet): 7,272'							
Anchor Radius (if applicable) in feet:		NA					

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:	

Attachment 1MM

Proposed Well/Structure Location							
Well Name/Number: IE002 Alt		Previously reviewed under an approved EP or DOCD? S-7996		X	Yes		No
Is this an existing well or structure?	Yes: / No: X	If this is an existing well or structure, list the Complex ID or API No.		NA			
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?				X	Yes		No
WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414	For structures, volume of all storage and pipelines (Bbls):NA		API Gravity of fluid	37.5		
	Surface Location	Bottom-Hole Location (For Wells)		Completion (For multiple completions, enter separate lines)			
Lease No.	OCS-G 26253	OCS-G 26253					
Area Name	Mississippi Canyon	Mississippi Canyon					
Block No.	MC 392	MC 392					
Blockline Departures (in feet)	N/S Departure: 7145' FNL						
	E/W Departure: 4672' FEL						
Lambert X-Y coordinates	X: 1,325,888						
	Y: 10,383,895						
Latitude/ Longitude	Latitude 28.6101875						
	Longitude -87.9805755						
Water Depth (Feet): 7,272'							
Anchor Radius (if applicable) in feet:		NA					

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:	

Attachment 1NN

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

Proposed Well/Structure Location						
Well Name/Number: **IE003**		Previously reviewed under an approved EP or DOCD? EP S-07444	X	Yes		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.	NA			
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?			X	Yes		No

WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414	For structures, volume of all storage and pipelines (Bbls):NA	API Gravity of fluid	37.5

	Surface Location	**Bottom-Hole Location (For Wells)**	**Completion (For multiple completions, enter separate lines)**
Lease No.	OCS-G 26253	OCS-G 26253	
Area Name	Mississippi Canyon	Mississippi Canyon	
Block No.	MC 392	MC 392	
Blockline Departures (in feet)	/S Departure: 7,438' FNL		
	E/W Departure: 4,490' FEL		
Lambert X-Y coordinates	X: 1,326,070		
	Y: 10,383,602		
Latitude/ Longitude	Latitude 28.6096266		
	Longitude -87.97998819		
Water Depth (Feet): 7,272'			
Anchor Radius (if applicable) in feet:	NA		

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:	

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

Attachment 1OO

Proposed Well/Structure Location						
Well Name/Number: **IE004**		Previously reviewed under an approved EP or DOCD? S-7444	X	Yes		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.	NA		
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?			X	Yes		No
WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414	For structures, volume of all storage and pipelines (Bbls):NA	API Gravity of fluid	37.5		
	Surface Location	**Bottom-Hole Location (For Wells)**	**Completion (For multiple completions, enter separate lines)**			
Lease No.	OCS-G 26253	OCS-G 26253				
Area Name	Mississippi Canyon	Mississippi Canyon				
Block No.	MC 392	MC 392				
Blockline Departures (in feet)	N/S Departure: 7,228' FNL					
	E/W Departure: 4,532' FEL					
Lambert X-Y coordinates	X: 1,326,028					
	Y: 10,383,812					
Latitude/ Longitude	Latitude 28.61020335					
	Longitude -87.98012449					
Water Depth (Feet): 7,272'						
Anchor Radius (if applicable) in feet:	NA					

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:	

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Attachment 1PP

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

Proposed Well/Structure Location							
Well Name/Number: **Drill Center Appo SW Injector (IW)**				Previously reviewed under an approved EP or DOCD? EP S-07444	X	Yes	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.	NA		
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?					X	Yes	No

WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414	For structures, volume of all storage and pipelines (Bbls):NA	API Gravity of fluid	37.5

	Surface Location	**Bottom-Hole Location (For Wells)**	**Completion (For multiple completions, enter separate lines)**
Lease No.	OCS-G 26252		
Area Name	Mississippi Canyon		
Block No.	MC 391		
Blockline Departures (in feet)	N/S Departure: 4,676' FSL		
	E/W Departure: 969' FEL		
Lambert X-Y coordinates	X: 1,313,751		
	Y: 10,379,876		
Latitude/ Longitude	Latitude: 28.59885247		
	Longitude: -88.01830246		

Water Depth (Feet): 7,287'	MD (Feet):	TVD (Feet):
Anchor Radius (if applicable) in feet:	NA	

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:	

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Proposed Well/Structure Location

Well Name/Number: IW001		Previously reviewed under an approved EP or DOCD? S-7996	X	Yes		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.	NA

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

WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414	For structures, volume of all storage and pipelines (Bbls):NA	API Gravity of fluid	37.5

	Surface Location	Bottom-Hole Location (For Wells)	Completion (For multiple completions, enter separate lines)
Lease No.	OCS-G 26252	OCS-G 26252	
Area Name	Mississippi Canyon	Mississippi Canyon	
Block No.	391	391	
Blockline Departures (in feet)	N/S Departure: 4719' FSL		
	E/W Departure: 858' FEL		
Lambert X-Y coordinates	X: 1,313,862		
	Y: 10,379,919		
Latitude/ Longitude	Latitude 28.5989734		
	Longitude -88.0179576		

Water Depth (Feet): 7,287'				
Anchor Radius (if applicable) in feet:	NA			

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:	

Proposed Well/Structure Location							
Well Name/Number: IW001 Alt			Previously reviewed under an approved EP or DOCD? S-7996	X	Yes		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.	NA	
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?				X	Yes		No
WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414	For structures, volume of all storage and pipelines (Bbls):NA		API Gravity of fluid	37.5		

	Surface Location	Bottom-Hole Location (For Wells)	Completion (For multiple completions, enter separate lines)
Lease No.	OCS-G 26252	OCS-G 26252	
Area Name	Mississippi Canyon	Mississippi Canyon	
Block No.	391	391	
Blockline Departures (in feet)	N/S Departure: 4585' FSL		
	E/W Departure: 1161' FEL		
Lambert X-Y coordinates	X: 1,313,559		
	Y: 10,379,785		
Latitude/ Longitude	Latitude 28.5985976		
	Longitude -88.0188985		
Water Depth (Feet): 7,378'			
Anchor Radius (if applicable) in feet:	NA		

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:	

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

Attachment 1SS

Proposed Well/Structure Location							
Well Name/Number: **IW002**		Previously reviewed under an approved EP or DOCD? EP S-07444		X	Yes		No
Is this an existing well or structure?	Yes: (blank) / No: X	If this is an existing well or structure, list the Complex ID or API No.		NA			
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?				X	Yes		No
WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414	For structures, volume of all storage and pipelines (Bbls):NA		API Gravity of fluid	37.5		
	Surface Location	**Bottom-Hole Location (For Wells)**		**Completion (For multiple completions, enter separate lines)**			
Lease No.	OCS-G 26252	OCS-G 26252					
Area Name	Mississippi Canyon	Mississippi Canyon					
Block No.	MC 391	MC391					
Blockline Departures (in feet)	N/S Departure: 4,792' FSL						
	E/W Departure: 995' FEL						
Lambert X-Y coordinates	X: 1,313,725						
	Y: 10,379,992						
Latitude/ Longitude	Latitude 28.59941225						
	Longitude -88.01837544						
Water Depth (Feet): 7,287'							
Anchor Radius (if applicable) in feet:		NA					

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:	

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Attachment 1TT

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

Proposed Well/Structure Location							
Well Name/Number: **IW003**				Previously reviewed under an approved EP or DOCD? EP S-07444	X	Yes	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.	NA		
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?					X	Yes	No

WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414	For structures, volume of all storage and pipelines (Bbls):NA	API Gravity of fluid	37.5

	Surface Location	**Bottom-Hole Location (For Wells)**	**Completion (For multiple completions, enter separate lines)**
Lease No.	OCS-G 26252	OCS-G 26253	
Area Name	Mississippi Canyon	Mississippi Canyon	
Block No.	MC 391	MC392	
Blockline Departures (in feet)	N/S Departure: 4,581' FSL		
	E/W Departure: 898' FEL		
Lambert X-Y coordinates	X: 1,313,822		
	Y: 10,379,781		
Latitude/ Longitude	Latitude 28.59883409		
	Longitude -88.01806749		
Water Depth (Feet): 7,287'			
Anchor Radius (if applicable) in feet:	NA		

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:	

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Proposed Well/Structure Location								
Well Name/Number: IW004			Previously reviewed under an approved EP or DOCD? S-7996		X	Yes		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.	NA		
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?					X	Yes		No
WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414	For structures, volume of all storage and pipelines (Bbls):NA		API Gravity of fluid	37.5			

	Surface Location	Bottom-Hole Location (For Wells)	Completion (For multiple completions, enter separate lines)
Lease No.	OCS-G 26252	OCS-G 26253	
Area Name	Mississippi Canyon	Mississippi Canyon	
Block No.	391	392	
Blockline Departures (in feet)	N/S Departure: 4646' FSL		
	E/W Departure: 1081' FEL		
Lambert X-Y coordinates	X: 1,313,639		
	Y: 10,379,846		
Latitude/ Longitude	Latitude 28.5987673		
	Longitude -88.0186508		
Water Depth (Feet): 7,287'			
Anchor Radius (if applicable) in feet:	NA		

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:	

Attachment 1VV

<table>
<tr><th colspan="8">Proposed Well/Structure Location</th></tr>
<tr><td colspan="3">Well Name/Number: IW005</td><td colspan="2">Previously reviewed under an approved EP or DOCD? S-7996</td><td>X</td><td>Yes</td><td></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="2">If this is an existing well or structure, list the Complex ID or API No.</td><td colspan="4">NA</td></tr>
<tr><td colspan="5">Do you plan to use a subsea BOP/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 blowout (Bbls/Day): 416,414</td><td>For structures, volume of all storage and pipelines (Bbls):NA</td><td>API Gravity of fluid</td><td>37.5</td></tr>
<tr><td></td><td>Surface Location</td><td>Bottom-Hole Location (For Wells)</td><td>Completion (For multiple completions, enter separate lines)</td></tr>
<tr><td>Lease No.</td><td>OCS-G 26252</td><td>OCS-G 26252</td><td></td></tr>
<tr><td>Area Name</td><td>Mississippi Canyon</td><td>Mississippi Canyon</td><td></td></tr>
<tr><td>Block No.</td><td>MC 391</td><td>MC 391</td><td></td></tr>
<tr><td rowspan="2">Blockline Departures (in feet)</td><td>N/S Departure: 4800’ FSL</td><td></td><td></td></tr>
<tr><td>E/W Departure: 820’ FEL</td><td></td><td></td></tr>
<tr><td rowspan="2">Lambert X-Y coordinates</td><td>X: 1,313,900</td><td></td><td></td></tr>
<tr><td>Y: 10,380,000</td><td></td><td></td></tr>
<tr><td rowspan="2">Latitude/ Longitude</td><td>Latitude 28.5991971</td><td></td><td></td></tr>
<tr><td>Longitude -88.0178413</td><td></td><td></td></tr>
<tr><td colspan="2">Water Depth (Feet): 7,287’</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Anchor Radius (if applicable) in feet:</td><td colspan="2">NA</td><td></td><td></td></tr>
</table>

<table>
<tr><th colspan="6">Anchor Locations for Drilling Rig or Construction Barge (If anchor radius 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>
</table>

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

Attachment 1WW

Proposed Well/Structure Location								
Well Name/Number: **Drill Center Vicksburg (VX)**				Previously reviewed under an approved EP or DOCD? EP S-07444	X	Yes		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.	NA		
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?					X	Yes		No

WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414	For structures, volume of all storage and pipelines (Bbls):NA	API Gravity of fluid	37.5

	Surface Location	**Bottom-Hole Location (For Wells)**	**Completion (For multiple completions, enter separate lines)**
Lease No.	OCS-G 26254		
Area Name	Mississippi Canyon		
Block No.	MC 393		
Blockline Departures (in feet)	N/S Departure: 5,714' FNL		
	E/W Departure: 743' FEL		
Lambert X-Y coordinates	X: 1,345,657		
	Y: 10,385,326		
Latitude/ Longitude	Latitude: 28.61455592		
	Longitude: -87.91898465		

Water Depth (Feet): 7,404’	MD (Feet):	TVD (Feet):		
Anchor Radius (if applicable) in feet:	NA			

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:	

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Proposed Well/Structure Location							
Well Name/Number: VX001			Previously reviewed under an approved EP or DOCD? S-7996	X	Yes		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.	NA	
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?				X	Yes		No
WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414	For structures, volume of all storage and pipelines (Bbls):NA		API Gravity of fluid	37.5		

	Surface Location	Bottom-Hole Location (For Wells)	Completion (For multiple completions, enter separate lines)
Lease No.	OCS-G 26254	OCS-G 26254	
Area Name	Mississippi Canyon	Mississippi Canyon	
Block No.	MC 393	MC 393	
Blockline Departures (in feet)	N/S Departure: 5578' FNL		
	E/W Departure: 729' FEL		
Lambert X-Y coordinates	X: 1,345,671		
	Y: 10,385,462		
Latitude/ Longitude	Latitude 28.6149304		
	Longitude -87.9189449		
Water Depth (Feet): 7,404'			
Anchor Radius (if applicable) in feet:	NA		

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:	

Attachment 1YY

Proposed Well/Structure Location							
Well Name/Number: VX001 Alt			Previously reviewed under an approved EP or DOCD? S-7996	X	Yes		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.	NA			
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?				X	Yes		No
WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414	For structures, volume of all storage and pipelines (Bbls):NA		API Gravity of fluid	37.5		
	Surface Location	Bottom-Hole Location (For Wells)		Completion (For multiple completions, enter separate lines)			
Lease No.	OCS-G 26254	OCS-G 26254					
Area Name	Mississippi Canyon	Mississippi Canyon					
Block No.	MC 393	MC 393					
Blockline Departures (in feet)	N/S Departure: 5577' FNL						
	E/W Departure: 680' FEL						
Lambert X-Y coordinates	X: 1,345,720						
	Y: 10,385,463						
Latitude/ Longitude	Latitude 28.6149341						
	Longitude -87.9187915						
Water Depth (Feet): 7,404'							
Anchor Radius (if applicable) in feet:	NA						

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:	

Attachment 1ZZ

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

Proposed Well/Structure Location						
Well Name/Number: **VX002**			Previously reviewed under an approved EP or DOCD? EP S-07444	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.	608174133300		
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?				X	Yes	No

WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414	For structures, volume of all storage and pipelines (Bbls):NA	API Gravity of fluid	37.5

	Surface Location	**Bottom-Hole Location (For Wells)**	**Completion (For multiple completions, enter separate lines)**
Lease No.	OCS-G 26254	OCS-G 26254	
Area Name	Mississippi Canyon	Mississippi Canyon	
Block No.	MC 393	MC 393	
Blockline Departures (in feet)	N/S Departure: 5,718' FNL		
	E/W Departure: 865' FEL		
Lambert X-Y coordinates	X: 1,345,535'		
	Y: 10,385,322'		
Latitude/ Longitude	Latitude 28° 36' 53.219"		
	Longitude -87° 55' 09.219"		

Water Depth (Feet): 7,404'			
Anchor Radius (if applicable) in feet:	NA		

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:	

Form BOEM- 0137 (December 2011 – Supersedes all previous editions of this form which may not be used.)

Attachment 1AAA

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

Proposed Well/Structure Location						
Well Name/Number: **VX004**			Previously reviewed under an approved EP or DOCD? EP S-07444	X	Yes	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.	NA		
Do you plan to use a subsea BOP/surface BOP on a floating facility to conduct your proposed activities?				X	Yes	No
WCD Info	For wells, volume of uncontrolled blowout (Bbls/Day): 416,414	For structures, volume of all storage and pipelines (Bbls):NA		API Gravity of fluid	37.5	

	Surface Location	**Bottom-Hole Location (For Wells)**	**Completion (For multiple completions, enter separate lines)**
Lease No.	OCS-G 26254	OCS-G 26254	
Area Name	Mississippi Canyon	Mississippi Canyon	
Block No.	MC 393	MC 393	
Blockline Departures (in feet)	N/S Departure 5,790' FNL		
	E/W Departure: : 835' FEL		
Lambert X-Y coordinates	X: 1,345,566		
	Y: 10,385,250		
Latitude/ Longitude	Latitude 28.61458603		
	Longitude -87.9192517		
Water Depth (Feet): 7,404'			
Anchor Radius (if applicable) in feet:	NA		

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:	

Form BOEM- 0137 (December 2011 – Supersedes all previous editions of this form which may not be used.)

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)

Type of Drilling Fluid	Estimated Volume of Drilling Fluid to be Used per well
Synthetic Based	51,000
DIF (Drill in Fluid) synthetic based	18,500
Water based	67,000
Oil Based	NA

C. Production

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

D. Oil Characteristics

Article I.

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

Oil properties from Appomattox and Vicksburg are listed:

1) Appomattox
2) Vicksburg "A"

Characteristic	Analytical Methodologies Should Be Compatible With:
1. Gravity (API) 37°/36°	ASTM D4052
2. Flash Point (°C) N/A	ASTM D93/IP 34
3. Pour Point (°C) 3°C/-1°C	ASTM D97
4. Viscosity (Centipoise at 25 °C) 11.3 cp @ 16°C/2.5 cp @ 54°C	ASTM D445
5. Wax Content (wt %) 4.8%/5.3%	Precipitate with 2-butanon/dichloromethane
(1 to 1 volume) at -10 °C	
6. Asphaltene Content (wt %) see below	IP-Method 143/84
7. Resin Content (wt %) see below	Jokuty et al., 1996
8. Boiling point distribution including, for each	

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 #	Sand	Saturates	Aromatics	Resin	Asphaltenes
(Appomattox) OCS-G-26253 MC392-1	61.7	31.6	5.8	1.0	11.5
(Vicksburg) OCS-G-26254 MC393-1	57.1	35.2	5.8	2.0	16.3

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)

Appomattox Area well

Area/Block	MC 392
Well	MC 392-1
API Number	608174117200
Completion Perforations	Sample Depths: 24785'/24824'/24938'
MMS Reservoir Name	Norphlet Formation
Sample Date	Dec. 13, 2009
Sample Number (if more than one)	NG-O-6207A/ NG-O-6205A/ NG-O-6200A

Vicksburg "A" well

Area/Block	MC 393
Well	MC393-1
API Number	608174125300
Completion Perforations	Sample Depths: 25417'/26000'
MMS Reservoir Name	Norphlet Formation
Sample Date	May 13, 2013
Sample Number (if more than one)	NG-T-2159/NG-T-2175

E. New or Unusual Technology

Well and Subsea Production Systems

The Appomattox and Vicksburg wells feature shut-in pressure conditions at the seafloor of approximately 12 kpsi, and flowing temperatures at the seafloor that may exceed 350°F temperature. Pressure conditions up to 15 kpsi are well-known and currently operated in the Gulf of Mexico with rated and proven equipment and technology. Temperature conditions exceeding 350°F have been operated safely onshore and in shallow offshore environments for years.

Shell and its contractors are developing and qualifying wellbore and subsea equipment for the deep-water Gulf of Mexico where temperatures potentially exceed 350°F, constituting an extension to the service conditions of existing, well established oil and gas equipment and technology. This equipment will be rated for 15 kpsi and up to 400°F service. This equipment will not impact air emissions, noise, vibrations, etc. by the nature of their design. Although the equipment will allow Shell to produce at higher temperatures, the subsea equipment, flowlines and risers will be insulated for flow assurance purposes and therefore will have a negligible impact on the subsea ecosystem due to temperature. (*Effects of Subsea Processing on Deepwater Environments in the Gulf of Mexico, U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA, OCS Study MMS 2008-022, 44-45 pp*).

Shell is complying with guidance and regulations on the qualification and certification of this equipment established by the US regulator, the Bureau of Safety and Environmental Enforcement (BSEE), including but not limited to Independent Third Party (I3P) verification for certain pressure-containing equipment exposed to temperatures at or above 350°F prior to BSEE's certification of the equipment for field use. Shell has submitted its plans for equipment qualification in accordance with BSEE's guidance, and upon successful fulfillment of these requirements, BSEE will issue a statement accepting use of the proposed equipment.

Hull Storage

Dead oil and production chemicals used for flow assurance will be stored within the hull of the Floating Production System (FPS). Dead oil and methanol will be stored in bulk tanks that are integral to the design of the hull. These tanks will be located inside the hull to provide maximum collision protection. These tanks are designed to eliminate piping penetrations through void or ballast compartments, to facilitate personnel accessibility, and to minimize the need for personnel to enter the hull.

Production chemicals will be stored in stainless steel "bullet tanks" that are not integral or welded to the hull. These tanks will be vertically supported from the hull column tops and supported laterally at locations below the column top. Like the bulk storage tanks, the bullet tanks will be located inside the hull to provide maximum collision protection. There will be no personnel access into the bullet tanks.

All hull compartments will follow rigorous electrical area classification requirements and all appropriate tanks will be provided with gas detection. A nitrogen blanketing system will be provided for the dead oil and methanol bulk storage tanks as well as the chemical bullet tanks.

Combined Cycle Power Generation

Appomattox will use a combined cycle power generation system that reduces greenhouse gas (GHG) emissions by 20-25% and improves fuel efficiency by approximately 40%. The system will consist of four (4) gas turbine driven generators (GTG) and one (1) condensing steam turbine generator (STG). Two of the GTGs will be dual fuel (diesel/natural gas) packages equipped with standard annular combustors (SAC), and the other two GTGs will be single fuel (gas) packages equipped with Dry Low Emission (DLE) combustion systems. High pressure steam is raised through Once Through Steam Generators (OTSG) fitted to each of the GTGs where the primary heat source for steam generation is exhaust heat from the gas turbines.

Environmental Impacts

Since the new technology listed is an integral part of the Appomattox Facility, the environmental impacts including noise, vibration and air emissions, are addressed in the EIA provided as Section 18 of this plan and other sections of the DOCD.

The following is a summary of specific sections where the information can be found:

- High Temperature/Subsea Production System – Section 1 Plans Content, Page 10 last Paragraph; Heat transfer;
- Hull Storage – Section 18 EIA, Impacts of Small or Large Spills throughout EIA;
- Combined Cycle Power Generation – Section 1 Plans Content, Page 14, paragraphs 5 & 6.

Impact to Protected Species

The proposed operation will be located outside the range of most listed species that may occur within the northern Gulf of Mexico (EIA Table 5) based on the operation's distance from shore and the depth of the seafloor in the area (7,400 ft [2,256 m]). The one exception is the sperm whale (Physeter macrocephalus). However, none of the items listed in the new technology section will have an anticipated impact on this or any other protected species.

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 556, Subpart I-Bonding and NTL No. 2015-N04, "General Financial Assurance."

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 553, 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

The Unit is currently producing.

J. Blowout scenario

Summary

Summary – NOTE: This well was reviewed and accepted by BOEM in Plan S-7444 (May 2011) for 405,000 BOPD/371,000 BOPD 30 day average and by BSEE on July 10, 2012 during the drilling of the well to 416,414 BOPD/391,808 30 day average. The 30-day average was updated in the OSRP in July 2012. The wells in this supplemental plan do not exceed the already-approved well for this area. The wells presented in this plan do not exceed the nu**mber referenced below or Shell's Regional OSR (see** Section 9).

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 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 to improve containment systems.

3. As outlined in Shell's OSRP, and detailed in EP Section 9 of Plan S-7444, 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 Appomattox is calculated for the MC-391 C (No. 1) well location, southwest penetration of the target Sand, and is based on the guidelines outlined in NTL No. 2010-N06 (now 2015-N01) along with subsequent Frequently Asked Questions (FAQ). The WCD does not take into account potential flow mitigating factors such as well bridging, obstructions in wellbore, reservoir barriers, or early intervention.

Uncontrolled blowout (volume first day)	416,414 BOPD
Uncontrolled blowout rate (first 30-days average daily rate)	391,808 BOPD
Duration of flow (days) based on relief well	128 days
Total volume of spill (bbls) for 128 days	48 MMBO

Table 2.1 Worst Case Discharge Summary

The Appomattox discovery is located approximately 72 miles east-southeast of the nearest shoreline in the Gulf of Mexico (GoM), in water depths of approximately 7,200 feet (ft) across the discovery. The structural component of the target is defined by a faulted anticline approximately 5 miles long by 4 miles wide. The south fault block contains one previously drilled well with two sidetracks (MC-392 #1, #1ST1, #1ST2BP1) drilled in 2009-2010. MC-391 #1, the WCD well, is an appraisal well in the South Fault Block. The only objective horizon with predicted flow potential is the reservoir of Jurassic age.

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 firstly enhance the ability to prevent a blowout and secondly to 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 offset Appomattox well and seismic. 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. They do not reflect probabilistic estimates.

2) Background

This attachment has been developed to document the additional information requirements for Exploration Plans as requested by NTL No. 2015-N01 in response to the explosion and sinking of the Mobile Offshore Drilling Unit (MODU) Deepwater Horizon and the resulting subsea well blowout and recovery operations of the exploration well at the MC-252 Macondo location.

3) Information Requirements

a) Blowout scenario

All well locations addressed in EP S-7444 were assessed for WCD. The MC-391 No. 1 well from the approved C location to the South Fault Block represented the highest flow potential. The C well was drilled to the target reservoir as outlined in the Geological and Geophysical Information Section of the Supplemental EP, and described above, using a subsea wellhead system, conductor, surface and intermediate casing program, and using a MODU rig with a marine riser and subsea blowout preventer (BOP). A hydrocarbon influx and a well control event are modeled to occur from the target 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-391
Facility Designation	MODU
Distance to Nearest Shoreline (miles)	72 Statute miles
Uncontrolled blowout (volume first day)	416,414 BOPD
Uncontrolled blowout rate (first 30-days average daily rate)	391,808 BOPD

Table 2.2 Estimated Flow Rates of a Potential Blowout

c) Total volume and maximum duration of the potential blowout

Duration of flow (days)	128 days total duration to drill relief well (14 rig mob, 3 transit, 80 spud to top of reservoir, 31 ranging).
Total volume of spill (bbls)	48 MMBO based on 128 days flowing. Note: From CMG dynamic reservoir models

Table 2.3 Estimated Duration and Volume of a Potential Blowout

There is usually a decline in the discharge rate as time proceeds, 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. 2015-N01 calculations 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 Plan S-7444)

e) Potential for the well to bridge over

Mechanical failure/collapse of the borehole in a blowout scenario is influenced by several factors including in-situ stress, rock strength, and fluid velocities at the sand face. Given the substantial fluid velocities inherent in the WCD, and the scenario as defined where the formation is not supported by a cased and cemented wellbore, it is possible that the borehole may 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.

Additionally the rig (either dynamically positioned semisubmersible or drillship) has a gas handler system at the top of the riser consisting of two annular preventers that can be closed in to allow hydrocarbons in the riser to be contained or circulated thru the rig's well control system. The rig has two shearing rams in the BOP for added redundancy. Also, the rig selected will be equipped with a deadman system and an auto shear system.

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. 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 2010-N10 Shell will provide additional information regarding our containment capabilities in a subsequent filing.

g) Availability of a rig to drill a relief well and rig package constraints

Blowout intervention can be conducted from an ROV equipped vessel, the existing drilling rig or from another drilling rig. 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 2016 – 2026 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 Appomattox water depths and reservoir depths are in the following table:

Rig Name	Rig Type
Transocean Deepwater Thalassa	Dynamically positioned drillsip
Noble Globetrotter I	Dynamically positioned drillship
Noble Bully I	Dynamically positioned drillship
Transocean Deepwater Proteus	Dynamically positioned drillship

Table 2.4 Shell contracted rigs capable at Appomattox

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 Appomattox 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 80 days to drill down to the last casing string above the blowout zone, plus approximately 31 days for precision ranging activity to intersect the blowout well bore. Total time to drill a relief well would be ~128 days for the Appomattox wells.

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. Shell has deepwater anchor handlers on contract to support its moored rigs.

It is not possible to drill relief wells from any existing platforms due to distances of over fifteen miles to the discovery.

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). The safety case requirement is ingrained into Shell's Health, Security, Safety, Environment, and Social Performance Control Framework. 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 Appomattox. 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 drilling foreman and Shell representative 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 lived virtually by onshore teams consisting of geoscientists, petrophysicists, well engineers, and 24/7 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 Foreman 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 and 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 and is a founding member of MWCC.

k) Arrangements for drilling a relief well

The size of the Shell contracted rig fleet in the GoM from 2016-2026 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 approved or proposed OSRP

Shell has designed a response program (Regional OSRP 2014, 2015) based upon a regional capability of responding to a range of spill volumes, from small operational spills up to and including the WCD from an exploration 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

A. Geological Description

All the drilling/completion of the wells proposed in this DOCD were previously approved in Supplemental EP S-07761 on January 14, 2016 and S-07996 approved July 31, 2020. There is no change to the G&G information previously submitted in those plans.

B. Structure Contour Maps

Previously approved in EP S-07761 on 1/14/2016 and S-07996 on 7/31/20.

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

Previously approved in EP S-07761 on 1/14/2016 and S-07996 on 7/31/20.

D. Geological Structure Cross-Sections

Previously approved in EP S-07761 on 1/14/2016 and S-07996 on 7/31/20.

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

Previously approved in EP S-07761 on 1/14/2016 and S-07996 on 7/31/20 .

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 (H_2S)

A. Concentration

20-40 ppm

B. Classification

Pursuant to 30 CFR 250.490(c) Shell request that the Regional Supervisor classify the area of the proposed activity as H_2S present.

C. H_2S Contingency Plan

Shell Offshore Inc. submitted to BSEE GOMR District office a H_2S Contingency Plan prepared according to 30 CFR 250.490(f) on July 17, 2015.

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

Shell Offshore Inc. (Shell) is submitting a Supplemental DOCD for at various Drill Centers in the Appomattox Development field, Mississippi Canyon MC 391, and 392 for the addition of new production wells and seafloor equipment to continue its development. The SDOCD will add well jumpers in the area of existing infrastructure approved in previous DOCD. Drill Centers and production wells were approved in EP Control No. S-07761. Supplemental production wells were added in Supplemental EP Plan No. S-7996. Original jumpers were approved in DOCD Control No. N-09969.

Previously approved EP's cleared 2000 ft. radius around all Drill Centers. The 2000 ft clearance covers the area of installation at each Drill Center. The data from various reports were used to investigate water depths, potential hazards, deep-water benthic communities and archaeological assessment for above referenced EP, DOCD and this assessment. This assessment clears a 500 ft radius around each of the Drill Centers inclusive of installation area.

Seafloor conditions appear favorable within the vicinity of the proposed equipment installation. There are no potential sites for deepwater high-density benthic communities within 500 ft of the installation sites and no sonar targets of archaeological significance were identified in the vicinity.

This report addresses seafloor and subsurface conditions specific to the following proposed well locations, 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).

Geohazards and Archaeological Assessment. The following summary of the geohazards and archaeological assessment is based on the findings provided within the following detailed report, which were previously submitted:

- Fugro Geoservices, Inc, "Shallow Drilling Hazards and Archaeological Assessment, Mississippi Canyon Blocks 347, 348, 391, 392, and Vicinity (OCS-G 28002, -19939, -26252, and -26253) Gulf of Mexico, Report No. 27.2008-5022, dated 5/6/2009. Previously Submitted.
- AOA Geophysics, Inc, "Shallow Hazards Assessment, MC 393 (OCS-G 26254), DC 353 (OCS-G 25852), DC354 (OCS-G 23507), DC397 (OCS-G 25853), and DC398 (OCS-G 25854), Mississippi Canyon and De Soto Canyon Areas, Gulf of Mexico", Report No. 3038.3-SHL-DES, dated 10/29/2004. Previously Submitted.
- Fugro Geoservices, Inc. "Regional Geohazards Assessment, Blocks 391-393, 435-437, 479-481, 523-525, and 567-569, Mississippi Canyon Area, Gulf of Mexico", Report No. 0201-3000, dated 12/27/1996. Previously Submitted.
- Fugro Geoservices, Inc, "Archaeological Assessment, ROV Survey, Sonar Contact Investigation, Block 391, Mississippi Canyon Area, Gulf of Mexico", Report 2409-1112, dated 7/13/2009. Previously Submitted.
- Fugro Geoservices, Inc, "Archaeological Survey, Blocks 347-349, 391-393, and Portions of 346, 390, 434-436, Mississippi Canyon Area, Gulf of Mexico", Report No. 2408-5022, dated 3/24/2009. Previously Submitted.
- Fugro Geoservices, Inc. "Archaeological Assessment, Proposed Anchor Locations, Block 393, Mississippi Canyon Area, Gulf of Mexico", Report No. 2407-1083, dated 5/1/2007. Previously sumbmitted.
- Hazard Survey Injector East (IE) Drill Center Block 392 Mississippi Canyon Areas. OII Doc. No. 196418-OII-RPT-HRC-02, Dec 2018. Previously submitted.
- Hazard Survey Injector West (IW) Drill Center Block 391 Mississippi Canyon Areas. OII Doc. No. 196418-OII-RPT-HRC-01, Dec 2018. Previously submitted.

Available Data

This assessment is based on the analysis of: a) high-resolution geophysical datasets b) reprocessed exploration 3D seismic data volume.

Oil Field Infrastructure and Military Warning Areas. Installation Site Conditions.
Infrastructure consisting of previously drilled wells, pipelines, sleds, umbilicals, and other equipment used in developing the field are within 500 ft. of the proposed installation sites. 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 wellsites.

Proposed Well Jumpers, Appomattox West Drill Center (AW) Mississippi Canyon Block 391 (OCS-G-26252)

Proposed Installation Location
The location of the installation area is in the northwestern corner of block MC 391. Table A-1 proposed and as-built location coordinates:

Table A-1. Location Coordinates of Proposed / AS-BUILT Equipment

Name	Spheroid & Datum: Clarke 1866 NAD27 Projection: UTM Zone 16 North	
MC 391 AW007	X: 1311273 ft	Y: 10387310 ft.
MC 391 AW007-ALT	X: 1311358 ft.	Y: 10387268 ft.
MC 391 AW DC Manifold	X: 1311235.62 ft.	Y: 10387181.94 ft.

Our assessment addresses the seafloor conditions within a 500-ft radius around the proposed area of impact. Figure AWDC-ESR.

Shell proposes to install a well jumper from AW DC Manifold Hub to proposed AW007 production well at an approximate length of 133 ft.

Shell proposes to install a well jumper from AW DC Manifold to proposed AW007 ALT production at an approximate length of 149 ft.

Water Depth and Seafloor Conditions. The water depths within 500 ft. of Appo West Drill Center (AW) ranges from 7160 ft. to 7170 ft. and the seafloor gently slopes to the south at 0.53°.

Deepwater Benthic Communities. There is no potential for high-density benthic communities within 500 ft. of the proposed installation site. There are no water bottom anomalies as defined by the BOEM (BOEM, 2019) within 500 ft of the proposed installation area. No MBES backscatter or side-scan sonar anomalies, or seafloor morphologic features possibly related to fluid expulsion features and/or hard grounds were identified within the study area.

Archaeological Assessment. There are no sonar contacts identified within 500 ft of the proposed installation area and therefore no archaeologically significant sonar contacts were identified.

Proposed Well Jumpers, Appomattox Southwest Injector Drill Center (IW), Mississippi Canyon Block 391 (OCS-G-26252)

Proposed Installation Location
The location of the installation area is in the middle of block MC 391. Table B-1 proposed and as-built location coordinates:

Table B-1. Location Coordinates of Proposed / AS-BUILT Equipment

Name	Spheroid & Datum: Clarke 1866 NAD27 Projection: UTM Zone 16 North	
MC 391 IW001	X: 1313862 ft	Y: 10379919 ft.
MC391 IW004	X: 1313639 ft	Y: 10379846 ft.
MC 391 IW005	X: 1313900 ft.	Y: 10380000 ft.
MC 391 IW001-ALT	X: 1313559 ft.	Y: 10379785 ft.
MC 391 IW DC Manifold	X: 1313746.23 ft.	Y: 10379869.76 ft.

Our assessment addresses the seafloor conditions within a 500-ft radius around the proposed area of impact. Figure IWDC-ESR.

Shell proposes to install a well jumper from IW DC Manifold Hub to proposed IW001 production well at an approximate length of 126 ft.

Shell proposes to install a well jumper from IW DC Manifold to proposed IW001 ALT production at an approximate length of 206 ft.

Shell proposes to install a well jumper from IW DC Manifold Hub to proposed IW004 production well at an approximate length of 110 ft.

Shell proposes to install a well jumper from IW DC Manifold to proposed IW005 production at an approximate length of 202 ft.

Water Depth and Seafloor Conditions. The water depths within 500 ft. of Appo Soutwest Injector Drill Center (IW) ranges from 7185 ft. to 7195 ft. and the seafloor slopes to the east with a gentle gradient of less than 1°.

Deepwater Benthic Communities. There is no potential for high-density benthic communities within 500 ft. of the proposed installation site. There are no water bottom anomalies as defined by the BOEM (BOEM, 2019) within 500 ft of the proposed installation area. No MBES backscatter or side-scan sonar anomalies, or seafloor morphologic features possibly related to fluid expulsion features and/or hard grounds were identified within the study area.

Archaeological Assessment. There are no sonar contacts identified within 500 ft of the proposed installation area and therefore no archaeologically significant sonar contacts were identified.

Proposed Well Jumpers, Appomattox Southeast Injector Drill Center (IE), Mississippi Canyon Block 392 (OCS-G-26253)

Proposed Installation Location
The location of the installation area is in the middle of block MC 392. Table C-1 proposed and as-built location coordinates:

Table C-1. Location Coordinates of Proposed / AS-BUILT Equipment

Name	Spheroid & Datum: Clarke 1866 NAD27 Projection: UTM Zone 16 North	
MC 392 IE002	X: 1326171 ft	Y: 10383811 ft
MC 392 IE002-ALT	X: 1325888 ft.	Y: 10383895 ft.
MC 392 IE DC Manifold	X: 1326090.83 ft.	Y: 10383716.74 ft.

Our assessment addresses the seafloor conditions within a 500-ft radius around the proposed area of impact. Figure IEDC-ESR.

Shell proposes to install a well jumper from IE DC Manifold Hub to proposed IE002 production well at an approximate length of 124 ft.

Shell proposes to install a well jumper from IE DC Manifold to proposed IE002-ALT production at an approximate length of 270 ft.

Water Depth and Seafloor Conditions. The water depths within 500 ft. of Appo Southeast Injector Drill Center (IE) ranges from 7270 ft. to 7280 ft. and the seafloor slopes to the east with a gentle gradient of 1°. There is evidence of drag scars, seafloor depressions/impressions and fractures within 2000 ft. of the proposed production wellsite.

Deepwater Benthic Communities. There is no potential for high-density benthic communities within 500 ft. of the installation site. There are no water bottom anomalies as defined by the BOEM (BOEM, 2019) within 500 ft of the proposed installation area. No MBES backscatter or side-scan sonar anomalies, or seafloor morphologic features possibly related to fluid expulsion features and/or hard grounds were identified within the study area.

Archaeological Assessment. There are no sonar contacts identified within 500 ft of the proposed installation area and therefore no archaeologically significant sonar contacts were identified.

Proposed Well Jumpers, Appomattox Central Drill Center (AC), Mississippi Canyon Block 392 (OCS-G-26253)

Proposed Installation Location
The location of the installation area is in the northern center of block MC 392. Table D-1 proposed and as-built location coordinates:

Table D-1. Location Coordinates of Proposed / AS-BUILT Equipment

Name	Spheroid & Datum: Clarke 1866 NAD27 Projection: UTM Zone 16 North	
MC 392 AC002	X: 1320642 ft	Y: 10389109 ft.
MC 392 AC DC Manifold	X: 1320729.71 ft.	Y: 10389026.28 ft.

Our assessment addresses the seafloor conditions within a 500-ft radius around the proposed area of impact. Figure ACDC-ESR.

Shell proposes to install a well jumper from AC DC Manifold to proposed AC002 production well at an approximate length of 120 ft.

Water Depth and Seafloor Conditions. The water depths within 500 ft. of Appo Central Drill Center (AC) ranges from 7220 ft. to 7230 ft.

Deepwater Benthic Communities. There is no evidence of seafloor or near-surface faulting, amplitudes or fluid expulsion features. The high resolution geophysical data does not indicate any high density deep water benthic communities in the area. The BOEM database shows possible seep anomalies which correspond to the sides of Mobile Dome where older sediments are exposed to due slope failure.

Archeological Assessments. There are no sonar targets within the 500 ft radius around Drill Center Appo Central (AC) and the proposed jumper location, therefore there are no archaeological avoidances in the proposed area.

Proposed Well Jumpers, Appomattox East Drill Center (AE), Mississippi Canyon Block 392 (OCS-G-26253)

The proposed production wellsites are located in the north center of MC 392. Table E-1 proposed and as-built location coordinates:

Table E-1. Location Coordinates of Proposed / AS-BUILT Equipment

Name	Spheroid & Datum: Clarke 1866 NAD27 Projection: UTM Zone 16 North	
MC 392 AE003	X: 1324869 ft	Y: 10388035 ft.
MC 392 AE002	X: 1324651 ft.	Y: 10388096 ft.
MC 392 AE DC Manifold	X: 1324749.14 ft.	Y: 10388022.54 ft.

Our assessment addresses the seafloor conditions within a 500-ft radius around the proposed area of impact. Figure AEDC-ESR.

Shell proposes to install a well jumper from AE DC Manifold to proposed AE002 production well at an approximate length of 122 ft.

Shell proposes to install a well jumper from AE DC Manifold to proposed AE003 production well at an approximate length of 120 ft.

Water Depth and Seafloor Conditions. Based on the AUV multibeam echo-sounder data, the water depth at the proposed well location is 7,255 ft. and the seafloor slopes at 1.00°.

Deepwater Benthic Communities. There is no potential for high-density benthic communities within 500 ft. of the installation site. There are no water bottom anomalies as defined by the BOEM (BOEM, 2019) within 500 ft of the proposed installation area. No MBES backscatter or side-scan sonar anomalies, or seafloor morphologic features possibly related to fluid expulsion features and/or hard grounds were identified within the study area.

Archaeological Assessment. There are no sonar contacts identified within 500 ft of the proposed installation area and therefore no archaeologically significant sonar contacts were identified.

Concluding Remarks

Based on detailed study of the high-resolution geophysical survey, consisting of frequency enhanced 3-D seismic, Enhanced Surface Renderings, and AUV high-resolution data, these area appears suitable for the planned activity.

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

The EIA found in Section 18 discusses potential impacts and mitigation measures related to threatened and endangered species.

I. Archaeological Report

See Section 6A above.

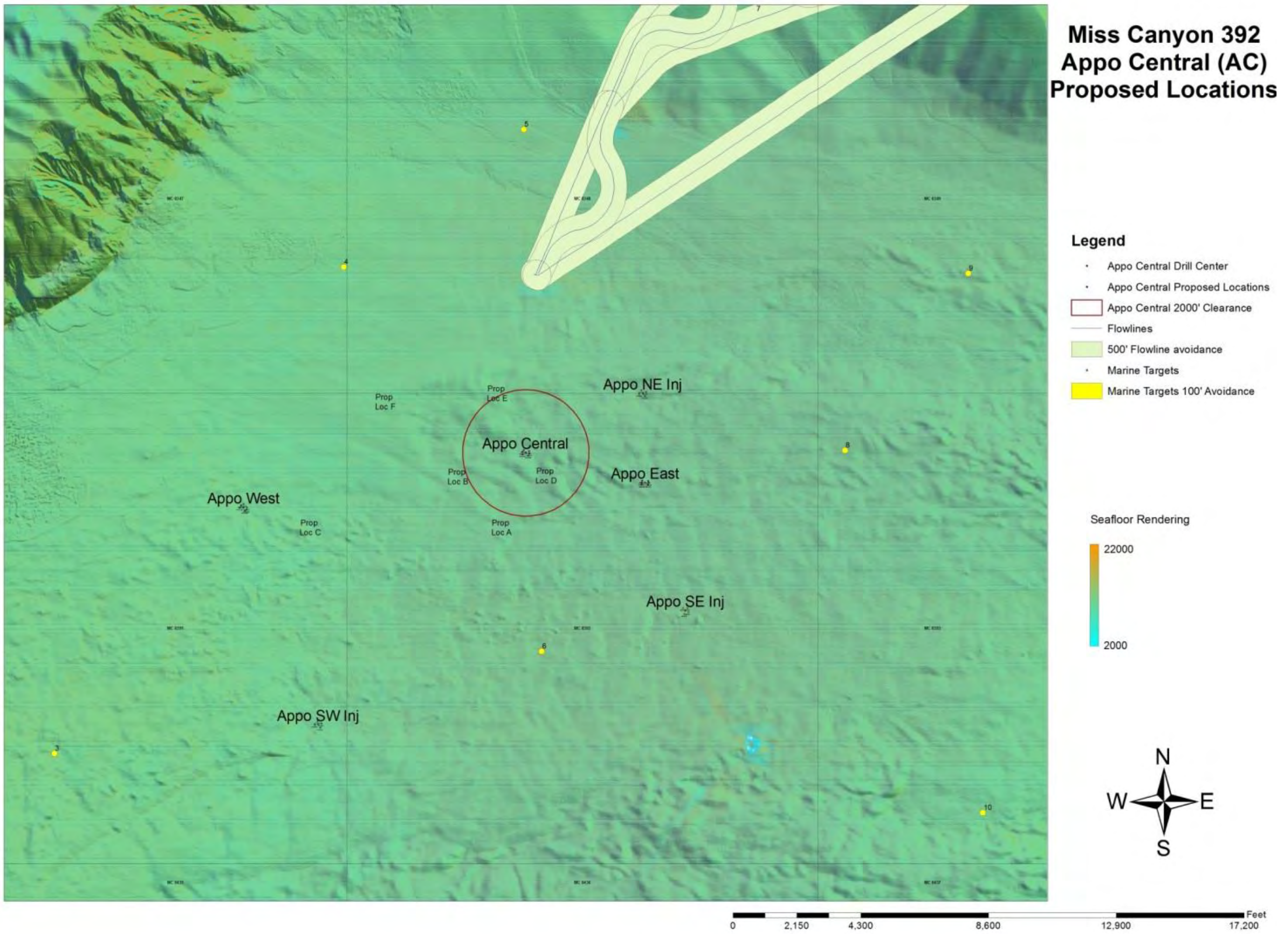
J. Air and Water Quality Information

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.

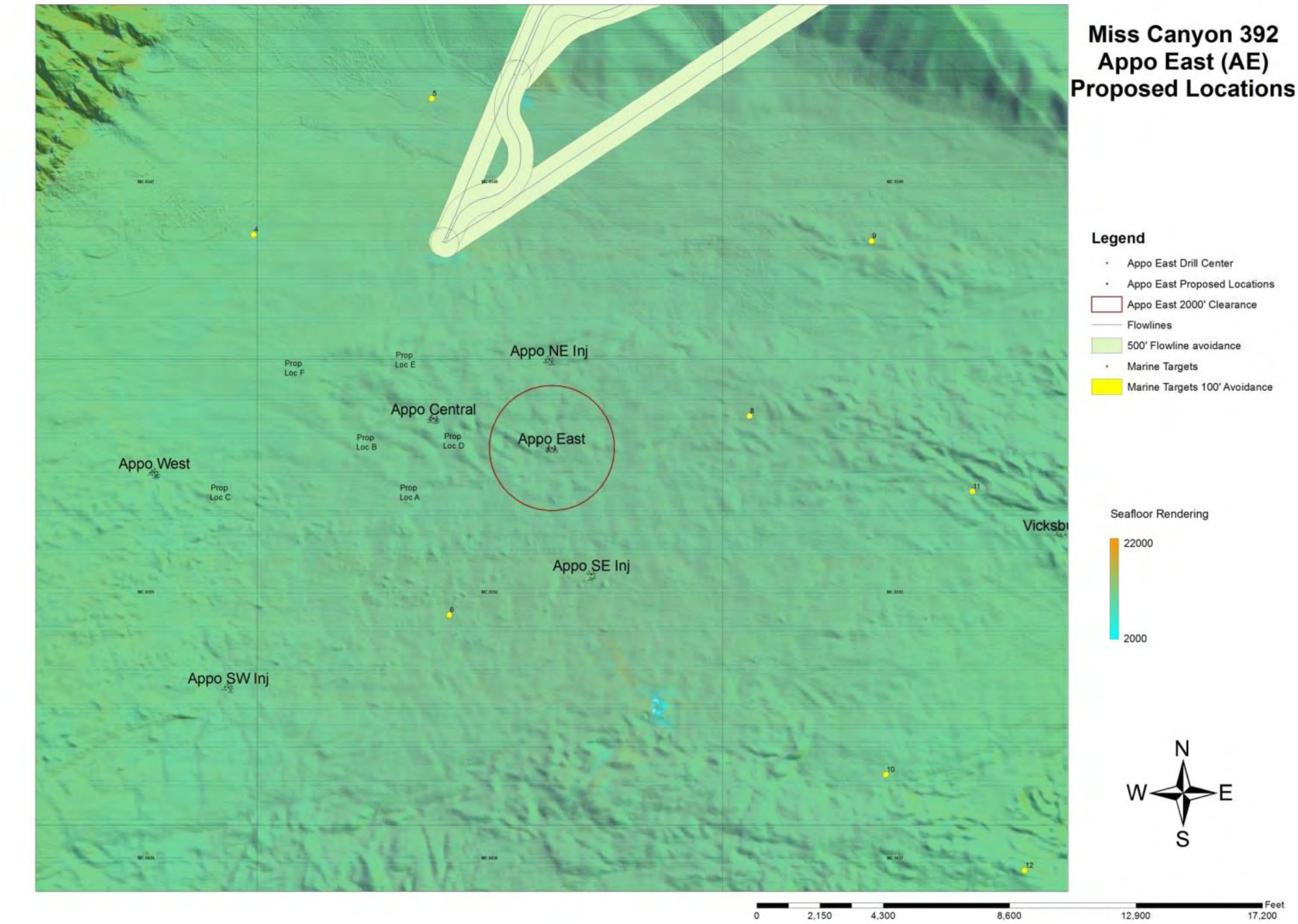
K. Socioeconomic Information

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.

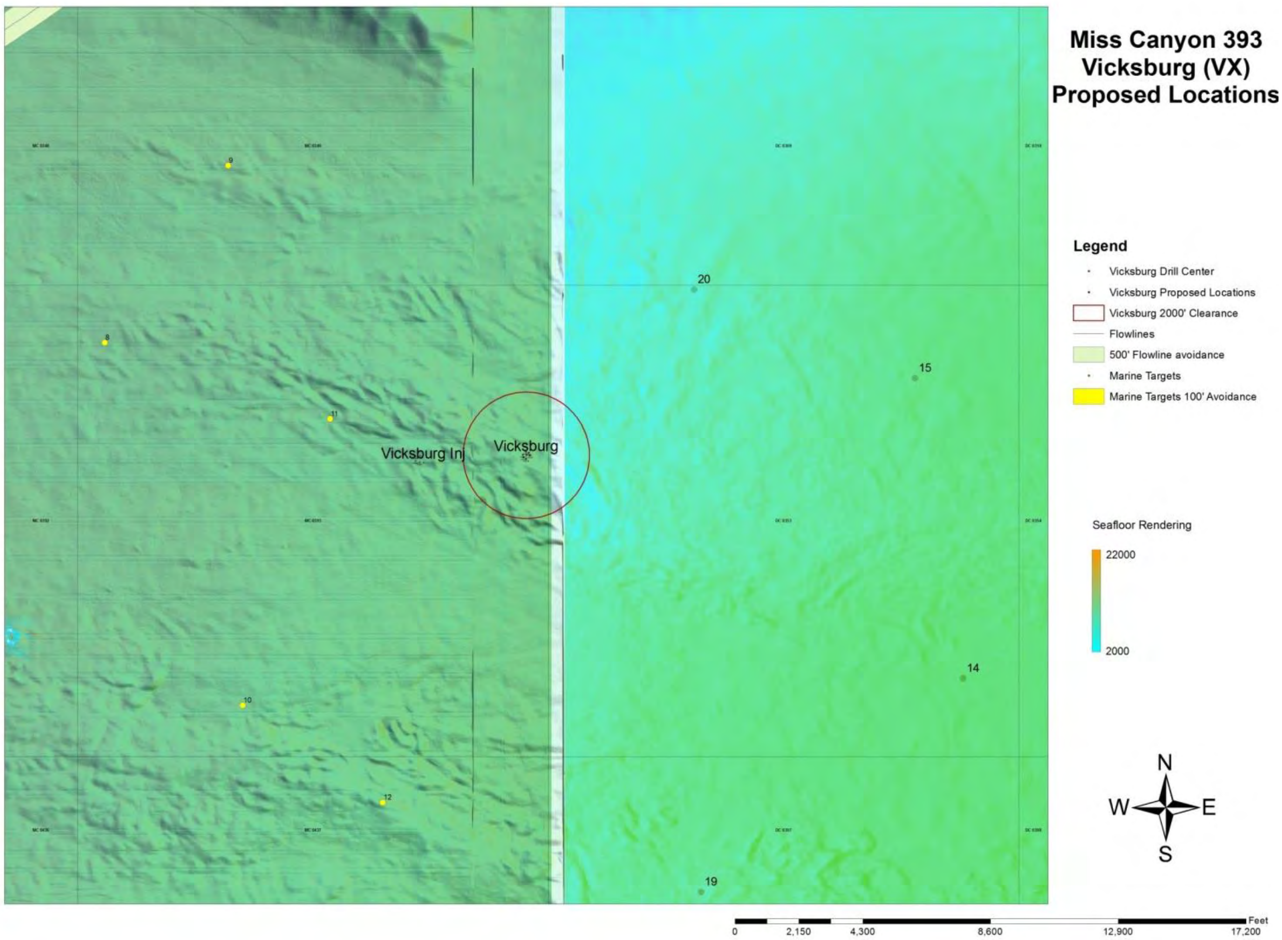
Attachment 6A – AC Drill Center

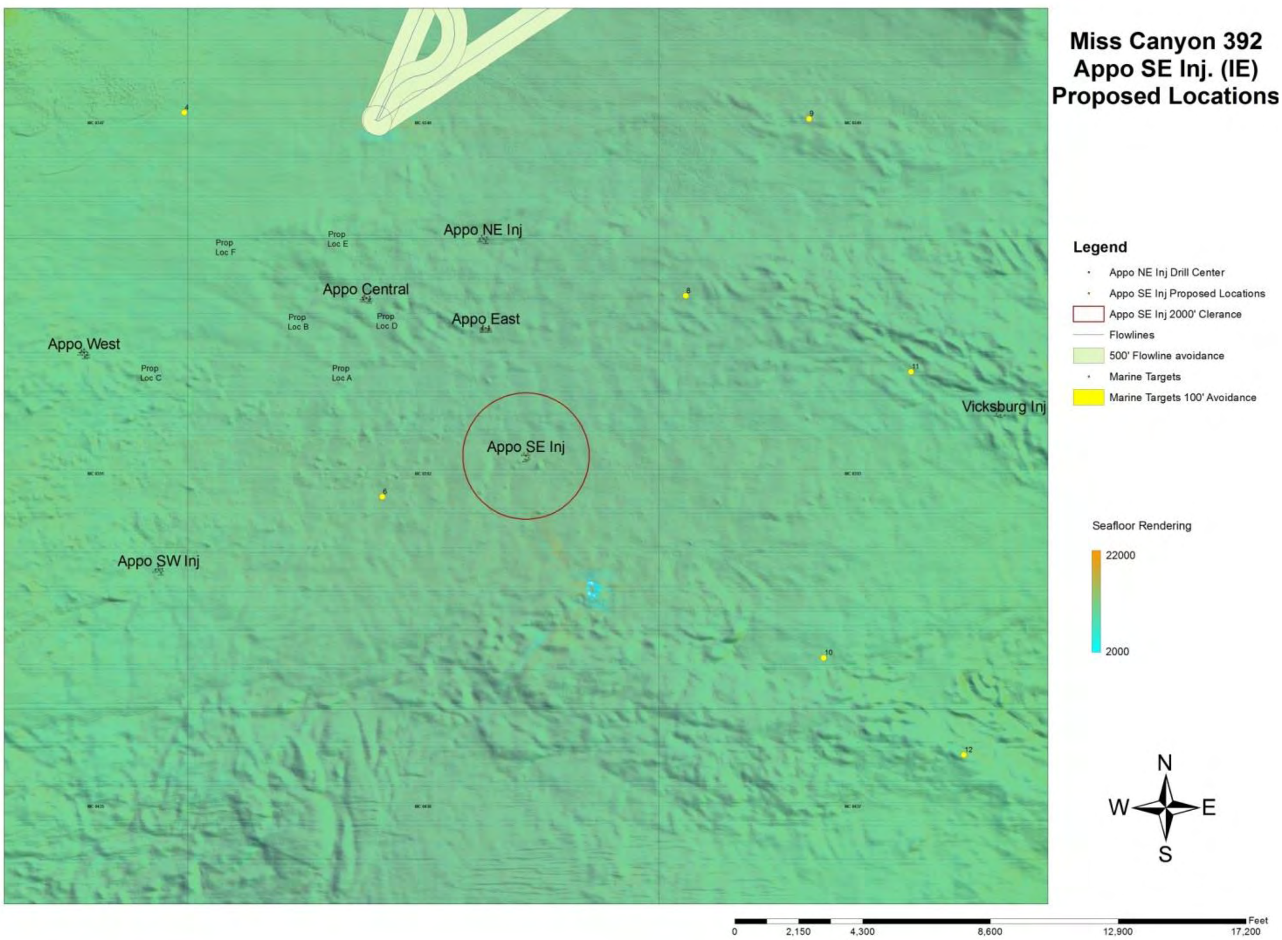


<u>Attachment 6B – AE Drill Center</u>

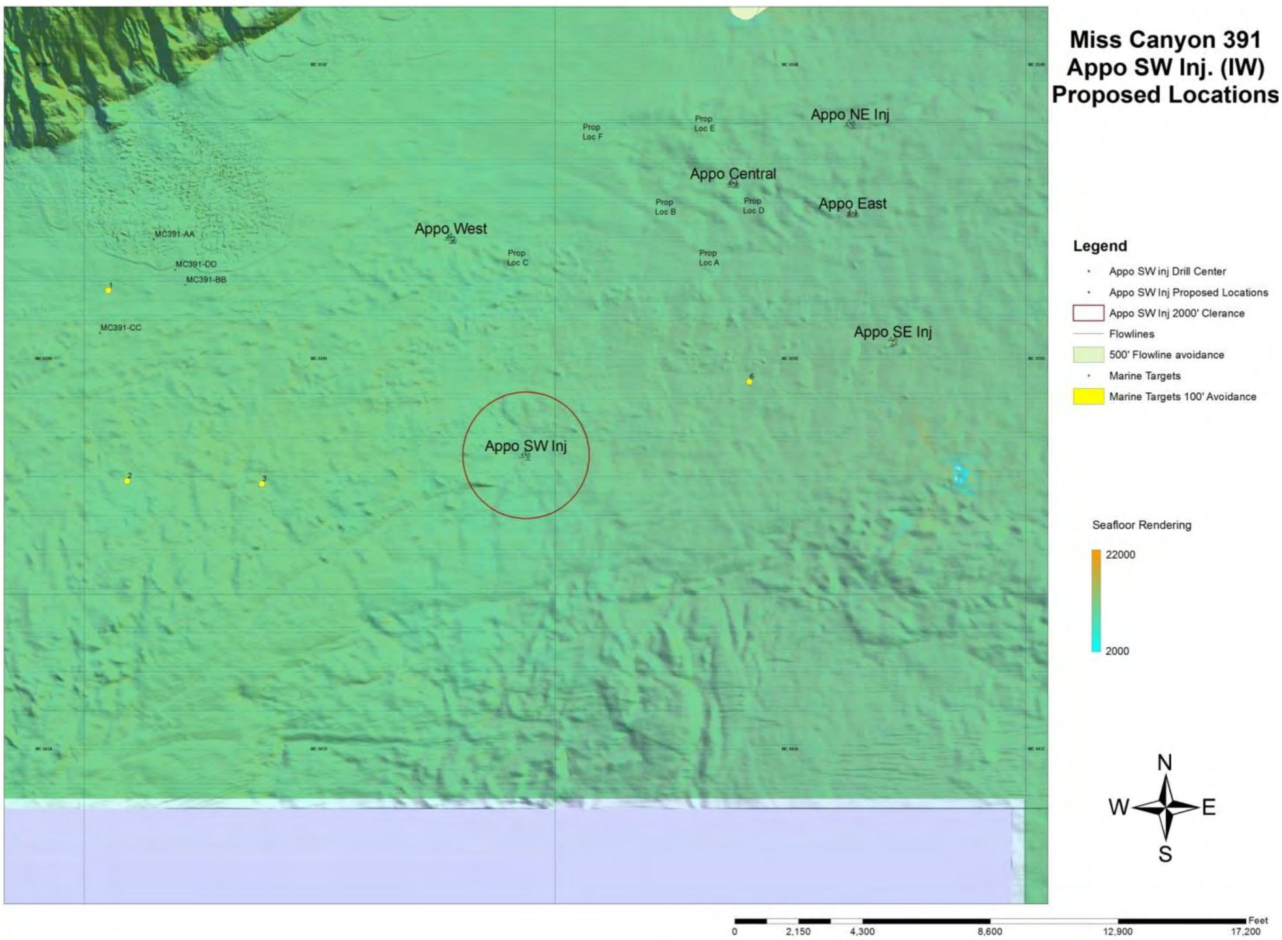


Attachment 6C – VX Drill Center




Miss Canyon 392
Appo SE Inj. (IE)
Proposed Locations
Legend
Appo NE Inj Drill Center
Appo SE Inj Proposed Locations
Appo SE Inj 2000' Clerance
Flowlines
500' Flowline avoidance
Marine Targets
Marine Targets 100' Avoidance
Seafloor Rendering
22000
2000
Appo NE Inj
Appo Central
Appo East
Appo West
Appo SE Inj
Appo SW Inj
Vicksburg Inj
Prop Loc A
Prop Loc B
Prop Loc C
Prop Loc D
Prop Loc E
Prop Loc F
N
W
E
S
0
2,150
4,300
8,600
12,900
17,200
Feet

Attachment 6E – IW Drill Center



Attachment 6F – AW Drill Center

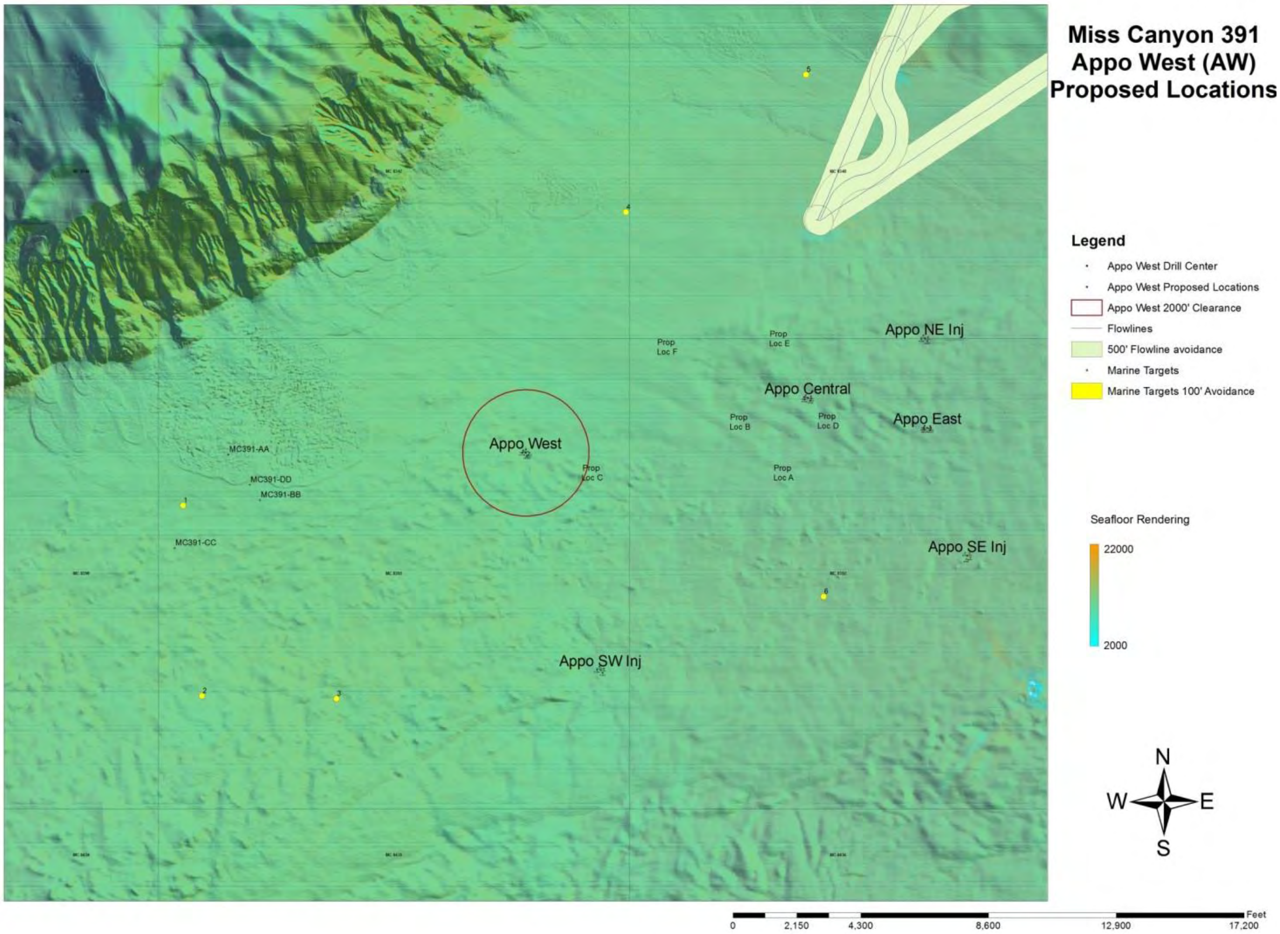


TABLE 7A: WASTES YOU WILL GENERATE, TREAT AND DOWNHOLE DISPOSE OR DISCHARGE TO THE GOM

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/well*	*discharge pipe*	*No*
Water-based drilling fluid	barite, additives, mud	85000 bbls/well	17000 bbls/day	marine riser installation	No
Cuttings wetted with water-based fluid	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	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	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	Synthetic-based drilling mud	0 bbls / well	0 bbls/day	Overboard discharge line below the water level	No
Spent drilling fluids - water based	Synthetic-based drilling mud	0 bbls / well	0 bbls/day	Overboard discharge line below the water level	No
Chemical product waste	Chemical product waste	0 bbls / well	0 bbls/day	Treated to meet NPDES limits and discharged overboard	No
Brine	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 (kitchen water, shower water)	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)	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					
Deck Drainage	Wash and rainwater	1800 bbls/well	20 bbls/day	Drained overboard through deck scuppers	No
Will you conduct well treatment, completion, or workover?					
well treatment fluids	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	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	Linear Frac Gel Flush Fluids, Crosslinked Frac Fluids carrying ceramic proppant, spacers, flushes, and acidic breaker fluid	450 bbls/well	15 bbls/day	NA	No
Miscellaneous discharges. If yes, only fill in those associated with your activity.					
Desalinization unit discharge	Rejected water from watermaker unit	36000 bbls/well	400 bbls/day/well	RO Desalinization Unit Discharge Line below waterline	No
Blowout preventer fluid	Water based	18 bbls/well	0 bbls/day	Discharge Line @ Subsea BOP @ seafloor	No
Ballast water	Uncontaminated seawater	294840 bbls/well	3276 bbls/day	Discharge line overboard just above water line	No
Bilge water	Bilge and drainage water will be treated to MARPOL standards (< 15ppm oil in water).	138870 bbls/well	1543 bbls/day	Bilge and drainage water will be treated to MARPOL standards (< 15ppm oil in water).	No
Excess cement at seafloor	Cement slurry	12000 bbls/well (assume planned 100% excess is discharged)	200 bbls/day	Discharged at seafloor.	No
Fire water	Treated seawater	6000 bbls/well	2000 bbls/month	Discharged below waterline	No
Cooling water	Treated seawater	41070870 bbls/well	456343 bbls/day/well	Discharged below waterline	No
Untreated or treated seawater	Treated Seawater	20000 bbls / flowline	300 gpm	Discharged at seafloor.	No
Hydrate Inhibitor	Hydrate Inhibitor	200 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	NA	NA	NA	NA	
Will you be covered by an individual or general NPDES permit ?			GENERAL PERMIT	GMG290103	
NOTE: If you will not have a type of waste, enter NA in the row.					

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*
Oil-based drilling fluid or mud	NA	NA	NA	NA	NA
Synthetic-based drilling fluid or mud	used SBF and additives	Drums/tanks on supply boat/barges	Halliburton Drilling Fluids, MiSwaco, Newpark Drilling Fluids - Fourchon, LA; Ecoserv (Fourchon, La.), or R360 Environmental Solutions (Fourchon, La.),	6,500 bbls/well	Recycled/Reconditioned; Deep Well Injection
Cuttings wetted with Water-based fluid	NA	NA	NA	NA	NA
Cuttings wetted with Synthetic-based fluid	Drill cuttings from synthetic based interval.	storage tank on supply boat.	Ecoserv (Fourchon, La.), or R360 Environmental Solutions (Fourchon, La.),	300 bbls / well	Deep Well Injection, or landfarm
Cuttings wetted with oil-based fluids	NA	NA	NA	NA	NA
Completion Fluids	Completion and treatment fluids	Storage tank on supply boat	Halliburton, Baker Hughes, Newpark, or Tetra - Fourchon, LA; Ecoserv (Fourchon, La.), or R360 Environmental Solutions (Fourchon, La.),	4,000 bbls/well	Recycled/Reconditioned; Deep Well Injection
Salvage Hydrocarbons	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	Sand Produced from formation	Drums/tanks on supply boat	Ecoserv (Fourchon, La.), 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*
Trash and debris - recyclables	trash and debris	various storage containers on supply boat	Omega Waste Managment, W. Patterson, LA; Lamp Environmental, Hammond, LA	200 lbs/month	Recycle
Trash and debris - non-recyclables	trash and debris	various storage containers on supply boat	Republic/BFI landfill, Sorrento, LA or the parish landfill, Avondale, LA	400 lbs/month	Landfill
E&P Wastes	Completion and treatment wastes	various storage containers on supply boat	Ecoserv (Fourchon, La.), or R360 Environmental Solutions (Fourchon, La.)	200 bbls / well	Deep Well Injection, or landfarm
Used oil and glycol	used oil, oily rags and pads, empty drums and cooking oil	various storage containers on supply boat	Omega Waste Managment, W. Patterson, LA	20 bbls/month	Recycle
Non-Hazardous Waste	paints, solvents, chemicals, completion and treatment fluids	various storage containers on supply boat	Republic/BFI landfill, Sorrento, LA Lamp Environmental, Hammond, LA	60 bbls/mo	Incineration or RCRA Subtitle C landfill
Non-Hazardous Oilfield Waste	Chemicals, completion and treatment fluids	various storage containers on supply boat	Ecoserv (Port Arthur, TX)	60 bbls/mo	Deep Well Injected
Hazardous Waste	paints, solvents, chemicals, completion and treatment, commissioning fluids	various storage containers on supply boat	Omega Waste Managment, W. Patterson, LA; Lamp Environmental, Hammond, LA	60 bbls/mo	Recycle, treatment, incineration, or landfill
Universal Waste Items	Batteries, lamps, glass and mercury-contaminated waste	various storage containers on supply boat	Lamp Environmental, Independence, 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 exploration activities more than 90% of the amounts calculated using the following formulas: CT = $3400D^{2/3}$ for CO, and CT = 33.3D for the other air pollutants (where D = distance to shore in miles)?		X
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 250.1105(a)(2) and (3)?		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.

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

CO					

(2) Contact: Cidney Christie, (504) 425-3014, Cidney.christie@shell.com

Worksheets – See modeling report

AQR FOR FPSO

	OCS-G 30380 (RUE Pending)
	Appomattox FPS
T	Cidney Christie / Josh O'Brien
	504.425.3014 / 504.425.9097
	SEPCo Environmental File - Appo-AQR-DOCD-20181012-BOEM.xlsx

INE CONSTRUCTION INFORMATION:	
NUMBER OF PIPELINES	TOTAL NUMBER OF CONSTRUCTION DAYS
	Install jumpers 2020-2057

Fuel Usage Conversion Factors	Natural Gas Turbines		Natural Gas Engines		Diesel Recip. Engine		REF.	DATE
	SCF/hp-hr	9.524	SCF/hp-hr	7.143	GAL/hp-hr	0.0483	AP42 3.2-1	4/76 & 8/84

BOEM Default Equipment/Emission Factors	units	PM	SOx	NOx	VOC	CO	REF.	DATE	Notes
NG Turbines	gms/hp-hr		0.0371	1.3	0.01	0.83	42 3.2-1& 3.1	10/96	1
NG 2-cycle lean	gms/hp-hr		0.0278	10.9	0.43	1.5	AP42 3.2-1	10/96	1
NG 4-cycle lean	gms/hp-hr		0.0278	11.8	0.72	1.6	AP42 3.2-1	10/96	1
NG 4-cycle rich	gms/hp-hr		0.0278	10	0.14	8.6	AP42 3.2-1	10/96	1
Diesel Recip. < 600 hp - Using ULSD	gms/hp-hr	1	0.0055	14	1.12	3.03	AP42 3.3-1	10/96	
Diesel Recip. > 600 hp - Using ULSD	gms/hp-hr	0.32	0.0055	11	0.33	2.4	AP42 3.4-1	10/96	
Diesel Boiler	lbs/bbl	0.084	0.0091	0.84	0.008	0.21	P42 1.3-12,1	9/98	1
NG Heaters/Boilers/Burners	lbs/mmscf	7.6	8.905	100	5.5	84	1.4-1, 14-2, 8	7/98	1
NG Flares	lbs/mmscf		28.496	71.4	60.3	388.5	AP42 11.5-1	9/91	
Liquid Flaring	lbs/bbl	0.42	6.83	2	0.01	0.21	42 1.3-1 & 1.	9/98	
Tank Vapors	lbs/bbl				0.03		E&P Forum	1/93	
Fugitives	lbs/hr/comp.				0.0005		API Study	12/93	
Glycol Dehydrator Vent	lbs/mmscf				6.6		La. DEQ	1991	1
Gas Venting	lbs/scf				0.0034				

Non-Default Equipment/Emission Factors	units	PM	SOx	NOx	VOC	CO	REF.	DATE	Notes
Distillate Turbines	lb/mmbtu	0.01	0.002	0.88	0.0004	0.003	42 3.2-1& 3.1	(04/00)	2
Distillate Turbines (LM2500)	gm/hp-hr	0.04	0.005	2.70	0.001	0.01			2
LM2500 SAC - Gas Fueled	gms/hp-hr		0.037	2.96	0.01	0.83			3
LM2500 DLE - Gas Fueled	gms/hp-hr		0.037	0.303	0.062	0.83			4
Diesel Recip. > 600 hp - Installation Vessels	gms/hp-hr	0.32	0.1835	11	0.33	2.4	AP42 3.4-1	10/96	7
IMO Tier 2 Certified Engines > 600 hp	gms/hp-hr	0.32	0.0055	7.23	0.33	2.4	.4-1 & IMO NO	N/A	1
IMO Tier 3 Certified Engines > 600 hp	gms/hp-hr	0.32	0.005505	1.8	0.33	2.4	.4-1 & IMO NO	N/A	1
EPA Tier 4i Certified Engines	gms/hp-hr	0.32	0.0055	1.0	0.33	2.4	4-1 & EPA Ce	N/A	1

Sulphur Content Source	**Value**	**Units**
Fuel Gas - Turbines - See Note 9	50	ppm
Fuel Gas - Duct Burners - See Note 9	50	ppm
Diesel Fuel - see Note 6	0.0015	% weight
Diesel Fuel - see Note 7	0.05	% weight
Produced Gas (Flares) - see Note 9	160	ppm
Produced Oil (Liquid Flaring) - see Note 1	1	% weight

COMPANY	AREA	BLOCK	LEASE	PLATFORM		WELL			CONTACT		PHONE	REMARKS					
Shell Offshore Inc	MC	437	OCS-G 33733	Appomattox FPS		0			Cidney Christie / Josh O'B		504.425.301	SEPCo Environmental File - Appo-AQR-DOCD-20181012-BOEM.xlsx					
MC	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	Notes	HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
FPS Production	Power Gen Turbine- (Dual Fuel) LM2500+G4 SAC - Gas Fueled (Nameplate Rating of 35MVA & PF =0.8)	41370	394008	9062181	no mitigation	23	365	0.00	3.38	269.73	0.91	75.63	0.00	14.19	1132.17	3.82	317.47
	Power Gen Turbine- (Dual Fuel) LM2500+G4 SAC - Diesel Fueled (Nameplate Rating of 35MVA & PF =0.8)	41370				1	365	3.36	0.42	246.23	0.11	0.92	0.61	0.08	44.94	0.02	0.17
	Power Gen Turbine- (Dual Fuel) LM2500+G4 SAC - Gas Fueled (Nameplate Rating of 35MVA & PF =0.8)	41370	394008	9062181	no mitigation	23	365	0.00	3.38	269.73	0.91	75.63	0.00	14.19	1132.17	3.82	317.47
	Power Gen Turbine- (Dual Fuel) LM2500+G4 SAC - Diesel Fueled (Nameplate Rating of 35MVA & PF =0.8)	41370				1	365	3.36	0.42	246.23	0.11	0.92	0.61	0.08	44.94	0.02	0.17
	Power Gen Turbine LM2500+G4 DLE - Gas Fueled (Nameplate Rating of 35MVA & PF =0.8)	40480	385532	9252756	no mitigation	24	365	0.00	3.31	27.02	5.53	74.01	0.00	14.49	118.33	24.21	324.14
	Power Gen Turbine LM2500+G4 DLE - Gas Fueled (Nameplate Rating of 35MVA & PF =0.8)	40480	385532	9252756	no mitigation	24	365	0.00	3.31	27.02	5.53	74.01	0.00	14.49	118.33	24.21	324.14
	Power Gen Turbine LM2500+G4 DLE - Gas Fueled (Nameplate Rating of 35MVA & PF =0.8)	40480	385532	9252756	no mitigation	24	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	WHRU Duct Burners - #1	57.2	54476	1307429	no mitigation	24	365	0.41	0.49	5.45	0.30	4.58	1.81	2.12	23.86	1.31	20.04
	WHRU Duct Burners - #2	57.2	54476	1307429	no mitigation	24	365	0.41	0.49	5.45	0.30	4.58	1.81	2.12	23.86	1.31	20.04
	WHRU Duct Burners - #3	57.2	54476	1307429	no mitigation	24	365	0.41	0.49	5.45	0.30	4.58	1.81	2.12	23.86	1.31	20.04
	WHRU Duct Burners - #4	57.2	54476	1307429	no mitigation	24	365	0.41	0.49	5.45	0.30	4.58	1.81	2.12	23.86	1.31	20.04
	RECIP. diesel Fire Pump #1	1065	51	103	no mitigation	2	52	0.75	0.01	25.80	0.77	5.63	0.04	0.00	1.34	0.04	0.29
	RECIP. diesel Fire Pump #2	1065	51	103	no mitigation	2	52	0.75	0.01	25.80	0.77	5.63	0.04	0.00	1.34	0.04	0.29
	Essential Generator	2552	123	247	no mitigation	2	52	1.80	0.03	61.83	1.85	13.49	0.09	0.00	3.22	0.10	0.70
	Emergency Generator	2552	123	247	no mitigation	2	52	1.80	0.03	61.83	1.85	13.49	0.09	0.00	3.22	0.10	0.70
	Cold Start Air Compressor	125	6	12	no mitigation	2	52	0.28	0.00	3.85	0.31	0.83	0.01	0.00	0.20	0.02	0.04
	Lifeboats/Rescue Boats	288	14	28	no mitigation	2	52	0.63	0.00	8.88	0.71	1.92	0.03	0.00	0.46	0.04	0.10
	Misc small temporary diesel engines (welding machines, air compressors	1000	48	869	no mitigation	18	365	0.70	0.01	24.23	0.73	5.29	2.32	0.04	79.59	2.39	17.37
	General Support all years	9790	473	11349	no mitigation	24	110	6.90	0.12	237.20	7.12	51.75	9.07	0.16	311.68	9.35	68.00
	Chemical Delivery	9790	473	11349	no mitigation	24	102	6.90	0.12	237.20	7.12	51.75	8.45	0.15	290.34	8.71	63.35
	MISC.	BPD	SCF/HR	COUNT													
	Intermittent Flaring (shut-in, equipment out of service, etc.) from either HP or LP Flare		150000			24	72	0.00	4.27	10.71	9.05	58.28	0.00	3.69	9.25	7.81	50.35
	HP Flare - Routine Flaring (pilot gas, purge gas, etc.		830			24	365	0.00	0.02	0.06	0.05	0.32	0.00	0.10	0.26	0.22	1.41
	LP Flare - Routine Flaring (pilot gas, purge gas, etc.		591			24	365	0.00	0.02	0.04	0.04	0.23	0.00	0.07	0.18	0.16	1.01
	Atmospheric Vent - Intermittent due to Equipment Maintenance/Malfunction		2083			24	72				7.08					6.12	
	Fugitives			11420		24	365				5.71					25.01	
	Various Storage Tanks (including but not limited to Water clarifier, silicone defoamer, Flurosilicone defoamer, Reverse Emulsion Breaker, Corrosion Inhibiotor, Emulsion Breaker, Asphaltene Inhibitor, Scale Inhibitor, H2S scavenger, Methanol, Scale Squeeze)	248				24	365				0.31					1.36	
CY2020	**YEAR TOTAL**							**28.89**	**20.82**	**1805.19**	**57.78**	**528.04**	**28.62**	**70.23**	**3387.41**	**122.82**	**1567.34**
EXEMPTION CALCULATION	**DISTANCE FROM LAND IN MILES**												**2397.60**	**2397.60**	**2397.60**	**2397.60**	**58843.78**
	72.0																

COMPANY	AREA	BLOCK	LEASE	PLATFORM		WELL		CONTACT		PHONE	REMARKS								
Shell Offshore Inc	MC	437	OCS-G 33733	Appomattox FPS		0			Cidney Christie / Josh O'B	504.425.301	SEPCo Environmental File - Appo-AQR-DOCD-20181012-BOEM.xlsx								
MC	**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**	**Notes**	**HR/D**	**DAYS**	**PM**	**SOx**	**NOx**	**VOC**	**CO**	**PM**	**SOx**	**NOx**	**VOC**	**CO**		
FPS Production	Power Gen Turbine- (Dual Fuel) LM2500+G4 SAC - Gas Fueled (Nameplate Rating of 35MVA & PF =0.8)	41370	394008	9062181	no mitigation	23	365	0.00	3.38	269.73	0.91	75.63	0.00	14.19	1132.17	3.82	317.47		
	Power Gen Turbine- (Dual Fuel) LM2500+G4 SAC - Diesel Fueled (Nameplate Rating of 35MVA & PF =0.8)	41370				1	365	3.36	0.42	246.23	0.11	0.92	0.61	0.08	44.94	0.02	0.17		
	Power Gen Turbine- (Dual Fuel) LM2500+G4 SAC - Gas Fueled (Nameplate Rating of 35MVA & PF =0.8)	41370	394008	9062181	no mitigation	23	365	0.00	3.38	269.73	0.91	75.63	0.00	14.19	1132.17	3.82	317.47		
	Power Gen Turbine- (Dual Fuel) LM2500+G4 SAC - Diesel Fueled (Nameplate Rating of 35MVA & PF =0.8)	41370				1	365	3.36	0.42	246.23	0.11	0.92	0.61	0.08	44.94	0.02	0.17		
	Power Gen Turbine LM2500+G4 DLE - Gas Fueled (Nameplate Rating of 35MVA & PF =0.8)	40480	385532	9252756	no mitigation	24	365	0.00	3.31	27.02	5.53	74.01	0.00	14.49	118.33	24.21	324.14		
	Power Gen Turbine LM2500+G4 DLE - Gas Fueled (Nameplate Rating of 35MVA & PF =0.8)	40480	385532	9252756	no mitigation	24	365	0.00	3.31	27.02	5.53	74.01	0.00	14.49	118.33	24.21	324.14		
	Power Gen Turbine LM2500+G4 DLE - Gas Fueled (Nameplate Rating of 35MVA & PF =0.8)	40480	385532	9252756	no mitigation	24	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	WHRU Duct Burners - #1	57.2	54476	1307429	no mitigation	24	365	0.41	0.49	5.45	0.30	4.58	1.81	2.12	23.86	1.31	20.04		
	WHRU Duct Burners - #2	57.2	54476	1307429	no mitigation	24	365	0.41	0.49	5.45	0.30	4.58	1.81	2.12	23.86	1.31	20.04		
	WHRU Duct Burners - #3	57.2	54476	1307429	no mitigation	24	365	0.41	0.49	5.45	0.30	4.58	1.81	2.12	23.86	1.31	20.04		
	WHRU Duct Burners - #4	57.2	54476	1307429	no mitigation	24	365	0.41	0.49	5.45	0.30	4.58	1.81	2.12	23.86	1.31	20.04		
	RECIP. diesel Fire Pump #1	1065	51	103	no mitigation	2	52	0.75	0.01	25.80	0.77	5.63	0.04	0.00	1.34	0.04	0.29		
	RECIP. diesel Fire Pump #2	1065	51	103	no mitigation	2	52	0.75	0.01	25.80	0.77	5.63	0.04	0.00	1.34	0.04	0.29		
	Essential Generator	2552	123	247	no mitigation	2	52	1.80	0.03	61.83	1.85	13.49	0.09	0.00	3.22	0.10	0.70		
	Emergency Generator	2552	123	247	no mitigation	2	52	1.80	0.03	61.83	1.85	13.49	0.09	0.00	3.22	0.10	0.70		
	Cold Start Air Compressor	125	6	12	no mitigation	2	52	0.28	0.00	3.85	0.31	0.83	0.01	0.00	0.20	0.02	0.04		
	Lifeboats/Rescue Boats	288	14	28	no mitigation	2	52	0.63	0.00	8.88	0.71	1.92	0.03	0.00	0.46	0.04	0.10		
	Misc small temporary diesel engines (welding machines, air compressors	1000	48	869	no mitigation	18	365	0.70	0.01	24.23	0.73	5.29	2.32	0.04	79.59	2.39	17.37		
	General Support all years	9790	473	11349	no mitigation	24	110	6.90	0.12	237.20	7.12	51.75	9.07	0.16	311.68	9.35	68.00		
	Chemical Delivery	9790	473	11349	no mitigation	24	102	6.90	0.12	237.20	7.12	51.75	8.45	0.15	290.34	8.71	63.35		
	MISC.	**BPD**	**SCF/HR**	**COUNT**															
	Intermittent Flaring (shut-in, equipment out of service, etc.) from either HP or LP Flare		150000			24	72	0.00	4.27	10.71	9.05	58.28	0.00	3.69	9.25	7.81	50.35		
	HP Flare - Routine Flaring (pilot gas, purge gas, etc.		830			24	365	0.00	0.02	0.06	0.05	0.32	0.00	0.10	0.26	0.22	1.41		
	LP Flare - Routine Flaring (pilot gas, purge gas, etc.		591			24	365	0.00	0.02	0.04	0.04	0.23	0.00	0.07	0.18	0.16	1.01		
	Atmospheric Vent - Intermittent due to Equipment Maintenance/Malfunctio		2083			24	72				7.08					6.12			
	Fugitives			11420		24	365				5.71					25.01			
	Various Storage Tanks (including but not limited to Water clarifier, silicone	248				24	365				0.31					1.36			
CY2021	**YEAR TOTAL**							**28.89**	**20.82**	**1805.19**	**57.78**	**528.04**	**28.62**	**70.23**	**3387.41**	**122.82**	**1567.34**		
EXEMPTION CALCULATION	**DISTANCE FROM LAND IN MILES**												**2397.60**	**2397.60**	**2397.60**	**2397.60**	**58843.78**		
	72.0																		
Notes -																			

Power generating turbine nameplate rating is 35 MVA and PF 0.8. This convert this to 37,548 hp (35 MWA * 0.8 = 28 MW * 1341.022 hp/MW); however, the Power Output rating from Vendor Spec Sheets is 41370 hp for SAC and 40480 hp for DLE at 70F, which is used for emission purposes.

COMPANY	AREA	BLOCK	LEASE	PLATFORM		WELL			CONTACT		PHONE	REMARKS					
Shell Offshore Inc	MC	437	OCS-G 33733	Appomattox FPS		0			Cidney Christie / Josh O'B		504.425.301	SEPCo Environmental File - Appo-AQR-DOCD-20181012-BOEM.xlsx					
MC	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	Notes	HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
FPS Production	Power Gen Turbine- (Dual Fuel) LM2500+G4 SAC - Gas Fueled (Nameplate Rating of 35MVA & PF =0.8)	41370	394008	9062181	no mitigation	23	365	0.00	3.38	269.73	0.91	75.63	0.00	14.19	1132.17	3.82	317.47
	Power Gen Turbine- (Dual Fuel) LM2500+G4 SAC - Diesel Fueled (Nameplate Rating of 35MVA & PF =0.8)	41370				1	365	3.36	0.42	246.23	0.11	0.92	0.61	0.08	44.94	0.02	0.17
	Power Gen Turbine- (Dual Fuel) LM2500+G4 SAC - Gas Fueled (Nameplate Rating of 35MVA & PF =0.8)	41370	394008	9062181	no mitigation	23	365	0.00	3.38	269.73	0.91	75.63	0.00	14.19	1132.17	3.82	317.47
	Power Gen Turbine- (Dual Fuel) LM2500+G4 SAC - Diesel Fueled (Nameplate Rating of 35MVA & PF =0.8)	41370				1	365	3.36	0.42	246.23	0.11	0.92	0.61	0.08	44.94	0.02	0.17
	Power Gen Turbine LM2500+G4 DLE - Gas Fueled (Nameplate Rating of 35MVA & PF =0.8)	40480	385532	9252756	no mitigation	24	365	0.00	3.31	27.02	5.53	74.01	0.00	14.49	118.33	24.21	324.14
	Power Gen Turbine LM2500+G4 DLE - Gas Fueled (Nameplate Rating of 35MVA & PF =0.8)	40480	385532	9252756	no mitigation	24	365	0.00	3.31	27.02	5.53	74.01	0.00	14.49	118.33	24.21	324.14
	Power Gen Turbine LM2500+G4 DLE - Gas Fueled (Nameplate Rating of 35MVA & PF =0.8)	40480	385532	9252756	no mitigation	24	365	0.00	3.31	27.02	5.53	74.01	0.00	14.49	118.33	24.21	324.14
	WHRU Duct Burners - #1	57.2	54476	1307429	no mitigation	24	365	0.41	0.49	5.45	0.30	4.58	1.81	2.12	23.86	1.31	20.04
	WHRU Duct Burners - #2	57.2	54476	1307429	no mitigation	24	365	0.41	0.49	5.45	0.30	4.58	1.81	2.12	23.86	1.31	20.04
	WHRU Duct Burners - #3	57.2	54476	1307429	no mitigation	24	365	0.41	0.49	5.45	0.30	4.58	1.81	2.12	23.86	1.31	20.04
	WHRU Duct Burners - #4	57.2	54476	1307429	no mitigation	24	365	0.41	0.49	5.45	0.30	4.58	1.81	2.12	23.86	1.31	20.04
	RECIP. diesel Fire Pump #1	1065	51	103	no mitigation	2	52	0.75	0.01	25.80	0.77	5.63	0.04	0.00	1.34	0.04	0.29
	RECIP. diesel Fire Pump #2	1065	51	103	no mitigation	2	52	0.75	0.01	25.80	0.77	5.63	0.04	0.00	1.34	0.04	0.29
	Essential Generator	2552	123	247	no mitigation	2	52	1.80	0.03	61.83	1.85	13.49	0.09	0.00	3.22	0.10	0.70
	Emergency Generator	2552	123	247	no mitigation	2	52	1.80	0.03	61.83	1.85	13.49	0.09	0.00	3.22	0.10	0.70
	Cold Start Air Compressor	125	6	12	no mitigation	2	52	0.28	0.00	3.85	0.31	0.83	0.01	0.00	0.20	0.02	0.04
	Lifeboats/Rescue Boats	288	14	28	no mitigation	2	52	0.63	0.00	8.88	0.71	1.92	0.03	0.00	0.46	0.04	0.10
	Misc small temporary diesel engines (welding machines, air compressors	1000	48	869	no mitigation	18	365	0.70	0.01	24.23	0.73	5.29	2.32	0.04	79.59	2.39	17.37
	General Support all years	9790	473	11349	no mitigation	24	110	6.90	0.12	237.20	7.12	51.75	9.07	0.16	311.68	9.35	68.00
	Chemical Delivery	9790	473	11349	no mitigation	24	102	6.90	0.12	237.20	7.12	51.75	8.45	0.15	290.34	8.71	63.35
	MISC.	BPD	SCF/HR	COUNT													
	Intermittent Flaring (shut-in, equipment out of service, etc.) from either HP or LP Flare		150000			24	72	0.00	4.27	10.71	9.05	58.28	0.00	3.69	9.25	7.81	50.35
	HP Flare - Routine Flaring (pilot gas, purge gas, etc.		830			24	365	0.00	0.02	0.06	0.05	0.32	0.00	0.10	0.26	0.22	1.41
	LP Flare - Routine Flaring (pilot gas, purge gas, etc.		591			24	365	0.00	0.02	0.04	0.04	0.23	0.00	0.07	0.18	0.16	1.01
	Atmospheric Vent - Intermittent due to Equipment Maintenance/Malfunction		2083			24	72				7.08					6.12	
	Fugitives			11420		24	365				5.71					25.01	
	Various Storage Tanks (including but not limited to Water clarifier, silicone	248				24	365				0.31					1.36	
CY2022 - 2057	**ANNUAL TOTAL**							**28.89**	**24.13**	**1832.20**	**63.30**	**602.05**	**28.62**	**84.72**	**3505.74**	**147.03**	**1891.49**
EXEMPTION CALCULATION	**DISTANCE FROM LAND IN MILES**												**2397.60**	**2397.60**	**2397.60**	**2397.60**	**58843.78**
	72.0																

Year	Emitted Substance				
	PM	SO2	NOx	VOC	CO
CY2020	28.62	70.23	3387.41	122.82	1567.34
CY2021	28.62	70.23	3387.41	122.82	1567.34
CY2022 - CY2057	28.62	84.72	3505.74	147.03	1891.49
Allowable	2397.60	2397.60	2397.60	2397.60	58843.78

DOCD DISPERSION MODELING REPORT

PROJECT APPOMATTOX

Date:
October 2016

Prepared for:
Shell Offshore, Inc.

Prepared by:
Ramboll Environ US Corporation
Lynnwood, Washington
Baton Rouge, Louisiana

Project Number:
26-23341W

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ACRONYMNS AND ABBREVIATIONS

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

DOCD................................. Development Operations Coordination Document

EP .... Exploration Plan

EPA.................................... Environmental Protection Agency

FLM .... Federal Land Manager

FWS.................................... Fish and Wildlife Service

GOMR .... Gulf of Mexico Region

IWAQM............................... Interagency Workgroup on Air Quality Modeling

NAAQS............................... National Ambient Air Quality Standard

OCD.................................... Offshore and coastal dispersion model

PSD .... Prevention of significant deterioration (an EPA program)

SCC .... Source Classification Code

SIL .... Significance Impact Level

VISTAS............................... Visibility Improvement State and Tribal Association of the Southeast

1. INTRODUCTION

Shell Offshore, Inc. (Shell) engaged Ramboll Environ US Corporation (Ramboll Environ) to perform modeling analyses associated with an initial Development Operations Coordination Document (DOCD) for the Appomattox Platform. Appomattox is a new production platform to be located in the Western Gulf of Mexico (WGOM), 72.0 miles (116 km) from shore in lease block MC437. See Figure 1 of this document.

The regulatory background on BOEM modeling requirements is discussed in the remainder of this section. Section 2 presents Ramboll Environ'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 0 of this report summarizes the modeling results.

1.1 Regulatory Background

As required by BOEM, assessments of proposed emissions are required in DOCDs and should incorporate details pertinent to the requirements of 30 CFR §550, specifically: air emissions (30 CFR §550.249), environmental impact assessment (30 CFR §550.261), support vessel and aircraft (30 CFR §550.257), and onshore support facilities (30 CFR §550.258).

Pursuant to requirements of 30 CFR §550.249 a DOCD must include projected emissions of sulfur dioxide (SO_2), particulate matter (PM_{10} and $PM_{2.5}$), nitrogen oxide (NO_x), carbon monoxide (CO), and volatile organic compounds (VOC) that will be generated by the proposed 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 exemption levels. The lessee shall compare the projected annual-total emissions, in tons per year (TPY), from the facility for each pollutant, to the emission threshold amount "E" for each pollutant, calculated using the following equations. "D" is the distance of the proposed facility from the closest onshore area of a State, expressed in statute miles:

CO:	$E = 3400 \times D^{2/3}$
TSP, SO2, NOx, and VOC:	$E = 33.3 \times D$

If the amount of the projected emissions is less than or equal to the emissions exemption threshold "E" for the pollutants, then the facility is exempt from further air quality review requirements in 30 CFR §550.303.

If emissions exceed the exemption level thresholds, the lessee must perform air modeling to determine whether the projected emissions result in an onshore ambient air concentration above the significance levels listed in 30 CFR §550.303(e), which are summarized in Table 1. It should be noted that the significance level for VOC is equivalent to the calculated exemption level. Furthermore, current BOEM policies and practices require applicants to compare concentrations to the most recent NAAQS SILs regardless of the values listed in §550.303(e). For example, the Environmental Impact Statement for the most recent Oil and Gas Lease Sales[1] lists the NAAQS as of its publication, including the 1-hour NO_2 Standard. Demonstrating insignificant onshore impacts therefore requires the use of the 1-hour NO_2 SIL. The most recent NAAQS SIL values are presented in Table 1 below despite their absence from 30 CFR §550.303(e).

Table 1: BOEM Class II Significance Levels - Air Pollutant Concentrations ($\mu g/m^3$)

Air Pollutant	Averaging time				
	Annual	24 hour	8 hour	3 hour	1 hour
SO_2	1	5	--	25	7.8 [a]
TSP[b]	1	5	--	--	--
NO_2	1	--	--	--	7.5 [a], [c]
CO	--	--	500	--	2000

[a] Reflects the current NAAQS SIL values not present in 30 CFR §550.303(e)

[b] Although newer SILs have been promulgated for PM_{10} and $PM_{2.5}$, 30 CFR §550.303(e) does not list either of these and no PM_{10} or $PM_{2.5}$ modeling analyses are therefore required.

[c] 1-hr NO2 SIL is an interim SIL established by the EPA in a memo issued June 29, 2010 and is not published in the CFR. See http://epa.gov/nsr/documents/20100629no2guidance.pdf.

The Notice to Lessees (NTL) and Operators of Federal Oil, Gas, and Sulfur Leases in the Outer Continental Shelf, Gulf of Mexico OCS Region number 2008-G04[2] states that applicants must adhere to 40 CFR 51 Appendix W, known as the modeling *Guidelines*.

BOEM has approved the Offshore and Coastal Dispersion (OCD) model and, more recently, has approved CALPUFF for use in satisfying the air modeling requirements. Any facility for which the projected emissions result in onshore ambient air concentrations above the significance levels 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

[1] http://www.boem.gov/Environmental-Stewardship/Environmental-Assessment/NEPA/BOEM2013-0116v1_pdf.aspx

[2] Available at http://www.boem.gov/Regulations/Notices-To-Lessees/2008/08-g04.aspx, extended by NTL 2014-G05.

of offsets would be required if a nonattainment area were to be significantly impacted by pollutants other than VOC.[3]

Historically, BOEM has requested Class I area concentration results be included in modeling reports for evaluation of model predicted concentrations against Class I SILs.

2. DISPERSION MODELING ANALYSIS

To fulfill the requirements of 30 CFR §550.303 outlined in Section 1.1 above, Shell/Ramboll Environ performed first an exemption level assessment, then dispersion modeling analysis of NO_x emitted by the sources on the platform. The dispersion modeling followed EPA guidance, including 40 CFR 51 Appendix W, the *Guidelines*.

2.1 Emission Rates and Emissions Exemption Threshold Screening

Calculations of emissions of all criteria pollutants were performed using BOEM's emission spreadsheet. Emission were calculated for each year from 2018 (the start of installation) to 2022 (the end of commissioning). Production, and its associated emissions, overlap with both installation and commissioning. The year 2018 was determined to have the maximum total emissions, and was therefore selected for this modeling. Emissions from 2018 are summarized in the Tables shown in Appendix A. Emission units are grouped into installation (INST), commissioning (COMM), production (PROD), and storage tanks (ST). Note that many of the emission units are not scheduled to be emitting yet in 2018.

An emissions exemption threshold assessment is presented at the bottom of Table 4 in Appendix A. Based on these calculations, only NO_x exceeded the exemption level and is the only pollutant required to be evaluated further, pursuant to 30 CFR §550.303.

2.2 Operational Scenario Stack Parameters

Stack parameters from the platform and associated support fleet from the DOCD are also given in Appendix A. Most units are diesel-fired with the exception of the flare and some of the turbines. Because specific stack parameters for support vessels 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. Support vessels were modeled as adjacent (500m) to the platform, even though they will likely spend a considerable portion of their time farther away (increasing initial dispersion).

[3] 30 CFR 550.303(g)(1)

3. DISPERSION MODELING TECHNIQUES

Ramboll Environ applied the modeling methodology recommended by the Interagency Workgroup on Air Quality Modeling (IWAQM) Phase 2 Report[4] and the FLMs.

3.1 Dispersion Model Selection

Because the Appomattox platform is more than 50 km from shore, Ramboll Environ used the CALPUFF modeling system to estimate impacts of air pollutants at discrete receptors placed along the States' shoreline areas. Receptors were also placed in the Breton Class I area. The modeling domain is shown in Figure 1 as the blue box labeled "Shell CALPUFF Domain," a sub-set of the full Visibility Improvement State & Tribal Association of the Southeast (VISTAS) Domain 2.

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 Guidelines. 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. As is currently required, CALPUFF Version 5.8.5 (release date December 14, 2015) and CALPOST version 6.221 (release date July 24, 2008) were used[5].

Ramboll Environ applied CALPUFF using input parameters approved by EPA and the FWS. The EPA and FLMs jointly clarified their required CALMET settings in a memo issued on August 31, 2009 (Fox 2009.)[6] The VISTAS Domain 2 CALMET dataset was originally run with the 2005 "BART" version and settings for CALMET, which pre-dated the 2009 EPA/FLM guidance. A revised version of the CALMET files was provided by the North Carolina Department of Environment and Natural Resources (NC DENR), who used the then-approved regulatory version of CALMET (Version 5.8, level 070623). The latest version of CALMET (Version 5.8.5, level 151214) contains only minimal changes that do not pertain to this CALMET run.

3.2 Domain and Receptors

The domain for the CALPUFF simulations is shown in Figure 1. The 740 km-by-428 km domain is large enough to include the shoreline areas of interest with at least a 50 km allowance for complex flows that might cause recirculation of plumes

[4] http://www.epa.gov/scram001/7thconf/calpuff/phase2.pdf

[5] See http://www.epa.gov/ttn/scram/dispersion_prefrec.htm#calpuff

[6] USEPA Memorandum. Clarification on EPA-FLM Recommended Settings for CALMET. August 2009. http://www.epa.gov/ttn/scram/CALMET%20CLARIFICATION.pdf

originating at the relevant lease blocks. A Lambert Conformal Conic (LCC) coordinate system was used for the coordinates.

Class I discrete receptors were obtained from the National Park Service website[7]. Class II discrete receptors were placed at 4 km intervals along the line defining the shore (according to USGS GIS information downloaded from the Internet.). Gridded receptors were turned off in the CALPUFF runs to make the runtimes more reasonable.

3.3 Building Downwash (Prime Algorithm)

Building downwash is the effect of nearby structures on the flow of emissions from their respective sources. However, Ramboll Environ did not account for building downwash effects as part of the modeling approach. Given that the nearest receptors are located about 100 km from the source, building downwash effects will not significantly affect the modeled results.

The details of the release (e.g. stack exit velocity or temperature) have an insignificant effect at these source-receptor distances, and only the magnitude of emissions has a significant effect on predicted concentrations.

3.4 Averaging Periods

CALPUFF-predicted pollutant concentrations were extracted using CALPOST Version 6.221, level 080724 for comparison with applicable 1-hour and annual NO_2 Class I and Class II SILs. In all instances, comparisons with regulatory criteria were based on the highest model-prediction of the three-year simulation (2001-2003) for the averaging period.

[7] http://www2.nature.nps.gov/air/maps/Receptors/index.cfm

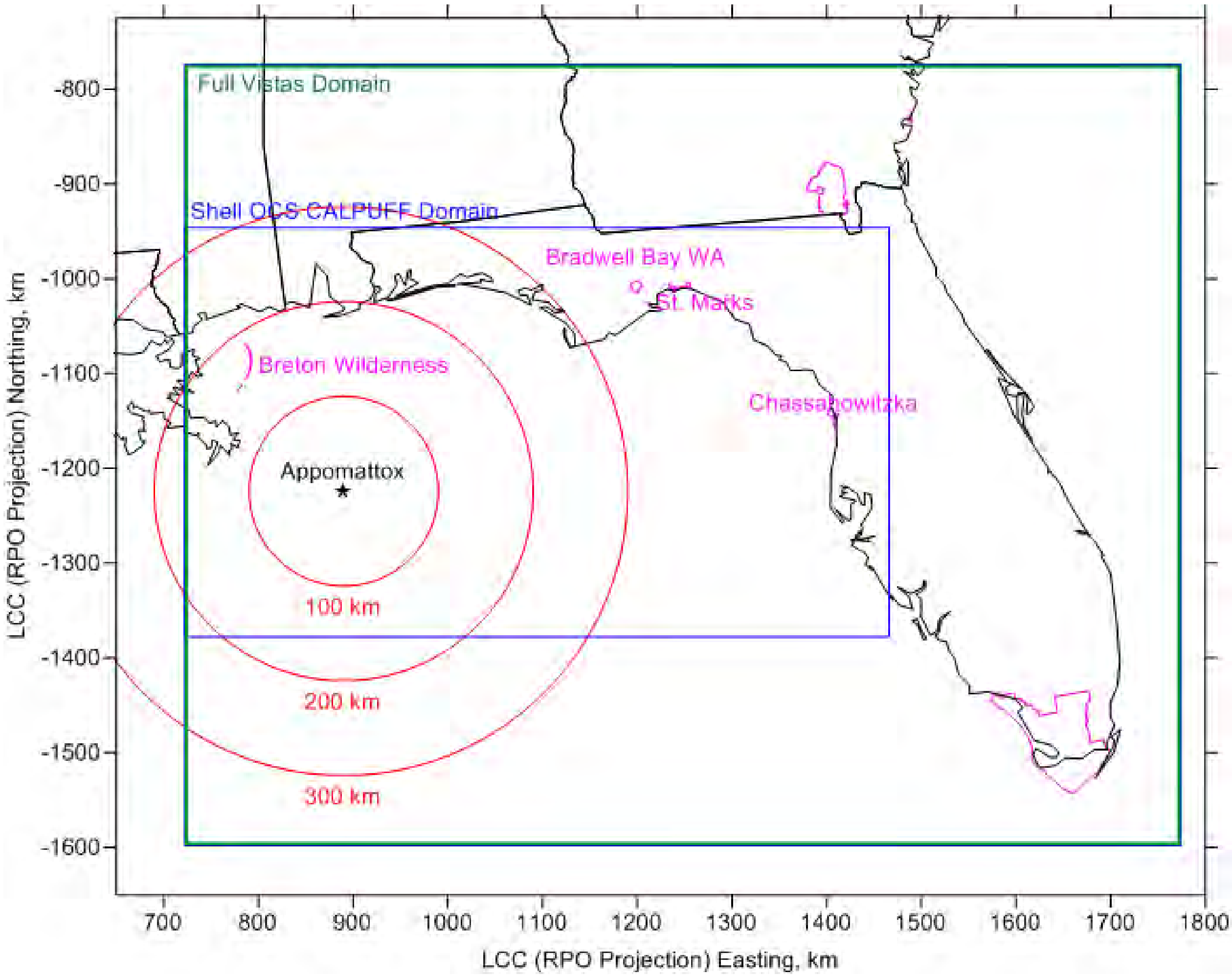

Figure 1: Appomattox Location, Modeling Domain, and Class I Areas.

3.5 CALPUFF Representation of Particulate Matter and Speciation

In the CALPUFF modeling system, particulate matter emission rates must be speciated into six fractions: soot or elemental carbon (EC), PM fine (PMF), PM coarse (PMC), organic carbon (OC), sulfate (SO_4), and nitrate (NO_3.). PM_{10} is the sum of these species, and $PM_{2.5}$ is equal to PM_{10} minus PMC.

Tables provided in Appendix A present the speciated particulate matter emission rates used in the analysis. The speciation was based on speciation profiles found in the Sparse Matrix Operator Kernel Emissions model (SMOKE). Sources in the database are referenced by Source Classification Code (SCC), and the database provided information for speciating the fine fraction into the other components required by CALPUFF. Most emission units are diesel-fired, and SCC code 20200102 was used to determine the speciation of particulate matter. For the PowerGen turbines, (PROD1-20) the SCC codes 20200102 (diesel) or 20100209 (natural gas) were used, as appropriate. For the flares (MISC1-3) the SCC code 31000160 (Crude Oil Production, Flares) was used.

3.6 Chemical Transformations

The NO_X chemistry in CALPUFF depends on the ambient ammonia concentration to establish the equilibrium between gaseous nitric acid and ammonium nitrate. However, ambient ammonia concentrations are not explicitly simulated by CALPUFF and the user must select an appropriate background concentration. The IWAQM Phase II Recommendations suggest typical ammonia concentrations as: 10 parts per billion (ppb) for grasslands, 0.5 ppb for forests, and 1 ppb for arid lands during warmer weather.

In September 2015, Ramboll Environ completed an analysis of ammonia observations along the coast of the GOM, and requested the use 1.75 ppb for CALPUFF modeling with the Gulf of Mexico that might affect the Breton Wilderness. In an email from Jill Webster (FWS) from September 16, 2015, the FWS accepted these values for background ammonia.

Reaction rates in the CALPUFF chemistry algorithms are also influenced by background ozone concentrations. Ramboll Environ used hourly ozone observations to represent background ozone concentrations for the modeled years. For the VISTAS years (2001-2003) an ozone data file was included in the VISTAS CALMET package. CALPUFF uses a background ozone value (BCK03) for hours when *none* of the supplied ozone stations have valid data. A conservative value of 65 ppb was specified, to avoid artificially limiting chemical transformations (e.g. NO_X titration.)

4. RESULTS

The results of the DOCD modeling simulations using the common VISTAS meteorological data set are presented in Table 2.

Table 2: Appomattox DOCD Modeling Results Using Maximum Emission (Year 2018)

Receptor Class	Standard	Receptor Set	Appomattox (µg/m³)	Limit (µg/m³)	Criteria	Pass?
Class I	NO_2 Annual	Breton	0.03	0.1	SIL	Yes
Class II	NO_2 1-hr	Shoreline	24.6	7.5 (Interim)	SIL	No
	NO_2 1-hr	Shoreline	107.3[1]	188	NAAQS	Yes
	NO_2 Annual	Shoreline	0.06	1	SIL	Yes

[1] Background added using EPA 2013-2015 NO_2 Design Value (DV) at Kenner, near New Orleans, LA, 44 ppb (82.72 µg/m³).

As shown, model-predicted maximum concentrations are significantly below both the Class I and Class II annual NO_2 SILs, but above the interim 1-hour NO_2 SIL for Class II using the emission inventory from the year of maximum emissions (2018). Following BOEM guidance[8], the maximum model concentration was added to the EPA's published 2013-2015 Design Value[9] for the Kenner site and compared to the NO_2 NAAQS. This analysis demonstrates that predicted 1-hr NO_2 onshore concentrations (107.3 µg/m³) are less than the NO_2 NAAQS (188 µg/m³) and that emissions from activities at Appomattox 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.

[8] Holli Ensz, personal communication, July 13, 2015

[9] EPA's published design values can be found at http://www.epa.gov/airtrends/values.html

APPENDIX A: APPOMATTOX STACK PARAMETERS & EMISSION RATES

Stack Parameters

Table A-1: Appomattox 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)
Heavy Lift Construction Vessel	INST1	893.66	-1225.17	6.10	0.001	0.001	533
DCV Support Vessel	INST2	893.66	-1225.67	6.10	0.001	0.001	533
Barge Tug1	INST3	893.16	-1225.67	6.10	0.001	0.001	533
Host Offshore Tow – Tug1	INST4	892.66	-1225.17	6.10	0.001	0.001	533
Host Offshore Tow – Tug2	INST5	892.66	-1224.67	6.10	0.001	0.001	533
Host Offshore Tow – Tug3	INST6	893.16	-1224.67	6.10	0.001	0.001	533
Host Offshore Tow – Tug4	INST7	893.66	-1224.67	6.10	0.001	0.001	533
Hookup Phase Support – 230′ OSV	INST8	893.66	-1225.17	6.10	0.001	0.001	533
Hookup Phase Support – 310′ PSV	INST9	893.66	-1225.67	6.10	0.001	0.001	533
Fiber Optic Cable – Cable Lay Vessel	INST10	893.66	-1225.67	6.10	0.001	0.001	533
Install N2 Blanket	INST11	893.66	-1225.17	6.10	0.001	0.001	533
Umbilical Installation – Construction Vessel	INST12	893.16	-1225.17	6.10	0.001	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)
SDH Installation – Construction Vessel	INST13	893.16	-1225.17	6.10	0.001	0.001	533
Jumper Installation Vessel	INST14	893.16	-1225.67	6.10	0.001	0.001	533
Incinerator	INST15	893.16	-1225.17	6.10	0.001	0.001	533
Temporary Power Generator - Diesel	COMM1	893.16	-1225.17	6.10	0.001	0.001	533
Temporary Power Generator - Diesel	COMM2	893.16	-1225.17	6.10	0.001	0.001	533
Misc. Small Temporary Diesel Engines	COMM3	893.16	-1225.17	6.10	0.001	0.001	533
HPU for Riser Pull-in - Diesel	COMM4	893.16	-1225.17	6.10	0.001	0.001	533
Power Generator for Riser Pull-in - Diesel	COMM5	893.16	-1225.17	6.10	0.001	0.001	533
Power Generator for Riser Pull-in - Diesel	COMM6	893.16	-1225.17	6.10	0.001	0.001	533
Umbilical Pull-in – Diesel Equipment	COMM7	893.16	-1225.17	6.10	0.001	0.001	533
Power Generator for Umbilical Pull-in - Diesel	COMM8	893.16	-1225.17	6.10	0.001	0.001	533
RECIP. Diesel Fire Pump #1	PROD1	893.12	-1225.23	30.80	85.30	0.20	633

Source	Source ID	X-Coord (km)	Y-Coord (km)	Exit Height (m)	Exit Diameter (m)	Exit Velocity (m/s)	Exit Temp (K)
RECIP. Diesel Fire Pump #2	PROD2	893.12	-1225.23	30.80	85.30	0.20	663
Essential Generator	PROD3	893.13	-1225.23	46.03	48.53	0.41	693
Emergency Generator	PROD4	893.13	-1225.21	46.03	48.53	0.41	693
Cold Start Air Compressor	PROD5	893.12	-1225.21	42.07	338.10	0.09	755
Lifeboats/Rescue Boats	PROD6	893.16	-1225.17	6.10	0.001	0.001	793
Misc. Small Temporary Diesel Engines	PROD7	893.16	-1225.17	6.10	0.001	0.001	533
Power Generator Turbine – Dual Fuel – LM2500+G 4 SAC - Gas	PROD8	893.11	-1225.16	73.76	18.80	3.27	796
Power Generator Turbine – Dual Fuel – LM2500+G 4 SAC - Diesel	PROD9	893.11	-1225.16	73.76	18.80	3.27	796
Power Generator Turbine – Dual Fuel – LM2500+G 4 SAC - Gas	PROD10	893.11	-1225.18	73.76	18.80	3.27	796
Power Generator Turbine – Dual Fuel – LM2500+G 4 SAC - Diesel	PROD11	893.11	-1225.18	73.76	18.80	3.27	796

Source	Source ID	X-Coord (km)	Y-Coord (km)	Exit Height (m)	Exit Diameter (m)	Exit Velocity (m/s)	Exit Temp (K)
Power Generator Turbine – LM2500+G 4 DLE - Gas	PROD12	893.11	-1225.16	73.76	18.70	3.27	798
Power Generator Turbine – LM2500+G 4 DLE - Gas	PROD13	893.11	-1225.17	73.76	18.70	3.27	798
Power Generator Turbine – LM2500+G 4 DLE - Gas	PROD14	893.11	-1225.19	73.76	18.70	3.27	798
WHRU Duct Burners - #1	PROD15	N/A	N/A	N/A	N/A	N/A	N/A
WHRU Duct Burners - #2	PROD16	N/A	N/A	N/A	N/A	N/A	N/A
WHRU Duct Burners - #3	PROD17	N/A	N/A	N/A	N/A	N/A	N/A
WHRU Duct Burners - #4	PROD18	N/A	N/A	N/A	N/A	N/A	N/A
General Support All Years	PROD19	893.16	-1225.17	6.10	0.001	0.001	533
Chemical Delivery	PROD20	893.16	-1225.17	6.10	0.001	0.001	533
Intermittent Flaring - Either HP or LP Flaring	MISC1	893.13	-1225.03	106.60	20.00	3.128	1273
HP Flare – Routing Flaring	MISC2	893.13	-1225.03	95.90	20.00	0.23	1273
LP Flare – Routing Flaring	MISC3	893.13	-1225.03	95.80	20.00	0.20	1273

Source	Source ID	X-Coord (km)	Y-Coord (km)	Exit Height (m)	Exit Diameter (m)	Exit Velocity (m/s)	Exit Temp (K)
Atmospheric Vent – Intermittent due to Equipment Maintenance	MISC4	N/A	N/A	N/A	N/A	N/A	N/A
Fugitives	MISC5	N/A	N/A	N/A	N/A	N/A	N/A
Water Clarifier Storage Tank ABJ-2601	ST1	N/A	N/A	N/A	N/A	N/A	N/A
Silicone Defoamer Storage Tank ABJ-2602	ST2	N/A	N/A	N/A	N/A	N/A	N/A
Flourosilicone Defoamer Storage Tank ABJ-2603	ST3	N/A	N/A	N/A	N/A	N/A	N/A
Reverse Emulsion Breaker Storage Tank ABJ-2604	ST4	N/A	N/A	N/A	N/A	N/A	N/A
Reverse Emulsion Breaker Storage Tank ABJ-2604	ST5	N/A	N/A	N/A	N/A	N/A	N/A
Emulsion Breaker Storage Tank ABJ-2661	ST6	N/A	N/A	N/A	N/A	N/A	N/A
Asphaltene Dispersant Day Tank ABJ-2662	ST7	N/A	N/A	N/A	N/A	N/A	N/A
Scale Inhibitor Day Tank ABJ-2663	ST8	N/A	N/A	N/A	N/A	N/A	N/A

Source	Source ID	X-Coord (km)	Y-Coord (km)	Exit Height (m)	Exit Diameter (m)	Exit Velocity (m/s)	Exit Temp (K)
Asphaltene Inhibitor Day Tank ABJ-2664	ST9	N/A	N/A	N/A	N/A	N/A	N/A
H2S Scavenger Day Tank ABJ-2665	ST10	N/A	N/A	N/A	N/A	N/A	N/A
Corrosion Inhibitor Day Tank ABJ-2666	ST11	N/A	N/A	N/A	N/A	N/A	N/A
Methanol Hull Storage Tank ABJ-1905	ST12	N/A	N/A	N/A	N/A	N/A	N/A
Methanol Hull Storage Tank ABJ-1900	ST13	N/A	N/A	N/A	N/A	N/A	N/A
Asphaltene Solvent Hull Storage Tank ABJ-2820	ST14	N/A	N/A	N/A	N/A	N/A	N/A
Corrosion Inhibitor Hull Storage Tank ABJ-2801	ST15	N/A	N/A	N/A	N/A	N/A	N/A
Asphaltene Inhibitor Hull Storage Tank ABJ-2746	ST16	N/A	N/A	N/A	N/A	N/A	N/A
Asphaltene Inhibitor Hull Storage Tank ABJ-2807	ST17	N/A	N/A	N/A	N/A	N/A	N/A
Scale Inhibitor Hull Storage Tank ABJ-2810	ST18	N/A	N/A	N/A	N/A	N/A	N/A

Source	Source ID	X-Coord (km)	Y-Coord (km)	Exit Height (m)	Exit Diameter (m)	Exit Velocity (m/s)	Exit Temp (K)
Asphaltene Dispersant Hull Storage Tank ABJ-2650	ST19	N/A	N/A	N/A	N/A	N/A	N/A
H2S Scavenger Hull Storage Tank ABJ-2670	ST20	N/A	N/A	N/A	N/A	N/A	N/A
Scale Squeeze Scale Inhibitor Hull Storage Tank ABJ-2804	ST21	N/A	N/A	N/A	N/A	N/A	N/A
Spare Chemical Hull Storage Tank ABJ-2796	ST22	N/A	N/A	N/A	N/A	N/A	N/A
Storage Tank Biocide - THPS	ST23	N/A	N/A	N/A	N/A	N/A	N/A
Storage TankBiocide - CMIT	ST24	N/A	N/A	N/A	N/A	N/A	N/A
Storage TankMembrane Scale Inhibitor	ST25	N/A	N/A	N/A	N/A	N/A	N/A
Storage Tank Waterflood Defoamer	ST26	N/A	N/A	N/A	N/A	N/A	N/A
Storage Tank Chlorine Scavenger	ST27	N/A	N/A	N/A	N/A	N/A	N/A
Storage Tank Oxygen Scavenger	ST28	N/A	N/A	N/A	N/A	N/A	N/A

Emission Rates

Table A-2: Emission Rates from Stacks Used in Appomattox CALPUFF Modeling Analysis using 2018 Emissions

Source ID	PM_{10}		SO_x		NO_x		VOC		CO	
	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY
INST1	38.37	44.01	22.00	25.24	1318.84	1512.97	39.57	45.39	287.75	330.10
INST2	13.72	11.81	7.87	6.77	471.72	405.86	14.15	12.18	102.92	88.55
INST3	4.23	9.70	2.43	5.56	145.37	333.55	4.36	10.01	31.72	72.77
INST4	7.75	0.60	4.45	0.34	266.52	20.47	8.00	0.61	58.15	4.47
INST5	7.75	0.60	4.45	0.34	266.52	20.47	8.00	0.61	58.15	4.47
INST6	7.75	0.60	4.45	0.34	266.52	20.47	8.00	0.61	58.15	4.47
INST7	7.75	0.60	4.45	0.34	266.52	20.47	8.00	0.61	58.15	4.47
INST8	3.67	2.57	2.10	1.47	126.16	88.18	3.78	2.65	27.53	19.24
INST9	7.12	9.95	4.08	5.71	244.66	342.03	7.34	10.26	53.38	74.63
INST10	9.41	0.79	5.39	0.45	323.34	27.16	9.70	0.81	70.55	5.93
INST11	0	0	0	0	0	0	0	0	0	0
INST12	49.45	8.31	28.36	4.76	1699.98	285.60	51.00	8.57	370.91	62.31
INST13	7.66	1.93	4.39	1.11	263.20	66.33	7.90	1.99	57.43	14.47
INST14	10.59	11.12	6.07	6.37	363.90	382.09	10.92	11.46	79.40	83.37
INST15	28.65	79.98	12.34	30.38	1.95	4.93	7.64	21.88	8.04	22.88
COMM1	1.18	3.74	0.02	0.06	40.61	128.67	1.22	3.86	8.86	28.07
COMM2	1.18	3.74	0.02	0.06	40.61	128.67	1.22	3.86	8.86	28.07
COMM3	0.70	1.12	0.01	0.02	24.23	38.38	0.73	1.15	5.29	8.37
COMM4	1.18	3.74	0.01	0.02	16.53	52.36	1.32	4.19	3.58	11.33
COMM5	0.25	0.79	0.00	0.00	3.47	11.00	0.28	0.88	0.75	2.38
COMM6	0.25	0.79	0.00	0.00	3.47	11.00	0.28	0.88	0.75	2.38
COMM7	0.06	0.17	0.00	0.00	0.77	2.44	0.06	0.20	0.17	0.53
COMM8	0.70	2.23	0.01	0.04	24.23	76.76	0.73	2.30	5.29	16.75
PROD1	0.75	0.04	0.01	0.00	25.80	1.34	0.77	0.04	5.63	0.29
PROD2	0.75	0.04	0.01	0.00	25.80	1.34	0.77	0.04	5.63	0.29
PROD3	1.80	0.09	0.03	0.00	61.83	3.22	1.85	0.10	13.49	0.70
PROD4	1.80	0.09	0.03	0.00	61.83	3.22	1.85	0.10	13.49	0.70
PROD5	0.28	0.01	0.00	0.00	3.85	0.20	0.31	0.02	0.83	0.04

Source ID	PM$_{10}$		SO$_x$		NO$_x$		VOC		CO	
	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY
PROD6	0.63	0.03	0.00	0.00	8.88	0.46	0.71	0.04	1.92	0.10
PROD7	0	0	0	0	0	0	0	0	0	0
PROD8	0	0	0	0	0	0	0	0	0	0
PROD9	3.36	0.24	0.42	0.03	246.23	17.73	0.11	0.01	0.92	0.07
PROD10	0	0	0	0	0	0	0	0	0	0
PROD11	3.36	0.24	0.42	0.03	246.23	17.73	0.11	0.01	0.92	0.07
PROD12	0	0	0	0	0	0	0	0	0	0
PROD13	0	0	0	0	0	0	0	0	0	0
PROD14	0	0	0	0	0	0	0	0	0	0
PROD15	0	0	0	0	0	0	0	0	0	0
PROD16	0	0	0	0	0	0	0	0	0	0
PROD17	0	0	0	0	0	0	0	0	0	0
PROD18	0	0	0	0	0	0	0	0	0	0
PROD19	0	0	0	0	0	0	0	0	0	0
PROD20	0	0	0	0	0	0	0	0	0	0
MISC1-5	0	0	0	0	0	0	0	0	0	0
ST1-28	0	0	0	0	0	0	0	0	0	0
TOTAL	222	200	114	90	6860	4025	201	145	1399	892
Exemption Level (EL)		2398		2398		2398		2398		58844
> EL ?		No		No		Yes		No		No

Table A-3: 1-Hour Speciated Emission Rates from Stacks Used in Appomattox CALPUFF Modeling Analysis for 2018 Emissions

Source ID	SO_X (g/s)	PSO_4 (g/s)	NO_x (g/s)	HNO_3 (g/s)	PNO_3 (g/s)	PEC (g/s)	POA (g/s)	PMC (g/s)	PMF (g/s)
INST1	2.7721	0.1157	166.1735	0	0.0060	3.5826	1.0848	0	0
INST2	0.9915	0.0414	59.4362	0	0.0021	1.2814	0.3880	0	0
INST3	0.3056	0.0127	18.3172	0	0.0007	0.3949	0.1196	0	0
INST4	0.5602	0.0234	33.5815	0	0.0012	0.7240	0.2192	0	0
INST5	0.5602	0.0234	33.5815	0	0.0012	0.7240	0.2192	0	0
INST6	0.5602	0.0234	33.5815	0	0.0012	0.7240	0.2192	0	0
INST7	0.5602	0.0234	33.5815	0	0.0012	0.7240	0.2192	0	0
INST8	0.2652	0.0111	15.8960	0	0.0006	0.3427	0.1038	0	0
INST9	0.5143	0.0215	30.8270	0	0.0011	0.6646	0.2012	0	0
INST10	0.6796	0.0284	40.7405	0	0.0015	0.8783	0.2660	0	0
INST11	0	0	0	0	0	0	0	0	0
INST12	3.5732	0.1491	214.1981	0	0.0077	4.6180	1.3983	0	0
INST13	0.5532	0.0231	33.1633	0	0.0012	0.7150	0.2165	0	0
INST14	0.7649	0.0319	45.8510	0	0.0017	0.9885	0.2993	0	0
INST15	1.5550	0.0864	0.2451	0	0.0045	2.6752	0.8100	0	0
COMM1	0.0026	0.0036	5.1174	0	0.0002	0.1103	0.0334	0	0
COMM2	0.0026	0.0036	5.1174	0	0.0002	0.1103	0.0334	0	0
COMM3	0.0015	0.0021	3.0529	0	0.0001	0.0658	0.0199	0	0
COMM4	0.0008	0.0036	2.0826	0	0.0002	0.1102	0.0334	0	0
COMM5	0.0002	0.0007	0.4377	0	0.0000	0.0232	0.0070	0	0
COMM6	0.0002	0.0007	0.4377	0	0.0000	0.0232	0.0070	0	0
COMM7	0.0000	0.0002	0.0971	0	0.0000	0.0051	0.0016	0	0
COMM8	0.0015	0.0021	3.0529	0	0.0001	0.0658	0.0199	0	0
PROD1	0.0016	0.0023	3.2513	0	0.0001	0.0701	0.0212	0	0
PROD2	0.0016	0.0023	3.2513	0	0.0001	0.0701	0.0212	0	0
PROD3	0.0039	0.0054	7.7909	0	0.0003	0.1680	0.0509	0	0
PROD4	0.0039	0.0054	7.7909	0	0.0003	0.1680	0.0509	0	0
PROD5	0.0002	0.0008	0.4857	0	0.0000	0.0257	0.0078	0	0
PROD6	0.0004	0.0019	1.1190	0	0.0001	0.0592	0.0179	0	0
PROD7	0	0	0	0	0	0	0	0	0
PROD8	0	0	0	0	0	0	0	0	0
PROD9	0.0534	0.0101	31.0249	0.0000	0.0005	0.3135	0.0949	0	0

Source ID	SO_X (g/s)	PSO_4 (g/s)	NO_x (g/s)	HNO_3 (g/s)	PNO_3 (g/s)	PEC (g/s)	POA (g/s)	PMC (g/s)	PMF (g/s)
PROD10	0	0	0	0	0	0	0	0	0
PROD11	0.0534	0.0101	31.0249	0.0000	0.0005	0.3135	0.0949	0	0
PROD12	0	0	0	0	0	0	0	0	0
PROD13	0	0	0	0	0	0	0	0	0
PROD14	0	0	0	0	0	0	0	0	0
PROD15	0	0	0	0	0	0	0	0	0
PROD16	0	0	0	0	0	0	0	0	0
PROD17	0	0	0	0	0	0	0	0	0
PROD18	0	0	0	0	0	0	0	0	0
PROD19	0	0	0	0	0	0	0	0	0
PROD20	0	0	0	0	0	0	0	0	0
MISC1-5	0	0	0	0	0	0	0	0	0
ST1-28	0	0	0	0	0	0	0	0	0

Table A-4: Annual Speciated Emission Rates from Stacks Used in Appomattox CALPUFF Modeling Analysis for 2018 Emissions

Source ID	SO_X (g/s)	PSO_4 (g/s)	NO_x (g/s)	HNO_3 (g/s)	PNO_3 (g/s)	PEC (g/s)	POA (g/s)	PMC (g/s)	PMF (g/s)
INST1	0.7260	0.0303	43.5230	0	0.0016	0.9383	0.2841	0	0
INST2	0.1948	0.0081	11.6753	0	0.0004	0.2517	0.0762	0	0
INST3	0.1601	0.0067	9.5950	0	0.0003	0.2069	0.0626	0	0
INST4	0.0098	0.0004	0.5888	0	0.0000	0.0127	0.0038	0	0
INST5	0.0098	0.0004	0.5888	0	0.0000	0.0127	0.0038	0	0
INST6	0.0098	0.0004	0.5888	0	0.0000	0.0127	0.0038	0	0
INST7	0.0098	0.0004	0.5888	0	0.0000	0.0127	0.0038	0	0
INST8	0.0423	0.0018	2.5368	0	0.0001	0.0547	0.0166	0	0
INST9	0.1641	0.0068	9.8391	0	0.0004	0.2121	0.0642	0	0
INST10	0.0130	0.0005	0.7813	0	0.0000	0.0168	0.0051	0	0
INST11	0	0	0	0	0	0	0	0	0
INST12	0.1371	0.0057	8.2157	0	0.0003	0.1771	0.0536	0	0
INST13	0.0318	0.0013	1.9080	0	0.0001	0.0411	0.0125	0	0
INST14	0.1834	0.0077	10.9915	0	0.0004	0.2370	0.0718	0	0
INST15	0.8740	0.0551	0.1419	0	0.0029	1.7052	0.5163	0	0
COMM1	0.0019	0.0026	3.7013	0	0.0001	0.0798	0.0242	0	0
COMM2	0.0019	0.0026	3.7013	0	0.0001	0.0798	0.0242	0	0
COMM3	0.0006	0.0008	1.1040	0	0.0000	0.0238	0.0072	0	0
COMM4	0.0006	0.0026	1.5063	0	0.0001	0.0797	0.0241	0	0
COMM5	0.0001	0.0005	0.3166	0	0.0000	0.0168	0.0051	0	0
COMM6	0.0001	0.0005	0.3166	0	0.0000	0.0168	0.0051	0	0
COMM7	0.0000	0.0001	0.0703	0	0.0000	0.0037	0.0011	0	0
COMM8	0.0011	0.0015	2.2081	0	0.0001	0.0476	0.0144	0	0
PROD1	0.0000	0.0000	0.0386	0	0.0000	0.0008	0.0003	0	0
PROD2	0.0000	0.0000	0.0386	0	0.0000	0.0008	0.0003	0	0
PROD3	0.0000	0.0001	0.0925	0	0.0000	0.0020	0.0006	0	0
PROD4	0.0000	0.0001	0.0925	0	0.0000	0.0020	0.0006	0	0
PROD5	0.0000	0.0000	0.0058	0	0.0000	0.0003	0.0001	0	0
PROD6	0.0000	0.0000	0.0133	0	0.0000	0.0007	0.0002	0	0
PROD7	0	0	0	0	0	0	0	0	0
PROD8	0	0	0	0	0	0	0	0	0
PROD9	0.0009	0.0002	0.5100	0	0.0000	0.0052	0.0016	0	0

Source ID	SO_X (g/s)	PSO_4 (g/s)	NO_x (g/s)	HNO_3 (g/s)	PNO_3 (g/s)	PEC (g/s)	POA (g/s)	PMC (g/s)	PMF (g/s)
PROD10	0	0	0	0	0	0	0	0	0
PROD11	0.0009	0.0002	0.5100	0	0.0000	0.0052	0.0016	0	0
PROD12	0	0	0	0	0	0	0	0	0
PROD13	0	0	0	0	0	0	0	0	0
PROD14	0	0	0	0	0	0	0	0	0
PROD15	0	0	0	0	0	0	0	0	0
PROD16	0	0	0	0	0	0	0	0	0
PROD17	0	0	0	0	0	0	0	0	0
PROD18	0	0	0	0	0	0	0	0	0
PROD19	0	0	0	0	0	0	0	0	0
PROD20	0	0	0	0	0	0	0	0	0
MISC1-5	0	0	0	0	0	0	0	0	0
ST1-28	0	0	0	0	0	0	0	0	0

AQR for Drill Center Future Well Work
IW, AW, AC, AE, IE, and VX

Purpose

Shell has reviewed engine information for its GOM fleet of Drillship and DP semi-sub MODUs. The single MODU with the largest power profile is the Noble Don Taylor, which has six main engines of 10,728 hp/engine. 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)	16128	Based on daily fuel records for the Noble Don Taylor from January1, 2015 to December 31, 2015.
Contingency factor	1.10	The contingency factor is used to allow for more usage if need be.
Campaign Average Daily Fuel Use (gal/day)	18,000	Calculated Value - PTE fuel use * Proposed Operating Load and rounded up to nearest thousand (for additional conservatism).
2020+ Fuel Limits MMGals	1.94	Calculated Value - Campaign Average Daily Fuel Use * Campaign Days

Step 3 - Support Vessel Fuel Loads

Description	Value	Notes
Proposed Operating Loads	50%	Shell policy restricts D/P to < 50% near rig. When in standby away from rig but within 25 miles load will be < 50% (conserve fuel). When transiting through field (25 nm), traveling at economical speeds.
OSV - PTE Fuel Use (gal/day)	11,349	Offshore Support Vessels are rated at 9790 hp. The PTE fuel use is then estimated using the AQR conversion factor of 0.0483 gal/hp-hr.
Campaign Average Daily Fuel Use (gal/day)	5,674	Calculated Value - PTE fuel use * Proposed Operating Load.
Crew Vessel - PTE Fuel Use (gal/day)	6,260	Crew Vessels are rated at 5400 hp. The PTE fuel use is then estimated using the AQR conversion factor of 0.0483 gal/hp-hr.
Crew Vessel - Campaign Average Daily Fuel Use (gal/day)	939	Calculated Value - PTE fuel use * Proposed Operating Load. Note that Crew Vessels are only in field 30% of campaign and daily average value has been
Total Vessel Activity		
2020+ Fuel Limits MMGals	0.83	Sum of (vessel daily fuel use * corresponding 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.

COMPANY	Shell Offshore Inc
AREA	Mississippi Canyon
BLOCK	391, 392, 393 (Surface Locations)
LEASE	OCS-G 26252, OCS-G 26253, OCS-G 26254
PLATFORM	DP MODU, DP Semi
WELL	Appomattox well work
DISTANCE TO LAND	72
COMPANY CONTACT	Bertrand Montchanin
TELEPHONE NO.	504-206-5120
REMARKS	Appomattox DOCD well work 2016-20-10.xlsx

Fuel Usage Conversion Factors	Natural Gas Turbines		Natural Gas Engines		Diesel Recip. Engine		REF.	DATE
	SCF/hp-hr	9.524	SCF/hp-hr	7.143	GAL/hp-hr	0.0483	AP42 3.2-1	4/76 & 8/84

Equipment/Emission Factors	units	PM	SOx	NOx	VOC	CO	REF.	DATE
NG Turbines	gms/hp-hr		0.00247	1.3	0.01	0.83	AP42 3.2-1& 3.1-1	10/96
NG 2-cycle lean	gms/hp-hr		0.00185	10.9	0.43	1.5	AP42 3.2-1	10/96
NG 4-cycle lean	gms/hp-hr		0.00185	11.8	0.72	1.6	AP42 3.2-1	10/96
NG 4-cycle rich	gms/hp-hr		0.00185	10	0.14	8.6	AP42 3.2-1	10/96
Diesel Recip. < 600 hp.	gms/hp-hr	1	0.1835	14	1.12	3.03	AP42 3.3-1	10/96
Diesel Recip. > 600 hp.	gms/hp-hr	0.32	0.1835	11	0.33	2.4	AP42 3.4-1	10/96
Diesel Boiler	lbs/bbl	0.084	0.3025	0.84	0.008	0.21	AP42 1.3-12,14	9/98
NG Heaters/Boilers/Burners	lbs/mmscf	7.6	0.593	100	5.5	84	42 1.4-1, 14-2, & 14	7/98
NG Flares	lbs/mmscf		0.593	71.4	60.3	388.5	AP42 11.5-1	9/91
Liquid Flaring	lbs/bbl	0.42	6.83	2	0.01	0.21	AP42 1.3-1 & 1.3-3	9/98
Tank Vapors	lbs/bbl				0.03		E&P Forum	1/93
Fugitives	lbs/hr/comp.				0.0005		API Study	12/93
Glycol Dehydrator Vent	lbs/mmscf				6.6		La. DEQ	1991
Gas Venting	lbs/scf				0.0034			

Sulphur Content Source	Value	Units
Fuel Gas	3.33	ppm
Diesel Fuel	0.05	% weight
Produced Gas(Flares)	3.33	ppm
Produced Oil (Liquid Flaring)	1	% weight

Per 40 CFR 80.510(a)(1), Locomotive and Marine (LM) diesel fuels are limited to 500 ppm maximum sulfur, effective June 1, 2007

Miscellaneous Constants and Conversions

365	days/yr - Follows FLAG 2010 Guidance
2000	lb/ton conversion factor
454	g/lb conversion factor
1000	SCF/MSCF conversion factor
1.341	hp/kW conversion factor

DNV·GL

INTERNATIONAL AIR POLLUTION PREVENTION CERTIFICATE

DNV GL Id No: **33159**
Date of issue: **2016-02-03**

Issued under the provisions of the Protocol of 1997 as amended by resolution MEPC.176(58) in 2008, to amend the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 related thereto (hereinafter referred to as "the Convention") under the authority of the Government of

THE REPUBLIC OF THE MARSHALL ISLANDS

by **DNV GL**

Particulars of Ship

Name of Ship:	**DEEPWATER PROTEUS**
Distinctive Number or Letters:	**5124**
Port of Registry:	**MAJURO**
Gross Tonnage:	**70095**
IMO Number:	**9675171**

This is to certify:

1. That the ship has been surveyed in accordance with regulation 5 of Annex VI of the Convention; and
2. That the survey shows that the equipment, systems, fittings, arrangements and materials fully comply with the applicable requirements of Annex VI of the Convention.

This Certificate is valid until **2020-12-14** subject to surveys in accordance with Regulation 5 of Annex VI of the Convention.

Completion date of survey on which this Certificate is based: **2015-12-14**

Issued at **Høvik, Norway** on **2016-02-03**

for **DNV GL**

Kristin Wilhelmsen
Head of Section

Form code: IAPP 101a Revision: 2015-10 www.dnvgl.com Page 1 of 8

HOLKIE

DNV GL Id No: **33159**
Date of issue: **2016-02-03**

Endorsement for annual and intermediate surveys

THIS IS TO CERTIFY:
that, at a survey required by Regulation 5 of Annex VI of the Convention, the ship was found to comply with the relevant provisions of that Annex..

Annual survey: Place: ____________________ Date: __________

Signature: ____________________

Stamp ____________________ Surveyor, DNV GL

Annual / Intermediate [1] survey: Place: ____________________ Date: __________

Signature: ____________________

Stamp ____________________ Surveyor, DNV GL

Annual / Intermediate [1] survey: Place: ____________________ Date: __________

Signature: ____________________

Stamp ____________________ Surveyor, DNV GL

Annual survey: Place: ____________________ Date: __________

Signature: ____________________

Stamp ____________________ Surveyor, DNV GL

Annual/intermediate survey in accordance with Regulation 9.8.3

THIS IS TO CERTIFY that, at an annual / intermediate [1] survey in accordance with Regulation 9.8.3 of Annex VI of the Convention, the ship was found to comply with the relevant provisions of that Annex.

Place: ____________________ Date: __________

Signature: ____________________

Stamp ____________________ Surveyor, DNV GL

1 Delete as appropriate.

DNV GL Id No: **33159**
Date of issue: **2016-02-03**

Endorsement to extend the Certificate if valid for less than 5 years where Regulation 9.3 applies

The ship complies with the relevant provisions of the Annex, and this Certificate shall, in accordance with Regulation 9.3 of Annex VI of the Convention, be accepted as valid until: ______

Place: ______ Date: ______

Signature: ______

Stamp ______ Surveyor, DNV GL

Endorsement where the renewal survey has been completed and Regulation 9.4 applies.

The ship complies with the relevant provisions of the Annex, and this Certificate shall, in accordance with Regulation 9.4 of Annex VI of the Convention, be accepted as valid until: ______

Place: ______ Date: ______

Signature: ______

Stamp ______ Surveyor, DNV GL

Endorsement to extend the validity of the Certificate until reaching the port of survey or for a period of grace where Regulation 9.5 or 9.6 applies.

This Certificate shall, in accordance with Regulation 9.5 / 9.6 [1] of Annex VI of the Convention, be accepted as valid until: ______

Place: ______ Date: ______

Signature: ______

Stamp ______ Surveyor, DNV GL

DNV GL

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DNV GL Id No: **33159**
Date of issue: **2016-02-03**

Endorsement for advancement of anniversary date where Regulation 9.8 applies.

In accordance with Regulation 9.8 of Annex VI of the Convention, the new anniversary date is: ____________

Place: ____________ Date: ____________

Signature: ____________

Stamp ____________ Surveyor, DNV GL

In accordance with Regulation 9.8 of Annex VI of the Convention, the new anniversary date is: ____________

Place: ____________ Date: ____________

Signature: ____________

Stamp ____________ Surveyor, DNV GL

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DNV GL Id No: **33159**
Date of issue: **2016-02-03**

SUPPLEMENT TO INTERNATIONAL AIR POLLUTION PREVENTION CERTIFICATE

(IAPP CERTIFICATE)

RECORD OF CONSTRUCTION AND EQUIPMENT

In respect of the provisions of Annex VI of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (hereinafter referred to as "the Convention").

This Record shall be permanently attached to the IAPP Certificate. The IAPP Certificate shall be available on board the ship at all times.

The Record shall be at least in English, French or Spanish. If an official language of the issuing country is also used, this shall prevail in case of a dispute or discrepancy.

Entries in boxes shall be made by inserting either a cross (x) for the answers "yes" and "applicable" or a dash (-) for the answers "no" and "not applicable" as appropriate.

Unless otherwise stated, regulations mentioned in this Record refer to regulations of Annex VI of the Convention and resolutions or circulars refer to those adopted by the International Maritime Organization.

1. Particulars of Ship

1.1	Name of Ship	**DEEPWATER PROTEUS**
1.2	IMO number	**9675171**
1.3	Date on which keel was laid or ship was at similar stage of construction	**2014-09-23**
1.4	Length of Ship [2]	**- m**

2. Control of emissions from ships

2.1 Ozone-depleting substances (Regulation 12)

2.1.1 The following fire-extinguishing systems, other systems and equipment containing ozone-depleting substances, other than hydro-chlorofluorocarbons (HCFCs), installed before 19 May 2005 may continue in service: [-]

System equipment	Location on board	Substance

2.1.2 The following systems and equipment containing hydro-chlorofluorocarbons (HCFCs) installed before 1 January 2020 may continue in service: [-]

System equipment	Location on board	Substance

[2] Completed only in respect of ships constructed on or after 1 January 2016 that are specially designed, and used solely, for recreational purposes and to which, in accordance with regulation 13.5.2.1 and regulation 13.5.2.3, the NOx emission limit as given by regulation 13.5.1.1 will not apply.

2.2 Nitrogen Oxides (NOx) (Regulation 13)

2.2.1 The following marine diesel engines with power output greater than 130 kW [3], installed on this ship comply with the applicable emission limit of Regulation 13 in accordance with the revised NOx Technical Code:

	Engine #1	Engine #2	Engine #3	Engine #4	Engine #5	Engine #6	Engine #7
Manufacturer and model	HYUNDAI HEAVY INDUSTRIES CO., LTD. 14H32/40V	HYUNDAI HEAVY INDUSTRIES CO., LTD. 14H32/40V	HYUNDAI HEAVY INDUSTRIES CO., LTD. 14H32/40V	HYUNDAI HEAVY INDUSTRIES CO., LTD. 14H32/40V	HYUNDAI HEAVY INDUSTRIES CO., LTD. 14H32/40V	HYUNDAI HEAVY INDUSTRIES CO., LTD. 14H32/40V	
Serial Number	BA5195-1	BA5195-2	BA5195-3	BA5195-4	BA5195-5	BA5195-6	
Use	Main Engine	Main Engine	Main Engine	Main Engine	Main Engine	Main Engine	
Power Output (kW)	7000	7000	7000	7000	7000	7000	
Rated speed (rpm)	720	720	720	720	720	720	
Date of install. (yyyy-mm-dd)	2015-12-14	2015-12-14	2015-12-14	2015-12-14	2015-12-14	2015-12-14	
Date of major conversion (yyyy-mm-dd) Acc. to reg. 13.2.2							
Date of major conversion (yyyy-mm-dd) Acc. to reg. 13.2.3							
Exempted by reg. 13.1.1.2	☐	☐	☐	☐	☐	☐	☐
Tier I Reg. 13.3	☐	☐	☐	☐	☐	☐	☐
Tier II Reg. 13.4	☒	☒	☒	☒	☒	☒	☐
Tier II Reg. 13.2.2. or 13.5.2	☐	☐	☐	☐	☐	☐	☐
Tier III Reg 13.5.1.1	☐	☐	☐	☐	☐	☐	☐
Approved Method exists	☐	☐	☐	☐	☐	☐	☐
Approved Method not commercially available	☐	☐	☐	☐	☐	☐	☐
Approved Method installed	☐	☐	☐	☐	☐	☐	☐

3 Note that Reg.13 is not applicable for lifeboat engines, emergency diesel generators and emergency fire pump diesel engines.

DNV GL Id No: **33159**
Date of issue: **2016-02-03**

2.3 Sulphur Oxides (SO_x) and particulate matter (Regulation 14)

2.3.1 When the ship operates outside of an Emission Control Area specified in regulation 14.3, the ship uses:

2.3.1.1 fuel oil with a sulphur content as documented by bunker delivery notes that does not exceed the limit value of:

- 4.50% m/m (not applicable on or after 1 January 2012); or [-]
- 3.50% m/m (not applicable on or after 1 January 2020); or [X]
- 0.50% m/m, and/or [X]

2.3.1.2 an equivalent arrangement approved in accordance with regulation 4.1 as listed in 2.6 that is at least as effective in terms of SO_x emission reductions as compared to using a fuel oil with a sulphur content limit value of:

- 4.50% m/m (not applicable on or after 1 January 2012); or [-]
- 3.50% m/m (not applicable on or after 1 January 2020); or [-]
- 0.50% m/m [-]

2.3.2 When the ship operates inside an Emission Control Area specified in regulation 14.3, the ship uses:

2.3.2.1 fuel oil with a sulphur content as documented by bunker delivery notes that does not exceed the limit value of:

- 1.00% m/m (not applicable on or after 1 January 2015); or [-]
- 0.10% m/m, and/or [X]

2.3.2.2 an equivalent arrangement approved in accordance with regulation 4.1 as listed in 2.6 that is at least as effective in terms of SO_x emission reductions as compared to using a fuel oil with a sulphur content limit value of:

- 1.00% m/m (not applicable on or after 1 January 2015); or [-]
- 0.10% m/m [-]

2.4 Volatile organic compounds (VOCs) (Regulation 15)

2.4.1 The tanker has a vapour collection system installed and approved in accordance with IMO MSC/Circ.585 [4]: [-]

2.4.2.1 For a tanker carrying crude oil, there is an approved VOC Management Plan [-]

2.4.2.2 VOC Management Plan approval reference: - [-]

2.5 Shipboard Incineration (Regulation 16)

2.5.1 The ship has an incinerator:

2.5.1.1 installed on or after 1 January 2000 which complies with resolution MEPC.76(40) as amended [-]

2.5.1.2 installed before 1 January 2000 which

2.5.1.2.1 complies with resolution MEPC.59(33) [-]

2.5.1.2.2 complies with resolution MEPC.76(40) [-]

2.5.1.2.3 does not comply with resolution MEPC.59(33) or resolution MEPC.76(40) [-]

2.6 Equivalents (Regulation 4)

The ship has been allowed to use the following fitting, material, appliance or apparatus to be fitted in a ship or other procedures, alternative fuel oils, or compliance methods used as an alternative to that required by this Annex:

System or equipment	Equivalent used	Approval reference

[4] Ships with DNV GL Class notation VCS-1 or VCS-2 (compliance with USCG CFR 46 Part 39) comply with IMO MSC/Circ.585.

DNV GL Id No: **33159**
Date of issue: **2016-02-03**

THIS IS TO CERTIFY that this Record is correct in all respects.

Issued at Høvik, Norway on 2016-02-03

for **DNV GL**

Morten Ingvaldsen
Surveyor

DNV·GL

INTERNATIONAL AIR POLLUTION PREVENTION CERTIFICATE

Certificate No:
n1109949-udq
DNV GL Id No:
33160
Date of issue:
2018-01-19

Issued under the provisions of the Protocol of 1997, as amended by resolution MEPC.176(58) in 2008, to amend the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 related thereto (hereinafter referred to as "the Convention")
under the authority of the Government of

THE REPUBLIC OF THE MARSHALL ISLANDS

by **DNV GL**

Particulars of Ship

Name of Ship:	**DEEPWATER PONTUS**
Distinctive Number or Letters:	**5125**
Port of Registry:	**MAJURO**
Gross Tonnage:	**70095**
IMO Number:	**9675183**

This is to certify:

1. That the ship has been surveyed in accordance with regulation 5 of Annex VI of the Convention; and
2. That the survey shows that the equipment, systems, fittings, arrangements and materials fully comply with the applicable requirements of Annex VI of the Convention.

This Certificate is valid until **2022-07-10** subject to surveys in accordance with Regulation 5 of Annex VI of the Convention.

Completion date of survey on which this Certificate is based: **2017-07-10**

Issued at **New Orleans, LA, United States** on **2018-01-19**

for **DNV GL**

This document is signed electronically in accordance with IMO FAL.5/Circ.39/Rev.2. Validation and authentication can be obtained from trust.dnvgl.com by using the Unique Tracking Number (UTN): n1109949-udq and ID: 33160

Derek Schmidt
Surveyor

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UTN: n1109949-udq

Certificate No: **n1109949-udq**
Date of issue: **2018-01-19**

Endorsement for annual and intermediate surveys

THIS IS TO CERTIFY:
that, at a survey required by Regulation 5 of Annex VI of the Convention, the ship was found to comply with the relevant provisions of that Annex.

Annual survey: Place: ________ Date: ________

Signature: ________

Stamp Surveyor, DNV GL

Annual/Intermediate[1] survey: Place: ________ Date: ________

Signature: ________

Stamp Surveyor, DNV GL

Annual/Intermediate[1] survey: Place: ________ Date: ________

Signature: ________

Stamp Surveyor, DNV GL

Annual survey: Place: ________ Date: ________

Signature: ________

Stamp Surveyor, DNV GL

Annual/intermediate survey in accordance with Regulation 9.8.3

THIS IS TO CERTIFY that, at an annual/intermediate[1] survey in accordance with Regulation 9.8.3 of Annex VI of the Convention, the ship was found to comply with the relevant provisions of that Annex.

Place: ________ Date: ________

Signature: ________

Stamp Surveyor, DNV GL

1 Delete as appropriate.

Certificate No: **n1109949-udq**
Date of issue: **2018-01-19**

Endorsement to extend the Certificate if valid for less than 5 years where Regulation 9.3 applies

The ship complies with the relevant provisions of the Annex, and this Certificate shall, in accordance with Regulation 9.3 of Annex VI of the Convention, be accepted as valid until

Place: Date:

Signature:

Stamp Surveyor, DNV GL

Endorsement where the renewal survey has been completed and Regulation 9.4 applies

The ship complies with the relevant provisions of the Annex, and this Certificate shall, in accordance with Regulation 9.4 of Annex VI of the Convention, be accepted as valid until

Place: Date:

Signature:

Stamp Surveyor, DNV GL

Endorsement to extend the validity of the Certificate until reaching the port of survey or for a period of grace where Regulation 9.5 or 9.6 applies

This Certificate shall, in accordance with Regulation 9.5 or 9.6[1] of Annex VI of the Convention, be accepted as valid until

Place: Date:

Signature:

Stamp Surveyor, DNV GL

Certificate No: **n1109949-udq**
Date of issue: **2018-01-19**

Endorsement for advancement of anniversary date where Regulation 9.8 applies

In accordance with Regulation 9.8 of Annex VI of the Convention, the new anniversary date is ____________

Place: ____________ Date: ____________

Signature: ____________

Stamp Surveyor, DNV GL

In accordance with Regulation 9.8 of Annex VI of the Convention, the new anniversary date is ____________

Place: ____________ Date: ____________

Signature: ____________

Stamp Surveyor, DNV GL

Certificate No: **n1109949-udq**
Date of issue: **2018-01-19**

SUPPLEMENT TO INTERNATIONAL AIR POLLUTION PREVENTION CERTIFICATE

(IAPP CERTIFICATE)

RECORD OF CONSTRUCTION AND EQUIPMENT

In respect of the provisions of Annex VI of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (hereinafter referred to as "the Convention").

This Record shall be permanently attached to the IAPP Certificate. The IAPP Certificate shall be available on board the ship at all times.

The Record shall be at least in English, French or Spanish. If an official language of the issuing country is also used, this shall prevail in case of a dispute or discrepancy.

Entries in boxes shall be made by inserting either a cross (x) for the answers "yes" and "applicable" or a dash (-) for the answers "no" and "not applicable" as appropriate.

Unless otherwise stated, regulations mentioned in this Record refer to regulations of Annex VI of the Convention and resolutions or circulars refer to those adopted by the International Maritime Organization.

1. Particulars of ship

Name of Ship:	**DEEPWATER PONTUS**
IMO Number:	**9675183**
Date on which keel was laid or ship was at similar stage of construction:	**2015-08-31**
Length of Ship: [2]	**- m**

2. Control of emissions from ships

2.1 Ozone-depleting substances (Regulation 12)

2.1.1 The following fire-extinguishing systems, other systems and equipment containing ozone-depleting substances, other than hydro-chlorofluorocarbons (HCFCs), installed before 19 May 2005 may continue in service: [-]

System equipment	Location on board	Substance

2.1.2 The following systems and equipment containing hydro-chlorofluorocarbons (HCFCs) installed before 1 January 2020 may continue in service: [-]

System equipment	Location on board	Substance

[2] Completed only in respect of ships constructed on or after 1 January 2016 that are specially designed, and used solely, for recreational purposes and to which, in accordance with regulation 13.5.2.1 or regulation 13.5.2.3, the NOx emission limit as given by regulation 13.5.1.1 will not apply.

2.2 Nitrogen Oxides (NOx) (Regulation 13)

2.2.1 The following marine diesel engines installed on this ship are in accordance with the requirements of regulation 13, as indicated:

Applicable regulation of MARPOL Annex VI (NTC = NOX Technical Code 2008) (AM = Approved Method)			Engine #1	Engine #2	Engine #3	Engine #4	Engine #5	Engine #6
1	Manufacturer and model		Hyundai Heavy Industries Co., Ltd., 14H32/40V	Hyundai Heavy Industries Co., Ltd., 14H32/40V	Hyundai Heavy Industries Co., Ltd., 14H32/40V	Hyundai Heavy Industries Co., Ltd., 14H32/40V	Hyundai Heavy Industries Co., Ltd., 14H32/40V	Hyundai Heavy Industries Co., Ltd., 14H32/40V
2	Serial Number		BA5196-1	BA5196-2	BA5196-3	BA5196-4	BA5196-5	BA5196-6
3	Use (applicable application cycle(s) – NTC 3.2)		E2/D2	E2/D2	E2/D2	E2/D2	E2/D2	E2/D2
4	Rated power (kW) (NTC 1.3.11)		7000	7000	7000	7000	7000	7000
5	Rated speed (RPM) (NTC 1.3.12)		720	720	720	720	720	720
6	Identical engine installed ≥ 2000-01-01 exempted by 13.1.1.2		☐	☐	☐	☐	☐	☐
7	Identical engine installation date as per 13.1.1.2 (yyyy-mm-dd)							
8a	Major Conversion (yyyy-mm-dd)	13.2.1.1 & 13.2.2						
8b		13.2.1.2 & 13.2.3						
8c		13.2.1.3 & 13.2.3						
9a	Tier I	13.3	☐	☐	☐	☐	☐	☐
9b		13.2.2	☐	☐	☐	☐	☐	☐
9c		13.2.3.1	☐	☐	☐	☐	☐	☐
9d		13.2.3.2	☐	☐	☐	☐	☐	☐
9e		13.7.1.2	☐	☐	☐	☐	☐	☐
10a	Tier II	13.4	☒	☒	☒	☒	☒	☒
10b		13.2.2	☐	☐	☐	☐	☐	☐
10c		13.2.2 (Tier III not possible)	☐	☐	☐	☐	☐	☐
10d		13.2.3.2	☐	☐	☐	☐	☐	☐
10e		13.5.2 (Exemptions)	☐	☐	☐	☐	☐	☐
10f		13.7.1.2	☐	☐	☐	☐	☐	☐
11a	Tier III (ECA-NOx only)	13.5.1.1	☐	☐	☐	☐	☐	☐
11b		13.2.2	☐	☐	☐	☐	☐	☐
11c		13.2.3.2	☐	☐	☐	☐	☐	☐
11d		13.7.1.2	☐	☐	☐	☐	☐	☐
12	AM[3]	installed	☐	☐	☐	☐	☐	☐
13		not commercially available at this survey	☐	☐	☐	☐	☐	☐
14		not applicable	☐	☐	☐	☐	☐	☐

2.3 Sulphur Oxides (SOx) and particulate matter (Regulation 14)

2.3.1 When the ship operates outside of an Emission Control Area specified in regulation 14.3, the ship uses:

2.3.1.1 fuel oil with a sulphur content as documented by bunker delivery notes that does not exceed the limit value of:

- 4.50% m/m (not applicable on or after 1 January 2012); or [-]
- 3.50% m/m (not applicable on or after 1 January 2020); or [X]
- 0.50% m/m, and/or [X]

2.3.1.2 an equivalent arrangement approved in accordance with regulation 4.1 as listed in 2.6 that is at least as effective in terms of SO_x emission reductions as compared to using a fuel oil with a sulphur content limit value of:

3 Refer to the 2014 Guidelines on the approved method process (resolution MEPC.243(66))

- 4.50% m/m (not applicable on or after 1 January 2012); or [-]
- 3.50% m/m (not applicable on or after 1 January 2020); or [-]
- 0.50% m/m [-]

2.3.2 When the ship operates inside an Emission Control Area specified in regulation 14.3, the ship uses:

2.3.2.1 fuel oil with a sulphur content as documented by bunker delivery notes that does not exceed the limit value of:

- 1.00% m/m (not applicable on or after 1 January 2015); or [-]
- 0.10% m/m, and/or [X]

2.3.2.2 an equivalent arrangement approved in accordance with regulation 4.1 as listed in 2.6 that is at least as effective in terms of SO_x emission reductions as compared to using a fuel oil with a sulphur content limit value of:

- 1.00% m/m (not applicable on or after 1 January 2015); or [-]
- 0.10% m/m [-]

2.4 Volatile organic compounds (VOCs) (Regulation 15)

2.4.1 The tanker has a vapour collection system installed and approved in accordance with IMO MSC/Circ.585 [4]: [-]

2.4.2.1 For a tanker carrying crude oil, there is an approved VOC Management Plan [-]

2.4.2.2 VOC Management Plan approval reference: - [-]

2.5 Shipboard Incineration (Regulation 16)

The ship has an incinerator:

2.5.1 installed on or after 1 January 2000 which complies with:

2.5.1.1 resolution MEPC.76(40), as amended[5] [-]

2.5.1.2 resolution MEPC.244(66) [-]

2.5.2 installed before 1 January 2000 which

2.5.2.1 complies with resolution MEPC.59(33), as amended[6] [-]

2.5.2.2 complies with resolution MEPC.76(40), as amended[5] [-]

2.5.2.3 does not comply with resolution MEPC.59(33) or resolution MEPC.76(40) [-]

2.6 Equivalents (Regulation 4)

The ship has been allowed to use the following fitting, material, appliance or apparatus to be fitted in a ship or other procedures, alternative fuel oils, or compliance methods used as an alternative to that required by this Annex:

System or equipment	Equivalent used	Approval reference

[4] Ships with DNV GL Class notation VCS-1 or VCS-2 (compliance with USCG CFR 46 Part 39) comply with IMO MSC/Circ.585.

[5] As amended by resolution MEPC.93(45)

[6] As amended by resolution MEPC.92(45)

Certificate No: **n1109949-udq**
Date of issue: **2018-01-19**

THIS IS TO CERTIFY that this Record is correct in all respects.

Issued at **New Orleans, LA, United States** on **2018-01-19**

for **DNV GL**

This document is signed electronically in accordance with IMO FAL.5/Circ.39/Rev.2. Validation and authentication can be obtained from trust.dnvgl.com by using the Unique Tracking Number (UTN): n1109949-udq and ID: 33160

Derek Schmidt
Surveyor

DNV·GL

INTERNATIONAL AIR POLLUTION PREVENTION CERTIFICATE

DNV GL Id No:
33158
Date of issue:
2016-01-14

Issued under the provisions of the Protocol of 1997 as amended by resolution MEPC.176(58) in 2008, to amend the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 related thereto (hereinafter referred to as "the Convention")
under the authority of the Government of

THE REPUBLIC OF THE MARSHALL ISLANDS

by **DNV GL**

Particulars of Ship

Name of Ship:	**DEEPWATER THALASSA**
Distinctive Number or Letters:	**5123**
Port of Registry:	**MAJURO**
Gross Tonnage:	**70095**
IMO Number:	**9675169**

This is to certify:

1. That the ship has been surveyed in accordance with regulation 5 of Annex VI of the Convention; and
2. That the survey shows that the equipment, systems, fittings, arrangements and materials fully comply with the applicable requirements of Annex VI of the Convention.

This Certificate is valid until **2020-09-09** subject to surveys in accordance with Regulation 5 of Annex VI of the Convention.

Completion date of survey on which this Certificate is based: **2015-09-09**

Issued at **Houston, Texas, United States** on **2016-01-14**

for **DNV GL**

Piotr Belka
Surveyor

Form code: IAPP 101a Revision: 2015-10 www.dnvgl.com Page 1 of 8

DNV GL Id No: **33158**
Date of issue: **2016-01-14**

Endorsement for annual and intermediate surveys

THIS IS TO CERTIFY:
that, at a survey required by Regulation 5 of Annex VI of the Convention, the ship was found to comply with the relevant provisions of that Annex..

Annual survey: Place: ____________________ Date: __________

Signature: ____________________
Stamp ____________________ Surveyor, DNV GL

Annual / Intermediate [1] survey: Place: ____________________ Date: __________

Signature: ____________________
Stamp ____________________ Surveyor, DNV GL

Annual / Intermediate [1] survey: Place: ____________________ Date: __________

Signature: ____________________
Stamp ____________________ Surveyor, DNV GL

Annual survey: Place: ____________________ Date: __________

Signature: ____________________
Stamp ____________________ Surveyor, DNV GL

Annual/intermediate survey in accordance with Regulation 9.8.3

THIS IS TO CERTIFY that, at an annual / intermediate [1] survey in accordance with Regulation 9.8.3 of Annex VI of the Convention, the ship was found to comply with the relevant provisions of that Annex.

Place: ____________________ Date: __________

Signature: ____________________
Stamp ____________________ Surveyor, DNV GL

[1] Delete as appropriate.

Form code: IAPP 101a Revision: 2015-10 www.dnvgl.com Page 2 of 8

DNV GL Id No: **33158**
Date of issue: **2016-01-14**

Endorsement to extend the Certificate if valid for less than 5 years where Regulation 9.3 applies

The ship complies with the relevant provisions of the Annex, and this Certificate shall, in accordance with Regulation 9.3 of Annex VI of the Convention, be accepted as valid until: ____________

Place: ____________ Date: ____________

Signature: ____________

Stamp ____________ Surveyor, DNV GL

Endorsement where the renewal survey has been completed and Regulation 9.4 applies.

The ship complies with the relevant provisions of the Annex, and this Certificate shall, in accordance with Regulation 9.4 of Annex VI of the Convention, be accepted as valid until: ____________

Place: ____________ Date: ____________

Signature: ____________

Stamp ____________ Surveyor, DNV GL

Endorsement to extend the validity of the Certificate until reaching the port of survey or for a period of grace where Regulation 9.5 or 9.6 applies.

This Certificate shall, in accordance with Regulation 9.5 / 9.6 [1] of Annex VI of the Convention, be accepted as valid until: ____________

Place: ____________ Date: ____________

Signature: ____________

Stamp ____________ Surveyor, DNV GL

Form code: IAPP 101a Revision: 2015-10 www.dnvgl.com Page 3 of 6

DNV GL Id No: **33158**
Date of issue: **2016-01-14**

Endorsement for advancement of anniversary date where Regulation 9.8 applies.

In accordance with Regulation 9.8 of Annex VI of the Convention, the new anniversary date is: ____________

Place: ______________________ Date: ____________

Signature: ______________________

Stamp Surveyor, DNV GL

In accordance with Regulation 9.8 of Annex VI of the Convention, the new anniversary date is: ____________

Place: ______________________ Date: ____________

Signature: ______________________

Stamp Surveyor, DNV GL

DNV GL Id No: **33158**
Date of issue: **2016-01-14**

SUPPLEMENT TO INTERNATIONAL AIR POLLUTION PREVENTION CERTIFICATE

(IAPP CERTIFICATE)

RECORD OF CONSTRUCTION AND EQUIPMENT

In respect of the provisions of Annex VI of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (hereinafter referred to as "the Convention").

This Record shall be permanently attached to the IAPP Certificate. The IAPP Certificate shall be available on board the ship at all times.

The Record shall be at least in English, French or Spanish. If an official language of the issuing country is also used, this shall prevail in case of a dispute or discrepancy.

Entries in boxes shall be made by inserting either a cross (x) for the answers "yes" and "applicable" or a dash (-) for the answers "no" and "not applicable" as appropriate.

Unless otherwise stated, regulations mentioned in this Record refer to regulations of Annex VI of the Convention and resolutions or circulars refer to those adopted by the International Maritime Organization.

1. Particulars of Ship

1.1	Name of Ship	**DEEPWATER THALASSA**
1.2	IMO number	**9675169**
1.3	Date on which keel was laid or ship was at similar stage of construction	**2014-03-31**
1.4	Length of Ship [2]	**- m**

2. Control of emissions from ships

2.1 Ozone-depleting substances (Regulation 12)

2.1.1 The following fire-extinguishing systems, other systems and equipment containing ozone-depleting substances, other than hydro-chlorofluorocarbons (HCFCs), installed before 19 May 2005 may continue in service: [-]

System equipment	Location on board	Substance

2.1.2 The following systems and equipment containing hydro-chlorofluorocarbons (HCFCs) installed before 1 January 2020 may continue in service: [-]

System equipment	Location on board	Substance

[2] Completed only in respect of ships constructed on or after 1 January 2016 that are specially designed, and used solely, for recreational purposes and to which, in accordance with regulation 13.5.2.1 and regulation 13.5.2.3, the NOx emission limit as given by regulation 13.5.1.1 will not apply.

2.2 Nitrogen Oxides (NOx) (Regulation 13)

2.2.1 The following marine diesel engines with power output greater than 130 kW [3], installed on this ship comply with the applicable emission limit of Regulation 13 in accordance with the revised NOx Technical Code:

	Engine #1	Engine #2	Engine #3	Engine #4	Engine #5	Engine #6	Engine #7
Manufacturer and model	HYUNDAI HEAVY INDUSTRIES CO., LTD., 14H32/40V	HYUNDAI HEAVY INDUSTRIES CO., LTD., 14H32/40V	HYUNDAI HEAVY INDUSTRIES CO., LTD., 14H32/40V	HYUNDAI HEAVY INDUSTRIES CO., LTD., 14H32/40V	HYUNDAI HEAVY INDUSTRIES CO., LTD., 14H32/40V	HYUNDAI HEAVY INDUSTRIES CO., LTD., 14H32/40V	
Serial Number	BA5194-1	BA5194-2	BA5194-3	BA5194-4	BA5194-5	BA5194-6	
Use	Main Engine	Main Engine	Main Engine	Main Engine	Main Engine	Main Engine	
Power Output (kW)	7000	7000	7000	7000	7000	7000	
Rated speed (rpm)	720	720	720	720	720	720	
Date of install. (yyyy-mm-dd)	2015-09-09	2015-09-09	2015-09-09	2015-09-09	2015-09-09	2015-09-09	
Date of major conversion (yyyy-mm-dd) Acc. to reg. 13.2.2							
Date of major conversion (yyyy-mm-dd) Acc. to reg. 13.2.3							
Exempted by reg. 13.1.1.2	☐	☐	☐	☐	☐	☐	☐
Tier I Reg. 13.3	☐	☐	☐	☐	☐	☐	☐
Tier II Reg. 13.4	☒	☒	☒	☒	☒	☒	☐
Tier II Reg. 13.2.2. or 13.5.2	☐	☐	☐	☐	☐	☐	☐
Tier III Reg 13.5.1.1	☐	☐	☐	☐	☐	☐	☐
Approved Method exists	☐	☐	☐	☐	☐	☐	☐
Approved Method not commercially available	☐	☐	☐	☐	☐	☐	☐
Approved Method installed	☐	☐	☐	☐	☐	☐	☐

3 Note that Reg.13 is not applicable for lifeboat engines, emergency diesel generators and emergency fire pump diesel engines.

2.3 Sulphur Oxides (SO_x) and particulate matter (Regulation 14)

2.3.1 When the ship operates outside of an Emission Control Area specified in regulation 14.3, the ship uses:

2.3.1.1 fuel oil with a sulphur content as documented by bunker delivery notes that does not exceed the limit value of:

- 4.50% m/m (not applicable on or after 1 January 2012); or [-]
- 3.50% m/m (not applicable on or after 1 January 2020); or [X]
- 0.50% m/m, and/or [X]

2.3.1.2 an equivalent arrangement approved in accordance with regulation 4.1 as listed in 2.6 that is at least as effective in terms of SO_x emission reductions as compared to using a fuel oil with a sulphur content limit value of:

- 4.50% m/m (not applicable on or after 1 January 2012); or [-]
- 3.50% m/m (not applicable on or after 1 January 2020); or [-]
- 0.50% m/m [-]

2.3.2 When the ship operates inside an Emission Control Area specified in regulation 14.3, the ship uses:

2.3.2.1 fuel oil with a sulphur content as documented by bunker delivery notes that does not exceed the limit value of:

- 1.00% m/m (not applicable on or after 1 January 2015); or [-]
- 0.10% m/m, and/or [X]

2.3.2.2 an equivalent arrangement approved in accordance with regulation 4.1 as listed in 2.6 that is at least as effective in terms of SO_x emission reductions as compared to using a fuel oil with a sulphur content limit value of:

- 1.00% m/m (not applicable on or after 1 January 2015); or [-]
- 0.10% m/m [-]

2.4 Volatile organic compounds (VOCs) (Regulation 15)

2.4.1 The tanker has a vapour collection system installed and approved in accordance with IMO MSC/Circ.585 [4]; [-]

2.4.2.1 For a tanker carrying crude oil, there is an approved VOC Management Plan [-]

2.4.2.2 VOC Management Plan approval reference: - [-]

2.5 Shipboard Incineration (Regulation 16)

2.5.1 The ship has an incinerator:

2.5.1.1 installed on or after 1 January 2000 which complies with resolution MEPC.76(40) as amended [-]

2.5.1.2 installed before 1 January 2000 which

2.5.1.2.1 complies with resolution MEPC.59(33) [-]

2.5.1.2.2 complies with resolution MEPC.76(40) [-]

2.5.1.2.3 does not comply with resolution MEPC.59(33) or resolution MEPC.76(40) [-]

2.6 Equivalents (Regulation 4)

The ship has been allowed to use the following fitting, material, appliance or apparatus to be fitted in a ship or other procedures, alternative fuel oils, or compliance methods used as an alternative to that required by this Annex:

System or equipment	Equivalent used	Approval reference

[4] Ships with DNV GL Class notation VCS-1 or VCS-2 (compliance with USCG CFR 46 Part 39) comply with IMO MSC/Circ.585.

DNV GL Id No: **33158**
Date of issue: **2016-01-14**

THIS IS TO CERTIFY that this Record is correct in all respects.

Issued at Houston, Texas, United States on 2016-01-14

for **DNV GL**

Piotr Belka
Surveyor

DNV·GL

INTERNATIONAL AIR POLLUTION PREVENTION CERTIFICATE

Certificate No:
n1060805-10-wir
DNV GL Id No:
33161
Date of issue:
2018-01-02

Issued under the provisions of the Protocol of 1997, as amended by resolution MEPC.176(58) in 2008, to amend the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 related thereto (hereinafter referred to as "the Convention")
under the authority of the Government of

THE REPUBLIC OF THE MARSHALL ISLANDS

by **DNV GL**

Particulars of Ship

Name of Ship:	**DEEPWATER POSEIDON**
Distinctive Number or Letters:	**5126**
Port of Registry:	**MAJURO**
Gross Tonnage:	**70095**
IMO Number:	**9675195**

This is to certify:

1. That the ship has been surveyed in accordance with regulation 5 of Annex VI of the Convention; and
2. That the survey shows that the equipment, systems, fittings, arrangements and materials fully comply with the applicable requirements of Annex VI of the Convention.

This Certificate is valid until **2022-10-28** subject to surveys in accordance with Regulation 5 of Annex VI of the Convention.

Completion date of survey on which this Certificate is based: **2017-10-28**

Issued at **Høvik, Norway** on **2018-01-02**

for **DNV GL**

This document is signed electronically in accordance with IMO FAL.5/Circ.39/Rev.2. Validation and authentication can be obtained from trust.dnvgl.com by using the Unique Tracking Number (UTN): n1060805-10-wir and ID: 33161

Heidi Emanuelsen
Head of Section

Form code: IAPP 101a Revision: 2017-09 www.dnvgl.com Page 1 of 8

UTN: n1060805-10-wir

Certificate No: **n1060805-10-wir**
Date of issue: **2018-01-02**

Endorsement for annual and intermediate surveys

THIS IS TO CERTIFY:
that, at a survey required by Regulation 5 of Annex VI of the Convention, the ship was found to comply with the relevant provisions of that Annex.

Annual survey: Place: ______ Date: ______

Signature: ______
Stamp Surveyor, DNV GL

Annual/Intermediate[1] survey: Place: ______ Date: ______

Signature: ______
Stamp Surveyor, DNV GL

Annual/Intermediate[1] survey: Place: ______ Date: ______

Signature: ______
Stamp Surveyor, DNV GL

Annual survey: Place: ______ Date: ______

Signature: ______
Stamp Surveyor, DNV GL

Annual/intermediate survey in accordance with Regulation 9.8.3

THIS IS TO CERTIFY that, at an annual/intermediate[1] survey in accordance with Regulation 9.8.3 of Annex VI of the Convention, the ship was found to comply with the relevant provisions of that Annex.

Place: ______ Date: ______

Signature: ______
Stamp Surveyor, DNV GL

1 Delete as appropriate.

Certificate No: **n1060805-10-wir**
Date of issue: **2018-01-02**

Endorsement to extend the Certificate if valid for less than 5 years where Regulation 9.3 applies

The ship complies with the relevant provisions of the Annex, and this Certificate shall, in accordance with Regulation 9.3 of Annex VI of the Convention, be accepted as valid until

Place: Date:

Signature:

Stamp Surveyor, DNV GL

Endorsement where the renewal survey has been completed and Regulation 9.4 applies

The ship complies with the relevant provisions of the Annex, and this Certificate shall, in accordance with Regulation 9.4 of Annex VI of the Convention, be accepted as valid until

Place: Date:

Signature:

Stamp Surveyor, DNV GL

Endorsement to extend the validity of the Certificate until reaching the port of survey or for a period of grace where Regulation 9.5 or 9.6 applies

This Certificate shall, in accordance with Regulation 9.5 or 9.6[1] of Annex VI of the Convention, be accepted as valid until

Place: Date:

Signature:

Stamp Surveyor, DNV GL

Certificate No: **n1060805-10-wir**
Date of issue: **2018-01-02**

Endorsement for advancement of anniversary date where Regulation 9.8 applies

In accordance with Regulation 9.8 of Annex VI of the Convention, the new anniversary date is ____________

Place: ______________________ Date: ____________

Signature: ______________________

Stamp Surveyor, DNV GL

In accordance with Regulation 9.8 of Annex VI of the Convention, the new anniversary date is ____________

Place: ______________________ Date: ____________

Signature: ______________________

Stamp Surveyor, DNV GL

Certificate No: **n1060805-10-wir**
Date of issue: **2018-01-02**

SUPPLEMENT TO INTERNATIONAL AIR POLLUTION PREVENTION CERTIFICATE

(IAPP CERTIFICATE)

RECORD OF CONSTRUCTION AND EQUIPMENT

In respect of the provisions of Annex VI of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (hereinafter referred to as "the Convention").

This Record shall be permanently attached to the IAPP Certificate. The IAPP Certificate shall be available on board the ship at all times.

The Record shall be at least in English, French or Spanish. If an official language of the issuing country is also used, this shall prevail in case of a dispute or discrepancy.

Entries in boxes shall be made by inserting either a cross (x) for the answers "yes" and "applicable" or a dash (-) for the answers "no" and "not applicable" as appropriate.

Unless otherwise stated, regulations mentioned in this Record refer to regulations of Annex VI of the Convention and resolutions or circulars refer to those adopted by the International Maritime Organization.

1. Particulars of ship

Name of Ship:	**DEEPWATER POSEIDON**
IMO Number:	**9675195**
Date on which keel was laid or ship was at similar stage of construction:	**2015-12-29**
Length of Ship: [2]	**- m**

2. Control of emissions from ships

2.1 Ozone-depleting substances (Regulation 12)

2.1.1 The following fire-extinguishing systems, other systems and equipment containing ozone-depleting substances, other than hydro-chlorofluorocarbons (HCFCs), installed before 19 May 2005 may continue in service: [-]

System equipment	Location on board	Substance

2.1.2 The following systems and equipment containing hydro-chlorofluorocarbons (HCFCs) installed before 1 January 2020 may continue in service: [-]

System equipment	Location on board	Substance

[2] Completed only in respect of ships constructed on or after 1 January 2016 that are specially designed, and used solely, for recreational purposes and to which, in accordance with regulation 13.5.2.1 or regulation 13.5.2.3, the NOx emission limit as given by regulation 13.5.1.1 will not apply.

Certificate No: **n1060805-10-wir**
Date of issue: **2018-01-02**

2.2 Nitrogen Oxides (NOx) (Regulation 13)

2.2.1 The following marine diesel engines installed on this ship are in accordance with the requirements of regulation 13, as indicated:

Applicable regulation of MARPOL Annex VI (NTC = NOX Technical Code 2008) (AM = Approved Method)			Engine #1	Engine #2	Engine #3	Engine #4	Engine #5	Engine #6
1	Manufacturer and model		HYUNDAI HEAVY IND. ENGINE & MACH. Co., Ltd., 14H32/40V	HYUNDAI HEAVY IND. ENGINE & MACH. Co., Ltd., 14H32/40V	HYUNDAI HEAVY IND. ENGINE & MACH. Co., Ltd., 14H32/40V	HYUNDAI HEAVY IND. ENGINE & MACH. Co., Ltd., 14H32/40V	HYUNDAI HEAVY IND. ENGINE & MACH. Co., Ltd., 14H32/40V	HYUNDAI HEAVY IND. ENGINE & MACH. Co., Ltd., 14H32/40V
2	Serial Number		BA5197-1	BA5197-2	BA5197-3	BA5197-4	BA5197-5	BA5197-6
3	Use (applicable application cycle(s) – NTC 3.2)		E2, D2	E2, D2	E2, D2	E2, D2	E2, D2	E2, D2
4	Rated power (kW) (NTC 1.3.11)		7000	7000	7000	7000	7000	7000
5	Rated speed (RPM) (NTC 1.3.12)		720	720	720	720	720	720
6	Identical engine installed ≥ 2000-01-01 exempted by 13.1.1.2		☐	☐	☐	☐	☐	☐
7	Identical engine installation date as per 13.1.1.2 (yyyy-mm-dd)				-	-		
8a	Major Conversion (yyyy-mm-dd)	13.2.1.1 & 13.2.2					-	-
8b		13.2.1.2 & 13.2.3	-			-		
8c		13.2.1.3 & 13.2.3	-	-		-	-	-
9a	Tier I	13.3	☐	☐	☐	☐	☐	☐
9b		13.2.2	☐	☐	☐	☐	☐	☐
9c		13.2.3.1	☐	☐	☐	☐	☐	☐
9d		13.2.3.2	☐	☐	☐	☐	☐	☐
9e		13.7.1.2	☐	☐	☐	☐	☐	☐
10a	Tier II	13.4	☒	☒	☒	☒	☒	☒
10b		13.2.2	☐	☐	☐	☐	☐	☐
10c		13.2.2 (Tier III not possible)	☐	☐	☐	☐	☐	☐
10d		13.2.3.2	☐	☐	☐	☐	☐	☐
10e		13.5.2 (Exemptions)	☐	☐	☐	☐	☐	☐
10f		13.7.1.2	☐	☐	☐	☐	☐	☐
11a	Tier III (ECA-NOx only)	13.5.1.1	☒	☒	☒	☒	☒	☒
11b		13.2.2	☐	☐	☐	☐	☐	☐
11c		13.2.3.2	☐	☐	☐	☐	☐	☐
11d		13.7.1.2	☐	☐	☐	☐	☐	☐
12	AM[3]	installed	☐	☐	☐	☐	☐	☐
13		not commercially available at this survey	☐	☐	☐	☐	☐	☐
14		not applicable	☐	☐	☐	☐	☐	☐

2.3 Sulphur Oxides (SOx) and particulate matter (Regulation 14)

2.3.1 When the ship operates outside of an Emission Control Area specified in regulation 14.3, the ship uses:

2.3.1.1 fuel oil with a sulphur content as documented by bunker delivery notes that does not exceed the limit value of:

- 4.50% m/m (not applicable on or after 1 January 2012); or [-]
- 3.50% m/m (not applicable on or after 1 January 2020); or [X]
- 0.50% m/m, and/or [X]

3 Refer to the 2014 Guidelines on the approved method process (resolution MEPC.243(66)).

2.3.1.2 an equivalent arrangement approved in accordance with regulation 4.1 as listed in 2.6 that is at least as effective in terms of SO_x emission reductions as compared to using a fuel oil with a sulphur content limit value of:

- 4.50% m/m (not applicable on or after 1 January 2012); or [-]
- 3.50% m/m (not applicable on or after 1 January 2020); or [-]
- 0.50% m/m [-]

2.3.2 When the ship operates inside an Emission Control Area specified in regulation 14.3, the ship uses:

2.3.2.1 fuel oil with a sulphur content as documented by bunker delivery notes that does not exceed the limit value of:

- 1.00% m/m (not applicable on or after 1 January 2015); or [-]
- 0.10% m/m, and/or [X]

2.3.2.2 an equivalent arrangement approved in accordance with regulation 4.1 as listed in 2.6 that is at least as effective in terms of SO_x emission reductions as compared to using a fuel oil with a sulphur content limit value of:

- 1.00% m/m (not applicable on or after 1 January 2015); or [-]
- 0.10% m/m [-]

2.4 Volatile organic compounds (VOCs) (Regulation 15)

2.4.1 The tanker has a vapour collection system installed and approved in accordance with IMO MSC/Circ.585 [4]: [-]

2.4.2.1 For a tanker carrying crude oil, there is an approved VOC Management Plan [-]

2.4.2.2 VOC Management Plan approval reference: - [-]

2.5 Shipboard Incineration (Regulation 16)

The ship has an incinerator:

2.5.1 installed on or after 1 January 2000 which complies with:

2.5.1.1 resolution MEPC.76(40), as amended[5] [-]

2.5.1.2 resolution MEPC.244(66) [-]

2.5.2 installed before 1 January 2000 which

2.5.2.1 complies with resolution MEPC.59(33), as amended[6] [-]

2.5.2.2 complies with resolution MEPC.76(40), as amended[5] [-]

2.5.2.3 does not comply with resolution MEPC.59(33) or resolution MEPC.76(40) [-]

2.6 Equivalents (Regulation 4)

The ship has been allowed to use the following fitting, material, appliance or apparatus to be fitted in a ship or other procedures, alternative fuel oils, or compliance methods used as an alternative to that required by this Annex:

System or equipment	Equivalent used	Approval reference

4 Ships with DNV GL Class notation VCS-1 or VCS-2 (compliance with USCG CFR 46 Part 39) comply with IMO MSC/Circ.585.
5 As amended by resolution MEPC.93(45)
6 As amended by resolution MEPC.92(45)

Certificate No: **n1060805-10-wir**
Date of issue: **2018-01-02**

THIS IS TO CERTIFY that this Record is correct in all respects.

Issued at **Høvik, Norway** on **2018-01-02**

for **DNV GL**

This document is signed electronically in accordance with IMO FAL.5/Circ.39/Rev.2. Validation and authentication can be obtained from trust.dnvgl.com by using the Unique Tracking Number (UTN): n1060805-10-wir and ID: 33161

Morten Ingvaldsen
Surveyor

DNV·GL

INTERNATIONAL AIR POLLUTION PREVENTION CERTIFICATE

Certificate No:
n1109949-udq
DNV GL Id No:
33160
Date of issue:
2018-01-19

Issued under the provisions of the Protocol of 1997, as amended by resolution MEPC.176(58) in 2008, to amend the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 related thereto (hereinafter referred to as "the Convention") under the authority of the Government of

THE REPUBLIC OF THE MARSHALL ISLANDS

by **DNV GL**

Particulars of Ship

Name of Ship:	**DEEPWATER PONTUS**
Distinctive Number or Letters:	**5125**
Port of Registry:	**MAJURO**
Gross Tonnage:	**70095**
IMO Number:	**9675183**

This is to certify:

1. That the ship has been surveyed in accordance with regulation 5 of Annex VI of the Convention; and
2. That the survey shows that the equipment, systems, fittings, arrangements and materials fully comply with the applicable requirements of Annex VI of the Convention.

This Certificate is valid until **2022-07-10** subject to surveys in accordance with Regulation 5 of Annex VI of the Convention.

Completion date of survey on which this Certificate is based: **2017-07-10**

Issued at **New Orleans, LA, United States** on **2018-01-19**

for **DNV GL**

This document is signed electronically in accordance with IMO FAL.5/Circ.39/Rev.2. Validation and authentication can be obtained from trust.dnvgl.com by using the Unique Tracking Number (UTN): n1109949-udq and ID: 33160

Derek Schmidt
Surveyor

Certificate No: **n1109949-udq**
Date of issue: **2018-01-19**

Endorsement for annual and intermediate surveys

THIS IS TO CERTIFY:
that, at a survey required by Regulation 5 of Annex VI of the Convention, the ship was found to comply with the relevant provisions of that Annex.

Annual survey: Place: ______ Date: ______

Signature: ______

Stamp Surveyor, DNV GL

Annual/Intermediate[1] survey: Place: ______ Date: ______

Signature: ______

Stamp Surveyor, DNV GL

Annual/Intermediate[1] survey: Place: ______ Date: ______

Signature: ______

Stamp Surveyor, DNV GL

Annual survey: Place: ______ Date: ______

Signature: ______

Stamp Surveyor, DNV GL

Annual/intermediate survey in accordance with Regulation 9.8.3

THIS IS TO CERTIFY that, at an annual/intermediate[1] survey in accordance with Regulation 9.8.3 of Annex VI of the Convention, the ship was found to comply with the relevant provisions of that Annex.

Place: ______ Date: ______

Signature: ______

Stamp Surveyor, DNV GL

[1] Delete as appropriate.

Certificate No: **n1109949-udq**
Date of issue: **2018-01-19**

Endorsement to extend the Certificate if valid for less than 5 years where Regulation 9.3 applies

EEVF

The ship complies with the relevant provisions of the Annex, and this Certificate shall, in accordance with Regulation 9.3 of Annex VI of the Convention, be accepted as valid until ____________

Place: ______________________ Date: ____________

Signature: ______________________

Stamp — Surveyor, DNV GL

Endorsement where the renewal survey has been completed and Regulation 9.4 applies

ERC

The ship complies with the relevant provisions of the Annex, and this Certificate shall, in accordance with Regulation 9.4 of Annex VI of the Convention, be accepted as valid until ____________

Place: ______________________ Date: ____________

Signature: ______________________

Stamp — Surveyor, DNV GL

Endorsement to extend the validity of the Certificate until reaching the port of survey or for a period of grace where Regulation 9.5 or 9.6 applies

EEV

This Certificate shall, in accordance with Regulation 9.5 or 9.6[1] of Annex VI of the Convention, be accepted as valid until ____________

Place: ______________________ Date: ____________

Signature: ______________________

Stamp — Surveyor, DNV GL

Certificate No: **n1109949-udq**
Date of issue: **2018-01-19**

Endorsement for advancement of anniversary date where Regulation 9.8 applies

In accordance with Regulation 9.8 of Annex VI of the Convention, the new anniversary date is ____________

Place: ______________________ Date: ____________

Signature: ______________________

Stamp Surveyor, DNV GL

In accordance with Regulation 9.8 of Annex VI of the Convention, the new anniversary date is ____________

Place: ______________________ Date: ____________

Signature: ______________________

Stamp Surveyor, DNV GL

Certificate No: **n1109949-udq**
Date of issue: **2018-01-19**

SUPPLEMENT TO INTERNATIONAL AIR POLLUTION PREVENTION CERTIFICATE
(IAPP CERTIFICATE)

RECORD OF CONSTRUCTION AND EQUIPMENT

In respect of the provisions of Annex VI of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (hereinafter referred to as "the Convention").

This Record shall be permanently attached to the IAPP Certificate. The IAPP Certificate shall be available on board the ship at all times.

The Record shall be at least in English, French or Spanish. If an official language of the issuing country is also used, this shall prevail in case of a dispute or discrepancy.

Entries in boxes shall be made by inserting either a cross (x) for the answers "yes" and "applicable" or a dash (-) for the answers "no" and "not applicable" as appropriate.

Unless otherwise stated, regulations mentioned in this Record refer to regulations of Annex VI of the Convention and resolutions or circulars refer to those adopted by the International Maritime Organization.

1. Particulars of ship

Name of Ship:	**DEEPWATER PONTUS**
IMO Number:	**9675183**
Date on which keel was laid or ship was at similar stage of construction:	**2015-08-31**
Length of Ship: [1]	**- m**

2. Control of emissions from ships

2.1 Ozone-depleting substances (Regulation 12)

2.1.1 The following fire-extinguishing systems, other systems and equipment containing ozone-depleting substances, other than hydro-chlorofluorocarbons (HCFCs), installed before 19 May 2005 may continue in service: [-]

System equipment	Location on board	Substance

2.1.2 The following systems and equipment containing hydro-chlorofluorocarbons (HCFCs) installed before 1 January 2020 may continue in service: [-]

System equipment	Location on board	Substance

[1] Completed only in respect of ships constructed on or after 1 January 2016 that are specially designed, and used solely, for recreational purposes and to which, in accordance with regulation 13.5.2.1 or regulation 13.5.2.3, the NOx emission limit as given by regulation 13.5.1.1 will not apply.

Certificate No: **n1109949-udq**
Date of issue: **2018-01-19**

2.2 Nitrogen Oxides (NOx) (Regulation 13)

2.2.1 The following marine diesel engines installed on this ship are in accordance with the requirements of regulation 13, as indicated:

Applicable regulation of MARPOL Annex VI (NTC = NOX Technical Code 2008) (AM = Approved Method)			Engine #1	Engine #2	Engine #3	Engine #4	Engine #5	Engine #6
1	Manufacturer and model		Hyundai Heavy Industries Co., Ltd., 14H32/40V	Hyundai Heavy Industries Co., Ltd., 14H32/40V	Hyundai Heavy Industries Co., Ltd., 14H32/40V	Hyundai Heavy Industries Co., Ltd., 14H32/40V	Hyundai Heavy Industries Co., Ltd., 14H32/40V	Hyundai Heavy Industries Co., Ltd., 14H32/40V
2	Serial Number		BA5196-1	BA5196-2	BA5196-3	BA5196-4	BA5196-5	BA5196-6
3	Use (applicable application cycle(s) - NTC 3.2)		E2/D2	E2/D2	E2/D2	E2/D2	E2/D2	E2/D2
4	Rated power (kW) (NTC 1.3.11)		7000	7000	7000	7000	7000	7000
5	Rated speed (RPM) (NTC 1.3.12)		720	720	720	720	720	720
6	Identical engine installed ≥ 2000-01-01 exempted by 13.1.1.2		☐	☐	☐	☐	☐	☐
7	Identical engine installation date as per 13.1.1.2 (yyyy-mm-dd)							
8a	Major Conversion (yyyy-mm-dd)	13.2.1.1 & 13.2.2						
8b		13.2.1.2 & 13.2.3						
8c		13.2.1.3 & 13.2.3						
9a	Tier I	13.3	☐	☐	☐	☐	☐	☐
9b		13.2.2	☐	☐	☐	☐	☐	☐
9c		13.2.3.1	☐	☐	☐	☐	☐	☐
9d		13.2.3.2	☐	☐	☐	☐	☐	☐
9e		13.7.1.2	☐	☐	☐	☐	☐	☐
10a	Tier II	13.4	☒	☒	☒	☒	☒	☒
10b		13.2.2	☐	☐	☐	☐	☐	☐
10c		13.2.2 (Tier III not possible)	☐	☐	☐	☐	☐	☐
10d		13.2.3.2	☐	☐	☐	☐	☐	☐
10e		13.5.2 (Exemptions)	☐	☐	☐	☐	☐	☐
10f		13.7.1.2	☐	☐	☐	☐	☐	☐
11a	Tier III (ECA-NOx only)	13.5.1.1	☐	☐	☐	☐	☐	☐
11b		13.2.2	☐	☐	☐	☐	☐	☐
11c		13.2.3.2	☐	☐	☐	☐	☐	☐
11d		13.7.1.2	☐	☐	☐	☐	☐	☐
12	AM[3]	installed	☐	☐	☐	☐	☐	☐
13		not commercially available at this survey	☐	☐	☐	☐	☐	☐
14		not applicable	☐	☐	☐	☐	☐	☐

2.3 Sulphur Oxides (SOx) and particulate matter (Regulation 14)

2.3.1 When the ship operates outside of an Emission Control Area specified in regulation 14.3, the ship uses:

2.3.1.1 fuel oil with a sulphur content as documented by bunker delivery notes that does not exceed the limit value of:

- 4.50% m/m (not applicable on or after 1 January 2012); or [-]
- 3.50% m/m (not applicable on or after 1 January 2020); or [X]
- 0.50% m/m, and/or [X]

2.3.1.2 an equivalent arrangement approved in accordance with regulation 4.1 as listed in 2.6 that is at least as effective in terms of SO_x emission reductions as compared to using a fuel oil with a sulphur content limit value of:

3 Refer to the 2014 Guidelines on the approved method process (resolution MEPC.243(66)).

- 4.50% m/m (not applicable on or after 1 January 2012); or [-]
- 3.50% m/m (not applicable on or after 1 January 2020); or [-]
- 0.50% m/m [-]

2.3.2 When the ship operates inside an Emission Control Area specified in regulation 14.3, the ship uses:

2.3.2.1 fuel oil with a sulphur content as documented by bunker delivery notes that does not exceed the limit value of:

- 1.00% m/m (not applicable on or after 1 January 2015); or [-]
- 0.10% m/m, and/or [X]

2.3.2.2 an equivalent arrangement approved in accordance with regulation 4.1 as listed in 2.6 that is at least as effective in terms of SO_x emission reductions as compared to using a fuel oil with a sulphur content limit value of:

- 1.00% m/m (not applicable on or after 1 January 2015); or [-]
- 0.10% m/m [-]

2.4 Volatile organic compounds (VOCs) (Regulation 15)

2.4.1 The tanker has a vapour collection system installed and approved in accordance with IMO MSC/Circ.585 (4): [-]

2.4.2.1 For a tanker carrying crude oil, there is an approved VOC Management Plan [-]

2.4.2.2 VOC Management Plan approval reference: - [-]

2.5 Shipboard Incineration (Regulation 16)

The ship has an incinerator:

2.5.1 installed on or after 1 January 2000 which complies with:

2.5.1.1 resolution MEPC.76(40), as amended[5] [-]

2.5.1.2 resolution MEPC.244(66) [-]

2.5.2 installed before 1 January 2000 which

2.5.2.1 complies with resolution MEPC.59(33), as amended[6] [-]

2.5.2.2 complies with resolution MEPC.76(40), as amended[5] [-]

2.5.2.3 does not comply with resolution MEPC.59(33) or resolution MEPC.76(40) [-]

2.6 Equivalents (Regulation 4)

The ship has been allowed to use the following fitting, material, appliance or apparatus to be fitted in a ship or other procedures, alternative fuel oils, or compliance methods used as an alternative to that required by this Annex:

System or equipment	Equivalent used	Approval reference

4 Ships with DNV GL Class notation VCS-1 or VCS-2 (compliance with USCG CFR 46 Part 39) comply with IMO MSC/Circ.585.

5 As amended by resolution MEPC.93(45)

6 As amended by resolution MEPC.92(45)

Certificate No: **n1109949-udq**
Date of issue: **2018-01-19**

THIS IS TO CERTIFY that this Record is correct in all respects.

Issued at **New Orleans, LA, United States** on **2018-01-19**

for **DNV GL**

This document is signed electronically in accordance with IMO FAL.5/Circ.39/Rev.2. Validation and authentication can be obtained from trust.dnvgl.com by using the Unique Tracking Number (UTN): n1109949-udq and ID: 33160

Derek Schmidt
Surveyor

SUPPLEMENT TO INTERNATIONAL AIR POLLUTION PREVENTION CERTIFICATE (IAPP CERTIFICATE)

RECORD OF CONSTRUCTION AND EQUIPMENT

Notes:

1. This Record shall be permanently attached to the IAPP Certificate. The IAPP Certificate shall be available on board the ship at all times.
2. The Record shall be at least in English, French or Spanish. If an official language of the issuing country is also used, this shall prevail in case of a dispute or discrepancy.
3. Entries in boxes shall be made by inserting either a cross (x) for the answer "yes" and "applicable" or a (-) for the answers "no" and "not applicable" as appropriate.
4. Unless otherwise stated, regulations mentioned in this Record refer to regulations of Annex VI of the Convention and resolutions or circulars refer to those adopted by the International Maritime Organization.

1 Particulars of ship

1.1 Name of ship: NOBLE GLOBETROTTER I

1.2 IMO number: 9540845

1.3 Date on which keel was laid or ship was at a similar stage of construction: 26 March 2010

1.4 Length (L)* metres: N/A

* Completed only in respect of ships constructed on or after 1 January 2010 that are specially designed, and used solely for recreational purposes and to which, in accordance with regulation 13.5.2.1 or regulation 13.5.2.3, the NOx emission limit as given by regulation 13.5.1.1 will not apply.

2 Control of emissions from ships

2.1 *Ozone-depleting substances* (regulation 12)

2.1.1 The following fire-extinguishing systems, other systems and equipment containing ozone-depleting substances, other than hydrochlorofluorocarbons (HCFCs), installed before 19 May 2005 may continue in service:

System or Equipment	Location on board	Substance
N/A	N/A	N/A

2.1.2 The following systems containing hydrochlorofluorocarbons (HCFCs) installed before 1 January 2020 may continue in service:

System or Equipment	Location on board	Substance
N/A	N/A	N/A

2.2 *Nitrogen oxides (NO_x)* (regulation 13)

2.2.1 The following marine diesel engines installed on this ship are in accordance with the requirements of regulation 13, as indicated:

Applicable regulation of MARPOL Annex VI (NTC = NOx Technical Code 2008) (AM = Approved Method)			Engine #1	Engine #2	Engine #3	Engine #4	Engine #5	Engine #6	Engine #7	Engine #8
1	Manufacturer and model		Caterpillar INC C280-16	Caterpillar INC C280-16	Caterpillar INC C280-16	Caterpillar INC C280-16	Caterpillar INC C280-16	Caterpillar INC C280-16	Caterpillar INC C280-16	Caterpillar INC C280-16
2	Serial number		NKB00153	NKB00154	NKB00156	NKB00157	NKB00158	NKB00159	NKB00161	NKB00172
3	Use (applicable application cycle(s) - NTC 3.2)		Main Generator Engine	Main Generator Engine	Main Generator Engine	Main Generator Engine	Main Generator Engine	Main Generator Engine	Main Generator Engine	Main Generator Engine
4	Rated power (kW) (NTC 1.3.11)		5060	5060	5060	5060	5060	5060	5060	5060
5	Rated speed (RPM) (NTC 1.3.12)		900	900	900	900	900	900	900	900
6	Identical engine installed ≥ 1/1/2000 exempted by 13.1.1.2		–	–	–	–	–	–	–	–
7	Identical engine installation date(dd/mm/yyyy) as per 13.1.1.2		–	–	–	–	–	–	–	–
8a	Major Conversion (dd/mm/yyyy)	13.2.1.1 & 13.2.2	–	–	–	–	–	–	–	–
8b		13.2.1.2 & 13.2.3	–	–	–	–	–	–	–	–
8c		13.2.1.3 & 13.2.3	–	–	–	–	–	–	–	–
9a	Tier I	13.3	–	–	–	–	–	–	–	–
9b		13.2.2	–	–	–	–	–	–	–	–
9c		13.2.3.1	–	–	–	–	–	–	–	–
9d		13.2.3.2	–	–	–	–	–	–	–	–
9e		13.7.1.2	–	–	–	–	–	–	–	–
10a	Tier II	13.4	X	X	X	X	X	X	X	X
10b		13.2.2	–	–	–	–	–	–	–	–
10c		13.2.2 (Tier III not possible)	–	–	–	–	–	–	–	–
10d		13.2.3.2	–	–	–	–	–	–	–	–
10e		13.5.2 (Exemptions)	–	–	–	–	–	–	–	–
10f		13.7.1.2	–	–	–	–	–	–	–	–
11a	Tier III (ECA NOx only)	13.5.1.1	–	–	–	–	–	–	–	–
11b		13.2.2	–	–	–	–	–	–	–	–
11c		13.2.3.2	–	–	–	–	–	–	–	–
11d		13.7.1.2	–	–	–	–	–	–	–	–
12	AM**	installed	–	–	–	–	–	–	–	–
13		not commercially available at this survey	–	–	–	–	–	–	–	–
14		not applicable	–	–	–	–	–	–	–	–

Engine Installation Date 23/03/2011

*** Refer to the 2014 Guidelines on the approved method process (resolution MEPC 243(66)*

2.3 *Sulphur oxides (SO_x) and particulate matter* (regulation 14)

2.3.1 When the ship operates outside of an Emission Control Area specified in regulation 14.3, the ship uses:

.1 fuel oil with a sulphur content as documented by bunker delivery notes that does not exceed the limit value of:

- 4.50% m/m (not applicable on or after 1 January 2012); or [–]
- 3.50% m/m (not applicable on or after 1 January 2020); or [X]
- 0.50% m/m, and/or [X]

.2 an equivalent arrangement approved in accordance with regulation 4.1 as listed in 2.6 that is at least as effective in terms of SO_x emission reductions as compared to using a fuel oil with a sulphur content limit value of:

- 4.50% m/m (not applicable on or after 1 January 2012) [–]
- 3.50% m/m (not applicable on or after 1 January 2020) [–]
- 0.50% m/m [–]

2.3.2 When the ship operates inside an Emission Control Area specified in regulation 14.3, the ship uses:

.1 fuel oil with a sulphur content as documented by bunker delivery notes that does not exceed the limit value of:

- 1.00% m/m (not applicable on or after 1 January 2015); or [–]
- 0.10% m/m, and/or [X]

.2 an equivalent arrangement approved in accordance with regulation 4.1 as listed in 2.6 that is at least as effective in terms of SO_x emission reductions as compared to using a fuel oil with a sulphur content limit value of:

- 1.00% m/m (not applicable on or after 1 January 2015) [–]
- 0.10% m/m [–]

2.4 *Volatile organic compounds (VOCs)* (regulation 15)

2.4.1 The tanker has a vapour collection system installed and approved in accordance with MSC/Circ.585 [–]

2.4.2.1 For a tanker carrying crude oil, there is an approved VOC Management Plan [–]

2.4.2.2 VOC Management Plan approval reference: ______________________ [–]

2.5 *Shipboard incineration* (regulation 16)

The ship has an incinerator:

2.5.1 installed on or after 1 January 2000 that complies with:

2.5.1.1 resolution MEPC.76(40), as amended+ [X]

2.5.1.2 resolution MEPC.244(66) [–]

2.5.2 installed before 1 January 2000 that complies with:

2.5.2.1 resolution MEPC.59(33) as amended++ [–]

2.5.2.2 resolution MEPC.76(40) as amended+ [–]

\+ As amended by resolution MEPC.93(45).
++ As amended by resolution MEPC.92(45).

2.6 *Equivalents* (regulation 4)

The ship has been allowed to use the following fitting, material, appliance or apparatus to be fitted in a ship or other procedures, alternative fuel oils, or compliance methods used as an alternative to that required by this Annex:

System or Equipment	Equivalent Used	Approval Reference
N/A	N/A	N/A

THIS IS TO CERTIFY that this Record is correct in all respects.

This Certificate replaces 12211662-3248382-011

Issued at Offshore Houma, LA on 14 February 2018
(Place of issue) (Date of issue)

Electronically Signed By
Soutiere, Jason, Houma Port
(Surveyor, American Bureau of Shipping)

MODU No. 1

SUPPLEMENT TO INTERNATIONAL AIR POLLUTION PREVENTION CERTIFICATE (IAPP CERTIFICATE)

RECORD OF CONSTRUCTION AND EQUIPMENT

Notes:

1. This Record shall be permanently attached to the IAPP Certificate. The IAPP Certificate shall be available on board the ship at all times.
2. The Record shall be at least in English, French or Spanish. If an official language of the issuing country is also used, this shall prevail in case of a dispute or discrepancy.
3. Entries in boxes shall be made by inserting either a cross (x) for the answer "yes" and "applicable" or a (-) for the answers "no" and "not applicable" as appropriate.
4. Unless otherwise stated, regulations mentioned in this Record refer to regulations of Annex VI of the Convention and resolutions or circulars refer to those adopted by the International Maritime Organization.

1 Particulars of ship

1.1 Name of ship: NOBLE GLOBETROTTER II

1.2 IMO number: 9600786

1.3 Date on which keel was laid or ship was at a similar stage of construction: 26 May 2011

1.4 Length (L)* metres: N/A

* Completed only in respect of ships constructed on or after 1 January 2016 that are specially designed, and used solely, for recreational purposes and to which, in accordance with regulation 13.5.2.1 or regulation 13.5.2.2, the NOx emission limit as given by regulation 13.5.1.1 will not apply.

2 Control of emissions from ships

2.1 *Ozone-depleting substances* (regulation 12)

2.1.1 The following fire-extinguishing systems, other systems and equipment containing ozone-depleting substances, other than hydrochlorofluorocarbons (HCFCs), installed before 19 May 2005 may continue in service:

System or Equipment	Location on board	Substance
N/A		

2.1.2 The following systems containing hydrochlorofluorocarbons (HCFCs) installed before 1 January 2020 may continue in service:

System or Equipment	Location on board	Substance
N/A		

2.2 *Nitrogen oxides (NO_X)* (regulation 13)

2.2.1 The following marine diesel engines installed on this ship are in accordance with the requirements of regulation 13, as indicated:

Applicable regulation of MARPOL Annex VI (NTC = NOx Technical Code 2008) (AM = Approved Method)			Engine #1	Engine #2	Engine #3	Engine #4	Engine #5	Engine #6	Engine #7	Engine #8
1	Manufacturer and model		Caterpillar Inc, C280-16	Caterpillar Inc, C280-16	Caterpillar Inc, C280-16	Caterpillar Inc, C280-16	Caterpillar Inc, C280-16	Caterpillar Inc, C280-16	Caterpillar Inc, C280-16	Caterpillar Inc, C280-16
2	Serial number		NKB00189	NKB00190	NKB00191	NKB00192	NKB00193	NKB00194	NKB00195	NKB00196
3	Use (applicable application cycle(s) - NTC 3.2)		E2	E2	E2	E2	E2	E2	E2	E2
4	Rated power (kW) (NTC 1.3.11)		5060	5060	5060	5060	5060	5060	5060	5060
5	Rated speed (RPM) (NTC 1.3.12)		900	900	900	900	900	900	900	900
6	Identical engine installed ≥ 1/1/2000 exempted by 13.1.1.2		–	–	–	–	–	–	–	–
7	Identical engine installation date(dd/mm/yyyy) as per 13.1.1.2		–	–	–	–	–	–	–	–
8a	Major Conversion (dd/mm/yyyy)	13.2.1.1 & 13.2.2	–	–	–	–	–	–	–	–
8b		13.2.1.2 & 13.2.3	–	–	–	–	–	–	–	–
8c		13.2.1.3 & 13.2.3	–	–	–	–	–	–	–	–
9a	Tier I	13.3	–	–	–	–	–	–	–	–
9b		13.2.2	–	–	–	–	–	–	–	–
9c		13.2.3.1	–	–	–	–	–	–	–	–
9d		13.2.3.2	–	–	–	–	–	–	–	–
9e		13.7.1.2	–	–	–	–	–	–	–	–
10a	Tier II	13.4	X	X	X	X	X	X	X	X
10b		13.2.2	–	–	–	–	–	–	–	–
10c		13.2.2 (Tier III not possible)	–	–	–	–	–	–	–	–
10d		13.2.3.2	–	–	–	–	–	–	–	–
10e		13.5.2 (Exemptions)	–	–	–	–	–	–	–	–
10f		13.7.1.2	–	–	–	–	–	–	–	–
11a	Tier III (ECA NOx only)	13.5.1.1	–	–	–	–	–	–	–	–
11b		13.2.2	–	–	–	–	–	–	–	–
11c		13.2.3.2	–	–	–	–	–	–	–	–
11d		13.7.1.2	–	–	–	–	–	–	–	–
12	AM**	installed	–	–	–	–	–	–	–	–
13		not commercially available at this survey	–	–	–	–	–	–	–	–
14		not applicable	–	–	–	–	–	–	–	–

** *Refer to the 2014 Guidelines on the approved method process (resolution MEPC 243(66)*

2.3 *Sulphur oxides (SO_X) and particulate matter* (regulation 14)

2.3.1 When the ship operates outside of an Emission Control Area specified in regulation 14.3, the ship uses:

.1 fuel oil with a sulphur content as documented by bunker delivery notes that does not exceed the limit value of:

- 4.50% m/m (not applicable on or after 1 January 2012); or [–]
- 3.50% m/m (not applicable on or after 1 January 2020); or [X]
- 0.50% m/m, and/or [X]

.2 an equivalent arrangement approved in accordance with regulation 4.1 as listed in 2.6 that is at least as effective in terms of SO_X emission reductions as compared to using a fuel oil with a sulphur content limit value of:

- 4.50% m/m (not applicable on or after 1 January 2012) [–]
- 3.50% m/m (not applicable on or after 1 January 2020) [–]
- 0.50% m/m [–]

2.3.2 When the ship operates inside an Emission Control Area specified in regulation 14.3, the ship uses:

.1 fuel oil with a sulphur content as documented by bunker delivery notes that does not exceed the limit value of:

- 1.00% m/m (not applicable on or after 1 January 2015); or [–]
- 0.10% m/m, and/or [X]

.2 an equivalent arrangement approved in accordance with regulation 4.1 as listed in 2.6 that is at least as effective in terms of SO_X emission reductions as compared to using a fuel oil with a sulphur content limit value of:

- 1.00% m/m (not applicable on or after 1 January 2015) [–]
- 0.10% m/m [–]

2.4 *Volatile organic compounds (VOCs)* (regulation 15)

2.4.1 The tanker has a vapour collection system installed and approved in accordance with MSC/Circ.585 [–]

2.4.2.1 For a tanker carrying crude oil, there is an approved VOC Management Plan [–]

2.4.2.2 VOC Management Plan approval reference: ______________________ [–]

2.5 *Shipboard incineration* (regulation 16)

The ship has an incinerator:

2.5.1 installed on or after 1 January 2000 that complies with:

2.5.1.1 resolution MEPC.76(40), as amended+ [X]

2.5.1.2 resolution MEPC.244(66) [–]

2.5.2 installed before 1 January 2000 that complies with:

2.5.2.1 resolution MEPC.59(33) as amended++ [–]

2.5.2.2 resolution MEPC.76(40) as amended+ [–]

+ As amended by resolution MEPC.93(45)
++ As amended by resolution MEPC.92(45)

2.6 *Equivalents* (regulation 4)

The ship has been allowed to use the following fitting, material, appliance or apparatus to be fitted in a ship or other procedures, alternative fuel oils, or compliance methods used as an alternative to that required by this Annex:

System or Equipment	Equivalent Used	Approval Reference
N/A		

THIS IS TO CERTIFY that this Record is correct in all respects.

Issued at Varna, BULGARIA on 11 August 2018
(Place of issue) *(Date of issue)*

ABS

Electronically Signed By
Mate, Alexandru-Alin, Constantza Port
(Surveyor, American Bureau of Shipping)

Well Work Drillship No. 1

COMPANY		Shell Offshore Inc
AREA		Mississippi Canyon
BLOCK		391, 392, 393
LEASE		OCS-G 26252, OCS-G 26253, OCS-G 26254
PLATFORM		MODU #1 (Semi-sub or Drillship)
WELL		Appomattox wells (AC, AE, IE, AW, and IW), Vicksburg Wells (VX). See DOCD Section 1 for details.
DISTANCE TO LAND		72
COMPANY CONTACT		Cidney Christie
TELEPHONE NO.		504-425-3014
REMARKS		Appo sDOCD AQR_MODU1_20200818_BOEM.xlsx

LEASE TERM PIPELINE CONSTRUCTION INFORMATION:

YEAR	NUMBER OF PIPELINES	TOTAL NUMBER OF CONSTRUCTION DAYS
2020		
2021		
2022		
2023		
2024		
2025		
2026		
2027		
2028		
2029		
2030		

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	1.20	The contingency factor is used to allow for more usage if need be.
Proposed MODU Campaign Average Daily Fuel Use (gal/day)	16,000	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.
2020-2057 Annual Fuel Limits,	3,680,000	Calculated Value - Campaign Average Daily Fuel Use * Campaign Days

Step 2 - Support Vessel Fuel Loads

Description	Value	Notes
Proposed Operating Loads	50%	Shell policy restricts D/P to < 50% near rig. When in standby away from rig but within 25 miles load will be < 50% (conserve fuel). When transiting through field (25 nm), traveling at economical speeds.
OSV - PTE Fuel Use (gal/day)	11,708	Offshore Support Vessels are rated at 10,098hp (rounded to 10,100 hp). The PTE fuel use is then estimated using the AQR conversion factor of 0.0483 gal/hp-hr.
Campaign Average Daily Fuel Use (gal/day)	5,854	Calculated Value - PTE fuel use * Proposed Operating Load.
Crew Vessel - PTE Fuel Use (gal/day)	9,274	Crew Vessels are rated at 7,944 hp (rounded to 8,000 hp). The PTE fuel use is then estimated using the AQR conversion factor of 0.0483 gal/hp-hr.
Crew Vessel - Campaign Average Daily Fuel Use (gal/day)	1,391	Calculated Value - PTE fuel use * Proposed Operating Load. Note that Crew Vessels are only in field 30% of campaign and daily average value has been
Proposed Vessel Campaign Average Daily Fuel Use (gal/day)	7,245	Calculated Value - Average fuel use * Contigency Factor and rounded up to nearest thousand (for additional conservatism). This represents total fuel use on the Support and Crew vessels.
Total Vessel Activity		
2020-2057 Annual Fuel Limits,	1,623,460	Sum of (vessel daily fuel use * corresponding campaign days)

	SCF/hp-hr	9.524	SCF/hp-hr	7.143	GAL/hp-hr	0.0483	AP42 3.2-1	4/76 & 8/84	

Equipment/Emission Factors	units	PM	SOx	NOx	VOC	CO	REF.	DATE	Notes
NG Turbines	gms/hp-hr		0.00247	1.3	0.01	0.83	AP42 3.2-1& 3.1-1	10/96	Factors not used in this spreadsheet
NG 2-cycle lean	gms/hp-hr		0.00185	10.9	0.43	1.5	AP42 3.2-1	10/96	Factors not used in this spreadsheet
NG 4-cycle lean	gms/hp-hr		0.00185	11.8	0.72	1.6	AP42 3.2-1	10/96	Factors not used in this spreadsheet
NG 4-cycle rich	gms/hp-hr		0.00185	10	0.14	8.6	AP42 3.2-1	10/96	Factors not used in this spreadsheet
Diesel Recip. < 600 hp.	gms/hp-hr	1	0.367	14	1.12	3.03	AP42 3.3-1	10/96	Typical BOEM Factors
Diesel Recip. > 600 hp.	gms/hp-hr	0.32	0.367	11	0.33	2.4	AP42 3.4-1	10/96	Typical BOEM Factors
IMO Tier 2 Certified Engines > 600 hp @ 720 rpm (4)	gms/hp-hr			7.22			IMO NOx Reg 13.4	N/A	
Diesel Boiler	lbs/bbl	0.084	0.605	0.84	0.008	0.21	AP42 1.3-12,14	9/98	Typical BOEM Factors
NG Heaters/Boilers/Burners	lbs/mmscf	7.6	0.593	100	5.5	84	42 1.4-1, 14-2, & 14	7/98	Factors not used in this spreadsheet
NG Flares	lbs/mmscf		0.593	71.4	60.3	388.5	AP42 11.5-1	9/91	Typical BOEM Factors
Liquid Flaring	lbs/bbl	0.42	6.83	2	0.01	0.21	AP42 1.3-1 & 1.3-3	9/98	Factors not used in this spreadsheet
Tank Vapors	lbs/bbl				0.03		E&P Forum	1/93	Factors not used in this spreadsheet
Fugitives	lbs/hr/comp.				0.0005		API Study	12/93	Factors not used in this spreadsheet
Glycol Dehydrator Vent	lbs/mmscf				6.6		La. DEQ	1991	Factors not used in this spreadsheet
Gas Venting	lbs/scf				0.0034				Factors not used in this spreadsheet

Sulphur Content Source	**Value**	**Units**
Fuel Gas	3.33	ppm
Diesel Fuel (7)	0.1	% weight
Produced Gas(Flares)	3.33	ppm
Produced Oil (Liquid Flaring)	1	% weight

365	days/yr - Follows FLAG 2010 Guidance
2000	lb/ton conversion factor
454	g/lb conversion factor
1000	SCF/MSCF conversion factor
1.341	hp/kW conversion factor

Notes

1. Reserved.
2. Reserved.
3. Reserved.
4. As evidenced by engine International Air Pollution Prevention certificates, the main engines on the Transocean Deepwater drillships are IMO Tier 2 compliant for NOx emissions. The corresponding NOx emission limit (Regulation 13.4 of Annex VI) for 720 rpm engine is 9.7 g/kw-hr, which is converted to gm/hp-hr using 1.341022 hp/kW. From prior conversations with BOEM, BOEM indicated that stack testing mitigations would not be included in Plan approval documents if the relevant engine certifications are provided. A copy of the relevant engine certifications are included in the EP/DOCD. All other emission factors are assumed to be as represented by BOEM default
5. Reserved.
6. Reserved.
7. Per 40 CFR Part 80 Subpart I, as of June 1, 2014, ECA marine fuel is subject to a maximum per-gallon sulfur content of 1,000 ppm. BOEM has indicated that use of low sulfur fuel content on the AQRs will not result in mitigations in Plan approval documents.

Shell Offshore Inc	Mississippi Canyon	391, 392, 393	OCS-G 26252, OCS-G 26253,		Appomattox wells (AC, AE, IE, AW, and M			Cidney Christie		504-425-3014	Appo sDOCD AQR_MODU1_20200818_BOEM.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**	**DAYS**	**PM**	**SOx**	**NOx**	**VOC**	**CO**	**PM**	**SOx**	**NOx**	**VOC**	**CO**
DP MODU WELL	PRIME MOVER>600hp diesel	9387	453	2333	24	365	6.62	7.59	149.38	6.82	49.62	6.21	7.13	140.30	6.41	46.61
WORK, VESSEL	PRIME MOVER>600hp diesel	9387	453	2333	24	365	6.62	7.59	149.38	6.82	49.62	6.21	7.13	140.30	6.41	46.61
INSTALLATION	PRIME MOVER>600hp diesel	9387	453	2333	24	365	6.62	7.59	149.38	6.82	49.62	6.21	7.13	140.30	6.41	46.61
	PRIME MOVER>600hp diesel	9387	453	2333	24	365	6.62	7.59	149.38	6.82	49.62	6.21	7.13	140.30	6.41	46.61
	PRIME MOVER>600hp diesel	9387	453	2333	24	365	6.62	7.59	149.38	6.82	49.62	6.21	7.13	140.30	6.41	46.61
	PRIME MOVER>600hp diesel	9387	453	2333	24	365	6.62	7.59	149.38	6.82	49.62	6.21	7.13	140.30	6.41	46.61
	Energency Generator>600hp diese	2547	123	2952	1	365	1.80	2.06	61.71	1.85	13.46	0.33	0.38	11.26	0.34	2.46
	Emergency Air Compressor< 600h	26	1	30	1	365	0.06	0.02	0.80	0.06	0.17	0.01	0.00	0.15	0.01	0.03
	All other rig-equipment is electric (e.g cranes) or negligible in emissions potential (e.g. life boats, welding equipment, etc.)															
	Supply Vessel>600hp diesel (gene	10100	488	5854	24	365	7.12	8.16	244.71	7.34	53.39	15.59	17.88	535.92	16.08	116.93
	Supply Vessel>600hp diesel (gene	10100	488	5854	24	10	7.12	8.16	244.71	7.34	53.39	0.43	0.49	14.68	0.44	3.20
	Supply Vessel>600hp diesel (gene	10100	488	5854	24	10	7.12	8.16	244.71	7.34	53.39	0.43	0.49	14.68	0.44	3.20
	Crew Vessel>600hp diesel	8000	386	1391	24	183	5.64	6.47	193.83	5.81	42.29	1.85	2.12	63.67	1.91	13.89
	MULTI-PURPOSE SERVICE VESSEL -General >600 hp diesel (1)	37500	1811	43470	24	6	26.43	30.31	908.59	27.26	198.24	1.90	2.18	65.42	1.96	14.27
2020-2057	**ANNUAL TOTAL**						**94.98**	**108.88**	**2795.38**	**97.95**	**712.08**	**57.82**	**66.31**	**1547.61**	**59.63**	**433.63**
EXEMPTION CALCULATION	**DISTANCE FROM LAND IN MILES**											**2397.60**	**2397.60**	**2397.60**	**2397.60**	**58843.78**
	72.0															

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

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL
Shell Offshore	Mississippi Canyon	391, 392, 393	OCS-G 26252, OCS-	MODU #1 (Semi-sub	Appomattox Wells (AC, AE, IE, AW, and IW), Vicksburg

Year	Emitted		Substance		
	PM	SOx	NOx	VOC	CO
	AQR Emissions if DP MODU(Semi-sub or Drillship) is Utilized				
2020-2057	57.82	66.31	1547.61	59.63	433.63
Allowable	2397.60	2397.60	2397.60	2397.60	58843.78

Notes

Well Work Drillship No. 2

COMPANY	Shell Offshore Inc
AREA	Mississippi Canyon
BLOCK	391, 392, 393
LEASE	OCS-G 26252, OCS-G 26253, OCS-G 26254
PLATFORM	MODU #2 (Drillship)
WELL	Appomattox wells (AC, AE, IE, AW, and IW), Vicksburg Wells (VX). See DOCD Section 1 for details.
DISTANCE TO LAND	72
COMPANY CONTACT	Cidney Christie
TELEPHONE NO.	504-425-3014
REMARKS	Appo sDOCD AQR_MODU2_08182020_BOEM.xlsx

LEASE TERM PIPELINE CONSTRUCTION INFORMATION:

YEAR	NUMBER OF PIPELINES	TOTAL NUMBER OF CONSTRUCTION DAYS
2020-2057	13	30/year

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	1.15	The contingency factor is used to allow for more usage if need be.
Proposed MODU Campaign Average Daily Fuel Use (gal/day)	15,000	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.
2020-2057 Annual Fuel Limits,	1,335,000	Calculated Value - Campaign Average Daily Fuel Use * Campaign Days

Step 2 - Support Vessel Fuel Loads

Description	Value	Notes
Proposed Operating Loads	50%	Shell policy restricts D/P to < 50% near rig. When in standby away from rig but within 25 miles load will be < 50% (conserve fuel). When transiting through field (25 nm), traveling at economical speeds.
OSV - PTE Fuel Use (gal/day)	11,708	Offshore Support Vessels are rated at 10,098hp (rounded to 10,100 hp). The PTE fuel use is then estimated using the AQR conversion factor of 0.0483 gal/hp-
Campaign Average Daily Fuel Use (gal/day)	5,854	Calculated Value - PTE fuel use * Proposed Operating Load.
Crew Vessel - PTE Fuel Use (gal/day)	9,274	Crew Vessels are rated at 7,944 hp (rounded to 8,000 hp). The PTE fuel use is then estimated using the AQR conversion factor of 0.0483 gal/hp-hr.
Crew Vessel - Campaign Average Daily Fuel Use (gal/day)	1,391	Calculated Value - PTE fuel use * Proposed Operating Load. Note that Crew Vessels are only in field 30% of campaign and daily average value has been
Proposed Vessel Campaign Average Daily Fuel Use (gal/day)	7,245	Calculated Value - Average fuel use * Contigency Factor and rounded up to nearest thousand (for additional conservatism). This represents total fuel use on the Support and Crew vessels.
Total Vessel Activity		
2020-2057 Annual Fuel Limits,	699,983	Sum of (vessel daily fuel use * corresponding 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.

Fuel Usage Conversion Factors	Natural Gas Turbines		Natural Gas Engines		Diesel Recip. Engine		REF.	DATE	
	SCF/hp-hr	9.524	SCF/hp-hr	7.143	GAL/hp-hr	0.0483	AP42 3.2-1	4/76 & 8/84	

Equipment/Emission Factors	units	PM	SOx	NOx	VOC	CO	REF.	DATE	Notes
NG Turbines	gms/hp-hr		0.00247	1.3	0.01	0.83	AP42 3.2-1& 3.1-1	10/96	Factors not used in this spreadsheet
NG 2-cycle lean	gms/hp-hr		0.00185	10.9	0.43	1.5	AP42 3.2-1	10/96	Factors not used in this spreadsheet
NG 4-cycle lean	gms/hp-hr		0.00185	11.8	0.72	1.6	AP42 3.2-1	10/96	Factors not used in this spreadsheet
NG 4-cycle rich	gms/hp-hr		0.00185	10	0.14	8.6	AP42 3.2-1	10/96	Factors not used in this spreadsheet
Diesel Recip. < 600 hp.	gms/hp-hr	1	0.367	14	1.12	3.03	AP42 3.3-1	10/96	Typical BOEM Factors
Diesel Recip. > 600 hp.	gms/hp-hr	0.32	0.367	11	0.33	2.4	AP42 3.4-1	10/96	Typical BOEM Factors
IMO Tier 2 Certified Engines > 600 hp @ 720 rpm (4)	gms/hp-hr			7.22			IMO NOx Reg 13.4	N/A	
Diesel Boiler	lbs/bbl	0.084	0.605	0.84	0.008	0.21	AP42 1.3-12,14	9/98	Typical BOEM Factors
NG Heaters/Boilers/Burners	lbs/mmscf	7.6	0.593	100	5.5	84	?42 1.4-1, 14-2, & 14	7/98	Factors not used in this spreadsheet
NG Flares	lbs/mmscf		0.593	71.4	60.3	388.5	AP42 11.5-1	9/91	Typical BOEM Factors
Liquid Flaring	lbs/bbl	0.42	6.83	2	0.01	0.21	AP42 1.3-1 & 1.3-3	9/98	Factors not used in this spreadsheet
Tank Vapors	lbs/bbl				0.03		E&P Forum	1/93	Factors not used in this spreadsheet
Fugitives	lbs/hr/comp.				0.0005		API Study	12/93	Factors not used in this spreadsheet
Glycol Dehydrator Vent	lbs/mmscf				6.6		La. DEQ	1991	Factors not used in this spreadsheet
Gas Venting	lbs/scf				0.0034				Factors not used in this spreadsheet

Sulphur Content Source	Value	Units
Fuel Gas	3.33	ppm
Diesel Fuel (7)	0.1	% weight
Produced Gas(Flares)	3.33	ppm
Produced Oil (Liquid Flaring)	1	% weight

365	days/yr - Follows FLAG 2010 Guidance
2000	lb/ton conversion factor
454	g/lb conversion factor
1000	SCF/MSCF conversion factor
1.341	hp/kW conversion factor

Notes

1. Reserved.
2. Reserved.
3. Reserved.
4. As evidenced by engine International Air Pollution Prevention certificates, the main engines on the Transocean Deepwater drillships are IMO Tier 2 compliant for NOx emissions. The corresponding NOx emission limit (Regulation 13.4 of Annex VI) for 720 rpm engine is 9.7 g/kw-hr, which is converted to gm/hp-hr using 1.341022 hp/kW. From prior conversations with BOEM, BOEM indicated that stack testing mitigations would not be included in Plan approval documents if the relevant engine certifications are provided. A copy of the relevant engine certifications are included in the EP/DOCD. All other emission factors are assumed to be as represented by BOEM default
5. Reserved.
6. Reserved.
7. Per 40 CFR Part 80 Subpart I, as of June 1, 2014, ECA marine fuel is subject to a maximum per-gallon sulfur content of 1,000 ppm. BOEM has indicated that use of low sulfur fuel content on the AQRs will not result in mitigations in Plan approval documents.

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT			PHONE	REMARKS					
Shell Offshore Inc	Mississippi Canyon	391, 392, 393	OCS-G 26252, OCS-G 26253,		Appomattox wells (AC, AE, IE, AW, and M		Cidney Christie			504-425-3014	Appo sDOCD AQR_MODU2_08182020_BOEM.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**	**DAYS**	**PM**	**SOx**	**NOx**	**VOC**	**CO**	**PM**	**SOx**	**NOx**	**VOC**	**CO**
DP MODU WELL	PRIME MOVER>600hp diesel	9387	453	2500	24	89	6.62	7.59	149.38	6.82	49.62	1.62	1.86	36.65	1.67	12.18
WORK, VESSEL	PRIME MOVER>600hp diesel	9387	453	2500	24	89	6.62	7.59	149.38	6.82	49.62	1.62	1.86	36.65	1.67	12.18
INSTALLATION	PRIME MOVER>600hp diesel	9387	453	2500	24	89	6.62	7.59	149.38	6.82	49.62	1.62	1.86	36.65	1.67	12.18
	PRIME MOVER>600hp diesel	9387	453	2500	24	89	6.62	7.59	149.38	6.82	49.62	1.62	1.86	36.65	1.67	12.18
	PRIME MOVER>600hp diesel	9387	453	2500	24	89	6.62	7.59	149.38	6.82	49.62	1.62	1.86	36.65	1.67	12.18
	PRIME MOVER>600hp diesel	9387	453	2500	24	89	6.62	7.59	149.38	6.82	49.62	1.62	1.86	36.65	1.67	12.18
	Energency Generator>600hp diese	2547	123	2952	1	89	1.80	2.06	61.71	1.85	13.46	0.08	0.09	2.75	0.08	0.60
	Emergency Air Compressor< 600h	26	1	30	1	89	0.06	0.02	0.80	0.06	0.17	0.00	0.00	0.04	0.00	0.01
	All other rig-equipment is electric (e.g cranes) or negligible in emissions potential (e.g. life boats, welding equipment, etc.)															
	Supply Vessel>600hp diesel (gene	10100	488	5854	24	89	7.12	8.16	244.71	7.34	53.39	3.80	4.36	130.68	3.92	28.51
	Supply Vessel>600hp diesel (gene	10100	488	5854	24	10	7.12	8.16	244.71	7.34	53.39	0.43	0.49	14.68	0.44	3.20
	Supply Vessel>600hp diesel (gene	10100	488	5854	24	10	7.12	8.16	244.71	7.34	53.39	0.43	0.49	14.68	0.44	3.20
	Crew Vessel>600hp diesel	8000	386	1391	24	45	5.64	6.47	193.83	5.81	42.29	0.45	0.52	15.53	0.47	3.39
	MULTI-PURPOSE SERVICE/SUPPORT Vessel Diesel - General (1)	37500	1811	43470	24	10	26.43	30.31	908.59	27.26	198.24	3.17	3.64	109.03	3.27	23.79
	MULTI-PURPOSE SERVICE/SUPPORT Vessel Diesel - General (1)	25500	1232	29560	24	30	17.97	20.61	617.84	18.54	134.80	6.47	7.42	222.42	6.67	48.53
	MULTI-PURPOSE SERVICE/SUPPORT Vessel Diesel - General (1)	13500	652	15649	24	30	9.52	10.91	327.09	9.81	71.37	3.43	3.93	117.75	3.53	25.69
2020-2057	**ANNUAL TOTAL**						**122.47**	**140.41**	**3740.31**	**126.30**	**918.25**	**28.00**	**32.11**	**847.48**	**28.87**	**209.98**
EXEMPTION CALCULATION	**DISTANCE FROM LAND IN MILES**											**2397.60**	**2397.60**	**2397.60**	**2397.60**	**58843.78**
	72.0															

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

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL
Shell Offshore	Mississippi Canyon	391, 392, 393	OCS-G 26252, OCS-	MODU #2 (Drillship)	Appomattox w ells (AC, AE, IE, AW, and IW), Vicksburg Wells (VX). See DOCD Section 1 for details.

Year	Emitted			Substance	
	PM	SOx	NOx	VOC	CO
	AQR Emissions if DP MODU(Semi-sub or Drillship) is Utilized				
2020-2057	28.00	32.11	847.48	28.87	209.98
Allowable	2397.60	2397.60	2397.60	2397.60	58843.78

Notes

SECTION 9: OIL SPILL RESPONSE PLANNING

All the proposed activities and facilities in this DOCD will be covered by the Regional OSRP filed by Shell Offshore Inc. (0689) in accordance with in accordance with 30 CFR 250 and 30 CFR 254, and approved by BSEE in 2017. The bi-annual review was found to be in compliance November 22, 2019.

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	EP	Regional OSRP	DOCD
Type of Activity	Exploratory Drilling	Exploratory Drilling	Production >10 miles to shore	Appomattox FPS
Facility Location (area/block)	MC 812	MC 391	MC 812	MC 437
Facility Designation	Subsea well B◇◇	Subsea well C◇	Kaikias◇◇	Appomattox◇
Distance to Nearest Shoreline (miles)	59	72	59	72
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 Bbls	 N/A N/A N/A 416,414* BOPD 416,414 Bbls	 16,600 Bbls 100 Bbls 27,428 Bbls 468,000 BOPD** 512,128	 43,950 Bbls 100 Bbls 1,055 Bbls 416,414 BOPD* 461,519
Type of Oil(s) - (crude oil, condensate, diesel)	Crude oil	Crude oil	Crude oil	Crude oil
API Gravity(s)	31°	37.5°	31°	37.5°

***24 hour rate (391,808 BOPD 30-day average) **24 hour rate (432,000 BOPD 30-day average)**

◇This well was reviewed and accepted by BOEM in Plan S-7444 (May 2011) and by BSEE on July 10, 2012 during the drilling of the well. OCS-G 25852 (DC 353) was added to this WCD review in Supplemental EP S-7761. The 30-day average was updated in OSRP in July 2012. The wells in this plan do not exceed the already-approved well for this area.

◇◇This well was reviewed and accepted by BOEM in Plan N-9840 approved by BOEM on December 31, 2014.

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 and the bi-annual update that was found to be in compliance on November 22, 2019. 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. Oil Spill Response Discussion

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 437	30380 (RUE Pending)	57	Camaeron, LA	1
			Vermilion, LA	1
			Iberia, LA	-
			Terrebonne, LA	2
			Lafourche, LA	2
			Jefferson, LA	-
			Plaquemines, LA	21
			St. Bernard, LA	3
			Hancock & Harrison, MS	1
			Jackson, MS	1
			Mobile, AL	1
			Baldwin, AL	1
			Escambia, FL	1
			Okaloosa, FL	1
			Walton, FL	1
			Bay, FL	1

Table 9.C.1 Probability of Land Segment Impact

C. Resource Identification

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 437 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 MC 437 Worst Case Discharge as effectively as possible. Below is a table outlining the applicable evaporation and surface dispersion quantity:

	Mississippi Canyon 437	**Calculations (BBLS)**
i.	**TOTAL WCD (based on 30 day average (per day))**	**~391,808**
ii.	Loss of volume of oil to natural surface dispersion and evaporation base (approximate bbls per day)* (18% Natural surface evaporation and dispersion in 24 hrs)	-70,812
	TOTAL REMAINING	**~320,996**

Table 9.D.1 Oil Remaining After Subsurface and 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 60 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 437 will be addressed in Shell's NTL10 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 1,177,000 barrels/day. Temporary storage associated with the identified skimming and temporary storage equipment equals approximately 910,000 barrels.

	De-rated Recovery Rate (bopd)	Storage (bbls)
Offshore Recovery and Storage	833,262	895,630
Nearshore Recovery and Storage	344,578	15,279
Total	1,177,840	910,909

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.

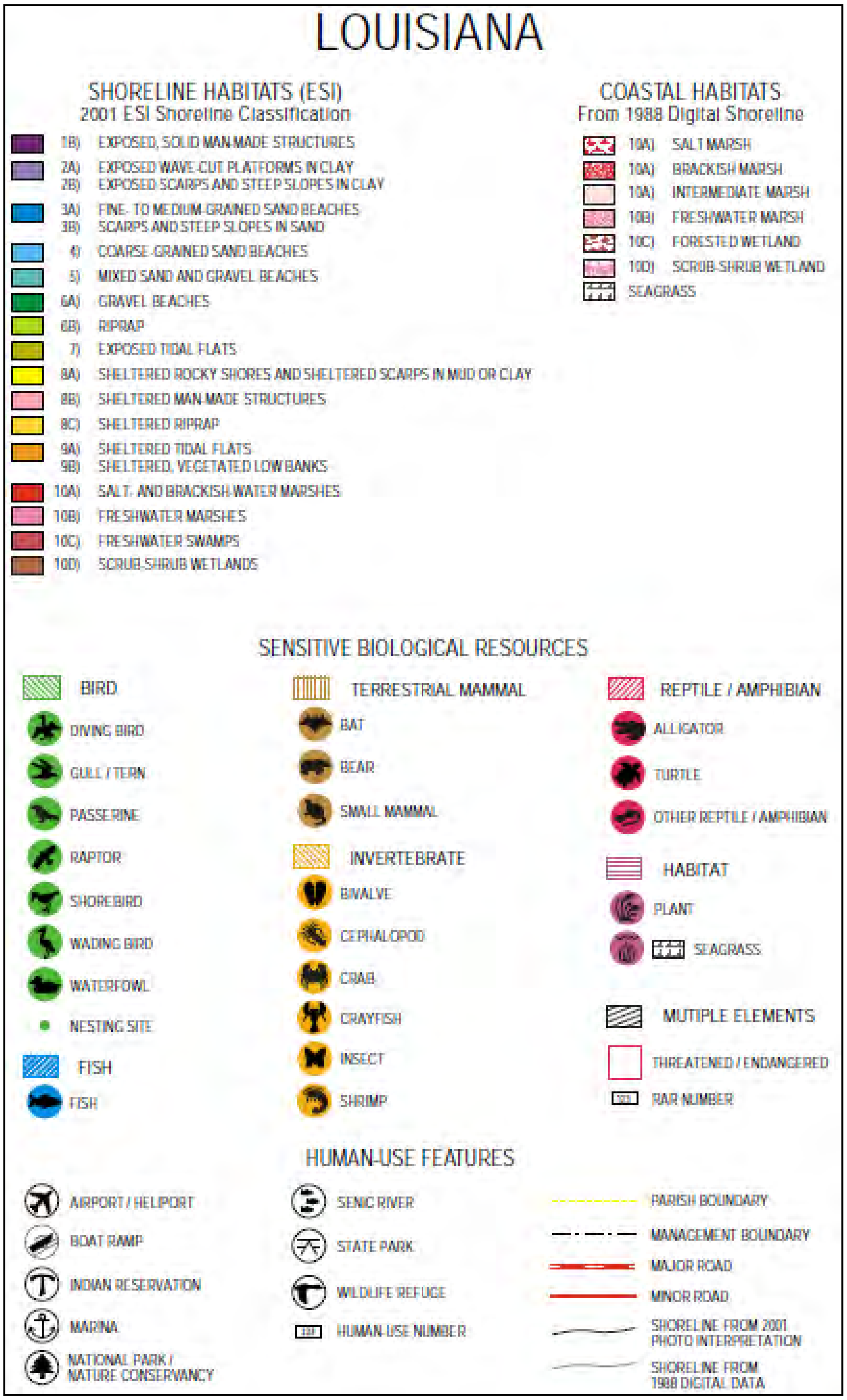
Table 9.D.10 In-Situ Burn Equipment Activation List

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

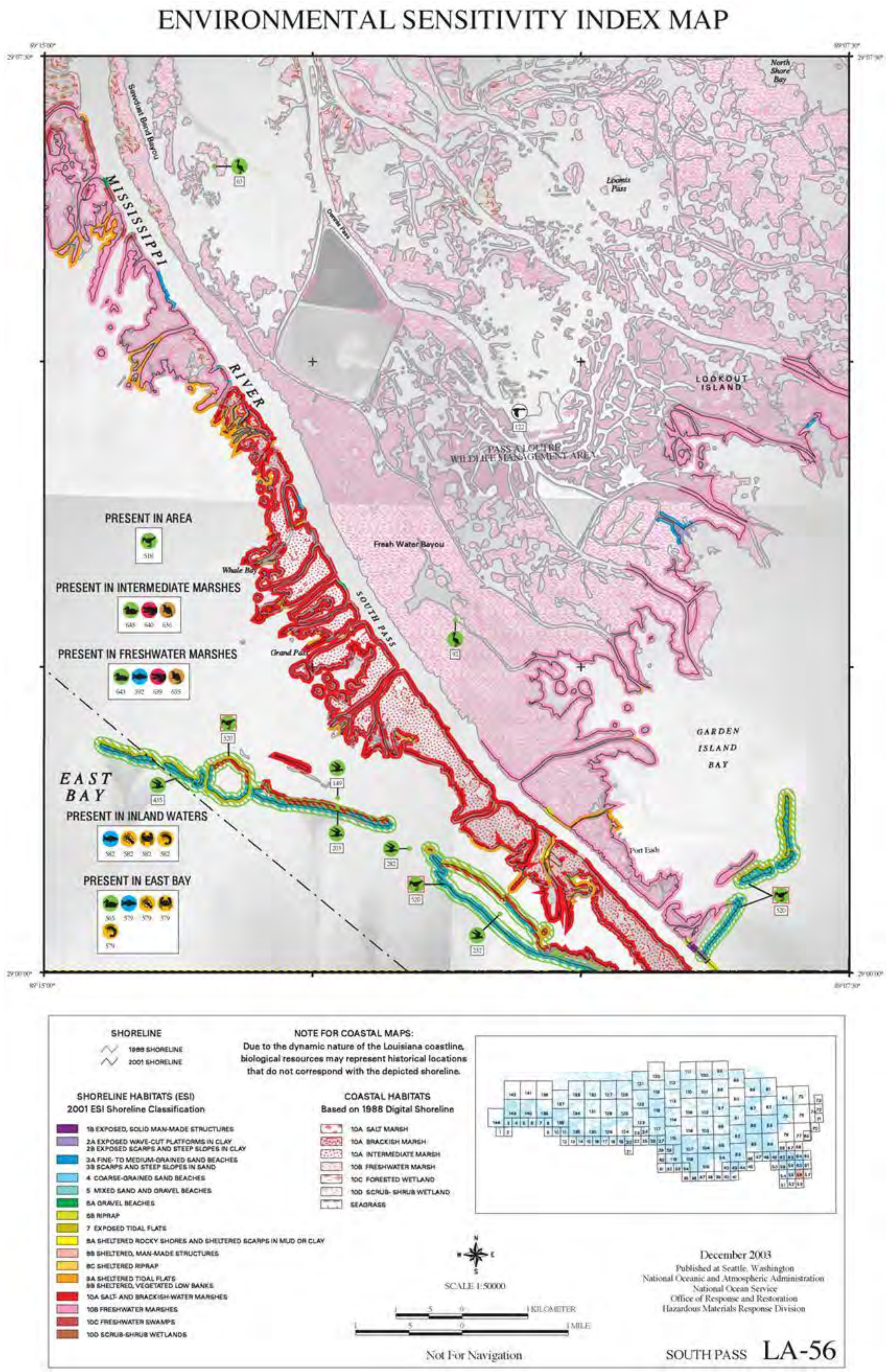


Figure 9.C.2 South Pass ESI Map

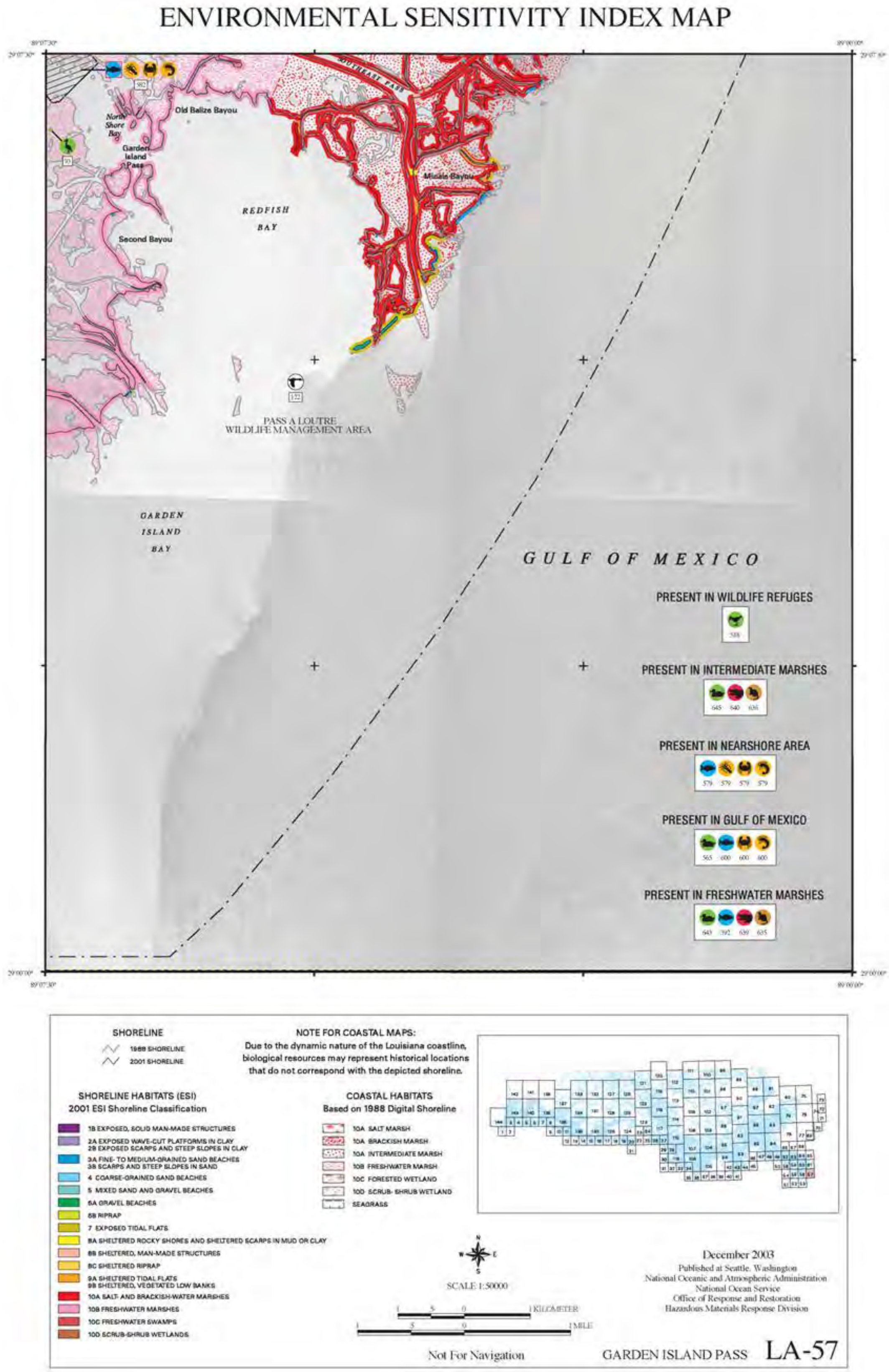


Figure 9.C.3 Garden Island Pass ESI Map

ENVIRONMENTAL SENSITIVITY INDEX MAP

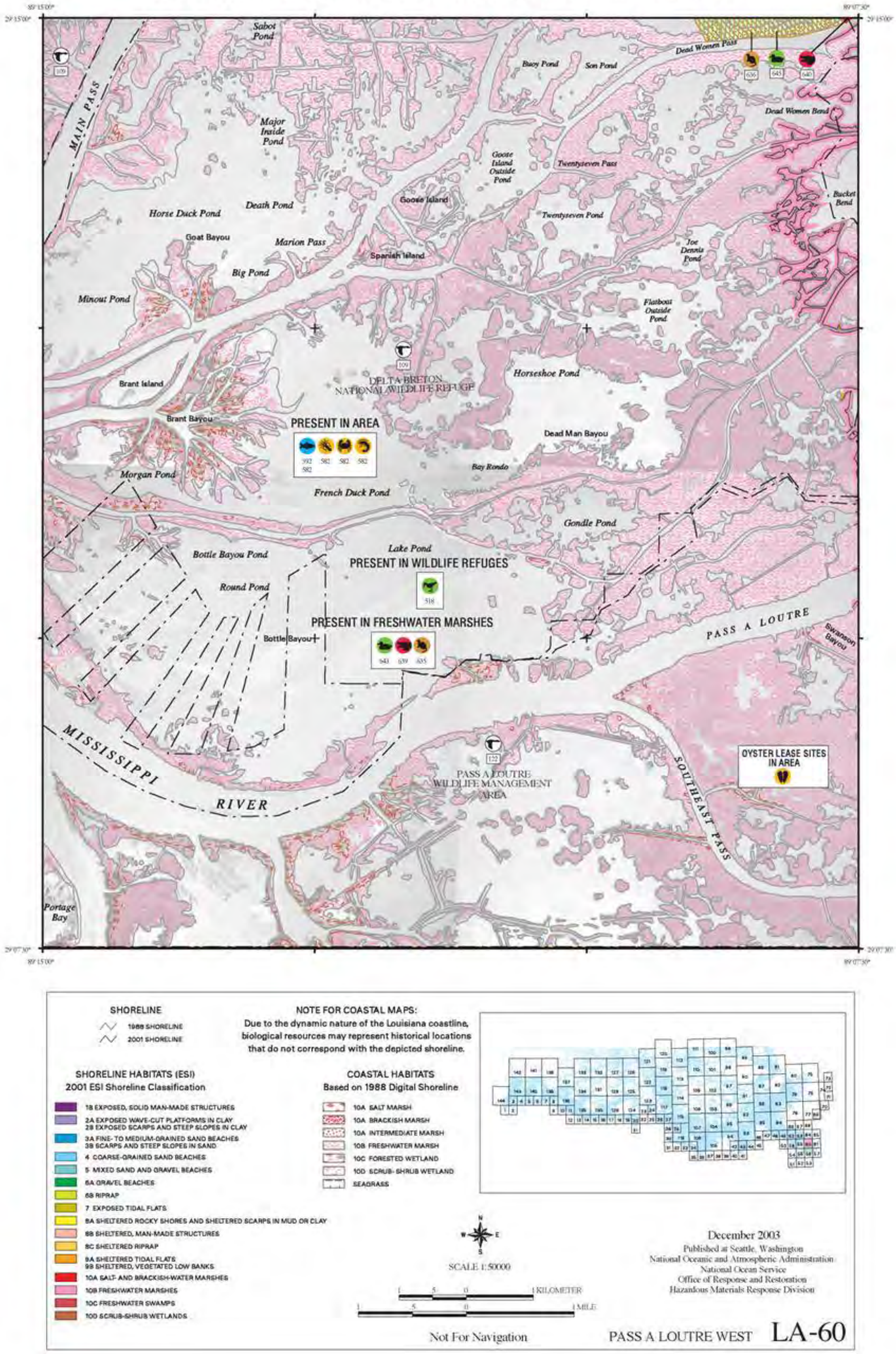


Figure 9.C.4 Pass a Loutre West ESI Map

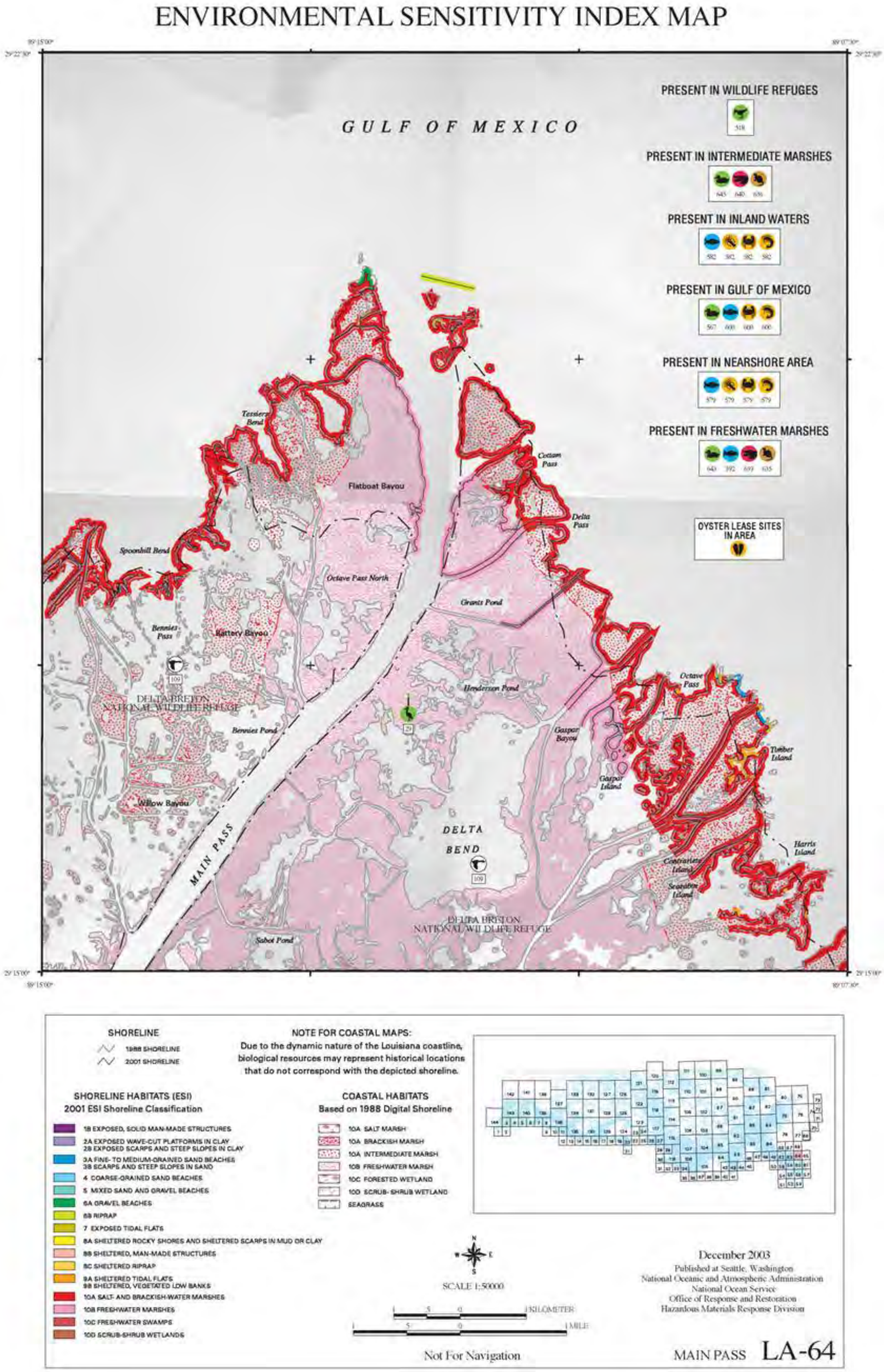


Figure 9.C.5 Main Pass ESI Map

Mississippi Canyon 437 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 are subject to change.													
FRV Breton Island	CGA (888) 242-2007	Venice, LA	Lamor Brush Skimmer	2	22,885	249	Venice, LA	123	2	0	7.5	1	11
			36" Boom	64									
			95' Vessel	1									
			X Band Radar	1									
			Personnel	6									
FRV H.I. Rich	CGA (888) 242-2007	Leeville, LA	Lamor Brush Skimmer	2	22,885	249	Leeville, LA	156	3	0	9	1	13
			36" Boom	64									
			95' Vessel	1									
			X Band Radar	1									
			Personnel	6									
Mississippi Responder Transrec-350	MSRC (800) OIL-SPIL	Pascagoula, MS	Transrec Skimmer	1	10,567	4,000	Pascagoula, MS	129	2	1	9	1	13
			Backup- Stress 1 Skimmer	1									
			67" Pressure Inflatable Boom	2640'									
			210' Vessel	1									
			Personnel	9									
			32' Support Boat	1									
			X Band Radar	1									
			Infrared Camera	1									
			FAES #4 "Buster"	1									
Louisiana Responder Transec 350	MSRC (800) OIL-SPIL	Fort Jackson, LA	Transrec	1	10,567	4,000	Fort Jackson, LA	132	2	1	9.5	1	14
			Backup- Stress 1 Skimmer	1									
			67" Pressure Inflatable Boom	2640'									
			210' Vessel	1									
			Personnel	9									
			32' Support Boat	1									
			X Band Radar	1									
			Infrared Camera	1									
			FAES #4 "Buster"	1									
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	146	2	1	10.5	1	15
			Backup- Stress 1 Skimmer	1									
			67" Pressure Inflatable Boom	2640'									
			210' Vessel	1									
			Personnel	9									
			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	123	4	1	9	1	15
			67" Pressure Inflatable Boom "Lousiana Responder"	110'									
			Personnel	5									
			*Appropriate Vessel	2									
			*Temporary Storage	1		500							
FRU 3.0 - Foilex 150 TDS	CGA (888) 242-2007	Lake Charles, LA	Weir Skimmer	1	1,131	0	Venice, LA	123	2	1	12.5	1	17
			Personnel	4									
			* Utility Boat (<100')	1									
			50 bbl Portable tank	1		50							
Stress 1	MSRC (800) OIL-SPIL	Port Fourchon, LA	Offshore Skimmer	1	15,840	0	Venice, LA	123	5.75	1	9	1	17
			67" Pressure Inflatable Boom "Lousiana Responder"	110'									
			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	123	5.5	1	9	1	17
			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	123	7	1	9	1	18
			67" Pressure Inflatable Boom	110'									
			Personnel	5									
			*Appropriate Vessel	2									
			*Temporary Storage	1		500							

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

Mississippi Canyon 437 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 are subject to change.													
FOILEX 250	MSRC (800) OIL-SPIL	Lake Charles, LA	Offshore Skimmer	1	3,977	0	Venice, LA	123	7	1	9	1	18
			67" Pressure Inflatable Boom	110'									
			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	123	7	1	9	1	18
			67" Pressure Inflatable Boom	110'									
			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	123	4	1	12.5	1	19
			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	123	4	1	12.5	1	19
			Personnel	4									
			* Offshore Utility Boat	1									
			* Add'l Storage	2		1,000							
GT-185	MSRC (800) OIL-SPIL	Port Arthur, TX	Offshore Skimmer	1	1,371	0	Venice, LA	123	8	1	9	1	19
			67" Pressure Inflatable Boom "Lousiana Responder"	110'									
			Personnel	5									
			*Appropriate Vessel	2									
			*Temporary Storage	1		500							
Fast Response Unit "FRU" 1.0	CGA (888) 242-2007	Venice, LA	Foilex 250 Skimmer	1	4,251	100	Venice, LA	123	4	2	12.5	1	20
			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	123	4	2	12.5	1	20
			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	Morgan City, LA	Foilex 250 Skimmer	1	4,251	100	Venice, LA	123	5	2	12.5	1	21
			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	Leeville, LA	Foilex 250 Skimmer	1	4,251	100	Venice, LA	123	5.5	2	12.5	1	21
			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	Leeville, LA	Foilex 250 Skimmer	1	4,251	100	Venice, LA	123	5.5	2	12.5	1	21
			Personnel	4									
			Utility Boat	1									
			53" Skimming Boom	75'									
			** 67" Sea Sentry	440'									
			** Crew Boat	1									
			** Add'l Storage	1		100							

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

Mississippi Canyon 437 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 are subject to change.													
MSRC-452 Offshore Barge	MSRC (800) OIL-SPIL	Fort Jackson, LA	Offshore Barge	1	14,139	45,000	Fort Jackson, LA	132	4	1	14.5	1	21
			67" Pressure Inflatable Boom	2640'									
			Crucial Disc Skimmer	1									
			Desmi Ocean	1									
			*Appropriate Vessel	1									
			Personnel	9									
			* Offshore Tug	2									
			X Band Radar	1									
			Infrared Camera	1									
GT-185	MSRC (800) OIL-SPIL	Galveston, TX	Offshore Skimmer	1	1,371	0	Venice, LA	123	9.5	1	9	1	21
			67" Pressure Inflatable Boom	110'									
			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	129	4	1	14.5	1	21
			67" Pressure Inflatable Boom	2640'									
			Crucial Disc Skimmer	2									
			*Appropriate Vessel	1									
			Personnel	9									
			* Offshore Tug	2									
			X Band Radar	1									
			Infrared Camera	1									
Fast Response Unit "FRU" 1.0	CGA (888) 242-2007	Vermilion, LA	Foilex 250 Skimmer	1	4,251	100	Venice, LA	123	6.25	2	12.5	1	22
			Personnel	4									
			Utility Boat	1									
			53" Skimming Boom	75'									
			** 67" Sea Sentry	440'									
			** Crew Boat	1									
Fast Response Unit "FRU" 1.0	CGA (888) 242-2007	Lake Charles, LA	Foilex 250 Skimmer	1	4,251	100	Venice, LA	123	7	2	12.5	1	23
			Personnel	4									
			Utility Boat	1									
			53" Skimming Boom	75'									
			** 67" Sea Sentry	440'									
			** Crew Boat	1									
			** Add'l Storage	1		100							
FRU 3.0 - Foilex 150 TDS	CGA (888) 242-2007	Galveston, TX	Weir Skimmer	1	1,131	0	Venice, LA	123	9.5	1	12.5	1	24
			Personnel	4									
			* Utility Boat (<100')	1									
			50 bbl Portable tank	1		50							
Fast Response Unit "FRU" 1.0	CGA (888) 242-2007	Aransas Pass, TX	Foilex 250 Skimmer	1	4,251	100	Venice, LA	123	12.25	2	12.5	1	28
			Personnel	4									
			* 100-140' Utility Boat	1									
			53" Skimming Boom	75'									
			** 67" Sea Sentry	440'									
			** Crew Boat	1									
			** Add'l Storage	1		100							
FRV Galveston Island	CGA (888) 242-2007	Galveston, TX	Lamor Brush Skimmer	2	22,885	249	Galveston, TX	420	2	0	24.5	1	28
			36" Boom	64									
			95' Vessel	1									
			X Band Radar	1									
			Personnel	6									
Gulf Coast Responder Transrec-350	MSRC (800) OIL-SPIL	Lake Charles, LA	Transrec Skimmer	1	10,567	4,000	Lake Charles, LA	361	2	1	26	1	30
			Backup - Stress 1 Skimmer	1									
			67" Pressure Inflatable Boom	2640'									
			210' Vessel	1									
			Personnel	9									
			32' Support Boat	1									
			X Band Radar	1									
			Infrared Camera	1									
			FAES #4 "Buster"	1									

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

Mississippi Canyon 437 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 are subject to change.													
CGA-200 HOSS Barge (OSRB)	CGA (888) 242-2007	Harvey, LA	Marco Skimmer	4	76,285	4,000	Harvey, LA	185	0	4	27.5	1	33
			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	420	2	1	30	1	34
			Backup - Stress 1 Skimmer	1									
			67" Pressure Inflatable Boom	2640'									
			210' Vessel	1									
			Personnel	9									
			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	146	24	1	10.5	1	37
			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	146	24	1	10.5	1	37
			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	146	24	1	10.5	1	37
			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	146	24	1	10.5	1	37
			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 (Transrec)	MSRC (800) OIL-SPIL	Houma, LA	Transrec 350 Skimmer	1	10,567	0	Houma, LA	206	24	1	14.5	1	41
			67" Pressure Inflatable Boom	1320'									
			* PSV-VOO	1									
			Personnel	9									
			Thermal Infrared Camera	1									
			*Appropriate Vessel	1									
			* Marine Portable Tank	2		1,000							
Southern Responder Transrec-350	MSRC (800) OIL-SPIL	Ingleside, TX	Transrec Skimmer	1	10,567	4,000	Ingleside, TX	572	2	1	41	1	45
			Backup - Stress 1 Skimmer	1									
			67" Pressure Inflatable Boom	2640'									
			210' Vessel	1									
			Personnel	9									
			32' Support Boat	1									
			X Band Radar	1									
			Infrared Camera	1									
			FAES #4 "Buster"	1									

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

Mississippi Canyon 437 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 are subject to change.													
MSRC-360 Offshore Barge	MSRC (800) OIL-SPIL	Tampa, FL	Offshore Barge	1	11,122	36,000	Tampa, FL	350	4	1	39	1	45
			67" Pressure Inflatable Boom	1320'									
			Crucial Disc Skimmer	1									
			*Appropriate Vessel	1									
			Personnel	9									
			* Offshore Tug	2									
			X Band Radar	1									
			Infrared Camera	1									
Fast Response Unit "FRU" 1.0	CGA (888) 242-2007	Galveston, TX	Foilex 250 Skimmer	1	4,251	100	Galveston, TX	420	4	2	42	1	49
			Personnel	4									
			* 100-165' Utility Boat	1									
			53' Skimming Boom	75'									
			** 67" Sea Sentry	440'									
			** Crew Boat	1									
			** Add'l Storage	1		100							
Florida Responder Transrec-350	MSRC (800) OIL-SPIL	Miami, FL	Transrec Skimmer	1	10,567	4,000	Miami, FL	622	2	1	44.5	1	49
			Backup - Stress 1 Skimmer	1									
			67" Pressure Inflatable Boom	2640'									
			210' Vessel	1									
			Personnel	9									
			32' Support Boat	1									
			X Band Radar	1									
			Infrared Camera	1									
			FAES #4 "Buster"	1									
PSV-VOO Skimming System (Crucial Disc)	MSRC (800) OIL-SPIL	Lake Charles, LA	Crucial Disc Skimmer	1	11,122	0	Lake Charles, LA	361	24	1	26	1	52
			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 (Crucial Disc)	MSRC (800) OIL-SPIL	Lake Charles, LA	Crucial Disc Skimmer	1	11,122	0	Lake Charles, LA	361	24	1	26	1	52
			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 (Transrec)	MSRC (800) OIL-SPIL	Lake Charles, LA	Transrec 350 Skimmer	1	10,567	0	Lake Charles, LA	361	24	1	26	1	52
			67" Pressure Inflatable Boom	1320'									
			* PSV-VOO	1									
			Personnel	9									
			Thermal Infrared Camera	1									
			*Appropriate Vessel	1									
			* Marine Portable Tank	2		1,000							
MSRC-570 Offshore Barge	MSRC (800) OIL-SPIL	Galveston, TX	Offshore Barge	1	22,244	56,900	Galveston, TX	420	4	1	46.5	1	53
			67" Pressure Inflatable Boom	2640'									
			Crucial Disc Skimmer	2									
			*Appropriate Vessel	1									
			Personnel	9									
			* Offshore Tug	2									
			X Band Radar	1									
			Infrared Camera	1									
Koseq Skimming Arms (6) (Mariflex Weir)	CGA (888) 242-2007	Harvey, LA	15m rigid skimming arm	2	36,326	0	Port Fourchon, LA	146	4	33	14.5	1	53
			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 437 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 are subject to change.													
Koseq Skimming Arms (7) (Mariflex Weir)	CGA (888) 242-2007	Harvey, LA	15m rigid skimming arm Personnel * Offshore vessel (>200') * 30T crane * 500 bbl Portable tank	2 5 1 1 4	36,326	0 2,000	Port Fourchon, LA	146	4	33	14.5	1	53
Koseq Skimming Arms (8) (Mariflex Weir)	CGA (888) 242-2007	Harvey, LA	15m rigid skimming arm Personnel * Offshore vessel (>200') * 30T crane * 500 bbl Portable tank	2 5 1 1 4	36,326	0 2,000	Port Fourchon, LA	146	4	33	14.5	1	53
Koseq Skimming Arms (9) (Lamor Brush)	CGA (888) 242-2007	Harvey, LA	15m rigid skimming arm Personnel * Offshore vessel (>200') * 30T crane * 500 bbl Portable tank	2 5 1 1 4	45,770	0 2,000	Port Fourchon, LA	146	4	33	14.5	1	53
Koseq Skimming Arms (10) (Mariflex Weir)	CGA (888) 242-2007	Harvey, LA	15m rigid skimming arm Personnel * Offshore vessel (>200') * 30T crane * 500 bbl Portable tank	2 5 1 1 4	36,326	0 2,000	Port Fourchon, LA	146	4	33	14.5	1	53
Koseq Skimming Arms (11) (Mariflex Weir)	CGA (888) 242-2007	Harvey, LA	15m rigid skimming arm Personnel * Offshore vessel (>200') * 30T crane * 500 bbl Portable tank	2 5 1 1 4	36,326	0 2,000	Port Fourchon, LA	146	4	33	14.5	1	53
MSRC-403 Offshore Barge	MSRC (800) OIL-SPIL	Ingleside, TX	Offshore Barge 67" Pressure Inflatable Boom Crucial Disc Skimmer *Appropriate Vessel Personnel * Offshore Tug X Band Radar Infrared Camera	1 2640' 1 1 9 2 1 1	11,122	40,300	Ingleside, TX	572	4	1	63.5	1	70
Koseq Skimming Arms (1) (Lamor Brush)	CGA (888) 242-2007	Galveston, TX	15m rigid skimming arm Personnel * Offshore vessel (>200') * 30T crane * 500 bbl Portable tank	2 5 1 1 4	45,770	0 2,000	Galveston, TX	420	4	24	42	1	71
***Moran/ Long Island	CGA (888) 242-2007	Houma, LA	Offshore Barge Personnel Offshore Tug	1 4 1	N/A	62,982	Houma, LA	206	24-72	0	25.5	1	51 to 99
***Moran/ Tennessee	CGA (888) 242-2007	Houma, LA	Offshore Barge Personnel Offshore Tug	1 4 1	N/A	82,022	Houma, LA	206	24-72	0	25.5	1	51 to 99
***Moran/ New Hampshire	CGA (888) 242-2007	Houma, LA	Offshore Barge Personnel Offshore Tug	1 4 1	N/A	118,836	Houma, LA	206	24-72	0	25.5	1	51 to 99
***K-Sea DBL 101 Offshore Barge	CGA (888) 242-2007	Belle Chasse, LA	Offshore Barge Personnel * Offshore Tug	1 10 1	N/A	107,285	Houma, LA	206	24-72	0	25.5	1	51 to 99
***K-Sea DBL 102 Offshore Barge	CGA (888) 242-2007	Belle Chasse, LA	Offshore Barge Personnel * Offshore Tug	1 10 1	N/A	107,285	Houma, LA	206	24-72	0	25.5	1	51 to 99
***Moran/ Massachusetts	CGA (888) 242-2007	Houma, LA	Offshore Barge Personnel Offshore Tug	1 4 1	N/A	137,123	Houma, LA	206	24-72	0	25.5	1	51 to 99
DERATED RECOVERY RATE (BBLS/DAY)													833,262
STORAGE CAPACITY INCLUDING SKIMMING VESSELS (BARRELS)													895,630

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

Mississippi Canyon 437 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	123	2	0	7.5	1	**11**
			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	123	2	0	7.5	1	**11**
			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	156	2	0	9	1	**12**
			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	123	4	1	7.5	1	**14**
			* 18" Boom (contractor)	100'									
			Personnel	3									
			36' Skimming Vessel	1									
			Shallow Water Barge	1		249							
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Belle Chasse, LA	Skimmer	1	905	400	Venice, LA	123	4	1	9	1	**15**
			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	123	4	1	9	1	**15**
			Personnel	2									
			30' Shallow Water Vessel	1									
SWS CGA-53 MARCO Shallow Water Skimmer	CGA (888) 242-2007	Leeville, LA	Marco Belt Skimmer	1	3,588	34	Venice, LA	123	5.5	1	7.5	1	**15**
			* 18" Boom (contractor)	100'									
			Personnel	3									
			38' Skimming Vessel	1									
SBS w/ GT-185 w/adapter	MSRC (800) OIL-SPIL	Baton Rouge, LA	Skimmer	1	1,371	400	Venice, LA	123	5	1	9	1	**16**
			18" Boom	50'									
			Personnel	4									
			Non-self-propelled barge	1									
			Push Boat	1									
SWS CGA-51 MARCO Shallow Water Skimmer	CGA (888) 242-2007	Lake Charles, LA	Marco Belt Skimmer	1	3,588	20	Venice, LA	123	7	1	7.5	1	**17**
			* 18" Boom (contractor)	100'									
			Personnel	3									
			34' Skimming Vessel	1									
			Shallow Water Barge	1		249							
MSRC "Kvichak"	MSRC (800) OIL-SPIL	Pascagoula, MS	Marco I Skimmer	1	3,588	24	Venice, LA	123	5.5	1	9	1	**17**
			Personnel	2									
			30' Shallow Water Vessel	1									
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Pascagoula, MS	Skimmer	1	905	400	Venice, LA	123	5.5	1	9	1	**17**
			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	123	5.5	1	9	1	**17**
			18" Boom	50'									
			Personnel	4									
			Self-propelled barge	1									
GT-185	MSRC (800) OIL-SPIL	Pascagoula, MS	Skimmer	1	1,371	*500	Venice, LA	123	6	1	9	1	**17**
			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	245	2	0	14.5	1	**18**
			36" Boom	46'									
			46' Vessel	1									
			Personnel	4									

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

Mississippi Canyon 437 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	Response Times (Hours): Loadout Time	Response Times (Hours): ETA to Nearshore Environment	Response Times (Hours): Deployment Time	Total ETA
* - These components are additional operational requirements that must be procured in addition to the system identified.													
SW CGA-72 FRV	CGA (888) 242-2007	Morgan City, LA	Marco Belt Skimmer 36" Auto Boom Personnel 56' SWS Vessel * 14'-16' Alum. Flatboat	2 150' 4 1 2	21,500	249	Morgan City, LA	245	2	0	14.5	1	18
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	123	7	1	9	1	18
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	123	7	1	9	1	18
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	123	7	1	9	1	18
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	123	7	1	9	1	18
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	123	7	1	9	1	18
MSRC "Kvichak"	MSRC (800) OIL-SPIL	Galveston, TX	Marco I Skimmer Personnel 30' Shallow Water Vessel	1 2 1	3,588	24	Venice, LA	123	9.5	1	9	1	21
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	123	9.5	1	9	1	21
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	123	9.5	1	9	1	21
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	123	9.5	1	9	1	21
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	320	2	0	19	1	22
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	123	12	1	9	1	23
FRV M/V Bastian Bay	CGA (888) 242-2007	Lake Charles, LA	Lori Brush Skimmer 36" Boom 46' Vessel Personnel	2 46' 1 4	15,257	65	Lake Charles, LA	361	2	0	21	1	24
MSRC "Kvichak"	MSRC (800) OIL-SPIL	Ingleside, TX	Marco I Skimmer Personnel 30' Shallow Water Vessel	1 2 1	3,588	24	Venice, LA	123	12.25	1	9	1	24

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

Mississippi Canyon 437 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.													
SW CGA-73 FRV	CGA (888) 242-2007	Lake Charles, LA	Marco Belt Skimmer	2	21,500	249	Lake Charles, LA	361	2	0	21	1	**24**
			36" Auto Boom	150'									
			Personnel	5									
			56' SWS Vessel	1									
			* 14'-16' Alum. Flatboat	2									
SBS w/ GT-185 w/adapter	MSRC (800) OIL-SPIL	Ingleside, TX	Skimmer	1	1,371	400	Venice, LA	123	12.25	1	9	1	**24**
			18" Boom	50'									
			Personnel	4									
			Self-propelled barge	1									
GT-185	MSRC (800) OIL-SPIL	Tampa, FL	Skimmer	1	1,371		Venice, LA	123	13	1	9	1	**24**
			18" Boom	50'									
			Personnel	5									
			*Appropriate Vessel	2									
			*Temporary Storage	1		500							
SWS CGA-55 Egmopol Shallow Water Skimmer	CGA (888) 242-2007	Morgan City, LA	Marco Skimmer	1	1,810	100	Venice, LA	123	5	1	17.5	1	**25**
			* 18" Boom (contractor)	100'									
			Personnel	3									
			38' Skimming Vessel	1									
			Shallow Water Barge	1		249							
MSRC "Kvichak"	MSRC (800) OIL-SPIL	Savannah, GA	Marco I Skimmer	1	3,588	24	Venice, LA	123	13.5	1	9	1	**25**
			Personnel	2									
			30' Shallow Water Vessel	1									
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Roxana, IL	Skimmer	1	905	400	Venice, LA	123	14	1	9	1	**25**
			18" Boom	50'									
			Personnel	4									
			Non-self-propelled barge	1									
			Push Boat	1									
WP-1	MSRC (800) OIL-SPIL	Miami, FL	Skimmer	1	3,017		Venice, LA	123	16	1	9	1	**27**
			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	123	16	1	9	1	**27**
			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	123	16	1	9	1	**27**
			18" Boom	50'									
			Personnel	5									
			* Appropriate Vessel	2									
			*Temporary Storage	1		500							
SW CGA-71 FRV	CGA (888) 242-2007	Aransas Pass, TX	Marco Belt Skimmer	2	21,500	249	Galveston, TX	420	2	0	24.5	1	**28**
			36" Auto Boom	150'									
			Personnel	5									
			56' SWS Vessel	1									
			* 14'-16' Alum. Flatboat	2									
SWS CGA-75 FRV	CGA (888) 242-2007	Galveston, TX	Lori Brush Skimmer	2	22,885	249	Galveston, TX	420	2	0	24.5	1	**28**
			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	123	10	1	17.5	1	**29**
			* 18" Boom (contractor)	100'									
			Personnel	3									
			34' Skimming Vessel	1									
			Shallow Water Barge	1		249							
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Whiting, IN	Skimmer	1	905	400	Venice, LA	123	17.25	1	9	1	**29**
			18" Boom	60'									
			Personnel	4									
			Non-self-propelled barge	1									
			Push Boat	1									

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

Mississippi Canyon 437 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.													
MSRC "Lightning"	MSRC (800) OIL-SPIL	Tampa, FL	LORI Brush Skimmer Personnel 47' Fast Response Boat	2 3 1	5,000	50	Tampa, FL	350	2	1	25	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	361	2	1	26	1	**30**
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	123	18.5	1	9	1	**30**
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	123	20	1	9	1	**31**
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	123	21.25	1	9	1	**33**
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	123	23	1	9	1	**34**
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	123	22.75	1	9	1	**34**
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	123	22.75	1	9	1	**34**
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	123	22.75	1	9	1	**34**
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	565	2	0	33	1	**36**
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	123	26	1	9	1	**37**
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	123	26	1	9	1	**37**
MSRC "Kvichak"	MSRC (800) OIL-SPIL	Portland, ME	Marco I Skimmer Personnel 30' Shallow Water Vessel	1 2 1	3,588	24	Venice, LA	123	28	1	9	1	**39**
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	123	28	1	9	1	**39**
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 437 Drilling > 10 Miles Sample Aerial Surveillance Activation List										
							Response Times (Hours)			
Aerial Surveillance System	Supplier & Phone	Airport/City, State	Aerial Surveillance Package	Quantity	Staging Location	Distance to Site from Staging (nautical miles)	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	178	1	0.25	0.59	1.85
			Spotter Personnel	2						
			Crew- Pilots	1						
Aztec Piper Air Speed - 150 Knots	Airborne Support (985) 851-6391	Houma, LA	Surveillance Aircraft	1	Houma, LA	178	1	0.25	1.04	2.30
			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	178	1	0.25	1.10	2.35
			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	178	1	0.25	1.10	2.35
			Spotter Personnel	2						
			Crew- Pilots	1						

Table 9.D.6 Aerial Surveillance Activation List

Mississippi Canyon 437 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	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 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	178	1	0	0.59	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**	178	2	0.5	0.92	0.5	**3.95**
			Dispersant - Gallons	2000							
			Spotter Aircraft	1							
			Spotter Personnel	2	Houma, LA **2nd Flight**	178	0.92	0.5	0.92	0.3	**2.65**
			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**	154	3	0.00	0.72	0.20	**3.95**
			Dispersant - Gallons	250							
			* Spotter Aircraft	1							
			*Spotter Personnel	2	Stennis INTL., MS **2nd Flight**	154	0.72	0.20	0.72	0.20	**1.85**
			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**	154	3	0.0	0.45	0.5	**4.00**
			Dispersant - Gallons	3250							
			*Spotter Aircraft	1							
			*Spotter Personnel	2	Stennis INTL., MS **2nd Flight**	154	0.50	0.3	0.45	0.5	**1.80**
			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**	178	2	0.5	1.19	0.5	**4.20**
			Dispersant - Gallons	1200							
			Spotter Aircraft	1							
			Spotter Personnel	2	Houma, LA **2nd Flight**	178	1.19	0.5	1.19	0.3	**3.20**
			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**	178	2	0.5	1.19	0.5	**4.20**
			Dispersant - Gallons	1200							
			Spotter Aircraft	1							
			Spotter Personnel	2	Houma, LA **2nd Flight**	178	1.19	0.5	1.19	0.3	**3.20**
			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**	154	7	0.3	0.45	0.5	**8.30**
			Dispersant - Gallons	4000							
			*Spotter Aircraft	1							
			*Spotter Personnel	2	Stennis INTL., MS **2nd Flight**	154	0.50	0.3	0.45	0.5	**1.80**
			Crew - Pilots	2							
BE-90 King Air Aircraft Air Speed - 213 MPH	MSRC (800) OIL-SPIL	Salisbury, MD	BE-90 Dispersant Aircraft	1	Stennis INTL., MS **1st Flight**	154	9	0.30	0.72	0.20	**10.25**
			Dispersant - Gallons	250							
			* Spotter Aircraft	1							
			*Spotter Personnel	2	Stennis INTL., MS **2nd Flight**	154	0.72	0.20	0.72	0.20	**1.85**
			Crew - Pilots	2							

Table 9.D.7 Offshore Aerial Dispersant Activation List

Mississippi Canyon 437 Drilling > 10 Miles Sample Offshore Boat Spray Dispersant Activation List											
							Response Times (Hours)				
Boat Spray Dispersant System	Supplier & Phone	Warehouse	Boat Spray Dispersant Package	Quantity	Staging Area	Distance to Site from Staging (Miles)	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 Dispersant (Gallons) Personnel * 110' Utility Boat * Crew Boat	1 500 4 1 1	Venice, LA	123	5.75	0.5	9	1	16.25
USCG SMART Team	USCG	Mobile, AL	Personnel * Crew Boat	4 1	Venice, LA	123	6	1	9	0.5	16.5
Vessel Based Dispersant Spray System	CGA (888) 242-2007	Harvey, LA	Dispersant Spray System Dispersant (Gallons) Personnel * Utility Boat	1 330 4 1	Venice, LA	123	4	0.5	12.5	1	18
Fire Monitor Induction Dispersant Spray System	AMPOL (800) 482-6765	Cameron, LA	Dispersant Spray System Dispersant (Gallons) Personnel * 110' Utility Boat * Crew Boat	1 500 4 1 1	Venice, LA	123	7.75	0.5	9	1	18.25
Vessel Based Dispersant Spray System	CGA (888) 242-2007	Aransas Pass, TX	Dispersant Spray System Dispersant (Gallons) Personnel * Utility Boat	1 330 4 1	Venice, LA	123	12.25	0.5	12.5	1	26.25

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

Mississippi Canyon 437 Drilling > 10 Miles Sample Subsea Dispersant Package Activation List											
							Response Times (Days)				
Containment System	Supplier & Phone	Warehouse	Package	Quantity	Staging Area	Distance to Site from Staging (Miles)	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	RP	Port Fourchon, LA	Multi-Service Vessel ROV's	1 2	Port Fourchon, LA	146	0	1.5	10.5	0.5	12.5
Subsea Dispersant Application	RP / MWCC	Port Fourchon, LA Houston, TX	Multi-Service Vessel ROV's Coil Tubing Unit Dispersant Manifold Subsea Dispersant Injection System	1 2 1 200,000 gal 1 1	Port Fourchon, LA	146	1.5	1.5	10.5	2	15.5
Capping Stack	RP / MWCC	Port Fourchon, LA Houston, TX	Anchor Handling Tug Supply Vessel ROV's Hydraulic System Capping Stack	1 1 1 1	Port Fourchon, LA	146	2*	1.5	10.5	3	17*
"Top Hat" Unit	RP / MWCC	Port Fourchon, LA Houston, TX	Anchor Handling Tug Supply Vessel ROV's Multi-Purpose Supply Vessel Drill Ship (Processing Vessel) "Top Hat" Containment Chamber Shuttle Barge	1 2 1 1 1 1 1	Port Fourchon, LA	146	13*	1	10.5	3	28*

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

Mississippi Canyon 437 Drilling > 10 Miles Sample In-Situ Burn Equipment Activation List												
							Response Times (Hours)					
Skimming System	Supplier & Phone	Warehouse	Skimming Package	Quantity	Staging Area	Distance to Site from Staging (Miles)	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 * Cranes * Roll-off Boxes Personnel * Air Monitoring Equipment	2 2 2 8 2	Venice, LA	123	4	1	9	1	15
SMART In-Situ Burn Monitoring Team	USCG	Mobile, AL	* Air Monitoring Equipment * Offshore Vessel Personnel	1 1 4	Venice, LA	123	4	1	9	1	15
Safety Monitoring Team	TBD	TBD	* Air Monitoring Equipment * Offshore Vessel Personnel	1 1 4	Venice, LA	123	4	1	9	1	15
Wildlife Monitoring Team	TBD	TBD	* Air Monitoring Equipment * Offshore Vessel Personnel	1 1 4	Venice, LA	123	4	1	9	1	15
Aerial Spotting Team (per 2 ISB Task Forces)	TBD	TBD	Fixed Wing Aircraft Trained ISB Spotter ISB Documenter	1 2 1	Venice, LA	123	4	1	9	1	15
Fire Team (In-Situ Burn Fire System)	MSRC (800) OIL-SPIL	Lake Charles, LA	**Fire Boom (ft) TowLine (ft) * Appropriate Vessel Personnel Ignition Device	2,000 600 2 2 25	Venice, LA	123	7	1	9	1	18
Fire Team (In-Situ Burn Fire System)	MSRC (800) OIL-SPIL	Houston, TX	**Fire Boom (ft) TowLine (ft) * Appropriate Vessel Personnel Ignition Device	16,000 600 2 2 155	Venice, LA	123	9	1	9	1	20
Fire Team (In-Situ Burn Fire System)	MSRC (800) OIL-SPIL	Galveston, TX	**Fire Boom (ft) TowLine (ft) * Appropriate Vessel Personnel Ignition Device	1,000 600 2 2 10	Venice, LA	123	9.5	1	9	1	20.5
Supply Team (Supply Vessel System)	MSRC (800) OIL-SPIL	Venice, LA	*Offshore Vessel 110' - 310' Personnel	1 6	Venice, LA	123	4	1	24.5	1	30.5
Fire Team (In-Situ Burn Fire System)	MSRC (800) OIL-SPIL	Portland, ME	**Fire Boom (ft) TowLine (ft) * Appropriate Vessel Personnel Ignition Device	1,000 600 2 2 10	Venice, LA	123	28	1	9	1	39
Fire Team (In-Situ Burn Fire System)	CGA (888) 242-2007	Harvey, LA	Fire Boom (ft) Guide Boom/TowLine (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 3 20 10	Venice, LA	123	4	24	12.5	1	41.5
Fire Team (In-Situ Burn Fire System)	CGA (888) 242-2007	Harvey, LA	Fire Boom (ft) Guide Boom/TowLine (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 3 20 10	Venice, LA	123	4	24	12.5	1	41.5
TOTAL FIRE BOOM AVAILABLE (FEET)										21,000	

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

Mississippi Canyon 437 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					
		ShallowWater 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					
		ShallowWater 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					
		ShallowWater 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 437 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					
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					
		ShallowWater 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					
		ShallowWater 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					
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					
		ShallowWater Skimmers	1					
		Response Personnel	6					
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					
		ShallowWater Skimmers	2					
		Wildlife Hazing Cannon	57					

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

Mississippi Canyon 437 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
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					
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					
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					
Clean Harbors (800) 645-8265	NewIberia, 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					
AMPOL (800) 482-6765	NewIberia, 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					
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					
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	NewIberia, 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 437 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	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					
		ShallowWater Skimmers	1					
		Response Personnel	49					
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					
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					
		ShallowWater Skimmers	1					
		Response Personnel	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					
		ShallowWater 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					
		ShallowWater Skimmers	1					
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
		ShallowWater 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					

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

Mississippi Canyon 437 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	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					
		ShallowWater 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					
Wildlife Ctr. of Texas (713) 861-9453	Houston, TX	Wildlife Specialist - Personnel	6 to 20	Venice, LA	9	1	1	11
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					
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					
		ShallowWater Skimmers	1					
		Response Personnel	9					
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					
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					
		ShallowWater Skimmers	1					
		Response Personnel	8					

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

Mississippi Canyon 437 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
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					
		ShallowWater Skimmers	1					
		Response Personnel	10					
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					
		ShallowWater 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	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					
		ShallowWater 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					
		ShallowWater 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

No incidental takes are anticipated. Shell implements the mitigation measures and monitors for incidental takes of protected species according to the following notices to lessees and operators from the Minerals Management Service:

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 2 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

Lease	Block	Military Stipulation	Protected Species	Current MWA
OCS G 26254	MC 393	No. 3 – EWTA 1 & 3	No. 6	EWTA 1
OCS G 25852	DC 353 (BHL)	No. 1 – EWTA 1 & 3, No. 2 - Evacuation, No. 3 Coorination	No. 4 – 2 & 3	EWTA 1

Military Area Stipulation

Shell will enter into an agreement with the Commander, Eglin AFB, prior to development activities in this area.

Protected Species Stipulation

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

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"

National Marine Fisheries Service 2020 Endangered Species Act, Section 7 Consultation – Biological Opinion:

MODU for Well Work:

Appendix A: No seismic survey activities will take place on the MODU.

Appendix B: Shell will comply with GOM Marine and Trash Requirements in Appendix B 2020 NMFS BiOp and BOEM/BSEE Regulations.

Appendix C: Shell will comply with GOM Vessel Strike Avoidance and Protected Species Reporting Requirements in Appendix C and BOEM/BSEE Regulations.

Appendix J: There will be no explosive severance operations conducted on the MODU that may result in potential for entanglement or entrapment of endangered marine species requiring resuscitation measures.

SECTION 13: RELATED FACILITIES AND OPERATIONS INFORMATION

The Appomattox Development is a joint venture operated by Shell Offshore Inc. that involves the development of two Units, Appomattox and Vicksburg, both of which will be produced to the Appomattox host facility. The partner in the development is Nexen.

The host facility is a semi-submersible Floating Production System (FPS) with 16 mooring lines centered in Mississippi Canyon Block 437 in the Eastern Gulf of Mexico. This location is approximately 140 nautical miles southeast of New Orleans and is in 7422 feet of water. The Appomattox FPS provides processing capabilities, including primary oil and gas separation, oil conditioning, gas compression, produced water treating, and water injection.

There will be no rig on the FPS. All wells will be drilled by dynamically positioned drilling rigs (MODUs) and will have subsea wellheads and trees. The subsea wells are being drilled from four (4) production and two (2) injection drill centers located between 3-7 miles away from the FPS above the Appomattox and Vicksburg reservoir structures. The current field development plan assumes a waterflood will be installed in the South Fault Block (SFB) of the Appomattox field to boost ultimate recovery.

The initial development plans for up to 24 subsea wells (19 producers and 5 injectors).

The subsea architecture consists of wells clustered at individual drill centers. For the production system, subsea manifolds will gather multiphase production from subsea trees via individual jumpers and route these fluids to the FPS via dual, looped flowlines. The flowlines transition to steel catenary risers (SCRs) that carry the fluids up to the FPS. Water injection will be routed similarly from the FPS down to wells clustered around subsea injection manifolds. However, each injection drill center is supported by a single flowline and SCR.

A service line SCR and flowline system is routed to each of the production centers to support minor well interventions such as scale squeeze operations and asphaltene solvent soaks. Dynamic umbilical risers are routed to the seabed and onward to each of the production and water injection drill centers to provide hydraulic power, chemicals, electrical power, and communication to and from the subsea facilities.

There are no pile-driving, new pipelines expected to make landfall, or seismic survey activities proposed in this DOCD. There is no moon poll used at the host.

(13b) Transportation System

Oil Export

The Appomattox oil export system consists of a 20.2-inch steel catenary riser terminated at a PLET and tied in subsea to the Mattox 24-inch pipeline. The 24" Mattox oil export line will be 90 miles long and end with a subsea tie-in at SP 89. The connection at SP 89 will connect the export line to the Endymion gathering system and allow for the oil to be transported to existing infrastructure at Clovelly in Louisiana.

The oil export pipeline and riser is designed in accordance with ANSI B31.4 for a Maximum Allowable Operating Pressure of 3705 psig (ANSI 1500#) and a Maximum Allowable Operating Temperature of 140° F.

Gas Export

The Appomattox gas export line consists of a 12.75-inch steel catenary riser terminated at a PLET and tied in subsea to a 16-inch pipeline. The 16" gas export line is 60 miles long and end with a subsea tie-in at MP 261. The connections from MP 261 allosw the gas to be delivered to existing infrastructure on the Alabama (Mobile Gas Plant) and Mississippi (Pascagoula Gas Plant) Gulf Coasts.

The gas export pipeline and riser is be designed in accordance with ANSI B31.8 for a Maximum Allowable Operating Pressure of 3705 psig (ANSI 1500#) and a Maximum Allowable Operating Temperature of 140° F.

(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
Crew Boats	8,000	2	2 per week
Offshore Support Vessels	120,000	2	2 per week
Helicopter	764	1	Once per day

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	1 month	Port Fourchon to MC 437

C. Drilling Fluids Transportation

See Vicinity Map for Routes.

D. Solid and Liquid Wastes Transportation

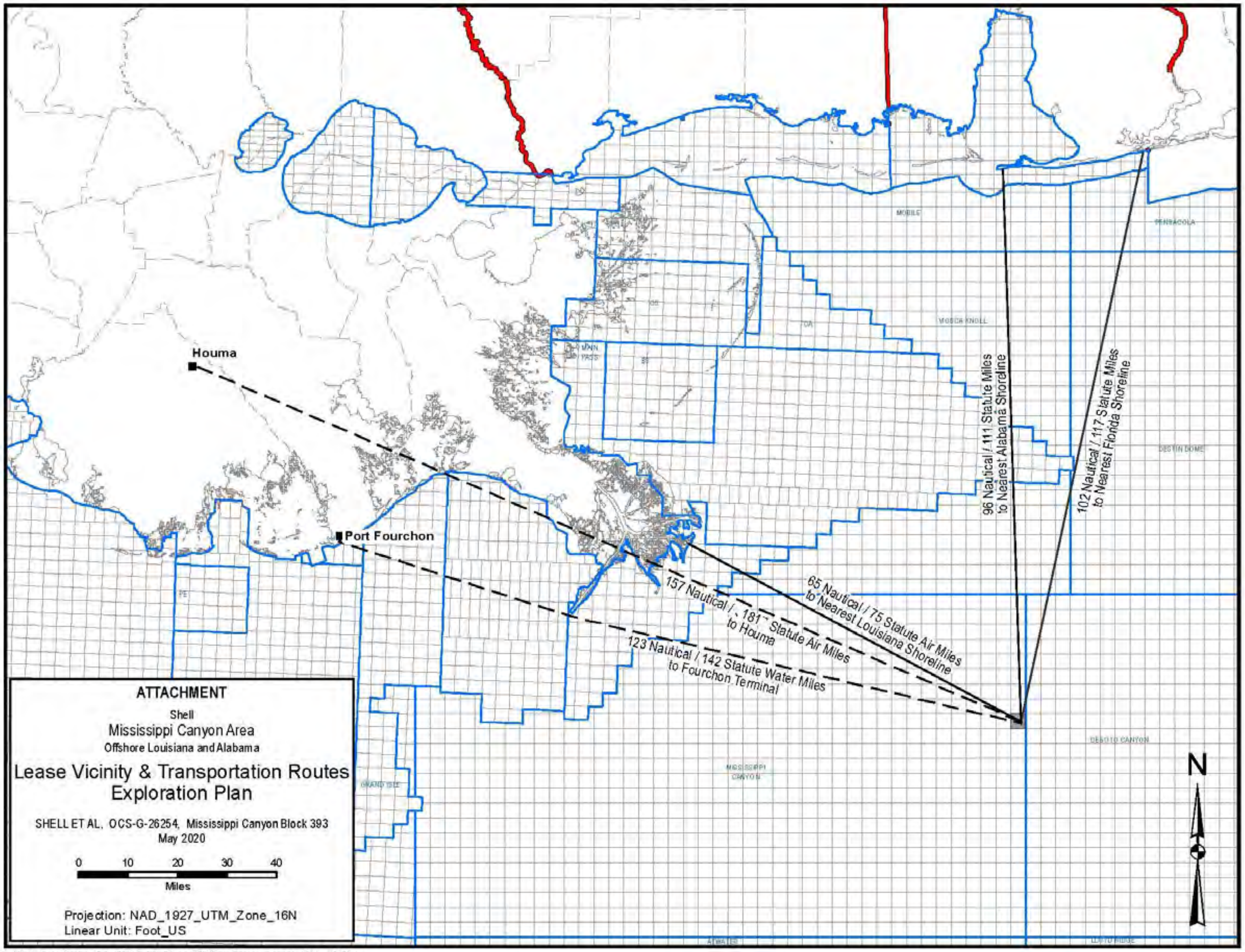
See Section 7, Tables 7A & 7B for this information.

E. Vicinity Map

See Attachment 14A for Vicinity Map

No Vessels associated with this plan will cros the designated Brydes Whale Area.

Attachment 14A – Vicinity Map



SECTION 15: ONSHORE SUPPORT FACILITIES INFORMATION

A. General

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

The onshore support bases for water and air transportation will be the existing terminals in Houma and Port Fouchon, Louisiana. The Fouchon boat facility is operated by SOI 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 Road, Houma, LA 70363.

Support Base Construction or Expansion

Shell is contracting with a third party to construct and operate, as part of their existing facility at Fourchon, a contained cement area to park transfer trucks and accommodate pumps, filtration and metering in order to transfer bulk chemicals through a hose from trucks to a marine vessel to use at this proposed FPS. This will be in lieu of transporting chemicals in intermediate storage containers (totes, ISOs, etc.).

Support Base Construction or Expansion Timetable

2018 through Q1 2019.

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 CZM concurrence for these leases were obtained in previous plans listed below and is not required for Supplemental DOCD's:

Plan N-8379

OCS-G 30380 (RUE Pending), Mississippi Canyon Block 437 (Host Location)
OCS-G 19939, Mississippi Canyon Block 348
OCS-G 26252, Mississippi Canyon Block 391
OCS-G 26253, Mississippi Canyon Block 392
OCS-G 26254, Mississippi Canyon Block 393

CZM concurrence is required for the State of Alabama and State of Texas is included in this plan.

ALABAMA
COASTAL ZONE MANAGEMENT
CONSISTENCY CERTIFICATION

Suplemental DOCD
Type of Plan

OCS-G 30380 (RUE Pending), Mississippi Canyon Block 437 (Host Location)
OCS-G 19939, Mississippi Canyon Block 348
OCS-G 26252, Mississippi Canyon Block 391
OCS-G 26253, Mississippi Canyon Block 392
OCS-G 26254, Mississippi Canyon Block 393
Lease Number and Area/Blocks

The proposed activities described in detail in this Plan will comply with Alabama's approved Coastal Resources Program and Coastal Area Management Program Policies.

SHELL OFFSHORE INC.
Operator

Tracy Albert
Certifying Official

08/20/20
Date

In accordance with 30 CFR 550.226, Shell is hereby providing the following information in support of Section 18 (Environmental Impact Analysis) of our Plan for this lease.

The regulations found in 15 CFR 930.58 identifies necessary data and information to be furnished to the State agency. The information is as follows:

- CONSISTENCY CERTIFICATION

  A Coastal Zone Consistency Certification for activities that affect the State of Alabama is provided in Section 17 of this plan.

- OTHER INFORMATION

  (1) Shell shall utilize a shore base in Fourchon, Louisiana for water support and PHI's Houma terminal for air traffic for the proposed activities.

  (2) As per NTL 2008-G04, the following items have been identified as being required:

  - A discussion of the method of disposal of wastes and discharges is provided in Section 7 of this EP.
  - Oil Spill Information is provided in Section 9 of this plan.
  - All operations are covered by Shell's Regional OSRP, which has approved by BOEM. Revisions to the plan have been approved (see Section 9). The Plan is available upon request.

  (3) The following is an evaluation that includes findings relating to the coastal effects of the proposed activities and associated facilities to the relevant enforceable policies of the Alabama's Coastal Management Program:

  All activities shall be consistent with Alabama's coastal management program and shall comply with all relevant rules and regulations. Pollution shall be prevented or reduced at the source; pollution that cannot be prevented shall be recycled in an environmentally safe manner; pollution that cannot be prevented or recycled shall be treated in an environmentally safe manner; and disposal or other release into the environment shall be employed only as a last resort and should be conducted in an environmentally safe manner. All activities comply with all applicable provisions of the administrative code. No activities are planned within special management areas. Activities will be carried out to avoid unnecessary conflicts with other uses of the vicinity.

  COASTAL RESOURCE USE POLICIES

  Coastal Development – All activities shall be conducted in a manner that minimizes significant impacts to coastal resources. No adverse effects to Alabama's coastal area are expected in association with the proposed activities.

  Mineral Resource Exploration and Extraction – No conflicts with any other mineral resource exploration and extraction are expected.

  Commercial Fishing – All uses and activities shall be planned, sited, designed, constructed, operated and maintained to avoid to the maximum extent practicable adverse disruptions to fishery migratory patterns.

  Hazard Management- Effective emergency plans are in place, practiced and updated as necessary. The best practical techniques shall be utilized to prevent the release of pollutants or toxic substances into the environment.

  Shoreline Erosion - All uses and activities shall be planned, sited, designed, constructed operated and maintained to avoid to the maximum extent practicable adverse alteration of protective coastal features

Recreation – We have considered the general factors utilized by permitting authorities and have determined that the proposed activities shall cause no adverse impacts on areas of public use or concern and all uses and activities shall be planned, sited, designed, constructed operated and maintained to avoid to the maximum extent practicable adverse alteration of these areas. BOEM has regulations in place which explicitly prohibit the disposal of equipment, cables, chains, chains, containers or other materials which may pose an unreasonable risk to public health, property, aquatic life, wildlife, recreation, navigation, commercial fishing, or other uses of the ocean into offshore waters. Although marine debris gets lost from time to time, the impact on Gulf Coast recreational beaches is expected to be minimal. No impacts are expected to adversely affect Public access to tidal and submerged lands, navigable waters and beaches or other public recreational resources.

Transportation - Alabama's transportation resources are not expected to be impacted, as shore bases in Fourchon and Amelia, Louisiana will be utilized for the proposed operations. Also, boats will not travel through any sensitive coastal areas off of the coast of Alabama.

NATURAL RESOURCE PROTECTION POLICIES

Biological Productivity - All uses and activities shall be planned, sited, designed, constructed, operated and maintained to avoid to the maximum extent practicable adverse alteration of biologically valuable areas. All uses and activities shall be planned, sited, designed, constructed, operated and maintained to avoid to the maximum extent practicable reductions in long-term biological productivity of the coastal ecosystem. No impacts are expected to adversely affect the biological productivity of the area.

Water Quality - The proposed activities shall be carried out in conformance with applicable water quality laws, standards and regulations. All discharges shall be covered by an NPDES permit. There shall be no discharge of untreated produced water, drilling muds, or cuttings resulting from energy exploration and production activities to the coastal waters of Alabama. Produced waters that are discharged offshore are diluted and dispersed to very near background levels at a distance of 1,000 m and are undetectable at a distance of 3,000 m from the discharge point. The BOEM regulations, the USEPA's NPDES general permit and the USCG regulations implementing MARPOL 73/78 Annex V prohibit the disposal of any trash and debris into the marine environment.

Water Resources - All uses and activities shall be planned, sited, designed, constructed, operated and maintained to avoid to the maximum extent practicable detrimental discharges into coastal waters.

Air Quality - The proposed activities shall be carried out in conformance with applicable air quality laws, standards and regulations. Emissions from the proposed activities are not expected to have significant impacts on onshore air quality because of the prevailing atmospheric conditions, emission heights, emission rates and the distance of these emissions from the coastline.

Wetlands and Submerged Grass beds - All uses and activities shall be planned, sited, designed, constructed, operated and maintained to avoid to the maximum extent practicable reductions of natural circulation patterns within or into wetlands and submerged grass beds. Pipeline and navigation canals are considered the most significant impacting factors to wetlands and neither is proposed in the plan. Proposed activities are not expected to have any adverse impact on sea grass communities.

Beach and Dune Protection - Effective environmental protection plans are in place, practiced and updated as necessary. No significant impacts to the physical shape and structure of barrier beaches and associated dunes are expected to occur. In the unlikely event of a spill contacting a barrier beach, sand removal during cleanup would be minimized.

Wildlife Habitat Protection - We have considered the general factors utilized by permitting authorities and have determined that the proposed activities shall cause no adverse impacts on wildlife habitat areas. All uses and activities shall be planned, sited, designed, constructed, operated and maintained to avoid to the maximum extent practicable adverse alteration of wildlife habitats or coastal wildlife. Proposed activities are in OCS waters, so they are located away from critical wildlife and vegetation areas. Access routes from shore base operations shall pose no adverse impacts on these critical wildlife and vegetation areas.

Endangered Species

No impacts are expected to adversely affect wildlife and fishery habitat, especially the designated Critical Habitats of Endangered Species.

Beach mice – Potential impacts include oil spills, oil-spill response activities, consumption of beach trash and debris and coastal habitat degradation. No significant impacts to beach mice are expected to occur. Protective measures required under the Endangered Species Act should prevent any oil-spill response and cleanup activities from having significant impact to beach mice and their habitat.

Marine birds– Potential impact-producing factors for marine birds in the offshore environment include helicopter and service vessel traffic and noise, air emissions, degradation of water quality, habitat degradation and ingestion discarded trash and debris from service vessels and OCS structures. Adverse impacts to endangered coastal and marine birds are expected to be sublethal.

Sea turtles – Potential impact-producing factors from the proposed activities that may affect sea turtles include water quality degradation from operational discharges, noise from helicopter and vessel traffic and operating platforms, vessel collisions, brightly lit platforms and swallowing or getting tangled in OCS-related trash and debris. Routine activities are expected to be sublethal and unlikely to have significant adverse effects on the size and recovery of any sea turtle species or population in the Gulf of Mexico.

Sturgeon – Drilling mud discharges may contain chemicals toxic to sturgeon, at concentrations four or five orders of magnitude higher than concentrations found a few meters from the discharge point. These discharges dilute to background levels within 1000m of the discharge point. No impacts from the proposed activities are expected.

Cultural Resources Protection - All uses and activities shall be planned, sited, designed, constructed, operated and maintained to avoid to the maximum extent practicable adverse alteration of cultural resources. No impacts are expected to adversely affect historical, architectural, or archaeological sites. Should any historical, architectural, or archaeological resource be discovered in the course of conducting authorized activities, the Alabama Department of Environmental Management and the Alabama State Historical Officer shall be notified.

TEXAS

COASTAL ZONE MANAGEMENT
CONSISTENCY CERTIFICATION

Supplemental Development Operations Coordination Document
Type of Plan

OCS-G 30380 (RUE Pending), Mississippi Canyon Block 437 (Host Location)
OCS-G 19939, Mississippi Canyon Block 348
OCS-G 26252, Mississippi Canyon Block 391
OCS-G 26253, Mississippi Canyon Block 392
OCS-G 26254, Mississippi Canyon Block 393
Lease Number and Area/Blocks

The proposed activities described in detail in this Plan will comply with Texas' State and Local Coastal Resources Management Act of 1978, Coastal Resources Program, and Coastal Area Management Enforceable Policies.

SHELL OFFSHORE INC.
Operator

Tracy Albert
Certifying Official

8-20-2020
Date

Coastal Zone Management Consistency Information
For the State of Texas

In accordance with Subpart E of 15 CFR 903 "Consistency for Outer Continental Shelf (OCS) Exploration, Development and Production Activities" and as required by 15 CFR 930.58, Shell is hereby providing the following information in support of the Environmental Impact Analysis submitted as Section 18 of this plan.

15 CFR 930.58 identifies necessary data and information to be furnished to the State agency. The information is as follows:

(a) CONSISTENCY CERTIFICATION
A Coastal Zone Consistency Certification for activities that affect the State of Texas is provided in Section 17 of the DOCD.

OTHER INFORMATION

A detailed description of the proposed activities, coastal effects, and comprehensive information sufficient to support this Consistency Certification is presented in Section 17 of the DOCD. As per NTL 2008-G04, the following items have been identified as being required:

- A discussion of the method of disposal of wastes and discharges is provided in Section 7 of the DOCD.

- Oil Spill Information is provided in Section 9 of the DOCD. All operations are covered by Shell's Regional Oil Spill Response Plan. The Plan is available upon request.

(2) Following is an evaluation that includes findings relating the coastal effects of the proposed activities and associated facilities to the relevant enforceable policies of the Texas' Coastal Management Program (TCMP), Title 31, Part 16, Chapter 501, Subchapter B:

(Category 2)
Construction, Operation & Maintenance of Oil & Gas Exploration & Production Facilities

No operations are proposed in or near any critical areas. The proposed activities are of a development in nature, but no facility construction is proposed. The proposed activities are located over 150 miles from the Texas shoreline; therefore we expect no adverse impacts to CNRAs or beach access and use rights of the public. All activities shall be conducted in a manner that minimizes significant impacts to coastal resources. No adverse effects to Texas' coastal area are expected in association with the proposed activities.

(Category 3)
Discharges of Wastewater and Disposal of Waste from Oil and Gas Exploration and Production Activities

No discharge of wastewater or disposal of waste from the proposed activities will occur in the Texas' coastal zone, therefore no impact to Texas' coastal waters is expected.

(Category 4)
Construction and Operation of Solid Waste Treatment, Storage, and Disposal Facilities

No construction of solid waste facilities or expansion of existing facilities in the coastal zone are proposed in the attached plan, therefore, no adverse effects on any features of Texas' coastal cone are expected.

(Category 5)
Prevention, Response, and Remediation of Oil Spills

The proposed activities will be covered under an approved Regional Oil Spill Response Plan. The plan is in place, practiced, and updated as necessary. The best practical techniques shall be utilized to prevent the release of pollutants or toxic substances into the environment. All involved vessels and facilities are designed to be capable of prompt response and adequate removal of accidental discharges of oil. In addition, the proposed activities are over 150 miles from the Texas shore; therefore no damages to natural resources are expected as the result of an unauthorized discharge of oil into coastal waters.

(Category 6)
Discharge of Municipal and Industrial Waster Water to Coastal Waters

No discharges from the proposed activities will occur in coastal waters. The proposed activities are over 150 miles from shore, therefore there will be no effect on coastal waters.

(Category 8)
Development in Critical Areas

None of the proposed activities will occur in a critical area; therefore no effects to Texas' coastal zone are expected. The activity will not jeopardize the continued existence of species listed as endangered or threatened, and will not result in likelihood of the destruction or adverse modification of a habitat determined to be a critical habitat under the Endangered Species Act. The activity will not cause or contribute to violation of any applicable surface water quality standards. The activity will not violate any requirement imposed to protect a marine sanctuary.

(Category 9)
Construction of Waterfront Facilities and Other Structures on Submerged lands

No waterfront facilities or other structures are proposed on submerged lands in the Texas coastal zone, therefore the proposed activities are not expected to have any adverse impacts on submerged lands.

(Category 10)
Dredging and Dredged Material Disposal and Placement

No dredging or disposal/placement of dredged material is proposed, therefore no adverse effects to coastal waters, submerged lands, critical areas, coastal shore areas, or Gulf beaches are expected.

(Category 11)
Construction in the Beach / Dune System

The proposed activities do not include any construction projects in critical dune areas or areas adjacent to or on Gulf beaches, therefore, no impact to Texas' beach or dune systems are expected.

(Category 15)
Alteration of Coastal Historic Areas

The proposed activities do not include any alteration or disturbance of a coastal historic area; therefore, no impacts to are expected to adversely affect any historical, architectural, or archaeological site in Texas' coastal zone.

(Category 16)
Transportation

The proposed activities do not include any transportation construction projects within the coastal zone; therefore, no impacts to Texas' coastal zone are expected.

(Category 17)

Emission of Air Pollutants

The proposed activities shall be carried out in conformance with applicable air quality laws, standards, and regulations. Emissions from the proposed activities are not expected to have significant impacts on onshore air quality because of the prevailing atmospheric conditions, emission heights, emission rates, and the distance of these emissions from the coastline. The proposed activities will occur over 150 miles from shore and will be within the exemption limits set by BOEM, therefore, no impacts to Texas' coastal zone is expected.

(Category 18)

Appropriations of Water

The proposed activities do not include the impoundment or diversion of state water, therefore, no impacts to Texas' coastal zone is expected.

(Category 20)

Marine Fishery Management

The proposed activities are located approximately 63 miles from shore and are not expected to have any effect on marine fishery management or fishery migratory patterns within waters in the coastal zone of Texas.

(Category 22)

Administrative Policies

The necessary information for applicable agencies to make an informed decision on the proposed activities has been provided

In conclusion, all activities shall be consistent with Texas' coastal management program and shall comply with all relevant rules and regulations. No activities are planned within any critical areas. Activities will be carried out avoiding unnecessary conflicts with other uses of the vicinity.

Section 18 Environmental Impact Analysis

For a

Supplemental Development Operations and Control Document

Mississippi Canyon Block 437 OCS-G 30380 (RUE Pending - Host Location)
Mississippi Canyon Block 348 (OCS-G 19939)
Mississippi Canyon Block 391 (OCS-G 26252)
Mississippi Canyon Block 392 (OCS-G 26253)
Mississippi Canyon Block 393 (OCS-G 26254)
Offshore Louisiana

August 2020

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Acronyms and Abbreviations

ac	acre
ADIOS	Automated Data Inquiry for Oil Spills
AQR	Air Quality Emissions Report
bbl	barrel
BOEM	Bureau of Ocean Energy Management
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
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
µPa	micropascal
MARPOL	International Convention for the Prevention of Pollution from Ships
MC	Mississippi Canyon
MMC	Marine Mammal Commission
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
MODU	mobile offshore drilling unit
MWCC	Marine Well Containment Company
NAAQS	National Ambient Air Quality Standards
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
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	referenced to
SBM	synthetic-based mud
SEL_{cum}	cumulative sound exposure level
sEP	Supplemental Exploration Plan
Shell	Shell Offshore Inc.
SO_x	sulfur oxides
SPL_{rms}	root-mean-square sound pressure level
$SPL_{0\text{-}pk}$	zero to peak sound pressure level
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 drilling muds
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 Mississippi Canyon (MC) Blocks 391 (MC 391), 392 (MC 392) and 393 (MC 393) to install seafloor equipment (jumpers, flying leads, etc.), to produce, and to perform future well work at four production and two injection drill center facilities. Environmental impacts associated with drilling and completion of the wells at the drill center facilities were previously evaluated in Supplemental Exploration Plan (sEP) No. S-7761 (26 wells), issued 20 November 2015, or will be evaluated in sEP No. S-7996 (13 wells in MC 391, MC 392, and MC 393, approved by the Bureau of Ocean Energy Management (BOEM), and a future sEP (8 wells in MC 393). Seafloor equipment installation, production, and well work for wells in sEP No. S-7761 were included in the previously approved DOCD No. N-9969, issued 6 October 2017. This Environmental Impact Analysis (EIA) provides information regarding potential impacts on environmental resources that could be affected by Shell's proposed activities in the project area under this DOCD. Distances in the EIA are measured from the nearest portion of MC 393.

The project area is in the Central Planning Area, approximately 75 miles (121 km) from the nearest shoreline (Louisiana), 142 miles (238 km) from the onshore support base at Port Fourchon, Louisiana, and 181 miles (291 km) from the helicopter base in Houma, Louisiana. All distances are in statute miles. The water depth at the location of the proposed activities ranges from approximately 7,349 to 7,524 ft (2,240 to 2,293 m).

One of Several mobile offshore drilling units (MODUs), which will be a dynamically positioned (DP) drillship, will be used for the well work proposed in this project. Jumper installations activities for the proposed 13 new wells are expected to performed by installation vessels at approximately 30 days a year from 2020-2057.

Purpose of the Environmental Impact Analysis

The EIA was prepared pursuant to the requirements of the Outer Continental Shelf Lands Act (OCSLA), 43 United States Code §§ 1331-1356 as well as regulations including 30 Code of Federal Regulations (CFR) 550.212 and 550.227. The EIA is a project- and site-specific analysis of Shell's planned activities under this 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 impact-producing factors (IPFs), resources, and impacts associated with the proposed project activities. It identifies mitigation measures to be implemented in connection with the planned activities. Potential environmental impacts of a blowout scenario and worst-case discharge (WCD) are also analyzed.

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

The most recent multisale EISs update environmental baseline information in light of the Macondo (*Deepwater Horizon*) incident and address potential impacts of a catastrophic spill (BOEM, 2012a,b; 2013;

2014; 2015; 2016b; 2017a). Numerous technical studies have also been conducted to address the impacts of the incident. The findings of the post-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 and development 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 in its Final Programmatic EIS for the OCS Oil and Gas Leasing Program for 2017 to 2022 (BOEM, 2016a). Under the OCSLA, the U.S. Department of the Interior (USDOI) is responsible for the administration of mineral exploration and development of the OCS. Within the USDOI, BOEM and the Bureau of Safety and Environmental Enforcement (BSEE) are responsible for managing and regulating the development of OCS oil and gas resources in accordance with the provisions of the OCSLA. The BSEE offshore regulations are in 30 CFR Chapter II, Subchapter B. BOEM offshore regulations are in 30 CFR Chapter V, Subchapter B.

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

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

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

NTL	Title	Summary
BOEM-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.
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.

Table 1. (Continued).

NTL	Title	Summary
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 Outer Continental Shelf (OCS) for Worst Case Discharge (WCD) Blowout Scenarios	Provides guidance regarding information required in WCD descriptions and blowout scenarios.
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-2014-N01	Elimination of Expiration Dates on Certain Notices to Lessees and Operators Pending Review and Reissuance	Eliminates expiration dates (past or upcoming) of all NTLs currently posted on the Bureau of Safety and Environmental Enforcement website.
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.
2011-JOINT-G01	Revisions to the List of OCS Blocks Requiring Archaeological Resource Surveys and Reports	Provides new information on which OCS blocks require archaeological surveys and reports and line spacing required in each block. This NTL augments NTL 2005-G07.

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 or surface blowout preventers on floating facilities that applications for well permits must include a statement signed by an authorized company official stating that the operator will conduct all activities in compliance with all applicable regulations, including the increased safety measures regulations (75 *Federal Register* 63346). Informs operators that the Bureau of Ocean Energy Management will be evaluating whether each operator has submitted adequate information demonstrating that it has access to and can deploy containment resources to promptly respond to a blowout or other loss of well control.
2009-G40	Deepwater 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 (e.g., topographic features, pinnacles, low-relief live bottom areas, other potentially sensitive biological features) when conducting OCS operations in water depths less than 984 ft (300 m) in the Gulf of Mexico.
2009-N11	Air Quality Jurisdiction on the OCS	Clarifies jurisdiction for regulation of air quality in the Gulf of Mexico OCS.
2008-G04	Information Requirements for Exploration Plans and Development Operations Coordination Documents	Provides guidance on the information requirements for OCS plans, including EIA requirements and information regarding compliance with the provisions of the Endangered Species Act and the Marine Mammal Protection Act.
2005-G07	Archaeological Resource Surveys and Reports	Provides guidance on regulations regarding archaeological discoveries, specifies requirements for archaeological resource surveys and reports, and outlines options for protecting archaeological resources.

Oil Spill Prevention and Contingency Planning

Shell has an approved Gulf of Mexico Regional Oil Spill Response Plan (OSRP) as a fundamental component of the planned drilling program that certifies Shell's capability to respond to the maximum extent practicable to a WCD (30 CFR 254.2) (see DOCD Section 9). The OSRP demonstrates Shell's capability to rapidly and effectively manage oil spills that may result from drilling operations. Despite the extremely low likelihood of a large oil spill occurring during the project, Shell has designed its response program based on a regional capability of responding to a range of spill volumes that increase from small operational spills to a WCD from a well blowout. Shell's program is intended to meet the response planning requirements of the relevant coastal states and federal oil spill planning regulations. The OSRP includes information regarding Shell's regional oil spill organization, dedicated response assets, potential spill risks, and local environmental sensitivities. The OSRP presents specific information on the response program that includes a description of personnel and equipment mobilization, the incident management team organization, and the strategies and tactics used to implement effective and sustained spill containment and recovery operations.

EIA Organization

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

A. Impact-Producing Factors

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

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

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

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

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

Table 2 Footnotes and Applicability:

(1) *Activities that may affect a marine sanctuary or topographic feature. Specifically, if the well, platform site, or any anchors will be on the seafloor within the following:*

(a) *4-mile zone surrounding the Flower Garden Banks, or the 3-mile zone of Stetson Bank;*

(b) *1,000-m, 1-mile, or 3-mile zone of any topographic feature (submarine bank) protected by the Topographic Features Stipulation attached to an Outer Continental Shelf (OCS) lease;*

(c) *Essential Fish Habitat (EFH) criteria of 500 ft from any no-activity zone; or*

(d) *Proximity of any submarine bank (500-ft buffer zone) with relief greater than 2 m that is not protected by the Topographic Features Stipulation attached to an OCS lease.*

- None of these conditions (a through d) are applicable. The project area is not within the given range (buffer zone) of any marine sanctuary, topographic feature, or no-activity zone. There are no submarine banks in the project area.

(2) *Activities with any bottom disturbance within an OCS lease block protected through the Live Bottom (Pinnacle Trend) Stipulation attached to an OCS lease.*

- The Live Bottom (Pinnacle Trend) Stipulation is not applicable to the project area.

(3) *Activities within any Eastern Gulf OCS block and portions of Pensacola and Destin Dome area blocks in the Central Planning Area where seafloor habitats are protected by the Live Bottom (Low-Relief) Stipulation attached to an OCS lease.*

- The Live Bottom (Low-Relief) Stipulation is not applicable to the project area.

(4) *Activities on blocks designated by the Bureau of Ocean Energy Management (BOEM) as being in water depths 300 m or greater.*

- No impacts on high-density deepwater benthic communities are anticipated. A wellsite assessment found that no features indicative of high-density chemosynthetic communities or coral communities were identified within 2,000 ft (610 m) of the proposed well locations (Fugro Geoservices, Inc., 1996; 2009a; AOA Geophysics, Inc., 2004; Oceaneering 2018a,b).

(5) *Exploration or production activities where hydrogen sulfide (H_2S) concentrations greater than 500 parts per million might be encountered.*

- Mississippi Canyon Blocks 391, 392, and 393 are classified as H_2S “present” (10 to 40 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 Environmental Impact Analysis (EIA) can note that in a sentence or two.*

- Accidental hydrocarbon spills could affect the resources marked (X) in the matrix, and impacts are analyzed in **Section C**.

(7) *All activities that involve seafloor disturbances, including anchor emplacements, in any OCS block designated by the BOEM as having high-probability for the occurrence of shipwrecks or prehistoric sites, including such blocks that will be affected that are adjacent to the lease block in which 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. Mississippi Canyon Blocks 391, 392, and 393 are on BOEM’s list of archaeology survey blocks (BOEM, 2011). However, the locations of the proposed activities are well beyond the 197 ft (60 m) depth contour used by BOEM as the seaward extent for prehistoric archaeological site potential in the Gulf of Mexico. Dynamically positioned mobile offshore drilling units (MODUs) will be used; therefore, seafloor disturbances due to anchoring will not occur.

(8) *All activities that might have an adverse effect on endangered or threatened marine mammals or sea turtles or their critical habitats.*

- IPFs that may affect marine mammals or sea turtles include MODU presence and emissions, support vessel and helicopter traffic, and accidents. See **Section C**.

(9) *Production activities that involve transportation of produced fluids to shore using shuttle tankers or barges.*

- Not applicable.

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

The MODUs to be used for the wells will be either DP drillships or DP semisubmersible drilling rigs. The MODUs are expected to be on site for up to 320 days per year from 2020 to 2057 for the Appomattox Central/East MODU, up to 230 days per year from 2020 to 2057 for the Appomattox West MODU, and up to 230 days per year from 2020 to 2057 for the Vicksburg MODU. 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 MODUs include the physical presence of the MODU in the ocean, increased light from working and safety lighting on the vessel, and noise audible above and below the water surface.

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

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

MODUs can be expected to produce noise from station keeping, drilling, and maintenance operations. The noise levels produced by DP vessels largely depend on the level of thruster activity required to keep position and, therefore, vary based on environmental site conditions and operational requirements. Representative source levels for vessels in DP mode range from 184 to 190 decibels (dB) referenced to (re) one micropascal (μPa) m from the source, with a primary frequency below 600 hertz (Hz) (Blackwell and Greene Jr., 2003; McKenna et al., 2012; Kyhn et al., 2014). Drilling operations produce noise that includes strong tonal components at low frequencies (Minerals Management Service [MMS], 2000). When drilling, the drill string represents a long vertical sound source (McCauley, 1998). Sound associated with drilling activities have a maximum broadband (10 Hz to 10 kilohertz [kHz]) source level of approximately 190 dB re 1 μPa m (Hildebrand, 2005). Based on available data, source levels generated from MODUs 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 (Nedwell and Howell, 2004).

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

Well work, inclusive of some drilling activities, and installation of subsea equipment will be accomplished with a DP MODU; no vessel will use anchors. There will be minimal disturbance to the seafloor and soft bottom communities during positioning of the equipment. Physical disturbance of the seafloor will be limited to the proximal area where the wellbore penetrates the substrate, where mud and drill cuttings will be deposited, and where subsea equipment is placed on the substrate. Depending on the specific well configuration, the total disturbed area is estimated to be 0.62 acres (ac) (0.25 hectares [ha]) per well (BOEM, 2012a).

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 will not be buried by trenching, but will instead be placed on the seafloor, decreasing the area of impact (DOCD Section 6).

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 MODUs as well as service vessels and helicopters. These emissions occur mainly from combustion of diesel. Primary air pollutants typically associated with OCS activities are suspended particulate matter (PM), sulfur oxides (SO_x), nitrogen oxides (NO_x), volatile organic compounds (VOCs), and carbon monoxide (CO) (Reşitoğlu et al., 2015).

The project 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.

A.4 Effluent Discharges

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

Water-based drilling muds (WBM) and cuttings will be released at the seafloor during the initial well intervals before the marine riser is set, which allows their return to the surface vessel. Excess cement slurry and blowout preventer 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. 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 the MODUs and support vessels are expected to include treated sanitary and domestic wastes, deck drainage, non-contaminated well treatment and completion fluids, workover fluids, desalination unit discharge, blowout preventer fluid, ballast water, bilge water, cement slurry, fire water, hydrate inhibitor, subsea production control fluid, non-contact cooling water, and treated or untreated seawater. All discharges shall comply with the NPDES General Permit and/or USCG regulations, as applicable.

A.5 Water Intake

Seawater will be drawn from several meters below the ocean surface for various services, including firewater and once-through, non-contact cooling of machinery on the MODUs (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 impacts from impingement and entrainment of aquatic organisms. The NPDES General Permit No. GMG290103 specifies requirements for new facilities for which construction commenced after July 17, 2006, with cooling water intake structures having a design intake capacity of greater than 2 million gallons of water per day, of which at least 25% is used for cooling purposes.

The MODUs 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 shore for recycling, reconditioning, or deep well injection at Halliburton Drilling Fluids, MiSwaco, Newpark Drilling Fluids, Ecoserv, or R360 Environmental Solutions, in Port Fourchon, Louisiana. Exploration and production wastes and cuttings wetted with SBMs will be transported to shore for deep well injection or landfarm at Ecoserv or R360 Environmental Solutions, in Port Fourchon, Louisiana. Completion fluids will be transported to shore for recycling or deep well injection at Haliburton, Baker Hughes, Tetra, Superior, Ecoserv, or R360 Environmental Solutions in Port Fourchon, Louisiana. Salvage hydrocarbons will be transported to shore for recycling or deep well injection at PSC Industrial Outsourcing, Inc. in Jeanerette, Louisiana.

Recyclable trash and debris will be generated during the proposed project and will be recycled at Omega Waste Management in West Patterson, Louisiana; Lamp Environmental in Hammond, Louisiana; or at a similarly permitted facility. Non-recyclable trash and debris will be transported to the Republic/BFI landfill in Sorrento, Louisiana; the parish landfill in Avondale, Louisiana; or to a similarly permitted facility. Used oil and glycol will be transported to Omega Waste Management in West Patterson, Louisiana. Non-hazardous waste will be transported to the Republic/BFI landfill in Sorrento, Louisiana; Lamp Environmental in Hammond, Louisiana; or to a similarly permitted facility. Non-hazardous oilfield waste will be transported to Ecoserv in Port Arthur, Texas. Universal waste items such as batteries, lamps, glass, and mercury contaminated waste will be sent to Lamp Environmental Services in Hammond, Louisiana, for processing. Hazardous waste will be sent to Omega Waste Management in West Patterson, Louisiana; Lamp Environmental in Hammond, Louisiana; or to a similarly permitted facility. Wastes will be recycled or disposed according to applicable regulations at the respective onshore facilities.

A.7 Marine Debris

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

A.8 Support Vessel and Helicopter Traffic

Shell will use existing shore-based facilities at Port Fourchon, Louisiana, for onshore support of vessels and at 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 below.

A.8.1 Physical Presence

The supply base at Port Fourchon, Louisiana, is operated by Shell and located on Bayou Lafourche, approximately 3 miles (5 km) from the Gulf of Mexico. There will likely be at least one support vessel in the field at all times during drilling activities. NMFS (2020) has found that support vessel traffic has the potential to disturb protected species (e.g., marine mammals, sea turtles, fishes) and creates a risk of vessel strikes. The probability of a vessel strike depends on the number, size, and speed of vessels as well as the distribution, abundance, and behavior of the species (Conn and Silber, 2013; Hazel et al., 2007; Jensen and Silber, 2004; Laist et al., 2001; Vanderlaan and Taggart, 2007; NMFS, 2020). To reduce the potential for vessel strikes, BOEM issued NTL BOEM-2016-G01, which 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. 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, 2020).

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 sound pressure levels in water of 109 dB re 1 µPa from a Bell 212 helicopter flying at an altitude of 500 ft (152 m). Penetration of aircraft noise below the sea surface is greatest directly below the aircraft; at angles greater than 13 degrees from vertical, much of the sound is reflected from the sea surface and so does not penetrate into the water (Richardson et al., 1995). The duration of underwater sound from passing aircraft is much shorter in water than air. For example, a helicopter passing at an altitude of 500 ft (152 m) that is audible in air for 4 minutes may be detectable under water for only 38 seconds at 10 ft (3 m) depth and for 11 seconds at 59 ft (18 m) depth (Richardson et al., 1995). Additionally, the sound amplitude is greatest as the aircraft approaches or leaves a location.

A.9 Accidents

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

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

The lease sale EISs (BOEM, 2012a, 2015, 2016b, 2017a) discuss other types of accidents: loss of well control, pipeline failures, vessel collisions, chemical and drilling fluid spills, and H_2S release. These are briefly discussed in this section. No other site-specific issues have been identified for the EIA. The analyses in the lease sale EISs for these topics are 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 release of gas, condensate, oil, sand, or water, the loss of well control can also suspend and disperse bottom sediments (BOEM, 2012a, 2017a). BOEM (2016a) noted that most OCS blowouts have resulted in the release of gas; ABSG Consulting Inc. (2018) reported that most loss of well control event spills were <1,000 bbl.

Shell has a robust system in place to prevent loss of well control. Included in this 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, as well as the Final Drilling Safety Rule, which specify additional safety measures for OCS activities. See DOCD Sections 2j and 9b for further information.

Pipeline Failures. Pipeline failures can result from mass sediment movements and mudslides, impacts from anchor drops, and accidental excavation in the case that the exact location of a pipeline is uncertain (BOEM, 2012a, 2013, 2015). The project area has been evaluated through geologic and geohazard surveys and found to be geologically suitable for the proposed exploration drilling (Fugro Geoservices, Inc., 1996, 2009a; AOA Geophysics, Inc., 2004; Oceaneering 2018a,b).

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

Chemical Spills. Chemicals are stored and used for pipeline hydrostatic testing, during drilling, and in well completion operations. The relative quantities of their use is reflected in the largest volumes spilled (BOEM, 2017c). Completion, workover, and treatment fluids are the largest quantity used and comprise the largest releases. Between 2007 and 2014, an average of two chemical spills <50 bbl in volume and three chemical spills >50 bbl in volume occurred each year (BOEM, 2017a).

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

H_2S Release. MC 391, MC 392, and MC 393 are classified as H_2S present. Per 30 CFR 250.490, 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 opportunity for impacts to occur would be very brief.

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

The fate of a small diesel fuel spill was estimated using NOAA's Automated Data Inquiry for Oil Spills (ADIOS) 2 model (NOAA, 2016a). This model uses the physical properties of oils in its database to predict the rate of evaporation and dispersion over time as well as changes in the density, viscosity, and water content of the product spilled. It is estimated that more than 90% of a small diesel spill would evaporate or naturally disperse within 24 hours. Based on the results of the ADIOS 2 model, 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 project area is 75 miles (121 km) from the nearest shoreline (Louisiana). Slicks from fuel spills are expected to persist for relatively short periods of time ranging from minutes (<1 bbl) to hours (<10 bbl) to a few days (10 to 1,000 bbl) and rapidly spread out, evaporate, and disperse into the water column (BOEM, 2012a). Because of the distance from shore of these potential spills and their lack of persistence, it is unlikely that a small diesel spill would make landfall prior to dissipation (BOEM, 2012a).

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

A.9.2 Large Oil Spill

by Shell's well control and blowout prevention measures detailed in DOCD Section 2j. Most well control incidents do not result in oil spills (BOEM, 2016a). According to ABS Consulting Inc. (2016), the spill rate for spills >1,000 bbl is 0.22 spills per billion bbl.

Spill Size. Shell has calculated the WCD for this DOCD using the requirements prescribed by NTL 2015-N01. The calculated initial release volume is 416,414 bbl of oil during the first day, and the calculated 30-day average WCD rate is 391,808 bbl of oil per day. The total potential spill volume along with a 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 incorporated in the WCD calculation, include, but are not limited to, obstructions or equipment in the wellbore, well bridging, and early intervention such as containment.

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

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

The results for Launch Area 57 (the launch area where MC 391, MC 392, and MC 393are located) are presented in **Table 3**. The 30-day OSRA model predicts a 4% chance of shoreline contact within 3 days of a spill (Plaquemines Parish, Louisiana), a 1% to 14% chance of shoreline contact within 10 days of a spill (Terrebonne, Lafourche, Plaquemines, St. Bernard parishes, Louisiana), and a 1% to 21% chance of shoreline contact within 30 days of a spill from Cameron Parish, Louisiana to Bay County, Florida. Counties whose conditional probability for shoreline contact is <0.5% for 3, 10, and 30 days are not shown in **Table 3**.

Table 3. Conditional probabilities of a spill in the project area (MC 391, MC 392, and MC 393) 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 57) 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
C13	Cameron, LA	--	--	1
C14	Vermilion, LA	--	--	1
C17	Terrebonne, LA	--	1	2
C18	Lafourche, LA	--	1	2
C20	Plaquemines, LA	4	14	21
C21	St. Bernard, LA	--	1	3
C22	Hancock and Harrison, MS	--	--	1
C23	Jackson, MS	--	--	1
C24	Mobile, AL	--	--	1
C25	Baldwin, AL	--	--	1
C26	Escambia, FL	--	--	1
C28	Okaloosa, FL	--	--	1
C29	Walton, FL	--	--	1
C30	Bay, FL	--	--	1

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

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

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

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

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

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

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

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

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

B. Affected Environment

The project area is in the Central Planning Area, approximately 75 miles (121 km) from the nearest shoreline (Louisiana), 142 miles (238 km) from the onshore support base at Port Fourchon, Louisiana, and 181 miles (291 km) from the helicopter base in Houma. Estimated water depth at the location of the proposed activities is approximately 7,406 ft (2,257 m).

The wellsites shallow hazards and archaeological assessments did not identify any seafloor anomalies within 2,000 ft (610 m) of the proposed project area that would indicate the potential for chemosynthetic or high-density deepwater benthic communities, or archaeologically significant sonar contacts (Fugro Geoservices, Inc., 1996; 2007, 2009a,b,c; AOA Geophysics, Inc., 2004; Oceaneering 2018a,b). There are no water bottom anomalies within 2,000 ft (610 m) of proposed wellsites as defined by BOEM (2019).

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

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

C. Impact Analysis

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

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

C.1 Physical/Chemical Environment

C.1.1 Air Quality

Due to the distance from shore-based pollution sources (approximately 75 miles [121 km] from the nearest shoreline, offshore air quality is expected to be good. The attainment status of federal OCS waters is unclassified because there is no provision in the Clean Air Act for classification of areas outside state waters (BOEM, 2012a).

In general, ambient air quality on coastal counties along the Gulf of Mexico is relatively good (BOEM, 2012a). As of June 2020, Mississippi, Alabama, and Florida Panhandle coastal counties are in attainment of the National Ambient Air Quality Standards (NAAQS) for all criteria pollutants (U.S. Environmental Protection Agency, 2020). St. Bernard Parish in Louisiana and Hillsborough County in Florida are nonattainment areas for sulfur dioxide based on the 2010 standard. One coastal metropolitan area in Texas (Houston-Galveston-Brazoria) is a nonattainment area for 8-hour ozone (2015 Standard). One coastal metropolitan area in Florida (Tampa) was reclassified in 2018 from a nonattainment area to maintenance status for lead based on the 2008 Standard (U.S. Environmental Protection Agency, 2020).

Winds in the region are driven by the anticyclonic (clockwise) atmospheric circulation around the Bermuda High, a semi-permanent, subtropical area of high pressure in the North Atlantic Ocean off the East Coast of North America that migrates east and west with varying central pressure (BOEM, 2017a). The Gulf of Mexico is located to the southwest of this center of circulation, resulting in a prevailing southeasterly to southerly flow, which is conducive to transporting emissions toward shore. However, circulation is also affected by tropical cyclones (hurricanes) during summer and fall and by extratropical cyclones (cold fronts) during winter.

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

Impacts of Air Pollutant Emissions

Air pollutant emissions are the only routine IPF anticipated to affect air quality. These emissions occur mainly from combustion of diesel and aviation fuel, also known as Jet-A. Primary air pollutants typically associated with the burning of these fuels are suspended particulate matter, sulfur oxides, NO_x, volatile organic compounds, and CO (Reşitoğlu et al., 2015).

Due to the distance from shore, most routine operations in the project area are not expected to impact air quality along the coast. As noted by BOEM (2012a, 2013; 2014; 2015; 2016b; 2017b), emissions of air pollutants from routine activities in the project area are projected to have minimal impacts on onshore air quality because of the prevailing atmospheric conditions, emission heights, emission rates, and the distance of these emissions from the coastline. However, support vessel and helicopter traffic entering or departing coastal facilities will release air pollutants in these areas during the project period.

MC 391, MC 392, and MC 393 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 AQR (see DOCD Section 8) prepared in accordance with BOEM requirements shows that the projected emissions from sources associated with the proposed activities meet BOEM's exemption criteria. Therefore, this 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. BOEM coordinates with the USFWS if emissions from proposed OCS projects may affect the Breton Class I area. The project area is approximately 91 miles (146 km) from the Breton Wilderness Area. Shell will comply with emissions requirements as directed by BOEM. 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 234 miles (377 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 all extant OCS oil and gas sources are 0.4% of the U.S. total. Greenhouse gas emissions from the proposed project represent a negligible contribution to the total greenhouse gas emissions from reasonably foreseeable activities in the Gulf of Mexico area and would not significantly alter any of the climate change impacts evaluated in the Programmatic EIS (BOEM, 2016a).

Impacts of a Small Fuel Spill

Potential impacts of a small spill on air quality are expected to be consistent with those analyzed and discussed by BOEM (2012a, 2015, 2016b, 2017a). **Section A.9.1** discusses the size and fate of a potential small diesel fuel spill as a result of Shell's proposed activities. DOCD Section 9b provides detail on spill response measures.

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

Because of the offshore location of the proposed small fuel spill, coastal air quality would not be affected because the spill would be expected to dissipate prior to making landfall or reaching coastal waters (see **Section A.9.1**).

Impacts of a Large Oil Spill

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

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

Due to the project area location, most air quality impacts associated with oil on the sea surface would occur in offshore waters. However, depending on the spill trajectory and the effectiveness of spill response measures, coastal air quality could be affected if oil on the sea surface approaches or contacts the coast. Based on the 30-day OSRA modeling (**Table 3**), Plaquemines Parish, Louisiana is the coastal area most likely to be affected (4% probability within 3 days, 14% within 10 days, and 21% probability within 30 days). Other Louisiana shorelines may be affected within 10 days (Terrebonne, St. Bernard, and Lafourche parishes), and shorelines in Louisiana, Alabama, Mississippi, and Florida could be affected within 30 days (1% to 21% conditional probability).

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

C.1.2 Water Quality

There are no site-specific baseline water quality data for the project area. Due to the lease location in deep, offshore waters, water quality is expected to be good, with low levels of contaminants. As noted by BOEM (2017a), deepwater areas in the northern Gulf of Mexico are relatively similar with respect to patterns of water column 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 (a small fuel spill and a large oil spill).

Impacts of Effluent Discharges

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

WBM and cuttings will be released at the seafloor during the initial well intervals before the marine riser is set, which allows their return to the surface vessel. Excess cement slurry and blowout preventer fluid will also be released at the seafloor. The seafloor discharges of WBM and associated drill cuttings will result in seafloor disturbances that will produce locally turbid conditions in the water column near the seafloor. The turbidity plume will be carried away from the well by near-bottom currents and, based on current speed(s), may be detectable within tens to hundreds of meters of the wellbore. As suspended WBM and 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). Recent EISs have 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 at the sea surface by the MODUs 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 MODUs will flow overboard without treatment. However, rainwater that falls on the MODU deck and other areas that may be contaminated with chemicals, such as chemical storage areas or places where equipment is exposed (such as drop or containment pans), 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 MODUs and support vessels are expected to include treated sanitary and domestic wastes, deck drainage, non-contaminated well treatment and completion fluids, workover fluids, desalination unit discharge, blowout preventer fluid, ballast water, bilge water, cement slurry, fire water, hydrate inhibitor, subsea production control fluid, non-contact cooling water, and treated or untreated seawater. All discharges shall comply with the NPDES General Permit and/or USCG regulations, as applicable, and therefore are not expected to cause significant impacts on offshore 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). In the EIA, the small spill scenario is proposed to occur in offshore waters at or near the MODUs. **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 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 a biological weathering processes (e.g., evaporation, dissolution, dispersion, photochemical oxidation) and biological processes (microbial degradation). Diesel oil is much lighter than water (specific gravity is between 0.83 and 0.88, compared to 1.03 for seawater). When spilled on water, diesel oil spreads very quickly to a thin film of rainbow and silver sheens, except for marine diesel, which may form a thicker film of dull or dark colors. However, because diesel oil has a very low viscosity, it is readily dispersed into the water column when winds reach 5 to 7 knots or with breaking waves (NOAA, 2019). It is possible for diesel oil that is dispersed by wave action to form droplets that are small enough be kept in suspension and moved by the currents.

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

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

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

Impacts of a Large Oil Spill

Potential impacts of a large oil spill on water quality are expected to be consistent with those analyzed and discussed by BOEM (2012a, 2015, 2016b, 2017a). **Section A.9.2** discusses the size and fate of a potential large oil spill as a result of Shell's proposed activities. A large spill would likely affect water quality by producing a slick on the water surface and increasing the concentrations of petroleum hydrocarbons and their degradation products. The extent and persistence of impacts would depend on the meteorological and oceanographic conditions at the time of the spill as well as the effectiveness of the spill response measures. Most of the spilled oil would be expected to form a slick at the surface, although observations following the *Deepwater Horizon* incident indicate that plumes of submerged oil droplets can be produced when subsea dispersants are applied at the wellhead (Camilli et al., 2010; Hazen et al., 2010; NOAA, 2011a,b,c). Recent analyses of the entire set of samples associated with the *Deepwater Horizon* incident have confirmed that the application of subsurface dispersants resulted in subsurface hydrocarbon plumes (Spier et al., 2013). A report by Kujawinski et al. (2011) indicates that chemical components of subsea dispersants used during the *Deepwater Horizon* incident persisted for up to 2 months and were detectable up to 186 miles (300 km) from the wellsite at water depths of 3,280 to 3,937 ft (1,000 to 1,200 m). Dispersants were detectable in <9% of the samples (i.e., 353 of the 4,114 total water samples), and concentrations in the samples were significantly below the chronic screening level for dispersants (BOEM, 2012b).

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

A large oil spill could result in a release of gaseous hydrocarbons that could affect water quality. During the *Deepwater Horizon* incident, large volumes of 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's location, most water quality impacts would occur in offshore waters. Depending on the spill trajectory and the effectiveness of spill response measures, coastal water quality could be affected. Based on the 30-day OSRA modeling (**Table 3**), Plaquemines Parish, Louisiana is the coastal area most likely to be affected (4% probability within 3 days, 14% within 10 days, and 21% probability within 30 days). Other Louisiana shorelines may be affected within 10 days (Terrebonne, St. Bernard, and Lafourche Parishes), and shorelines in Louisiana, Alabama, Mississippi, and Florida could be affected within 30 days (1% to 21% conditional probability).

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures detailed in DOCD Section 2j. In the event of a large spill, water quality could be temporarily affected, but no long-term significant impacts are expected. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce any resultant impacts. DOCD Section 9b provides detail on spill response measures.

C.2 Seafloor Habitats and Biota

The water depth at the location of the proposed activities ranges from approximately 7,349 to 7,524 ft (2,240 to 2,293 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 in the project area is composed primarily of soft (unconsolidated) sediments; exposed hard substrate habitats and associated biological communities are rare. No features or areas that could support significant, high-density benthic communities were found within 2,000 ft (610 m) of the proposed wellsites (Fugro Geoservices, Inc., 1996, 2009a; AOA Geophysics, Inc., 2004; Oceaneering 2018a,b). There are no water bottom anomalies within 2,000 ft (610 m) of proposed wellsites as defined by BOEM (BOEM, 2019; Fugro Geoservices, Inc., 1996, 2009a; AOA Geophysics, Inc., 2004; Oceaneering 2018a,b).

C.2.1 Soft Bottom Benthic Communities

There are no site-specific benthic community data from the project area. However, data from various gulf-wide studies have been conducted to regionally characterize the continental slope habitats and benthic ecology (Wei, 2006; Rowe and Kennicutt, 2009; Wei et al., 2010; Carvalho et al., 2013), which can be used to describe typical baseline benthic communities that could be present in vicinity of the proposed wellsites. **Table 4** summarizes data from two stations in the vicinity of the proposed wells. Sediments at these two stations were similar, predominantly clay (57% at Station S37 and 51% at Station S36) and silt (35% at Station S37 and 41% at Station S36), respectively (Rowe and Kennicutt, 2009).

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

Station	Location Relative to Project Area	Water Depth (m)	Density		
			Meiofauna (individuals m^{-2})	Macroinfauna (individuals m^{-2})	Megafauna (individuals ha^{-1})
S37	15 miles	2,382	291,179	2,192	1451
S36	28 miles	1,839	799,963	4,481	359

ha=hectare.

Densities of meiofauna (animals that pass through a 0.5-millimeter sieve but are retained on a 0.062-millimeter sieve) in sediments collected at water depths representative of the project area were approximately between 291,000 to 800,000 individuals m^{-2} (Rowe and Kennicutt, 2009). Nematodes, nauplii, and harpacticoid copepods were the three dominant groups in the meiofauna, accounting for approximately 90% of total abundance.

The benthic macroinfauna is characterized by small mean individual sizes and low densities, both of which reflect the intrinsically low primary production in surface waters of the Gulf of Mexico continental slope (Wei, 2006). Densities decrease exponentially with water depth (Carvalho et al., 2013). Based on an equation presented by Wei (2006), the macroinfaunal densities in the water depths of the proposed activities are estimated to be approximately 1,277 individuals m^{-2}; however, actual densities at the proposed wellsites are unknown and often highly variable.

Polychaetes are typically the most abundant macroinfaunal group on the northern Gulf of Mexico continental slope, followed by amphipods, tanaids, bivalves, and isopods (Rowe and Kennicutt, 2009). Carvalho et al. (2013) found polychaete abundance to be higher in the central region of the northern Gulf of Mexico when compared to the eastern and western regions. Wei (2006) recognized four depth-dependent faunal zones (1 through 4), two of which (Zones 2 and 3) are divided horizontally. The project area is located near the border of Zones 2E and 3E. Zone 2E, 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* spp. Zone 3E is a broad zone that encompasses the west flank of the lower Mississippi Fan, the lower Mississippi Canyon, the lower DeSoto Canyon, the lower West Florida Terrace, the deep Mississippi Fan, and the base of the Sigsbee Escarpment. The most abundant species in this zone were the polychaetes *Paraonella monilaris* and *Tharyx marioni*; the bivalves *Heterodonta* spp.; and the isopod *Macrostylis* spp. (Wei, 2006; Wei et al., 2010).

Megafaunal density at stations in the vicinity of the proposed activities are approximately 359 to 1,451 individuals ha^{-1} (**Table 4**). Common megafauna included motile taxa such as decapod crustaceans, holothurian echinoderms, and demersal fishes as well as sessile taxa such as sponges and octocorals (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). In deep-sea sediments, Main et al. (2015) observed that microbial oxygen consumption rates increased and bacterial biomass decreased with hydrocarbon contamination. Bacterial biomass at the depth range of the project area typically is approximately 1 to 2 g C m^{-2} in the top 6 inches (15 cm) of sediments (Rowe and Kennicutt, 2009).

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

Impacts of Physical Disturbance to the Seafloor

In water depths such as those that are encountered in the project area, DP MODUs disturb the seafloor only around the wellbore (seafloor surface hole location) where the bottom template and blowout preventer are located. Depending upon the specific well configuration, this area is generally about 0.62 ac (0.25 ha) per well (BOEM, 2012a). Additional seafloor disturbance will occur where the new seafloor infrastructure (e.g., manifolds, umbilicals, flowlines) is installed. Infrastructure will be installed using a DP MODU and seafloor disturbance is only expected in the immediate vicinity of the equipment installation.

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

Impacts of Effluent Discharges

Drilling mud and cuttings are the only effluents that could be present in vicinity of the additional wellsites that are likely to affect local soft bottom benthic communities. During initial well drilling 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). Small amounts of water-based blowout preventer fluid will also be released at the seafloor but 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, and blowout preventer fluid will eventually be recolonized through larval settlement and migration from adjacent areas. Some localized habitat covered with cement slurry may become unavailable to recolonization until the cement is buried with sediment. Because the sedimentation rate in many areas of the deep sea is slow, and some deep-sea biota grow and reproduce slowly, recovery of these local benthic communities may require several years.

Discharges of treated SBM-associated cuttings from the MODUs may affect benthic communities, primarily within several hundred meters of the wellsites. The fate and effects of SBM cuttings have been reviewed by Neff et al. (2000), and monitoring studies have been conducted in the Gulf of Mexico by Continental Shelf Associates (2004, 2006). In general, cuttings with adhering SBM tend to clump together and form thick cuttings piles close to the drillsites. SBM cuttings deposition may elevate local organic carbon concentrations and generate anoxic conditions during biodegradation of the SBF by sulfate-reducing bacteria (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 community structure may change during and subsequent to biodegradation of SBM in sediments. Infaunal numbers may increase and diversity may decrease as opportunistic species that tolerate low oxygen and high H_2S predominate (as a by-product of anaerobic bacterial biodegradation) (Continental Shelf Associates, 2006). As the base synthetic fluid 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 regional benthic community are expected to be consistent with those analyzed and discussed by BOEM (2012a, 2015, 2016b, 2017a). Impacts from a subsea blowout could include smothering and exposure to toxic hydrocarbons from oiled sediment settling to the seafloor. The most likely effects of a subsea blowout on benthic communities would be within a few hundred meters of the wellsites. BOEM (2012a) estimated that a severe subsurface blowout could suspend and disperse sediments within a 984 ft (300 m) radius. Although any coarse sediments (sands) would probably settle at a rapid rate within 1,312 ft (400 m) from the blowout site, fine sediments (silts and clays) could be suspended for more than 30 days and dispersed over a much wider area. A previous study characterized surface sediments at the sampling stations in the vicinity of the proposed wellsites. Sediments at these two stations were similar, predominantly clay (57% at Station S37 and 51% at Station S36) and silt (35% at Station S37 and 41% at Station S36), respectively (Rowe and Kennicutt, 2009).

Previous analyses by BOEM (2016b, 2017a) concluded that oil spills would be unlikely to affect benthic communities beyond the immediate vicinity of the wellhead (i.e., due to physical impacts of a blowout) because the oil would rise quickly to the sea surface directly over the spill location. During the *Deepwater Horizon* incident, the use of subsea dispersants at the wellhead caused the formation of subsurface plumes (NOAA, 2011b). While the behavior and impacts of subsurface plumes are not well known, a subsurface plume could contact the seafloor and affect benthic communities beyond the 984 ft (300 m) radius (BOEM, 2012a), depending on its extent, trajectory, and persistence (Spier et al., 2013). This contact could result in smothering and/or toxicity to benthic organisms. The subsurface plumes observed following the *Deepwater Horizon* incident were reported in water depths of approximately 3,600 ft (1,100 m), extending at least 22 miles (35 km) from the wellsite and persisting for more than a month (Camilli et al., 2010). The subsurface plumes apparently resulted from the use of subsea dispersants at the wellhead (NOAA, 2011b; Spier et al., 2013). Montagna et al. (2013) estimated that the most severe impacts to soft bottom benthic communities (e.g., reduction of faunal abundance and diversity) from the *Deepwater Horizon* incident extended 2 miles (3 km) from the wellhead in all directions, covering an area of approximately 9 $miles^2$ (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. 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.

C.2.2 High-Density Deepwater Benthic Communities

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

Monitoring programs on the Gulf of Mexico continental slope have shown that benthic impacts from drilling discharges typically are concentrated within approximately 1,640 ft (500 m) of the wellsite, although detectable deposits may extend beyond this distance (Continental Shelf Associates, 2004, 2006; Neff et al., 2005). The nearest known high-density deepwater benthic communities are found in Viosca Knoll Block 826, approximately 38 miles (61 km) from the project area (BOEM, nd).

In water depths such as those encountered in the project area, the DP MODUs will disturb the seafloor only in the immediate vicinity of the drill sites and areas of seafloor infrastructure installation (Section A.2). Based on the site clearance letters, no features or areas that could support significant, high-density benthic communities were found within 2,000 ft (610 m) of the proposed wellsites (Fugro Geoservices, Inc., 1996, 2009a; AOA Geophysics, Inc., 2004; Oceaneering 2018a,b). There are no water bottom anomalies within 2,000 ft (610 m) of proposed wellsites as defined by BOEM (BOEM, 2019) (Fugro Geoservices, Inc., 1996, 2009a; AOA Geophysics, Inc., 2004; Oceaneering 2018a,b). As a result, high-density deepwater benthic communities are not expected to be present.

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

Impacts of a Large Oil Spill

The wellsites assessment did not identify high-density deepwater benthic communities within 2,000 ft (610 m) of the proposed wellsites (Fugro Geoservices, Inc., 1996, 2009a; AOA Geophysics, Inc., 2004; Oceaneering 2018a,b).

BOEM (2012a, 2015, 2016c, 2017a) concluded that oil spills would be unlikely to affect benthic communities beyond the immediate vicinity of the wellhead (i.e., due to physical impacts of a blowout) because the oil would rise quickly to the sea surface directly over the spill location. However, subsea oil plumes resulting from a seafloor blowout could affect sensitive deepwater communities (BOEM, 2016b). During the *Deepwater Horizon* incident, subsurface plumes were reported at a water depth of approximately 3,600 ft (1,100 m), extending at least 22 miles (35 km) from the wellsite and persisting for more than a month (Camilli et al., 2010). The subsurface plumes apparently resulted from the use of subsea dispersants at the wellhead (NOAA, 2011c). Chemical components of subsea dispersants used during the *Deepwater Horizon* incident persisted for up to 2 months and were detectable up to 186 miles (300 km) from the wellsite at a water depths of 3,280 to 3,937 ft (1,000 to 1,200 m) (Kujawinski et al., 2011). However, estimated dispersant concentrations in the subsea plume were below levels known to be toxic to marine life. While the behavior and impacts of subsurface plumes are not well known, a subsurface plume could have the potential to contact high-density deepwater benthic communities beyond the 984 ft (300 m) radius estimated by (BOEM, 2016a), depending on its extent, trajectory, and persistence (Spier et al., 2013). Potential impacts on sensitive resources would be an integral part of the decision and approval processes for the use of dispersants.

Potential impacts of oil on high-density deepwater benthic communities are discussed by BOEM (2012a, 2015, 2016c, 2017a). Oil plumes that directly contact localized patches of sensitive benthic communities before degrading could potentially impact the resource. However, the potential impacts would be localized due to the directional movement of oil plumes by the water currents and because the sensitive habitats have a scattered, patchy distribution. The more likely result would be exposure to widely dispersed, biodegraded particles that “rain” down from a passing oil plume.

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 (authigenic carbonate and changes in unconsolidated sediment characteristics) and biodiversity, and reduction or loss of one or more commercial and recreational fishery habitats.

Lethal and sublethal effects are possible for deepwater coral communities that receive a lower level of oil impact. Effects to deepwater coral communities could be temporary (e.g., lack of feeding, loss of tissue mass) or long-lasting and affect the resilience of coral colonies to natural disturbances (e.g., elevated water temperature, diseases) (BOEM, 2012a, 2015, 2016b, 2017a). The potential for a spill to affect deepwater corals was observed during an October 2010 survey of deepwater coral habitats in water depths of 4,600 ft (1,400 m) approximately 7 miles (11 km) southwest of the Macondo wellhead. Much of the octocoral fauna observed in a location measuring approximately 50 ft × 130 ft (15 m × 40 m) was covered by a brown flocculent material (Bureau of Ocean Energy Management, Regulation, and Enforcement, 2010) with signs of stress, including varying degrees of tissue loss and excess mucous production (White et al., 2012). Hopanoid petroleum biomarker analysis of the flocculent material indicated that it contained oil from the *Deepwater Horizon* incident. The injured and dead corals were in an area in which a subsea plume of oil had been documented during the spill in June 2010. The deepwater coral at this location showed signs of tissue damage that was not observed elsewhere during these surveys or in previous deepwater coral studies in the Gulf of Mexico. The team of researchers concluded that the observed coral injuries likely resulted from exposure to the subsurface oil plume (White et al., 2012). Apparent recovery of some affected areas by March2012 correlated negatively with the proportion of the coral covered with floc in late 2010 (Hsing et al., 2013). Fisher et al. (2014b) reported two additional coral areas affected by the *Deepwater Horizon* incident; one 4 miles (6 km) south of the Macondo wellsite, and the other 14 miles (22 km) to the southeast. Prouty et al. (2016) found evidence that corals located northeast of the *Deepwater Horizon* incident were also affected. In addition to direct impacts on corals and other sessile epifauna, the spill also affected macroinfauna associated with these hard bottom communities (Fisher et al., 2014a).

Although no known deepwater coral communities near the project area 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. Overall, while patches of habitat may be affected, the Gulf-wide ecosystem of high-density deepwater benthic communities would be expected to suffer no significant effects (BOEM, 2016b).

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 approximately 92 miles (148 km) from the project area. There are no IPFs associated with either routine operations or accidents that could cause impacts to designated topographic features due to their distance from the project area.

C.2.4 Pinnacle Trend Area Live Bottoms

The project area is not covered by the Live Bottom (Pinnacle Trend) Stipulation. As defined in NTL 2009-G39, the nearest pinnacle trend block is Viosca Knoll Block 778, approximately 40 miles (64 km) from the project area. There are no IPFs associated with either routine operations or accidents that could cause impacts to pinnacle trend area live bottoms due to the distance from the project area.

C.2.5 Eastern Gulf Live Bottoms

The project area is not covered by the Live Bottom (Low-Relief) Stipulation, which pertains to seagrass communities and low-relief hard bottom reef within the Gulf of Mexico Eastern Planning Area blocks in water depths of 328 ft (100 m) or less and portions of Pensacola and Destin Dome Area Blocks in the Central Planning Area. The nearest block covered by the Live Bottom Stipulation, as defined in NTL 2009-G39, is Destin Dome Block 573, located approximately 52 miles (84 km) northeast from the project area. There are no IPFs associated with either routine operations or accidents that could cause impacts to eastern Gulf of Mexico live bottom areas due to the distance from the project area.

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

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

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

Table 5. Federally listed Endangered and Threatened species potentially present in the project area and along the northern Gulf Coast.

Species	Scientific Name	Status	Potential Presence		Critical Habitat Designated in Gulf of Mexico
			Project Area	Coastal	
Marine Mammals					
Bryde's whale	*Balaenoptera edeni*[1]	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*	TE[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

Table 5. (Continued).

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

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

[1] Distinct (unnamed) Gulf of Mexico subspecies

[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 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*), Whooping Crane (*Grus americana*), Gulf sturgeon (*Acipenser oxyrinchus desotoi*), smalltooth sawfish (*Pristis pectinata*), four subspecies of beach mouse, and the Florida salt marsh vole (*Microtus pennsylvanicus dukecampbelli*). Critical habitat has been designated for all of these species except the Florida salt marsh vole as indicated in **Table 5** and discussed in individual sections. Two other coastal bird species (Bald Eagle [*Haliaeetus leucocephalus*] and Brown Pelican [*Pelecanus occidentalis*]) are no longer federally listed as Endangered or Threatened; these are discussed in **Section C.4.2**.

Five sea turtle species, the sperm whale (*Physeter macrocephalus*), and the oceanic whitetip shark (*Carcharhinus longimanus*) are the only Endangered or Threatened species likely to occur within the project area. The listed sea turtles include the leatherback turtle (*Dermochelys coriacea*), Kemp's ridley turtle (*Lepidochelys kempii*), hawksbill turtle (*Eretmochelys imbricata*), loggerhead turtle (*Caretta caretta*), and green turtle (*Chelonia mydas*) (Pritchard, 1997). Effective August 11, 2014, NMFS has designated certain marine areas as critical habitat for the northwest Atlantic distinct population segment (DPS) of the loggerhead sea turtle (**Section C.3.5**). No critical habitat has been designated in the Gulf of Mexico for the leatherback turtle, Kemp's ridley turtle, hawksbill turtle, or the green turtle. Listed marine mammal species include one odontocete whale (sperm whale) which is known to occur in the Gulf of Mexico (Würsig et al., 2000); no critical habitat has been designated for the sperm whale. The Bryde's whale (*Balaenoptera edeni*) exists in the Gulf of Mexico as a small, resident population. It is the only baleen whale known to be resident to the Gulf. The genetically distinct Northern Gulf of Mexico stock is severely restricted in range, being found almost exclusively in its core distribution area within the northeastern Gulf in the waters of the DeSoto Canyon (Waring et al., 2016) and is therefore not likely to occur within the project area. The giant manta ray (*Mobula birostris*) could occur in the project area but is most commonly observed in the Gulf of Mexico at the Flower Garden Banks. The Nassau grouper (*Epinephelus striatus*) has been observed in the Gulf of Mexico at the Flower Garden Banks but is most commonly observed in shallow tropical reefs of the Caribbean and is not expected to occur in the project area.

Five Endangered mysticete whales (blue whale [*Balaenoptera musculus*], fin whale [*Balaenoptera physalus*], humpback whale [*Megaptera novaeangliae*], 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., 2019) 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*). These corals are shallow water, zooxanthellate species (containing symbiotic photosynthetic zooxanthellae which contribute to their nutritional needs) and so are not present in the deepwater project area (see **Section C.3.15**).

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

C.3.1 Sperm Whale (Endangered)

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

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

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

The distribution of sperm whales in the Gulf of Mexico is correlated with mesoscale physical features such as eddies associated with the Loop Current (Jochens et al., 2008). Sperm whale populations in the north-central Gulf of Mexico are present there throughout the year (Davis et al., 2000). Results of a multi-year tracking study show female sperm whales typically concentrated along the upper continental slope between the 656- and 3,280-foot (200- and 1,000-meter) depth contours (Jochens et al., 2008). Male sperm whales were more variable in their movements and were documented in water depths greater than 9,843 ft (3,000 m). Generally, groups of sperm whales sighted in the Gulf of Mexico during the MMS-funded Sperm Whale Seismic Study consisted of mixed-sex groups comprising adult females and juveniles, and groups of bachelor males. Typical group size for mixed groups was 10 individuals (Jochens et al., 2008). A review of sighting reports from seismic mitigation surveys in the Gulf of Mexico conducted over a 6-year period found a mean group size for sperm whales of 2.5 individuals (Barkaszi et al., 2012).

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

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

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

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

Some sounds produced by the MODUs 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 and installation activities is relatively weak in intensity, and an individual animal's noise exposure would be transient. As discussed in **Section A.1**, sounds generated by an actively drilling MODU using DP propulsion are maximum broadband (10 Hz to 10 kHz) source levels of approximately 190 dB re 1 µPa m (Hildebrand, 2005).

NMFS (2018b) 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 MODU operations, sperm whales would move away from the proposed operations area, and related noise levels that could cause auditory injury would be avoided. Noise associated with proposed support 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, 2009a). 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).

NOAA Fisheries West Coast Region (2018) presents criteria that are used in the interim to determine behavioral disturbance thresholds for marine mammals and are applied equally across all functional hearing groups. Received root-mean-square sound pressure levels (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.

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, 2016a). 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.

The MODUs will be located within a deepwater, open ocean environment. Based on distributional data, it is likely that sperm whales may occur within the project area. Sounds generated by drilling operations will be generally non-impulsive, with some temporal variability in sound level. This analysis assumes that the continuous nature of sounds produced by the MODUs 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 MODUs will allow for active avoidance of potential physical impacts. Drilling and installation-related noise associated with this project may contribute to increases in the ambient noise environment of the Gulf of Mexico, but it is not expected to be at amplitudes sufficient enough to cause hearing effects to sperm whales. Due to the open ocean environment, transient nature of sperm whales, and the stationary nature of the proposed activites, it is not expected that any sperm whales will remain in proximity to the source for a full 24-hour period to receive SEL_{cum} necessary for the onset of auditory threshold shifts. Impacts to this species are expected to be limited to behavioral effects, including displacement from or avoidance of waters around the active MODUs. MODU lighting and rig presence are not identified as IPFs for sperm whales (BOEM, 2014a,b,c; 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, slow down or stop their vessel to avoid striking protected species, and requires operators to report sightings of any injured or dead protected species. 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, 2020). 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 [2020] Appendix C). Compliance with these mitigation measures will minimize the likelihood of vessel strikes as well as reduce the chance for disturbing sperm whales. However, this mitigation is effective only during daylight hours and during periods of adequate visibility.

NMFS (2020) 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 (2020) in addition to the NTL BOEM-2016-G01, NMFS concluded that the likelihood of collisions between vessels and sperm whales would be reduced during daylight hours. During nighttime and during periods of poor visibility, it is assumed that vessel noise and sperm whale avoidance of moving vessels would reduce the chance of vessel strikes with this species. It is, however, likely that a collision between a sperm whale and a moving support vessel would result in severe injury or mortality of the stricken animal. The current Potential Biological Removal (PBR) level for the Gulf of Mexico stock of sperm whales is 1.1 (Hayes et al., 2019). The PBR level is defined by the MMPA as the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population. Mortality of a single sperm whale would constitute a significant impact to the local (Gulf of Mexico) stock of sperm whales but would not likely be significant at the species level.

Helicopter traffic also has the potential to disturb sperm whales. Smultea et al. (2008) documented responses of sperm whales offshore Hawaii to fixed wing aircraft flying at an altitude of 804 ft (245 m). A reaction to the initial pass of the aircraft was observed during 3 (12%) of 24 sightings. All three reactions consisted of a hasty dive and occurred at less than 1,180 ft (360 m) lateral distance from the aircraft. Additional reactions were seen when the 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, 2020). Although whales may respond to helicopters (Smultea et al., 2008), NMFS (2020) concluded that this altitude would minimize the potential for disturbing sperm whales. Therefore, no significant impacts are expected.

Impacts of a Small Fuel Spill

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

The probability of a fuel spill will be minimized by Shell's preventative measures during routine operations, including fuel transfer. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the potential for impacts on sperm whales. 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 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 (2020). Oil impacts on marine mammals are discussed by Geraci and St. Aubin (1990) and by the MMC (2011). For the EIA, there are no unique site-specific issues with respect to spill impacts on sperm whales.

Impacts of oil spills on sperm whales can include direct impacts from oil exposure as well as indirect impacts due to response activities and materials (e.g., vessel traffic, noise, dispersants) (MMC, 2011). Direct physical and physiological effects can include skin irritation, inflammation, or necrosis; chemical burns of skin, eyes, and mucous membranes; inhalation of toxic fumes; ingestion of oil (and dispersants) directly or via contaminated prey; and stress from the activities and noise of response vessels and aircraft. The level of impact of oil exposure depends on the amount, frequency, and duration of exposure; route of exposure; and type or condition of petroleum compounds or chemical dispersants (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). Ackleh et al. (2012) hypothesized that sperm whales may have temporarily relocated away from the vicinity of the Deepwater Horizon incident in 2010. However, based on aerial surveys conducted in the aftermath of the spill, visibly oiled cetaceans (including several sperm whales) were identified within the footprint of the oil slick (Dias et al., 2017).

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

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in 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) stock of sperm whales but would not likely be significant at the species level. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. DOCD Section 9b provides detail on spill response measures.

C.3.2 Bryde's Whale (Endangered)

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

Bryde's whales found in the Gulf of Mexico are distinct from Bryde's whales worldwide and are considered a separate (unnamed) subspecies. The Gulf of Mexico Bryde's whale subspecies was classified by NOAA as an Endangered species under the ESA on May 15, 2019.

IPFs that could affect the Bryde's whales include MODU presence, noise, and lights; support vessel and helicopter traffic; and both types of spill accidents: a small fuel spill and a large oil spill. Effluent discharges are likely to have negligible impacts on Bryde's whales due to rapid dispersion, the small area of ocean affected, the intermittent nature of the discharges, and the mobility and low abundance of Bryde's whales in the Gulf of Mexico. Compliance with BSEE NTL 2015-G03 will minimize the potential for marine debris-related impacts on Bryde's whales.

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

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

Some sounds produced by the MODUs may be emitted at levels that could potentially disturb individual whales or mask the sounds animals would normally produce or hear. Noise associated with drilling is relatively weak in intensity, and an individual animal's noise exposure would be transient. As discussed in **Section A.1**, frequencies generated by an actively drilling MODU are maximum broadband (10 Hz to 10 kHz) with a root-mean-square source level of approximately 177 to 190 dB re 1 µPa m (Hildebrand, 2005).

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

It is expected that, due to the relatively stationary nature of the MODU operations, Bryde's whales would move away from the proposed operations area, and noise levels that could cause auditory injury would be avoided. Noise associated with proposed vessel operations may cause behavioral (disturbance) effects to individual Bryde's whales. NOAA Fisheries West Coast Region (2018) presents criteria that are used in the interim to determine behavioral disturbance thresholds for marine mammals and are applied equally across all hearing groups. Received SPL_{rms} of 120 dB re 1 µPa from a non-impulsive source is 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 an SPL_{rms} of 120 dB re 1 µPa 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.

For low-frequency cetaceans, specifically the Bryde's whale, permanent and temporary threshold shift onset from non-impulsive sources are estimated to occur at sound exposure levels of 199 dB re 1 μPa^2 s and 179 re 1 μPa^2 s, repectively.

The MODUs will be located within a deepwater, open ocean environment. Sounds generated by drilling operations will be generally non-impulsive, with some variability in sound level and frequency. This analysis assumes that the continuous nature of sounds produced by the MODUs 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 MODUs will allow for active avoidance of potential physical impacts. Drilling and installation-related noise associated with this project may 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. Furthermore, it is very unlikely that Bryde's whales occur within the project area and occur only in low densities in the Gulf of Mexico; therefore, 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, 2020). 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 [2020] Appendix C). However, this mitigation is effective only during daylight hours and during periods of adequate visibility.

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

Helicopter traffic also has the potential to disturb Bryde's whales. Based on studies of cetacean responses to sound, the observed reactions to brief overflights by aircraft were short-term and limited to behavioral disturbances (Smultea et al., 2008). Helicopters maintain altitudes above 700 ft (213 m) during transit to and from the offshore working area. In the event 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, 2020). 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 (2020) 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 (2020). 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 impact to the local (Gulf of Mexico) stock of Bryde's whales. The core distribution area for Bryde's whales is within the eastern Gulf of Mexico OCS Planning Area; therefore, it is very unlikely that Bryde's whale occur within the project area and surrounding waters. Consequently, the probability of spilled oil from a project-related well blowout reaching Bryde's whales is extremely low.

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.3.3 West Indian Manatee (Threatened)

Most of the Gulf of Mexico West Indian manatee population is located in peninsular Florida (USFWS, 2001). 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). On 5 May 2017, the USFWS reclassified the West Indian manatee from Endangered to Threatened under the authority of the ESA. 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 75 miles (121 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 breaking up. Compliance with NTL BSEE 2015-G013 (see **Table 1**) will minimize the potential for marine debris-related impacts on manatees. Consistent with the analysis by BOEM (2016a), impacts of routine project-related activities on the manatee would be negligible.

Impacts of Support Vessel and Helicopter Traffic

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

Compliance with these mitigation measures will minimize the likelihood of vessel strikes as well as reduce the chance for disturbing manatees during daylight hours. 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, 2020). This mitigation measure will minimize the potential for disturbing manatees, and no significant impacts are expected.

Impacts of a Large Oil Spill

Based on the 30-day OSRA modeling (**Table 3**), Plaquemines Parish, Louisiana is the coastal area most likely to be affected (4% probability within 3 days, 14% within 10 days, and 21% probability within 30 days). Other Louisiana shorelines may be affected within 10 days (Terrebonne, St. Bernard, and Lafourche), and shorelines in Louisiana, Alabama, Mississippi, and Florida could be affected within 30 days (1% to 21% conditional probability). There is no manatee critical habitat designated in these areas, and the number of manatees potentially present is a small fraction of the population in peninsular Florida.

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

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

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in 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 GOM; therefore, in the event of mortality of individual manatees from a large oil spill would constitute an adverse but insignificant impact to the subspecies. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. 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 whales and dolphins (cetaceans) may be found in the Gulf of Mexico. These include the dwarf and pygmy sperm whales, 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, spinner dolphin, and Clymene dolphin. A brief summary is presented in this section, and additional information on these groups is presented by BOEM (2017a).

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

<u>Beaked whales</u>. 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). Blainville's beaked whales are rare, with only four documented strandings in the northern Gulf of Mexico (Würsig et al., 2000).

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

Delphinids. Fourteen species of delphinids are known to occur in the Gulf of Mexico: Atlantic spotted dolphin (*Stenella frontalis*), bottlenose dolphin (*Tursiops truncatus*), Clymene dolphin (*Stenella clymene*), killer whale (*Orcinus orca*), false killer whale (*Pseudorca crassidens*), Fraser's dolphin (*Lagenodelphis hosei*), 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 of the northern Gulf of Mexico are the pantropical spotted dolphin, spinner dolphin, and rough-toothed dolphin. However, any of these species could occur in the project area (Waring et al. 2016; Hayes et al., 2019).

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

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

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

Noise from routine drilling 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, 2018b). 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, 2018b). 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 and installation operations), permanent threshold shifts are estimated to occur when the mammal has received an SEL_{cum} of 198 dB re 1 μPa^2 s over a 24-hour period. Simlarly, temporary threshold shifts are estimated to occur when the mammal has received an SEL_{cum} of 178 dB re 1 μPa^2 s over a 24-hour period. Due to the transient nature of marine mammals and the stationary nature of the proposed activites, it is not expected that any marine mammals will remain in proximity to the source for a full 24-hour period to receive SEL_{cum} necessary for the onset of auditory threshold shifts. NOAA Fisheries West Coast Region (2018) presents criteria that are used in the interim to determine 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.

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

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

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

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, 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 328 ft (100 m) or greater from whales and 164 ft (50 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 (2020) are only applicable to ESA-listed species, complying with them may provide additional indirect protections to non-listed species as well. However, this mitigation is effective only during daylight hours and during periods of adequate visibility.

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

Helicopter traffic also has the potential to disturb marine mammals (Würsig et al., 1998). However, while flying offshore, helicopters maintain altitudes above 700 ft (213 m) during transit to and from the working area. In addition, guidelines and regulations issued by NMFS under the authority of the MMPA specify that helicopters maintain an altitude of 1,000 ft (305 m) within 328 ft (100 m) of marine mammals (BOEM, 2017a; NMFS, 2020). Maintaining this altitude will minimize the potential for disturbing marine mammals, and no significant impacts are expected.

Impacts of a Small Fuel Spill

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

The probability of a fuel spill will be minimized by Shell's preventative measures, including fuel transfer. In the unlikely event of a spill, implementation of Shell's OSRP is expected to mitigate and reduce the potential for impacts on marine mammals. 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 the concentrations of petroleum hydrocarbons and their degradation products. The extent and persistence of impacts would depend on the meteorological and oceanographic conditions at the time and the effectiveness of spill response measures. **Section A.9.1** discusses the likely fate of a small fuel spill and indicates that over 90% would evaporate or disperse naturally within 24 hours. The area of diesel fuel on the sea surface would range from 1.2 to 12 ac (0.5 to 5 ha), depending on sea state and weather conditions.

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

Impacts of a Large Oil Spill

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

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

Data from the *Deepwater Horizon* incident, as analyzed and summarized by NOAA (2016b) indicate the scope of potential impacts from a large spill. Tens of thousands of marine mammals were exposed to oil, where they likely inhaled, aspirated, ingested, physically contacted, and absorbed oil components (NOAA, 2016b; Takeshita et al., 2017). Nearly all of the marine mammal stocks in the northern Gulf of Mexico were affected. The oil's physical, chemical, and toxic effects damaged tissues and organs, leading to a constellation of adverse health effects, including reproductive failure, adrenal disease, lung disease, and poor body condition (NOAA, 2016b). According to the National Wildlife Federation (2016a), nearly all of the 20 species of dolphins and whales that live in the northern Gulf of Mexico had demonstrable, quantifiable injuries. NMFS (2014a) documented 13 dolphins and whales live-stranded, and over 150 dolphins and whales dead during the oil spill response. Because of known low detection rates of carcasses (Williams et al., 2011), it is possible that the number of marine mammal deaths is underestimated. Also, necropsies to confirm the cause of death could not be conducted for many of these marine mammals, therefore some cause of deaths reported as unknown are likely attributable to oil interaction. Schwacke et al. (2014a) reported that 1 year after the spill, many dolphins in Barataria Bay, Louisiana, showed evidence of disease conditions associated with petroleum exposure and toxicity. Lane et al. (2015) noted a decline in pregnancy success rate among dolphins in the same region. BOEM (2012a) concluded that potential effects from a large spill could potentially contribute to more significant and longer-lasting impacts including mortality and longer-lasting chronic or sublethal effects than a small, but severe accidental spill.

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

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in 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 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 are the leatherback, Kemp's ridley, and hawksbill turtles. As of May 6, 2016, the entire North Atlantic DPS of the green turtle is listed as threatened (81 *Federal Register* [*FR*] 20057). The DPS of loggerhead turtle that occurs in the Gulf of Mexico is listed as Threatened, although other DPSs are Endangered. Of the sea turtle species that may be found in the project area, only the Kemp's ridley relies on the Gulf of Mexico as its sole breeding ground. Species descriptions are presented by (BOEM, 2017a).

Critical habitat has been designated for the loggerhead turtle in the Gulf of Mexico as shown in **Figure 1**. Critical habitat in the northern Gulf of Mexico includes nesting beaches in Mississippi, Alabama, and the Florida Panhandle; nearshore reproductive habitat seaward from these beaches; and a large area of *Sargassum* habitat. The nearest designated nearshore reproductive critical habitat for loggerhead sea turtles is approximately 109 miles (175 km) from the project area.

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

Leatherbacks are the species most likely to be present near the project area, as they feed on populations of gelatinous plankton, such as jellyfish and salps in all water depths. Loggerhead, green, hawksbill, and Kemp's ridley turtles are typically inner-shelf and nearshore species but may be found transiting in oceanic waters during seasonal migrations. Loggerheads are more likely to occur near, or be attracted to, offshore structures than the other species. Hatchlings or juveniles of any of the sea turtle species may be present in deepwater areas, including the project area, where they may be associated with *Sargassum* spp. and other flotsam.

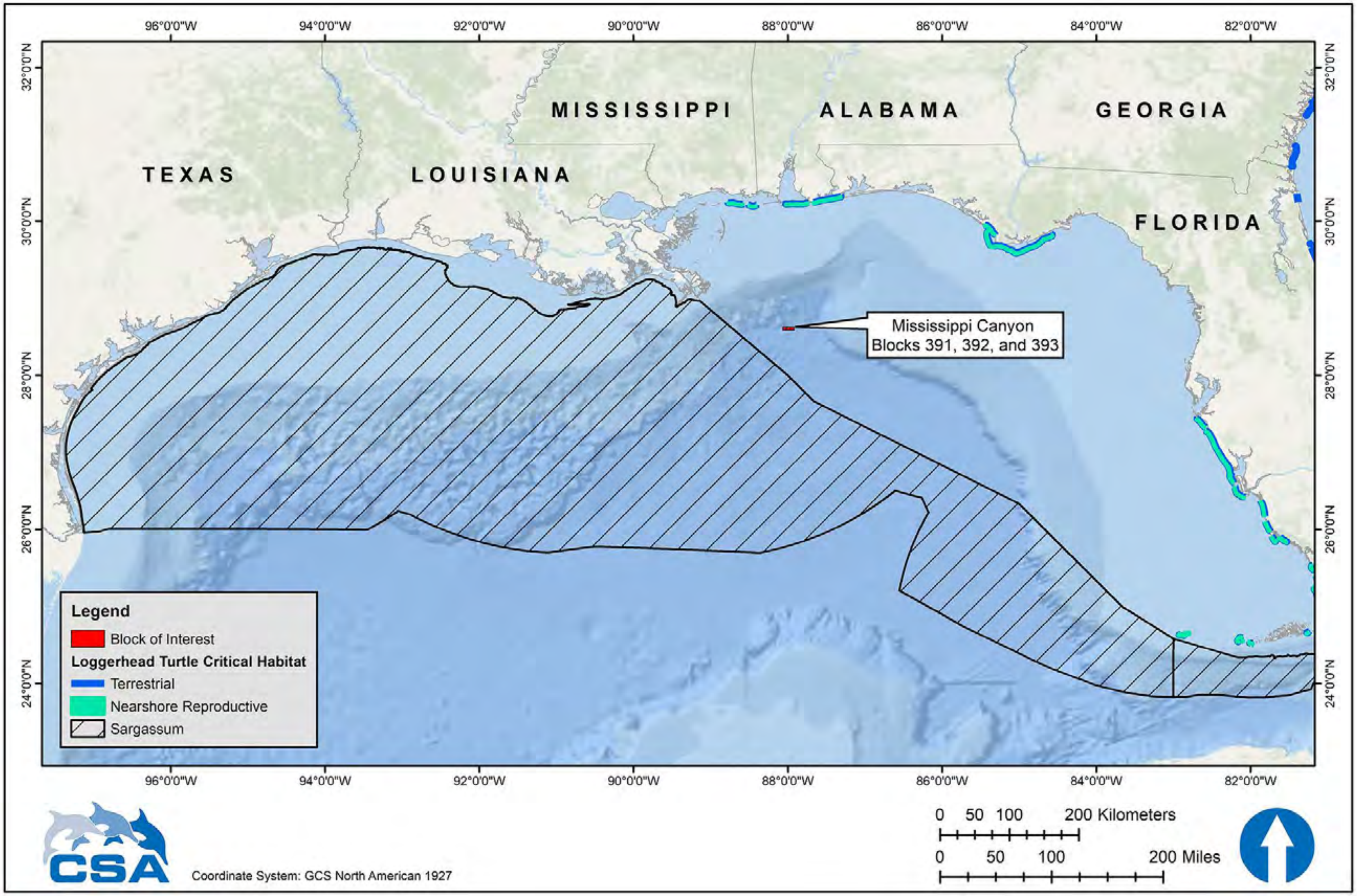

Figure 1. Location of loggerhead turtle critical habitat in the northern Gulf of Mexico in relation to the project area. The critical habitat includes terrestrial habitat (nesting beaches) and nearshore reproductive habitat in Mississippi, Alabama, and the Florida Panhandle as well as *Sargassum* habitat.

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

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

- Loggerhead turtles—Loggerhead turtles nest in significant numbers along the Florida Panhandle (Florida Fish and Wildlife Conservation Commission, 2017a) and, to a lesser extent, from Texas through Alabama (NMFS and USFWS, 2008);
- Green and leatherback turtles—Green and leatherback turtles infrequently nest on Florida Panhandle beaches (Florida Fish and Wildlife Conservation Commission, 2017b,c);
- Kemp's ridley turtles—The main nesting site is Rancho Nuevo beach in Tamaulipas, Mexico (NMFS et al., 2011). As of June 2020, a total of 256 Kemp's ridley turtle nests have been counted on Texas beaches for the 2020 nesting season. A total of 190 Kemp's ridley turtle nests were counted on Texas beaches during the 2019 nesting season and a total of 250 Kemp's ridley turtle nests were counted on Texas beaches during the 2018 nesting season. These are a decrease from the 353 Kemp's ridley turtle nests counted in the 2017 nesting season (Turtle Island Restoration Network, 2020). Padre Island National Seashore, along the coast of Willacy, Kenedy, and Kleberg Counties in southern Texas, is the most important nesting location for this species in the U.S.; and
- Hawksbill turtles—Hawksbill turtles typically do not nest anywhere near the project area, with most nesting in the region located in the Caribbean Sea and on beaches of the Yucatán Peninsula (U.S. Fish and Wildlife Service, 2016).

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

Though NMFS (2020) stated marine debris as an IPF, compliance with NTL BSEE 2015-G013 (See **Table 1**) and NMFS (2020) Appendix B will minimize the potential for marine debris-related impacts on sea turtles. NMFS (2020) estimated a small proportion of individual sea turtles would be adversely affected from exposure to marine debris. Therefore, marine debris is likely to have negligible impacts on sea turtles and is not further discussed (See **Table 2**).

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

Offshore drilling and installation 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). The NMFS Biological Opinion (NMFS, 2020) lists the sea turtle zero to peak sound pressure level ($SPL_{0\text{-}pk}$) threshold of 232 dB re 1 µPa, and the SEL_{cum} threshold of 204 dB re 1 μPa^2 s. Blackstock et al. (2018) identified the sea turtle underwater acoustic SPL_{rms} behavioral threshold as 175 dB re 1 µPa. No distinction is made between impulsive and non-impulsive sources for these thresholds. Based on transmission loss calculations (Urick, 1983), open water propagation of noise produced by typical sources with DP thrusters in use during drilling are not expected to produce SPL_{rms} greater than 160 dB re 1 µPa beyond 32 m from the source. Certain sea turtles, especially loggerheads, may be attracted to offshore structures (Lohoefener et al., 1990; Gitschlag et al., 1997) and thus, may be more susceptible to impacts from sounds produced during routine drilling and completion activities. Helicopters and support vessels may also affect sea turtles because of machinery noise or visual disturbances. Any impacts would likely be short-term behavioral changes such as diving and evasive swimming, disruption of activities, or departure from the area. Because of the limited scope and short duration of drilling activities, these short-term impacts are not expected to be biologically significant to sea turtle populations.

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

NMFS (2020) 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 (2020) estimated approximately about one sea turtle will be sub lethally entrapped in moon pools every year. Therefore, no significant impacts are expected.

Impacts of Support Vessel and Helicopter Traffic

Support vessel traffic has the potential to disturb sea turtles, and there is also a risk of vessel strikes. Data show that vessel traffic is one cause of sea turtle mortality in the Gulf of Mexico (Lutcavage et al., 1997; NMFS, 2020). 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, 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 [2020] Appendix C). However, this mitigation is effective only during daylight hours and during periods of adequate visibility.

Compliance with these mitigation measures will minimize the likelihood of vessel strikes as well as reduce the chance for disturbing sea turtles on the sea surface. However, mortality of individuals would constitute an adverse, though not a significant impact to each species affected.

Impacts of a Small Fuel Spill

Potential spill impacts on sea turtles are discussed by NMFS (2020) and BOEM (2017a). 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, 2014a). 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.

<u>Loggerhead Critical Habitat – Nesting Beaches</u>. A small fuel spill in the project area would be unlikely to affect sea turtle nesting beaches because the project area is 75 miles (121 km) from the nearest shoreline (Louisiana). Loggerhead turtle nesting beaches and nearshore reproductive habitat designated as critical habitat are located in Mississippi, Alabama, and the Florida Panhandle, at least 109 miles (175 km) from the project area. As explained in **Section A.9.1**, a small fuel spill would not be expected to make landfall or reach coastal waters prior to breaking up.

<u>Loggerhead Critical Habitat – *Sargassum* Habitat</u>. The project area is 30 miles (48 km) from the *Sargassum* portion of the loggerhead turtle critical habitat (**Figure 1**). It is unlikely a small fuel spill could affect *Sargassum* spp. and juvenile turtles by contaminating this habitat due to the distance from it. Juvenile sea turtles could come into contact with or ingest oil, resulting in death, injury, or other sublethal effects. Effects would be limited to the small area (1.2 to 12 ac [0.5 to 5 ha]) likely to be impacted by a small spill. A 12-acre (5-hectare) impact would represent a negligible portion of the 96,776,959 ac (39,164,246 ha) designated *Sargassum* habitat for loggerhead turtles in the northern Gulf of Mexico.

Impacts of a Large Oil Spill

Impacts of oil spills on sea turtles can include direct impacts from oil exposure as well as indirect impacts due to response activities and materials (e.g., vessel traffic, noise, dispersants). Direct physical and physiological effects can include skin irritation, inflammation, or necrosis; chemical burns of skin, eyes, and mucous membranes; inhalation of toxic fumes and smoke (e.g., from *in situ* burning of oil); ingestion of oil (and dispersants) directly or via contaminated food; and stress from the activities and noise of response vessels and aircraft. Complications of the above may lead to dysfunction of immune and reproductive systems, physiological stress, declining physical condition, and death. Behavioral responses can include displacement of animals from prime habitat, disruption of social structure, change in food availability and foraging distribution and/or patterns, changing reproductive behavior/productivity, and changing movement patterns or migration (MMC, 2011; NMFS, 2014b). 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, 2020).

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

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

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

Based on the 30-day OSRA modeling (**Table 3**), Plaquemines Parish, Louisiana is the coastal area most likely to be affected (4% probability within 3 days, 14% within 10 days, and 21% probability within 30 days). Other Louisiana shorelines may be affected within 10 days (Terrebonne, St. Bernard, and Lafourche parishes), and shorelines in Louisiana, Alabama, Mississippi, and Florida could be affected within 30 days (1% to 21% conditional probability). The nearest nearshore reproductive critical habitat for loggerhead turtles is 109 miles (175 km) from the project area.

Loggerhead Critical Habitat – *Sargassum* Habitat. The project area is 30 miles (48 km) from the *Sargassum* habitat portion of the loggerhead turtle critical habitat (**Figure 1**). Due to the large area covered by the designated *Sargassum* habitat for loggerhead turtles, a large spill could result in oiling of a substantial part of the *Sargassum* habitat in the northern Gulf of Mexico. The *Deepwater Horizon* incident affected approximately one-third of the *Sargassum* habitat in the northern Gulf of Mexico (BOEM, 2016b). It is extremely unlikely that the entire *Sargassum* habitat would be affected by a large spill. Because *Sargassum* spp. is a floating, pelagic species, it would only be affected by oil that is present near the surface.

The effects of oiling on *Sargassum* spp. vary with severity, but moderate to heavy oiling as could occur during a large spill could cause complete mortality to *Sargassum* spp. and its associated communities (BOEM, 2017a). *Sargassum* spp. also has the potential to sink during a large spill; thus temporarily removing the habitat and possibly being an additional pathway of exposure to the benthic environment (Powers et al., 2013). Lower levels of oiling may cause sublethal effects, including reduced growth, productivity, and recruitment of organisms associated with *Sargassum* spp. The *Sargassum* spp. algae itself could be less impacted by light to moderate oiling than associated organisms because of a waxy outer layer that might help protect it from oiling (BOEM, 2016b). *Sargassum* spp. have a yearly seasonal cycle of growth and a yearly cycle of dispersal from the Gulf of Mexico to the western Atlantic. A large spill could affect a large portion of the annual crop of the algae; however, because of its ubiquitous distribution and seasonal cycle, recovery of the *Sargassum* spp. community would be expected to take one to two years (BOEM, 2017a).

Impacts to sea turtles from a large oil spill and associated cleanup activities would depend on spill extent, duration, and season (relative to turtle nesting season); the amount of oil reaching the shore; the importance of specific beaches to sea turtle nesting; and the level of cleanup vessel and beach crew activity required. A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in 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 sea turtles would be adverse but not likely significant at the population level. In the event that spilled oil reached nesting beaches during nesting period(s), the level of mortality (and impact) would increase. 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 (Bird Life International, 2018). Critical overwintering habitat has been designated, including beaches in Texas, Louisiana, Mississippi, Alabama, and Florida (**Figure 2**). Piping Plovers inhabit coastal sandy beaches and mudflats, feeding by probing for invertebrates at or just below the surface. They use beaches adjacent to foraging areas for roosting and preening (USFWS, 2010). A species description is presented by BOEM (2017a).

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

Impacts of a Large Oil Spill

The project area is 75 miles (121 km) from the nearest shoreline designated as Piping Plover critical habitat. The 30-day OSRA modeling (**Table 3**) predicts that Piping Plover critical habitat in Plaquemines Parish, Louisiana could be contacted within 3 days of a spill (4% conditional probability). Within 30 days of a spill, the model predicts conditional probabilities of shoreline contact of 21%.

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 substantially 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.

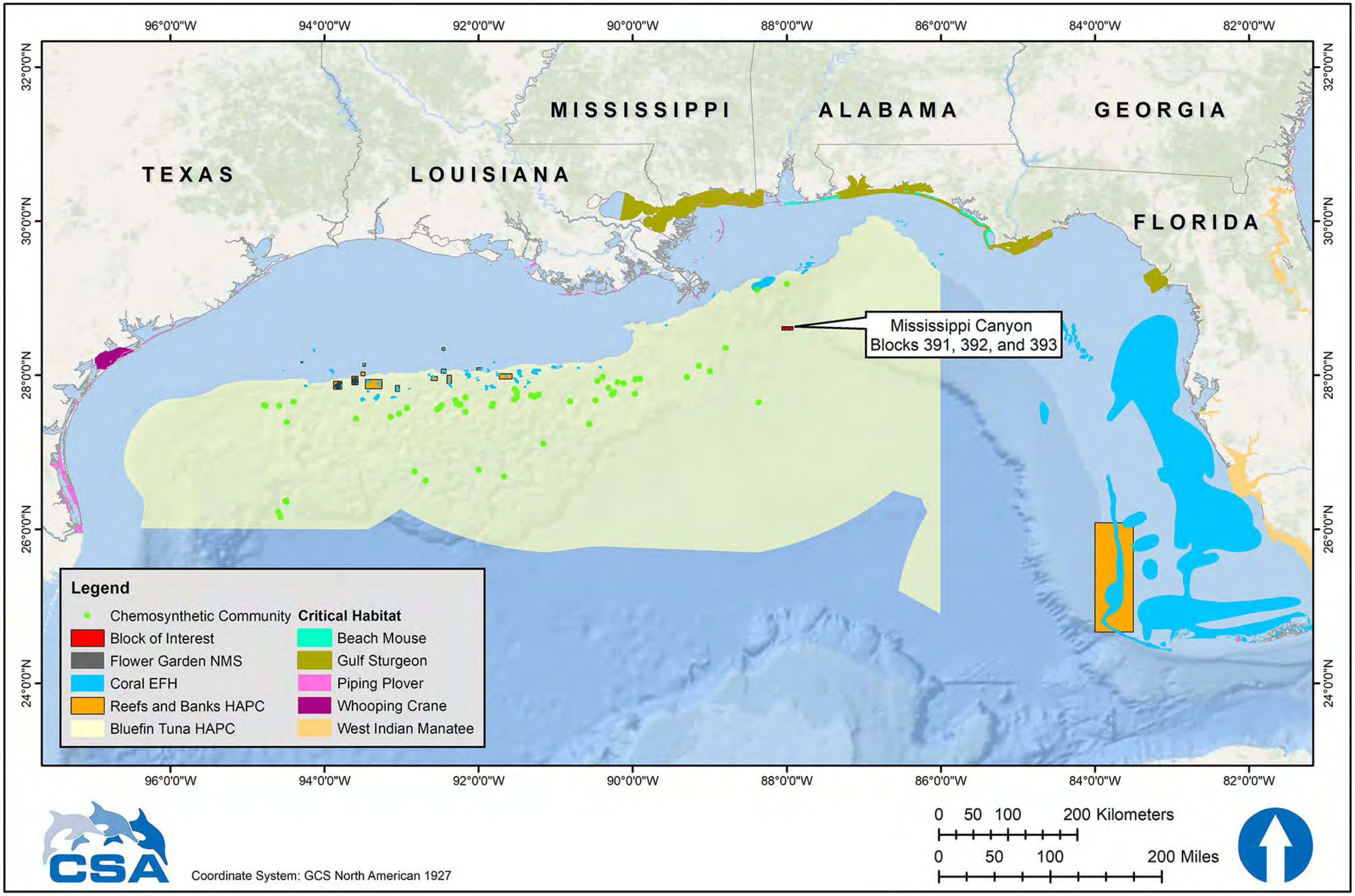

Figure 2. Location of selected environmental features in relation to the project area. EFH = Essential Fish Habitat; HAPC = Habitat Area of Particular Concern.

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 and a federally listed endangered species. Three wild populations live in North America (National Wildlife Federation, 2016b). One of these populations winters along the Texas coast at Aransas NWR and summers at Wood Buffalo National Park in Canada. This population represents the majority of the world's population of free-ranging Whooping Cranes, reaching an estimated population of 506 at Aransas NWR during the 2019 to 2020 winter (USFWS, 2020). A non-migratory population was reintroduced in central Florida and another reintroduced population summers in Wisconsin and migrates to the southeastern U.S. for the winter (USFWS, 2015a). Whooping Cranes breed, migrate, winter, and forage in a variety of habitats, including coastal marshes and estuaries, inland marshes, lakes, ponds, wet meadows and rivers, and agricultural fields (USFWS, 2007). About 22,240 ac (9,000 ha) of salt flats in Aransas NWR and adjacent islands comprise the principal wintering grounds of the Whooping Crane. Aransas NWR is designated as critical habitat for the species (**Figure 2**). A species description is presented by (BOEM, 2012a).

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

Impacts of a Large Oil Spill

The 30-day OSRA modeling (**Table 3**) predicts a <0.5% or less chance of oil contacting Whooping Crane critical habitat (Calhoun or Aransas Counties, Texas) within 30 days of a spill.

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

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in DOCD Section 2j. In the event of oil from a large spill contacting Whooping Crane habitat, it is expected that impacts resulting in the injury or death of individual Whooping Cranes 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.3.8 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, assessment of population trends heavily relies 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 (2018a) noted that there has been an 88% decline in abundance of the species in the Gulf of Mexico since the mid-1990s due to commercial fishing pressure.

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

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

Offshore drilling 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 sound pressure levels associated with drilling activities (typically 10 Hz to 10 kHz) (Hildebrand, 2005). Impacts from offshore drilling activities (i.e., non-impulsive sound) could include masking or behavioral change (Popper et al., 2014). However, because of the limited propagation distances of high sound pressure levels from the drilling rig, impacts would be limited in geographic scope. It is anticipated that animals would move away from the static sound source and avoid auditory injury or disturbances. Therefore, no population level impacts on oceanic whitetip sharks are expected.

Impacts of a Large Oil Spill

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

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

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell’s well control and blowout prevention measures as detailed in 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. At least 74 unique individuals have been positively identified at the Flower Garden Banks based on unique underbelly coloration (Flower Garden Banks National Marine Sanctuary, 2018). Genetic and photographic evidence in the Flower Garden Banks over 25 years of monitoring showed that 95% of identified giant manta ray male individuals were smaller than mature size (Stewart et al., 2018).

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

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

Offshore drilling 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 sound pressure levels associated with drilling activities (typically 10 Hz to 10 kHz) (Hildebrand, 2005). Impacts from offshore drilling activities (i.e., continuous sound) could include masking or behavioral change (Popper et al., 2014). However, because of the limited propagation distances of high sound pressure levels from the drilling rig, impacts would be limited in geographic scope. It is anticipated that animals would move away from the static sound source and avoid auditory injury or disturbances. Therefore, no population level impacts on giant manta rays are expected.

Impacts of a Large Oil Spill

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

In the event of a large oil spill, due to the distance between the project area and the Flower Garden Banks (approximately 345 miles [555 km]), it is unlikely that oil would impact the giant manta ray nursery habitat. It is possible that a large oil spill could contact individual giant manta rays, but due to the low density of individuals thought to occur in the Gulf of Mexico, there would not likely be any population-level effects.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in 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 Pearl River systems 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, 2014c) (**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 because NMFS (2020) 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 (110 miles [177 km]) and the support vessel base being in Port Fourchon, Louisiana, it is anticipated that 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 (2020). For this DOCD, there are no unique site-specific issues with respect to this species.

The project area is approximately 110 miles (177 km) from the nearest Gulf sturgeon critical habitat. The 30-day OSRA modeling (**Table 3**) predicts that a spill in the project area has 3% or less conditional probability of contacting any coastal areas containing Gulf sturgeon critical habitat within 30 days of a spill.

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

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 significant at the population level. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. Shell has extensive resources available to protect coastal and estuarine wildlife and habitats in the event of a spill reaching the shoreline, as detailed in the OSRP. 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 345 miles [555 km]), and the difference in water depth between the project area (7,406 ft [2,257 m]) and the Banks (approximately 17 to 145 m [56 to 476 ft]). 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 345 miles [555 km]), and the shallow location of the coral cap of the Banks. Near-bottom currents in the region are predicted to flow along the isobaths (Nowlin et al., 2001) and typically would not carry a plume up onto the continental shelf edge. Valentine et al. (2014) observed the spatial distribution of excess hopane, a crude oil tracer from the *Deepwater Horizon* incident sediment core samples, to be in the deeper waters and not transported up the shelf, thus confirming that near-bottom currents flow along the isobaths.

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

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

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in 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 after their flat, saw-like rostrum, is an elasmobranch ray which lives in shallow coastal tropical seas and estuaries where they feed on fish and invertebrates such as shrimp and crabs (NOAA Fisheries, nd). Once found along most of the northern Gulf of Mexico coast from Texas to Florida, their current range in Gulf of Mexico is restricted to areas primarily in southwest Florida (Brame et al., 2019) where several areas of critical habitat have been designated (**Figure 2**). A species description is presented in the recovery plan for this species (NMFS, 2009b).

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 369 miles (593 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.

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.3.13 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 subspecies of *Peromyscus* beach mouse inhabiting dunes on the western Florida Panhandle, the Santa Rosa beach mouse (*P. p. leucocephalus*), is not listed under the ESA. Species descriptions are presented by BOEM (2017a).

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

Impacts of a Large Oil Spill

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

The project area is approximately 110 miles (177 km) from the nearest beach mouse critical habitat. The 30-day OSRA modeling (**Table 3**) predicts that a spill in the project area has 2% or less conditional probability of contacting any coastal areas containing beach mouse critical habitat within 30 days of a spill.

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

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in 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 potentially 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.3.14 Florida Salt Marsh Vole (Endangered)

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

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

Impacts of a Large Oil Spill

Florida salt marsh vole habitat in Levy and Dixie counties, Florida is approximately 291 miles (468 km) from the project area. The 30-day OSRA modeling (**Table 3**) predicts that a spill in the project area has <0.5% or less conditional probability of contacting any coastal areas containing Florida salt marsh voles within 30 days.

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

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

C.3.15 Threatened Coral Species

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

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

Impacts of a Large Oil Spill

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

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

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

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

C.4 Coastal and Marine Birds

C.4.1 Marine Birds

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

Seabirds 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, Least Tern, Sandwich Tern, Magnificent Frigatebird); winter residents (gannets, gulls, jaegers); and permanent resident species (Laughing Gulls, Royal Terns, Bridled Terns) (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 MODU presence, noise, and lights; support vessel and helicopter traffic; and two types of accidents (a small fuel spill and a large oil spill). Effluent discharges permitted under the NPDES general permit are likely to have negligible impacts on the birds due to rapid dispersion, the small area of ocean affected, the intermittent nature of the discharges, and the mobility of these animals. Compliance with BSEE NTL 2015-G013 (See **Table 1**) will minimize the potential for marine debris-related impacts on birds.

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

Birds migrating over water have been known to strike offshore structures, resulting in death or injury (Wiese et al., 2001; Russell, 2005). Mortality of migrant birds at tall towers and other land-based structures has been reviewed extensively, and the mechanisms involved in platform collisions appear to be similar. In some cases, migrants simply do not see a part of the platform until it is too late to avoid it. In other cases, navigation may be disrupted by noise or lighting (Russell, 2005; Ronconi et al., 2015). However, offshore structures may, in some cases, serve as suitable stopover habitats for trans-Gulf migrant species, particularly in the spring (Russell, 2005; Ronconi et al., 2015).

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

Impacts of Support Vessel and Helicopter Traffic

Support vessels and helicopters are unlikely to substantially disturb marine birds in open, offshore waters. Schwemmer et al. (2011) showed that several sea birds showed behavioral responses and altered distribution patterns in response to ship traffic, which could potentially cause loss of foraging time and resting habitat. However, it is likely that individual birds would experience, at most, only short-term behavioral disruption resulting from support vessel and helicopter traffic, and the impact would not be significant.

Impacts of a Small Fuel Spill

Potential spill impacts on marine birds are discussed by BOEM (2016b, 2017a). For this DOCD, there are no unique site-specific issues with respect to spill impacts on marine birds.

The probability of a fuel spill will be minimized by Shell's preventative measures implemented during routine operations, including fuel transfer. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the potential for impacts on marine birds. DOCD Section 9b provides detail on spill response measures. Given the open ocean location of the project area and the short duration of a small spill, the potential exposure for pelagic marine birds would be brief.

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

Birds exposed to oil on the sea surface could experience direct physical and physiological effects including skin irritation; chemical burns of skin, eyes, and mucous membranes; and inhalation of VOCs. Because of the limited areal extent and short duration of water quality impacts from a small fuel spill, secondary impacts due to ingestion of oil via contaminated prey or reductions in prey abundance are unlikely. Due to the low densities of birds in open ocean areas, the small area affected, and the brief duration of the surface slick, no significant impacts on marine birds are expected.

Impacts of a Large Oil Spill

Potential spill impacts on marine birds are discussed by BOEM (2016b, 2017a). For this DOCD, there are no unique site-specific issues with respect to spill impacts on marine birds.

Pelagic seabirds could be exposed to oil from a spill at the project area. Hess and Ribic (2000) reported that terns, storm-petrels, shearwaters, and jaegers were the most frequently sighted seabirds in the deepwater Gulf of Mexico (>200 m). Haney et al. (2014) estimated that seabird densities over the open ocean are approximately 1.6 birds km^{-2}. The number of marine birds that could be affected in open, offshore waters would depend on the extent and persistence of the oil slick.

Data following the *Deepwater Horizon* incident provide relevant information about the species of marine birds that may be affected in the event of a large oil spill. Birds that have been treated for oiling include several pelagic species such as the Northern Gannet, Magnificent Frigatebird, and Masked Booby (USFWS, 2011). The Northern Gannet was among the species with the largest numbers of individuals affected by the spill. NOAA reported that at least 93 resident and migratory bird species across all five Gulf Coast states were exposed to oil from the *Deepwater Horizon* incident in multiple habitats, including offshore/open waters, island waterbird colonies, barrier islands, beaches, bays, and marshes (NOAA, 2016b). Exposure of marine birds to oil can result in adverse health, with severity depending on the level of oiling. Effects can range from plumage damage and loss of buoyancy for external oiling to more severe effects such as organ damage, immune suppression, endocrine imbalance, reduced aerobic capacity and death as a result of oil inhalation or ingestion (NOAA, 2016b).

However, a blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in 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 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, Black Skimmer, Forster's Tern, Gull-Billed Tern, 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). 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, 2015b). 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 and helicopters will transit coastal areas where coastal birds may be found. These activities could periodically disturb individuals or groups of birds within sensitive coastal habitats (e.g., wetlands that may support feeding, resting, or breeding birds).

Vessel traffic may disturb some foraging and resting birds. Flushing distances vary among species and individuals (Rodgers and Schwikert, 2002; Schwemmer et al., 2011). The disturbances will be limited to flushing birds away from vessel pathways; known distances are from 65 to 160 ft (20 to 49 m) for personal watercraft and 75 to 190 ft (23 to 58 m) for outboard-powered boats (Rodgers and Schwikert, 2002). Flushing distances may be similar or less for the support vessels to be used for this project, and some species such as gulls are attracted to boats. Support vessels will not approach nesting or breeding areas on the shoreline, so nesting birds, eggs, and chicks will not be disturbed. Vessel operators will use designated navigation channels and comply with posted speed and wake restrictions while transiting sensitive inland waterways. Due to the limited scope, duration, and geographic extent of drilling activities, any short-term impacts are not expected to be significant to coastal bird populations.

Helicopter traffic can cause some disturbance to birds on shore and offshore. Responses highly depend on the type of aircraft, bird species, activities that animals were previously engaged in, and previous exposures to overflights (Efroymson et al., 2000). Helicopters seem to cause the most intense responses over other human disturbances for some species (Bélanger and Bédard, 1989). 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. (2000). With these guidelines in effect, it is likely that individual birds would experience, at most, only short-term behavioral disruption. The potential impacts are not expected to be significant to bird populations or species in the project area.

Impacts of Large Oil Spill

Coastal birds can be exposed to oil as they float on the water surface, dive during foraging, or wade in oiled coastal waters. The Brown Pelican and Bald Eagle could be impacted by the ingestion of contaminated fish or birds (BOEM, 2012a, 2016b). In the event of a large oil spill reaching coastal habitats, cleanup personnel and equipment could create short-term disturbances to coastal birds. Indirect effects could occur from restoration efforts, resulting in habitat loss, alteration, or fragmentation (BOEM, 2017a). Based on the 30-day OSRA results summarized in **Table 3,** shorelines in Plaquemines Parish could be contacted within 3 days of a spill (4% conditional probability) and 10 days of a spill (14% conditional probability). Terrebonne, St. Bernard, and Lafourche parishes in Louisiana could also be contacted within 10 days (1% conditional probabilities). Other Louisiana, Alabama, Mississippi, and Florida shorelines could be affected within 30 days (1% to 21% conditional probability).

Studies concerning the *Deepwater Horizon* incident provide additional information regarding impacts on coastal birds that may be affected in the event that a large oil spill reaches coastal habitats. According to NOAA (2016b), an estimated 51,600 to 84,500 birds were killed by the spill, and the reproductive output lost as a result of breeding adult bird mortality was estimated to range from 4,600 to 17,900 fledglings that would have been produced in the absence of premature deaths of adult birds (NOAA, 2016b). Species with the largest numbers of estimated mortalities were American White Pelican, 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). A study by Ross et al. (2012) on midwater fauna to characterize vertical distribution of mesopelagic fishes in selected deepwater areas in the Gulf of Mexico substantiated high species richness, but the community was dominated by relatively few families and species.

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

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

The MODUs, floating structures in the deepwater environment, will act as fish-aggregating devices (FADs). 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). New seafloor infrastructure may also act as a FAD. 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). The FAD effect could possibly enhance the feeding of epipelagic predators by attracting and concentrating smaller fish species. MODU noise could potentially cause acoustic masking in fishes, thereby reducing their ability to hear biologically relevant sounds (Radford et al., 2014). The only defined acoustic threshold levels for continuous noise are given by Popper et al. (2014) and apply only to species of fish with swim bladders that provide some hearing (pressure detection) function. Popper et al. (2014) estimated threshold SPL_{rms} of 170 dB re 1 µPa accumulated over a 48-hour period for onset of recoverable injury and 158 dB re 1 µPa accumulated over a 12-hour period for onset temporary auditory threshold shifts. However, no consistent behavioral thresholds for fish have been established (Popper et al., 2014). Rather, Popper et al. (2014) provide qualitative criteria portraying risk of impact relative to the animal's distance from the source (i.e., near, intermediate, far). Noise may 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 MODUs are temporary structures, impacts on fish populations, whether beneficial or adverse, are not expected to be significant.

Few data exist regarding the impacts of noise on pelagic larvae and eggs. Generally, it is believed that larval fish will have similar hearing sensitivities as adults, but may be more susceptible to barotrauma injuries associated with impulsive noise (Popper et al., 2014). Larval fish were experimentally exposed to simulated impulsive sounds by Bolle et al. (2012). The controlled playbacks produced SEL_{cum} of 206 dB re 1 μPa^2 s but resulted in no increased mortality between the exposure and control groups. Non-impulsive noise sources (such as MODU operations) are expected to be far less injurious than impulsive noise. Because of the periodic and transient nature of ichthyoplankton, they are not expected to remain in proximity to the source for a full 24-hour period to receive above-threshold sound levels, and no impacts to these life stages are expected.

Impacts of Effluent Discharges

Discharges of treated WBM- and SBM-associated cuttings will produce temporary, localized increases in suspended solids in the water column around the MODU. In general, turbid water can be expected to extend between a few hundred meters and several kilometers down current from the discharge point (National Research Council, 1983; Neff, 1987). NPDES permit limits and requirements will be met.

WBM and cuttings will be released at the seafloor during the initial well intervals before the marine riser is set, which allows their return to the surface vessel. Excess cement slurry and blowout preventer fluid will also be released at the seafloor. These discharges could smother or cover benthic communities in the vicinity of the discharge location. Impacts will be limited to the immediate area of the discharge, with little or no impact to fisheries resources.

Treated sanitary and domestic wastes may have little or no effect on the pelagic environment in the immediate vicinity of these discharges. These wastes may have elevated levels of nutrients, organic matter, and chlorine, but should dilute rapidly to undetectable levels within tens to hundreds of meters from the source. As a result of quick dilution, minimal impacts on water quality, plankton, and nekton are anticipated.

Deck drainage will have little or no impact on the pelagic environment in the immediate vicinity of these discharges. Deck drainage from oily areas will be passed through an oil-and-water separator prior to release, and discharges will be monitored for visible sheen. The discharges may have slightly elevated levels of hydrocarbons but should dilute rapidly to undetectable levels within tens to hundreds of meters from the source. Minimal impacts on water quality, plankton, and nekton are anticipated.

Other effluent discharges from the MODUs and support vessels are expected to include treated sanitary and domestic wastes, deck drainage, non-contaminated well treatment and completion fluids, workover fluids, desalination unit discharge, blowout preventer fluid, ballast water, bilge water, cement slurry, fire water, hydrate inhibitor, subsea production control fluid, non-contact cooling water, and treated or untreated seawater. The MODUs and support vessel discharges are expected to be in compliance with NPDES permit and USCG regulations, as applicable, and are not expected to cause significant impacts on water quality (BOEM, 2012a).

Impacts of Water Intakes

Seawater will be drawn from several meters below the ocean surface for various services, including firewater and once-through, non-contact cooling of machinery on the MODU (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. GMG290103 specifies requirements for new facilities for which construction commenced after 17 July 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 MODUs selected for this project meet the described applicability for new facilities, and the vessel's water intakes are expected to be in compliance with the design, monitoring, and recordkeeping requirements of the NPDES permit.

The intake of seawater for cooling water will entrain plankton. The low intake velocity should allow most strong-swimming juvenile fishes and smaller adults to escape entrainment or impingement. However, drifting plankton would not be able to escape entrainment except for a few fast-swimming larvae of certain taxonomic groups. Those organisms entrained may be stressed or killed, primarily through changes in water temperature during the route from cooling intake structure to discharge structure and mechanical damage (turbulence in pumps and condensers). Because of the limited scope and short duration of drilling activities, any short-term impacts of entrainment are not expected to be biologically significant to plankton or ichthyoplankton populations (BOEM, 2017a).

Impacts of a Small Fuel Spill

Potential spill impacts on fisheries resources are discussed by BOEM (2016b, 2017a). For this 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 pelagic communities, including ichthyoplankton. 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 thin slick on the water surface and introduce concentrations of petroleum hydrocarbons and their degradation products. The extent and persistence of impacts would depend on the meteorological and oceanographic conditions at the time and the effectiveness of spill response measures. **Section A.9.1** discusses the likely fate of a small fuel spill and indicates that more than 90% would evaporate or disperse naturally within 24 hours. The area of diesel fuel on the sea surface would range from 1.2 to 12 ac (0.5 to 5 ha), depending on sea state and weather conditions.

A small fuel spill could have localized impacts on phytoplankton, zooplankton, ichthyoplankton, and nekton. Due to the limited areal extent and short duration of water quality impacts, a small fuel spill would be unlikely to produce detectable impacts on pelagic communities.

Impacts of a Large Oil Spill

Potential spill impacts on pelagic communities and ichthyoplankton are discussed by BOEM (2016b, 2017a). For this DOCD, there are no unique site-specific issues.

A large oil spill could directly affect water column biota including phytoplankton, zooplankton, ichthyoplankton, and nekton. A large spill that persisted for weeks or months would be more likely to affect these communities. While adult and juvenile fishes may actively avoid a large spill, planktonic eggs and larvae would be unable to avoid contact. Eggs and larvae of fishes in the upper layers of the water column are especially vulnerable to oiling; certain toxic fractions of spilled oil may be lethal to these life stages. Impacts would be potentially greater if local scale currents retained planktonic larval assemblages (and the floating oil slick) within the same water mass. Impacts to ichthyoplankton from a large spill would be greatest during spring and summer when concentrations of ichthyoplankton on the continental shelf peak (BOEM, 2014, 2015, 2016b).

Oil spill impacts to phytoplankton include changes in community structure and increases in biomass, which have been attributed to the effects of oil contamination and of decreased predation due to zooplankton mortality (Abbriano et al., 2011; Ozhan et al., 2014). Ozhan et al. (2014) reported that the formation of oil films on the water surface can limit gas exchange through the air-sea interface and can reduce light penetration into the water column which will limit phytoplankton photosynthesis. Determining the impact of a diesel spill on phytoplankton is a complex issue, as some phytoplankton species are more tolerant of oil exposure than others while some species are more tolerant under low concentrations and some under high concentrations (Ozhan et al., 2014). Phytoplankton populations can change quickly on small temporal and spatial scales, making it difficult to predict how a phytoplankton community as a whole will respond to an oil spill.

Mortality of zooplankton has been shown to be positively correlated with oil concentrations (Lennuk et al., 2015). Spills that are not immediately lethal can have short- or long-term impacts on biomass and community composition, behavior, reproduction, feeding, growth and development, immune response and respiration (Harvell et al., 1999; Wootton et al., 2003; Auffret et al., 2004; Hannam et al., 2010; Bellas et al., 2013; Blackburn et al., 2014). Zooplankton are especially vulnerable to acute oil pollution, showing increased mortality and sublethal changes in physiological activities (e.g., egg production) (Moore and Dwyer, 1974; Linden, 1976; Lee et al., 1978; Suchanek, 1993). Zooplankton may also accumulate PAHs through diffusion from surrounding waters, direct ingestion of micro-droplets (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 (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. In 2005, the EFH for these managed species was redefined in Generic Amendment No. 3 to the various Fishery Management Plans (GMFMC, 2005). The EFH for most of these GMFMC-managed species is on the continental shelf in waters shallower than 600 ft (183 m). The shelf edge is the outer boundary for coastal migratory pelagic fishes, reef fishes, and shrimps. EFH for corals and coral reefs includes some shelf-edge topographic features located approximately 40 miles (64 km) from the project area.

EFH has been identified in the deepwater Gulf of Mexico for highly migratory pelagic fishes, which occur as transients in the project area. Species in this group, including tunas, swordfishes, billfishes, and sharks, are managed by NMFS. Highly migratory species with EFH within or near the project area include the following (NMFS, 2009c):

- Bigeye thresher shark (all)
- Blue marlin (juveniles, adults)
- Bluefin tuna (spawning, eggs, larvae, adult)
- Longbill spearfish (juveniles, adults)
- Longfin mako shark (all)
- Oceanic whitetip shark (all)
- Silky Shark (all)
- Skipjack tuna (spawning, adults)
- Swordfish (larvae, juveniles, adults)
- Whale shark (all)
- White marlin (juveniles, adults)
- Yellowfin tuna (spawning, juveniles, adults)

Research indicates the central and western Gulf of Mexico may be important spawning habitat for Atlantic bluefin tuna (*Thunnus thynnus*) (Theo and Block, 2010), and NMFS (2009b) has designated a Habitat Area of Particular Concern (HAPC) for this species. The HAPC covers much of the deepwater Gulf of Mexico, including the project area (**Figure 2**). The areal extent of the HAPC is approximately 115,830 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 U.S. and Canadian coasts, followed by migration to the Gulf of Mexico to spawn in April, May, and June (NMFS, 2009c). The Atlantic bluefin tuna has also been designated as a species of concern (NMFS, 2011).

NTLs 2009-G39 and 2009-G40 provide guidance and clarification of regulations for biologically sensitive underwater features and areas, and benthic communities that are considered EFH. As part of an agreement between BOEM and NMFS to complete a new programmatic EFH consultation for each new Five-Year Program, an EFH consultation was initiated between BOEM's Gulf of Mexico Region and NOAA's Southeastern Region during the preparation, distribution, and review of BOEM's 2017-2022 WPA/CPA Multisale EIS (BOEM, 2017a). The EFH assessment was completed and there is ongoing coordination among NMFS, BOEM, and BSEE, including discussions of mitigation (BOEM, 2016c).

Other HAPCs have been designated in the Gulf of Mexico Fishery Management Council (2005, 2010). These include the Florida Middle Grounds, Madison-Swanson Marine Reserve, Tortugas North and South Ecological Reserves, Pulley Ridge, and several other reefs and banks of the northwestern Gulf of

Mexico (**Figure 2**). The nearest HAPC is Madison-Swanson Marine Reserve, which is located approximately 130 miles (209 km) from the project area.

Routine IPFs that could potentially affect EFH and fisheries resources include MODU presence, noise, and lights; effluent discharges; and water intakes. In addition, two types of accidents (a small fuel spill and a large oil spill) may potentially affect EFH and fisheries resources.

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

The MODUs, as floating structures in the deepwater environment, will act as FADs. 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). The FAD effect would likely attract and concentrate smaller fish species and thus enhance feeding of epipelagic predators.

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

Effluent discharges from the MODUs and support vessels are expected to include treated sanitary and domestic wastes, deck drainage, non-contaminated well treatment and completion fluids, workover fluids, desalination unit discharge, blowout preventer fluid, ballast water, bilge water, cement slurry, fire water, hydrate inhibitor, subsea production control fluid, non-contact cooling water, and treated or untreated seawater. All discharges shall comply with the NPDES General Permit and/or USCG regulations, as applicable.

Effluent discharges affecting EFH by diminishing ambient water quality include drilling muds and cuttings, treated sanitary and domestic wastes, deck drainage, non-contaminated well treatment and completion fluids, workover fluids, desalination unit discharge, blowout preventer fluid, ballast water, bilge water, cement slurry, fire water, hydrate inhibitor, subsea production control fluid, non-contact cooling water, and treated or untreated seawater. 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 biologically 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 thin slick on the water surface and introduce concentrations of petroleum hydrocarbons and their degradation products. The extent and persistence of impacts would depend on the meteorological and oceanographic conditions at the time and the effectiveness of spill response measures. **Section A.9.1** discusses the likely fate of a small fuel spill and indicates that more than 90% would evaporate or disperse naturally within 24 hours. The area of diesel fuel on the sea surface would range from 1.2 to 12 ac (0.5 to 5 ha), depending on sea state and weather conditions.

A small fuel spill could have localized impacts on EFH for highly migratory pelagic fishes, including tunas, swordfishes, billfishes, and sharks. These species occur as transients in the project area. A spill would also produce short-term impact on surface and near-surface water quality in the HAPC for spawning Atlantic bluefin tuna, which covers much of the deepwater Gulf of Mexico. The affected area would represent a negligible portion of the HAPC, which covers approximately 115,830 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 of which is located approximately 40 miles (64 km) from the project area. A small fuel spill would float and dissipate on the sea surface and would not contact these seafloor features. Therefore, no significant spill impacts on EFH for corals and coral reefs are expected.

Impacts of a Large Oil Spill

Potential spill impacts on EFH are discussed by BOEM (2016b, 2017a). For this 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 bluefin tuna (NMFS, 2009b). A large spill could temporarily degrade the HAPC due to increased hydrocarbon concentrations in the water column, with the potential for lethal or sublethal impacts on spawning tuna. Potential impacts would depend in part on the timing of a spill, as this species migrates to the Gulf of Mexico to spawn in April, May, and June (NMFS, 2009b).

The nearest feature designated as EFH for corals is located 40 miles (64 km) from the project area. An accidental spill could reach or affect this feature, although near-bottom currents in the region are expected to flow along the isobaths (Nowlin et al., 2001; Valentine et al., 2014) and typically would not carry a plume up onto the continental shelf edge.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in 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 would likely be temporary and short-term. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. 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 >656 ft (200 m) water depth that have been exempted from high-resolution surveys. Since significant historic shipwrecks have recently been discovered outside the previously designated high-probability areas (some of which show evidence of impacts from permitted activities prior to their discovery), a survey is now required for exploration and development projects.

Based on NTL 2011-JOINT-G01, the project area is on BOEM's list of archaeological survey blocks determined to have a high potential for containing archaeological properties (BOEM, 2011). The shallow hazard assessment identified no sonar contacts within 2,000 ft (610 m) of proposed wellsites considered to have archaeological potential (Fugro Geoservices, Inc., 1996, 2007, 2009a,b,c; AOA Geophysics, Inc., 2004; Oceaneering 2018a,b). No archaeological impacts are expected from routine activities in the project area.

Because no historic shipwreck sites are 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 historic shipwrecks in the project area, this impact would not be relevant.

Beyond the seafloor blowout radius, there is the potential for impacts from oil, dispersants, and depleted oxygen levels (BOEM, 2017a). These impacts could include chemical contamination, alteration of the rates of microbial activity (BOEM, 2017a), and reduced biodiversity as shipwreck-associated sediment microbiomes (Hamdan et al., 2018). During the *Deepwater Horizon* incident, subsurface plumes were reported at a water depth of approximately 3,600 ft (1,100 m), extending at least 22 miles (35 km) from the wellsite and persisting for more than a month (Camilli et al., 2010). The subsurface plumes apparently resulted from the use of dispersants at the wellhead (NOAA, 2011b). While the behavior and impacts of subsurface plumes are not well known, a subsurface plume could contact shipwreck sites beyond the 984-foot (300-meter) radius estimated by BOEM (2012a), depending on its extent, trajectory, and persistence (Spier et al., 2013). If oil from a subsea spill should contact wooden shipwrecks on the seafloor, it could adversely affect their condition or preservation.

A spill entering shallow coastal waters could conceivably contaminate undiscovered or known historic shipwreck sites. Based on the 30-day OSRA modeling (**Table 3**), coastal areas in Plaquemines Parish could be affected within 3 days of a spill (4% conditional probability), within 10 days of a spill (14% conditional probability). Terrebonne, St. Bernard, and Lafourche parishes may also be affected within 10 days of a spill (up to 3% conditional probability). Coastal areas between Cameron parish, Louisiana, and Bay County, Florida, may be affected within 30 days (1% to 21% conditional probability). If an oil spill contacted a coastal historic site, such as a fort or a lighthouse, the impacts may be temporary and reversible (BOEM, 2017a). Undiscovered shipwreck sites on or nearshore could also be impacted by foot or vehicle traffic during response and clean-up efforts in the aftermath of a spill.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in 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.6.2 Prehistoric Archaeological Sites

As the water depth at the proposed project area ranges from approximately 7,349 to 7,524 ft (2,240 to 2,293 m), the project area is well beyond the 197 ft (60 m) depth contour used by BOEM as the seaward extent for prehistoric archaeological site potential in the Gulf of Mexico. Because prehistoric archaeological sites are not found in the project area, the only relevant IPF is a large oil spill that would reach coastal waters within the 197 ft (60 m) depth contour.

Impacts of a Large Oil Spill

Because of the water depth and the lack of prehistoric archaeological sites found in the project area, it is highly unlikely that any such resources would be affected by the physical effects of a subsea blowout. BOEM (2012a) estimates that a severe subsurface blowout could resuspend and disperse sediments within a 984 ft (300 m) radius.

Along the northern Gulf Coast, prehistoric sites occur frequently along the barrier islands and mainland coast and along the margins of bays and bayous (BOEM, 2012a). Based on the 30-day OSRA modeling (**Table 3**), coastal areas in Plaquemines Parish could be affected within 3 days of a spill (4% conditional probability) and within 10 days of a spill (14% conditional probability). Terrebonne, St. Bernard, and Lafourche parishes may also be affected within 10 days of a spill (up to 3% conditional probability). Coastal areas between Cameron Parish, Louisiana, and Bay County, Florida, may be affected within 30 days (1% to 21% conditional probability). A spill reaching a prehistoric site along these shorelines could coat fragile artifacts or site features and compromise the potential for radiocarbon dating organic materials in a site (although other dating methods are available, and it is possible to decontaminate an oiled sample for radiocarbon dating). Coastal prehistoric sites could also be damaged by spill cleanup operations (e.g., destroying fragile artifacts, 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. Most of the northern Gulf of Mexico is fringed by coastal and barrier island beaches, with wetlands, oyster reefs, and submerged seagrass beds occurring in sheltered areas behind the barrier islands and in estuaries.

Because of the distance from shore, the only IPF associated with routine activities in the project area that could affect beaches and dunes, wetlands, oyster reefs, seagrass beds, coastal wildlife refuges, wilderness areas, or any other managed or protected coastal area is support vessel traffic. The support bases at Port Fourchon and Houma, Louisiana are not located in wildlife refuges or wilderness areas. Potential impacts of support vessel traffic are briefly addressed below.

A large oil spill is the only accidental IPF that could affect coastal habitats and protected areas. A small fuel spill in the project area would be unlikely to affect coastal habitats because the project area is 75 miles (121 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

Support operations, including the crew boats and supply boats as detailed in DOCD Section 14, may have a minor incremental impact on coastal and barrier island beaches, wetlands, oyster reefs, and protected habitats. Over time with a large number of vessel trips, vessel wakes can erode shorelines along inlets, channels, and harbors, resulting in localized land loss. Impacts will be minimized by following the speed and wake restrictions in harbors and channels.

Support operations, including crew boats and supply boats, are not anticipated to have a significant impact on submerged seagrass beds. While submerged seagrass beds have the potential to be uprooted, scarred, or lost due to direct contact from vessels, use of navigation channels and adherence to local requirements and implemented programs will decrease the likelihood of impacts to submerged seagrass beds BOEM (2017a,c).

Impacts of a Large Oil Spill

Potential spill impacts on coastal habitats are discussed by BOEM (2016b, 2017a). Coastal habitats inshore of the project area include coastal and barrier island beaches, wetlands, oyster reefs, and submerged seagrass beds. For this DOCD, there are no unique site-specific issues with respect to coastal habitats.

Based on the 30-day OSRA modeling (**Table 3**), coastal areas in Plaquemines Parish could be affected within 3 days of a spill (4% conditional probability) and within 10 days of a spill (4% conditional probability). Terrebonne, St. Bernard, and Lafourche parishes may also be affected within 10 days of a spill (up to 3% conditional probability). Coastal areas between Cameron Parish, Louisiana, and Bay County, Florida, may be affected within 30 days (1% to 21% conditional probability).

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**.

Table 6. Wildlife refuges, wilderness areas, and state and national parks and preserves within the geographic range of 1% or greater conditional probability of shoreline contacts within 30 days of a hypothetical spill from Launch Point 57 based on the 30-day Oil Spill Risk Analysis model.

County or Parish, State	Wildlife Refuge, Wilderness Area, or State/National Park
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
Terrebonne, Louisiana	Isles Dernieres Barrier Islands Refuge
	Pointe aux Chenes Wildlife Management Area
Lafourche, Louisiana	Pointe aux Chenes Wildlife Management Area
	Wisner Wildlife Management Area (Includes Picciola Tract)
Plaquemines, Louisiana	Breton National Wildlife Refuge
	Delta National Wildlife Refuge
	Pass a Loutre Wildlife Management Area
St. Bernard, Louisiana	Biloxi State Wildlife Management Area
	Breton National Wildlife Refuge
Hancock, Mississippi	Buccaneer State Park
	Grand Bayou Preserve
	Jourdan River Preserve
	Hancock County Marshes Preserve
Harrison, Mississippi	Bayou Portage Preserve
	Biloxi River Marshes Preserve
	Cat Island Preserve
	Deer Island Preserve
	Gulf Islands National Seashore
	Hiller Park Recreation Area
	Jourdan River Preserve
	Sandhill Crane Refuge Preserve
	Ship Island Preserve
	Wolf River Preserve
Jackson, Mississippi	Bellefontaine Marsh Preserve
	Davis Bayou Preserve
	Escatawpa River Marsh Preserve
	Grand Bay National Estuarine Research Reserve
	Grand Bay Savanna Preserve
	Graveline Bay Preserve
	Gulf Islands National Seashore
	Gulf Islands Wilderness
	Horn Island Preserve
	Old Fort Bayou Preserve
	Pascagoula River Marsh Preserve
	Petit Bois Island Preserve
	Round Island Preserve
	Shepard State Park

County or Parish, State	Wildlife Refuge, Wilderness Area, or State/National Park
Baldwin, Alabama	Betty and Crawford Rainwater Perdido River Nature Preserve
	Bon Secour NWR
	Gulf State Park
	Meaher State Park
	Mobile-Tensaw Delta CIAP Parcel State Habitat Area
	Mobile-Tensaw Delta WMA
	Perdido River Water Management Area
	W.L. Holland WMA
	Weeks Bay Harris and Worcester Tracts
	Weeks Bay National Estuarine Research Reserve
	Weeks Bay Reserve Addition - Beck Tract
Mobile, Alabama	Grand Bay National Wildlife Refuge
	Grand Bay Savanna State Nature Preserve
	Mobile-Tensaw Delta WMA
	Penalver Park
	The Grand Bay Savanna Tract (and Addition Tract)
	W.L. Holland WMA
Escambia, Florida	Bayou Marcus Wetlands
	Big Lagoon State Park
	Blue Angel Recreation Park
	Bay Bluffs Park
	Ft. Pickens Aquatic Preserve
	Gulf Islands National Seashore
	Mallory Heights Park #3
	Perdido Bay/Crown Pointe Preserve
	Perdido Key State Park
	Tarkiln Bayou Preserve State Park
	USS Massachusetts (BB-2) Underwater Archaeological Preserve
	Wayside 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
Walton, Florida	Choctawhatchee River Delta Preserve
	Choctawhatchee River Water Management Area
	Deer Lake State Park
	Grayton Beach State Park
	Point Washington State Forest
	Topsail Hill Preserve State Park
Bay, Florida	Camp Helen State Park
	SS Tarpon Underwater Archaeological Preserve
	St. Andrews Aquatic Preserve
	St. Andrews State Park
	Vamar Underwater Archaeological Preserve

The level of impacts from oil spills on coastal habitats depends on many factors, including the oil characteristics, the geographic location of the landfall, and the weather and oceanographic conditions at the time of the spill (BOEM, 2017a). Oil that makes it to beaches may be liquid, weathered oil, an oil-and-water mousse, or tarballs. Oil is generally deposited on beaches in lines defined by wave action at the time of landfall. Oil that remains on the beach will thicken as its volatile components are lost. Thickened oil may form tarballs or aggregations that incorporate sand, shell, and other materials into its mass. Tar may be buried to varying depths under the sand. On warm days, both exposed and buried tarballs may liquefy and ooze. Oozing may also serve to expand the size of a mass as it incorporates beach materials. Oil on beaches may be cleaned up manually, mechanically, or both. Some oil can remain on the beach at varying depths and may persist for several years as it slowly biodegrades and volatilizes (BOEM, 2017a). Impacts associated with an extensive oiling of coastal and barrier island beaches from a large oil spill are expected to be adverse.

Coastal wetlands are highly sensitive to oiling and can be significantly impacted because of the inherent toxicity of hydrocarbon and non-hydrocarbon components of the spilled substances (Mendelssohn et al., 2012; Lin et al., 2016). Numerous variables such as oil concentration and chemical composition, vegetation type and density, season or weather, preexisting stress levels, soil types, and water levels may influence the impacts of oil exposure on wetlands. Light oiling could cause plant die-back, followed by recovery in a fairly short time. Vegetation exposed to oil that persists in wetlands could take years to recover (BOEM, 2017a). However, in a study in Barataria Bay, Louisiana, after the *Deepwater Horizon* spill, Silliman et al. (2012) reported that previously healthy marshes largely recovered to a pre-oiling state within 18 months. At 103 salt marsh locations that spanned 267 miles (430 km) of shoreline in Louisiana, Mississippi, and Alabama, Silliman et al. (2016) determined a threshold for oil impacts on marsh edge erosion, with higher erosion rates occurring for approximately 1 to 2 years after the *Deepwater Horizon* spill at sites with the highest amounts of plant stem oiling (90% to 100%); thus, displaying a large-scale ecosystem loss. In addition to the direct impacts of oil, cleanup activities in marshes may accelerate rates of erosion and retard recovery rates (BOEM, 2017a). Impacts associated with an extensive oiling of coastal wetland habitat are expected to be significant.

In addition to the direct impacts of oil, cleanup activities in marshes may accelerate rates of erosion and retard recovery rates (BOEM, 2017a). A review of the literature and new studies indicated that oil spill impacts to seagrass beds are often limited and may be limited to when oil is in direct contact with these plants (Fonseca et al., 2017). Impacts associated with an extensive oiling of coastal wetland habitat are expected to be significant.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in 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 major species sought by commercial fishermen in federal waters of the Gulf of Mexico include shrimp, menhaden, red snapper, tunas, and groupers (BOEM, 2017a). However, most of the fishing effort for these species is on the continental shelf in shallow waters. The main commercial fishing activity in deep waters of the northern Gulf of Mexico is pelagic longlining for tunas, swordfishes, and other billfishes (Continental

Shelf Associates, 2002; Beerkircher et al., 2009). Pelagic longlining has occurred historically in the project area, primarily during spring and summer.

It is unlikely that any commercial fishing activity other than longlining will occur at or near the project area due to the water depth at the project area. Benthic species targeted by commercial fishers occur on the upper continental slope, well inshore of the project area. Royal red shrimp (*Pleoticus robustus*) are caught by trawlers in water depths of approximately 820 to 1,804 ft (250 to 550 m) (Stiles et al., 2007). Tilefishes (primarily *Lopholatilus chamaeleonticeps*) are caught by bottom longlining in water depths from approximately 540 to 1,476 ft (165 to 450 m) (Continental Shelf Associates, 2002).

Most recreational fishing activity in the region occurs in water depths less than 656 ft (200 m) (Continental Shelf Associates, 1997, 2002; Keithly and Roberts, 2017). In deeper water, the main attraction to recreational fishers is petroleum rigs offshore Texas and Louisiana. Due to the project site's distance from shore, it is unlikely that recreational fishing activity is occurring in the project area.

The only routine IPF that could potentially affect fisheries (commercial and recreational) is MODU presence (including noise and lights). Two types of potential accidents are also addressed in this section: a small fuel spill and a large oil spill.

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

There is a slight possibility of pelagic longlines drifting into and becoming entangled in the MODUs. For example, in January 1999, a portion of a pelagic longline snagged on the acoustic Doppler current profiler of a drillship working in the Gulf of Mexico (Continental Shelf Associates, 2002). The line was removed without incident. Generally, longline fishers use radar and are aware of offshore structures and ships when placing their sets. Therefore, little or no impact on pelagic longlining is expected.

No other adverse impacts on fishing activities are anticipated. The presence of the MODUs would result in a limited area being unavailable for fishing activity, but this effect is considered negligible. Other factors such as effluent discharges are likely to have negligible impacts on commercial or recreational fisheries due to rapid dispersion, the small area of ocean affected, and the intermittent nature of the discharges.

Impacts of a Small Fuel Spill

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

Pelagic longlining activities in the project area, if any, could be interrupted in the event of a small fuel spill. The area of diesel fuel on the sea surface would range from 1.2 to 12 ac (0.5 to 5 ha), depending on sea state and weather conditions. Fishing activities could be interrupted due to the activities of response vessels operating in the project area. A small fuel spill would not affect coastal water quality because the spill would not be expected to make landfall or reach coastal waters prior to breaking up (**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, 2010b). 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 Exclusive Economic Zone. BOEM (2012a) notes that fisheries closures from a large spill event could have a negative effect on short-term fisheries catch and marketability.

According to BOEM (2012a, 2017a), the potential impacts on commercial and recreational fishing activities from an accidental oil spill are anticipated to be minimal because the potential for oil spills is very low; the most typical events are small and of short duration; and the effects are so localized that fishes are typically able to avoid the affected area. Fish populations may be affected by an oil spill event should it occur, but they would be primarily affected if the oil reaches the productive shelf and estuarine areas where many fishes spend a portion of their life cycle. However, most species of commercially valuable fish in the Gulf of Mexico have planktonic eggs or larvae which may be affected by a large oil spill in deep water (BOEM, 2017a). The probability of an offshore spill affecting these nearshore environments is also low.

Should a large oil spill occur, economic impacts on commercial and recreational fishing activities would likely occur, but are difficult to predict because impacts would differ by fishery and season (BOEM, 2017a,c). 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 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.8.2 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, 75 miles (121 km) from the nearest shoreline (Louisiana). 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 MODUs maintain 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. No significant spill impacts on public health and safety are expected.

C.8.3 Employment and Infrastructure

There are no IPFs associated with routine operations that are expected to affect employment and infrastructure. The project involves drilling with support from existing shore-based facilities in Texas and Louisiana. No new or expanded facilities will be constructed, and no new employees are expected to move permanently into the area. The project will have a negligible impact on socioeconomic conditions such as local employment and existing offshore and coastal infrastructure (including major sources of supplies, services, energy, and water). A small fuel spill that is dissipated within a few days would have little or no economic impact, as the spill response would use existing facilities, resources, and personnel. A large oil spill is the only IPF that has the potential to affect employment and infrastructure.

Impacts of a Large Oil Spill

Potential socioeconomic impacts of an oil spill are discussed by BOEM (2016b, 2017a). For this 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 activities, including service and support operations that are an important part of local economies, could be suspended.

Nonmarket effects such as traffic congestion, strains on public services, shortages of commodities or services, and disruptions to the normal patterns of activities or expectations could also occur in the short term. These negative, short-term social and economic consequences of a spill are expected to be modest in terms of projected cleanup expenditures and the number of people employed in cleanup and remediation activities (BOEM, 2017a). Net employment impacts from a spill would not be expected to exceed 1% of baseline employment in any given year (BOEM, 2017a).

The project area is 75 miles (121 km) from the nearest shoreline (Louisiana). Based on the 30-day OSRA modeling (**Table 3**), coastal areas in Plaquemines Parish could be affected within 3 days of a spill (4% conditional probability) and within 10 days of a spill (14% conditional probability). Terrebonne, St. Bernard, and Lafourche parishes may also be affected within 10 days of a spill (up to 3% conditional probability). Coastal areas between Cameron Parish, Louisiana, and Bay County, Florida, may be affected within 30 days (1% to 21% conditional probability).

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

C.8.4 Recreation and Tourism

For this DOCD, there are no unique site-specific issues with respect to recreation and tourism. There are no known recreational or tourism uses in the project area. Recreational resources and tourism in coastal areas would not be affected by routine activities due to the distance from shore. Compliance with NTL BSEE-2015-G013 (See **Table 1**) will minimize the chance of trash or debris being lost overboard from the MODUs and subsequently washing up on beaches. As explained in **Section A.9.1**, a small fuel spill would not be expected to make landfall or reach coastal waters prior to 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. Loss of tourist confidence and public health concerns can then lead to the potential for economic loss. Media coverage of oil contamination, or word-of-mouth, can have implications on public perception of the incident. However, quantifying financial loss due to loss in confidence can be difficult because it depends on implementation of an effective response plan as well as a strategy to restore any loss of appeal to tourists that the area may have suffered.

Based on the 30-day OSRA modeling (**Table 3**), coastal areas in Plaquemines Parish could be affected within 3 days of a spill (4% conditional probability) and within 10 days of a spill (14% conditional probability). Terrebonne, St. Bernard, and Lafourche parishes may also be affected within 10 days of a spill (up to 3% conditional probability). Coastal areas between Cameron Parish, Louisiana, and Bay County, Florida, may be affected within 30 days (1% to 21% conditional probability).

According to BOEM (2017a), should an oil spill occur and contact a beach area or other recreational resource, it would cause some disruption during the impact and cleanup phases of the spill. However, these effects are also likely to be small in scale and of short duration, in part because the probability of an offshore spill contacting most beaches is small. In the unlikely event that a spill occurs that is sufficiently large to affect large 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. The U.S. Travel Association has estimated the economic impact of the *Deepwater Horizon* incident on tourism across the Gulf Coast over a 3-year period at $22.7 billion (Oxford Economics, 2010). Hotels and restaurants were the most affected tourism businesses, but charter fishing, marinas, and boat dealers and sellers were among the others affected (Eastern Research Group, 2014).

However, a blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell’s well control and blowout prevention measures as detailed in 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 accidental IPF. A small fuel spill would not have impacts on land use, as the response would be staged out of existing shorebases and facilities.

Impacts of a Large Oil Spill

The initial response for a large oil spill would be staged out of existing facilities, with no effect on land use. A large spill could have limited temporary impacts on land use along the coast if additional staging areas were needed. For example, during the *Deepwater Horizon* incident, 25 temporary staging areas were established in Louisiana, Mississippi, Alabama, and Florida for spill response and cleanup efforts (BOEM, 2012a). In the event of a large spill in the project area, similar temporary staging areas could be needed. These areas would eventually return to their original use as the response is demobilized.

An oil spill is not likely to significantly affect land use and coastal infrastructure in the region, in part because an offshore spill would have a small probability of contacting onshore resources. BOEM (2016b) states that landfill capacity would probably not be an issue at any phase of an oil spill event or the long-term recovery. In the case of the *Deepwater Horizon* incident and response, USEPA reported that existing landfills receiving oil spill waste had sufficient capacity to handle waste volumes; the wastes that were disposed of in landfills represented less than 7% of the total daily waste normally accepted at these landfills (USEPA, 2016).

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in 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 or shipping lane but is located within a Military Warning Area (EWTA-1). Shell will comply with BOEM requirements and lease stipulations to avoid impacts on uses of the area by military vessels and aircrafts.

Previously drilled wells, flowlines, umbilical, transponder frames, and other subsea equipment are located within 2,000 ft (610 m) of the proposed wellsites (Fugro Geoservices, Inc., 1996, 2009a; AOA Geophysics, Inc., 2004; Oceaneering 2018a,b). Operations will be conducted using DGPS for positioning to avoid all existing pipelines, wells, and other equipment located within 500 ft (152 m) the proposed production wellsites or infrastructure installation location.

The shallow hazard assessment identified no sonar contacts within 2,000 ft (610 m) of proposed wellsites that were determined to have archaeological potential (Fugro Geoservices, Inc., 1996, 2007, 2009a,b,c;

AOA Geophysics, Inc., 2004; Oceaneering 2018a,b). However, two sonar contacts were identified within 2,000 ft (610 m). These sonar contacts were identified as modern debris with suggested 100 ft (30 m) avoidance radius. No archaeological impacts are expected from routine activities in the project area. A large oil spill is the only relevant IPF. A small fuel spill would not have impacts on other marine uses because the spill and response activities would be mainly within the project area, and the duration would be brief.

Impacts of a Large Oil Spill

An accidental spill would be unlikely to significantly affect shipping or other marine uses. The lease block is not located within any USCG-designated fairway or shipping lane but is within a Military Warning Area (EWTA-1). In the event of a large spill requiring numerous response vessels, coordination would be required to manage the vessel traffic for safe operations.

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

<u>Prior Studies</u>. 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,b, 2013, 2014, 2015, 2016a,b, 2017a). Past, present, and reasonably foreseeable activities were identified in the cumulative effects scenario of these documents, which are incorporated by reference. The proposed action will not result in any additional impacts beyond those evaluated in the multisale and Final EISs.

<u>Description of Activities Reasonably Expected to Occur in the Vicinity of Project Area</u>. 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).

<u>Cumulative Impacts of Activities in the Exploration Plan</u>. The BOEM (2017a) Final EIS included a lengthy discussion of cumulative impacts, which analyzed the environmental and socioeconomic impacts from the incremental impact of the 10 proposed lease sales, in addition to all activities (including non-OCS activities) projected to occur from past, proposed, and future lease sales. The EISs considered exploration, delineation, and development wells; platform installation; service vessel trips; and oil spills. The EISs examined the potential cumulative effects on each specific resource for the entire Gulf of Mexico.

The EIA incorporates and builds on these analyses by examining the potential impacts on physical, biological, and socioeconomic resources from the work planned in this 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 the impacts on the physical/chemical environment will be correspondingly limited.

Air Quality. Emissions from pollutants into the atmosphere from activities are not projected to have significant effects on onshore air quality because of the distance from shore, the prevailing atmospheric conditions, emission rates and heights, and resulting pollutant concentrations. As BOEM found in the multisale EISs, the incremental contribution of activities similar to Shell's proposed activities to the cumulative impacts is not significant and will not cause or contribute to a violation of NAAQS (BOEM, 2012a, 2013, 2014, 2015, 2016b, 2017a). In addition, the cumulative contribution to visibility impairment is also very small. As mentioned in previous sections, projected emissions meet BOEM's exemption criteria and would not contribute to cumulative impacts on air quality.

Climate Change. 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 water-based drilling fluids and associated cuttings, cuttings wetted with SBM, treated sanitary and domestic wastes, deck drainage, non-contaminated well treatment and completion fluids, workover fluids, desalination unit discharge, blowout preventer fluid, ballast water, bilge water, cement slurry, fire water, hydrate inhibitor, subsea production control fluid, non-contact cooling water, and treated or untreated seawater. These effects are expected to be minor (localized to the area within a few hundred meters of the MODUs) and temporary (lasting only hours longer than the disturbance or discharge). Any cumulative effects to water quality are expected to be negligible.

Archaeological Resources. MC 391, MC 392, and MC 393 are on the list of archaeology survey blocks (BOEM, 2011). No known shipwrecks or other archaeological artifacts were identified during the archaeological assessment (Fugro Geoservices, Inc., 1996, 2007, 2009a,b,c; AOA Geophysics, Inc., 2004; Oceaneering 2018a,b). The project area is well beyond the 197 ft (60 m) depth contour used by BOEM as the seaward extent for prehistoric archaeological site potential in the Gulf of Mexico. Therefore, Shell's operations will have no cumulative impacts on historic shipwrecks or prehistoric archaeological resources.

New Information. New information included in the most recent Programmatic, Supplemental, and Final EISs (BOEM, 2012a, 2013, 2014, 2015, 2016a,b, 2017a) has been incorporated into the EIA, where applicable.

C.9.2 Cumulative Impacts to Biological Resources

The work planned in this 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 discharges of drilling mud and cuttings are expected to be minor and limited to a small area. The geophysical survey data did not identify any features that could support high-density deepwater benthic communities within 2,000 ft (610 m) of the proposed wellsite locations (Fugro Geoservices, Inc., 1996, 2009a; AOA Geophysics, Inc., 2004; Oceaneering 2018a,b).

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 are 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 aircraft 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 (2020) Appendix B and C. No significant cumulative impacts are expected.

Coastal and Marine Birds. Birds may be exposed to contaminants, including air pollutants and routine discharges, but significant impacts are unlikely due to rapid dispersion. Shell's compliance with NTL BSEE-2015-G013 will minimize the likelihood of debris-related impacts on birds. Support vessel and helicopter traffic may disturb some foraging and resting birds; however, it is likely that individual birds would experience, at most, only short-term behavioral disruption.

Due to the limited scope, timing, and geographic extent of drilling activities, collisions or other adverse effects are unlikely, and no significant cumulative impacts are expected.

Fisheries Resources. Exploration and production structures occur in the vicinity of the project area. The additional effect of the proposed drilling activity would be negligible.

Coastal Habitats. Due to the distance of the wellsites from shore, routine activities are not expected to have any impacts on beaches and dunes, wetlands, seagrass beds, coastal wildlife refuges, wilderness areas, or any other managed or protected coastal area. The support bases are not in wildlife refuges or wilderness areas. Support operations, including the crew boat and supply boats, may have a minor incremental impact on coastal habitats. Over time with a large number of vessel trips, vessel wakes can erode shorelines along inlets, channels, and harbors. Impacts will be minimized by following the speed and wake restrictions in harbors and channels.

New Information. New information included in the most recent Programmatic, Supplemental, and Final EISs (BOEM, 2012a,b, 2013, 2014, 2015, 2016a,b, 2017a) has been incorporated into the EIA, where applicable.

C.9.3 Cumulative Impacts to Socioeconomic Resources

The work planned in this DOCD is limited in geographic scope and duration, and the impacts on socioeconomic resources will be correspondingly limited.

The multisale, Supplemental, and Final EISs analyzed the cumulative impacts of oil and gas exploration and development in the project area, in combination with other impact-producing activities, on commercial fishing, recreational fishing, recreational resources, historical and archaeological resources, land use and coastal infrastructure, demographics, and environmental justice (BOEM, 2012a, 2013, 2014, 2015, 2016b, 2017a). BOEM also analyzed the economic impact of oil and gas activities on the Gulf States, finding only minor impacts in most of Texas, Mississippi, Alabama, and Florida, more significant impacts in parts of Texas, and substantial impacts on Louisiana.

Shell's proposed activities will have negligible cumulative impacts on socioeconomic resources. There are no IPFs associated with routine operations that are expected to affect public health and safety, employment and infrastructure, recreation and tourism, land use, or other marine uses. Due to the distance from shore, it is unlikely that any recreational fishing activity is occurring in the project area, and it is unlikely that any commercial fishing activity other than longlining occurs at or near the project area. The project will have negligible impacts on fishing activities.

New Information. New information included in the most recent Programmatic, Supplemental, and Final EISs (BOEM, 2012a,b, 2013, 2014, 2015, 2016a,b, 2017a) has been incorporated into the EIA, where applicable.

D. Environmental Hazards

D.1 Geologic Hazards

The wellsite assessment reports (Fugro Geoservices, Inc., 1996, 2007, 2009a,b,c; AOA Geophysics, Inc., 2004; Oceaneering 2018a,b) concluded that wellsite locations are suitable for the proposed exploratory drilling activities and no seafloor obstructions or conditions were found that would constrain the proposed project activities. 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 MODUs. 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 MODUs for safety reasons until the storm or weather event passes. In the event of a hurricane, procedures in Shell's Hurricane Evacuation Plan would be followed.

D.3 Currents and Waves

A rig-based acoustic Doppler current profiler will be used to continuously monitor the current beneath the MODUs. Metocean conditions, such as sea state, wind speed, ocean currents, etc., will also be continuously monitored. Under most circumstances, physical oceanographic conditions are not expected to have any effect on the proposed activities. Strong currents (caused by Loop Current eddies and intrusions) and large waves were considered in the design criteria for the MODUs. High waves during a severe storm could disrupt support activities (e.g., vessel and helicopter traffic) and make it necessary to suspend some activities on the MODUs 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 wellsites and the selection of the MODUs, 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 2J.

G. Consultation

No persons beyond those cited as Preparers (**Section H.**, **Preparers**) or agencies were consulted regarding potential impacts associated with the proposed activities during the preparation of the EIA.

H. Preparers

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I. References

Abbriano, R.M., M.M. Carranza, S.L. Hogle, R.A. Levin, A.N. Netburn, K.L. Seto, S.M. Snyder, and P.J.S. Franks. 2011. *Deepwater Horizon* oil spill: A review of the planktonic response. Oceanography 24(3): 294-301.

ABS Consulting Inc. 2016. 2016 Update of Occurrence Rates for Offshore Oil Spills. Prepared for the Bureau of Ocean Energy Management and the Bureau of Safety and Environmental Enforcement. Contract # E15PX00045, Deliverable 7. https://www.bsee.gov/sites/bsee.gov/files/osrr-oil-spill-response-research//1086aa.pdf

ABSG Consulting Inc. 2018. US Outer Continental Shelf Oil Spill Statistics. Arlington (VA): Prepared for US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2018-006. 36 pp.

Ackleh, A.S., G.E. Ioup, J.W. Ioup, B. Ma, J.J. Newcomb, N. Pal, N.A. Sidorovskaia, and C. Tiemann. 2012. Assessing the *Deepwater Horizon* oil spill impact on marine mammal population through acoustics: endangered sperm whales. Journal of the Acoustical Society of America 131(3): 2306-2314.

Almeda, R., Z. Wambaugh, Z. Wang, C. Hyatt, Z. Liu, and E.J. Buskey. 2013. Interactions between zooplankton and crude oil: toxic effects and bioaccumulation of polycyclic aromatic hydrocarbons. PLoS ONE 8(6): e67212.

Anderson, C.M., M. Mayes, and R. LaBelle. 2012. Update of Occurence Rates for Offshore Oil Spills. U.S. Department of the Interior, Bureau of Ocean Energy Management and Bureau of Safety and Environmental Enforcement. OCS Report BOEM 2012-069, BSEE 2012-069. 76 pp.

AOA Geophysics, Inc. 2004. Shallow Hazards Assessment, MC 393 (OCS-G 26254), DC 353 (OCS-G 25852), DC354 (OCS-G 23507), DC397 (OCS-G 25853), and DC398 (OCS-G 25854), Mississippi Canyon and De Soto Canyon Areas, Gulf of Mexico. Report No. 3038.3-SHL-DES. Dated 10/29/2004.

Auffret, M., M. Duchemin, S. Rousseau, I. Boutet, A. Tanguy, D. Moraga, and A. Marhic. 2004. Monitoring of immunotoxic responses in oysters reared in areas contaminated by the Erikaoil spill. Aquatic Living Resources 17(3): 297-302.

Baguley, J.G., P.A. Montagna, C. Cooksey, J.L. Hyland, H.W. Bang, C.L. Morrison, A. Kamikawa, P. Bennetts, G. Saiyo, E. Parsons, M. Herdener, and M. Ricci. 2015. Community response of deep-sea soft sediment metazoan meiofauna to the *Deepwater Horizon* blowout and oil Spill. Marine Ecology Progress Series 528: 127-140.

Barkaszi, M.J., M. Butler, R. Compton, A. Unietis, and B. Bennett. 2012. Seismic Survey Mitigation Measures and Marine Mammal Observer Reports. New Orleans, LA. OCS Study BOEM 2012-015. 51 pp.

Barkaszi, M.J. and C.J. Kelly. 2019. Seismic Survey mitigation Measures and Protected Species Observer Reports: Synthesis Report. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study BOEM 2019-012. 141 pp + apps.

Barkuloo, J.M. 1988. Report on the Conservation Status of the Gulf of Mexico sturgeon, *Acipenser oxyrinchus desotoi*. U.S. Department of the Interior, U.S. Fish and Wildlife Service. Panama City, FL.

Baum, J.K. and R.A. Myers. 2004. Shifting baselines and the decline of pelagic sharks in the Gulf of Mexico. Ecology Letters 7(2): 135-145.

Beerkircher, L., C.A. Brown, and V. Restrepo. 2009. Pelagic Observer Program Data Summary, Gulf of Mexico Bluefin Tuna (Thunnus thynnus) Spawning Season 2007 and 2008; and Analysis of Observer Coverage Levels. NOAA Technical Memorandum NMFS-SEFSC-588. 33 pp.

Bélanger, L. and J. Bédard. 1989. Responses of staging greater snow geese to human disturbance. Journal of Wildlife Management 53(3): 713-719.

Bellas, J., L. Saco-Álvarez, Ó. Nieto, J.M. Bayona, J. Albaigés, and R. Beiras. 2013. Evaluation of artificially-weathered standard fuel oil toxicity by marine invertebrate embryo-genesis bioassays. Chemosphere 90: 1103-1108.

Berrojalbiz, N., S. Lacorte, A. Calbet, E. Saiz, C. Barata, and J. Dachs. 2009. Accumulation and cycling of polycyclic aromatic hydrocarbons in zooplankton. Environmental Science and Technology 43: 2295-2301.

Berry, M., D.T. Booth, and C.J. Limpus. 2013. Artificial lighting and disrupted sea-finding behaviour in hatchling loggerhead turtles (*Caretta caretta*) on the Woongarra coast, south-east Queensland, Australia. Australian Journal of Zoology 61(2): 137-145.

Biggs, D.C. and P.H. Ressler. 2000. Water column biology. In: Deepwater Program: Gulf of Mexico Deepwater Information Resources Data Search and Literature Synthesis. Volume I: Narrative Report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2000-049. pp. 141-187.

BirdLife International 2018. *Charadrius melodus*. The IUCN Red List of Threatened Species 2018. http://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T22693811A131930146.en.

Blackburn, M., C.A.S. Mazzacano, C. Fallon, and S.H. Black. 2014. Oil in Our Oceans. A Review of the Impacts of Oil Spills on Marine Invertebrates. The Xerces Society for Invertebrate Conservation, Portland, OR. 160 pp.

Blackstock, S.A., J.O. Fayton, P.H. Hulton, T.E. Moll, K. Jenkins, S. Kotecki, E. Henderson, V. Bowman, S. Rider, and C. Martin. 2018. Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing. NUWC-NPT Technical Report August 2018. N.U.W.C. Division. Newport, Rhode Island.

Blackwell, S.B. and C.R. Greene Jr. 2003. Acoustic Measurements in Cook Inlet, Alaska, during August 2001. Greeneridge Sciences, Inc., for NMFS, Anchorage, AK. 43 pp.

Boehm, P., D. Turton, A. Raval, D. Caudle, D. French, N. Rabalais, R. Spies, and J. Johnson. 2001. Deepwater Program: Literature Review, Environmental Risks of Chemical Products Used in Gulf of Mexico Deepwater Oil and Gas Operations. Volume I: Technical report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2001-011. 326 pp.

Bolle, L.J., C.A.F. de Jong, S.M. Bierman, P.J.G. Van Beek, O.A. van Keeken, P.W. Wessels, C.J.G. van Damme, H.V. Winter, D. de Haan, and R.P.A. Dekeling. 2012. Common sole larvae survive high levels of pile-driving sound in controlled exposure experiments. PLoS One 7(3): e33052.

Bonde, R.K., and T.J. O'Shea. 1989. Sowerby's beaked whale (*Mesoplodon bidens*) in the Gulf of Mexico. J. Mammal. 70: 447-449.

Brooks, J.M., C. Fisher, H. Roberts, E. Cordes, I. Baums, B. Bernard, R. Church, P. Etnoyer, C. German, E. Goehring, I. McDonald, H. Roberts, T. Shank, D. Warren, S. Welsh, and G. Wolff. 2012. Exploration and Research of Northern Gulf of Mexico Deepwater Natural and Artificial Hard-Bottom Habitats with Emphasis on Coral Communities: Reefs, Rigs, and Wrecks — "Lophelia II" Interim Report. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study BOEM 2012-106.

Bruintjes, R., and A.N. Radford. 2013. Context-dependent impacts of anthropogenic noise on individual and social behaviour in a cooperatively breeding fish. Animal Behaviour 85(6): 1343-1349.

Buehler, D.A. 2000. Bald Eagle (*Haliaeetus leucocephalus*), version 2.0. In: The Birds of North America, A.F Poole, and F.B. Gill, (Eds)i. Cornell Lab of Ornithology, Ithaca, NY, USA. https://birdsna.org/Species-Account/bna/species/baleag/introduction

Bureau of Ocean Energy Management, Regulation, and Enforcement. 2010. Federal & Academic Scientists Return from Deep-sea Research Cruise in Gulf of Mexico: Scientists Observe Damage to Deep-sea Corals. U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement. https://www.boem.gov/BOEM-Newsroom/Press-Releases/2010/press1104a.aspx

Bureau of Ocean Energy Management. 2011. Archaeology Survey Blocks. http://www.boem.gov/Environmental-Stewardship/Archaeology/surveyblocks-pdf.aspx

Bureau of Ocean Energy Management. 2012a. Gulf of Mexico OCS Oil and Gas Lease Sales: 2012-2017. Western Planning Area Lease Sales 229, 233, 238, 246, and 248. Central Planning Area Lease Sales 227, 231, 235, 241, and 247. Final Environmental Impact Statement. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS EIS/EA BOEM 2012-019.

Bureau of Ocean Energy Management. 2012b. Gulf of Mexico OCS Oil and Gas Lease Sale: 2012. Central Planning Area Lease Sale 216/222. Final Supplemental Environmental Impact Statement. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS EIS/EA BOEM 2012-058.

Bureau of Ocean Energy Management. 2013. Gulf of Mexico OCS Oil and Gas Lease Sales: 2013-2014. Western Planning Are Lease Sale 233. Central Planning Area 231. Final Supplemental Environmental Impact Statement. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS EIS/EA BOEM 2013-0118.

Bureau of Ocean Energy Management. 2014. Gulf of Mexico OCS Oil and Gas Lease Sales: 2015-2017. Central Planning Area Lease Sales 235, 241, and 247. Final Supplemental Environmental Impact Statement. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS EIS/EA BOEM 2014-655.

Bureau of Ocean Energy Management. 2015. Gulf of Mexico OCS Oil and Gas Lease Sales: 2016 and 2017. Central Planning Area Lease Sales 241 and 247; Eastern Planning Area Lease Sale 226. Final Supplemental Environmental Impact Statement. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS EIS/EA BOEM 2015-033.

Bureau of Ocean Energy Management. 2016a. Outer Continental Shelf Oil and Gas Leasing Program: 2017-2022. Final Programmatic Environmental Impact Statement. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. OCS EIS/EIA BOEM 2016-060.

Bureau of Ocean Energy Management. 2016b. Gulf of Mexico OCS Oil and Gas Lease Sale: 2016. Western Planning Area Lease Sale 248. Final Supplemental Environmental Impact Statement. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS EIS/EA BOEM 2016-005.

Bureau of Ocean Energy Management. 2016c. Essential Fish Habitat Assessment for the Gulf of Mexico. U.S. Department of the Interior. New Orleans, LA. OCS Report BOEM 2016-016.

Bureau of Ocean Energy Management. 2017a. Gulf of Mexico OCS Oil and Gas Lease Sales: 2017-2025. Gulf of Mexico Lease Sales 249, 250, 251, 252, 253, 254, 256, 257, 259, and 261. Final Multisale Environmental Impact Statement. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA.

Bureau of Ocean Energy Management. 2017b. Gulf of Mexico OCS Oil and Gas Lease Sale. Final Supplemental Environmental Impact Statement 2018. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS EIS/EA BOEM 2017-074.

Bureau of Ocean Energy Management. 2017c. Catastrophic Spill Event Analysis: High-Volume, Extended Duration Oil Spill Resulting from Loss of Well Control on the Gulf of Mexico Outer Continental Shelf. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study BOEM 2017-007. 339 pp.

Bureau of Ocean Energy Management. nd. Chemosynthetic Community Locations in the Gulf of Mexico. http://www.boem.gov/Chemo-Community-Locations-in-the-GOM/

Bureau of Ocean Energy Management. 2019. Seismic Water Bottom Anomalies Map Gallery. https://www.boem.gov/oil-gas-energy/mapping-and-data/map-gallery/seismic-water-bottom-anomalies-map-galleryb

Bureau of Safety and Environmental Enforcement. 2018. Offshore Incident Statistics. U.S. Department of the Interior, Bureau of Safety and Environmental Enforcement. https://www.bsee.gov/stats-facts/offshore-incident-statistics

Camhi, M.D., E.K. Pikitch, and e. E.A. Babcock. 2008. Sharks of the Open Ocean: Biology, Fisheries, and Conservation. Oxford, UK., Blackwell Publishing Ltd. 537 pp.

Camilli, R., C.M. Reddy, D.R. Yoerger, B.A. Van Mooy, M.V. Jakuba, J.C. Kinsey, C.P. McIntyre, S.P. Sylva, and J.V. Maloney. 2010. Tracking hydrocarbon plume transport and biodegradation at *Deepwater Horizon*. Science 330(6001): 201-204.

Carlson, J.K., J. Osborne, and T.W. Schmidt. 2007. Monitoring of the recovery of smalltooth sawfish, *Pristis pectinata*, using standardized relative indices of abundance. Biological Conservation 136: 195-202.

Carlson, J.K. and J. Osborne. 2012. Relative abundance of smalltooth sawfish (*Pristis pectinata*) based on Everglades National Park Creel Survey. NOAA Technical Memorandum NMFS-SEFSC-626. 15 pp. https://repository.library.noaa.gov/view/noaa/4326

Carmichael, R.H., W.M. Graham, A. Aven, G. Worthy, and S. Howden. 2012. Were multiple stressors a 'perfect storm' for northern Gulf of Mexico bottlenose dolphins (*Tursiops truncatus*) in 2011? PLoS One 7(7): e41155.

Carr, A. 1996. Suwanee River sturgeon, pp 73-83. In: M.H. Carr (Ed.), A Naturalist in Florida. Yale University Press, New Haven, CT.

Carroll, M., B. Gentner, S. Larkin, K. Quigley, N. Perlot, L. Degner, and A. Kroetz. 2016. An Analysis of the Impacts of the *Deepwater Horizon* Oil Spill on the Gulf of Mexico Seafood Industry. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study BOEM 2016-020. 179 pp.

Carvalho, R., C.-L. Wei, G.T. Rowe, and A. Schulze. 2013. Complex depth-related patterns in taxonomic and functional diversity of Polychaetes in the Gulf of Mexico. Deep Sea Research Part I: Oceanographic Research Papers 80: 66-77.

Casper, B.M., P.S. Lobel, and H.Y. Yan. 2003. The hearing sensitivity of the little skate, Raja erinacea: a comparison of two methods. Environmental Biology of Fishes 68: 371–379.

Casper, B.M., and D.A. Mann. 2006. Evoked potential audiograms of the nurse shark (Ginglymostoma cirratum) and the yellow stingray (*Urobatis jamaicensis*). Environmental Biology of Fishes 76: 101 108.

Cave, E.J. and S.M. Kajiura. 2018. Effect of *Deepwater Horizon* crude oil water accomodated fraction on olfactory function in the Atlantic stingray, *Hypanus sabinus*. Scientific Reports 8:15786.

Clapp, R.B., R.C. Banks, D. Morgan-Jacobs, and W.A. Hoffman. 1982a. Marine Birds of the Southeastern United States and Gulf of Mexico. Part I. Gaviiformes through Pelicaniformes. U.S. Fish and Wildlife Service, Office of Biological Services. Washington, DC. FWS/OBS-82/01.

Clapp, R.B., D. Morgan-Jacobs, and R.C. Banks. 1982b. Marine Birds of the Southeastern United States and Gulf of Mexico. Part II. Anseriformes. U.S. Fish and Wildlife Service, Office of Biological Services. Washington DC. FWS/OBS 82/20.

Clapp, R.B., D. Morgan-Jacobs, and R.C. Banks. 1983. Marine Birds of the Southeastern United States and Gulf of Mexico. Part III. Charadriiformes. U.S. Fish and Wildlife Service, Office of Biological Services. Washington, DC. FWS/OBS-83/30.

Conn, P. B., and G. K. Silber. 2013. Vessel speed restrictions reduce risk of collision-related mortality for North Atlantic right whales. Ecosphere 4(4):1–16.

Continental Shelf Associates, Inc. 1997. Characterization and Trends of Recreational and Commercial Fishing from the Florida Panhandle. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. USGS/BRD/CR--1997-0001 and OCS Study MMS 97-0020. 336 pp.

Continental Shelf Associates, Inc. 2002. Deepwater Program: Bluewater Fishing and OCS activity, Interactions Between the Fishing and Petroleum Industries in Deepwaters of the Gulf of Mexico. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2002-078. 272 pp.

Continental Shelf Associates, Inc. 2004. Final Report: Gulf of Mexico Comprehensive Synthetic Based Muds Monitoring Program. 3 volumes.

Continental Shelf Associates, Inc. 2006. Effects of Oil and Gas Exploration and Development at Selected Continental Slope Sites in the Gulf of Mexico. Volume II: Technical report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2006-045. 595 pp.

Cordes, E., M.P. McGinley, E.L. Podowski, E.L. Becker, S. Lessard-Pilon, S.T. Viada, and C.R. Fisher. 2008. Coral communities of the deep Gulf of Mexico. Deep Sea Research Part I: Oceanographic Research Papers 55(6): 777-787.

Cruz-Kaegi, M.E. 1998. Latitudinal variations in biomass and metabolism of benthic infaunal communities. Ph.D. Dissertation, Texas A&M University, College Station, TX.

Davis, R.W., W.E. Evans, and B. Würsig. 2000. Cetaceans, Sea Turtles, and Seabirds in the Northern Gulf of Mexico: Distribution, Abundance and Habitat Associations. Volume II: Technical Report. U.S. Geological Survey, Biological Resources Division, USGS/BRD/CR--1999-0006 and U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2000-003. 346 pp.

DeGuise, S., M. Levin, E. Gebhard, L. Jasperse, L.B. Hart, C.R. Smith, S. Venn-Watson, F.I. Townsend, R.S. Wells, B.C. Balmer, E.S. Zolman, T.K. Rowles, and L.H. Schwacke. 2017. Changes in immune functions in bottlenose dolphins in the northern Gulf of Mexico associated with the *Deepwater Horizon* oil spill. Endangered Species Research 33: 291-303.

Demopoulos, A.W.J., J.R. Bourque, E. Cordes, and K.M. Stamler. 2016. Impacts of the *Deepwater Horizon* oil spill on deep-sea coral-associated sediment communities. Marine Ecology Progress Series 561(51-68).

Demopoulos, A.W.J., S.W. Ross, C.A. Kellogg, C.L. Morrison, M.S. Nizinski, N.G. Prouty, J.R. Borque, J.P. Galkiewicz, M.A. Gray, M.J. Springmann, D.K. Coykendall, A. Miller, M. Rhode, A.M. Quattrini, C.L. Ames, S. Brooke, J. McClain-Counts, E.B. Roark, N.A. Buster, R.M. Phillips, and J. Frometa. 2017. Deepwater Program: Lophelia II: Continuing Ecological Research on Deep-Sea Corals and Deep-Reef Habitats in the Gulf of Mexico. U.S. Geological Survey Open-File Report 2017-1139. 269 pp.

Dias, L.A., J. Litz, L. Garrison, A. Martinez, K. Barry, and T. Speakman. 2017. Exposure of cetaceans to petroleum products following the *Deepwater Horizon* oil spill in the Gulf of Mexico. Endangered Species Research 33: 119-125.

Ditty, J.G. 1986. Ichthyoplankton in neritic waters of the northern Gulf of Mexico off Louisiana: Composition, relative abundance, and seasonality. Fishery Bulletin 84(4): 935-946.

Ditty, J.G., G.G. Zieske, and R.F. Shaw. 1988. Seasonality and depth distribution of larval fishes in the northern Gulf of Mexico above 26°00'N. Fishery Bulletin 86(4): 811-823.

Eastern Research Group, Inc. 2014. Assessing the Impacts of the *Deepwater Horizon* Oil Spill on Tourism in the Gulf of Mexico Region. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study BOEM 2014-661.

Efroymson, R.A., W.H. Rose, S. Nemeth, and G.W. Sutter II. 2001. Ecological Risk Assessment Framework for Low Altitude Overflights by Fixed-Wing and Rotary-Wing Military Aircraft. Oak Ridge National Lab, Oak Ridge, TN. ONL/TM-2000/289. 116 pp.

Fertl, D., A.J. Schiro, G.T. Regan, C.A. Beck, and N. Adimey. 2005. Manatee occurrence in the northern Gulf of Mexico, West of Florida. Gulf and Caribbean Research 17(1): 69-94.

Fisher, C.R., P.Y. Hsing, C.L. Kaiser, D.R. Yoerger, H.H. Roberts, W.W. Shedd, E.E. Cordes, T.M. Shank, S.P. Berlet, M.G. Saunders, E.A. Larcom, and J.M. Brooks. 2014a. Footprint of *Deepwater Horizon* blowout impact to deep-water coral communities. Proceedings of the National Academy of Sciences USA 111(32): 11744-11749.

Fisher, C.R., A.W.J. Demopoulos, E.E. Cordes, I.B. Baums, H.K. White, and J.R. Borque. 2014b. Coral communities as indicators of ecosystem-level impacts of the *Deepwater Horizon* spill. BioScience 64: 796-807.

Florida Fish and Wildlife Conservation Commission. nd. Florida Salt Marsh Vole, *Microtus pennsylvanicus dekecampbelli*. https://myfwc.com/wildlifehabitats/profiles/mammals/land/florida-salt-marsh-vole/
Florida Fish and Wildlife Conservation Commission. 2016. Florida's endangered and threatened species. http://myfwc.com/media/1515251/Threatened_Endangered_Species.pdf

Florida Fish and Wildlife Conservation Commission. 2017a. Loggerhead nesting in Florida. http://myfwc.com/research/wildlife/sea-turtles/nesting/loggerhead/

Florida Fish and Wildlife Conservation Commission. 2017b. Green turtle nesting in Florida. http://myfwc.com/research/wildlife/sea-turtles/nesting/green-turtle/

Florida Fish and Wildlife Conservation Commission. 2017c. Leatherback nesting in Florida. http://myfwc.com/research/wildlife/sea-turtles/nesting/leatherback/

Florida Fish and Wildlife Conservation Commission. 2018. Listed Invertebrates. http://myfwc.com/wildlifehabitats/imperiled/profiles/invertebrates/

Flower Garden Banks National Marine Sanctuary. 2018. Manta Catalog. https://flowergarden.noaa.gov/science/mantacatalog.html

Foley, K.A., C. Caldow, and E.L. Hickerson. 2007. First confirmed record of Nassau Grouper *Epinephelus striatus* (Pisces: Serranidae) in the Flower Garden Banks National Marine Sanctuary. Gulf of Mexico Science 25(2): 162-165.

Fonseca, M., G.A. Piniak, and N. Cosentino-Manning. 2017. Susceptibility of seagrass to oil spills: A case study with eelgrass, Zostera marina in San Francisco Bay, USA. Marine Pollution Bulletin 115(1-2): 29-38.

Fox, D.A., J.E. Hightower, and F.M. Parauka. 2000. Gulf sturgeon spawning migration and habitat in the Choctawhatchee River System, Alabama–Florida. Transactions of the American Fisheries Society 129(3): 811-826.

Fritts, T.H. and R.P. Reynolds. 1981. Pilot Study of the Marine Mammals, Birds, and Turtles in OCS Areas of the Gulf of Mexico. U.S. Department of the Interior, Fish and Wildlife Service, Biological Services Program. FWS/OBS 81/36.

Fugro Geoservices, Inc. 1996. Regional Geohazards Assessment, Blocks 391-393, 435-437, 479-481, 523-525, and 567-569, Mississippi Canyon Area, Gulf of Mexico. Report No. 0201-3000. Dated 12/27/1996.

Fugro Geoservices, Inc. 2007. Archaeological Assessment, Proposed Anchor Locations, Block 393, Mississippi Canyon Area, Gulf of Mexico. Report No. 2407-1083.

Fugro Geoservices, Inc. 2009a. Shallow Drilling Hazards and Archaeological Assessment, Mississippi Canyon Blocks 347, 348, 391, 392, and Vicinity (OCS-G 28002, -19939, -26252, and -26253) Gulf of Mexico, Report No. 27.2008-5022. Dated 5/6/2009.

Fugro Geoservices, Inc. 2009b. Archaeological Assessment, ROV Survey, Sonar Contact Investigation, Block 391, Mississippi Canyon Area, Gulf of Mexico. Report 2409-1112. Dated 7/13/2009.

Fugro Geoservices, Inc. 2009c. Archaeological Survey, Blocks 347-349, 391-393, and Portions of 346, 390, 434-436, Mississippi Canyon Area, Gulf of Mexico. Report No. 2408-5022. Dated 3/24/2009.

Gallaway, B.J. and G.S. Lewbel. 1982. The Ecology of Petroleum Platforms in the Northwestern Gulf of Mexico: a Community Profile. U.S. Fish and Wildlife Service, Biological Services Program and U.S. Department of the Interior, Bureau of Land Management. Washington, D.C. FWS/OBS-82/27 and Open File Report 82-03.

Gallaway, B.J., J.G. Cole, and R.G. Fechhelm. 2003. Selected Aspects of the Ecology of the Continental Slope Fauna of the Gulf of Mexico: A Synopsis of the Northern Gulf of Mexico Continental Slope Study, 1983-1988. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2003-072. 52 pp.

Gallaway, B.J., (ed.). 1988. Northern Gulf of Mexico Continental Slope Study, Final report: Year 4. Volume II: Synthesis report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 88-0053. 322 pp.

Geraci, J.R., and D.J. St. Aubin. 1990. Sea Mammals and Oil: Confronting the Risks. San Diego, CA, Academic Press. 282 pp.

Gibson, D., D.H. Catlin, K.L. Hunt, J.D. Fraser, S.M. Karpanty, M.J. Friedrich, M.K. Bimbi, J.B. Cohen, and S.B. Maddock. 2017. Evaluating the impact of man-made distasters on imperiled species: Piping plovers and the *Deepwater Horizon* oil spill. Biological Conservation 2012: 48-62.

Gitschlag, G., B. Herczeg, and T. Barcack. 1997. Observations of sea turtles and other marine life at the explosive removal of offshore oil and gas structures in the Gulf of Mexico. Gulf Research Reports 9(4): 247-262.

Gulf of Mexico Fishery Management Council. 2005. Generic Amendment Number 3 for addressing Essential Fish Habitat Requirements, Habitat Areas of Particular Concern, and adverse effects of fishing in the following Fishery Management Plans of the Gulf of Mexico: Shrimp fishery of the Gulf of Mexico, United States waters red drum fishery of the Gulf of Mexico, reef fish fishery of the Gulf of Mexico coastal migratory pelagic resources (mackerels) in the Gulf of Mexico and South Atlantic, stone crab fishery of the Gulf of Mexico, spiny lobster in the Gulf of Mexico and South Atlantic, coral and coral reefs of the Gulf of Mexico. Tampa, FL.

Gulf of Mexico Fishery Management Council. 2010. 5-Year Review of the Final Generic Amendment Number 3 Addressing Essential Fish Habitat Requirements, Habitat Areas of Particular Concern, and Adverse Effects of Fishing in the Fishery Management Plans of the Gulf of Mexico. https://gulfcouncil.org/wp-content/uploads/EFH-5-Year-Review-Final-10-10.pdf

Hamdan, L.J., J.L. Salerno, A. Reed, S.B. Joye, and M. Damour. 2018. The impact of the *Deepwater Horizon* blowout on historic shipwreck-associated sediment microbiomes in the northern Gulf of Mexico. Scientific Reports 8: 9057.

Haney, C.J., H.J. Geiger, and J.W. Short. 2014. Bird mortality from the *Deepwater Horizon* oil spill. Exposure probability in the Gulf of Mexico. Marine Ecology Progress Series 513: 225-237.

Hannam, M.L., S.D. Bamber, A.J. Moody, T.S. Galloway, and M.B. Jones. 2010. Immunotoxicity and oxidative stress in the Arctic scallop *Chlamys islandica*: Effects of acute oil exposure. Ecotoxicology and Environmental Safety 73: 1440-1448.

Harvell, C.D., K. Kim, J.M. Burkholder, R.R. Colwell, P.R. Epstein, D.J. Grimes, E.E. Hoffmann, E.K. Lipp, A.D.M.E. Osterhaus, R.M. Overstreet, J.W. Porter, G.W. Smith, and G.R. Vasta. 1999. Emerging marine diseases: climate links and anthropogenic factors. Science 285(5433): 1505-1510.

Hayes, S.A., E. Josephson, K. Maze-Foley, P.E. Rosel, B. Byrd, S. Chavez-Rosales, L.P. Garrison, J. Hatch, A. Henry, S.C. Horstman, J. Litz, M.C. Lyssikatos, K.D. Mullin, C. Orphanides, R.M. Pace, D.L. Palka, J. Powell, and F.W. Wenzel. 2019. US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2018. U.S. Department of Commerce. NOAA Technical Memorandum NMFS-NE-258.

Hazel, J., I. R. Lawler, H. Marsh, and S. Robson. 2007. Vessel speed increases collision risk for the green turtle *Chelonia mydas*. Endangered Species Research 3:105-113.

Hazen, T.C., E.A. Dubinsky, T.Z. DeSantis, G.L. Andersen, Y.M. Piceno, N. Singh, J.K. Jansson, A. Probst, S.E. Borglin, J.L. Fortney, W.T. Stringfellow, M. Bill, M.E. Conrad, L.M. Tom, K.L. Chavarria, T.R. Alusi, R. Lamendella, D.C. Joyner, C. Spier, J. Baelum, M. Auer, M.L. Zemla, R. Chakraborty, E.L. Sonnenthal, P. D'Haeseleer, H.Y. Holman, S. Osman, Z. Lu, J.D. Van Nostrand, Y. Deng, J. Zhou, and O.U. Mason. 2010. Deep-sea oil plume enriches indigenous oil-degrading bacteria. Science 330(6001): 204-208.

Hess, N.A., and C.A. Ribic. 2000. Seabird ecology, pp 275-315. In: R.W. Davis, W.E. Evans and B. Würsig, Cetaceans, Sea Turtles, and Seabirds in the Northern Gulf of Mexico: Distribution, Abundance and Habitat Associations. Volume II: Technical report. U.S. Geological Survey, Biological Resources Division, USGS/BRD/CR 1999 0006 and U.S. Department of the Interior, Minerals Management Service, New Orleans, LA.

Higashi, G.R. 1994. Ten years of fish aggregating device (FAD) design development in Hawaii. Bulletin of Marine Science 55(2-3): 651-666.

Hildebrand, J.A. 2004. Impacts of anthropogenic sound on cetaceans. Unpublished paper submitted to the International Whaling Commission Scientific Committee SC/56 E 13.

Hildebrand, J.A. 2005. Impacts of anthropogenic sound, pp. 101-124. In: J.E. Reynolds III, W.F. Perrin, R.R. Reeves, S. Montgomery and T.J. Ragen, (Eds.). Marine Mammal Research: Conservation Beyond Crisis. Johns Hopkins University Press, Baltimore, MD.

Hildebrand, J.A. 2009. Anthropogenic and natural sources of ambient noise in the ocean. Marine Ecology Progress Series 395: 5-20.Hildebrand, J.A., S. Baumann-Pickering, K.E. Frasier, J.S. Trickey, K.P. Merkens, S.M. Wiggins, M.A. McDonald, L.P. Garrison, D. Harris, T.A. Marques, and L. Thomas. 2015. Passive acoustic monitoring of beaked whale densities in the Gulf of Mexico. Scientific Reports 5(16343).

Hinwood, J.B., A.E. Potts, L.R. Dennis, J.M. Carey, H. Houridis, R.J. Bell, J.R. Thomson, P. Boudreau, and A.M. Ayling. 1994. Part 3: Drilling activities. In: Swan, J.M., Neff, J.M., Young, P.C. (Eds.), Environmental Implications of Offshore Oil and Gas Development in Australia; the Findings of an Independent Scientific Review. Australian Petroleum Exploration Association and Energy Research and Development Corporation. Sydney, Australia. pp. 124-206.

Holland, K.N. 1990. Horizontal and vertical movements of yellowfin and bigeye tuna associated with fish aggregating devices. Fishery Bulletin 88:493-507.

Hourigan, T.F., P. Etnoyer, and S.D. Cairns. 2017. The State of Deep-sea Coral and Sponge Ecosystems of the United States. U.S. Department of Commerce, National Oceanographic and Atmospheric Administration. NOAA Technical Memorandum NMFS OHC 4.

Hsing, P.-Y., B. Fu, E.A. Larcom, S.P. Berlet, T.M. Shank, A.F. Govindarajan, A.J. Lukasiewicz, P.M. Dixon, and C.R. Fisher. 2013. Evidence of lasting impact of the *Deepwater Horizon* oil spill on a deep Gulf of Mexico coral community. Elementa: Science of the Anthropocene 1(1): 000012.

Intergovernmental Panel on Climate Change. 2014. Climate Change 2014: Impacts, Adaptation and Vulnerability. http://www.ipcc.ch/report/ar5/wg2/

International Tanker Owners Pollution Federation Limited. 2018. Weathering. https://www.itopf.org/knowledge-resources/documents-guides/fate-of-oil-spills/weathering/

International Tanker Owners Pollution Federation Limited. 2014. Effects of Oil Pollution on Fisheries and Mariculture. 12 pp.

Jasny, M., J. Reynolds, C. Horowitz, and A. Wetzler. 2005. Sounding the Depths II: The Rising Toll of Sonar, Shipping and Industrial Ocean Noise on Marine Life. Natural Resources Defense Council, New York, NY. vii + 76 pp.

Jensen, A. S. and G. K. Silber. 2004. Large whale ship strike database. Office of Protected Resources, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, NOAA Technical Memorandum NMFSOPR-25, Silver Spring, Maryland.

Ji, Z.-G., W.R. Johnson, C.F. Marshall, and E.M. Lear. 2004. Oil-Spill Risk Analysis: Contingency Planning Statistics for Gulf of Mexico OCS Activities. Minerals Management Service. U.S. Department of the Interior, Gulf of Mexico OCS Region. New Orleans, LA. OCS Report MMS 2004-026. 53 pp.

Jochens, A., D.C. Biggs, D. Benoit-Bird, D. Engelhaupt, J. Gordon, C. Hu, N. Jaquet, M. Johnson, R.R. Leben, B. Mate, P. Miller, J.G. Ortega-Ortiz, A. Thode, P. Tyack, and B. Würsig. 2008. Sperm whale seismic study in the Gulf of Mexico: Synthesis report. Minerals Management Service. U.S. Department of the Interior, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2008-006. 323 pp.

Joye, S.B., I.R. MacDonald, I. Leifer, and V. Asper. 2011. Magnitude and oxidation potential of hydrocarbon gases released from the BP oil well blowout. Nature Geoscience 4: 160-164.

Keithly, W.R., and K.J. Roberts. 2017. Commercial and recreational fisheries of the Gulf of Mexico, pp. 1039-1188. In: C.H. Ward, Habitats and Biota of the Gulf of Mexico: Before the *Deepwater Horizon* Oil Spill. Volume 2: Fish Resources, Fisheries, Sea Turtles, Avian Resources, Marine Mammals, Diseases and Mortalities. Springer, New York.

Kellar, N.M., T.R. Speakman, C.R. Smith, S.M. Lane, B.C. Balmer, M.L. Trego, K.N. Catelani, M.N. Robbins, C.D. Allen, R.S. Wells, E.S. Zolman, T.K. Rowles, and L.H. Schwacke. 2017. Low reproductive success rates of common bottlenose dolphins *Tursiops truncatus* in the northern Gulf of Mexico following the *Deepwater Horizon* disaster (2010-2015). Endangered Species Research 33: 143-158.

Kennicutt, M.C. 2000. Chemical oceanography, pp. 123-139. In: Continental Shelf Associates, Inc. Deepwater Program: Gulf of Mexico Deepwater Information Resources Data Search and Literature Synthesis. Volume I: Narrative report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2000-049. 340 pp.

Kessler, J.D., D.L. Valentine, M.C. Redmond, M. Du, E.W. Chan, S.D. Mendes, E.W. Quiroz, C.J. Villanueva, S.S. Shusta, L.M. Werra, S.A. Yvon-Lewis, and T.C. Weber. 2011. A persistent oxygen anomaly reveals the fate of spilled methane in the deep Gulf of Mexico. Science 331: 312-315.

Ketten, D.R., and S.M. Bartol. 2005. Functional Measures of Sea Turtle Hearing, Woods Hole Oceanographic Institution: ONR Award No: N00014-02-0510.

Kujawinski, E.B., M.C. Kido Soule, D.L. Valentine, A.K. Boysen, K. Longnecker, and M.C. Redmond. 2011. Fate of dispersants associated with the *Deepwater Horizon* oil spill. Environmental Science and Technology 45(4): 1298-1306.

Kyhn, L.A., S. Sveegaard, and J. Tougaard. 2014. Underwater noise emissions from a drillship in the Arctic. Marine Pollution Bulletin 86: 424-433.

Ladich, F., and R.R. Fay. 2013. Auditory evoked potential audiometry in fish. Reviews in Fish Biology and Fisheries 23(3): 317-364.

Laist, D. W., A. R. Knowlton, J. G. Mead, A. S. Collet, and M. Podesta. 2001. Collisions between ships and whales. Marine Mammal Science 17(1):35-75.

Lane, S.M., C.R. Smith, J. Mitchell, B.C. Balmer, K.P. Barry, T. McDonald, C.S. Mori, P.E. Rosel, T.K. Rowles, T.R. Speakman, F.I. Townsend, M.C. Tumlin, R.S. Wells, E.S. Zolman, and L.H. Schwacke. 2015. Reproductive outcome and survival of common bottlenose dolphins sampled in Barataria Bay, Louisiana, USA, following the *Deepwater Horizon* oil spill. Proceedings of the Royal Society B: Biological Sciences 282:20151944.

Lauritsen, A.M., P.M. Dixon, D. Cacela, B. Brost, R. Hardy, S.L. MacPherson, A. Meylan, B.P. Wallace, and B. Witherington. 2017. Impact of the *Deepwater Horizon* oil spill on loggerhead turtle Caretta caretta nest densities in northwest Florida. Endangered Species Research 33: 83-93.

Lee, R.F., M. Koster, and G.A. Paffenhofer. 2012. Ingestion and defecation of dispersed oil droplets by pelagic tunicates. Journal of Plankton Research 34: 1058-1063.

Lee, R.F. 2013. Ingestion and Effects of Dispersed Oil on Marine Zooplankton. Anchorage, Alaska., Prepared for: Prince William Sound Regional Citizens' Advisory Council (PWSRCAC). 21 pp.

Lee, W.Y., K. Winters, and J.A.C. Nicol. 1978. The biological effects of the water-soluble fractions of a No. 2 fuel oil on the planktonic shrimp, *Lucifer faxoni*. Environmental Pollution 15: 167-183.

Lennuk, L., J. Kotta, K. Taits, and K. Teeveer. 2015. The short-term effects of crude oil on the survival of different size-classes of cladoceran *Daphnia magna* (Straus, 1820). Oceanologia 57(1): 71-77.

Lin, Q., I.A. Mendelssohn, S.A. Graham, A. Hou, J.W. Fleeger, and D.R. Deis. 2016. Response of salt marshes to oiling from the *Deepwater Horizon* spill: Implications for plant growth, soil-surface erosion, and shoreline stability. Science of the Total Environment 557-558: 369-377.

Linden, O. 1976. Effects of oil on the reproduction of the amphipod *Gammarus oceanicus*. Ambio 5: 36-37.

Liu, J., H.P. Bacosa, and Z. Liu. 2017. Potential environmental factors affecting oil-degrading bacterial populations in deep and surface waters of the northern Gulf of Mexico. Frontiers in Microbiology 7:2131.

Lohoefener, R., W. Hoggard, K.D. Mullin, C. Roden, and C. Rogers. 1990. Association of Sea Turtles with Petroleum Platforms in the North Central Gulf of Mexico. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 90-0025. 90 pp.

Lutcavage, M.E., P.L. Lutz, G.D. Bossart, and D.M. Hudson. 1995. Physiologic and clinicopathologic effects of crude oil on loggerhead sea turtles. Archives of Environmental Contaminaton and Toxicology 28(4):417-422.

Lutcavage, M.E., P. Plotkin, B. Witherington, and P.L. Lutz. 1997. Human impacts on sea turtle survival, pp. 387-409. In: P.L. Lutz and J.A. Musick (Eds.), The Biology of Sea Turtles. CRC Press, Boca Raton, FL.

MacDonald, I.R. 2002. Stability and Change in Gulf of Mexico Chemosynthetic Communities. Volume II: Technical Report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2002-036. 455 pp.

Main, C.E., H.A. Ruhl, D.O.B. Jones, A. Yool, B. Thornton, and D.J. Mayor. 2015. Hydrocarbon contamination affects deep-sea benthic oxygen uptake and microbial community composition. Deep Sea Research Part I: Oceanographic Research Papers 100: 79-87.

Marine Mammal Commission. 2011. Assessing the Long-term Effects of the BP *Deepwater Horizon* Oil Spill on Marine Mammals in the Gulf of Mexico: A statement of research needs. http://www.mmc.gov/wp-content/uploads/longterm_effects_bp_oilspil.pdf

Marshall, A., M.B. Bennett, G. Kodja, S. Hinojosa-Alvarez, F. Galvan-Magana, M. Harding, G. Stevens, and T. Kashiwagi. 2018. *Mobula birostris* (amended version of 2011 assessment). The IUCN Red List of Threatened Species. 2018: e.T198921A126669349. http://www.iucnredlist.org/details/198921/0.

McCauley, R. 1998. Radiated Underwater Noise Measured from the Drilling Rig Ocean General, Rig Tenders Pacific Ariki and Pacific Frontier, Fishing Vessel Reef Venture and Natural Sources in the Timor Sea, Northern Australia. Prepared for Shell Australia, Melbourne. 52 pp. http://cmst.curtin.edu.au/local/docs/pubs/1998-19.pdf

McDonald, T.L., F.E. Hornsby, T.R. Speakman, E.S. Zolman, K.D. Mullin, C. Sinclair, P.E. Rosel, L. Thomas, and L.H. Schwacke. 2017a. Survival, density, and abundance of common bottlenose dolphins in Barataria Bay (USA) following the *Deepwater Horizon* oil spill. Endangered Species Research 33: 193-209.

McDonald, T.L., B.A. Schroeder, B.A. Stacy, B.P. Wallace, L.A. Starcevich, J. Gorham, M.C. Tumlin, D. Cacela, M. Rissing, D.B. McLamb, E. Ruder, and B.E. Witherington. 2017b. Density and exposure of surface-pelagic juvenile sea turtles to *Deepwater Horizon* oil. Endangered Species Research 33: 69-82.

McKenna, M.F., D. Ross, S.M. Wiggins, and J.A. Hildebrand. 2012. Underwater radiated noise from modern commercial ships. Journal of the Acoustical Society of America 131: 92-103.

McLaughlin, K.E., and H.P. Kunc. 2015. Changes in the acoustic environment alter the foraging and sheltering behaviour of the cichlid *Amititlania nigrofasciata*. Behavioural Processes 116: 75-79.

Mendelssohn, I.A., G.L. Andersen, D.M. Baltx, R.H. Caffey, K.R. Carman, J.W. Fleeger, S.B. Joyce, Q. Lin, E. Maltby, E.B. Overton, and L.P. Rozas. 2012. Oil impacts on coastal wetlands: Implications for the Mississippi River delta ecosystem after the *Deepwater Horizon* oil spill. BioScience 62(6): 562-574.

Minerals Management Service. 2000. Gulf of Mexico Deepwater Operations and Activities: Environmental Assessment. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS EIS/EA MMS 2000-001.

Mississippi Natural Heritage Program. 2018. Natural Heritage Program online database. https://www.mdwfp.com/museum/seek-study/heritage-program/nhp-online-data/

Møhl, B., M. Wahlberg, and P.T. Madsen. 2003. The monopulsed nature of sperm whale clicks. Journal of the Acoustical Society of America 114(2): 1143-1154.

Montagna, P.A., J.G. Baguley, C. Cooksey, I. Hartwell, L.J. Hyde, J.L. Hyland, R.D. Kalke, L.M. Kracker, M. Reuscher, and A.C. Rhodes. 2013. Deep-sea benthic footprint of the *Deepwater Horizon* blowout. PLoS One 8(8): e70540.

Montagna, P.A., J.G. Baguley, C. Cooksey, and J.L. Hyland. 2016. Persistent impacts to the deep soft bottom benthos one year after the Deepwater Horizon event. Integrated Environmental Assessment and Management 13(2): 342-351.

Moore, S.F. and R.L. Dwyer. 1974. Effects of oil on marine organisms: a critical assessment of published data. Water Research 8: 819-827.

Morrow, J.V.J., J.P. Kirk, K.J. Killgore, H. Rugillio, and C. Knight. 1998. Status and recovery of Gulf sturgeon in the Pearl River system, Louisiana-Mississippi. North American Journal of Fisheries Management 18: 798-808.

Mullin, K.D., W. Hoggard, C. Roden, R. Lohoefener, C. Rogers, and B. Taggart. 1991. Cetaceans on the Upper Continental Slope in the North-central Gulf of Mexico. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 91-0027. 108 pp.

Mullin, K.D. 2007. Abundance of Cetaceans in the Oceanic Gulf of Mexico based on 2003-2004 ship surveys. National Marine Fisheries Service, Southeast Fisheries Science Center. Pascagoula, MS. 26 pp. http://aquaticcommons.org/15062/1/CSAR15736.pdf

National Marine Fisheries Service. 2007. Endangered Species Act, Section 7 Consultation – Biological Opinion. Gulf of Mexico Oil and Gas Activities: Five Year Leasing Plan for Western and Central Planning Areas 2007-2012. U.S. Department of Commerce, National Oceanic and Atmospheric Administration. St. Petersburg, FL. http://www.nmfs.noaa.gov/ocs/mafac/meetings/2010_06/docs/mms_02611_leases_2007_2012.pdf

National Marine Fisheries Service and U.S. Fish and Wildlife Service. 2008. Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle (*Caretta caretta*), Second Revision. https://www.fisheries.noaa.gov/resource/document/recovery-plan-northwest-atlantic-population-loggerhead-sea-turtle-caretta-caretta

National Marine Fisheries Service. 2009a. Sperm Whale (*Physeter macrocephalus*) 5-Year Review: Summary and Evaluation. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Sustainable Fisheries, Highly Migratory Species Management Division. Silver Spring, MD. https://repository.library.noaa.gov/view/noaa/17032

National Marine Fisheries Service. 2009b. Smalltooth Sawfish Recovery Plan (*Pristis pectinata*). Prepared by the Smalltooth Sawfish Recovery Team for the National Marine Fisheries Service, Silver Spring, MD. 102 pp. https://repository.library.noaa.gov/view/noaa/15983

National Marine Fisheries Service. 2009c. Final Amendment 1 to the Consolidated Atlantic Highly Migratory Species Fishery Management Plan Essential Fish Habitat. Highly Migratory Species Management Division, Office of Sustainable Fisheries. Silver Spring, MD. http://pbadupws.nrc.gov/docs/ML1219/ML12195A241.pdf

National Marine Fisheries Service. 2010a. Final Recovery Plan for the Sperm Whale (*Physeter macrocephalus*). Silver Spring, MD. http://www.nmfs.noaa.gov/pr/pdfs/health/oil_impacts.pdf

National Marine Fisheries Service. 2010b. *Deepwater Horizon*/BP oil spill: Size and Percent Coverage of Fishing Area Closures due to BP oil spill. http://sero.nmfs.noaa.gov/deepwater_horizon/size_percent_closure/index.html

National Marine Fisheries Service. 2011. Species of Concern: Atlantic bluefin tuna, *Thunnus thynnus*. http://www.nmfs.noaa.gov/pr/pdfs/species/bluefintuna_detailed.pdf

National Marine Fisheries Service, U.S. Fish and Wildlife Service and Secretaría de Medio Ambiente y Recursos Naturales. 2011. Bi-National Recovery Plan for the Kemp's Ridley Sea Turtle (*Lepidochelys kempii*), Second Revision. http://www.nmfs.noaa.gov/pr/pdfs/recovery/kempsridley_revision2.pdf

National Marine Fisheries Service. 2014a. Sea Turtles, Dolphins, and Whales and the Gulf of Mexico Oil Spill. http://www.nmfs.noaa.gov/pr/health/oilspill/gulf2010.htm

National Marine Fisheries Service. 2014b. Loggerhead Sea Turtle Critical Habitat in the Northwest Atlantic Ocean. http://www.nmfs.noaa.gov/pr/species/turtles/criticalhabitat_loggerhead.htm

National Marine Fisheries Service. 2014c. Gulf sturgeon (*Acipenser oxyrinchus desotoi*). http://www.nmfs.noaa.gov/pr/species/fish/gulfsturgeon.htm

National Marine Fisheries Service. 2015. Endangered Species Act Section 7 Consultation Biological Opinion for the Virginia Offshore Wind Technology Advancement Project. NER-2015-12128

National Marine Fisheries Service. 2016a. Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing: Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts. NOAA Technical Memorandum NMFS-OPR-55.

National Marine Fisheries Service. 2016b. Marine Mammal Stock Assessment Reports (SARs) by Species/Stock. http://www.nmfs.noaa.gov/pr/sars/species.htm

National Marine Fisheries Service. 2018a. Oceanic Whitetip Shark, *Carcharhinus longimanus*. https://www.fisheries.noaa.gov/species/oceanic-whitetip-shark

National Marine Fisheries Service. 2018b. Revisions to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts. NOAA Technical Memorandum NMFS OPR-59.

National Marine Fisheries Service. 2018c. Smalltooth Sawfish (*Pristis pectinata*) 5-Year Review: Summary and Evaluation of United States Distinct Population Segment of Smalltooth Sawfish. Southeast Regional Office, St. Petersburg, Florida. 63 pp. https://repository.library.noaa.gov/view/noaa/19253/Print

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. https://www.fisheries.noaa.gov/resource/document/biological-opinion-federally-regulated-oil-and-gas-program-activities-gulf-mexico

National Oceanic and Atmospheric Administration. 2010. Oil and Sea Turtles. Biology, Planning, and Response. http://response.restoration.noaa.gov/sites/default/files/Oil_Sea_Turtles.pdf

National Oceanic and Atmospheric Administration. 2011a. Joint Analysis Group. *Deepwater Horizon* oil spill: Review of Preliminary Data to Examine Subsurface Oil in the Vicinity of MC252#1, May 19 to June 19, 2010. U.S. Department of Commerce, National Ocean Service. Silver Spring, MD. NOAA Technical Report NOS OR&R 25. http://service.ncddc.noaa.gov/rdn/www/media/documents/activities/jag-reports/NTR-NOS-ORR-25-082011.pdf

National Oceanic and Atmospheric Administration. 2011b. Joint Analysis Group, *Deepwater Horizon* Oil Spill: Review of R/V Brooks McCall Data to Examine Subsurface Oil. U.S. Department of Commerce, National Ocean Service. Silver Spring, MD. NOAA Technical Report NOS OR&R 24. http://service.ncddc.noaa.gov/rdn/www/media/documents/activities/jag-reports/NTR-NOS-ORR-24-062011.pdf

National Oceanic and Atmospheric Administration. 2011c. Joint Analysis Group, *Deepwater Horizon* Oil Spill: Review of Preliminary Data to Examine Oxygen Levels in the Vicinity of MC252#1 May 8 to August 9, 2010. U.S. Department of Commerce, National Ocean Service. Silver Spring, MD. NOAA Technical Report NOS OR&R 26. http://service.ncddc.noaa.gov/rdn/www/media/documents/activities/jag-reports/NTR-NOS-ORR-26-082011.pdf

National Oceanic and Atmospheric Administration. 2014. Flower Garden Banks National Marine Sanctuary. Cnidarian Species. http://flowergarden.noaa.gov/about/cnidarianlist.html

National Oceanic and Atmospheric Administration. 2016a. Cetacean Unusual Mortality Event in Northern Gulf of Mexico (2010-2014). http://www.nmfs.noaa.gov/pr/health/mmume/cetacean_gulfofmexico.htm

National Oceanic and Atmospheric Administration. 2016b. ADIOS 2 (Automated Data Inquiry for Oil Spills). http://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/response-tools/downloading-installing-and-running-adios.html

National Oceanic and Atmospheric Administration. 2016c. *Deepwater Horizon* Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement. http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan/

National Oceanic and Atmospheric Administration. 2017. Oil Types. Office of Response and Restoration. http://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/oil-types.html

National Oceanic and Atmospheric Administration. 2019. Small Diesel Spills (500 - 5,000 gallons). Office of Response and Restoration. https://response.restoration.noaa.gov/sites/default/files/Small-Diesel-Spills.pdf

National Oceanic and Atmospheric Administration. 2018a. Giant Manta Ray - Manta birostris. https://www.fisheries.noaa.gov/species/giant-manta-ray

National Oceanic and Atmospheric Administration. 2018b. Gulf Sturgeon: About the species. https://www.fisheries.noaa.gov/species/gulf-sturgeon#overview

National Oceanic and Atmospheric Administration. nd. Nassau Grouper, *Epinephelus striatus*. https://www.fisheries.noaa.gov/species/nassau-grouper

National Oceanic and Atmospheric Administration Fisheries West Coast Region. 2018. Interim Sound Threshold Guidance. http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/threshold_guidance.html

NOAA Fisheries (National Marine Fisheries Service). nd. Smalltooth Sawfish, *Pristis pectinata*. https://www.fisheries.noaa.gov/species/smalltooth-sawfish.

National Research Council. 1983. Drilling Discharges in the Marine Environment. Washington, DC. 180 pp.

National Research Council. 2003a. Oil in the Sea III: Inputs, Fates, and Effects. Washington, DC. 182 pp. + app.

National Research Council. 2003b. Ocean Noise and Marine Mammals. Washington, DC. 204 pp.

National Wildlife Federation. 2016a. *Deepwater Horizon's Impact on Wildlife*. http://nwf.org/oilspill/

National Wildlife Federation. 2016b. Wildlife Library: Whooping Crane. https://www.nwf.org/Educational-Resources/Wildlife-Guide/Birds/Whooping-Crane

Natural Resources Defense Council. 2014. A Petition to List the Gulf of Mexico Bryde's Whale (*Balaenoptera edeni*) as Endangered under the Endangered Species Act. https://www.nrdc.org/sites/default/files/wil_14091701a.pdf

Nedelec, S.L., A.N. Radford, L. Pearl, B. Nedelec, M.I. McCormick, M.G. Meekan, and S.D. Simpson. 2017. Motorboat noise impacts parental behaviour and offspring survival in a reef fish. Proceedings of the Royal Society B: Biological Sciences 284(1856): p20170143.

Nedwell, J.R., K. Needham, and B. Edwards. 2001. Report on Measurements of Underwater Noise from the Jack Bates Drill Rig. Report No. 462 R 0202. Subacoustech Ltd., Southhampton, UK. 49 pp.

Nedwell, J.R., and D. Howell. 2004. A Review of Offshore Windfarm Related Underwater Noise Sources. Report No. 544 R 0308, 0308. Subacoustech Ltd., Southampton, UK. 63 pp.

Neff, J.M. 1987. Biological effects of drilling fluids, drill cuttings and produced waters, pp 469-538. In: D.F. Boesch and N.N. Rabalais (Eds.), Long Term Effects of Offshore Oil and Gas Development. Elsevier Applied Science Publishers, London, UK.

Neff, J.M., S. McKelvie, and R.C. Ayers. 2000. Environmental impacts of synthetic based drilling fluids. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2000-064. 121 pp.

Neff, J.M., A.D. Hart, J.P. Ray, J.M. Limia, and T.W. Purcell (2005). An Assessment of Seabed Impacts of Synthetic Based Drilling-Mud Cuttings in the Gulf of Mexico. 2005 SPE/EPA/DOE Exploration and Production Environmental Conference, 7-9 March 2005, Galveston, TX. SPE 94086.

NOAA Fisheries (National Marine Fisheries Service). nd. Smalltooth Sawfish, *Pristis pectinata*. https://www.fisheries.noaa.gov/species/smalltooth-sawfish

Nowlin, W.D.J., A.E. Jochens, S.F. DiMarco, R.O. Reid, and M.K. Howard. 2001. Deepwater Physical Oceanography Reanalysis and Synthesis of Historical Data: Synthesis Report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2001-064. 514 pp.

Oceaneering. 2018a. Hazard Survey Injector East (IE) Drill Center Block 392 Mississippi Canyon Areas. OII Doc. No. 196418-OII-RPT-HRC-02.

Oceaneering. 2018b. Hazard Survey Injector West (IW) Drill Center Block 391 Mississippi Canyon Areas. OII Doc. No. 196418-OII-RPT-HRC-01.

Operational Science Advisory Team. 2010. Summary report for sub-surface and sub sea oil and dispersant detection: Sampling and monitoring. Prepared for Paul F. Zukunft, U.S. Coast Guard Federal on Scene Coordinator, *Deepwater Horizon* MC252. http://www.restorethegulf.gov/sites/default/files/documents/pdf/OSAT_Report_FINAL_17DEC.pdf

Oxford Economics. 2010. Potential impact of the Gulf oil spill on tourism. Report prepared for the U.S. Travel Association. http://www.mississippiriverdelta.org/blog/files/2010/10/Gulf_Oil_Spill_Analysis_Oxford_Economics_710.pdf

Ozhan, K., M.L. Parsons, and S. Bargu. 2014. How were phytoplankton affected by the *Deepwater Horizon* oil spill? Bioscience 64: 829-836.

Peake, D.E. 1996. Bird surveys, pp. 271 304. In: R.W. Davis and G.S. Fargion (eds.), Distribution and Abundance of Cetaceans in the North Central and Western Gulf of Mexico, Final report. Volume II: Technical report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region New Orleans, LA. OCS Study MMS 96-0027. 356 pp.

Picciulin, M., L. Sebastianutto, A. Codarin, A. Farina, and E.A. Ferrero. 2010. In situ behavioural responses to boat noise exposure of *Gobius cruentatus* (Gmelin, 1789; fam. Gobiidae) and *Chromis chromis* (Linnaeus, 1758; fam. Pomacentridae) living in a Marine Protected Area. Journal of Experimental Marine Biology and Ecology 386(1): 125-132.

Pine III, W.E, and S. Martell. 2009. Status of Gulf Sturgeon *Acipenser oxyrinchus desotoi* in the Gulf of Mexico. Unpublished report by University of Florida prepared for 2009 Gulf sturgeon annual working group meeting, Cedar Key, FL. 17-19 November 2009. 51 pp.

Popper, A.N., A.D. Hawkins, R.R. Fay, D. Mann, S. Bartol, T.J. Carlson, S. Coombs, W.T. Ellison, R.L. Gentry, M.B. Halvorsen, S. Lokkeborg, P. Rogers, B.L. Southall, D. Zeddies, and W.N. Tavolga. 2014. Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report. ASA S3/SC1.4 TR-2014 prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI. Springer, Cham, Switzerland. 73 pp.

Powers, S.P., F.J. Hernandez, R.H. Condon, J.M. Drymon, and C.M. Free. 2013. Novel pathways for injury from offshore oil spills: Direct, sublethal and indirect effects of the *Deepwater Horizon* oil spill on pelagic Sargassum communities. PLoS One 8(9): e74802.

Pritchard, P.C.H. 1997. Evolution, phylogeny, and current status, pp. 1-28. In: P.L. Lutz and J.A. Musick (Eds.), The Biology of Sea Turtles. CRC Press, Boca Raton, FL.

Prouty, N.G., C.R. Fisher, A.W.J. Demopoulos, and E.R.M. Druffel. 2016. Growth rates and ages of deep sea corals impacted by the *Deepwater Horizon* oil spill. Deep-Sea Research Part II: Topical Studies in Oceanography 129: 196-212.

Radford, A.N., E. Kerridge, and S.D. Simpson. 2014. Acoustic communication in a noisy world: Can fish compete with anthropogenic noise? Behavioral Ecology 25: 1,022-1,030.

Rathbun, G.B. 1988. Fixed-wing airplane versus helicopter surveys of manatees. Marine Mammal Science 4(1): 71-75.

Relini, M., L.R. Orsi, and G. Relini. 1994. An offshore buoy as a FAD in the Mediterranean. Bulletin of Marine Science 55(2-3): 1099-1105.

Reşitoğlu, İ.A., K. Altinişik, and A. Keskin. 2015. The pollutant emissions from diesel-engine vehicles and exhaust aftertreatment systems. Clean Technologies and Environmental Policy 17(1): 15-27.

Reuscher, M.G., J.G. Baguley, N. Conrad-Forrest, C. Cooksey, J.L. Hyland, C. Lewis, P.A. Montagna, R.W. Ricker, M. Rohal, and T. Washburn. 2017. Temporal patterns of *Deepwater Horizon* impacts on the benthic infauna of the northern Gulf of Mexico continental slope. PLoS One 12(6): e0179923.

Richards, W.J., T. Leming, M.F. McGowan, J.T. Lamkin, and S. Kelley-Farga. 1989. Distribution of fish larvae in relation to hydrographic features of the Loop Current boundary in the Gulf of Mexico. ICES Marine Science Symposia 191: 169-176.

Richards, W.J., M.F. McGowan, T. Leming, J.T. Lamkin, and S. Kelley-Farga. 1993. Larval fish assemblages at the Loop Current boundary in the Gulf of Mexico. Bulletin of Marine Science 53(2): 475-537.

Richardson, W.J., C.R. Greene Jr., C.I. Malme, and D.H. Thomson. 1995. Marine Mammals and Noise. San Diego, CA, Academic Press. 576 pp.

Rigby, C.L., Barreto, R., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Herman, K., Jabado, R.W., Liu, K.M., Marshall, A., Pacoureau, N., Romanov, E., Sherley, R.B. & Winker, H. 2019. *Carcharhinus longimanus*. The IUCN Red List of Threatened Species 2019: e.T39374A2911619. https://www.iucnredlist.org/species/39374/2911619

Rodgers, J.A. and S.T. Schwikert. 2002. Buffer-zone distances to protect foraging and loafing waterbirds from disturbance by personal watercraft and outboard-powered boats. Conservation Biology 16(1): 216-224.

Ronconi, R.A., K.A. Allard, and P.D. Taylor. 2015. Bird interactions with offshore oil and gas platforms: Review of impacts and monitoring techniques. Journal of Environmental Management 147: 34-45.

Rosel, P.E., P. Corkeron, L. Engleby, D. Epperson, K.D. Mullin, M.S. Soldevilla, and B.L. Taylor. 2016. Status Review of Bryde's Whales (Balaenoptera edeni) in the Gulf of Mexico under the Endangered Species Act. National Oceanic and Atmospheric Administration. NOAA Technical Memorandum NMFS-SEFSC-692.

Ross, S.W., A.W.J. Demopoulos, C.A. Kellogg, C.L. Morrison, M.S. Nizinski, C.L. Ames, T.L. Casazza, D. Gualtieri, K. Kovacs, J.P. McClain, A.M. Quattrini, A.Y. Roa-Varón, and A.D. Thaler. 2012. Deepwater Program: Studies of Gulf of Mexico lower continental slope communities related to chemosynthetic and hard substrate habitats. U.S. Department of the Interior, U.S. Geological Survey. U.S. Geological Survey Open-File Report 2012-1032.

Rowe, G.T., and M.C. Kennicutt. 2009. Northern Gulf of Mexico Continental Slope Habitats and Benthic Ecology Study. Final Report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2009-039. 419 pp.

Rudd, M.B., R.N.M. Ahrens, W.E. Pine III, and S.K. Bolden. 2014. Empirical spatially explicit natural mortality and movement rate estimates for the threatened Gulf Sturgeon (*Acipenser oxyrinchus desotoi*). Canadian Journal of Fisheries and Aquatic Sciences 71: 1407-1417.

Russell, R.W. 2005. Interactions Between Migrating Birds and Offshore Oil and Gas Platforms in the Northern Gulf of Mexico: Final Report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2005-009. 325 pp.

Sadovy, Y. 1997. The case of the disappearing grouper; *Epinephelus striatus*, the Nassau grouper in the Caribbean and western Atlantic. Proceedings of the Gulf and Caribbean Fisheries Institute 45: 5 22.

Salmon, M., and J. Wyneken. 1990. Do swimming loggerhead sea turtles (*Caretta caretta* L.) use light cues for offshore orientation? Marine and Freshwater Behaviour and Physiology 17(4): 233-246.

Samuel, Y., S.J. Morreale, C.W. Clark, C.H. Greene, and M.E. Richmond. 2005. Underwater, low-frequency noise in a coastal sea turtle habitat. Journal of the Acoustical Society of America 117(3): 1465 1472.

Schwacke, L.H., C.R. Smith, F.I. Townsend, R.S. Wells, L.B. Hart, B.C. Balmer, T.K. Collier, S. De Guise, M.M. Fry, L.J. Guillette, Jr., S.V. Lamb, S.M. Lane, W.E. McFee, N.J. Place, M.C. Tumlin, G.M. Ylitalo, E.S. Zolman, and T.K. Rowles. 2014a. Response to comment on health of common bottlenose dolphins (*Tursiops truncatus*) in Barataria Bay, Louisiana following the *Deepwater Horizon* oil spill. Environmental Science & Technology 48(7): 4,209-4,211.

Schwacke, L.H., C.R. Smith, F.I. Townsend, R.S. Wells, L.B. Hart, B.C. Balmer, T.K. Collier, S. De Guise, M.M. Fry, J.L.J. Guillette, and S.V. Lamb. 2014b. Health of common bottlenose dolphins (*Tursiops truncatus*) in Barataria Bay, Louisiana, following the *Deepwater Horizon* oil spill. Environmental Science Technology 48(1): 93-103.

Schwemmer, P., B. Mendel, N. Sonntag, V. Dierschke, and S. Garthe. 2011. Effects of ship traffic on seabirds in offshore waters: implications for marine conservation and spatial planning. Ecological Applications 21(5): 1851-1860.

Seitz, J.C. and G.R. Poulakis. 2006. Anthropogenic effects on the smalltooth sawfish (*Pristis pectinata*) in the United States. Marine Pollution Bulletin 52(11): 1533-1540.

Silliman, B.R., J. van de Koppel, M.W. McCoy, J. Diller, G.N. Kasozi, K. Earl, P.N. Adams, and A.R. Zimmerman. 2012. Degradation and resilience in Louisiana salt marshes after the BP *Deepwater Horizon* oil spill. Proceedings of the National Academy of Sciences USA 109(28): 11234-11239.

Silliman, B.R., P.M. Dixon, C. Wobus, Q. He, P. Daleo, B.B. Hughes, M. Rissing, J.M. Willis, and M.W. Hester. 2016. Thresholds in marsh resilience to the *Deepwater Horizon* oil spill. Scientific Reports 6. Article number 32520.

Simões, T.N., A. Candido de Silva, and C. Carneiro de Melo Moura. 2017. Influence of artificial lights on the orientation of hatchlings of *Eretmochelys imbricata* in Pernambuco, Brazil. Zoologia 34: e13727.

Smultea, M.A., J.R. Mobley Jr., D. Fertl, and G.L. Fulling. 2008. An unusual reaction and other observations of sperm whales near fixed wing aircraft. Gulf and Caribbean Research 20: 75-80.

Spier, C., W.T. Stringfellow, T.C. Hazen, and M. Conrad. 2013. Distribution of hydrocarbons released during the 2010 MC252 oil spill in deep offshore waters. Environmental Pollution 173: 224-230.

Stewart, J.D., M. Nuttall, E.L. Hickerson, and M.A. Johnston. 2018. Important juvenile manta ray habitat at Flower Garden Banks National Marine Sanctuary in the northwestern Gulf of Mexico. Marine Biology 165:111.

Stiles, M.L., E. Harrould-Kolieb, R. Faure, H. Ylitalo-Ward, and M.F. Hirshfield. 2007. Deep Sea Trawl Fisheries of the Southeast U.S. and Gulf of Mexico: Rock Shrimp, Royal Red Shrimp, Calico Scallops. Oceana, Washington DC. 18 pp.

Stout, S.A., and J.R. Payne. 2017. Footprint, weathering, and persistence of synthetic-base drilling mud olefins in deep-sea sediments following the *Deepwater Horizon* disaster. Marine Pollution Bulletin 118: 328-340.

Suchanek, T.H. 1993. Oil impacts on marine invertebrate populations and communities. American Zoologist 33: 510-523.

Sulak, K.J., and J.P. Clugston. 1998. Early life history stages of Gulf sturgeon in the Suwanee River, Florida. Transactions of the American Fisheries Society 127: 758-771.

Takeshita, R., L. Sullivan, C.R. Smith, T.K. Collier, A. Hall, T. Brosnan, T.K. Rowles, and L.H. Schwacke. 2017. The *Deepwater Horizon* oil spill marine mammal injury assessment. Endangered Species Research 33: 95-106.

Texas Parks and Wildlife Department. 2017. Federal and State Listed Species in Texas. https://tpwd.texas.gov/huntwild/wild/wildlife_diversity/nongame/listed-species/

Theo, S.L.H., and B.A. Block. 2010. Comparative influence of ocean conditions on Yellowfin and Atlantic Bluefin Tuna catch from longlines in the Gulf of Mexico. PLoS One5(5):e10756.

Todd, V.L.G., W.D. Pearse, N.C. Tegenza, P.A. Lepper, and I.B. Todd. 2009. Diel echolocation activity of harbour porpoises (*Phocoena phocoena*) around North Sea offshore gas installations. ICES Journal of Marine Science 66: 734-745.

Turtle Island Restoration Network. 2020. Kemp's Ridley Sea Turtle Count on the Texas Coast. https://seaturtles.org/turtle-count-texas-coast/

Tuxbury, S.M., and M. Salmon. 2005. Competitive interactions between artificial lighting and natural cues during seafinding by hatchling marine turtles. Biological Conservation 121: 311-316.

Urick, R.J. 1983. Principles of Underwater Sound. Los Altos Hills, CA, Peninsula Publishing. 423 pp.

U.S. Environmental Protection Agency. 2016. Questions and Answers about the BP Oil Spill in the Gulf Coast. https://archive.epa.gov/emergency/bpspill/web/html/qanda.html

U.S. Environmental Protection Agency. 2020. The green book nonattainment areas for criteria pollutants. https://www.epa.gov/green-book

U.S. Fish and Wildlife Service. 2011. FWS *Deepwater Horizon* Oil Spill Response. Bird Impact Data and Consolidated Wildlife Reports. *Deepwater Horizon* Bird Impact Data from the DOI-ERDC NRDA Database 12 May 2011. http://www.fws.gov/home/dhoilspill/pdfs/Bird%20Data%20Species%20Spreadsheet%2005122011.pdf

U.S. Fish and Wildlife Service. 2016. Hawksbill Sea Turtle (*Eretmochelys imbricata*). http://www.fws.gov/northflorida/SeaTurtles/Turtle%20Factsheets/hawksbill-sea-turtle.htm

U.S. Fish and Wildlife Service. 2020. Whooping Crane Survey Results: Winter 2019-2020. https://www.fws.gov/uploadedFiles/WHCR%20Update%20Winter%202019-2020b.pdf

U.S. Fish and Wildlife Service, Gulf States Marine Fisheries Commission and National Marine Fisheries Service. 1995. Gulf Sturgeon Recovery/Management Plan. U.S. Department of Interior, U.S. Fish and Wildlife Service, Southeast Region. Atlanta, GA. https://www.fisheries.noaa.gov/resource/document/recovery-management-plan-gulf-sturgeon-acipenser-oxyrinchus-desotoi

U.S. Fish and Wildlife Service. 2001a. Florida manatee recovery plan (Trichechus manatus latirostris), Third Revision. U.S. Department of the Interior, Southeast Region. Atlanta, GA.

U.S. Fish and Wildlife Service. 2001b. Endangered and threatened wildlife and plants; Endangered status for the Florida salt marsh vole. Federal Register 56(9):1457-1459.

U.S. Fish and Wildlife Service. 2003. Recovery plan for the Great Lakes Piping Plover (Charadrius melodus). U.S. Department of the Interior. Fort Snelling, MN.

U.S. Fish and Wildlife Service. 2007. International Recovery Plan: Whooping Crane (Grus americana), Third Revision. U.S. Department of the Interior. Albequerque, NM.

U.S. Fish and Wildlife Service. 2010. Beach-nesting Birds of the Gulf. http://www.fws.gov/home/dhoilspill/pdfs/DHBirdsOfTheGulf.pdf

U.S. Fish and Wildlife Service. 2015a. Whooping Crane (Grus americana). http://www.fws.gov/refuge/Quivira/wildlife_and_habitat/whooping_crane.html

U.S. Fish and Wildlife Service. 2015b. Bald and Golden Eagle Information. http://www.fws.gov/birds/management/managed-species/bald-and-golden-eagle-information.php

U.S. Fish and Wildlife Service. 2016. Find Endangered Species. http://www.fws.gov/endangered/

Valentine, D.L., G.B. Fisher, S.C. Bagby, R.K. Nelson, C.M. Reddy, S.P. Sylva, and M.A. Woo. 2014. Fallout plume of submerged oil from *Deepwater Horizon*. Proceedings of the National Academy of Sciences USA 111(45): 906-915.

Vanderlaan, A. S., and C. T. Taggart. 2007. Vessel collisions with whales: The probability of lethal injury based on vessel speed. Marine Mammal Science 23(1):144-156.

Venn-Watson, S., K.M. Colegrove, J. Litz, M. Kinsel, K. Terio, J. Saliki, S. Fire, R.H. Carmichael, C. Chevis, W. Hatchett, J. Pitchford, M.C. Tumlin, C. Field, S. Smith, R. Ewing, D. Fauquier, G. Lovewell, H. Whitehead, D. Rotstein, W.E. McFee, and E. Fougeres. 2015. Adrenal gland and lung lesions in Gulf of Mexico common bottlenose dolphins (*Tursiops truncates*) found dead following the *Deepwater Horizon* Oil Spill. PLoS One 10(5): e0126538.

Wakeford, A. 2001. State of Florida conservation plan for Gulf sturgeon (Acipencer oxyrinchus desotoi). St. Petersburg, FL, Florida Marine Research Institute. FMRI Technical Report TR-8. http://aquaticcommons.org/119/1/TR8.pdf

Waring, G.T., E. Josephson, K. Maze-Foley, and P.E. Rosel. 2016. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2015. U.S. Department of Commerce, National Oceanic and Atmospheric Administration. NOAA Technical Memorandum NMFS NE 238.

Wartzok, D., and D.R. Ketten. 1999. Marine mammal sensory systems, pp 117-175. In: J.E. Reynolds III and S. Rommel (Eds.), Biology of Marine Mammals. Smithsonian Institution Press, Washington, DC.

Washburn, T.W., M.G. Reuscher, P.A. Montagna, and C. Cooksey. 2017. Macrobenthic community structure in the deep Gulf of Mexico one year after the *Deepwater Horizon* blowout. Deep-Sea Research Part I: Oceanographic Research Papers 127:21-30.

Wei, C.-L. 2006. The bathymetric zonation and community structure of deep-sea macrobenthos in the northern Gulf of Mexico. M.S. Thesis, Texas A&M University. http://repository.tamu.edu/handle/1969.1/4927

Wei, C.-L., G.T. Rowe, G.F. Hubbard, A.H. Scheltema, G.D.F. Wilson, I. Petrescu, J.M. Foster, M.K. Wickstein, M. Chen, R. Davenport, Y. Soliman, and Y. Wang. 2010. Bathymetric zonation of deep-sea macrofauna in relation to export of surface phytoplankton production. Marine Ecology Progress Series 39: 1-14.

White, H.K., P.Y. Hsing, W. Cho, T.M. Shank, E.E. Cordes, A.M. Quattrini, R.K. Nelson, R. Camilli, A.W.J. Demopoulos, C. German, J.M. Brooks, H. Roberts, W.W. Shedd, C.M. Reddy, and C. Fisher. 2012. Impact of the *Deepwater Horizon* oil spill on a deep-water coral community in the Gulf of Mexico. Proceedings of the National Academy of Sciences USA 109(50): 20303-20308.

Wiese, F.K., W.A. Montevecchi, G.K. Davoren, F. Huettmann, A.W. Diamond, and J. Linke. 2001. Seabirds at risk around offshore oil platforms in the north-west Atlantic. Marine Pollution Bulletin 42(12): 1285-1290.

Williams, R., E. Ashe, and P.D. O'Hara. 2011. Marine mammals and debris in coastal waters of British Columbia, Canada. Marine Pollution Bulletin 62(6): 1303-1316.

Wilson, C.A., A. Pierce, and M.W. Miller. 2003. Rigs and Reefs: A Comparison of the Fish Communities at Two Artificial Reefs, a Production Platform, and a Natural Reef in the Northern Gulf of Mexico. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2003-009. 95 pp.

Wilson, C.A., M.W. Miller, Y.C. Allen, K.M. Boswell, and D.L. Nieland. 2006. Effects of Depth, Location, and Habitat Type on Relative Abundance and Species Composition of Fishes Associated with Petroleum Platforms and Sonnier Bank in the Northern Gulf of Mexico. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2006-037. 85 pp.

Wilson, J. 2003. Manatees in Louisiana. Louisiana Conservationist July/August 2003: 7 pp.

Wootton, E.C., E.A. Dyrynda, R.K. Pipe, and N.A. Ratcliffe. 2003. Comparisons of PAH-induced immunomodulation in three bivalve molluscs. Aquatic Toxicology 65(1): 13-25.

Würsig, B., S.K. Lynn, T.A. Jefferson, and K.D. Mullin. 1998. Behaviour of cetaceans in the northern Gulf of Mexico relative to survey ships and aircraft. Aquatic Mammals 24(1): 41-50.

Würsig, B., T.A. Jefferson, and D.J. Schmidly. 2000. The Marine Mammals of the Gulf of Mexico. College Station, TX, Texas A&M University Press. 232 pp.

Young, C.N. and J.K. Carlson. 2020. The biology and conservation status of the oceanic whitetip shark (*Carcharhinus longimanus*) and future directions for recovery. Reviews in Fish Biology and Fisheries. 30:293-321.

Introduction

Project Summary

Shell Offshore Inc. (Shell) is submitting a Supplemental Development Operations Coordination Document (DOCD) for Mississippi Canyon (MC) Blocks 391 (MC 391), 392 (MC 392) and 393 (MC 393) to install seafloor equipment (jumpers, flying leads, etc.), to produce, and to perform future well work at four production and two injection drill center facilities. Environmental impacts associated with drilling and completion of the wells at the drill center facilities were previously evaluated in Supplemental Exploration Plan (sEP) No. S-7761 (26 wells), issued 20 November 2015, or will be evaluated in sEP No. S-7996 (13 wells in MC 391, MC 392, and MC 393, approved by the Bureau of Ocean Energy Management (BOEM), and a future sEP (8 wells in MC 393). Seafloor equipment installation, production, and well work for wells in sEP No. S-7761 were included in the previously approved DOCD No. N-9969, issued 6 October 2017. This Environmental Impact Analysis (EIA) provides information regarding potential impacts on environmental resources that could be affected by Shell's proposed activities in the project area under this DOCD. Distances in the EIA are measured from the nearest portion of MC 393.

The project area is in the Central Planning Area, approximately 75 miles (121 km) from the nearest shoreline (Louisiana), 142 miles (238 km) from the onshore support base at Port Fourchon, Louisiana, and 181 miles (291 km) from the helicopter base in Houma, Louisiana. All distances are in statute miles. The water depth at the location of the proposed activities ranges from approximately 7,349 to 7,524 ft (2,240 to 2,293 m).

One of Several mobile offshore drilling units (MODUs), which will be a dynamically positioned (DP) drillship, will be used for the well work proposed in this project. Jumper installations activities for the proposed 13 new wells are expected to performed by installation vessels at approximately 30 days a year from 2020-2057.

Purpose of the Environmental Impact Analysis

The EIA was prepared pursuant to the requirements of the Outer Continental Shelf Lands Act (OCSLA), 43 United States Code §§ 1331-1356 as well as regulations including 30 Code of Federal Regulations (CFR) 550.212 and 550.227. The EIA is a project- and site-specific analysis of Shell's planned activities under this 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 impact-producing factors (IPFs), resources, and impacts associated with the proposed project activities. It identifies mitigation measures to be implemented in connection with the planned activities. Potential environmental impacts of a blowout scenario and worst-case discharge (WCD) are also analyzed.

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

The most recent multisale EISs update environmental baseline information in light of the Macondo (*Deepwater Horizon*) incident and address potential impacts of a catastrophic spill (BOEM, 2012a,b; 2013;

2014; 2015; 2016b; 2017a). Numerous technical studies have also been conducted to address the impacts of the incident. The findings of the post-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 and development 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 in its Final Programmatic EIS for the OCS Oil and Gas Leasing Program for 2017 to 2022 (BOEM, 2016a). Under the OCSLA, the U.S. Department of the Interior (USDOI) is responsible for the administration of mineral exploration and development of the OCS. Within the USDOI, BOEM and the Bureau of Safety and Environmental Enforcement (BSEE) are responsible for managing and regulating the development of OCS oil and gas resources in accordance with the provisions of the OCSLA. The BSEE offshore regulations are in 30 CFR Chapter II, Subchapter B. BOEM offshore regulations are in 30 CFR Chapter V, Subchapter B.

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

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

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

NTL	Title	Summary
BOEM-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.
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.

Table 1. (Continued).

NTL	Title	Summary
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 Outer Continental Shelf (OCS) for Worst Case Discharge (WCD) Blowout Scenarios	Provides guidance regarding information required in WCD descriptions and blowout scenarios.
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-2014-N01	Elimination of Expiration Dates on Certain Notices to Lessees and Operators Pending Review and Reissuance	Eliminates expiration dates (past or upcoming) of all NTLs currently posted on the Bureau of Safety and Environmental Enforcement website.
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.
2011-JOINT-G01	Revisions to the List of OCS Blocks Requiring Archaeological Resource Surveys and Reports	Provides new information on which OCS blocks require archaeological surveys and reports and line spacing required in each block. This NTL augments NTL 2005-G07.
2010-N10	Statement of Compliance with Applicable Regulations and Evaluation of Information Demonstrating Adequate Spill Response and Well Containment Resources	Informs operators using subsea or surface blowout preventers on floating facilities that applications for well permits must include a statement signed by an authorized company official stating that the operator will conduct all activities in compliance with all applicable regulations, including the increased safety measures regulations (75 *Federal Register* 63346). Informs operators that the Bureau of Ocean Energy Management will be evaluating whether each operator has submitted adequate information demonstrating that it has access to and can deploy containment resources to promptly respond to a blowout or other loss of well control.

Table 1. (Continued).

NTL	Title	Summary
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 (e.g., topographic features, pinnacles, low-relief live bottom areas, other potentially sensitive biological features) when conducting OCS operations in water depths less than 984 ft (300 m) in the Gulf of Mexico.
2009-N11	Air Quality Jurisdiction on the OCS	Clarifies jurisdiction for regulation of air quality in the Gulf of Mexico OCS.
2008-G04	Information Requirements for Exploration Plans and Development Operations Coordination Documents	Provides guidance on the information requirements for OCS plans, including EIA requirements and information regarding compliance with the provisions of the Endangered Species Act and the Marine Mammal Protection Act.
2005-G07	Archaeological Resource Surveys and Reports	Provides guidance on regulations regarding archaeological discoveries, specifies requirements for archaeological resource surveys and reports, and outlines options for protecting archaeological resources.

Oil Spill Prevention and Contingency Planning

Shell has an approved Gulf of Mexico Regional Oil Spill Response Plan (OSRP) as a fundamental component of the planned drilling program that certifies Shell's capability to respond to the maximum extent practicable to a WCD (30 CFR 254.2) (see DOCD Section 9). The OSRP demonstrates Shell's capability to rapidly and effectively manage oil spills that may result from drilling operations. Despite the extremely low likelihood of a large oil spill occurring during the project, Shell has designed its response program based on a regional capability of responding to a range of spill volumes that increase from small operational spills to a WCD from a well blowout. Shell's program is intended to meet the response planning requirements of the relevant coastal states and federal oil spill planning regulations. The OSRP includes information regarding Shell's regional oil spill organization, dedicated response assets, potential spill risks, and local environmental sensitivities. The OSRP presents specific information on the response program that includes a description of personnel and equipment mobilization, the incident management team organization, and the strategies and tactics used to implement effective and sustained spill containment and recovery operations.

EIA Organization

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

B. Impact-Producing Factors

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

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

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

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

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

Table 2 Footnotes and Applicability:

(1) *Activities that may affect a marine sanctuary or topographic feature. Specifically, if the well, platform site, or any anchors will be on the seafloor within the following:*

(a) *4-mile zone surrounding the Flower Garden Banks, or the 3-mile zone of Stetson Bank;*

(b) *1,000-m, 1-mile, or 3-mile zone of any topographic feature (submarine bank) protected by the Topographic Features Stipulation attached to an Outer Continental Shelf (OCS) lease;*

(c) *Essential Fish Habitat (EFH) criteria of 500 ft from any no-activity zone; or*

(d) *Proximity of any submarine bank (500-ft buffer zone) with relief greater than 2 m that is not protected by the Topographic Features Stipulation attached to an OCS lease.*

- None of these conditions (a through d) are applicable. The project area is not within the given range (buffer zone) of any marine sanctuary, topographic feature, or no-activity zone. There are no submarine banks in the project area.

(2) *Activities with any bottom disturbance within an OCS lease block protected through the Live Bottom (Pinnacle Trend) Stipulation attached to an OCS lease.*

- The Live Bottom (Pinnacle Trend) Stipulation is not applicable to the project area.

(3) *Activities within any Eastern Gulf OCS block and portions of Pensacola and Destin Dome area blocks in the Central Planning Area where seafloor habitats are protected by the Live Bottom (Low-Relief) Stipulation attached to an OCS lease.*

- The Live Bottom (Low-Relief) Stipulation is not applicable to the project area.

(4) *Activities on blocks designated by the Bureau of Ocean Energy Management (BOEM) as being in water depths 300 m or greater.*

- No impacts on high-density deepwater benthic communities are anticipated. A wellsite assessment found that no features indicative of high-density chemosynthetic communities or coral communities were identified within 2,000 ft (610 m) of the proposed well locations (Fugro Geoservices, Inc., 1996; 2009a; AOA Geophysics, Inc., 2004; Oceaneering 2018a,b).

(5) *Exploration or production activities where hydrogen sulfide (H_2S) concentrations greater than 500 parts per million might be encountered.*

- Mississippi Canyon Blocks 391, 392, and 393 are classified as H_2S "present" (10 to 40 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 Environmental Impact Analysis (EIA) can note that in a sentence or two.*

- Accidental hydrocarbon spills could affect the resources marked (X) in the matrix, and impacts are analyzed in **Section C**.

(7) *All activities that involve seafloor disturbances, including anchor emplacements, in any OCS block designated by the BOEM as having high-probability for the occurrence of shipwrecks or prehistoric sites, including such blocks that will be affected that are adjacent to the lease block in which 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. Mississippi Canyon Blocks 391, 392, and 393 are on BOEM's list of archaeology survey blocks (BOEM, 2011). However, the locations of the proposed activities are well beyond the 197 ft (60 m) depth contour used by BOEM as the seaward extent for prehistoric archaeological site potential in the Gulf of Mexico. Dynamically positioned mobile offshore drilling units (MODUs) will be used; therefore, seafloor disturbances due to anchoring will not occur.

(8) *All activities that might have an adverse effect on endangered or threatened marine mammals or sea turtles or their critical habitats.*

- IPFs that may affect marine mammals or sea turtles include MODU presence and emissions, support vessel and helicopter traffic, and accidents. See **Section C**.

(9) *Production activities that involve transportation of produced fluids to shore using shuttle tankers or barges.*

- Not applicable.

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

The MODUs to be used for the wells will be either DP drillships or DP semisubmersible drilling rigs. The MODUs are expected to be on site for up to 320 days per year from 2020 to 2057 for the Appomattox Central/East MODU, up to 230 days per year from 2020 to 2057 for the Appomattox West MODU, and up to 230 days per year from 2020 to 2057 for the Vicksburg MODU. 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 MODUs include the physical presence of the MODU in the ocean, increased light from working and safety lighting on the vessel, and noise audible above and below the water surface.

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

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

MODUs can be expected to produce noise from station keeping, drilling, and maintenance operations. The noise levels produced by DP vessels largely depend on the level of thruster activity required to keep position and, therefore, vary based on environmental site conditions and operational requirements. Representative source levels for vessels in DP mode range from 184 to 190 decibels (dB) referenced to (re) one micropascal (µPa) m from the source, with a primary frequency below 600 hertz (Hz) (Blackwell and Greene Jr., 2003; McKenna et al., 2012; Kyhn et al., 2014). Drilling operations produce noise that includes strong tonal components at low frequencies (Minerals Management Service [MMS], 2000). When drilling, the drill string represents a long vertical sound source (McCauley, 1998). Sound associated with drilling activities have a maximum broadband (10 Hz to 10 kilohertz [kHz]) source level of approximately 190 dB re 1 µPa m (Hildebrand, 2005). Based on available data, source levels generated from MODUs 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 (Nedwell and Howell, 2004).

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

Well work, inclusive of some drilling activities, and installation of subsea equipment will be accomplished with a DP MODU; no vessel will use anchors. There will be minimal disturbance to the seafloor and soft bottom communities during positioning of the equipment. Physical disturbance of the seafloor will be limited to the proximal area where the wellbore penetrates the substrate, where mud and drill cuttings will be deposited, and where subsea equipment is placed on the substrate. Depending on the specific well configuration, the total disturbed area is estimated to be 0.62 acres (ac) (0.25 hectares [ha]) per well (BOEM, 2012a).

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 will not be buried by trenching, but will instead be placed on the seafloor, decreasing the area of impact (DOCD Section 6).

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 MODUs as well as service vessels and helicopters. These emissions occur mainly from combustion of diesel. Primary air pollutants typically associated with OCS activities are suspended particulate matter (PM), sulfur oxides (SO_x), nitrogen oxides (NO_x), volatile organic compounds (VOCs), and carbon monoxide (CO) (Reşitoğlu et al., 2015).

The project 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.

A.4 Effluent Discharges

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

Water-based drilling muds (WBM) and cuttings will be released at the seafloor during the initial well intervals before the marine riser is set, which allows their return to the surface vessel. Excess cement slurry and blowout preventer 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. 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 the MODUs and support vessels are expected to include treated sanitary and domestic wastes, deck drainage, non-contaminated well treatment and completion fluids, workover fluids, desalination unit discharge, blowout preventer fluid, ballast water, bilge water, cement slurry, fire water, hydrate inhibitor, subsea production control fluid, non-contact cooling water, and treated or untreated seawater. All discharges shall comply with the NPDES General Permit and/or USCG regulations, as applicable.

A.5 Water Intake

Seawater will be drawn from several meters below the ocean surface for various services, including firewater and once-through, non-contact cooling of machinery on the MODUs (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 impacts from impingement and entrainment of aquatic organisms. The NPDES General Permit No. GMG290103 specifies requirements for new facilities for which construction commenced after July 17, 2006, with cooling water intake structures having a design intake capacity of greater than 2 million gallons of water per day, of which at least 25% is used for cooling purposes.

The MODUs 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 shore for recycling, reconditioning, or deep well injection at Halliburton Drilling Fluids, MiSwaco, Newpark Drilling Fluids, Ecoserv, or R360 Environmental Solutions, in Port Fourchon, Louisiana. Exploration and production wastes and cuttings wetted with SBMs will be transported to shore for deep well injection or landfarm at Ecoserv or R360 Environmental Solutions, in Port Fourchon, Louisiana. Completion fluids will be transported to shore for recycling or deep well injection at Haliburton, Baker Hughes, Tetra, Superior, Ecoserv, or R360 Environmental Solutions in Port Fourchon, Louisiana. Salvage hydrocarbons will be transported to shore for recycling or deep well injection at PSC Industrial Outsourcing, Inc. in Jeanerette, Louisiana.

Recyclable trash and debris will be generated during the proposed project and will be recycled at Omega Waste Management in West Patterson, Louisiana; Lamp Environmental in Hammond, Louisiana; or at a similarly permitted facility. Non-recyclable trash and debris will be transported to the Republic/BFI landfill in Sorrento, Louisiana; the parish landfill in Avondale, Louisiana; or to a similarly permitted facility. Used oil and glycol will be transported to Omega Waste Management in West Patterson, Louisiana. Non-hazardous waste will be transported to the Republic/BFI landfill in Sorrento, Louisiana; Lamp Environmental in Hammond, Louisiana; or to a similarly permitted facility. Non-hazardous oilfield waste will be transported to Ecoserv in Port Arthur, Texas. Universal waste items such as batteries, lamps, glass, and mercury contaminated waste will be sent to Lamp Environmental Services in Hammond, Louisiana, for processing. Hazardous waste will be sent to Omega Waste Management in West Patterson, Louisiana; Lamp Environmental in Hammond, Louisiana; or to a similarly permitted facility. Wastes will be recycled or disposed according to applicable regulations at the respective onshore facilities.

A.7 Marine Debris

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

A.8 Support Vessel and Helicopter Traffic

Shell will use existing shore-based facilities at Port Fourchon, Louisiana, for onshore support of vessels and at 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 below.

A.8.1 Physical Presence

The supply base at Port Fourchon, Louisiana, is operated by Shell and located on Bayou Lafourche, approximately 3 miles (5 km) from the Gulf of Mexico. There will likely be at least one support vessel in the field at all times during drilling activities. NMFS (2020) has found that support vessel traffic has the potential to disturb protected species (e.g., marine mammals, sea turtles, fishes) and creates a risk of vessel strikes. The probability of a vessel strike depends on the number, size, and speed of vessels as well as the distribution, abundance, and behavior of the species (Conn and Silber, 2013; Hazel et al., 2007; Jensen and Silber, 2004; Laist et al., 2001; Vanderlaan and Taggart, 2007; NMFS, 2020). To reduce the potential for vessel strikes, BOEM issued NTL BOEM-2016-G01, which 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. 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, 2020).

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 sound pressure levels in water of 109 dB re 1 µPa from a Bell 212 helicopter flying at an altitude of 500 ft (152 m). Penetration of aircraft noise below the sea surface is greatest directly below the aircraft; at angles greater than 13 degrees from vertical, much of the sound is reflected from the sea surface and so does not penetrate into the water (Richardson et al., 1995). The duration of underwater sound from passing aircraft is much shorter in water than air. For example, a helicopter passing at an altitude of 500 ft (152 m) that is audible in air for 4 minutes may be detectable under water for only 38 seconds at 10 ft (3 m) depth and for 11 seconds at 59 ft (18 m) depth (Richardson et al., 1995). Additionally, the sound amplitude is greatest as the aircraft approaches or leaves a location.

A.9 Accidents

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

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

The lease sale EISs (BOEM, 2012a, 2015, 2016b, 2017a) discuss other types of accidents: loss of well control, pipeline failures, vessel collisions, chemical and drilling fluid spills, and H_2S release. These are briefly discussed in this section. No other site-specific issues have been identified for the EIA. The analyses in the lease sale EISs for these topics are 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 release of gas, condensate, oil, sand, or water, the loss of well control can also suspend and disperse bottom sediments (BOEM, 2012a, 2017a). BOEM (2016a) noted that most OCS blowouts have resulted in the release of gas; ABSG Consulting Inc. (2018) reported that most loss of well control event spills were <1,000 bbl.

Shell has a robust system in place to prevent loss of well control. Included in this 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, as well as the Final Drilling Safety Rule, which specify additional safety measures for OCS activities. See DOCD Sections 2j and 9b for further information.

Pipeline Failures. Pipeline failures can result from mass sediment movements and mudslides, impacts from anchor drops, and accidental excavation in the case that the exact location of a pipeline is uncertain (BOEM, 2012a, 2013, 2015). The project area has been evaluated through geologic and geohazard surveys and found to be geologically suitable for the proposed exploration drilling (Fugro Geoservices, Inc., 1996, 2009a; AOA Geophysics, Inc., 2004; Oceaneering 2018a,b).

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

Chemical Spills. Chemicals are stored and used for pipeline hydrostatic testing, during drilling, and in well completion operations. The relative quantities of their use is reflected in the largest volumes spilled (BOEM, 2017c). Completion, workover, and treatment fluids are the largest quantity used and comprise the largest releases. Between 2007 and 2014, an average of two chemical spills <50 bbl in volume and three chemical spills >50 bbl in volume occurred each year (BOEM, 2017a).

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

H_2S Release. MC 391, MC 392, and MC 393 are classified as H_2S present. Per 30 CFR 250.490, 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 opportunity for impacts to occur would be very brief.

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

The fate of a small diesel fuel spill was estimated using NOAA's Automated Data Inquiry for Oil Spills (ADIOS) 2 model (NOAA, 2016a). This model uses the physical properties of oils in its database to predict the rate of evaporation and dispersion over time as well as changes in the density, viscosity, and water content of the product spilled. It is estimated that more than 90% of a small diesel spill would evaporate or naturally disperse within 24 hours. Based on the results of the ADIOS 2 model, 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 project area is 75 miles (121 km) from the nearest shoreline (Louisiana). Slicks from fuel spills are expected to persist for relatively short periods of time ranging from minutes (<1 bbl) to hours (<10 bbl) to a few days (10 to 1,000 bbl) and rapidly spread out, evaporate, and disperse into the water column (BOEM, 2012a). Because of the distance from shore of these potential spills and their lack of persistence, it is unlikely that a small diesel spill would make landfall prior to dissipation (BOEM, 2012a).

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

A.9.2 Large Oil Spill

by Shell's well control and blowout prevention measures detailed in DOCD Section 2j. Most well control incidents do not result in oil spills (BOEM, 2016a). According to ABS Consulting Inc. (2016), the spill rate for spills >1,000 bbl is 0.22 spills per billion bbl.

Spill Size. Shell has calculated the WCD for this DOCD using the requirements prescribed by NTL 2015-N01. The calculated initial release volume is 416,414 bbl of oil during the first day, and the calculated 30-day average WCD rate is 391,808 bbl of oil per day. The total potential spill volume along with a 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 incorporated in the WCD calculation, include, but are not limited to, obstructions or equipment in the wellbore, well bridging, and early intervention such as containment.

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

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

The results for Launch Area 57 (the launch area where MC 391, MC 392, and MC 393are located) are presented in **Table 3**. The 30-day OSRA model predicts a 4% chance of shoreline contact within 3 days of a spill (Plaquemines Parish, Louisiana), a 1% to 14% chance of shoreline contact within 10 days of a spill (Terrebonne, Lafourche, Plaquemines, St. Bernard parishes, Louisiana), and a 1% to 21% chance of shoreline contact within 30 days of a spill from Cameron Parish, Louisiana to Bay County, Florida. Counties whose conditional probability for shoreline contact is <0.5% for 3, 10, and 30 days are not shown in **Table 3**.

Table 3. Conditional probabilities of a spill in the project area (MC 391, MC 392, and MC 393) 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 57) 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
C13	Cameron, LA	--	--	1
C14	Vermilion, LA	--	--	1
C17	Terrebonne, LA	--	1	2
C18	Lafourche, LA	--	1	2
C20	Plaquemines, LA	4	14	21
C21	St. Bernard, LA	--	1	3
C22	Hancock and Harrison, MS	--	--	1
C23	Jackson, MS	--	--	1
C24	Mobile, AL	--	--	1
C25	Baldwin, AL	--	--	1
C26	Escambia, FL	--	--	1
C28	Okaloosa, FL	--	--	1
C29	Walton, FL	--	--	1
C30	Bay, FL	--	--	1

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

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

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

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

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

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

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

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

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

B. Affected Environment

The project area is in the Central Planning Area, approximately 75 miles (121 km) from the nearest shoreline (Louisiana), 142 miles (238 km) from the onshore support base at Port Fourchon, Louisiana, and 181 miles (291 km) from the helicopter base in Houma. Estimated water depth at the location of the proposed activities is approximately 7,406 ft (2,257 m).

The wellsites shallow hazards and archaeological assessments did not identify any seafloor anomalies within 2,000 ft (610 m) of the proposed project area that would indicate the potential for chemosynthetic or high-density deepwater benthic communities, or archaeologically significant sonar contacts (Fugro Geoservices, Inc., 1996; 2007, 2009a,b,c; AOA Geophysics, Inc., 2004; Oceaneering 2018a,b). There are no water bottom anomalies within 2,000 ft (610 m) of proposed wellsites as defined by BOEM (2019).

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

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

C. Impact Analysis

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

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

C.1 Physical/Chemical Environment

C.1.1 Air Quality

Due to the distance from shore-based pollution sources (approximately 75 miles [121 km] from the nearest shoreline, offshore air quality is expected to be good. The attainment status of federal OCS waters is unclassified because there is no provision in the Clean Air Act for classification of areas outside state waters (BOEM, 2012a).

In general, ambient air quality on coastal counties along the Gulf of Mexico is relatively good (BOEM, 2012a). As of June 2020, Mississippi, Alabama, and Florida Panhandle coastal counties are in attainment of the National Ambient Air Quality Standards (NAAQS) for all criteria pollutants (U.S. Environmental Protection Agency, 2020). St. Bernard Parish in Louisiana and Hillsborough County in Florida are nonattainment areas for sulfur dioxide based on the 2010 standard. One coastal metropolitan area in Texas (Houston-Galveston-Brazoria) is a nonattainment area for 8-hour ozone (2015 Standard). One coastal metropolitan area in Florida (Tampa) was reclassified in 2018 from a nonattainment area to maintenance status for lead based on the 2008 Standard (U.S. Environmental Protection Agency, 2020).

Winds in the region are driven by the anticyclonic (clockwise) atmospheric circulation around the Bermuda High, a semi-permanent, subtropical area of high pressure in the North Atlantic Ocean off the East Coast of North America that migrates east and west with varying central pressure (BOEM, 2017a). The Gulf of Mexico is located to the southwest of this center of circulation, resulting in a prevailing southeasterly to southerly flow, which is conducive to transporting emissions toward shore. However, circulation is also affected by tropical cyclones (hurricanes) during summer and fall and by extratropical cyclones (cold fronts) during winter.

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

Impacts of Air Pollutant Emissions

Air pollutant emissions are the only routine IPF anticipated to affect air quality. These emissions occur mainly from combustion of diesel and aviation fuel, also known as Jet-A. Primary air pollutants typically associated with the burning of these fuels are suspended particulate matter, sulfur oxides, NO_x, volatile organic compounds, and CO (Reşitoğlu et al., 2015).

Due to the distance from shore, most routine operations in the project area are not expected to impact air quality along the coast. As noted by BOEM (2012a, 2013; 2014; 2015; 2016b; 2017b), emissions of air pollutants from routine activities in the project area are projected to have minimal impacts on onshore air quality because of the prevailing atmospheric conditions, emission heights, emission rates, and the distance of these emissions from the coastline. However, support vessel and helicopter traffic entering or departing coastal facilities will release air pollutants in these areas during the project period.

MC 391, MC 392, and MC 393 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 AQR (see DOCD Section 8) prepared in accordance with BOEM requirements shows that the projected emissions from sources associated with the proposed activities meet BOEM's exemption criteria. Therefore, this 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. BOEM coordinates with the USFWS if emissions from proposed OCS projects may affect the Breton Class I area. The project area is approximately 91 miles (146 km) from the Breton Wilderness Area. Shell will comply with emissions requirements as directed by BOEM. 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 234 miles (377 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 all extant OCS oil and gas sources are 0.4% of the U.S. total. Greenhouse gas emissions from the proposed project represent a negligible contribution to the total greenhouse gas emissions from reasonably foreseeable activities in the Gulf of Mexico area and would not significantly alter any of the climate change impacts evaluated in the Programmatic EIS (BOEM, 2016a).

Impacts of a Small Fuel Spill

Potential impacts of a small spill on air quality are expected to be consistent with those analyzed and discussed by BOEM (2012a, 2015, 2016b, 2017a). **Section A.9.1** discusses the size and fate of a potential small diesel fuel spill as a result of Shell's proposed activities. DOCD Section 9b provides detail on spill response measures.

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

Because of the offshore location of the proposed small fuel spill, coastal air quality would not be affected because the spill would be expected to dissipate prior to making landfall or reaching coastal waters (see **Section A.9.1**).

Impacts of a Large Oil Spill

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

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

Due to the project area location, most air quality impacts associated with oil on the sea surface would occur in offshore waters. However, depending on the spill trajectory and the effectiveness of spill response measures, coastal air quality could be affected if oil on the sea surface approaches or contacts the coast. Based on the 30-day OSRA modeling (**Table 3**), Plaquemines Parish, Louisiana is the coastal area most likely to be affected (4% probability within 3 days, 14% within 10 days, and 21% probability within 30 days). Other Louisiana shorelines may be affected within 10 days (Terrebonne, St. Bernard, and Lafourche parishes), and shorelines in Louisiana, Alabama, Mississippi, and Florida could be affected within 30 days (1% to 21% conditional probability).

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

C.1.2 Water Quality

There are no site-specific baseline water quality data for the project area. Due to the lease location in deep, offshore waters, water quality is expected to be good, with low levels of contaminants. As noted by BOEM (2017a), deepwater areas in the northern Gulf of Mexico are relatively similar with respect to patterns of water column 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 (a small fuel spill and a large oil spill).

Impacts of Effluent Discharges

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

WBM and cuttings will be released at the seafloor during the initial well intervals before the marine riser is set, which allows their return to the surface vessel. Excess cement slurry and blowout preventer fluid will also be released at the seafloor. The seafloor discharges of WBM and associated drill cuttings will result in seafloor disturbances that will produce locally turbid conditions in the water column near the seafloor. The turbidity plume will be carried away from the well by near-bottom currents and, based on current speed(s), may be detectable within tens to hundreds of meters of the wellbore. As suspended WBM and 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). Recent EISs have 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 at the sea surface by the MODUs 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 MODUs will flow overboard without treatment. However, rainwater that falls on the MODU deck and other areas that may be contaminated with chemicals, such as chemical storage areas or places where equipment is exposed (such as drop or containment pans), 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 MODUs and support vessels are expected to include treated sanitary and domestic wastes, deck drainage, non-contaminated well treatment and completion fluids, workover fluids, desalination unit discharge, blowout preventer fluid, ballast water, bilge water, cement slurry, fire water, hydrate inhibitor, subsea production control fluid, non-contact cooling water, and treated or untreated seawater. All discharges shall comply with the NPDES General Permit and/or USCG regulations, as applicable, and therefore are not expected to cause significant impacts on offshore 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). In the EIA, the small spill scenario is proposed to occur in offshore waters at or near the MODUs. **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 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 a biological weathering processes (e.g., evaporation, dissolution, dispersion, photochemical oxidation) and biological processes (microbial degradation). Diesel oil is much lighter than water (specific gravity is between 0.83 and 0.88, compared to 1.03 for seawater). When spilled on water, diesel oil spreads very quickly to a thin film of rainbow and silver sheens, except for marine diesel, which may form a thicker film of dull or dark colors. However, because diesel oil has a very low viscosity, it is readily dispersed into the water column when winds reach 5 to 7 knots or with breaking waves (NOAA, 2019). It is possible for diesel oil that is dispersed by wave action to form droplets that are small enough be kept in suspension and moved by the currents.

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

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

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

Impacts of a Large Oil Spill

Potential impacts of a large oil spill on water quality are expected to be consistent with those analyzed and discussed by BOEM (2012a, 2015, 2016b, 2017a). **Section A.9.2** discusses the size and fate of a potential large oil spill as a result of Shell's proposed activities. A large spill would likely affect water quality by producing a slick on the water surface and increasing the concentrations of petroleum hydrocarbons and their degradation products. The extent and persistence of impacts would depend on the meteorological and oceanographic conditions at the time of the spill as well as the effectiveness of the spill response measures. Most of the spilled oil would be expected to form a slick at the surface, although observations following the *Deepwater Horizon* incident indicate that plumes of submerged oil droplets can be produced when subsea dispersants are applied at the wellhead (Camilli et al., 2010; Hazen et al., 2010; NOAA, 2011a,b,c). Recent analyses of the entire set of samples associated with the *Deepwater Horizon* incident have confirmed that the application of subsurface dispersants resulted in subsurface hydrocarbon plumes (Spier et al., 2013). A report by Kujawinski et al. (2011) indicates that chemical components of subsea dispersants used during the *Deepwater Horizon* incident persisted for up to 2 months and were detectable up to 186 miles (300 km) from the wellsite at water depths of 3,280 to 3,937 ft (1,000 to 1,200 m). Dispersants were detectable in <9% of the samples (i.e., 353 of the 4,114 total water samples), and concentrations in the samples were significantly below the chronic screening level for dispersants (BOEM, 2012b).

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

A large oil spill could result in a release of gaseous hydrocarbons that could affect water quality. During the *Deepwater Horizon* incident, large volumes of 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's location, most water quality impacts would occur in offshore waters. Depending on the spill trajectory and the effectiveness of spill response measures, coastal water quality could be affected. Based on the 30-day OSRA modeling (**Table 3**), Plaquemines Parish, Louisiana is the coastal area most likely to be affected (4% probability within 3 days, 14% within 10 days, and 21% probability within 30 days). Other Louisiana shorelines may be affected within 10 days (Terrebonne, St. Bernard, and Lafourche Parishes), and shorelines in Louisiana, Alabama, Mississippi, and Florida could be affected within 30 days (1% to 21% conditional probability).

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures detailed in DOCD Section 2j. In the event of a large spill, water quality could be temporarily affected, but no long-term significant impacts are expected. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce any resultant impacts. DOCD Section 9b provides detail on spill response measures.

C.2 Seafloor Habitats and Biota

The water depth at the location of the proposed activities ranges from approximately 7,349 to 7,524 ft (2,240 to 2,293 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 in the project area is composed primarily of soft (unconsolidated) sediments; exposed hard substrate habitats and associated biological communities are rare. No features or areas that could support significant, high-density benthic communities were found within 2,000 ft (610 m) of the proposed wellsites (Fugro Geoservices, Inc., 1996, 2009a; AOA Geophysics, Inc., 2004; Oceaneering 2018a,b). There are no water bottom anomalies within 2,000 ft (610 m) of proposed wellsites as defined by BOEM (BOEM, 2019; Fugro Geoservices, Inc., 1996, 2009a; AOA Geophysics, Inc., 2004; Oceaneering 2018a,b).

C.2.1 Soft Bottom Benthic Communities

There are no site-specific benthic community data from the project area. However, data from various gulf-wide studies have been conducted to regionally characterize the continental slope habitats and benthic ecology (Wei, 2006; Rowe and Kennicutt, 2009; Wei et al., 2010; Carvalho et al., 2013), which can be used to describe typical baseline benthic communities that could be present in vicinity of the proposed wellsites. **Table 4** summarizes data from two stations in the vicinity of the proposed wells. Sediments at these two stations were similar, predominantly clay (57% at Station S37 and 51% at Station S36) and silt (35% at Station S37 and 41% at Station S36), respectively (Rowe and Kennicutt, 2009).

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

Station	Location Relative to Project Area	Water Depth (m)	Density		
			Meiofauna (individuals m^{-2})	Macroinfauna (individuals m^{-2})	Megafauna (individuals ha^{-1})
S37	15 miles	2,382	291,179	2,192	1451
S36	28 miles	1,839	799,963	4,481	359

ha=hectare.

Densities of meiofauna (animals that pass through a 0.5-millimeter sieve but are retained on a 0.062-millimeter sieve) in sediments collected at water depths representative of the project area were approximately between 291,000 to 800,000 individuals m^{-2} (Rowe and Kennicutt, 2009). Nematodes, nauplii, and harpacticoid copepods were the three dominant groups in the meiofauna, accounting for approximately 90% of total abundance.

The benthic macroinfauna is characterized by small mean individual sizes and low densities, both of which reflect the intrinsically low primary production in surface waters of the Gulf of Mexico continental slope (Wei, 2006). Densities decrease exponentially with water depth (Carvalho et al., 2013). Based on an equation presented by Wei (2006), the macroinfaunal densities in the water depths of the proposed activities are estimated to be approximately 1,277 individuals m^{-2}; however, actual densities at the proposed wellsites are unknown and often highly variable.

Polychaetes are typically the most abundant macroinfaunal group on the northern Gulf of Mexico continental slope, followed by amphipods, tanaids, bivalves, and isopods (Rowe and Kennicutt, 2009). Carvalho et al. (2013) found polychaete abundance to be higher in the central region of the northern Gulf of Mexico when compared to the eastern and western regions. Wei (2006) recognized four depth-dependent faunal zones (1 through 4), two of which (Zones 2 and 3) are divided horizontally. The project area is located near the border of Zones 2E and 3E. Zone 2E, 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* spp. Zone 3E is a broad zone that encompasses the west flank of the lower Mississippi Fan, the lower Mississippi Canyon, the lower DeSoto Canyon, the lower West Florida Terrace, the deep Mississippi Fan, and the base of the Sigsbee Escarpment. The most abundant species in this zone were the polychaetes *Paraonella monilaris* and *Tharyx marioni*; the bivalves *Heterodonta* spp.; and the isopod *Macrostylis* spp. (Wei, 2006; Wei et al., 2010).

Megafaunal density at stations in the vicinity of the proposed activities are approximately 359 to 1,451 individuals ha^{-1} (**Table 4**). Common megafauna included motile taxa such as decapod crustaceans, holothurian echinoderms, and demersal fishes as well as sessile taxa such as sponges and octocorals (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). In deep-sea sediments, Main et al. (2015) observed that microbial oxygen consumption rates increased and bacterial biomass decreased with hydrocarbon contamination. Bacterial biomass at the depth range of the project area typically is approximately 1 to 2 g C m^{-2} in the top 6 inches (15 cm) of sediments (Rowe and Kennicutt, 2009).

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

Impacts of Physical Disturbance to the Seafloor

In water depths such as those that are encountered in the project area, DP MODUs disturb the seafloor only around the wellbore (seafloor surface hole location) where the bottom template and blowout preventer are located. Depending upon the specific well configuration, this area is generally about 0.62 ac (0.25 ha) per well (BOEM, 2012a). Additional seafloor disturbance will occur where the new seafloor infrastructure (e.g., manifolds, umbilicals, flowlines) is installed. Infrastructure will be installed using a DP MODU and seafloor disturbance is only expected in the immediate vicinity of the equipment installation.

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

Impacts of Effluent Discharges

Drilling mud and cuttings are the only effluents that could be present in vicinity of the additional wellsites that are likely to affect local soft bottom benthic communities. During initial well drilling 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). Small amounts of water-based blowout preventer fluid will also be released at the seafloor but 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, and blowout preventer fluid will eventually be recolonized through larval settlement and migration from adjacent areas. Some localized habitat covered with cement slurry may become unavailable to recolonization until the cement is buried with sediment. Because the sedimentation rate in many areas of the deep sea is slow, and some deep-sea biota grow and reproduce slowly, recovery of these local benthic communities may require several years.

Discharges of treated SBM-associated cuttings from the MODUs may affect benthic communities, primarily within several hundred meters of the wellsites. The fate and effects of SBM cuttings have been reviewed by Neff et al. (2000), and monitoring studies have been conducted in the Gulf of Mexico by Continental Shelf Associates (2004, 2006). In general, cuttings with adhering SBM tend to clump together and form thick cuttings piles close to the drillsites. SBM cuttings deposition may elevate local organic carbon concentrations and generate anoxic conditions during biodegradation of the SBF by sulfate-reducing bacteria (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 community structure may change during and subsequent to biodegradation of SBM in sediments. Infaunal numbers may increase and diversity may decrease as opportunistic species that tolerate low oxygen and high H_2S predominate (as a by-product of anaerobic bacterial biodegradation) (Continental Shelf Associates, 2006). As the base synthetic fluid 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 regional benthic community are expected to be consistent with those analyzed and discussed by BOEM (2012a, 2015, 2016b, 2017a). Impacts from a subsea blowout could include smothering and exposure to toxic hydrocarbons from oiled sediment settling to the seafloor. The most likely effects of a subsea blowout on benthic communities would be within a few hundred meters of the wellsites. BOEM (2012a) estimated that a severe subsurface blowout could suspend and disperse sediments within a 984 ft (300 m) radius. Although any coarse sediments (sands) would probably settle at a rapid rate within 1,312 ft (400 m) from the blowout site, fine sediments (silts and clays) could be suspended for more than 30 days and dispersed over a much wider area. A previous study characterized surface sediments at the sampling stations in the vicinity of the proposed wellsites. Sediments at these two stations were similar, predominantly clay (57% at Station S37 and 51% at Station S36) and silt (35% at Station S37 and 41% at Station S36), respectively (Rowe and Kennicutt, 2009).

Previous analyses by BOEM (2016b, 2017a) concluded that oil spills would be unlikely to affect benthic communities beyond the immediate vicinity of the wellhead (i.e., due to physical impacts of a blowout) because the oil would rise quickly to the sea surface directly over the spill location. During the *Deepwater Horizon* incident, the use of subsea dispersants at the wellhead caused the formation of subsurface plumes (NOAA, 2011b). While the behavior and impacts of subsurface plumes are not well known, a subsurface plume could contact the seafloor and affect benthic communities beyond the 984 ft (300 m) radius (BOEM, 2012a), depending on its extent, trajectory, and persistence (Spier et al., 2013). This contact could result in smothering and/or toxicity to benthic organisms. The subsurface plumes observed following the *Deepwater Horizon* incident were reported in water depths of approximately 3,600 ft (1,100 m), extending at least 22 miles (35 km) from the wellsite and persisting for more than a month (Camilli et al., 2010). The subsurface plumes apparently resulted from the use of subsea dispersants at the wellhead (NOAA, 2011b; Spier et al., 2013). Montagna et al. (2013) estimated that the most severe impacts to soft bottom benthic communities (e.g., reduction of faunal abundance and diversity) from the *Deepwater Horizon* incident extended 2 miles (3 km) from the wellhead in all directions, covering an area of approximately 9 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. 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.

C.2.2 High-Density Deepwater Benthic Communities

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

Monitoring programs on the Gulf of Mexico continental slope have shown that benthic impacts from drilling discharges typically are concentrated within approximately 1,640 ft (500 m) of the wellsite, although detectable deposits may extend beyond this distance (Continental Shelf Associates, 2004, 2006;

Neff et al., 2005). The nearest known high-density deepwater benthic communities are found in Viosca Knoll Block 826, approximately 38 miles (61 km) from the project area (BOEM, nd).

In water depths such as those encountered in the project area, the DP MODUs will disturb the seafloor only in the immediate vicinity of the drill sites and areas of seafloor infrastructure installation (Section A.2). Based on the site clearance letters, no features or areas that could support significant, high-density benthic communities were found within 2,000 ft (610 m) of the proposed wellsites (Fugro Geoservices, Inc., 1996, 2009a; AOA Geophysics, Inc., 2004; Oceaneering 2018a,b). There are no water bottom anomalies within 2,000 ft (610 m) of proposed wellsites as defined by BOEM (BOEM, 2019) (Fugro Geoservices, Inc., 1996, 2009a; AOA Geophysics, Inc., 2004; Oceaneering 2018a,b). As a result, high-density deepwater benthic communities are not expected to be present.

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

Impacts of a Large Oil Spill

The wellsites assessment did not identify high-density deepwater benthic communities within 2,000 ft (610 m) of the proposed wellsites (Fugro Geoservices, Inc., 1996, 2009a; AOA Geophysics, Inc., 2004; Oceaneering 2018a,b).

BOEM (2012a, 2015, 2016c, 2017a) concluded that oil spills would be unlikely to affect benthic communities beyond the immediate vicinity of the wellhead (i.e., due to physical impacts of a blowout) because the oil would rise quickly to the sea surface directly over the spill location. However, subsea oil plumes resulting from a seafloor blowout could affect sensitive deepwater communities (BOEM, 2016b). During the *Deepwater Horizon* incident, subsurface plumes were reported at a water depth of approximately 3,600 ft (1,100 m), extending at least 22 miles (35 km) from the wellsite and persisting for more than a month (Camilli et al., 2010). The subsurface plumes apparently resulted from the use of subsea dispersants at the wellhead (NOAA, 2011c). Chemical components of subsea dispersants used during the *Deepwater Horizon* incident persisted for up to 2 months and were detectable up to 186 miles (300 km) from the wellsite at a water depths of 3,280 to 3,937 ft (1,000 to 1,200 m) (Kujawinski et al., 2011). However, estimated dispersant concentrations in the subsea plume were below levels known to be toxic to marine life. While the behavior and impacts of subsurface plumes are not well known, a subsurface plume could have the potential to contact high-density deepwater benthic communities beyond the 984 ft (300 m) radius estimated by (BOEM, 2016a), depending on its extent, trajectory, and persistence (Spier et al., 2013). Potential impacts on sensitive resources would be an integral part of the decision and approval processes for the use of dispersants.

Potential impacts of oil on high-density deepwater benthic communities are discussed by BOEM (2012a, 2015, 2016c, 2017a). Oil plumes that directly contact localized patches of sensitive benthic communities before degrading could potentially impact the resource. However, the potential impacts would be localized due to the directional movement of oil plumes by the water currents and because the sensitive habitats have a scattered, patchy distribution. The more likely result would be exposure to widely dispersed, biodegraded particles that “rain” down from a passing oil plume.

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 (authigenic carbonate and changes in unconsolidated sediment characteristics) and biodiversity, and reduction or loss of one or more commercial and recreational fishery habitats.

Lethal and sublethal effects are possible for deepwater coral communities that receive a lower level of oil impact. Effects to deepwater coral communities could be temporary (e.g., lack of feeding, loss of tissue mass) or long-lasting and affect the resilience of coral colonies to natural disturbances (e.g., elevated water temperature, diseases) (BOEM, 2012a, 2015, 2016b, 2017a). The potential for a spill to affect deepwater corals was observed during an October 2010 survey of deepwater coral habitats in water depths of 4,600 ft (1,400 m) approximately 7 miles (11 km) southwest of the Macondo wellhead. Much of the octocoral fauna observed in a location measuring approximately 50 ft × 130 ft (15 m × 40 m) was covered by a brown flocculent material (Bureau of Ocean Energy Management, Regulation, and Enforcement, 2010) with signs of stress, including varying degrees of tissue loss and excess mucous production (White et al., 2012). Hopanoid petroleum biomarker analysis of the flocculent material indicated that it contained oil from the *Deepwater Horizon* incident. The injured and dead corals were in an area in which a subsea plume of oil had been documented during the spill in June 2010. The deepwater coral at this location showed signs of tissue damage that was not observed elsewhere during these surveys or in previous deepwater coral studies in the Gulf of Mexico. The team of researchers concluded that the observed coral injuries likely resulted from exposure to the subsurface oil plume (White et al., 2012). Apparent recovery of some affected areas by March2012 correlated negatively with the proportion of the coral covered with floc in late 2010 (Hsing et al., 2013). Fisher et al. (2014b) reported two additional coral areas affected by the *Deepwater Horizon* incident; one 4 miles (6 km) south of the Macondo wellsite, and the other 14 miles (22 km) to the southeast. Prouty et al. (2016) found evidence that corals located northeast of the *Deepwater Horizon* incident were also affected. In addition to direct impacts on corals and other sessile epifauna, the spill also affected macroinfauna associated with these hard bottom communities (Fisher et al., 2014a).

Although no known deepwater coral communities near the project area 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. Overall, while patches of habitat may be affected, the Gulf-wide ecosystem of high-density deepwater benthic communities would be expected to suffer no significant effects (BOEM, 2016b).

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 approximately 92 miles (148 km) from the project area. There are no IPFs associated with either routine operations or accidents that could cause impacts to designated topographic features due to their distance from the project area.

C.2.4 Pinnacle Trend Area Live Bottoms

The project area is not covered by the Live Bottom (Pinnacle Trend) Stipulation. As defined in NTL 2009-G39, the nearest pinnacle trend block is Viosca Knoll Block 778, approximately 40 miles (64 km) from the project area. There are no IPFs associated with either routine operations or accidents that could cause impacts to pinnacle trend area live bottoms due to the distance from the project area.

C.2.5 Eastern Gulf Live Bottoms

The project area is not covered by the Live Bottom (Low-Relief) Stipulation, which pertains to seagrass communities and low-relief hard bottom reef within the Gulf of Mexico Eastern Planning Area blocks in water depths of 328 ft (100 m) or less and portions of Pensacola and Destin Dome Area Blocks in the Central Planning Area. The nearest block covered by the Live Bottom Stipulation, as defined in NTL 2009-G39, is Destin Dome Block 573, located approximately 52 miles (84 km) northeast from the project area. There are no IPFs associated with either routine operations or accidents that could cause impacts to eastern Gulf of Mexico live bottom areas due to the distance from the project area.

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

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

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

Table 5. Federally listed Endangered and Threatened species potentially present in the project area and along the northern Gulf Coast.

Species	Scientific Name	Status	Potential Presence		Critical Habitat Designated in Gulf of Mexico
			Project Area	Coastal	
Marine Mammals					
Bryde's whale	*Balaenoptera edeni*[1]	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*	TE[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)

Table 5. (Continued).

Species	Scientific Name	Status	Potential Presence		Critical Habitat Designated in Gulf of Mexico
			Project Area	Coastal	
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

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

[1] Distinct (unnamed) Gulf of Mexico subspecies

[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 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*), Whooping Crane (*Grus americana*), Gulf sturgeon (*Acipenser oxyrinchus desotoi*), smalltooth sawfish (*Pristis pectinata*), four subspecies of beach mouse, and the Florida salt marsh vole (*Microtus pennsylvanicus dukecampbelli*). Critical habitat has been designated for all of these species except the Florida salt marsh vole as indicated in **Table 5** and discussed in individual sections. Two other coastal bird species (Bald Eagle [*Haliaeetus leucocephalus*] and Brown Pelican [*Pelecanus occidentalis*]) are no longer federally listed as Endangered or Threatened; these are discussed in **Section C.4.2**.

Five sea turtle species, the sperm whale (*Physeter macrocephalus*), and the oceanic whitetip shark (*Carcharhinus longimanus*) are the only Endangered or Threatened species likely to occur within the project area. The listed sea turtles include the leatherback turtle (*Dermochelys coriacea*), Kemp's ridley turtle (*Lepidochelys kempii*), hawksbill turtle (*Eretmochelys imbricata*), loggerhead turtle (*Caretta*

caretta), and green turtle (*Chelonia mydas*) (Pritchard, 1997). Effective August 11, 2014, NMFS has designated certain marine areas as critical habitat for the northwest Atlantic distinct population segment (DPS) of the loggerhead sea turtle (**Section C.3.5**). No critical habitat has been designated in the Gulf of Mexico for the leatherback turtle, Kemp's ridley turtle, hawksbill turtle, or the green turtle. Listed marine mammal species include one odontocete whale (sperm whale) which is known to occur in the Gulf of Mexico (Würsig et al., 2000); no critical habitat has been designated for the sperm whale. The Bryde's whale (*Balaenoptera edeni*) exists in the Gulf of Mexico as a small, resident population. It is the only baleen whale known to be resident to the Gulf. The genetically distinct Northern Gulf of Mexico stock is severely restricted in range, being found almost exclusively in its core distribution area within the northeastern Gulf in the waters of the DeSoto Canyon (Waring et al., 2016) and is therefore not likely to occur within the project area. The giant manta ray (*Mobula birostris*) could occur in the project area but is most commonly observed in the Gulf of Mexico at the Flower Garden Banks. The Nassau grouper (*Epinephelus striatus*) has been observed in the Gulf of Mexico at the Flower Garden Banks but is most commonly observed in shallow tropical reefs of the Caribbean and is not expected to occur in the project area.

Five Endangered mysticete whales (blue whale [*Balaenoptera musculus*], fin whale [*Balaenoptera physalus*], humpback whale [*Megaptera novaeangliae*], 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., 2019) 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*). These corals are shallow water, zooxanthellate species (containing symbiotic photosynthetic zooxanthellae which contribute to their nutritional needs) and so are not present in the deepwater project area (see **Section C.3.15**).

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

C.3.1 Sperm Whale (Endangered)

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

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

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

The distribution of sperm whales in the Gulf of Mexico is correlated with mesoscale physical features such as eddies associated with the Loop Current (Jochens et al., 2008). Sperm whale populations in the north-central Gulf of Mexico are present there throughout the year (Davis et al., 2000). Results of a multi-year tracking study show female sperm whales typically concentrated along the upper continental slope between the 656- and 3,280-foot (200- and 1,000-meter) depth contours (Jochens et al., 2008). Male sperm whales were more variable in their movements and were documented in water depths greater than 9,843 ft (3,000 m). Generally, groups of sperm whales sighted in the Gulf of Mexico during the MMS-funded Sperm Whale Seismic Study consisted of mixed-sex groups comprising adult females and juveniles, and groups of bachelor males. Typical group size for mixed groups was 10 individuals (Jochens et al., 2008). A review of sighting reports from seismic mitigation surveys in the Gulf of Mexico conducted over a 6-year period found a mean group size for sperm whales of 2.5 individuals (Barkaszi et al., 2012).

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

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

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

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

Some sounds produced by the MODUs 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 and installation activities is relatively weak in intensity, and an individual animal's noise exposure would be transient. As discussed in **Section A.1**, sounds generated by an actively drilling MODU using DP propulsion are maximum broadband (10 Hz to 10 kHz) source levels of approximately 190 dB re 1 µPa m (Hildebrand, 2005).

NMFS (2018b) 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 MODU operations, sperm whales would move away from the proposed operations area, and related noise levels that could cause auditory injury would be avoided. Noise associated with proposed support 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, 2009a). 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).

NOAA Fisheries West Coast Region (2018) presents criteria that are used in the interim to determine behavioral disturbance thresholds for marine mammals and are applied equally across all functional hearing groups. Received root-mean-square sound pressure levels (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.

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, 2016a). 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.

The MODUs will be located within a deepwater, open ocean environment. Based on distributional data, it is likely that sperm whales may occur within the project area. Sounds generated by drilling operations will be generally non-impulsive, with some temporal variability in sound level. This analysis assumes that the continuous nature of sounds produced by the MODUs 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 MODUs will allow for active avoidance of potential physical impacts. Drilling and installation-related noise associated with this project may contribute to increases in the ambient noise environment of the Gulf of Mexico, but it is not expected to be at amplitudes sufficient enough to cause hearing effects to sperm whales. Due to the open ocean environment, transient nature of sperm whales, and the stationary nature of the proposed activites, it is not expected that any sperm whales will remain in proximity to the source for a full 24-hour period to receive SEL_{cum} necessary for the onset of auditory threshold shifts. Impacts to this species are expected to be limited to behavioral effects, including displacement from or avoidance of waters around the active MODUs. MODU lighting and rig presence are not identified as IPFs for sperm whales (BOEM, 2014a,b,c; 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, slow down or stop their vessel to avoid striking protected species, and requires operators to report sightings of any injured or dead protected species. 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, 2020). 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 [2020] Appendix C). Compliance with these mitigation measures will minimize the likelihood of vessel strikes as well as reduce the chance for disturbing sperm whales. However, this mitigation is effective only during daylight hours and during periods of adequate visibility.

NMFS (2020) 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 (2020) in addition to the NTL BOEM-2016-G01, NMFS concluded that the likelihood of collisions between vessels and sperm whales would be reduced during daylight hours. During nighttime and during periods of poor visibility, it is assumed that vessel noise and sperm whale avoidance of moving vessels would reduce the chance of vessel strikes with this species. It is, however, likely that a collision between a sperm whale and a moving support vessel would result in severe injury or mortality of the stricken animal. The current Potential Biological Removal (PBR) level for the Gulf of Mexico stock of sperm whales is 1.1 (Hayes et al., 2019). The PBR level is defined by the MMPA as the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population. Mortality of a single sperm whale would constitute a significant impact to the local (Gulf of Mexico) stock of sperm whales but would not likely be significant at the species level.

Helicopter traffic also has the potential to disturb sperm whales. Smultea et al. (2008) documented responses of sperm whales offshore Hawaii to fixed wing aircraft flying at an altitude of 804 ft (245 m). A reaction to the initial pass of the aircraft was observed during 3 (12%) of 24 sightings. All three reactions consisted of a hasty dive and occurred at less than 1,180 ft (360 m) lateral distance from the aircraft. Additional reactions were seen when the 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, 2020). Although whales may respond to helicopters (Smultea et al., 2008), NMFS (2020) concluded that this altitude would minimize the potential for disturbing sperm whales. Therefore, no significant impacts are expected.

Impacts of a Small Fuel Spill

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

The probability of a fuel spill will be minimized by Shell's preventative measures during routine operations, including fuel transfer. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the potential for impacts on sperm whales. 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 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 (2020). Oil impacts on marine mammals are discussed by Geraci and St. Aubin (1990) and by the MMC (2011). For the EIA, there are no unique site-specific issues with respect to spill impacts on sperm whales.

Impacts of oil spills on sperm whales can include direct impacts from oil exposure as well as indirect impacts due to response activities and materials (e.g., vessel traffic, noise, dispersants) (MMC, 2011). Direct physical and physiological effects can include skin irritation, inflammation, or necrosis; chemical burns of skin, eyes, and mucous membranes; inhalation of toxic fumes; ingestion of oil (and dispersants) directly or via contaminated prey; and stress from the activities and noise of response vessels and aircraft. The level of impact of oil exposure depends on the amount, frequency, and duration of exposure; route of exposure; and type or condition of petroleum compounds or chemical dispersants (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). Ackleh et al. (2012) hypothesized that sperm whales may have temporarily relocated away from the vicinity of the Deepwater Horizon incident in 2010. However, based on aerial surveys conducted in the aftermath of the spill, visibly oiled cetaceans (including several sperm whales) were identified within the footprint of the oil slick (Dias et al., 2017).

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

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in 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) stock of sperm whales but would not likely be significant at the species level. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. DOCD Section 9b provides detail on spill response measures.

C.3.2 Bryde's Whale (Endangered)

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

Bryde's whales found in the Gulf of Mexico are distinct from Bryde's whales worldwide and are considered a separate (unnamed) subspecies. The Gulf of Mexico Bryde's whale subspecies was classified by NOAA as an Endangered species under the ESA on May 15, 2019.

IPFs that could affect the Bryde's whales include MODU presence, noise, and lights; support vessel and helicopter traffic; and both types of spill accidents: a small fuel spill and a large oil spill. Effluent discharges are likely to have negligible impacts on Bryde's whales due to rapid dispersion, the small area of ocean affected, the intermittent nature of the discharges, and the mobility and low abundance of Bryde's whales in the Gulf of Mexico. Compliance with BSEE NTL 2015-G03 will minimize the potential for marine debris-related impacts on Bryde's whales.

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

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

Some sounds produced by the MODUs may be emitted at levels that could potentially disturb individual whales or mask the sounds animals would normally produce or hear. Noise associated with drilling is relatively weak in intensity, and an individual animal's noise exposure would be transient. As discussed in **Section A.1**, frequencies generated by an actively drilling MODU are maximum broadband (10 Hz to 10 kHz) with a root-mean-square source level of approximately 177 to 190 dB re 1 µPa m (Hildebrand, 2005).

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

It is expected that, due to the relatively stationary nature of the MODU operations, Bryde's whales would move away from the proposed operations area, and noise levels that could cause auditory injury would be avoided. Noise associated with proposed vessel operations may cause behavioral (disturbance) effects to individual Bryde's whales. NOAA Fisheries West Coast Region (2018) presents criteria that are used in the interim to determine behavioral disturbance thresholds for marine mammals and are applied equally across all hearing groups. Received SPL_{rms} of 120 dB re 1 µPa from a non-impulsive source is 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 an SPL_{rms} of 120 dB re 1 µPa 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.

For low-frequency cetaceans, specifically the Bryde's whale, permanent and temporary threshold shift onset from non-impulsive sources are estimated to occur at sound exposure levels of 199 dB re 1 μPa^2 s and 179 re 1 μPa^2 s, repectively.

The MODUs will be located within a deepwater, open ocean environment. Sounds generated by drilling operations will be generally non-impulsive, with some variability in sound level and frequency. This analysis assumes that the continuous nature of sounds produced by the MODUs 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 MODUs will allow for active avoidance of potential physical impacts. Drilling and installation-related noise associated with this project may 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. Furthermore, it is very unlikely that Bryde's whales occur within the project area and occur only in low densities in the Gulf of Mexico; therefore, 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, 2020). 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 [2020] Appendix C). However, this mitigation is effective only during daylight hours and during periods of adequate visibility.

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

Helicopter traffic also has the potential to disturb Bryde's whales. Based on studies of cetacean responses to sound, the observed reactions to brief overflights by aircraft were short-term and limited to behavioral disturbances (Smultea et al., 2008). Helicopters maintain altitudes above 700 ft (213 m) during transit to and from the offshore working area. In the event 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, 2020). 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 (2020) 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 (2020). 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 impact to the local (Gulf of Mexico) stock of Bryde's whales. The core distribution area for Bryde's whales is within the eastern Gulf of Mexico OCS Planning Area; therefore, it is very unlikely that Bryde's whale occur within the project area and surrounding waters. Consequently, the probability of spilled oil from a project-related well blowout reaching Bryde's whales is extremely low.

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.3.3 West Indian Manatee (Threatened)

Most of the Gulf of Mexico West Indian manatee population is located in peninsular Florida (USFWS, 2001). 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). On 5 May 2017, the USFWS reclassified the West Indian manatee from Endangered to Threatened under the authority of the ESA. 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 75 miles (121 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 breaking up. Compliance with NTL BSEE 2015-G013 (see **Table 1**) will minimize the potential for marine debris-related impacts on manatees. Consistent with the analysis by BOEM (2016a), impacts of routine project-related activities on the manatee would be negligible.

Impacts of Support Vessel and Helicopter Traffic

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

Compliance with these mitigation measures will minimize the likelihood of vessel strikes as well as reduce the chance for disturbing manatees during daylight hours. 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, 2020). This mitigation measure will minimize the potential for disturbing manatees, and no significant impacts are expected.

Impacts of a Large Oil Spill

Based on the 30-day OSRA modeling (**Table 3**), Plaquemines Parish, Louisiana is the coastal area most likely to be affected (4% probability within 3 days, 14% within 10 days, and 21% probability within 30 days). Other Louisiana shorelines may be affected within 10 days (Terrebonne, St. Bernard, and Lafourche), and shorelines in Louisiana, Alabama, Mississippi, and Florida could be affected within 30 days (1% to 21% conditional probability). There is no manatee critical habitat designated in these areas, and the number of manatees potentially present is a small fraction of the population in peninsular Florida.

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

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

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in 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 GOM; therefore, in the event of mortality of individual manatees from a large oil spill would constitute an adverse but insignificant impact to the subspecies. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. 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 whales and dolphins (cetaceans) may be found in the Gulf of Mexico. These include the dwarf and pygmy sperm whales, 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, spinner dolphin, and Clymene dolphin. A brief summary is presented in this section, and additional information on these groups is presented by BOEM (2017a).

<u>Dwarf and pygmy sperm whales</u>. At sea, it is difficult to differentiate dwarf sperm whales (*Kogia sima*) from pygmy sperm whales (*K. breviceps*), and sightings are often grouped together as *Kogia* spp. Both species have a worldwide distribution in temperate to tropical waters. In the Gulf of Mexico, both species

occur primarily along the continental shelf edge and in deeper waters off the continental shelf (Mullin et al., 1991; Mullin, 2007; Hayes et al., 2019). Either species could occur in the project area.

Beaked whales. Four species of beaked whales are known from the Gulf of Mexico. They are Blainville's beaked whale (*Mesoplodon densirostris*), Sowerby's beaked whale (*Mesoplodon bidens*), Gervais' beaked whale (*Mesoplodon europaeus*), and Cuvier's beaked whale (*Ziphius cavirostris*). Stranding records (Würsig et al., 2000), as well as passive acoustic monitoring in the Gulf of Mexico (Hildebrand et al., 2015), suggest that Gervais' beaked whale and Cuvier's beaked whale are the most common species in the region. The Sowerby's beaked whale is considered extralimital, with only one documented stranding in the Gulf of Mexico (Bonde and O'Shea, 1989). Blainville's beaked whales are rare, with only four documented strandings in the northern Gulf of Mexico (Würsig et al., 2000).

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

Delphinids. Fourteen species of delphinids are known to occur in the Gulf of Mexico: Atlantic spotted dolphin (*Stenella frontalis*), bottlenose dolphin (*Tursiops truncatus*), Clymene dolphin (*Stenella clymene*), killer whale (*Orcinus orca*), false killer whale (*Pseudorca crassidens*), Fraser's dolphin (*Lagenodelphis hosei*), 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 of the northern Gulf of Mexico are the pantropical spotted dolphin, spinner dolphin, and rough-toothed dolphin. However, any of these species could occur in the project area (Waring et al. 2016; Hayes et al., 2019).

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

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

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

Noise from routine drilling 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, 2018b). 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, 2018b). 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 and installation operations), permanent threshold shifts are estimated to occur when the mammal has received an SEL_{cum} of 198 dB re 1 μPa^2 s over a 24-hour period. Simlarly, temporary threshold shifts are estimated to occur when the mammal has received an SEL_{cum} of 178 dB re 1 μPa^2 s over a 24-hour period. Due to the transient nature of marine mammals and the stationary nature of the proposed activites, it is not expected that any marine mammals will remain in proximity to the source for a full 24-hour period to receive SEL_{cum} necessary for the onset of auditory threshold shifts. NOAA Fisheries West Coast Region (2018) presents criteria that are used in the interim to determine 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.

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

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

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

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, 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 328 ft (100 m) or greater from whales and 164 ft (50 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 (2020) are only applicable to ESA-listed species, complying with them may provide additional indirect protections to non-listed species as well. However, this mitigation is effective only during daylight hours and during periods of adequate visibility.

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

Helicopter traffic also has the potential to disturb marine mammals (Würsig et al., 1998). However, while flying offshore, helicopters maintain altitudes above 700 ft (213 m) during transit to and from the working area. In addition, guidelines and regulations issued by NMFS under the authority of the MMPA specify that helicopters maintain an altitude of 1,000 ft (305 m) within 328 ft (100 m) of marine mammals (BOEM, 2017a; NMFS, 2020). Maintaining this altitude will minimize the potential for disturbing marine mammals, and no significant impacts are expected.

Impacts of a Small Fuel Spill

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

The probability of a fuel spill will be minimized by Shell's preventative measures, including fuel transfer. In the unlikely event of a spill, implementation of Shell's OSRP is expected to mitigate and reduce the potential for impacts on marine mammals. 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 the concentrations of petroleum hydrocarbons and their degradation products. The extent and persistence of impacts would depend on the meteorological and oceanographic conditions at the time and the effectiveness of spill response measures. **Section A.9.1** discusses the likely fate of a small fuel spill and indicates that over 90% would evaporate or disperse naturally within 24 hours. The area of diesel fuel on the sea surface would range from 1.2 to 12 ac (0.5 to 5 ha), depending on sea state and weather conditions.

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

Impacts of a Large Oil Spill

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

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

Data from the *Deepwater Horizon* incident, as analyzed and summarized by NOAA (2016b) indicate the scope of potential impacts from a large spill. Tens of thousands of marine mammals were exposed to oil, where they likely inhaled, aspirated, ingested, physically contacted, and absorbed oil components (NOAA, 2016b; Takeshita et al., 2017). Nearly all of the marine mammal stocks in the northern Gulf of Mexico were affected. The oil's physical, chemical, and toxic effects damaged tissues and organs, leading to a constellation of adverse health effects, including reproductive failure, adrenal disease, lung disease, and poor body condition (NOAA, 2016b). According to the National Wildlife Federation (2016a), nearly all of the 20 species of dolphins and whales that live in the northern Gulf of Mexico had demonstrable, quantifiable injuries. NMFS (2014a) documented 13 dolphins and whales live-stranded, and over 150 dolphins and whales dead during the oil spill response. Because of known low detection rates of carcasses (Williams et al., 2011), it is possible that the number of marine mammal deaths is underestimated. Also, necropsies to confirm the cause of death could not be conducted for many of these marine mammals, therefore some cause of deaths reported as unknown are likely attributable to oil interaction. Schwacke et al. (2014a) reported that 1 year after the spill, many dolphins in Barataria Bay, Louisiana, showed evidence of disease conditions associated with petroleum exposure and toxicity. Lane et al. (2015) noted a decline in pregnancy success rate among dolphins in the same region. BOEM (2012a) concluded that potential effects from a large spill could potentially contribute to more significant and longer-lasting impacts including mortality and longer-lasting chronic or sublethal effects than a small, but severe accidental spill.

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

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in 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 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 are the leatherback, Kemp's ridley, and hawksbill turtles. As of May 6, 2016, the entire North Atlantic DPS of the green turtle is listed as threatened (81 *Federal Register* [*FR*] 20057). The DPS of loggerhead turtle that occurs in the Gulf of Mexico is listed as Threatened, although other DPSs are Endangered. Of the sea turtle species that may be found in the project area, only the Kemp's ridley relies on the Gulf of Mexico as its sole breeding ground. Species descriptions are presented by (BOEM, 2017a).

Critical habitat has been designated for the loggerhead turtle in the Gulf of Mexico as shown in **Figure 1**. Critical habitat in the northern Gulf of Mexico includes nesting beaches in Mississippi, Alabama, and the Florida Panhandle; nearshore reproductive habitat seaward from these beaches; and a large area of *Sargassum* habitat. The nearest designated nearshore reproductive critical habitat for loggerhead sea turtles is approximately 109 miles (175 km) from the project area.

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

Leatherbacks are the species most likely to be present near the project area, as they feed on populations of gelatinous plankton, such as jellyfish and salps in all water depths. Loggerhead, green, hawksbill, and Kemp's ridley turtles are typically inner-shelf and nearshore species but may be found transiting in oceanic waters during seasonal migrations. Loggerheads are more likely to occur near, or be attracted to, offshore structures than the other species. Hatchlings or juveniles of any of the sea turtle species may be present in deepwater areas, including the project area, where they may be associated with *Sargassum* spp. and other flotsam.

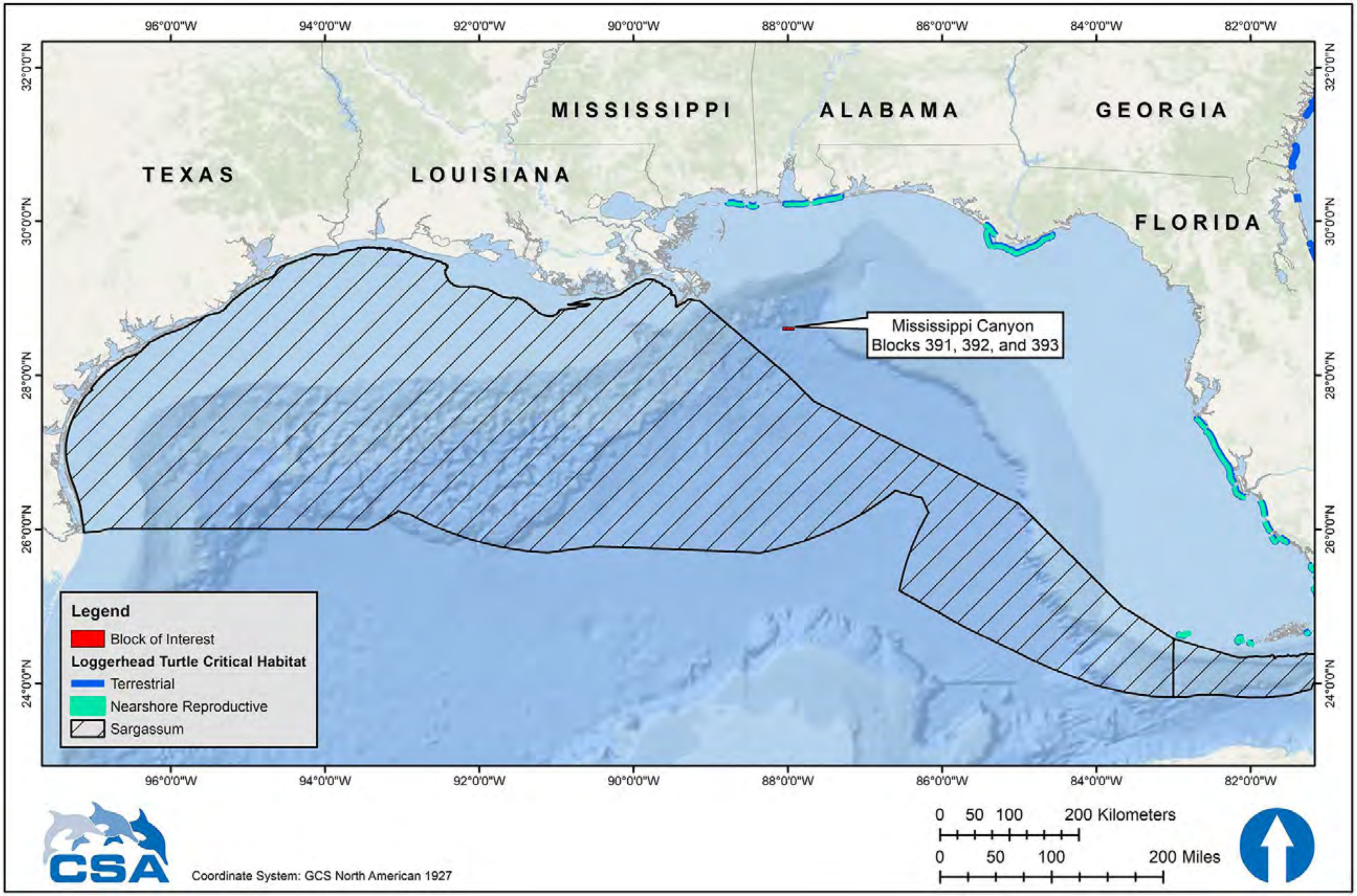

Figure 1. Location of loggerhead turtle critical habitat in the northern Gulf of Mexico in relation to the project area. The critical habitat includes terrestrial habitat (nesting beaches) and nearshore reproductive habitat in Mississippi, Alabama, and the Florida Panhandle as well as *Sargassum* habitat.

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

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

- Loggerhead turtles—Loggerhead turtles nest in significant numbers along the Florida Panhandle (Florida Fish and Wildlife Conservation Commission, 2017a) and, to a lesser extent, from Texas through Alabama (NMFS and USFWS, 2008);
- Green and leatherback turtles—Green and leatherback turtles infrequently nest on Florida Panhandle beaches (Florida Fish and Wildlife Conservation Commission, 2017b,c);
- Kemp's ridley turtles—The main nesting site is Rancho Nuevo beach in Tamaulipas, Mexico (NMFS et al., 2011). As of June 2020, a total of 256 Kemp's ridley turtle nests have been counted on Texas beaches for the 2020 nesting season. A total of 190 Kemp's ridley turtle nests were counted on Texas beaches during the 2019 nesting season and a total of 250 Kemp's ridley turtle nests were counted on Texas beaches during the 2018 nesting season. These are a decrease from the 353 Kemp's ridley turtle nests counted in the 2017 nesting season (Turtle Island Restoration Network, 2020). Padre Island National Seashore, along the coast of Willacy, Kenedy, and Kleberg Counties in southern Texas, is the most important nesting location for this species in the U.S.; and
- Hawksbill turtles—Hawksbill turtles typically do not nest anywhere near the project area, with most nesting in the region located in the Caribbean Sea and on beaches of the Yucatán Peninsula (U.S. Fish and Wildlife Service, 2016).

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

Though NMFS (2020) stated marine debris as an IPF, compliance with NTL BSEE 2015-G013 (See **Table 1**) and NMFS (2020) Appendix B will minimize the potential for marine debris-related impacts on sea turtles. NMFS (2020) estimated a small proportion of individual sea turtles would be adversely affected from exposure to marine debris. Therefore, marine debris is likely to have negligible impacts on sea turtles and is not further discussed (See **Table 2**).

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

Offshore drilling and installation 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). The NMFS Biological Opinion (NMFS, 2020) lists the sea turtle zero to peak sound pressure level ($SPL_{0\text{-}pk}$) threshold of 232 dB re 1 µPa, and the SEL_{cum} threshold of 204 dB re 1 μPa^2 s. Blackstock et al. (2018) identified the sea turtle underwater acoustic SPL_{rms} behavioral threshold as 175 dB re 1 µPa. No distinction is made between impulsive and non-impulsive sources for these thresholds. Based on transmission loss calculations (Urick, 1983), open water propagation of noise produced by typical sources with DP thrusters in use during drilling are not expected to produce SPL_{rms} greater than 160 dB re 1 µPa beyond 32 m from the source. Certain sea turtles, especially loggerheads, may be attracted to offshore structures (Lohoefener et al., 1990; Gitschlag et al., 1997) and thus, may be more susceptible to impacts from sounds produced during routine drilling and completion activities. Helicopters and support vessels may also affect sea turtles because of machinery noise or visual disturbances. Any impacts would likely be short-term behavioral changes such as diving and evasive swimming, disruption of activities, or departure from the area. Because of the limited scope and short duration of drilling activities, these short-term impacts are not expected to be biologically significant to sea turtle populations.

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

NMFS (2020) 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 (2020) estimated approximately about one sea turtle will be sub lethally entrapped in moon pools every year. Therefore, no significant impacts are expected.

Impacts of Support Vessel and Helicopter Traffic

Support vessel traffic has the potential to disturb sea turtles, and there is also a risk of vessel strikes. Data show that vessel traffic is one cause of sea turtle mortality in the Gulf of Mexico (Lutcavage et al., 1997; NMFS, 2020). 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, 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 [2020] Appendix C). However, this mitigation is effective only during daylight hours and during periods of adequate visibility.

Compliance with these mitigation measures will minimize the likelihood of vessel strikes as well as reduce the chance for disturbing sea turtles on the sea surface. However, mortality of individuals would constitute an adverse, though not a significant impact to each species affected.

Impacts of a Small Fuel Spill

Potential spill impacts on sea turtles are discussed by NMFS (2020) and BOEM (2017a). 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, 2014a). As discussed in **Section A.9.1**, more than 90% of a small diesel spill in offshore waters would evaporate or disperse naturally within 24 hours. Therefore, due to the limited areal extent and short duration of water quality impacts from a small fuel spill, no significant impacts to sea turtles from direct or indirect exposure would be expected.

Loggerhead Critical Habitat – Nesting Beaches. A small fuel spill in the project area would be unlikely to affect sea turtle nesting beaches because the project area is 75 miles (121 km) from the nearest shoreline (Louisiana). Loggerhead turtle nesting beaches and nearshore reproductive habitat designated as critical habitat are located in Mississippi, Alabama, and the Florida Panhandle, at least 109 miles (175 km) from the project area. As explained in **Section A.9.1**, a small fuel spill would not be expected to make landfall or reach coastal waters prior to breaking up.

Loggerhead Critical Habitat – *Sargassum* Habitat. The project area is 30 miles (48 km) from the *Sargassum* portion of the loggerhead turtle critical habitat (**Figure 1**). It is unlikely a small fuel spill could affect *Sargassum* spp. and juvenile turtles by contaminating this habitat due to the distance from it. Juvenile sea turtles could come into contact with or ingest oil, resulting in death, injury, or other sublethal effects. Effects would be limited to the small area (1.2 to 12 ac [0.5 to 5 ha]) likely to be impacted by a small spill. A 12-acre (5-hectare) impact would represent a negligible portion of the 96,776,959 ac (39,164,246 ha) designated *Sargassum* habitat for loggerhead turtles in the northern Gulf of Mexico.

Impacts of a Large Oil Spill

Impacts of oil spills on sea turtles can include direct impacts from oil exposure as well as indirect impacts due to response activities and materials (e.g., vessel traffic, noise, dispersants). Direct physical and physiological effects can include skin irritation, inflammation, or necrosis; chemical burns of skin, eyes, and mucous membranes; inhalation of toxic fumes and smoke (e.g., from *in situ* burning of oil); ingestion of oil (and dispersants) directly or via contaminated food; and stress from the activities and noise of response vessels and aircraft. Complications of the above may lead to dysfunction of immune and reproductive systems, physiological stress, declining physical condition, and death. Behavioral responses can include displacement of animals from prime habitat, disruption of social structure, change in food availability and foraging distribution and/or patterns, changing reproductive behavior/productivity, and changing movement patterns or migration (MMC, 2011; NMFS, 2014b). 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, 2020).

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

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

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

Based on the 30-day OSRA modeling (**Table 3**), Plaquemines Parish, Louisiana is the coastal area most likely to be affected (4% probability within 3 days, 14% within 10 days, and 21% probability within 30 days). Other Louisiana shorelines may be affected within 10 days (Terrebonne, St. Bernard, and Lafourche parishes), and shorelines in Louisiana, Alabama, Mississippi, and Florida could be affected within 30 days (1% to 21% conditional probability). The nearest nearshore reproductive critical habitat for loggerhead turtles is 109 miles (175 km) from the project area.

<u>Loggerhead Critical Habitat – *Sargassum* Habitat</u>. The project area is 30 miles (48 km) from the *Sargassum* habitat portion of the loggerhead turtle critical habitat (**Figure 1**). Due to the large area covered by the designated *Sargassum* habitat for loggerhead turtles, a large spill could result in oiling of a substantial part of the *Sargassum* habitat in the northern Gulf of Mexico. The *Deepwater Horizon* incident affected approximately one-third of the *Sargassum* habitat in the northern Gulf of Mexico (BOEM, 2016b). It is extremely unlikely that the entire *Sargassum* habitat would be affected by a large spill. Because *Sargassum* spp. is a floating, pelagic species, it would only be affected by oil that is present near the surface.

The effects of oiling on *Sargassum* spp. vary with severity, but moderate to heavy oiling as could occur during a large spill could cause complete mortality to *Sargassum* spp. and its associated communities (BOEM, 2017a). *Sargassum* spp. also has the potential to sink during a large spill; thus temporarily removing the habitat and possibly being an additional pathway of exposure to the benthic environment (Powers et al., 2013). Lower levels of oiling may cause sublethal effects, including reduced growth, productivity, and recruitment of organisms associated with *Sargassum* spp*.* The *Sargassum* spp. algae itself could be less impacted by light to moderate oiling than associated organisms because of a waxy outer layer that might help protect it from oiling (BOEM, 2016b). *Sargassum* spp. have a yearly seasonal cycle of growth and a yearly cycle of dispersal from the Gulf of Mexico to the western Atlantic. A large spill could affect a large portion of the annual crop of the algae; however, because of its ubiquitous distribution and seasonal cycle, recovery of the *Sargassum* spp. community would be expected to take one to two years (BOEM, 2017a).

Impacts to sea turtles from a large oil spill and associated cleanup activities would depend on spill extent, duration, and season (relative to turtle nesting season); the amount of oil reaching the shore; the importance of specific beaches to sea turtle nesting; and the level of cleanup vessel and beach crew activity required. A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in 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 sea turtles would be adverse but not likely significant at the population level. In the event that spilled oil reached nesting beaches during nesting period(s), the level of mortality (and impact) would increase. 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 (Bird Life International, 2018). Critical overwintering habitat has been designated, including beaches in Texas, Louisiana, Mississippi, Alabama, and Florida (**Figure 2**). Piping Plovers inhabit coastal sandy beaches and mudflats, feeding by probing for invertebrates at or just below the surface. They use beaches adjacent to foraging areas for roosting and preening (USFWS, 2010). A species description is presented by BOEM (2017a).

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

Impacts of a Large Oil Spill

The project area is 75 miles (121 km) from the nearest shoreline designated as Piping Plover critical habitat. The 30-day OSRA modeling (**Table 3**) predicts that Piping Plover critical habitat in Plaquemines Parish, Louisiana could be contacted within 3 days of a spill (4% conditional probability). Within 30 days of a spill, the model predicts conditional probabilities of shoreline contact of 21%.

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 substantially 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.

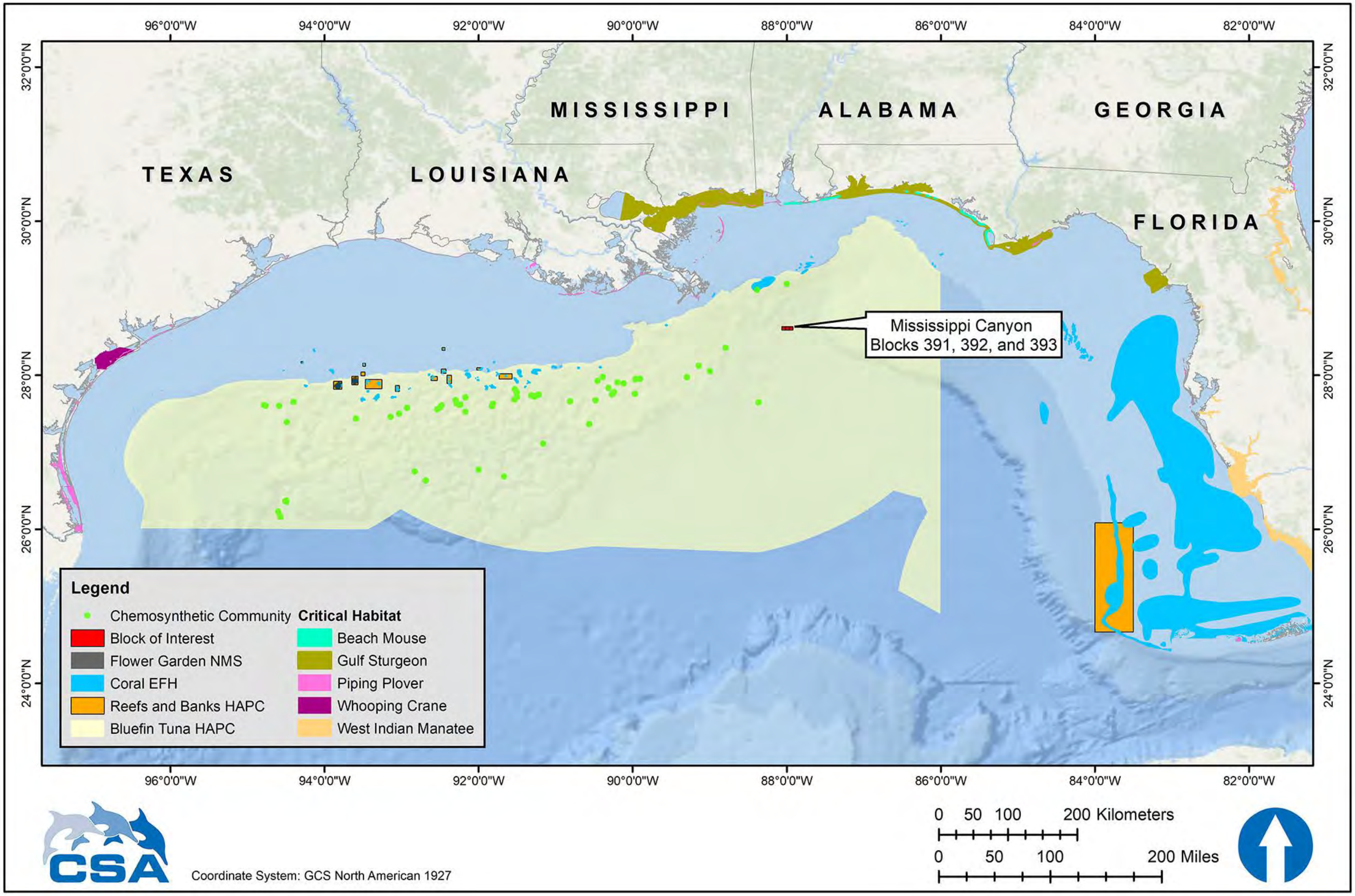

Figure 2. Location of selected environmental features in relation to the project area. EFH = Essential Fish Habitat; HAPC = Habitat Area of Particular Concern.

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 and a federally listed endangered species. Three wild populations live in North America (National Wildlife Federation, 2016b). One of these populations winters along the Texas coast at Aransas NWR and summers at Wood Buffalo National Park in Canada. This population represents the majority of the world's population of free-ranging Whooping Cranes, reaching an estimated population of 506 at Aransas NWR during the 2019 to 2020 winter (USFWS, 2020). A non-migratory population was reintroduced in central Florida and another reintroduced population summers in Wisconsin and migrates to the southeastern U.S. for the winter (USFWS, 2015a). Whooping Cranes breed, migrate, winter, and forage in a variety of habitats, including coastal marshes and estuaries, inland marshes, lakes, ponds, wet meadows and rivers, and agricultural fields (USFWS, 2007). About 22,240 ac (9,000 ha) of salt flats in Aransas NWR and adjacent islands comprise the principal wintering grounds of the Whooping Crane. Aransas NWR is designated as critical habitat for the species (**Figure 2**). A species description is presented by (BOEM, 2012a).

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

Impacts of a Large Oil Spill

The 30-day OSRA modeling (**Table 3**) predicts a <0.5% or less chance of oil contacting Whooping Crane critical habitat (Calhoun or Aransas Counties, Texas) within 30 days of a spill.

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

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in DOCD Section 2j. In the event of oil from a large spill contacting Whooping Crane habitat, it is expected that impacts resulting in the injury or death of individual Whooping Cranes 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.3.8 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, assessment of population trends heavily relies 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 (2018a) noted that there has been an 88% decline in abundance of the species in the Gulf of Mexico since the mid-1990s due to commercial fishing pressure.

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

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

Offshore drilling 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 sound pressure levels associated with drilling activities (typically 10 Hz to 10 kHz) (Hildebrand, 2005). Impacts from offshore drilling activities (i.e., non-impulsive sound) could include masking or behavioral change (Popper et al., 2014). However, because of the limited propagation distances of high sound pressure levels from the drilling rig, impacts would be limited in geographic scope. It is anticipated that animals would move away from the static sound source and avoid auditory injury or disturbances. Therefore, no population level impacts on oceanic whitetip sharks are expected.

Impacts of a Large Oil Spill

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

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

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in 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. At least 74 unique individuals have been positively identified at the Flower Garden Banks based on unique underbelly coloration (Flower Garden Banks National Marine Sanctuary, 2018). Genetic and photographic evidence in the Flower Garden Banks over 25 years of monitoring showed that 95% of identified giant manta ray male individuals were smaller than mature size (Stewart et al., 2018).

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

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

Offshore drilling 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 sound pressure levels associated with drilling activities (typically 10 Hz to 10 kHz) (Hildebrand, 2005). Impacts from offshore drilling activities (i.e., continuous sound) could include masking or behavioral change (Popper et al., 2014). However, because of the limited propagation distances of high sound pressure levels from the drilling rig, impacts would be limited in geographic scope. It is anticipated that animals would move away from the static sound source and avoid auditory injury or disturbances. Therefore, no population level impacts on giant manta rays are expected.

Impacts of a Large Oil Spill

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

In the event of a large oil spill, due to the distance between the project area and the Flower Garden Banks (approximately 345 miles [555 km]), it is unlikely that oil would impact the giant manta ray nursery habitat. It is possible that a large oil spill could contact individual giant manta rays, but due to the low density of individuals thought to occur in the Gulf of Mexico, there would not likely be any population-level effects.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in 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 Pearl River systems 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, 2014c) (**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 because NMFS (2020) 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 (110 miles [177 km]) and the support vessel base being in Port Fourchon, Louisiana, it is anticipated that 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 (2020). For this DOCD, there are no unique site-specific issues with respect to this species.

The project area is approximately 110 miles (177 km) from the nearest Gulf sturgeon critical habitat. The 30-day OSRA modeling (**Table 3**) predicts that a spill in the project area has 3% or less conditional probability of contacting any coastal areas containing Gulf sturgeon critical habitat within 30 days of a spill.

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

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 significant at the population level. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. Shell has extensive resources available to protect coastal and estuarine wildlife and habitats in the event of a spill reaching the shoreline, as detailed in the OSRP. 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 345 miles [555 km]), and the difference in water depth between the project area (7,406 ft [2,257 m]) and the Banks (approximately 17 to 145 m [56 to 476 ft]). 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 345 miles [555 km]), and the shallow location of the coral cap of the Banks. Near-bottom currents in the region are predicted to flow along the isobaths (Nowlin et al., 2001) and typically would not carry a plume up onto the continental shelf edge. Valentine et al. (2014) observed the spatial distribution of excess hopane, a crude oil tracer from the *Deepwater Horizon* incident sediment core samples, to be in the deeper waters and not transported up the shelf, thus confirming that near-bottom currents flow along the isobaths.

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

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

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in 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 after their flat, saw-like rostrum, is an elasmobranch ray which lives in shallow coastal tropical seas and estuaries where they feed on fish and invertebrates such as shrimp and crabs (NOAA Fisheries, nd). Once found along most of the northern Gulf of Mexico coast from Texas to Florida, their current range in Gulf of Mexico is restricted to areas primarily in southwest Florida (Brame et al., 2019) where several areas of critical habitat have been designated (**Figure 2**). A species description is presented in the recovery plan for this species (NMFS, 2009b).

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 369 miles (593 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.

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.3.13 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 subspecies of *Peromyscus* beach mouse inhabiting dunes on the western Florida Panhandle, the Santa Rosa beach mouse (*P. p. leucocephalus*), is not listed under the ESA. Species descriptions are presented by BOEM (2017a).

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

Impacts of a Large Oil Spill

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

The project area is approximately 110 miles (177 km) from the nearest beach mouse critical habitat. The 30-day OSRA modeling (**Table 3**) predicts that a spill in the project area has 2% or less conditional probability of contacting any coastal areas containing beach mouse critical habitat within 30 days of a spill.

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

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in 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 potentially 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.3.14 Florida Salt Marsh Vole (Endangered)

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

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

Impacts of a Large Oil Spill

Florida salt marsh vole habitat in Levy and Dixie counties, Florida is approximately 291 miles (468 km) from the project area. The 30-day OSRA modeling (**Table 3**) predicts that a spill in the project area has <0.5% or less conditional probability of contacting any coastal areas containing Florida salt marsh voles within 30 days.

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

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

C.3.15 Threatened Coral Species

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

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

Impacts of a Large Oil Spill

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

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

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

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

C.4 Coastal and Marine Birds

C.4.1 Marine Birds

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

Seabirds 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, Least Tern, Sandwich Tern, Magnificent Frigatebird); winter residents (gannets, gulls, jaegers); and permanent resident species (Laughing Gulls, Royal Terns, Bridled Terns) (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 MODU presence, noise, and lights; support vessel and helicopter traffic; and two types of accidents (a small fuel spill and a large oil spill). Effluent discharges permitted under the NPDES general permit are likely to have negligible impacts on the birds due to rapid dispersion, the small area of ocean affected, the intermittent nature of the discharges, and the mobility of these animals. Compliance with BSEE NTL 2015-G013 (See **Table 1**) will minimize the potential for marine debris-related impacts on birds.

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

Birds migrating over water have been known to strike offshore structures, resulting in death or injury (Wiese et al., 2001; Russell, 2005). Mortality of migrant birds at tall towers and other land-based structures has been reviewed extensively, and the mechanisms involved in platform collisions appear to be similar. In some cases, migrants simply do not see a part of the platform until it is too late to avoid it. In other cases, navigation may be disrupted by noise or lighting (Russell, 2005; Ronconi et al., 2015). However, offshore structures may, in some cases, serve as suitable stopover habitats for trans-Gulf migrant species, particularly in the spring (Russell, 2005; Ronconi et al., 2015).

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

Impacts of Support Vessel and Helicopter Traffic

Support vessels and helicopters are unlikely to substantially disturb marine birds in open, offshore waters. Schwemmer et al. (2011) showed that several sea birds showed behavioral responses and altered distribution patterns in response to ship traffic, which could potentially cause loss of foraging time and resting habitat. However, it is likely that individual birds would experience, at most, only short-term behavioral disruption resulting from support vessel and helicopter traffic, and the impact would not be significant.

Impacts of a Small Fuel Spill

Potential spill impacts on marine birds are discussed by BOEM (2016b, 2017a). For this DOCD, there are no unique site-specific issues with respect to spill impacts on marine birds.

The probability of a fuel spill will be minimized by Shell’s preventative measures implemented during routine operations, including fuel transfer. In the unlikely event of a spill, implementation of Shell’s OSRP will mitigate and reduce the potential for impacts on marine birds. DOCD Section 9b provides detail on spill response measures. Given the open ocean location of the project area and the short duration of a small spill, the potential exposure for pelagic marine birds would be brief.

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

Birds exposed to oil on the sea surface could experience direct physical and physiological effects including skin irritation; chemical burns of skin, eyes, and mucous membranes; and inhalation of VOCs. Because of the limited areal extent and short duration of water quality impacts from a small fuel spill, secondary impacts due to ingestion of oil via contaminated prey or reductions in prey abundance are unlikely. Due to the low densities of birds in open ocean areas, the small area affected, and the brief duration of the surface slick, no significant impacts on marine birds are expected.

Impacts of a Large Oil Spill

Potential spill impacts on marine birds are discussed by BOEM (2016b, 2017a). For this DOCD, there are no unique site-specific issues with respect to spill impacts on marine birds.

Pelagic seabirds could be exposed to oil from a spill at the project area. Hess and Ribic (2000) reported that terns, storm-petrels, shearwaters, and jaegers were the most frequently sighted seabirds in the deepwater Gulf of Mexico (>200 m). Haney et al. (2014) estimated that seabird densities over the open ocean are approximately 1.6 birds km^{-2}. The number of marine birds that could be affected in open, offshore waters would depend on the extent and persistence of the oil slick.

Data following the *Deepwater Horizon* incident provide relevant information about the species of marine birds that may be affected in the event of a large oil spill. Birds that have been treated for oiling include several pelagic species such as the Northern Gannet, Magnificent Frigatebird, and Masked Booby (USFWS, 2011). The Northern Gannet was among the species with the largest numbers of individuals affected by the spill. NOAA reported that at least 93 resident and migratory bird species across all five Gulf Coast states were exposed to oil from the *Deepwater Horizon* incident in multiple habitats, including offshore/open waters, island waterbird colonies, barrier islands, beaches, bays, and marshes (NOAA, 2016b). Exposure of marine birds to oil can result in adverse health, with severity depending on the level of oiling. Effects can range from plumage damage and loss of buoyancy for external oiling to more severe effects such as organ damage, immune suppression, endocrine imbalance, reduced aerobic capacity and death as a result of oil inhalation or ingestion (NOAA, 2016b).

However, a blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in 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 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, Black Skimmer, Forster's Tern, Gull-Billed Tern, 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). 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, 2015b). 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 and helicopters will transit coastal areas where coastal birds may be found. These activities could periodically disturb individuals or groups of birds within sensitive coastal habitats (e.g., wetlands that may support feeding, resting, or breeding birds).

Vessel traffic may disturb some foraging and resting birds. Flushing distances vary among species and individuals (Rodgers and Schwikert, 2002; Schwemmer et al., 2011). The disturbances will be limited to flushing birds away from vessel pathways; known distances are from 65 to 160 ft (20 to 49 m) for personal watercraft and 75 to 190 ft (23 to 58 m) for outboard-powered boats (Rodgers and Schwikert, 2002). Flushing distances may be similar or less for the support vessels to be used for this project, and some species such as gulls are attracted to boats. Support vessels will not approach nesting or breeding areas on the shoreline, so nesting birds, eggs, and chicks will not be disturbed. Vessel operators will use designated navigation channels and comply with posted speed and wake restrictions while transiting sensitive inland waterways. Due to the limited scope, duration, and geographic extent of drilling activities, any short-term impacts are not expected to be significant to coastal bird populations.

Helicopter traffic can cause some disturbance to birds on shore and offshore. Responses highly depend on the type of aircraft, bird species, activities that animals were previously engaged in, and previous exposures to overflights (Efroymson et al., 2000). Helicopters seem to cause the most intense responses over other human disturbances for some species (Bélanger and Bédard, 1989). 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. (2000). With these guidelines in effect, it is likely that individual birds would experience, at most, only short-term behavioral disruption. The potential impacts are not expected to be significant to bird populations or species in the project area.

Impacts of Large Oil Spill

Coastal birds can be exposed to oil as they float on the water surface, dive during foraging, or wade in oiled coastal waters. The Brown Pelican and Bald Eagle could be impacted by the ingestion of contaminated fish or birds (BOEM, 2012a, 2016b). In the event of a large oil spill reaching coastal habitats, cleanup personnel and equipment could create short-term disturbances to coastal birds. Indirect effects could occur from restoration efforts, resulting in habitat loss, alteration, or fragmentation (BOEM, 2017a). Based on the 30-day OSRA results summarized in **Table 3,** shorelines in Plaquemines Parish could be contacted within 3 days of a spill (4% conditional probability) and 10 days of a spill (14% conditional probability). Terrebonne, St. Bernard, and Lafourche parishes in Louisiana could also be contacted within 10 days (1% conditional probabilities). Other Louisiana, Alabama, Mississippi, and Florida shorelines could be affected within 30 days (1% to 21% conditional probability).

Studies concerning the *Deepwater Horizon* incident provide additional information regarding impacts on coastal birds that may be affected in the event that a large oil spill reaches coastal habitats. According to NOAA (2016b), an estimated 51,600 to 84,500 birds were killed by the spill, and the reproductive output lost as a result of breeding adult bird mortality was estimated to range from 4,600 to 17,900 fledglings that would have been produced in the absence of premature deaths of adult birds (NOAA, 2016b). Species with the largest numbers of estimated mortalities were American White Pelican, 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). A study by Ross et al. (2012) on midwater fauna to characterize vertical distribution of mesopelagic fishes in selected deepwater areas in the Gulf of Mexico substantiated high species richness, but the community was dominated by relatively few families and species.

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

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

The MODUs, floating structures in the deepwater environment, will act as fish-aggregating devices (FADs). 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). New seafloor infrastructure may also act as a FAD. 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). The FAD effect could possibly enhance the feeding of epipelagic predators by attracting and concentrating smaller fish species. MODU noise could potentially cause acoustic masking in fishes, thereby reducing their ability to hear biologically relevant sounds (Radford et al., 2014). The only defined acoustic threshold levels for continuous noise are given by Popper et al. (2014) and apply only to species of fish with swim bladders that provide some hearing (pressure detection) function. Popper et al. (2014) estimated threshold SPL_{rms} of 170 dB re 1 µPa accumulated over a 48-hour period for onset of recoverable injury and 158 dB re 1 µPa accumulated over a 12-hour period for onset temporary auditory threshold shifts. However, no consistent behavioral thresholds for fish have been established (Popper et al., 2014). Rather, Popper et al. (2014) provide qualitative criteria portraying risk of impact relative to the animal's distance from the source (i.e., near, intermediate, far). Noise may 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 MODUs are temporary structures, impacts on fish populations, whether beneficial or adverse, are not expected to be significant.

Few data exist regarding the impacts of noise on pelagic larvae and eggs. Generally, it is believed that larval fish will have similar hearing sensitivities as adults, but may be more susceptible to barotrauma injuries associated with impulsive noise (Popper et al., 2014). Larval fish were experimentally exposed to simulated impulsive sounds by Bolle et al. (2012). The controlled playbacks produced SEL_{cum} of 206 dB re 1 µPa^2 s but resulted in no increased mortality between the exposure and control groups. Non-impulsive noise sources (such as MODU operations) are expected to be far less injurious than impulsive noise. Because of the periodic and transient nature of ichthyoplankton, they are not expected to remain in proximity to the source for a full 24-hour period to receive above-threshold sound levels, and no impacts to these life stages are expected.

Impacts of Effluent Discharges

Discharges of treated WBM- and SBM-associated cuttings will produce temporary, localized increases in suspended solids in the water column around the MODU. In general, turbid water can be expected to extend between a few hundred meters and several kilometers down current from the discharge point (National Research Council, 1983; Neff, 1987). NPDES permit limits and requirements will be met.

WBM and cuttings will be released at the seafloor during the initial well intervals before the marine riser is set, which allows their return to the surface vessel. Excess cement slurry and blowout preventer fluid will also be released at the seafloor. These discharges could smother or cover benthic communities in the vicinity of the discharge location. Impacts will be limited to the immediate area of the discharge, with little or no impact to fisheries resources.

Treated sanitary and domestic wastes may have little or no effect on the pelagic environment in the immediate vicinity of these discharges. These wastes may have elevated levels of nutrients, organic matter, and chlorine, but should dilute rapidly to undetectable levels within tens to hundreds of meters from the source. As a result of quick dilution, minimal impacts on water quality, plankton, and nekton are anticipated.

Deck drainage will have little or no impact on the pelagic environment in the immediate vicinity of these discharges. Deck drainage from oily areas will be passed through an oil-and-water separator prior to release, and discharges will be monitored for visible sheen. The discharges may have slightly elevated levels of hydrocarbons but should dilute rapidly to undetectable levels within tens to hundreds of meters from the source. Minimal impacts on water quality, plankton, and nekton are anticipated.

Other effluent discharges from the MODUs and support vessels are expected to include treated sanitary and domestic wastes, deck drainage, non-contaminated well treatment and completion fluids, workover fluids, desalination unit discharge, blowout preventer fluid, ballast water, bilge water, cement slurry, fire water, hydrate inhibitor, subsea production control fluid, non-contact cooling water, and treated or untreated seawater. The MODUs and support vessel discharges are expected to be in compliance with NPDES permit and USCG regulations, as applicable, and are not expected to cause significant impacts on water quality (BOEM, 2012a).

Impacts of Water Intakes

Seawater will be drawn from several meters below the ocean surface for various services, including firewater and once-through, non-contact cooling of machinery on the MODU (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. GMG290103 specifies requirements for new facilities for which construction commenced after 17 July 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 MODUs selected for this project meet the described applicability for new facilities, and the vessel's water intakes are expected to be in compliance with the design, monitoring, and recordkeeping requirements of the NPDES permit.

The intake of seawater for cooling water will entrain plankton. The low intake velocity should allow most strong-swimming juvenile fishes and smaller adults to escape entrainment or impingement. However, drifting plankton would not be able to escape entrainment except for a few fast-swimming larvae of certain taxonomic groups. Those organisms entrained may be stressed or killed, primarily through changes in water temperature during the route from cooling intake structure to discharge structure and mechanical damage (turbulence in pumps and condensers). Because of the limited scope and short duration of drilling activities, any short-term impacts of entrainment are not expected to be biologically significant to plankton or ichthyoplankton populations (BOEM, 2017a).

Impacts of a Small Fuel Spill

Potential spill impacts on fisheries resources are discussed by BOEM (2016b, 2017a). For this 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 pelagic communities, including ichthyoplankton. 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 thin slick on the water surface and introduce concentrations of petroleum hydrocarbons and their degradation products. The extent and persistence of impacts would depend on the meteorological and oceanographic conditions at the time and the effectiveness of spill response measures. **Section A.9.1** discusses the likely fate of a small fuel spill and indicates that more than 90% would evaporate or disperse naturally within 24 hours. The area of diesel fuel on the sea surface would range from 1.2 to 12 ac (0.5 to 5 ha), depending on sea state and weather conditions.

A small fuel spill could have localized impacts on phytoplankton, zooplankton, ichthyoplankton, and nekton. Due to the limited areal extent and short duration of water quality impacts, a small fuel spill would be unlikely to produce detectable impacts on pelagic communities.

Impacts of a Large Oil Spill

Potential spill impacts on pelagic communities and ichthyoplankton are discussed by BOEM (2016b, 2017a). For this DOCD, there are no unique site-specific issues.

A large oil spill could directly affect water column biota including phytoplankton, zooplankton, ichthyoplankton, and nekton. A large spill that persisted for weeks or months would be more likely to affect these communities. While adult and juvenile fishes may actively avoid a large spill, planktonic eggs and larvae would be unable to avoid contact. Eggs and larvae of fishes in the upper layers of the water column are especially vulnerable to oiling; certain toxic fractions of spilled oil may be lethal to these life stages. Impacts would be potentially greater if local scale currents retained planktonic larval assemblages (and the floating oil slick) within the same water mass. Impacts to ichthyoplankton from a large spill would be greatest during spring and summer when concentrations of ichthyoplankton on the continental shelf peak (BOEM, 2014, 2015, 2016b).

Oil spill impacts to phytoplankton include changes in community structure and increases in biomass, which have been attributed to the effects of oil contamination and of decreased predation due to zooplankton mortality (Abbriano et al., 2011; Ozhan et al., 2014). Ozhan et al. (2014) reported that the formation of oil films on the water surface can limit gas exchange through the air-sea interface and can reduce light penetration into the water column which will limit phytoplankton photosynthesis. Determining the impact of a diesel spill on phytoplankton is a complex issue, as some phytoplankton species are more tolerant of oil exposure than others while some species are more tolerant under low concentrations and some under high concentrations (Ozhan et al., 2014). Phytoplankton populations can change quickly on small temporal and spatial scales, making it difficult to predict how a phytoplankton community as a whole will respond to an oil spill.

Mortality of zooplankton has been shown to be positively correlated with oil concentrations (Lennuk et al., 2015). Spills that are not immediately lethal can have short- or long-term impacts on biomass and community composition, behavior, reproduction, feeding, growth and development, immune response and respiration (Harvell et al., 1999; Wootton et al., 2003; Auffret et al., 2004; Hannam et al., 2010; Bellas et al., 2013; Blackburn et al., 2014). Zooplankton are especially vulnerable to acute oil pollution, showing increased mortality and sublethal changes in physiological activities (e.g., egg production) (Moore and Dwyer, 1974; Linden, 1976; Lee et al., 1978; Suchanek, 1993). Zooplankton may also accumulate PAHs through diffusion from surrounding waters, direct ingestion of micro-droplets (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 (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. In 2005, the EFH for these managed species was redefined in Generic Amendment No. 3 to the various Fishery Management Plans (GMFMC, 2005). The EFH for most of these GMFMC-managed species is on the continental shelf in waters shallower than 600 ft (183 m). The shelf edge is the outer boundary for coastal migratory pelagic fishes, reef fishes, and shrimps. EFH for corals and coral reefs includes some shelf-edge topographic features located approximately 40 miles (64 km) from the project area.

EFH has been identified in the deepwater Gulf of Mexico for highly migratory pelagic fishes, which occur as transients in the project area. Species in this group, including tunas, swordfishes, billfishes, and sharks, are managed by NMFS. Highly migratory species with EFH within or near the project area include the following (NMFS, 2009c):

- Bigeye thresher shark (all)
- Blue marlin (juveniles, adults)
- Bluefin tuna (spawning, eggs, larvae, adult)
- Longbill spearfish (juveniles, adults)
- Longfin mako shark (all)
- Oceanic whitetip shark (all)
- Silky Shark (all)
- Skipjack tuna (spawning, adults)
- Swordfish (larvae, juveniles, adults)
- Whale shark (all)
- White marlin (juveniles, adults)
- Yellowfin tuna (spawning, juveniles, adults)

Research indicates the central and western Gulf of Mexico may be important spawning habitat for Atlantic bluefin tuna (*Thunnus thynnus*) (Theo and Block, 2010), and NMFS (2009b) has designated a Habitat Area of Particular Concern (HAPC) for this species. The HAPC covers much of the deepwater Gulf of Mexico, including the project area (**Figure 2**). The areal extent of the HAPC is approximately 115,830 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 U.S. and Canadian coasts, followed by migration to the Gulf of Mexico to spawn in April, May, and June (NMFS, 2009c). The Atlantic bluefin tuna has also been designated as a species of concern (NMFS, 2011).

NTLs 2009-G39 and 2009-G40 provide guidance and clarification of regulations for biologically sensitive underwater features and areas, and benthic communities that are considered EFH. As part of an agreement between BOEM and NMFS to complete a new programmatic EFH consultation for each new Five-Year Program, an EFH consultation was initiated between BOEM's Gulf of Mexico Region and NOAA's Southeastern Region during the preparation, distribution, and review of BOEM's 2017-2022 WPA/CPA Multisale EIS (BOEM, 2017a). The EFH assessment was completed and there is ongoing coordination among NMFS, BOEM, and BSEE, including discussions of mitigation (BOEM, 2016c).

Other HAPCs have been designated in the Gulf of Mexico Fishery Management Council (2005, 2010). These include the Florida Middle Grounds, Madison-Swanson Marine Reserve, Tortugas North and South Ecological Reserves, Pulley Ridge, and several other reefs and banks of the northwestern Gulf of

Mexico (**Figure 2**). The nearest HAPC is Madison-Swanson Marine Reserve, which is located approximately 130 miles (209 km) from the project area.

Routine IPFs that could potentially affect EFH and fisheries resources include MODU presence, noise, and lights; effluent discharges; and water intakes. In addition, two types of accidents (a small fuel spill and a large oil spill) may potentially affect EFH and fisheries resources.

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

The MODUs, as floating structures in the deepwater environment, will act as FADs. 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). The FAD effect would likely attract and concentrate smaller fish species and thus enhance feeding of epipelagic predators.

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

Effluent discharges from the MODUs and support vessels are expected to include treated sanitary and domestic wastes, deck drainage, non-contaminated well treatment and completion fluids, workover fluids, desalination unit discharge, blowout preventer fluid, ballast water, bilge water, cement slurry, fire water, hydrate inhibitor, subsea production control fluid, non-contact cooling water, and treated or untreated seawater. All discharges shall comply with the NPDES General Permit and/or USCG regulations, as applicable.

Effluent discharges affecting EFH by diminishing ambient water quality include drilling muds and cuttings, treated sanitary and domestic wastes, deck drainage, non-contaminated well treatment and completion fluids, workover fluids, desalination unit discharge, blowout preventer fluid, ballast water, bilge water, cement slurry, fire water, hydrate inhibitor, subsea production control fluid, non-contact cooling water, and treated or untreated seawater. 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 biologically 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 thin slick on the water surface and introduce concentrations of petroleum hydrocarbons and their degradation products. The extent and persistence of impacts would depend on the meteorological and oceanographic conditions at the time and the effectiveness of spill response measures. **Section A.9.1** discusses the likely fate of a small fuel spill and indicates that more than 90% would evaporate or disperse naturally within 24 hours. The area of diesel fuel on the sea surface would range from 1.2 to 12 ac (0.5 to 5 ha), depending on sea state and weather conditions.

A small fuel spill could have localized impacts on EFH for highly migratory pelagic fishes, including tunas, swordfishes, billfishes, and sharks. These species occur as transients in the project area. A spill would also produce short-term impact on surface and near-surface water quality in the HAPC for spawning Atlantic bluefin tuna, which covers much of the deepwater Gulf of Mexico. The affected area would represent a negligible portion of the HAPC, which covers approximately 115,830 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 of which is located approximately 40 miles (64 km) from the project area. A small fuel spill would float and dissipate on the sea surface and would not contact these seafloor features. Therefore, no significant spill impacts on EFH for corals and coral reefs are expected.

Impacts of a Large Oil Spill

Potential spill impacts on EFH are discussed by BOEM (2016b, 2017a). For this 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 bluefin tuna (NMFS, 2009b). A large spill could temporarily degrade the HAPC due to increased hydrocarbon concentrations in the water column, with the potential for lethal or sublethal impacts on spawning tuna. Potential impacts would depend in part on the timing of a spill, as this species migrates to the Gulf of Mexico to spawn in April, May, and June (NMFS, 2009b).

The nearest feature designated as EFH for corals is located 40 miles (64 km) from the project area. An accidental spill could reach or affect this feature, although near-bottom currents in the region are expected to flow along the isobaths (Nowlin et al., 2001; Valentine et al., 2014) and typically would not carry a plume up onto the continental shelf edge.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in 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 would likely be temporary and short-term. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. 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 >656 ft (200 m) water depth that have been exempted from high-resolution surveys. Since significant historic shipwrecks have recently been discovered outside the previously designated high-probability areas (some of which show evidence of impacts from permitted activities prior to their discovery), a survey is now required for exploration and development projects.

Based on NTL 2011-JOINT-G01, the project area is on BOEM's list of archaeological survey blocks determined to have a high potential for containing archaeological properties (BOEM, 2011). The shallow hazard assessment identified no sonar contacts within 2,000 ft (610 m) of proposed wellsites considered to have archaeological potential (Fugro Geoservices, Inc., 1996, 2007, 2009a,b,c; AOA Geophysics, Inc., 2004; Oceaneering 2018a,b). No archaeological impacts are expected from routine activities in the project area.

Because no historic shipwreck sites are 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 historic shipwrecks in the project area, this impact would not be relevant.

Beyond the seafloor blowout radius, there is the potential for impacts from oil, dispersants, and depleted oxygen levels (BOEM, 2017a). These impacts could include chemical contamination, alteration of the rates of microbial activity (BOEM, 2017a), and reduced biodiversity as shipwreck-associated sediment microbiomes (Hamdan et al., 2018). During the *Deepwater Horizon* incident, subsurface plumes were reported at a water depth of approximately 3,600 ft (1,100 m), extending at least 22 miles (35 km) from the wellsite and persisting for more than a month (Camilli et al., 2010). The subsurface plumes apparently resulted from the use of dispersants at the wellhead (NOAA, 2011b). While the behavior and impacts of subsurface plumes are not well known, a subsurface plume could contact shipwreck sites beyond the 984-foot (300-meter) radius estimated by BOEM (2012a), depending on its extent, trajectory, and persistence (Spier et al., 2013). If oil from a subsea spill should contact wooden shipwrecks on the seafloor, it could adversely affect their condition or preservation.

A spill entering shallow coastal waters could conceivably contaminate undiscovered or known historic shipwreck sites. Based on the 30-day OSRA modeling (**Table 3**), coastal areas in Plaquemines Parish could be affected within 3 days of a spill (4% conditional probability), within 10 days of a spill (14% conditional probability). Terrebonne, St. Bernard, and Lafourche parishes may also be affected within 10 days of a spill (up to 3% conditional probability). Coastal areas between Cameron parish, Louisiana, and Bay County, Florida, may be affected within 30 days (1% to 21% conditional probability). If an oil spill contacted a coastal historic site, such as a fort or a lighthouse, the impacts may be temporary and reversible (BOEM, 2017a). Undiscovered shipwreck sites on or nearshore could also be impacted by foot or vehicle traffic during response and clean-up efforts in the aftermath of a spill.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in 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.6.2 Prehistoric Archaeological Sites

As the water depth at the proposed project area ranges from approximately 7,349 to 7,524 ft (2,240 to 2,293 m), the project area is well beyond the 197 ft (60 m) depth contour used by BOEM as the seaward extent for prehistoric archaeological site potential in the Gulf of Mexico. Because prehistoric archaeological sites are not found in the project area, the only relevant IPF is a large oil spill that would reach coastal waters within the 197 ft (60 m) depth contour.

Impacts of a Large Oil Spill

Because of the water depth and the lack of prehistoric archaeological sites found in the project area, it is highly unlikely that any such resources would be affected by the physical effects of a subsea blowout. BOEM (2012a) estimates that a severe subsurface blowout could resuspend and disperse sediments within a 984 ft (300 m) radius.

Along the northern Gulf Coast, prehistoric sites occur frequently along the barrier islands and mainland coast and along the margins of bays and bayous (BOEM, 2012a). Based on the 30-day OSRA modeling (**Table 3**), coastal areas in Plaquemines Parish could be affected within 3 days of a spill (4% conditional probability) and within 10 days of a spill (14% conditional probability). Terrebonne, St. Bernard, and Lafourche parishes may also be affected within 10 days of a spill (up to 3% conditional probability). Coastal areas between Cameron Parish, Louisiana, and Bay County, Florida, may be affected within 30 days (1% to 21% conditional probability). A spill reaching a prehistoric site along these shorelines could coat fragile artifacts or site features and compromise the potential for radiocarbon dating organic materials in a site (although other dating methods are available, and it is possible to decontaminate an oiled sample for radiocarbon dating). Coastal prehistoric sites could also be damaged by spill cleanup operations (e.g., destroying fragile artifacts, 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. Most of the northern Gulf of Mexico is fringed by coastal and barrier island beaches, with wetlands, oyster reefs, and submerged seagrass beds occurring in sheltered areas behind the barrier islands and in estuaries.

Because of the distance from shore, the only IPF associated with routine activities in the project area that could affect beaches and dunes, wetlands, oyster reefs, seagrass beds, coastal wildlife refuges, wilderness areas, or any other managed or protected coastal area is support vessel traffic. The support bases at Port Fourchon and Houma, Louisiana are not located in wildlife refuges or wilderness areas. Potential impacts of support vessel traffic are briefly addressed below.

A large oil spill is the only accidental IPF that could affect coastal habitats and protected areas. A small fuel spill in the project area would be unlikely to affect coastal habitats because the project area is 75 miles (121 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

Support operations, including the crew boats and supply boats as detailed in DOCD Section 14, may have a minor incremental impact on coastal and barrier island beaches, wetlands, oyster reefs, and protected habitats. Over time with a large number of vessel trips, vessel wakes can erode shorelines along inlets, channels, and harbors, resulting in localized land loss. Impacts will be minimized by following the speed and wake restrictions in harbors and channels.

Support operations, including crew boats and supply boats, are not anticipated to have a significant impact on submerged seagrass beds. While submerged seagrass beds have the potential to be uprooted, scarred, or lost due to direct contact from vessels, use of navigation channels and adherence to local requirements and implemented programs will decrease the likelihood of impacts to submerged seagrass beds BOEM (2017a,c).

Impacts of a Large Oil Spill

Potential spill impacts on coastal habitats are discussed by BOEM (2016b, 2017a). Coastal habitats inshore of the project area include coastal and barrier island beaches, wetlands, oyster reefs, and submerged seagrass beds. For this DOCD, there are no unique site-specific issues with respect to coastal habitats.

Based on the 30-day OSRA modeling (**Table 3**), coastal areas in Plaquemines Parish could be affected within 3 days of a spill (4% conditional probability) and within 10 days of a spill (4% conditional probability). Terrebonne, St. Bernard, and Lafourche parishes may also be affected within 10 days of a spill (up to 3% conditional probability). Coastal areas between Cameron Parish, Louisiana, and Bay County, Florida, may be affected within 30 days (1% to 21% conditional probability).

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**.

Table 6. Wildlife refuges, wilderness areas, and state and national parks and preserves within the geographic range of 1% or greater conditional probability of shoreline contacts within 30 days of a hypothetical spill from Launch Point 57 based on the 30-day Oil Spill Risk Analysis model.

County or Parish, State	Wildlife Refuge, Wilderness Area, or State/National Park
Cameron, Louisiana	Sabine National Wildlife Refuge
Cameron, Louisiana	Rockefeller State Wildlife Refuge and Game Preserve
Cameron, Louisiana	Peveto Woods Sanctuary
Vermilion, Louisiana	Paul J. Rainey Wildlife Refuge and Game Preserve
Vermilion, Louisiana	Rockefeller State Wildlife Refuge and Game Preserve
Vermilion, Louisiana	State Wildlife Refuge
Terrebonne, Louisiana	Isles Dernieres Barrier Islands Refuge
Terrebonne, Louisiana	Pointe aux Chenes Wildlife Management Area
Lafourche, Louisiana	Pointe aux Chenes Wildlife Management Area
Lafourche, Louisiana	Wisner Wildlife Management Area (Includes Picciola Tract)
Plaquemines, Louisiana	Breton National Wildlife Refuge
Plaquemines, Louisiana	Delta National Wildlife Refuge
Plaquemines, Louisiana	Pass a Loutre Wildlife Management Area
St. Bernard, Louisiana	Biloxi State Wildlife Management Area
St. Bernard, Louisiana	Breton National Wildlife Refuge
Hancock, Mississippi	Buccaneer State Park
Hancock, Mississippi	Grand Bayou Preserve
Hancock, Mississippi	Jourdan River Preserve
Hancock, Mississippi	Hancock County Marshes Preserve
Harrison, Mississippi	Bayou Portage Preserve
Harrison, Mississippi	Biloxi River Marshes Preserve
Harrison, Mississippi	Cat Island Preserve
Harrison, Mississippi	Deer Island Preserve
Harrison, Mississippi	Gulf Islands National Seashore
Harrison, Mississippi	Hiller Park Recreation Area
Harrison, Mississippi	Jourdan River Preserve
Harrison, Mississippi	Sandhill Crane Refuge Preserve
Harrison, Mississippi	Ship Island Preserve
Harrison, Mississippi	Wolf River Preserve
Jackson, Mississippi	Bellefontaine Marsh Preserve
Jackson, Mississippi	Davis Bayou Preserve
Jackson, Mississippi	Escatawpa River Marsh Preserve
Jackson, Mississippi	Grand Bay National Estuarine Research Reserve
Jackson, Mississippi	Grand Bay Savanna Preserve
Jackson, Mississippi	Graveline Bay Preserve
Jackson, Mississippi	Gulf Islands National Seashore
Jackson, Mississippi	Gulf Islands Wilderness
Jackson, Mississippi	Horn Island Preserve
Jackson, Mississippi	Old Fort Bayou Preserve
Jackson, Mississippi	Pascagoula River Marsh Preserve
Jackson, Mississippi	Petit Bois Island Preserve
Jackson, Mississippi	Round Island Preserve
Jackson, Mississippi	Shepard State Park

County or Parish, State	Wildlife Refuge, Wilderness Area, or State/National Park
Baldwin, Alabama	Betty and Crawford Rainwater Perdido River Nature Preserve
	Bon Secour NWR
	Gulf State Park
	Meaher State Park
	Mobile-Tensaw Delta CIAP Parcel State Habitat Area
	Mobile-Tensaw Delta WMA
	Perdido River Water Management Area
	W.L. Holland WMA
	Weeks Bay Harris and Worcester Tracts
	Weeks Bay National Estuarine Research Reserve
	Weeks Bay Reserve Addition - Beck Tract
Mobile, Alabama	Grand Bay National Wildlife Refuge
	Grand Bay Savanna State Nature Preserve
	Mobile-Tensaw Delta WMA
	Penalver Park
	The Grand Bay Savanna Tract (and Addition Tract)
	W.L. Holland WMA
Escambia, Florida	Bayou Marcus Wetlands
	Big Lagoon State Park
	Blue Angel Recreation Park
	Bay Bluffs Park
	Ft. Pickens Aquatic Preserve
	Gulf Islands National Seashore
	Mallory Heights Park #3
	Perdido Bay/Crown Pointe Preserve
	Perdido Key State Park
	Tarkiln Bayou Preserve State Park
	USS Massachusetts (BB-2) Underwater Archaeological Preserve
	Wayside 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
Walton, Florida	Choctawhatchee River Delta Preserve
	Choctawhatchee River Water Management Area
	Deer Lake State Park
	Grayton Beach State Park
	Point Washington State Forest
	Topsail Hill Preserve State Park
Bay, Florida	Camp Helen State Park
	SS Tarpon Underwater Archaeological Preserve
	St. Andrews Aquatic Preserve
	St. Andrews State Park
	Vamar Underwater Archaeological Preserve

The level of impacts from oil spills on coastal habitats depends on many factors, including the oil characteristics, the geographic location of the landfall, and the weather and oceanographic conditions at the time of the spill (BOEM, 2017a). Oil that makes it to beaches may be liquid, weathered oil, an oil-and-water mousse, or tarballs. Oil is generally deposited on beaches in lines defined by wave action at the time of landfall. Oil that remains on the beach will thicken as its volatile components are lost. Thickened oil may form tarballs or aggregations that incorporate sand, shell, and other materials into its mass. Tar may be buried to varying depths under the sand. On warm days, both exposed and buried tarballs may liquefy and ooze. Oozing may also serve to expand the size of a mass as it incorporates beach materials. Oil on beaches may be cleaned up manually, mechanically, or both. Some oil can remain on the beach at varying depths and may persist for several years as it slowly biodegrades and volatilizes (BOEM, 2017a). Impacts associated with an extensive oiling of coastal and barrier island beaches from a large oil spill are expected to be adverse.

Coastal wetlands are highly sensitive to oiling and can be significantly impacted because of the inherent toxicity of hydrocarbon and non-hydrocarbon components of the spilled substances (Mendelssohn et al., 2012; Lin et al., 2016). Numerous variables such as oil concentration and chemical composition, vegetation type and density, season or weather, preexisting stress levels, soil types, and water levels may influence the impacts of oil exposure on wetlands. Light oiling could cause plant die-back, followed by recovery in a fairly short time. Vegetation exposed to oil that persists in wetlands could take years to recover (BOEM, 2017a). However, in a study in Barataria Bay, Louisiana, after the *Deepwater Horizon* spill, Silliman et al. (2012) reported that previously healthy marshes largely recovered to a pre-oiling state within 18 months. At 103 salt marsh locations that spanned 267 miles (430 km) of shoreline in Louisiana, Mississippi, and Alabama, Silliman et al. (2016) determined a threshold for oil impacts on marsh edge erosion, with higher erosion rates occurring for approximately 1 to 2 years after the *Deepwater Horizon* spill at sites with the highest amounts of plant stem oiling (90% to 100%); thus, displaying a large-scale ecosystem loss. In addition to the direct impacts of oil, cleanup activities in marshes may accelerate rates of erosion and retard recovery rates (BOEM, 2017a). Impacts associated with an extensive oiling of coastal wetland habitat are expected to be significant.

In addition to the direct impacts of oil, cleanup activities in marshes may accelerate rates of erosion and retard recovery rates (BOEM, 2017a). A review of the literature and new studies indicated that oil spill impacts to seagrass beds are often limited and may be limited to when oil is in direct contact with these plants (Fonseca et al., 2017). Impacts associated with an extensive oiling of coastal wetland habitat are expected to be significant.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in 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 major species sought by commercial fishermen in federal waters of the Gulf of Mexico include shrimp, menhaden, red snapper, tunas, and groupers (BOEM, 2017a). However, most of the fishing effort for these species is on the continental shelf in shallow waters. The main commercial fishing activity in deep waters of the northern Gulf of Mexico is pelagic longlining for tunas, swordfishes, and other billfishes (Continental Shelf Associates, 2002; Beerkircher et al., 2009). Pelagic longlining has occurred historically in the project area, primarily during spring and summer.

It is unlikely that any commercial fishing activity other than longlining will occur at or near the project area due to the water depth at the project area. Benthic species targeted by commercial fishers occur on the upper continental slope, well inshore of the project area. Royal red shrimp (*Pleoticus robustus*) are caught by trawlers in water depths of approximately 820 to 1,804 ft (250 to 550 m) (Stiles et al., 2007). Tilefishes (primarily *Lopholatilus chamaeleonticeps*) are caught by bottom longlining in water depths from approximately 540 to 1,476 ft (165 to 450 m) (Continental Shelf Associates, 2002).

Most recreational fishing activity in the region occurs in water depths less than 656 ft (200 m) (Continental Shelf Associates, 1997, 2002; Keithly and Roberts, 2017). In deeper water, the main attraction to recreational fishers is petroleum rigs offshore Texas and Louisiana. Due to the project site's distance from shore, it is unlikely that recreational fishing activity is occurring in the project area.

The only routine IPF that could potentially affect fisheries (commercial and recreational) is MODU presence (including noise and lights). Two types of potential accidents are also addressed in this section: a small fuel spill and a large oil spill.

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

There is a slight possibility of pelagic longlines drifting into and becoming entangled in the MODUs. For example, in January 1999, a portion of a pelagic longline snagged on the acoustic Doppler current profiler of a drillship working in the Gulf of Mexico (Continental Shelf Associates, 2002). The line was removed without incident. Generally, longline fishers use radar and are aware of offshore structures and ships when placing their sets. Therefore, little or no impact on pelagic longlining is expected.

No other adverse impacts on fishing activities are anticipated. The presence of the MODUs would result in a limited area being unavailable for fishing activity, but this effect is considered negligible. Other factors such as effluent discharges are likely to have negligible impacts on commercial or recreational fisheries due to rapid dispersion, the small area of ocean affected, and the intermittent nature of the discharges.

Impacts of a Small Fuel Spill

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

Pelagic longlining activities in the project area, if any, could be interrupted in the event of a small fuel spill. The area of diesel fuel on the sea surface would range from 1.2 to 12 ac (0.5 to 5 ha), depending on sea state and weather conditions. Fishing activities could be interrupted due to the activities of response vessels operating in the project area. A small fuel spill would not affect coastal water quality because the spill would not be expected to make landfall or reach coastal waters prior to breaking up (**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, 2010b). 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 Exclusive Economic Zone. BOEM (2012a) notes that fisheries closures from a large spill event could have a negative effect on short-term fisheries catch and marketability.

According to BOEM (2012a, 2017a), the potential impacts on commercial and recreational fishing activities from an accidental oil spill are anticipated to be minimal because the potential for oil spills is very low; the most typical events are small and of short duration; and the effects are so localized that fishes are typically able to avoid the affected area. Fish populations may be affected by an oil spill event should it occur, but they would be primarily affected if the oil reaches the productive shelf and estuarine areas where many fishes spend a portion of their life cycle. However, most species of commercially valuable fish in the Gulf of Mexico have planktonic eggs or larvae which may be affected by a large oil spill in deep water (BOEM, 2017a). The probability of an offshore spill affecting these nearshore environments is also low.

Should a large oil spill occur, economic impacts on commercial and recreational fishing activities would likely occur, but are difficult to predict because impacts would differ by fishery and season (BOEM, 2017a,c). 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 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.8.2 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, 75 miles (121 km) from the nearest shoreline (Louisiana). 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 MODUs maintain 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. No significant spill impacts on public health and safety are expected.

C.8.3 Employment and Infrastructure

There are no IPFs associated with routine operations that are expected to affect employment and infrastructure. The project involves drilling with support from existing shore-based facilities in Texas and Louisiana. No new or expanded facilities will be constructed, and no new employees are expected to move permanently into the area. The project will have a negligible impact on socioeconomic conditions such as local employment and existing offshore and coastal infrastructure (including major sources of supplies, services, energy, and water). A small fuel spill that is dissipated within a few days would have little or no economic impact, as the spill response would use existing facilities, resources, and personnel. A large oil spill is the only IPF that has the potential to affect employment and infrastructure.

Impacts of a Large Oil Spill

Potential socioeconomic impacts of an oil spill are discussed by BOEM (2016b, 2017a). For this 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 activities, including service and support operations that are an important part of local economies, could be suspended.

Nonmarket effects such as traffic congestion, strains on public services, shortages of commodities or services, and disruptions to the normal patterns of activities or expectations could also occur in the short term. These negative, short-term social and economic consequences of a spill are expected to be modest in terms of projected cleanup expenditures and the number of people employed in cleanup and remediation activities (BOEM, 2017a). Net employment impacts from a spill would not be expected to exceed 1% of baseline employment in any given year (BOEM, 2017a).

The project area is 75 miles (121 km) from the nearest shoreline (Louisiana). Based on the 30-day OSRA modeling (**Table 3**), coastal areas in Plaquemines Parish could be affected within 3 days of a spill (4% conditional probability) and within 10 days of a spill (14% conditional probability). Terrebonne, St. Bernard, and Lafourche parishes may also be affected within 10 days of a spill (up to 3% conditional probability). Coastal areas between Cameron Parish, Louisiana, and Bay County, Florida, may be affected within 30 days (1% to 21% conditional probability).

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

C.8.4 Recreation and Tourism

For this DOCD, there are no unique site-specific issues with respect to recreation and tourism. There are no known recreational or tourism uses in the project area. Recreational resources and tourism in coastal areas would not be affected by routine activities due to the distance from shore. Compliance with NTL BSEE-2015-G013 (See **Table 1**) will minimize the chance of trash or debris being lost overboard from the MODUs and subsequently washing up on beaches. As explained in **Section A.9.1**, a small fuel spill would not be expected to make landfall or reach coastal waters prior to 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. Loss of tourist confidence and public health concerns can then lead to the potential for economic loss. Media coverage of oil contamination, or word-of-mouth, can have implications on public perception of the incident. However, quantifying financial loss due to loss in confidence can be difficult because it depends on implementation of an effective response plan as well as a strategy to restore any loss of appeal to tourists that the area may have suffered.

Based on the 30-day OSRA modeling (**Table 3**), coastal areas in Plaquemines Parish could be affected within 3 days of a spill (4% conditional probability) and within 10 days of a spill (14% conditional probability). Terrebonne, St. Bernard, and Lafourche parishes may also be affected within 10 days of a spill (up to 3% conditional probability). Coastal areas between Cameron Parish, Louisiana, and Bay County, Florida, may be affected within 30 days (1% to 21% conditional probability).

According to BOEM (2017a), should an oil spill occur and contact a beach area or other recreational resource, it would cause some disruption during the impact and cleanup phases of the spill. However, these effects are also likely to be small in scale and of short duration, in part because the probability of an offshore spill contacting most beaches is small. In the unlikely event that a spill occurs that is sufficiently large to affect large 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. The U.S. Travel Association has estimated the economic impact of the *Deepwater Horizon* incident on tourism across the Gulf Coast over a 3-year period at $22.7 billion (Oxford Economics, 2010). Hotels and restaurants were the most affected tourism businesses, but charter fishing, marinas, and boat dealers and sellers were among the others affected (Eastern Research Group, 2014).

However, a blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in 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 accidental IPF. A small fuel spill would not have impacts on land use, as the response would be staged out of existing shorebases and facilities.

Impacts of a Large Oil Spill

The initial response for a large oil spill would be staged out of existing facilities, with no effect on land use. A large spill could have limited temporary impacts on land use along the coast if additional staging areas were needed. For example, during the *Deepwater Horizon* incident, 25 temporary staging areas were established in Louisiana, Mississippi, Alabama, and Florida for spill response and cleanup efforts (BOEM, 2012a). In the event of a large spill in the project area, similar temporary staging areas could be needed. These areas would eventually return to their original use as the response is demobilized.

An oil spill is not likely to significantly affect land use and coastal infrastructure in the region, in part because an offshore spill would have a small probability of contacting onshore resources. BOEM (2016b) states that landfill capacity would probably not be an issue at any phase of an oil spill event or the long-term recovery. In the case of the *Deepwater Horizon* incident and response, USEPA reported that existing landfills receiving oil spill waste had sufficient capacity to handle waste volumes; the wastes that were disposed of in landfills represented less than 7% of the total daily waste normally accepted at these landfills (USEPA, 2016).

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in 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 or shipping lane but is located within a Military Warning Area (EWTA-1). Shell will comply with BOEM requirements and lease stipulations to avoid impacts on uses of the area by military vessels and aircrafts.

Previously drilled wells, flowlines, umbilical, transponder frames, and other subsea equipment are located within 2,000 ft (610 m) of the proposed wellsites (Fugro Geoservices, Inc., 1996, 2009a; AOA Geophysics, Inc., 2004; Oceaneering 2018a,b). Operations will be conducted using DGPS for positioning to avoid all existing pipelines, wells, and other equipment located within 500 ft (152 m) the proposed production wellsites or infrastructure installation location.

The shallow hazard assessment identified no sonar contacts within 2,000 ft (610 m) of proposed wellsites that were determined to have archaeological potential (Fugro Geoservices, Inc., 1996, 2007, 2009a,b,c; AOA Geophysics, Inc., 2004; Oceaneering 2018a,b). However, two sonar contacts were identified within 2,000 ft (610 m). These sonar contacts were identified as modern debris with suggested 100 ft (30 m) avoidance radius. No archaeological impacts are expected from routine activities in the project area. A large oil spill is the only relevant IPF. A small fuel spill would not have impacts on other marine uses because the spill and response activities would be mainly within the project area, and the duration would be brief.

Impacts of a Large Oil Spill

An accidental spill would be unlikely to significantly affect shipping or other marine uses. The lease block is not located within any USCG-designated fairway or shipping lane but is within a Military Warning Area (EWTA-1). In the event of a large spill requiring numerous response vessels, coordination would be required to manage the vessel traffic for safe operations.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in 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,b, 2013, 2014, 2015, 2016a,b, 2017a). Past, present, and reasonably foreseeable activities were identified in the cumulative effects scenario of these documents, which are incorporated by reference. The proposed action will not result in any additional impacts beyond those evaluated in the multisale and Final EISs.

Description of Activities Reasonably Expected to Occur in the Vicinity of Project Area. Shell does not anticipate other projects in the vicinity of the project area beyond the types of projects analyzed in the lease sale and Supplemental EISs (BOEM, 2012a, 2013, 2014, 2015, 2016b, 2017a).

Cumulative Impacts of Activities in the Exploration Plan. The BOEM (2017a) Final EIS included a lengthy discussion of cumulative impacts, which analyzed the environmental and socioeconomic impacts from the incremental impact of the 10 proposed lease sales, in addition to all activities (including non-OCS activities) projected to occur from past, proposed, and future lease sales. The EISs considered exploration, delineation, and development wells; platform installation; service vessel trips; and oil spills. The EISs examined the potential cumulative effects on each specific resource for the entire Gulf of Mexico.

The EIA incorporates and builds on these analyses by examining the potential impacts on physical, biological, and socioeconomic resources from the work planned in this 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 the impacts on the physical/chemical environment will be correspondingly limited.

Air Quality. Emissions from pollutants into the atmosphere from activities are not projected to have significant effects on onshore air quality because of the distance from shore, the prevailing atmospheric conditions, emission rates and heights, and resulting pollutant concentrations. As BOEM found in the multisale EISs, the incremental contribution of activities similar to Shell's proposed activities to the cumulative impacts is not significant and will not cause or contribute to a violation of NAAQS (BOEM, 2012a, 2013, 2014, 2015, 2016b, 2017a). In addition, the cumulative contribution to visibility impairment is also very small. As mentioned in previous sections, projected emissions meet BOEM's exemption criteria and would not contribute to cumulative impacts on air quality.

Climate Change. 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 water-based drilling fluids and associated cuttings, cuttings wetted with SBM, treated sanitary and domestic wastes, deck drainage, non-contaminated well treatment and completion fluids, workover fluids, desalination unit discharge, blowout preventer fluid, ballast water, bilge water, cement slurry, fire water, hydrate inhibitor, subsea production control fluid, non-contact cooling water, and treated or untreated seawater. These effects are expected to be minor (localized to the area within a few hundred meters of the MODUs) and temporary (lasting only hours longer than the disturbance or discharge). Any cumulative effects to water quality are expected to be negligible.

Archaeological Resources. MC 391, MC 392, and MC 393 are on the list of archaeology survey blocks (BOEM, 2011). No known shipwrecks or other archaeological artifacts were identified during the archaeological assessment (Fugro Geoservices, Inc., 1996, 2007, 2009a,b,c; AOA Geophysics, Inc., 2004; Oceaneering 2018a,b). The project area is well beyond the 197 ft (60 m) depth contour used by BOEM as the seaward extent for prehistoric archaeological site potential in the Gulf of Mexico. Therefore, Shell's operations will have no cumulative impacts on historic shipwrecks or prehistoric archaeological resources.

New Information. New information included in the most recent Programmatic, Supplemental, and Final EISs (BOEM, 2012a, 2013, 2014, 2015, 2016a,b, 2017a) has been incorporated into the EIA, where applicable.

C.9.2 Cumulative Impacts to Biological Resources

The work planned in this 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 discharges of drilling mud and cuttings are expected to be minor and limited to a small area. The geophysical survey data did not identify any features that could support high-density deepwater benthic communities within 2,000 ft (610 m) of the proposed wellsite locations (Fugro Geoservices, Inc., 1996, 2009a; AOA Geophysics, Inc., 2004; Oceaneering 2018a,b).

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 are 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 aircraft 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 (2020) Appendix B and C. No significant cumulative impacts are expected.

Coastal and Marine Birds. Birds may be exposed to contaminants, including air pollutants and routine discharges, but significant impacts are unlikely due to rapid dispersion. Shell's compliance with NTL BSEE-2015-G013 will minimize the likelihood of debris-related impacts on birds. Support vessel and helicopter traffic may disturb some foraging and resting birds; however, it is likely that individual birds would experience, at most, only short-term behavioral disruption.

Due to the limited scope, timing, and geographic extent of drilling activities, collisions or other adverse effects are unlikely, and no significant cumulative impacts are expected.

Fisheries Resources. Exploration and production structures occur in the vicinity of the project area. The additional effect of the proposed drilling activity would be negligible.

Coastal Habitats. Due to the distance of the wellsites from shore, routine activities are not expected to have any impacts on beaches and dunes, wetlands, seagrass beds, coastal wildlife refuges, wilderness areas, or any other managed or protected coastal area. The support bases are not in wildlife refuges or wilderness areas. Support operations, including the crew boat and supply boats, may have a minor incremental impact on coastal habitats. Over time with a large number of vessel trips, vessel wakes can erode shorelines along inlets, channels, and harbors. Impacts will be minimized by following the speed and wake restrictions in harbors and channels.

New Information. New information included in the most recent Programmatic, Supplemental, and Final EISs (BOEM, 2012a,b, 2013, 2014, 2015, 2016a,b, 2017a) has been incorporated into the EIA, where applicable.

C.9.3 Cumulative Impacts to Socioeconomic Resources

The work planned in this DOCD is limited in geographic scope and duration, and the impacts on socioeconomic resources will be correspondingly limited.

The multisale, Supplemental, and Final EISs analyzed the cumulative impacts of oil and gas exploration and development in the project area, in combination with other impact-producing activities, on commercial fishing, recreational fishing, recreational resources, historical and archaeological resources, land use and coastal infrastructure, demographics, and environmental justice (BOEM, 2012a, 2013, 2014, 2015, 2016b, 2017a). BOEM also analyzed the economic impact of oil and gas activities on the Gulf States, finding only minor impacts in most of Texas, Mississippi, Alabama, and Florida, more significant impacts in parts of Texas, and substantial impacts on Louisiana.

Shell's proposed activities will have negligible cumulative impacts on socioeconomic resources. There are no IPFs associated with routine operations that are expected to affect public health and safety, employment and infrastructure, recreation and tourism, land use, or other marine uses. Due to the distance from shore, it is unlikely that any recreational fishing activity is occurring in the project area, and it is unlikely that any commercial fishing activity other than longlining occurs at or near the project area. The project will have negligible impacts on fishing activities.

New Information. New information included in the most recent Programmatic, Supplemental, and Final EISs (BOEM, 2012a,b, 2013, 2014, 2015, 2016a,b, 2017a) has been incorporated into the EIA, where applicable.

D. Environmental Hazards

D.1 Geologic Hazards

The wellsite assessment reports (Fugro Geoservices, Inc., 1996, 2007, 2009a,b,c; AOA Geophysics, Inc., 2004; Oceaneering 2018a,b) concluded that wellsite locations are suitable for the proposed exploratory drilling activities and no seafloor obstructions or conditions were found that would constrain the proposed project activities. 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 MODUs. 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 MODUs for safety reasons until the storm or weather event passes. In the event of a hurricane, procedures in Shell's Hurricane Evacuation Plan would be followed.

D.3 Currents and Waves

A rig-based acoustic Doppler current profiler will be used to continuously monitor the current beneath the MODUs. Metocean conditions, such as sea state, wind speed, ocean currents, etc., will also be continuously monitored. Under most circumstances, physical oceanographic conditions are not expected to have any effect on the proposed activities. Strong currents (caused by Loop Current eddies and intrusions) and large waves were considered in the design criteria for the MODUs. High waves during a severe storm could disrupt support activities (e.g., vessel and helicopter traffic) and make it necessary to suspend some activities on the MODUs 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 wellsites and the selection of the MODUs, 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 2J.

G. Consultation

No persons beyond those cited as Preparers (**Section H.**, **Preparers**) or agencies were consulted regarding potential impacts associated with the proposed activities during the preparation of the EIA.

H. Preparers

The EIA was prepared for Shell Offshore Inc. by its contractor, CSA Ocean Sciences Inc. Contributors included the following:

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II. References

Abbriano, R.M., M.M. Carranza, S.L. Hogle, R.A. Levin, A.N. Netburn, K.L. Seto, S.M. Snyder, and P.J.S. Franks. 2011. *Deepwater Horizon* oil spill: A review of the planktonic response. Oceanography 24(3): 294-301.

ABS Consulting Inc. 2016. 2016 Update of Occurrence Rates for Offshore Oil Spills. Prepared for the Bureau of Ocean Energy Management and the Bureau of Safety and Environmental Enforcement. Contract # E15PX00045, Deliverable 7. https://www.bsee.gov/sites/bsee.gov/files/osrr-oil-spill-response-research//1086aa.pdf

ABSG Consulting Inc. 2018. US Outer Continental Shelf Oil Spill Statistics. Arlington (VA): Prepared for US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2018-006. 36 pp.

Ackleh, A.S., G.E. Ioup, J.W. Ioup, B. Ma, J.J. Newcomb, N. Pal, N.A. Sidorovskaia, and C. Tiemann. 2012. Assessing the *Deepwater Horizon* oil spill impact on marine mammal population through acoustics: endangered sperm whales. Journal of the Acoustical Society of America 131(3): 2306-2314.

Almeda, R., Z. Wambaugh, Z. Wang, C. Hyatt, Z. Liu, and E.J. Buskey. 2013. Interactions between zooplankton and crude oil: toxic effects and bioaccumulation of polycyclic aromatic hydrocarbons. PLoS ONE 8(6): e67212.

Anderson, C.M., M. Mayes, and R. LaBelle. 2012. Update of Occurence Rates for Offshore Oil Spills. U.S. Department of the Interior, Bureau of Ocean Energy Management and Bureau of Safety and Environmental Enforcement. OCS Report BOEM 2012-069, BSEE 2012-069. 76 pp.

AOA Geophysics, Inc. 2004. Shallow Hazards Assessment, MC 393 (OCS-G 26254), DC 353 (OCS-G 25852), DC354 (OCS-G 23507), DC397 (OCS-G 25853), and DC398 (OCS-G 25854), Mississippi Canyon and De Soto Canyon Areas, Gulf of Mexico. Report No. 3038.3-SHL-DES. Dated 10/29/2004.

Auffret, M., M. Duchemin, S. Rousseau, I. Boutet, A. Tanguy, D. Moraga, and A. Marhic. 2004. Monitoring of immunotoxic responses in oysters reared in areas contaminated by the Erikaoil spill. Aquatic Living Resources 17(3): 297-302.

Baguley, J.G., P.A. Montagna, C. Cooksey, J.L. Hyland, H.W. Bang, C.L. Morrison, A. Kamikawa, P. Bennetts, G. Saiyo, E. Parsons, M. Herdener, and M. Ricci. 2015. Community response of deep-sea soft sediment metazoan meiofauna to the *Deepwater Horizon* blowout and oil Spill. Marine Ecology Progress Series 528: 127-140.

Barkaszi, M.J., M. Butler, R. Compton, A. Unietis, and B. Bennett. 2012. Seismic Survey Mitigation Measures and Marine Mammal Observer Reports. New Orleans, LA. OCS Study BOEM 2012-015. 51 pp.

Barkaszi, M.J. and C.J. Kelly. 2019. Seismic Survey mitigation Measures and Protected Species Observer Reports: Synthesis Report. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study BOEM 2019-012. 141 pp + apps.

Barkuloo, J.M. 1988. Report on the Conservation Status of the Gulf of Mexico sturgeon, *Acipenser oxyrinchus desotoi*. U.S. Department of the Interior, U.S. Fish and Wildlife Service. Panama City, FL.

Baum, J.K. and R.A. Myers. 2004. Shifting baselines and the decline of pelagic sharks in the Gulf of Mexico. Ecology Letters 7(2): 135-145.

Beerkircher, L., C.A. Brown, and V. Restrepo. 2009. Pelagic Observer Program Data Summary, Gulf of Mexico Bluefin Tuna (Thunnus thynnus) Spawning Season 2007 and 2008; and Analysis of Observer Coverage Levels. NOAA Technical Memorandum NMFS-SEFSC-588. 33 pp.

Bélanger, L. and J. Bédard. 1989. Responses of staging greater snow geese to human disturbance. Journal of Wildlife Management 53(3): 713-719.

Bellas, J., L. Saco-Álvarez, Ó. Nieto, J.M. Bayona, J. Albaigés, and R. Beiras. 2013. Evaluation of artificially-weathered standard fuel oil toxicity by marine invertebrate embryo-genesis bioassays. Chemosphere 90: 1103-1108.

Berrojalbiz, N., S. Lacorte, A. Calbet, E. Saiz, C. Barata, and J. Dachs. 2009. Accumulation and cycling of polycyclic aromatic hydrocarbons in zooplankton. Environmental Science and Technology 43: 2295-2301.

Berry, M., D.T. Booth, and C.J. Limpus. 2013. Artificial lighting and disrupted sea-finding behaviour in hatchling loggerhead turtles (*Caretta caretta*) on the Woongarra coast, south-east Queensland, Australia. Australian Journal of Zoology 61(2): 137-145.

Biggs, D.C. and P.H. Ressler. 2000. Water column biology. In: Deepwater Program: Gulf of Mexico Deepwater Information Resources Data Search and Literature Synthesis. Volume I: Narrative Report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2000-049. pp. 141-187.

BirdLife International 2018. *Charadrius melodus*. The IUCN Red List of Threatened Species 2018. http://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T22693811A131930146.en.

Blackburn, M., C.A.S. Mazzacano, C. Fallon, and S.H. Black. 2014. Oil in Our Oceans. A Review of the Impacts of Oil Spills on Marine Invertebrates. The Xerces Society for Invertebrate Conservation, Portland, OR. 160 pp.

Blackstock, S.A., J.O. Fayton, P.H. Hulton, T.E. Moll, K. Jenkins, S. Kotecki, E. Henderson, V. Bowman, S. Rider, and C. Martin. 2018. Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing. NUWC-NPT Technical Report August 2018. N.U.W.C. Division. Newport, Rhode Island.

Blackwell, S.B. and C.R. Greene Jr. 2003. Acoustic Measurements in Cook Inlet, Alaska, during August 2001. Greeneridge Sciences, Inc., for NMFS, Anchorage, AK. 43 pp.

Boehm, P., D. Turton, A. Raval, D. Caudle, D. French, N. Rabalais, R. Spies, and J. Johnson. 2001. Deepwater Program: Literature Review, Environmental Risks of Chemical Products Used in Gulf of Mexico Deepwater Oil and Gas Operations. Volume I: Technical report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2001-011. 326 pp.

Bolle, L.J., C.A.F. de Jong, S.M. Bierman, P.J.G. Van Beek, O.A. van Keeken, P.W. Wessels, C.J.G. van Damme, H.V. Winter, D. de Haan, and R.P.A. Dekeling. 2012. Common sole larvae survive high levels of pile-driving sound in controlled exposure experiments. PLoS One 7(3): e33052.

Bonde, R.K., and T.J. O'Shea. 1989. Sowerby's beaked whale (*Mesoplodon bidens*) in the Gulf of Mexico. J. Mammal. 70: 447-449.

Brooks, J.M., C. Fisher, H. Roberts, E. Cordes, I. Baums, B. Bernard, R. Church, P. Etnoyer, C. German, E. Goehring, I. McDonald, H. Roberts, T. Shank, D. Warren, S. Welsh, and G. Wolff. 2012. Exploration and Research of Northern Gulf of Mexico Deepwater Natural and Artificial Hard-Bottom Habitats with Emphasis on Coral Communities: Reefs, Rigs, and Wrecks — "Lophelia II" Interim Report. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study BOEM 2012-106.

Bruintjes, R., and A.N. Radford. 2013. Context-dependent impacts of anthropogenic noise on individual and social behaviour in a cooperatively breeding fish. Animal Behaviour 85(6): 1343-1349.

Buehler, D.A. 2000. Bald Eagle (*Haliaeetus leucocephalus*), version 2.0. In: The Birds of North America, A.F Poole, and F.B. Gill, (Eds)i. Cornell Lab of Ornithology, Ithaca, NY, USA. https://birdsna.org/Species-Account/bna/species/baleag/introduction

Bureau of Ocean Energy Management, Regulation, and Enforcement. 2010. Federal & Academic Scientists Return from Deep-sea Research Cruise in Gulf of Mexico: Scientists Observe Damage to Deep-sea Corals. U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement. https://www.boem.gov/BOEM-Newsroom/Press-Releases/2010/press1104a.aspx

Bureau of Ocean Energy Management. 2011. Archaeology Survey Blocks. http://www.boem.gov/Environmental-Stewardship/Archaeology/surveyblocks-pdf.aspx

Bureau of Ocean Energy Management. 2012a. Gulf of Mexico OCS Oil and Gas Lease Sales: 2012-2017. Western Planning Area Lease Sales 229, 233, 238, 246, and 248. Central Planning Area Lease Sales 227, 231, 235, 241, and 247. Final Environmental Impact Statement. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS EIS/EA BOEM 2012-019.

Bureau of Ocean Energy Management. 2012b. Gulf of Mexico OCS Oil and Gas Lease Sale: 2012. Central Planning Area Lease Sale 216/222. Final Supplemental Environmental Impact Statement. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS EIS/EA BOEM 2012-058.

Bureau of Ocean Energy Management. 2013. Gulf of Mexico OCS Oil and Gas Lease Sales: 2013-2014. Western Planning Are Lease Sale 233. Central Planning Area 231. Final Supplemental Environmental Impact Statement. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS EIS/EA BOEM 2013-0118.

Bureau of Ocean Energy Management. 2014. Gulf of Mexico OCS Oil and Gas Lease Sales: 2015-2017. Central Planning Area Lease Sales 235, 241, and 247. Final Supplemental Environmental Impact Statement. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS EIS/EA BOEM 2014-655.

Bureau of Ocean Energy Management. 2015. Gulf of Mexico OCS Oil and Gas Lease Sales: 2016 and 2017. Central Planning Area Lease Sales 241 and 247; Eastern Planning Area Lease Sale 226. Final Supplemental Environmental Impact Statement. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS EIS/EA BOEM 2015-033.

Bureau of Ocean Energy Management. 2016a. Outer Continental Shelf Oil and Gas Leasing Program: 2017-2022. Final Programmatic Environmental Impact Statement. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. OCS EIS/EIA BOEM 2016-060.

Bureau of Ocean Energy Management. 2016b. Gulf of Mexico OCS Oil and Gas Lease Sale: 2016. Western Planning Area Lease Sale 248. Final Supplemental Environmental Impact Statement. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS EIS/EA BOEM 2016-005.

Bureau of Ocean Energy Management. 2016c. Essential Fish Habitat Assessment for the Gulf of Mexico. U.S. Department of the Interior. New Orleans, LA. OCS Report BOEM 2016-016.

Bureau of Ocean Energy Management. 2017a. Gulf of Mexico OCS Oil and Gas Lease Sales: 2017-2025. Gulf of Mexico Lease Sales 249, 250, 251, 252, 253, 254, 256, 257, 259, and 261. Final Multisale Environmental Impact Statement. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA.

Bureau of Ocean Energy Management. 2017b. Gulf of Mexico OCS Oil and Gas Lease Sale. Final Supplemental Environmental Impact Statement 2018. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS EIS/EA BOEM 2017-074.

Bureau of Ocean Energy Management. 2017c. Catastrophic Spill Event Analysis: High-Volume, Extended Duration Oil Spill Resulting from Loss of Well Control on the Gulf of Mexico Outer Continental Shelf. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study BOEM 2017-007. 339 pp.

Bureau of Ocean Energy Management. nd. Chemosynthetic Community Locations in the Gulf of Mexico. http://www.boem.gov/Chemo-Community-Locations-in-the-GOM/

Bureau of Ocean Energy Management. 2019. Seismic Water Bottom Anomalies Map Gallery. https://www.boem.gov/oil-gas-energy/mapping-and-data/map-gallery/seismic-water-bottom-anomalies-map-galleryb

Bureau of Safety and Environmental Enforcement. 2018. Offshore Incident Statistics. U.S. Department of the Interior, Bureau of Safety and Environmental Enforcement. https://www.bsee.gov/stats-facts/offshore-incident-statistics

Camhi, M.D., E.K. Pikitch, and e. E.A. Babcock. 2008. Sharks of the Open Ocean: Biology, Fisheries, and Conservation. Oxford, UK., Blackwell Publishing Ltd. 537 pp.

Camilli, R., C.M. Reddy, D.R. Yoerger, B.A. Van Mooy, M.V. Jakuba, J.C. Kinsey, C.P. McIntyre, S.P. Sylva, and J.V. Maloney. 2010. Tracking hydrocarbon plume transport and biodegradation at *Deepwater Horizon*. Science 330(6001): 201-204.

Carlson, J.K., J. Osborne, and T.W. Schmidt. 2007. Monitoring of the recovery of smalltooth sawfish, *Pristis pectinata*, using standardized relative indices of abundance. Biological Conservation 136: 195-202.

Carlson, J.K. and J. Osborne. 2012. Relative abundance of smalltooth sawfish (*Pristis pectinata*) based on Everglades National Park Creel Survey. NOAA Technical Memorandum NMFS-SEFSC-626. 15 pp. https://repository.library.noaa.gov/view/noaa/4326

Carmichael, R.H., W.M. Graham, A. Aven, G. Worthy, and S. Howden. 2012. Were multiple stressors a 'perfect storm' for northern Gulf of Mexico bottlenose dolphins (*Tursiops truncatus*) in 2011? PLoS One 7(7): e41155.

Carr, A. 1996. Suwanee River sturgeon, pp 73-83. In: M.H. Carr (Ed.), A Naturalist in Florida. Yale University Press, New Haven, CT.

Carroll, M., B. Gentner, S. Larkin, K. Quigley, N. Perlot, L. Degner, and A. Kroetz. 2016. An Analysis of the Impacts of the *Deepwater Horizon* Oil Spill on the Gulf of Mexico Seafood Industry. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study BOEM 2016-020. 179 pp.

Carvalho, R., C.-L. Wei, G.T. Rowe, and A. Schulze. 2013. Complex depth-related patterns in taxonomic and functional diversity of Polychaetes in the Gulf of Mexico. Deep Sea Research Part I: Oceanographic Research Papers 80: 66-77.

Casper, B.M., P.S. Lobel, and H.Y. Yan. 2003. The hearing sensitivity of the little skate, Raja erinacea: a comparison of two methods. Environmental Biology of Fishes 68: 371–379.

Casper, B.M., and D.A. Mann. 2006. Evoked potential audiograms of the nurse shark (Ginglymostoma cirratum) and the yellow stingray (*Urobatis jamaicensis*). Environmental Biology of Fishes 76: 101 108.

Cave, E.J. and S.M. Kajiura. 2018. Effect of *Deepwater Horizon* crude oil water accomodated fraction on olfactory function in the Atlantic stingray, *Hypanus sabinus*. Scientific Reports 8:15786.

Clapp, R.B., R.C. Banks, D. Morgan-Jacobs, and W.A. Hoffman. 1982a. Marine Birds of the Southeastern United States and Gulf of Mexico. Part I. Gaviiformes through Pelicaniformes. U.S. Fish and Wildlife Service, Office of Biological Services. Washington, DC. FWS/OBS-82/01.

Clapp, R.B., D. Morgan-Jacobs, and R.C. Banks. 1982b. Marine Birds of the Southeastern United States and Gulf of Mexico. Part II. Anseriformes. U.S. Fish and Wildlife Service, Office of Biological Services. Washington DC. FWS/OBS 82/20.

Clapp, R.B., D. Morgan-Jacobs, and R.C. Banks. 1983. Marine Birds of the Southeastern United States and Gulf of Mexico. Part III. Charadriiformes. U.S. Fish and Wildlife Service, Office of Biological Services. Washington, DC. FWS/OBS-83/30.

Conn, P. B., and G. K. Silber. 2013. Vessel speed restrictions reduce risk of collision-related mortality for North Atlantic right whales. Ecosphere 4(4):1–16.

Continental Shelf Associates, Inc. 1997. Characterization and Trends of Recreational and Commercial Fishing from the Florida Panhandle. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. USGS/BRD/CR--1997-0001 and OCS Study MMS 97-0020. 336 pp.

Continental Shelf Associates, Inc. 2002. Deepwater Program: Bluewater Fishing and OCS activity, Interactions Between the Fishing and Petroleum Industries in Deepwaters of the Gulf of Mexico. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2002-078. 272 pp.

Continental Shelf Associates, Inc. 2004. Final Report: Gulf of Mexico Comprehensive Synthetic Based Muds Monitoring Program. 3 volumes.

Continental Shelf Associates, Inc. 2006. Effects of Oil and Gas Exploration and Development at Selected Continental Slope Sites in the Gulf of Mexico. Volume II: Technical report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2006-045. 595 pp.

Cordes, E., M.P. McGinley, E.L. Podowski, E.L. Becker, S. Lessard-Pilon, S.T. Viada, and C.R. Fisher. 2008. Coral communities of the deep Gulf of Mexico. Deep Sea Research Part I: Oceanographic Research Papers 55(6): 777-787.

Cruz-Kaegi, M.E. 1998. Latitudinal variations in biomass and metabolism of benthic infaunal communities. Ph.D. Dissertation, Texas A&M University, College Station, TX.

Davis, R.W., W.E. Evans, and B. Würsig. 2000. Cetaceans, Sea Turtles, and Seabirds in the Northern Gulf of Mexico: Distribution, Abundance and Habitat Associations. Volume II: Technical Report. U.S. Geological Survey, Biological Resources Division, USGS/BRD/CR--1999-0006 and U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2000-003. 346 pp.

DeGuise, S., M. Levin, E. Gebhard, L. Jasperse, L.B. Hart, C.R. Smith, S. Venn-Watson, F.I. Townsend, R.S. Wells, B.C. Balmer, E.S. Zolman, T.K. Rowles, and L.H. Schwacke. 2017. Changes in immune functions in bottlenose dolphins in the northern Gulf of Mexico associated with the *Deepwater Horizon* oil spill. Endangered Species Research 33: 291-303.

Demopoulos, A.W.J., J.R. Bourque, E. Cordes, and K.M. Stamler. 2016. Impacts of the *Deepwater Horizon* oil spill on deep-sea coral-associated sediment communities. Marine Ecology Progress Series 561(51-68).

Demopoulos, A.W.J., S.W. Ross, C.A. Kellogg, C.L. Morrison, M.S. Nizinski, N.G. Prouty, J.R. Borque, J.P. Galkiewicz, M.A. Gray, M.J. Springmann, D.K. Coykendall, A. Miller, M. Rhode, A.M. Quattrini, C.L. Ames, S. Brooke, J. McClain-Counts, E.B. Roark, N.A. Buster, R.M. Phillips, and J. Frometa. 2017. Deepwater Program: Lophelia II: Continuing Ecological Research on Deep-Sea Corals and Deep-Reef Habitats in the Gulf of Mexico. U.S. Geological Survey Open-File Report 2017-1139. 269 pp.

Dias, L.A., J. Litz, L. Garrison, A. Martinez, K. Barry, and T. Speakman. 2017. Exposure of cetaceans to petroleum products following the *Deepwater Horizon* oil spill in the Gulf of Mexico. Endangered Species Research 33: 119-125.

Ditty, J.G. 1986. Ichthyoplankton in neritic waters of the northern Gulf of Mexico off Louisiana: Composition, relative abundance, and seasonality. Fishery Bulletin 84(4): 935-946.

Ditty, J.G., G.G. Zieske, and R.F. Shaw. 1988. Seasonality and depth distribution of larval fishes in the northern Gulf of Mexico above 26°00'N. Fishery Bulletin 86(4): 811-823.

Eastern Research Group, Inc. 2014. Assessing the Impacts of the *Deepwater Horizon* Oil Spill on Tourism in the Gulf of Mexico Region. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study BOEM 2014-661.

Efroymson, R.A., W.H. Rose, S. Nemeth, and G.W. Sutter II. 2001. Ecological Risk Assessment Framework for Low Altitude Overflights by Fixed-Wing and Rotary-Wing Military Aircraft. Oak Ridge National Lab, Oak Ridge, TN. ONL/TM-2000/289. 116 pp.

Fertl, D., A.J. Schiro, G.T. Regan, C.A. Beck, and N. Adimey. 2005. Manatee occurrence in the northern Gulf of Mexico, West of Florida. Gulf and Caribbean Research 17(1): 69-94.

Fisher, C.R., P.Y. Hsing, C.L. Kaiser, D.R. Yoerger, H.H. Roberts, W.W. Shedd, E.E. Cordes, T.M. Shank, S.P. Berlet, M.G. Saunders, E.A. Larcom, and J.M. Brooks. 2014a. Footprint of *Deepwater Horizon* blowout impact to deep-water coral communities. Proceedings of the National Academy of Sciences USA 111(32): 11744-11749.

Fisher, C.R., A.W.J. Demopoulos, E.E. Cordes, I.B. Baums, H.K. White, and J.R. Borque. 2014b. Coral communities as indicators of ecosystem-level impacts of the *Deepwater Horizon* spill. BioScience 64: 796-807.

Florida Fish and Wildlife Conservation Commission. nd. Florida Salt Marsh Vole, *Microtus pennsylvanicus dekecampbelli*. https://myfwc.com/wildlifehabitats/profiles/mammals/land/florida-salt-marsh-vole/ Florida Fish and Wildlife Conservation Commission. 2016. Florida's endangered and threatened species. http://myfwc.com/media/1515251/Threatened_Endangered_Species.pdf

Florida Fish and Wildlife Conservation Commission. 2017a. Loggerhead nesting in Florida. http://myfwc.com/research/wildlife/sea-turtles/nesting/loggerhead/

Florida Fish and Wildlife Conservation Commission. 2017b. Green turtle nesting in Florida. http://myfwc.com/research/wildlife/sea-turtles/nesting/green-turtle/

Florida Fish and Wildlife Conservation Commission. 2017c. Leatherback nesting in Florida. http://myfwc.com/research/wildlife/sea-turtles/nesting/leatherback/

Florida Fish and Wildlife Conservation Commission. 2018. Listed Invertebrates. http://myfwc.com/wildlifehabitats/imperiled/profiles/invertebrates/

Flower Garden Banks National Marine Sanctuary. 2018. Manta Catalog. https://flowergarden.noaa.gov/science/mantacatalog.html

Foley, K.A., C. Caldow, and E.L. Hickerson. 2007. First confirmed record of Nassau Grouper *Epinephelus striatus* (Pisces: Serranidae) in the Flower Garden Banks National Marine Sanctuary. Gulf of Mexico Science 25(2): 162-165.

Fonseca, M., G.A. Piniak, and N. Cosentino-Manning. 2017. Susceptibility of seagrass to oil spills: A case study with eelgrass, Zostera marina in San Francisco Bay, USA. Marine Pollution Bulletin 115(1-2): 29-38.

Fox, D.A., J.E. Hightower, and F.M. Parauka. 2000. Gulf sturgeon spawning migration and habitat in the Choctawhatchee River System, Alabama–Florida. Transactions of the American Fisheries Society 129(3): 811-826.

Fritts, T.H. and R.P. Reynolds. 1981. Pilot Study of the Marine Mammals, Birds, and Turtles in OCS Areas of the Gulf of Mexico. U.S. Department of the Interior, Fish and Wildlife Service, Biological Services Program. FWS/OBS 81/36.

Fugro Geoservices, Inc. 1996. Regional Geohazards Assessment, Blocks 391-393, 435-437, 479-481, 523-525, and 567-569, Mississippi Canyon Area, Gulf of Mexico. Report No. 0201-3000. Dated 12/27/1996.

Fugro Geoservices, Inc. 2007. Archaeological Assessment, Proposed Anchor Locations, Block 393, Mississippi Canyon Area, Gulf of Mexico. Report No. 2407-1083.

Fugro Geoservices, Inc. 2009a. Shallow Drilling Hazards and Archaeological Assessment, Mississippi Canyon Blocks 347, 348, 391, 392, and Vicinity (OCS-G 28002, -19939, -26252, and -26253) Gulf of Mexico, Report No. 27.2008-5022. Dated 5/6/2009.

Fugro Geoservices, Inc. 2009b. Archaeological Assessment, ROV Survey, Sonar Contact Investigation, Block 391, Mississippi Canyon Area, Gulf of Mexico. Report 2409-1112. Dated 7/13/2009.

Fugro Geoservices, Inc. 2009c. Archaeological Survey, Blocks 347-349, 391-393, and Portions of 346, 390, 434-436, Mississippi Canyon Area, Gulf of Mexico. Report No. 2408-5022. Dated 3/24/2009.

Gallaway, B.J. and G.S. Lewbel. 1982. The Ecology of Petroleum Platforms in the Northwestern Gulf of Mexico: a Community Profile. U.S. Fish and Wildlife Service, Biological Services Program and U.S. Department of the Interior, Bureau of Land Management. Washington, D.C. FWS/OBS-82/27 and Open File Report 82-03.

Gallaway, B.J., J.G. Cole, and R.G. Fechhelm. 2003. Selected Aspects of the Ecology of the Continental Slope Fauna of the Gulf of Mexico: A Synopsis of the Northern Gulf of Mexico Continental Slope Study, 1983-1988. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2003-072. 52 pp.

Gallaway, B.J., (ed.). 1988. Northern Gulf of Mexico Continental Slope Study, Final report: Year 4. Volume II: Synthesis report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 88-0053. 322 pp.

Geraci, J.R., and D.J. St. Aubin. 1990. Sea Mammals and Oil: Confronting the Risks. San Diego, CA, Academic Press. 282 pp.

Gibson, D., D.H. Catlin, K.L. Hunt, J.D. Fraser, S.M. Karpanty, M.J. Friedrich, M.K. Bimbi, J.B. Cohen, and S.B. Maddock. 2017. Evaluating the impact of man-made distasters on imperiled species: Piping plovers and the *Deepwater Horizon* oil spill. Biological Conservation 2012: 48-62.

Gitschlag, G., B. Herczeg, and T. Barcack. 1997. Observations of sea turtles and other marine life at the explosive removal of offshore oil and gas structures in the Gulf of Mexico. Gulf Research Reports 9(4): 247-262.

Gulf of Mexico Fishery Management Council. 2005. Generic Amendment Number 3 for addressing Essential Fish Habitat Requirements, Habitat Areas of Particular Concern, and adverse effects of fishing in the following Fishery Management Plans of the Gulf of Mexico: Shrimp fishery of the Gulf of Mexico, United States waters red drum fishery of the Gulf of Mexico, reef fish fishery of the Gulf of Mexico coastal migratory pelagic resources (mackerels) in the Gulf of Mexico and South Atlantic, stone crab fishery of the Gulf of Mexico, spiny lobster in the Gulf of Mexico and South Atlantic, coral and coral reefs of the Gulf of Mexico. Tampa, FL.

Gulf of Mexico Fishery Management Council. 2010. 5-Year Review of the Final Generic Amendment Number 3 Addressing Essential Fish Habitat Requirements, Habitat Areas of Particular Concern, and Adverse Effects of Fishing in the Fishery Management Plans of the Gulf of Mexico. https://gulfcouncil.org/wp-content/uploads/EFH-5-Year-Review-Final-10-10.pdf

Hamdan, L.J., J.L. Salerno, A. Reed, S.B. Joye, and M. Damour. 2018. The impact of the *Deepwater Horizon* blowout on historic shipwreck-associated sediment microbiomes in the northern Gulf of Mexico. Scientific Reports 8: 9057.

Haney, C.J., H.J. Geiger, and J.W. Short. 2014. Bird mortality from the *Deepwater Horizon* oil spill. Exposure probability in the Gulf of Mexico. Marine Ecology Progress Series 513: 225-237.

Hannam, M.L., S.D. Bamber, A.J. Moody, T.S. Galloway, and M.B. Jones. 2010. Immunotoxicity and oxidative stress in the Arctic scallop *Chlamys islandica*: Effects of acute oil exposure. Ecotoxicology and Environmental Safety 73: 1440-1448.

Harvell, C.D., K. Kim, J.M. Burkholder, R.R. Colwell, P.R. Epstein, D.J. Grimes, E.E. Hoffmann, E.K. Lipp, A.D.M.E. Osterhaus, R.M. Overstreet, J.W. Porter, G.W. Smith, and G.R. Vasta. 1999. Emerging marine diseases: climate links and anthropogenic factors. Science 285(5433): 1505-1510.

Hayes, S.A., E. Josephson, K. Maze-Foley, P.E. Rosel, B. Byrd, S. Chavez-Rosales, L.P. Garrison, J. Hatch, A. Henry, S.C. Horstman, J. Litz, M.C. Lyssikatos, K.D. Mullin, C. Orphanides, R.M. Pace, D.L. Palka, J. Powell, and F.W. Wenzel. 2019. US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2018. U.S. Department of Commerce. NOAA Technical Memorandum NMFS-NE-258.

Hazel, J., I. R. Lawler, H. Marsh, and S. Robson. 2007. Vessel speed increases collision risk for the green turtle *Chelonia mydas*. Endangered Species Research 3:105-113.

Hazen, T.C., E.A. Dubinsky, T.Z. DeSantis, G.L. Andersen, Y.M. Piceno, N. Singh, J.K. Jansson, A. Probst, S.E. Borglin, J.L. Fortney, W.T. Stringfellow, M. Bill, M.E. Conrad, L.M. Tom, K.L. Chavarria, T.R. Alusi, R. Lamendella, D.C. Joyner, C. Spier, J. Baelum, M. Auer, M.L. Zemla, R. Chakraborty, E.L. Sonnenthal, P. D'Haeseleer, H.Y. Holman, S. Osman, Z. Lu, J.D. Van Nostrand, Y. Deng, J. Zhou, and O.U. Mason. 2010. Deep-sea oil plume enriches indigenous oil-degrading bacteria. Science 330(6001): 204-208.

Hess, N.A., and C.A. Ribic. 2000. Seabird ecology, pp 275-315. In: R.W. Davis, W.E. Evans and B. Würsig, Cetaceans, Sea Turtles, and Seabirds in the Northern Gulf of Mexico: Distribution, Abundance and Habitat Associations. Volume II: Technical report. U.S. Geological Survey, Biological Resources Division, USGS/BRD/CR 1999 0006 and U.S. Department of the Interior, Minerals Management Service, New Orleans, LA.

Higashi, G.R. 1994. Ten years of fish aggregating device (FAD) design development in Hawaii. Bulletin of Marine Science 55(2-3): 651-666.

Hildebrand, J.A. 2004. Impacts of anthropogenic sound on cetaceans. Unpublished paper submitted to the International Whaling Commission Scientific Committee SC/56 E 13.

Hildebrand, J.A. 2005. Impacts of anthropogenic sound, pp. 101-124. In: J.E. Reynolds III, W.F. Perrin, R.R. Reeves, S. Montgomery and T.J. Ragen, (Eds.). Marine Mammal Research: Conservation Beyond Crisis. Johns Hopkins University Press, Baltimore, MD.

Hildebrand, J.A. 2009. Anthropogenic and natural sources of ambient noise in the ocean. Marine Ecology Progress Series 395: 5-20.Hildebrand, J.A., S. Baumann-Pickering, K.E. Frasier, J.S. Trickey, K.P. Merkens, S.M. Wiggins, M.A. McDonald, L.P. Garrison, D. Harris, T.A. Marques, and L. Thomas. 2015. Passive acoustic monitoring of beaked whale densities in the Gulf of Mexico. Scientific Reports 5(16343).

Hinwood, J.B., A.E. Potts, L.R. Dennis, J.M. Carey, H. Houridis, R.J. Bell, J.R. Thomson, P. Boudreau, and A.M. Ayling. 1994. Part 3: Drilling activities. In: Swan, J.M., Neff, J.M., Young, P.C. (Eds.), Environmental Implications of Offshore Oil and Gas Development in Australia; the Findings of an Independent Scientific Review. Australian Petroleum Exploration Association and Energy Research and Development Corporation. Sydney, Australia. pp. 124-206.

Holland, K.N. 1990. Horizontal and vertical movements of yellowfin and bigeye tuna associated with fish aggregating devices. Fishery Bulletin 88:493-507.

Hourigan, T.F., P. Etnoyer, and S.D. Cairns. 2017. The State of Deep-sea Coral and Sponge Ecosystems of the United States. U.S. Department of Commerce, National Oceanographic and Atmospheric Administration. NOAA Technical Memorandum NMFS OHC 4.

Hsing, P.-Y., B. Fu, E.A. Larcom, S.P. Berlet, T.M. Shank, A.F. Govindarajan, A.J. Lukasiewicz, P.M. Dixon, and C.R. Fisher. 2013. Evidence of lasting impact of the *Deepwater Horizon* oil spill on a deep Gulf of Mexico coral community. Elementa: Science of the Anthropocene 1(1): 000012.

Intergovernmental Panel on Climate Change. 2014. Climate Change 2014: Impacts, Adaptation and Vulnerability. http://www.ipcc.ch/report/ar5/wg2/

International Tanker Owners Pollution Federation Limited. 2018. Weathering. https://www.itopf.org/knowledge-resources/documents-guides/fate-of-oil-spills/weathering/

International Tanker Owners Pollution Federation Limited. 2014. Effects of Oil Pollution on Fisheries and Mariculture. 12 pp.

Jasny, M., J. Reynolds, C. Horowitz, and A. Wetzler. 2005. Sounding the Depths II: The Rising Toll of Sonar, Shipping and Industrial Ocean Noise on Marine Life. Natural Resources Defense Council, New York, NY. vii + 76 pp.

Jensen, A. S. and G. K. Silber. 2004. Large whale ship strike database. Office of Protected Resources, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, NOAA Technical Memorandum NMFSOPR-25, Silver Spring, Maryland.

Ji, Z.-G., W.R. Johnson, C.F. Marshall, and E.M. Lear. 2004. Oil-Spill Risk Analysis: Contingency Planning Statistics for Gulf of Mexico OCS Activities. Minerals Management Service. U.S. Department of the Interior, Gulf of Mexico OCS Region. New Orleans, LA. OCS Report MMS 2004-026. 53 pp.

Jochens, A., D.C. Biggs, D. Benoit-Bird, D. Engelhaupt, J. Gordon, C. Hu, N. Jaquet, M. Johnson, R.R. Leben, B. Mate, P. Miller, J.G. Ortega-Ortiz, A. Thode, P. Tyack, and B. Würsig. 2008. Sperm whale seismic study in the Gulf of Mexico: Synthesis report. Minerals Management Service. U.S. Department of the Interior, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2008-006. 323 pp.

Joye, S.B., I.R. MacDonald, I. Leifer, and V. Asper. 2011. Magnitude and oxidation potential of hydrocarbon gases released from the BP oil well blowout. Nature Geoscience 4: 160-164.

Keithly, W.R., and K.J. Roberts. 2017. Commercial and recreational fisheries of the Gulf of Mexico, pp. 1039-1188. In: C.H. Ward, Habitats and Biota of the Gulf of Mexico: Before the *Deepwater Horizon* Oil Spill. Volume 2: Fish Resources, Fisheries, Sea Turtles, Avian Resources, Marine Mammals, Diseases and Mortalities. Springer, New York.

Kellar, N.M., T.R. Speakman, C.R. Smith, S.M. Lane, B.C. Balmer, M.L. Trego, K.N. Catelani, M.N. Robbins, C.D. Allen, R.S. Wells, E.S. Zolman, T.K. Rowles, and L.H. Schwacke. 2017. Low reproductive success rates of common bottlenose dolphins *Tursiops truncatus* in the northern Gulf of Mexico following the *Deepwater Horizon* disaster (2010-2015). Endangered Species Research 33: 143-158.

Kennicutt, M.C. 2000. Chemical oceanography, pp. 123-139. In: Continental Shelf Associates, Inc. Deepwater Program: Gulf of Mexico Deepwater Information Resources Data Search and Literature Synthesis. Volume I: Narrative report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2000-049. 340 pp.

Kessler, J.D., D.L. Valentine, M.C. Redmond, M. Du, E.W. Chan, S.D. Mendes, E.W. Quiroz, C.J. Villanueva, S.S. Shusta, L.M. Werra, S.A. Yvon-Lewis, and T.C. Weber. 2011. A persistent oxygen anomaly reveals the fate of spilled methane in the deep Gulf of Mexico. Science 331: 312-315.

Ketten, D.R., and S.M. Bartol. 2005. Functional Measures of Sea Turtle Hearing, Woods Hole Oceanographic Institution: ONR Award No: N00014-02-0510.

Kujawinski, E.B., M.C. Kido Soule, D.L. Valentine, A.K. Boysen, K. Longnecker, and M.C. Redmond. 2011. Fate of dispersants associated with the *Deepwater Horizon* oil spill. Environmental Science and Technology 45(4): 1298-1306.

Kyhn, L.A., S. Sveegaard, and J. Tougaard. 2014. Underwater noise emissions from a drillship in the Arctic. Marine Pollution Bulletin 86: 424-433.

Ladich, F., and R.R. Fay. 2013. Auditory evoked potential audiometry in fish. Reviews in Fish Biology and Fisheries 23(3): 317-364.

Laist, D. W., A. R. Knowlton, J. G. Mead, A. S. Collet, and M. Podesta. 2001. Collisions between ships and whales. Marine Mammal Science 17(1):35-75.

Lane, S.M., C.R. Smith, J. Mitchell, B.C. Balmer, K.P. Barry, T. McDonald, C.S. Mori, P.E. Rosel, T.K. Rowles, T.R. Speakman, F.I. Townsend, M.C. Tumlin, R.S. Wells, E.S. Zolman, and L.H. Schwacke. 2015. Reproductive outcome and survival of common bottlenose dolphins sampled in Barataria Bay, Louisiana, USA, following the *Deepwater Horizon* oil spill. Proceedings of the Royal Society B: Biological Sciences 282:20151944.

Lauritsen, A.M., P.M. Dixon, D. Cacela, B. Brost, R. Hardy, S.L. MacPherson, A. Meylan, B.P. Wallace, and B. Witherington. 2017. Impact of the *Deepwater Horizon* oil spill on loggerhead turtle Caretta caretta nest densities in northwest Florida. Endangered Species Research 33: 83-93.

Lee, R.F., M. Koster, and G.A. Paffenhofer. 2012. Ingestion and defecation of dispersed oil droplets by pelagic tunicates. Journal of Plankton Research 34: 1058-1063.

Lee, R.F. 2013. Ingestion and Effects of Dispersed Oil on Marine Zooplankton. Anchorage, Alaska., Prepared for: Prince William Sound Regional Citizens' Advisory Council (PWSRCAC). 21 pp.

Lee, W.Y., K. Winters, and J.A.C. Nicol. 1978. The biological effects of the water-soluble fractions of a No. 2 fuel oil on the planktonic shrimp, *Lucifer faxoni*. Environmental Pollution 15: 167-183.

Lennuk, L., J. Kotta, K. Taits, and K. Teeveer. 2015. The short-term effects of crude oil on the survival of different size-classes of cladoceran *Daphnia magna* (Straus, 1820). Oceanologia 57(1): 71-77.

Lin, Q., I.A. Mendelssohn, S.A. Graham, A. Hou, J.W. Fleeger, and D.R. Deis. 2016. Response of salt marshes to oiling from the *Deepwater Horizon* spill: Implications for plant growth, soil-surface erosion, and shoreline stability. Science of the Total Environment 557-558: 369-377.

Linden, O. 1976. Effects of oil on the reproduction of the amphipod *Gammarus oceanicus*. Ambio 5: 36-37.

Liu, J., H.P. Bacosa, and Z. Liu. 2017. Potential environmental factors affecting oil-degrading bacterial populations in deep and surface waters of the northern Gulf of Mexico. Frontiers in Microbiology 7:2131.

Lohoefener, R., W. Hoggard, K.D. Mullin, C. Roden, and C. Rogers. 1990. Association of Sea Turtles with Petroleum Platforms in the North Central Gulf of Mexico. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 90-0025. 90 pp.

Lutcavage, M.E., P.L. Lutz, G.D. Bossart, and D.M. Hudson. 1995. Physiologic and clinicopathologic effects of crude oil on loggerhead sea turtles. Archives of Environmental Contaminaton and Toxicology 28(4):417-422.

Lutcavage, M.E., P. Plotkin, B. Witherington, and P.L. Lutz. 1997. Human impacts on sea turtle survival, pp. 387-409. In: P.L. Lutz and J.A. Musick (Eds.), The Biology of Sea Turtles. CRC Press, Boca Raton, FL.

MacDonald, I.R. 2002. Stability and Change in Gulf of Mexico Chemosynthetic Communities. Volume II: Technical Report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2002-036. 455 pp.

Main, C.E., H.A. Ruhl, D.O.B. Jones, A. Yool, B. Thornton, and D.J. Mayor. 2015. Hydrocarbon contamination affects deep-sea benthic oxygen uptake and microbial community composition. Deep Sea Research Part I: Oceanographic Research Papers 100: 79-87.

Marine Mammal Commission. 2011. Assessing the Long-term Effects of the BP *Deepwater Horizon* Oil Spill on Marine Mammals in the Gulf of Mexico: A statement of research needs. http://www.mmc.gov/wp-content/uploads/longterm_effects_bp_oilspil.pdf

Marshall, A., M.B. Bennett, G. Kodja, S. Hinojosa-Alvarez, F. Galvan-Magana, M. Harding, G. Stevens, and T. Kashiwagi. 2018. *Mobula birostris* (amended version of 2011 assessment). The IUCN Red List of Threatened Species. 2018: e.T198921A126669349. http://www.iucnredlist.org/details/198921/0.

McCauley, R. 1998. Radiated Underwater Noise Measured from the Drilling Rig Ocean General, Rig Tenders Pacific Ariki and Pacific Frontier, Fishing Vessel Reef Venture and Natural Sources in the Timor Sea, Northern Australia. Prepared for Shell Australia, Melbourne. 52 pp. http://cmst.curtin.edu.au/local/docs/pubs/1998-19.pdf

McDonald, T.L., F.E. Hornsby, T.R. Speakman, E.S. Zolman, K.D. Mullin, C. Sinclair, P.E. Rosel, L. Thomas, and L.H. Schwacke. 2017a. Survival, density, and abundance of common bottlenose dolphins in Barataria Bay (USA) following the *Deepwater Horizon* oil spill. Endangered Species Research 33: 193-209.

McDonald, T.L., B.A. Schroeder, B.A. Stacy, B.P. Wallace, L.A. Starcevich, J. Gorham, M.C. Tumlin, D. Cacela, M. Rissing, D.B. McLamb, E. Ruder, and B.E. Witherington. 2017b. Density and exposure of surface-pelagic juvenile sea turtles to *Deepwater Horizon* oil. Endangered Species Research 33: 69-82.

McKenna, M.F., D. Ross, S.M. Wiggins, and J.A. Hildebrand. 2012. Underwater radiated noise from modern commercial ships. Journal of the Acoustical Society of America 131: 92-103.

McLaughlin, K.E., and H.P. Kunc. 2015. Changes in the acoustic environment alter the foraging and sheltering behaviour of the cichlid *Amititlania nigrofasciata*. Behavioural Processes 116: 75-79.

Mendelssohn, I.A., G.L. Andersen, D.M. Baltx, R.H. Caffey, K.R. Carman, J.W. Fleeger, S.B. Joyce, Q. Lin, E. Maltby, E.B. Overton, and L.P. Rozas. 2012. Oil impacts on coastal wetlands: Implications for the Mississippi River delta ecosystem after the *Deepwater Horizon* oil spill. BioScience 62(6): 562-574.

Minerals Management Service. 2000. Gulf of Mexico Deepwater Operations and Activities: Environmental Assessment. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS EIS/EA MMS 2000-001.

Mississippi Natural Heritage Program. 2018. Natural Heritage Program online database. https://www.mdwfp.com/museum/seek-study/heritage-program/nhp-online-data/

Møhl, B., M. Wahlberg, and P.T. Madsen. 2003. The monopulsed nature of sperm whale clicks. Journal of the Acoustical Society of America 114(2): 1143-1154.

Montagna, P.A., J.G. Baguley, C. Cooksey, I. Hartwell, L.J. Hyde, J.L. Hyland, R.D. Kalke, L.M. Kracker, M. Reuscher, and A.C. Rhodes. 2013. Deep-sea benthic footprint of the *Deepwater Horizon* blowout. PLoS One 8(8): e70540.

Montagna, P.A., J.G. Baguley, C. Cooksey, and J.L. Hyland. 2016. Persistent impacts to the deep soft bottom benthos one year after the Deepwater Horizon event. Integrated Environmental Assessment and Management 13(2): 342-351.

Moore, S.F. and R.L. Dwyer. 1974. Effects of oil on marine organisms: a critical assessment of published data. Water Research 8: 819-827.

Morrow, J.V.J., J.P. Kirk, K.J. Killgore, H. Rugillio, and C. Knight. 1998. Status and recovery of Gulf sturgeon in the Pearl River system, Louisiana-Mississippi. North American Journal of Fisheries Management 18: 798-808.

Mullin, K.D., W. Hoggard, C. Roden, R. Lohoefener, C. Rogers, and B. Taggart. 1991. Cetaceans on the Upper Continental Slope in the North-central Gulf of Mexico. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 91-0027. 108 pp.

Mullin, K.D. 2007. Abundance of Cetaceans in the Oceanic Gulf of Mexico based on 2003-2004 ship surveys. National Marine Fisheries Service, Southeast Fisheries Science Center. Pascagoula, MS. 26 pp. http://aquaticcommons.org/15062/1/CSAR15736.pdf

National Marine Fisheries Service. 2007. Endangered Species Act, Section 7 Consultation – Biological Opinion. Gulf of Mexico Oil and Gas Activities: Five Year Leasing Plan for Western and Central Planning Areas 2007-2012. U.S. Department of Commerce, National Oceanic and Atmospheric Administration. St. Petersburg, FL. http://www.nmfs.noaa.gov/ocs/mafac/meetings/2010_06/docs/mms_02611_leases_2007_2012.pdf

National Marine Fisheries Service and U.S. Fish and Wildlife Service. 2008. Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle (*Caretta caretta*), Second Revision. https://www.fisheries.noaa.gov/resource/document/recovery-plan-northwest-atlantic-population-loggerhead-sea-turtle-caretta-caretta

National Marine Fisheries Service. 2009a. Sperm Whale (*Physeter macrocephalus*) 5-Year Review: Summary and Evaluation. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Sustainable Fisheries, Highly Migratory Species Management Division. Silver Spring, MD. https://repository.library.noaa.gov/view/noaa/17032

National Marine Fisheries Service. 2009b. Smalltooth Sawfish Recovery Plan (*Pristis pectinata*). Prepared by the Smalltooth Sawfish Recovery Team for the National Marine Fisheries Service, Silver Spring, MD. 102 pp. https://repository.library.noaa.gov/view/noaa/15983

National Marine Fisheries Service. 2009c. Final Amendment 1 to the Consolidated Atlantic Highly Migratory Species Fishery Management Plan Essential Fish Habitat. Highly Migratory Species Management Division, Office of Sustainable Fisheries. Silver Spring, MD. http://pbadupws.nrc.gov/docs/ML1219/ML12195A241.pdf

National Marine Fisheries Service. 2010a. Final Recovery Plan for the Sperm Whale (*Physeter macrocephalus*). Silver Spring, MD. http://www.nmfs.noaa.gov/pr/pdfs/health/oil_impacts.pdf

National Marine Fisheries Service. 2010b. *Deepwater Horizon*/BP oil spill: Size and Percent Coverage of Fishing Area Closures due to BP oil spill. http://sero.nmfs.noaa.gov/deepwater_horizon/size_percent_closure/index.html

National Marine Fisheries Service. 2011. Species of Concern: Atlantic bluefin tuna, *Thunnus thynnus*. http://www.nmfs.noaa.gov/pr/pdfs/species/bluefintuna_detailed.pdf

National Marine Fisheries Service, U.S. Fish and Wildlife Service and Secretaría de Medio Ambiente y Recursos Naturales. 2011. Bi-National Recovery Plan for the Kemp's Ridley Sea Turtle (*Lepidochelys kempii*), Second Revision. http://www.nmfs.noaa.gov/pr/pdfs/recovery/kempsridley_revision2.pdf

National Marine Fisheries Service. 2014a. Sea Turtles, Dolphins, and Whales and the Gulf of Mexico Oil Spill. http://www.nmfs.noaa.gov/pr/health/oilspill/gulf2010.htm

National Marine Fisheries Service. 2014b. Loggerhead Sea Turtle Critical Habitat in the Northwest Atlantic Ocean. http://www.nmfs.noaa.gov/pr/species/turtles/criticalhabitat_loggerhead.htm

National Marine Fisheries Service. 2014c. Gulf sturgeon (*Acipenser oxyrinchus desotoi*). http://www.nmfs.noaa.gov/pr/species/fish/gulfsturgeon.htm

National Marine Fisheries Service. 2015. Endangered Species Act Section 7 Consultation Biological Opinion for the Virginia Offshore Wind Technology Advancement Project. NER-2015-12128

National Marine Fisheries Service. 2016a. Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing: Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts. NOAA Technical Memorandum NMFS-OPR-55.

National Marine Fisheries Service. 2016b. Marine Mammal Stock Assessment Reports (SARs) by Species/Stock. http://www.nmfs.noaa.gov/pr/sars/species.htm

National Marine Fisheries Service. 2018a. Oceanic Whitetip Shark, *Carcharhinus longimanus*. https://www.fisheries.noaa.gov/species/oceanic-whitetip-shark

National Marine Fisheries Service. 2018b. Revisions to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts. NOAA Technical Memorandum NMFS OPR-59.

National Marine Fisheries Service. 2018c. Smalltooth Sawfish (*Pristis pectinata*) 5-Year Review: Summary and Evaluation of United States Distinct Population Segment of Smalltooth Sawfish. Southeast Regional Office, St. Petersburg, Florida. 63 pp. https://repository.library.noaa.gov/view/noaa/19253/Print

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. https://www.fisheries.noaa.gov/resource/document/biological-opinion-federally-regulated-oil-and-gas-program-activities-gulf-mexico

National Oceanic and Atmospheric Administration. 2010. Oil and Sea Turtles. Biology, Planning, and Response. http://response.restoration.noaa.gov/sites/default/files/Oil_Sea_Turtles.pdf

National Oceanic and Atmospheric Administration. 2011a. Joint Analysis Group. *Deepwater Horizon* oil spill: Review of Preliminary Data to Examine Subsurface Oil in the Vicinity of MC252#1, May 19 to June 19, 2010. U.S. Department of Commerce, National Ocean Service. Silver Spring, MD. NOAA Technical Report NOS OR&R 25. http://service.ncddc.noaa.gov/rdn/www/media/documents/activities/jag-reports/NTR-NOS-ORR-25-082011.pdf

National Oceanic and Atmospheric Administration. 2011b. Joint Analysis Group, *Deepwater Horizon* Oil Spill: Review of R/V Brooks McCall Data to Examine Subsurface Oil. U.S. Department of Commerce, National Ocean Service. Silver Spring, MD. NOAA Technical Report NOS OR&R 24. http://service.ncddc.noaa.gov/rdn/www/media/documents/activities/jag-reports/NTR-NOS-ORR-24-062011.pdf

National Oceanic and Atmospheric Administration. 2011c. Joint Analysis Group, *Deepwater Horizon* Oil Spill: Review of Preliminary Data to Examine Oxygen Levels in the Vicinity of MC252#1 May 8 to August 9, 2010. U.S. Department of Commerce, National Ocean Service. Silver Spring, MD. NOAA Technical Report NOS OR&R 26. http://service.ncddc.noaa.gov/rdn/www/media/documents/activities/jag-reports/NTR-NOS-ORR-26-082011.pdf

National Oceanic and Atmospheric Administration. 2014. Flower Garden Banks National Marine Sanctuary. Cnidarian Species. http://flowergarden.noaa.gov/about/cnidarianlist.html

National Oceanic and Atmospheric Administration. 2016a. Cetacean Unusual Mortality Event in Northern Gulf of Mexico (2010-2014). http://www.nmfs.noaa.gov/pr/health/mmume/cetacean_gulfofmexico.htm

National Oceanic and Atmospheric Administration. 2016b. ADIOS 2 (Automated Data Inquiry for Oil Spills). http://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/response-tools/downloading-installing-and-running-adios.html

National Oceanic and Atmospheric Administration. 2016c. *Deepwater Horizon* Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement. http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan/

National Oceanic and Atmospheric Administration. 2017. Oil Types. Office of Response and Restoration. http://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/oil-types.html

National Oceanic and Atmospheric Administration. 2019. Small Diesel Spills (500 - 5,000 gallons). Office of Response and Restoration. https://response.restoration.noaa.gov/sites/default/files/Small-Diesel-Spills.pdf

National Oceanic and Atmospheric Administration. 2018a. Giant Manta Ray - Manta birostris. https://www.fisheries.noaa.gov/species/giant-manta-ray

National Oceanic and Atmospheric Administration. 2018b. Gulf Sturgeon: About the species. https://www.fisheries.noaa.gov/species/gulf-sturgeon#overview

National Oceanic and Atmospheric Administration. nd. Nassau Grouper, *Epinephelus striatus*. https://www.fisheries.noaa.gov/species/nassau-grouper

National Oceanic and Atmospheric Administration Fisheries West Coast Region. 2018. Interim Sound Threshold Guidance. http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/threshold_guidance.html

NOAA Fisheries (National Marine Fisheries Service). nd. Smalltooth Sawfish, *Pristis pectinata*. https://www.fisheries.noaa.gov/species/smalltooth-sawfish.

National Research Council. 1983. Drilling Discharges in the Marine Environment. Washington, DC. 180 pp.

National Research Council. 2003a. Oil in the Sea III: Inputs, Fates, and Effects. Washington, DC. 182 pp. + app.

National Research Council. 2003b. Ocean Noise and Marine Mammals. Washington, DC. 204 pp.

National Wildlife Federation. 2016a. *Deepwater Horizon's Impact on Wildlife*. http://nwf.org/oilspill/

National Wildlife Federation. 2016b. Wildlife Library: Whooping Crane. https://www.nwf.org/Educational-Resources/Wildlife-Guide/Birds/Whooping-Crane

Natural Resources Defense Council. 2014. A Petition to List the Gulf of Mexico Bryde's Whale (*Balaenoptera edeni*) as Endangered under the Endangered Species Act. https://www.nrdc.org/sites/default/files/wil_14091701a.pdf

Nedelec, S.L., A.N. Radford, L. Pearl, B. Nedelec, M.I. McCormick, M.G. Meekan, and S.D. Simpson. 2017. Motorboat noise impacts parental behaviour and offspring survival in a reef fish. Proceedings of the Royal Society B: Biological Sciences 284(1856): p20170143.

Nedwell, J.R., K. Needham, and B. Edwards. 2001. Report on Measurements of Underwater Noise from the Jack Bates Drill Rig. Report No. 462 R 0202. Subacoustech Ltd., Southhampton, UK. 49 pp.

Nedwell, J.R., and D. Howell. 2004. A Review of Offshore Windfarm Related Underwater Noise Sources. Report No. 544 R 0308, 0308. Subacoustech Ltd., Southampton, UK. 63 pp.

Neff, J.M. 1987. Biological effects of drilling fluids, drill cuttings and produced waters, pp 469-538. In: D.F. Boesch and N.N. Rabalais (Eds.), Long Term Effects of Offshore Oil and Gas Development. Elsevier Applied Science Publishers, London, UK.

Neff, J.M., S. McKelvie, and R.C. Ayers. 2000. Environmental impacts of synthetic based drilling fluids. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2000-064. 121 pp.

Neff, J.M., A.D. Hart, J.P. Ray, J.M. Limia, and T.W. Purcell (2005). An Assessment of Seabed Impacts of Synthetic Based Drilling-Mud Cuttings in the Gulf of Mexico. 2005 SPE/EPA/DOE Exploration and Production Environmental Conference, 7-9 March 2005, Galveston, TX. SPE 94086.

NOAA Fisheries (National Marine Fisheries Service). nd. Smalltooth Sawfish, *Pristis pectinata*. https://www.fisheries.noaa.gov/species/smalltooth-sawfish

Nowlin, W.D.J., A.E. Jochens, S.F. DiMarco, R.O. Reid, and M.K. Howard. 2001. Deepwater Physical Oceanography Reanalysis and Synthesis of Historical Data: Synthesis Report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2001-064. 514 pp.

Oceaneering. 2018a. Hazard Survey Injector East (IE) Drill Center Block 392 Mississippi Canyon Areas. OII Doc. No. 196418-OII-RPT-HRC-02.

Oceaneering. 2018b. Hazard Survey Injector West (IW) Drill Center Block 391 Mississippi Canyon Areas. OII Doc. No. 196418-OII-RPT-HRC-01.

Operational Science Advisory Team. 2010. Summary report for sub-surface and sub sea oil and dispersant detection: Sampling and monitoring. Prepared for Paul F. Zukunft, U.S. Coast Guard Federal on Scene Coordinator, *Deepwater Horizon* MC252. http://www.restorethegulf.gov/sites/default/files/documents/pdf/OSAT_Report_FINAL_17DEC.pdf

Oxford Economics. 2010. Potential impact of the Gulf oil spill on tourism. Report prepared for the U.S. Travel Association. http://www.mississippiriverdelta.org/blog/files/2010/10/Gulf_Oil_Spill_Analysis_Oxford_Economics_710.pdf

Ozhan, K., M.L. Parsons, and S. Bargu. 2014. How were phytoplankton affected by the *Deepwater Horizon* oil spill? Bioscience 64: 829-836.

Peake, D.E. 1996. Bird surveys, pp. 271 304. In: R.W. Davis and G.S. Fargion (eds.), Distribution and Abundance of Cetaceans in the North Central and Western Gulf of Mexico, Final report. Volume II: Technical report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region New Orleans, LA. OCS Study MMS 96-0027. 356 pp.

Picciulin, M., L. Sebastianutto, A. Codarin, A. Farina, and E.A. Ferrero. 2010. In situ behavioural responses to boat noise exposure of *Gobius cruentatus* (Gmelin, 1789; fam. Gobiidae) and *Chromis chromis* (Linnaeus, 1758; fam. Pomacentridae) living in a Marine Protected Area. Journal of Experimental Marine Biology and Ecology 386(1): 125-132.

Pine III, W.E, and S. Martell. 2009. Status of Gulf Sturgeon *Acipenser oxyrinchus desotoi* in the Gulf of Mexico. Unpublished report by University of Florida prepared for 2009 Gulf sturgeon annual working group meeting, Cedar Key, FL. 17-19 November 2009. 51 pp.

Popper, A.N., A.D. Hawkins, R.R. Fay, D. Mann, S. Bartol, T.J. Carlson, S. Coombs, W.T. Ellison, R.L. Gentry, M.B. Halvorsen, S. Lokkeborg, P. Rogers, B.L. Southall, D. Zeddies, and W.N. Tavolga. 2014. Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report. ASA S3/SC1.4 TR-2014 prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI. Springer, Cham, Switzerland. 73 pp.

Powers, S.P., F.J. Hernandez, R.H. Condon, J.M. Drymon, and C.M. Free. 2013. Novel pathways for injury from offshore oil spills: Direct, sublethal and indirect effects of the *Deepwater Horizon* oil spill on pelagic Sargassum communities. PLoS One 8(9): e74802.

Pritchard, P.C.H. 1997. Evolution, phylogeny, and current status, pp. 1-28. In: P.L. Lutz and J.A. Musick (Eds.), The Biology of Sea Turtles. CRC Press, Boca Raton, FL.

Prouty, N.G., C.R. Fisher, A.W.J. Demopoulos, and E.R.M. Druffel. 2016. Growth rates and ages of deep sea corals impacted by the *Deepwater Horizon* oil spill. Deep-Sea Research Part II: Topical Studies in Oceanography 129: 196-212.

Radford, A.N., E. Kerridge, and S.D. Simpson. 2014. Acoustic communication in a noisy world: Can fish compete with anthropogenic noise? Behavioral Ecology 25: 1,022-1,030.

Rathbun, G.B. 1988. Fixed-wing airplane versus helicopter surveys of manatees. Marine Mammal Science 4(1): 71-75.

Relini, M., L.R. Orsi, and G. Relini. 1994. An offshore buoy as a FAD in the Mediterranean. Bulletin of Marine Science 55(2-3): 1099-1105.

Reşitoğlu, İ.A., K. Altinişik, and A. Keskin. 2015. The pollutant emissions from diesel-engine vehicles and exhaust aftertreatment systems. Clean Technologies and Environmental Policy 17(1): 15-27.

Reuscher, M.G., J.G. Baguley, N. Conrad-Forrest, C. Cooksey, J.L. Hyland, C. Lewis, P.A. Montagna, R.W. Ricker, M. Rohal, and T. Washburn. 2017. Temporal patterns of *Deepwater Horizon* impacts on the benthic infauna of the northern Gulf of Mexico continental slope. PLoS One 12(6): e0179923.

Richards, W.J., T. Leming, M.F. McGowan, J.T. Lamkin, and S. Kelley-Farga. 1989. Distribution of fish larvae in relation to hydrographic features of the Loop Current boundary in the Gulf of Mexico. ICES Marine Science Symposia 191: 169-176.

Richards, W.J., M.F. McGowan, T. Leming, J.T. Lamkin, and S. Kelley-Farga. 1993. Larval fish assemblages at the Loop Current boundary in the Gulf of Mexico. Bulletin of Marine Science 53(2): 475-537.

Richardson, W.J., C.R. Greene Jr., C.I. Malme, and D.H. Thomson. 1995. Marine Mammals and Noise. San Diego, CA, Academic Press. 576 pp.

Rigby, C.L., Barreto, R., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Herman, K., Jabado, R.W., Liu, K.M., Marshall, A., Pacoureau, N., Romanov, E., Sherley, R.B. & Winker, H. 2019. *Carcharhinus longimanus*. The IUCN Red List of Threatened Species 2019: e.T39374A2911619. https://www.iucnredlist.org/species/39374/2911619

Rodgers, J.A. and S.T. Schwikert. 2002. Buffer-zone distances to protect foraging and loafing waterbirds from disturbance by personal watercraft and outboard-powered boats. Conservation Biology 16(1): 216-224.

Ronconi, R.A., K.A. Allard, and P.D. Taylor. 2015. Bird interactions with offshore oil and gas platforms: Review of impacts and monitoring techniques. Journal of Environmental Management 147: 34-45.

Rosel, P.E., P. Corkeron, L. Engleby, D. Epperson, K.D. Mullin, M.S. Soldevilla, and B.L. Taylor. 2016. Status Review of Bryde's Whales (Balaenoptera edeni) in the Gulf of Mexico under the Endangered Species Act. National Oceanic and Atmospheric Administration. NOAA Technical Memorandum NMFS-SEFSC-692.

Ross, S.W., A.W.J. Demopoulos, C.A. Kellogg, C.L. Morrison, M.S. Nizinski, C.L. Ames, T.L. Casazza, D. Gualtieri, K. Kovacs, J.P. McClain, A.M. Quattrini, A.Y. Roa-Varón, and A.D. Thaler. 2012. Deepwater Program: Studies of Gulf of Mexico lower continental slope communities related to chemosynthetic and hard substrate habitats. U.S. Department of the Interior, U.S. Geological Survey. U.S. Geological Survey Open-File Report 2012-1032.

Rowe, G.T., and M.C. Kennicutt. 2009. Northern Gulf of Mexico Continental Slope Habitats and Benthic Ecology Study. Final Report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2009-039. 419 pp.

Rudd, M.B., R.N.M. Ahrens, W.E. Pine III, and S.K. Bolden. 2014. Empirical spatially explicit natural mortality and movement rate estimates for the threatened Gulf Sturgeon (*Acipenser oxyrinchus desotoi*). Canadian Journal of Fisheries and Aquatic Sciences 71: 1407-1417.

Russell, R.W. 2005. Interactions Between Migrating Birds and Offshore Oil and Gas Platforms in the Northern Gulf of Mexico: Final Report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2005-009. 325 pp.

Sadovy, Y. 1997. The case of the disappearing grouper; *Epinephelus striatus*, the Nassau grouper in the Caribbean and western Atlantic. Proceedings of the Gulf and Caribbean Fisheries Institute 45: 5 22.

Salmon, M., and J. Wyneken. 1990. Do swimming loggerhead sea turtles (*Caretta caretta* L.) use light cues for offshore orientation? Marine and Freshwater Behaviour and Physiology 17(4): 233-246.

Samuel, Y., S.J. Morreale, C.W. Clark, C.H. Greene, and M.E. Richmond. 2005. Underwater, low-frequency noise in a coastal sea turtle habitat. Journal of the Acoustical Society of America 117(3): 1465 1472.

Schwacke, L.H., C.R. Smith, F.I. Townsend, R.S. Wells, L.B. Hart, B.C. Balmer, T.K. Collier, S. De Guise, M.M. Fry, L.J. Guillette, Jr., S.V. Lamb, S.M. Lane, W.E. McFee, N.J. Place, M.C. Tumlin, G.M. Ylitalo, E.S. Zolman, and T.K. Rowles. 2014a. Response to comment on health of common bottlenose dolphins (*Tursiops truncatus*) in Barataria Bay, Louisiana following the *Deepwater Horizon* oil spill. Environmental Science & Technology 48(7): 4,209-4,211.

Schwacke, L.H., C.R. Smith, F.I. Townsend, R.S. Wells, L.B. Hart, B.C. Balmer, T.K. Collier, S. De Guise, M.M. Fry, J.L.J. Guillette, and S.V. Lamb. 2014b. Health of common bottlenose dolphins (*Tursiops truncatus*) in Barataria Bay, Louisiana, following the *Deepwater Horizon* oil spill. Environmental Science Technology 48(1): 93-103.

Schwemmer, P., B. Mendel, N. Sonntag, V. Dierschke, and S. Garthe. 2011. Effects of ship traffic on seabirds in offshore waters: implications for marine conservation and spatial planning. Ecological Applications 21(5): 1851-1860.

Seitz, J.C. and G.R. Poulakis. 2006. Anthropogenic effects on the smalltooth sawfish (*Pristis pectinata*) in the United States. Marine Pollution Bulletin 52(11): 1533-1540.

Silliman, B.R., J. van de Koppel, M.W. McCoy, J. Diller, G.N. Kasozi, K. Earl, P.N. Adams, and A.R. Zimmerman. 2012. Degradation and resilience in Louisiana salt marshes after the BP *Deepwater Horizon* oil spill. Proceedings of the National Academy of Sciences USA 109(28): 11234-11239.

Silliman, B.R., P.M. Dixon, C. Wobus, Q. He, P. Daleo, B.B. Hughes, M. Rissing, J.M. Willis, and M.W. Hester. 2016. Thresholds in marsh resilience to the *Deepwater Horizon* oil spill. Scientific Reports 6. Article number 32520.

Simões, T.N., A. Candido de Silva, and C. Carneiro de Melo Moura. 2017. Influence of artificial lights on the orientation of hatchlings of *Eretmochelys imbricata* in Pernambuco, Brazil. Zoologia 34: e13727.

Smultea, M.A., J.R. Mobley Jr., D. Fertl, and G.L. Fulling. 2008. An unusual reaction and other observations of sperm whales near fixed wing aircraft. Gulf and Caribbean Research 20: 75-80.

Spier, C., W.T. Stringfellow, T.C. Hazen, and M. Conrad. 2013. Distribution of hydrocarbons released during the 2010 MC252 oil spill in deep offshore waters. Environmental Pollution 173: 224-230.

Stewart, J.D., M. Nuttall, E.L. Hickerson, and M.A. Johnston. 2018. Important juvenile manta ray habitat at Flower Garden Banks National Marine Sanctuary in the northwestern Gulf of Mexico. Marine Biology 165:111.

Stiles, M.L., E. Harrould-Kolieb, R. Faure, H. Ylitalo-Ward, and M.F. Hirshfield. 2007. Deep Sea Trawl Fisheries of the Southeast U.S. and Gulf of Mexico: Rock Shrimp, Royal Red Shrimp, Calico Scallops. Oceana, Washington DC. 18 pp.

Stout, S.A., and J.R. Payne. 2017. Footprint, weathering, and persistence of synthetic-base drilling mud olefins in deep-sea sediments following the *Deepwater Horizon* disaster. Marine Pollution Bulletin 118: 328-340.

Suchanek, T.H. 1993. Oil impacts on marine invertebrate populations and communities. American Zoologist 33: 510-523.

Sulak, K.J., and J.P. Clugston. 1998. Early life history stages of Gulf sturgeon in the Suwanee River, Florida. Transactions of the American Fisheries Society 127: 758-771.

Takeshita, R., L. Sullivan, C.R. Smith, T.K. Collier, A. Hall, T. Brosnan, T.K. Rowles, and L.H. Schwacke. 2017. The *Deepwater Horizon* oil spill marine mammal injury assessment. Endangered Species Research 33: 95-106.

Texas Parks and Wildlife Department. 2017. Federal and State Listed Species in Texas. https://tpwd.texas.gov/huntwild/wild/wildlife_diversity/nongame/listed-species/

Theo, S.L.H., and B.A. Block. 2010. Comparative influence of ocean conditions on Yellowfin and Atlantic Bluefin Tuna catch from longlines in the Gulf of Mexico. PLoS One5(5):e10756.

Todd, V.L.G., W.D. Pearse, N.C. Tegenza, P.A. Lepper, and I.B. Todd. 2009. Diel echolocation activity of harbour porpoises (*Phocoena phocoena*) around North Sea offshore gas installations. ICES Journal of Marine Science 66: 734-745.

Turtle Island Restoration Network. 2020. Kemp's Ridley Sea Turtle Count on the Texas Coast. https://seaturtles.org/turtle-count-texas-coast/

Tuxbury, S.M., and M. Salmon. 2005. Competitive interactions between artificial lighting and natural cues during seafinding by hatchling marine turtles. Biological Conservation 121: 311-316.

Urick, R.J. 1983. Principles of Underwater Sound. Los Altos Hills, CA, Peninsula Publishing. 423 pp.

U.S. Environmental Protection Agency. 2016. Questions and Answers about the BP Oil Spill in the Gulf Coast. https://archive.epa.gov/emergency/bpspill/web/html/qanda.html

U.S. Environmental Protection Agency. 2020. The green book nonattainment areas for criteria pollutants. https://www.epa.gov/green-book

U.S. Fish and Wildlife Service. 2011. FWS *Deepwater Horizon* Oil Spill Response. Bird Impact Data and Consolidated Wildlife Reports. *Deepwater Horizon* Bird Impact Data from the DOI-ERDC NRDA Database 12 May 2011. http://www.fws.gov/home/dhoilspill/pdfs/Bird%20Data%20Species%20Spreadsheet%2005122011.pdf

U.S. Fish and Wildlife Service. 2016. Hawksbill Sea Turtle (*Eretmochelys imbricata*). http://www.fws.gov/northflorida/SeaTurtles/Turtle%20Factsheets/hawksbill-sea-turtle.htm

U.S. Fish and Wildlife Service. 2020. Whooping Crane Survey Results: Winter 2019-2020. https://www.fws.gov/uploadedFiles/WHCR%20Update%20Winter%202019-2020b.pdf

U.S. Fish and Wildlife Service, Gulf States Marine Fisheries Commission and National Marine Fisheries Service. 1995. Gulf Sturgeon Recovery/Management Plan. U.S. Department of Interior, U.S. Fish and Wildlife Service, Southeast Region. Atlanta, GA. https://www.fisheries.noaa.gov/resource/document/recovery-management-plan-gulf-sturgeon-acipenser-oxyrinchus-desotoi

U.S. Fish and Wildlife Service. 2001a. Florida manatee recovery plan (Trichechus manatus latirostris), Third Revision. U.S. Department of the Interior, Southeast Region. Atlanta, GA.

U.S. Fish and Wildlife Service. 2001b. Endangered and threatened wildlife and plants; Endangered status for the Florida salt marsh vole. Federal Register 56(9):1457-1459.

U.S. Fish and Wildlife Service. 2003. Recovery plan for the Great Lakes Piping Plover (Charadrius melodus). U.S. Department of the Interior. Fort Snelling, MN.

U.S. Fish and Wildlife Service. 2007. International Recovery Plan: Whooping Crane (Grus americana), Third Revision. U.S. Department of the Interior. Albequerque, NM.

U.S. Fish and Wildlife Service. 2010. Beach-nesting Birds of the Gulf. http://www.fws.gov/home/dhoilspill/pdfs/DHBirdsOfTheGulf.pdf

U.S. Fish and Wildlife Service. 2015a. Whooping Crane (Grus americana). http://www.fws.gov/refuge/Quivira/wildlife_and_habitat/whooping_crane.html

U.S. Fish and Wildlife Service. 2015b. Bald and Golden Eagle Information. http://www.fws.gov/birds/management/managed-species/bald-and-golden-eagle-information.php

U.S. Fish and Wildlife Service. 2016. Find Endangered Species. http://www.fws.gov/endangered/

Valentine, D.L., G.B. Fisher, S.C. Bagby, R.K. Nelson, C.M. Reddy, S.P. Sylva, and M.A. Woo. 2014. Fallout plume of submerged oil from *Deepwater Horizon*. Proceedings of the National Academy of Sciences USA 111(45): 906-915.

Vanderlaan, A. S., and C. T. Taggart. 2007. Vessel collisions with whales: The probability of lethal injury based on vessel speed. Marine Mammal Science 23(1):144-156.

Venn-Watson, S., K.M. Colegrove, J. Litz, M. Kinsel, K. Terio, J. Saliki, S. Fire, R.H. Carmichael, C. Chevis, W. Hatchett, J. Pitchford, M.C. Tumlin, C. Field, S. Smith, R. Ewing, D. Fauquier, G. Lovewell, H. Whitehead, D. Rotstein, W.E. McFee, and E. Fougeres. 2015. Adrenal gland and lung lesions in Gulf of Mexico common bottlenose dolphins (*Tursiops truncates*) found dead following the *Deepwater Horizon* Oil Spill. PLoS One 10(5): e0126538.

Wakeford, A. 2001. State of Florida conservation plan for Gulf sturgeon (Acipencer oxyrinchus desotoi). St. Petersburg, FL, Florida Marine Research Institute. FMRI Technical Report TR-8. http://aquaticcommons.org/119/1/TR8.pdf

Waring, G.T., E. Josephson, K. Maze-Foley, and P.E. Rosel. 2016. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2015. U.S. Department of Commerce, National Oceanic and Atmospheric Administration. NOAA Technical Memorandum NMFS NE 238.

Wartzok, D., and D.R. Ketten. 1999. Marine mammal sensory systems, pp 117-175. In: J.E. Reynolds III and S. Rommel (Eds.), Biology of Marine Mammals. Smithsonian Institution Press, Washington, DC.

Washburn, T.W., M.G. Reuscher, P.A. Montagna, and C. Cooksey. 2017. Macrobenthic community structure in the deep Gulf of Mexico one year after the *Deepwater Horizon* blowout. Deep-Sea Research Part I: Oceanographic Research Papers 127:21-30.

Wei, C.-L. 2006. The bathymetric zonation and community structure of deep-sea macrobenthos in the northern Gulf of Mexico. M.S. Thesis, Texas A&M University. http://repository.tamu.edu/handle/1969.1/4927

Wei, C.-L., G.T. Rowe, G.F. Hubbard, A.H. Scheltema, G.D.F. Wilson, I. Petrescu, J.M. Foster, M.K. Wickstein, M. Chen, R. Davenport, Y. Soliman, and Y. Wang. 2010. Bathymetric zonation of deep-sea macrofauna in relation to export of surface phytoplankton production. Marine Ecology Progress Series 39: 1-14.

White, H.K., P.Y. Hsing, W. Cho, T.M. Shank, E.E. Cordes, A.M. Quattrini, R.K. Nelson, R. Camilli, A.W.J. Demopoulos, C. German, J.M. Brooks, H. Roberts, W.W. Shedd, C.M. Reddy, and C. Fisher. 2012. Impact of the *Deepwater Horizon* oil spill on a deep-water coral community in the Gulf of Mexico. Proceedings of the National Academy of Sciences USA 109(50): 20303-20308.

Wiese, F.K., W.A. Montevecchi, G.K. Davoren, F. Huettmann, A.W. Diamond, and J. Linke. 2001. Seabirds at risk around offshore oil platforms in the north-west Atlantic. Marine Pollution Bulletin 42(12): 1285-1290.

Williams, R., E. Ashe, and P.D. O'Hara. 2011. Marine mammals and debris in coastal waters of British Columbia, Canada. Marine Pollution Bulletin 62(6): 1303-1316.

Wilson, C.A., A. Pierce, and M.W. Miller. 2003. Rigs and Reefs: A Comparison of the Fish Communities at Two Artificial Reefs, a Production Platform, and a Natural Reef in the Northern Gulf of Mexico. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2003-009. 95 pp.

Wilson, C.A., M.W. Miller, Y.C. Allen, K.M. Boswell, and D.L. Nieland. 2006. Effects of Depth, Location, and Habitat Type on Relative Abundance and Species Composition of Fishes Associated with Petroleum Platforms and Sonnier Bank in the Northern Gulf of Mexico. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2006-037. 85 pp.

Wilson, J. 2003. Manatees in Louisiana. Louisiana Conservationist July/August 2003: 7 pp.

Wootton, E.C., E.A. Dyrynda, R.K. Pipe, and N.A. Ratcliffe. 2003. Comparisons of PAH-induced immunomodulation in three bivalve molluscs. Aquatic Toxicology 65(1): 13-25.

Würsig, B., S.K. Lynn, T.A. Jefferson, and K.D. Mullin. 1998. Behaviour of cetaceans in the northern Gulf of Mexico relative to survey ships and aircraft. Aquatic Mammals 24(1): 41-50.

Würsig, B., T.A. Jefferson, and D.J. Schmidly. 2000. The Marine Mammals of the Gulf of Mexico. College Station, TX, Texas A&M University Press. 232 pp.

Young, C.N. and J.K. Carlson. 2020. The biology and conservation status of the oceanic whitetip shark (*Carcharhinus longimanus*) and future directions for recovery. Reviews in Fish Biology and Fisheries. 30:293-321.

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

Fugro Geoservices, Inc, "Shallow Drilling Hazards and Archaeological Assessment, Mississippi Canyon Blocks 347, 348, 391, 392, and Vicinity (OCS-G 28002, -19939, -26252, and -26253) Gulf of Mexico, Report No. 27.2008-5022, dated 5/6/2009. Previously Submitted.

AOA Geophysics, Inc, "Shallow Hazards Assessment, MC 393 (OCS-G 26254), DC 353 (OCS-G 25852), DC354 (OCS-G 23507), DC397 (OCS-G 25853), and DC398 (OCS-G 25854), Mississippi Canyon and De Soto Canyon Areas, Gulf of Mexico", Report No. 3038.3-SHL-DES, dated 10/29/2004. Previously Submitted.

Fugro Geoservices, Inc. "Regional Geohazards Assessment, Blocks 391-393, 435-437, 479-481, 523-525, and 567-569, Mississippi Canyon Area, Gulf of Mexico", Report No. 0201-3000, dated 12/27/1996. Previously Submitted.

Fugro Geoservices, Inc, "Archaeological Assessment, ROV Survey, Sonar Contact Investigation, Block 391, Mississippi Canyon Area, Gulf of Mexico", Report 2409-1112, dated 7/13/2009. Previously Submitted.

Fugro Geoservices, Inc, "Archaeological Survey, Blocks 347-349, 391-393, and Portions of 346, 390, 434-436, Mississippi Canyon Area, Gulf of Mexico", Report No. 2408-5022, dated 3/24/2009. Previously Submitted.

Fugro Geoservices, Inc. "Archaeological Assessment, Proposed Anchor Locations, Block 393, Mississippi Canyon Area, Gulf of Mexico", Report No. 2407-1083, dated 5/1/2007. Previously sumbmitted.

Hazard Survey Injector East (IE) Drill Center Block 392 Mississippi Canyon Areas. OII Doc. No. 196418-OII-RPT-HRC-02, Dec 2018. Previously submitted.

Hazard Survey Injector West (IW) Drill Center Block 391 Mississippi Canyon Areas. OII Doc. No. 196418-OII-RPT-HRC-01, Dec 2018. Previously submitted.

Shell's OSRP