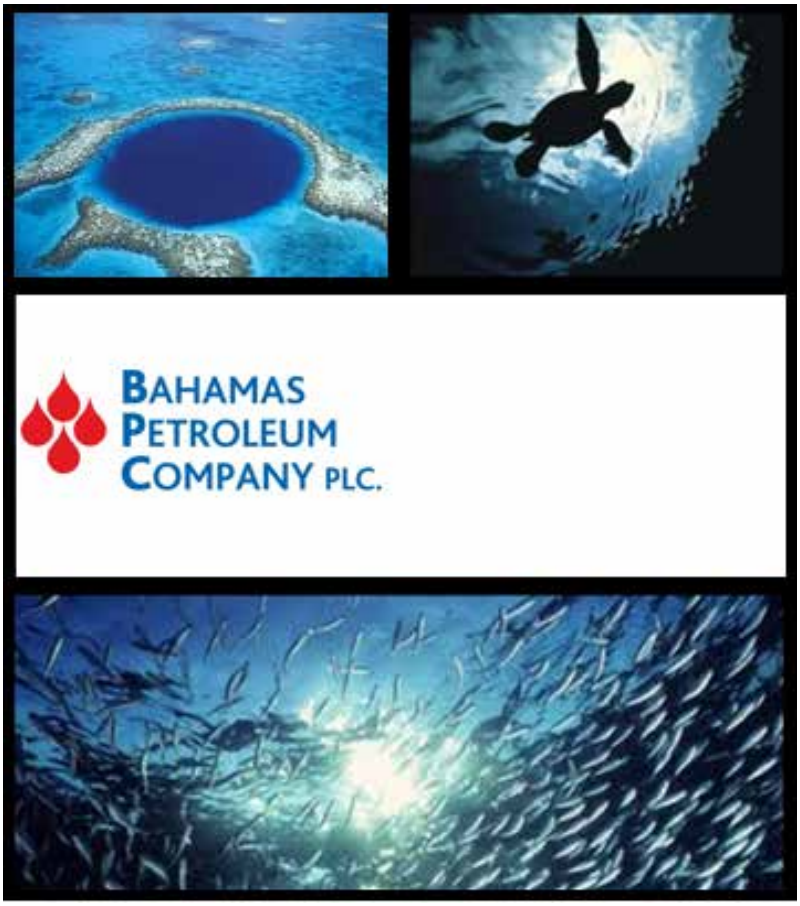
Environmental Impact Assessment for Exploratory Drilling in the Cooper Block, Offshore The Bahamas



Bahamas Petroleum Company Plc.
Building 5
Caves Village
West Bay Street
P. O. Box SP-64135
Nassau, The Bahamas

Presented By:

Acorn International, LLC

Acorn INTERNATIONAL
LOCAL CONTENT & GLOBAL ASSURANCE

SEV Consulting Group

SEV Consulting Group

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1. Introduction

1.1 Project Overview

Bahamas Offshore Petroleum Limited ("Bahamas Petroleum Company", "BPC", or "the Company"), a wholly-owned Bahamian subsidiary of Bahamas Petroleum Company Plc, signed License Agreements with the Commonwealth of The Bahamas for the Bain, Cooper, Donaldson and Eneas Blocks ("the Blocks") on 26 April 2007 to explore for oil and gas resources offshore The Bahamas. As required in the License Agreements (and subsequent extensions), BPC must drill at least one exploration well by the end of 2020.

Bahamas Petroleum Company plans to drill the Perseverance #1 well (i.e. B-north) at 23°16'23.89882" N and -79°07'54.81097" W, located at a water depth of 1,689 ft (~515 m) in the first quarter of 2020. The proposed location of the first well is in the Cooper Block, approximately 90.9 miles (~146.3 km) from Andros Island, approximately 84.2 miles (~135.5 km) from Cay Sal and 41.3 miles (~66.4 km) from the nearest Cuban islands (Figure 1-1).

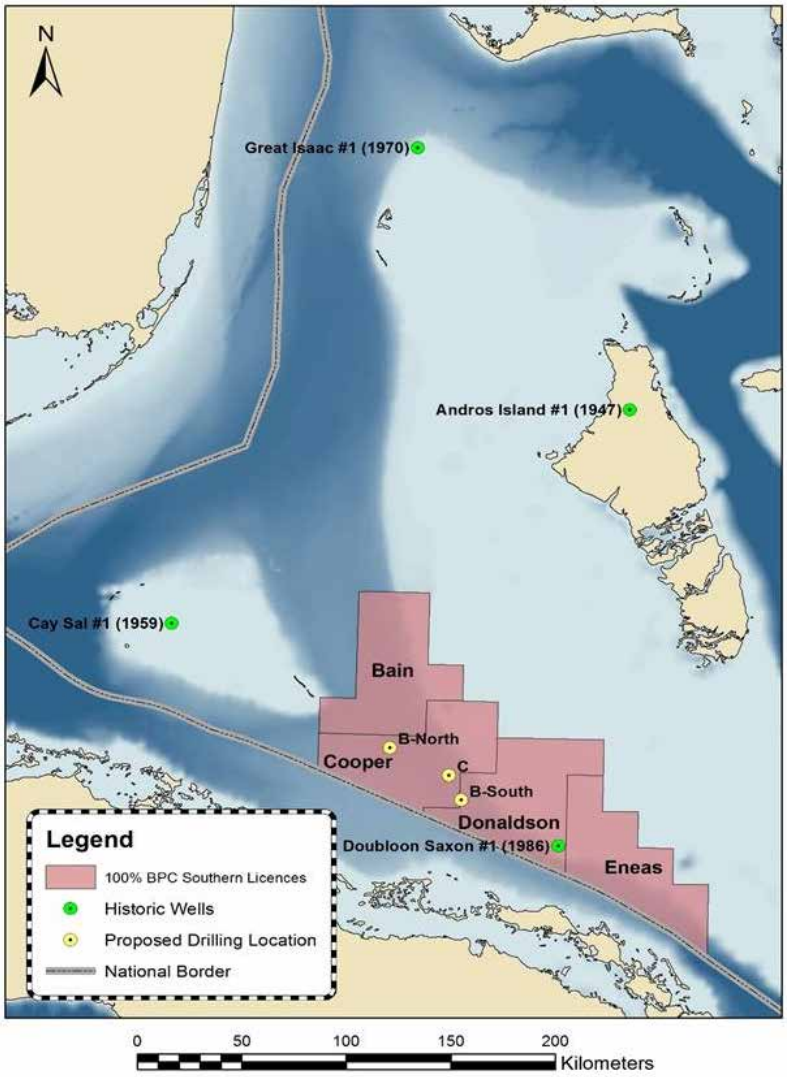

Figure 1-1: Location of Concession Areas and Potential Drilling Locations

1.2 Background

Prior to drilling, The Bahamas Environment Science & Technology Commission (BEST) required BPC develop an Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) to identify potential impacts from the proposed drilling program and develop appropriate mitigation measures to ensure drilling is conducted in a responsible manner.

BPC commissioned Acorn International to develop the EIA and EMP which were submitted to BEST in 3Q 2011. Review by BEST and their independent consultant, Black & Veatch Corporation (Black & Veatch), identified a number of gaps. Acorn International submitted a revised EIA and EMP in 1Q 2012 and many of the gaps were closed. However, at that time The Bahamas regulatory framework was not yet in place and BPC could not sign contracts to execute on drilling. Without firm contracts, some gaps could not be filled, and BEST and BPC agreed to submit a revised EIA and EMP when the information was available.

Following changes in the regulatory framework, BPC submitted a revised EIA and EMP in March of 2017. In March 2019, BEST requested that Black & Veatch reopen the project review. Based on that review, Black & Veatch recommended that BPC provide additional information, particularly as it pertains to gaps in the site-specific EMP. Other general gaps identified by Black & Veatch include the assessment of the project's potential risks, appropriate mitigation measures and information in accordance with World Bank and International Finance Corporation (IFC) Environmental and Social Performance Standards (Performance Standards). BPC now has firm commitments with contractors and enough information is available to fill the gaps identified.

1.3 Purpose of Report

To address gaps identified by BEST and Black and Veatch, Acorn International has developed this EIA and a site-specific EMP (separate document).

The purpose of this report is to integrate updated information and revise the impact assessment based on the new information available. Findings of the revised impact assessment are carried over to the accompanying site-specific EMP, although that document is stand-alone and is intended for use during operations. The structure of the report and key changes in each chapter are presented below.

Chapter 1: Introduction – The Introduction provides background on the project history and status of regulatory submittals, and on the structure of the report
Chapter 2: Project Description – The Project Description provides updated information based on actual rig, schedule and other details.
Chapter 3: Legislative and Institutional Framework – The Legislative and Institutional Framework provides an overview of relevant regulatory framework.
Chapter 4: Baseline Conditions – Supplemental information provided throughout the baseline from BPC studies completed. Key inputs included: Marine Mammal Observer records from the seismic survey program in the blocks and site specific geologic evaluations.
Chapter 5: Impact Identification and Evaluation: This chapter re-assessed the impacts based on the new information and site-specific information available.

No mitigation chapter is presented, as these changes have been carried over to the Perseverance #1 Environmental Management Plan.

2. Project Description

This Chapter discusses the various activities which will be completed by Bahamas Petroleum Company (BPC) as part of the exploratory drilling program in the Cooper Block, offshore The Bahamas. The Project will be performed in accordance with the License Agreements between Bahamas Offshore Petroleum Ltd ("Bahamas Petroleum Company" or "the Company") and the Commonwealth of The Bahamas. Information used to develop this Chapter was provided by both Bahamas Petroleum Company and other industry sources.

2.1 Project Location and Schedule

The Blocks, shown in Figure 2-1, are located offshore The Bahamas, southwest of Andros Island adjacent to the marine border with Cuba, and cover approximately 3 million acres (Table 2-1). Bahamas Petroleum Company is drilling the Perseverance #1 Well (i.e. "B-north") at 23°16'23.89882" N and -79°07'54.81097" W in a water depth of 1,689 ft (~515 m) during the first quarter of 2020 to test the Albian and Aptian formations. The current proposed location of the first well (Figure 2-2) is in the Cooper Block, approximately 90.9 miles (~146.3 km) from Andros Island, approximately 84.2 miles (~135.5 km) from Cay Sal, and 41.3 miles (~66.4 km) from the nearest Cuban islands.

The final well depth will be between 15,000 and 18,000 feet (~4,500 to 5,400 m) depending on the location of the bottom objective. Depths of geologic formation tops as determined through seismic evaluations are shown in Table 2-2.

Table 2-1: License Areas

Block	License Area	
	Acres	km^2
Bain	778,534.55 acres	3,150.62 km^2
Cooper	772,971.17 acres	3,128.11 km^2
Donaldson	794,167.42 acres	3,213.88 km^2
Eneas	734,385.74 acres	2,971.95 km^2
Total	**3,080,057.88 acres**	**12,464.56 km^2**

Table 2-2: Depths of Geologic Formations

Formation	Top of Formation (Subsea) (ft.)	Top of Formation (Subsea) (m)
Abian	5726	1745
Intra Albian	8311	2533
Aptian	9725	2964
Mid Aptian	11,168	3404
Intra Aptian	13,572	4136
Base Aptian	15,566	4744

The operations are expected to start on March 1, 2020 and be completed within 60 days. The following sections describe the operation.

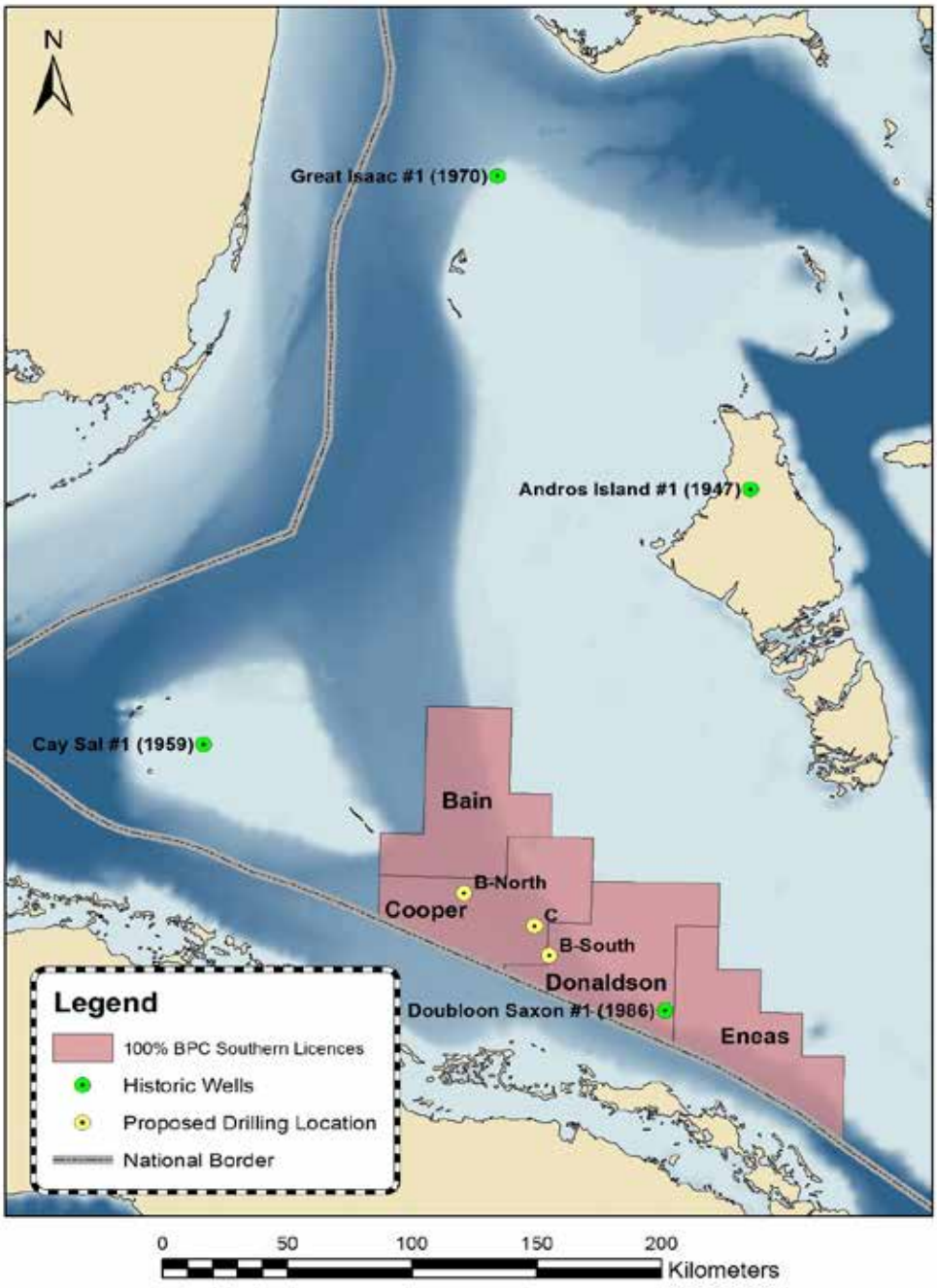

Figure 2-1: Bahamas Petroleum Company License Blocks
Source: Bahamas Petroleum Company[1]

[1] International boundary line shown in the figure is the coordinates agreed upon by Cuba and The Bahamas.

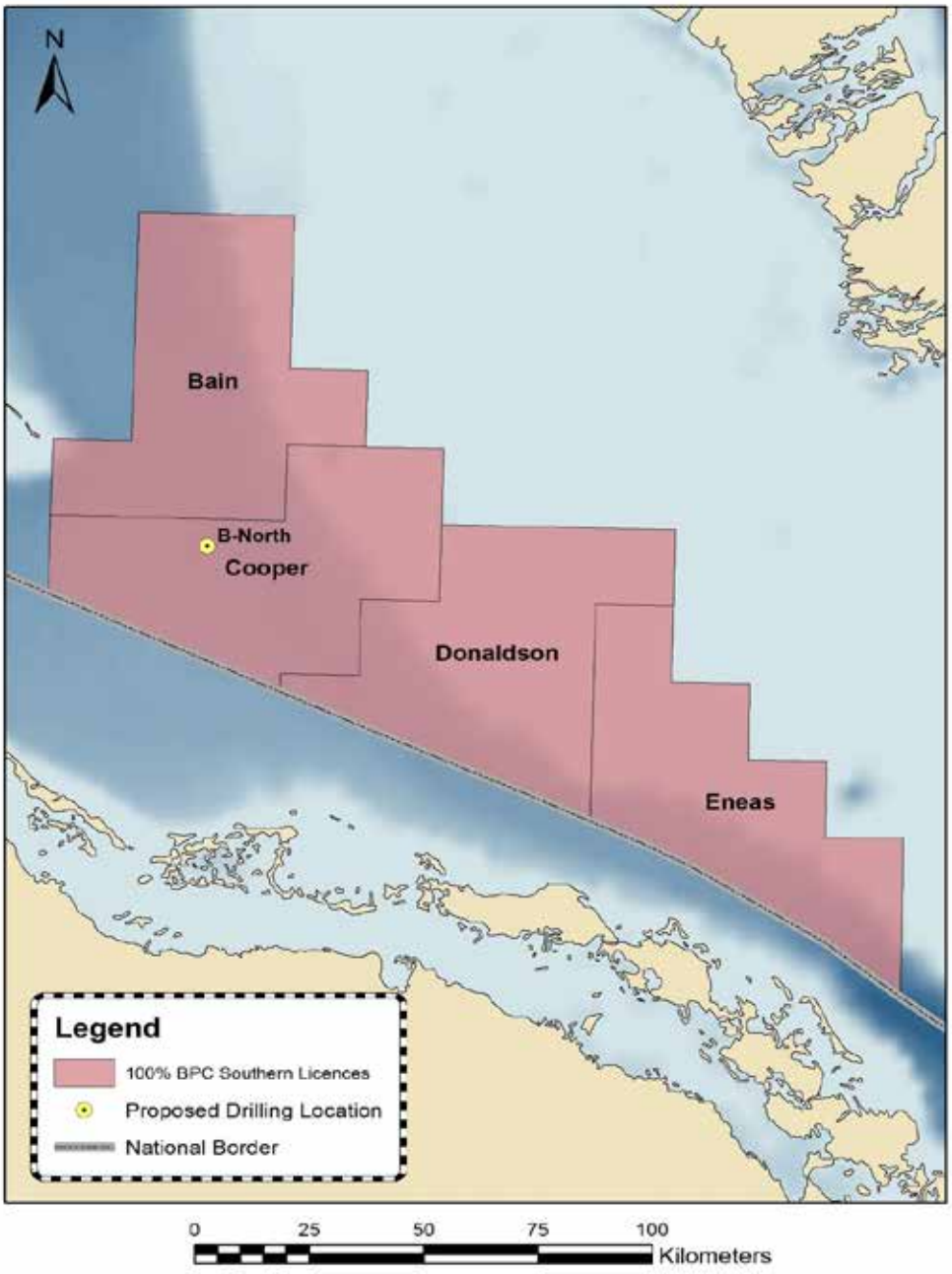

Figure 2-2: Proposed Location of the First Exploration Well

Note: Preliminary coordinates for the well are: 23°16'23.89882" N, -79°07'54.81097" W. Maritime Boundary shown in grey.[2]

The drilling rig will mobilize to the Blocks from its previous assignment and is planned to commence its first well in the first quarter of 2020. Each well is scheduled to take approximately 40 - 60 days; therefore, the entire drilling program should be completed within 2 months for this well. A detailed diagram of the proposed schedule is presented in Figure 2-3.

2 The first well will be located at the coordinates provided in Figure 2-2. This is the location used for the oil spill modeling.

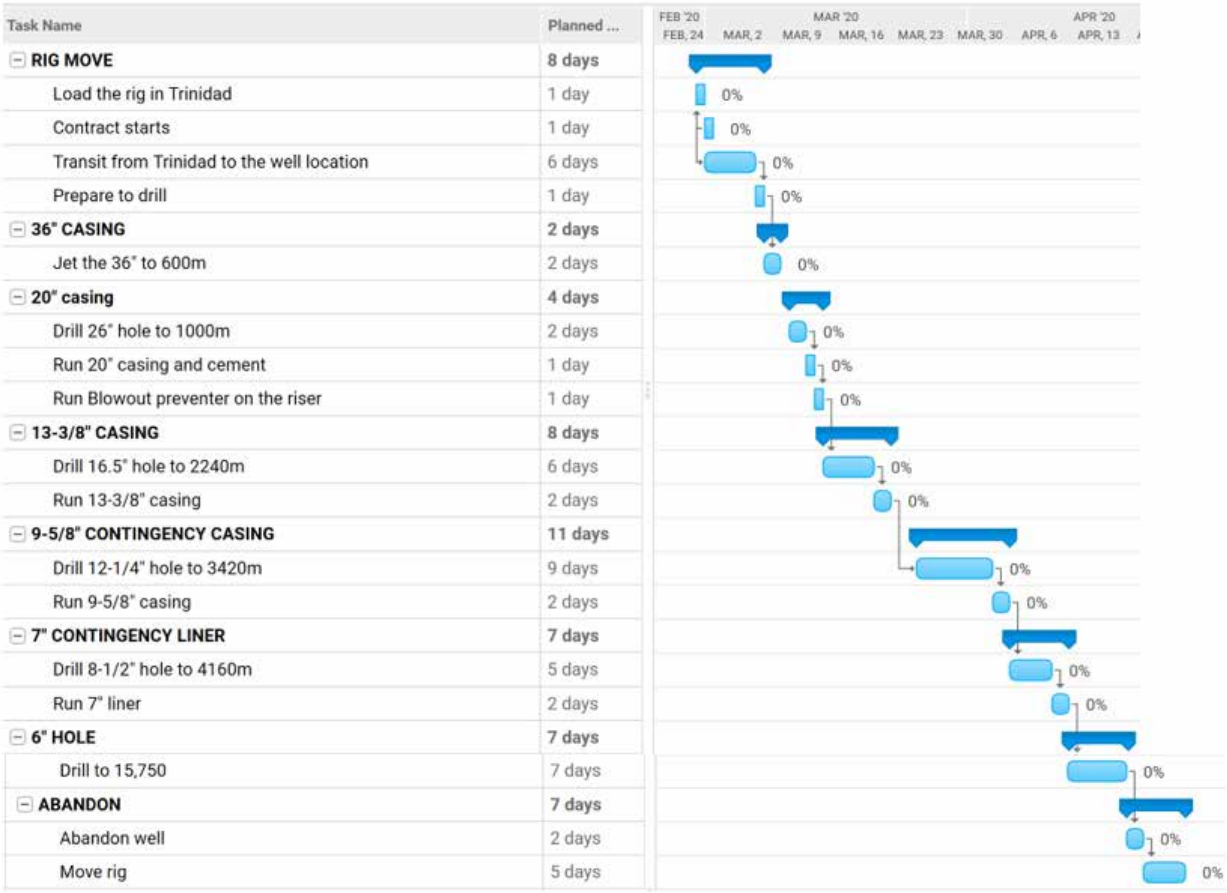

Figure 2-3: Proposed Schedule for Well Drilling

2.2 Rig Specifications

Bahamas Petroleum Company will utilize the drillship *West Saturn* owned and operated by Seadrill. The *West Saturn* was built in 2014 and is a 6th generation ultra-deepwater drillship. The experienced crews have drilled many wells in much deeper waters and to much greater depths than this well in The Bahamas, with the most recent well being drilled in Brazil.

The rig includes all components required to safely drill the wells. Components include:

- Derrick, draw-works and top drive;
- Casing and pipe racks;
- Primary and emergency generators;
- Mud circulation and solids removal equipment;
- Bulk storage tanks for fuel, mud, cement, fresh water, brine;
- Safety and fire-fighting equipment;
- Potable water system;
- Sewage treatment; and,
- Personnel accommodations and support facilities, including medical.

Information on the drilling rig is presented below. The West Saturn drillship is shown in Figure 2-4 and its specifications are shown in Figure 2-5.

Figure 2-4: West Saturn Drillship

Source: Seadrill

Seadrill

WEST SATURN

The West Saturn is a 6th generation ultra-deepwater drillship with operational history offshore Africa.

GENERAL (U.S)	
Built	2014 Samsung Heavy Industries
Design	Samsung 12,000
Flag/Class	Panama / ABS
Dimensions	748 ft Long / 137.8 ft Wide
Draft	39.4 ft Drilling / 27.9 ft Transit
Displacement	106,087 st Drilling / 73,881 st Transit
Variable Load	22,046 st Drilling / 18,188 st Transit
Accommodations	200 Persons
Helideck	Sikorsky S61N & S92
Max. Water Depth	12,000 ft Designed / 9,900 ft Outfitted
Max. Drilling Depth	37,500 ft
STATION KEEPING	
Dynamic Positioning	Kongsberg DP Class 3
Thrusters	6 x Rolls Royce 6,035 HP Azimuthing
Transit Speed	Up to 11.5 Knots
Mooring Lines	Harbor Mooring Only
Mooring Winches	Harbor Mooring Only
STORAGE CAPACITIES	
Fuel	37,793 bbl
Drill Water	15,362 bbl
Potable Water	9,132 bbl
Active Liquid Mud	6,544 bbl
Reserve Liquid Mud	9,435 bbl
Bulk Bentonite / Barite	15,962 ft^3
Bulk Cement	15,962 ft^3
Sack Storage	7,000 Sacks
DRILLING PACKAGE	
Derrick	Dual NOV 210 ft Tall with 80 ft x 60 ft Base 1,250 + 1,000 St Gross Nominal Capacity
Top Drive	1 x Main + 1 x Aux NOV TDX 1250 Rated for 1,250 st Hoisting Capacity, 2 x 1,340 HP AC Motors, Max. Continuous Torque 105,000 ft-lbs at 125 RPM
Drawworks	Main: NOV Dreco w/ 2" Drill Line Max. Line Pull 16 Lines of 1,250 st Aux: NOV Dreco 2" Drill Line Max. Pull 14 Lines 1,000 st
Rotary Table	Main: VARCO RST 75.5" Aux: VARCO RST 60.5"
Compensator	Main: NOV Crown Mounted Rated for 766 st Compensated, 1,250 st Static
Tubular Handling	NOV Automated Hydraracker
Mud Pumps	4 x NOV 14-P-220 2,200 HP
HP Mud System	Rated for 7,500 psi
Shale Shakers	6 x NOV VSM 300
SUBSEA EQUIPMENT	
BOP	NOV 18 ¾" 7 NXT RAM 15,000 psi
Annular	2 x Shaffer 18 ¾" 10,000 psi
Diverter	Shaffer Max. Bore 21-1/4"
Wellhead Connector	Drill-Quip DX-DW Dressed for 27" Wellhead
Riser	Shaffer ft-h 90 ft Length 21" OD, 4" ID Boost Line
Tensioners	8 x Dual Shaffer 112.5 st Capacity EA, 50 ft Line Travel
CRANES	
Primary Cranes	3 x NOV Hydralift Knuckle Boom Rated for 93.6 st at 62.3 ft Radius
X-Mas Tree Handling	NOV Heave Compensated Knuckle Boom Rated for 181.9 st at 59 ft Radius
POWER	
Main Engines	6 x Himsen 16H32/40V 10,877 HP Diesel Engines
Main Generators	6 x ABB 9,387 HP @ 0.8 P.F
Emergency Power	1 x MTU 2,145 HP Diesel Engine 1 x Leroy Somer 1,350 kW Generator @ 0.8 P.F

Seadrill

WEST SATURN

The West Saturn is a 6th generation ultra-deepwater drillship with operational history offshore Africa.

GENERAL (METRIC)	
Built	2014 Samsung Heavy Industries
Design	Samsung 12,000
Flag/Class	Panama / ABS
Dimensions	228 m Long / 42 m Wide
Draft	12 m Drilling / 8.5 ft Transit
Displacement	96,241 mt Drilling / 66,369 mt Transit
Variable Load	20,000 mt Drilling / 16,500 mt Transit
Accommodations	200 Persons
Helideck	Sikorsky S92 / MIL-MI-8
Max. Water Depth	3,657 m Designed / 3,135 m Outfitted
Max. Drilling Depth	11,429 m
STATION KEEPING	
Dynamic Positioning	Kongsberg DP Class 3
Thrusters	6 x Rolls Royce 4,500 kW Azimuthing
Transit Speed	Up to 5.9 m/s
Mooring Lines	Harbor Mooring Only
Mooring Winches	Harbor Mooring Only
STORAGE CAPACITIES	
Fuel	6,009 m^3
Drill Water	2,442 m^3
Potable Water	1,452 m^3
Active Liquid Mud	1,040 m^3
Reserve Liquid Mud	1,500 m^3
Bulk Bentonite / Barite	452 m^3
Bulk Cement	452 m^3
Sack Storage	7,000 Sacks
DRILLING PACKAGE	
Derrick	Dual NOV 64 m Tall with 24.4 m x 18.3 m Base 1,134 + 901 mt Gross Nominal Capacity
Top Drive	1 x Main + 1 x Aux NOV TDX 1250 Rated for 1,134 mt Hoisting Capacity, 2 x 999 kW AC Motors, Max. Continuous Torque 142,360 nm at 125 RPM
Drawworks	Main: NOV Dreco 50.8 Drill Line Max. Line Pull 16 Lines of 1,134 mt Aux: NOV Dreco 2" Drill Line Max. Pull 14 Lines 907 mt
Rotary Table	Main: VARCO RST 1.917 m Aux: VARCO RST .536 m
Compensator	Main: NOV Crown Mounted Rated for 695 mt Compensated, 1,134 mt Static
Tubular Handling	NOV Automated Hydraracker
Mud Pumps	4 x NOV 14-P-220 1,640 kW
HP Mud System	Rated for 517 bar
Shale Shakers	6 x NOV VSM 300
SUBSEA EQUIPMENT	
BOP	NOV 47.625 cm 7 NXT RAM 1,034 bar
Annular	2 x Shaffer 47.625 cm 689 bar
Diverter	Shaffer Max. Bore 53.975 cm
Wellhead Connector	Drill-Quip DX-DW Dressed for 68.58 cm Wellhead
Riser	Shaffer 27.43 m Length 0.5334 m OD 10.16 cm ID Boost Line
Tensioners	8 x Dual Shaffer 102 mt Capacity EA, 15.24 m Line Travel
CRANES	
Primary Cranes	3 x NOV Hydralift Knuckle Boom Rated for 165 mt at 19 m Radius
X-Mas Tree Handling	NOV Heave Compensated Knuckle Boom Rated for 165 mt at 18 m Radius
POWER	
Main Engines	6 x Himsen 16H32/40V 8,000 kW Diesel Engines
Main Generators	6 x ABB 7,000 kW @ 0.8 P.F
Emergency Power	1 x MTU 1,600 kW Diesel Engine 1 x Leroy Somer 1,350 kW Generator @ 0.8 P.F

Figure 2-5: West Saturn Specifications

Source: Seadrill

2.2.1 Dynamic Positioning

In order to stay precisely on the drilling location, the drillship has a sophisticated system of propellers and thrusters which are managed by a computerized control system; this is known as a dynamic positioning (DP) system. Acoustic and global positioning satellite inputs continuously monitor the drilling rig's position. As the drilling rig operates, the DP system reacts to environmental loads such as ocean currents, swells, and winds, to accurately maintain the rig's position. There are typically three different and independent positioning systems, such that failure of any one system will not result in any unplanned movement out of position. A dynamic positioning operator (DPO) is the primary watch keeper at the DP control desk, operating and monitoring the DP system, and monitoring logistic operations around the vessel.

2.3 Support Operations

A shore base is required to support drilling operations. In particular, the shore base is needed to supply food, water and fuel, and for supporting services such as docking of boats, waste management, movement and storage of cargo and for crew support. In addition, the shore base will likely be near onshore certified waste management facilities. Based on the current availability of infrastructure and service providers needed to support drilling, and the project timeline, the primary BPC shore base is located in the Port of Fourchon, Louisiana, USA.

2.3.1 Port Fourchon, Louisiana, United States of America

Port Fourchon (Figure 2-6) is Louisiana's southernmost port, located on the southern tip of Lafourche Parish, Louisiana, on the Gulf of Mexico. Port Fourchon currently services over 90% of the Gulf of Mexico's deepwater oil and gas production installations. It is one of the best dedicated oil and gas supply bases in the world. No Infrastructure upgrades will be required to support this drilling program.

Figure 2-6: View of Port Fourchon, Louisiana, USA

Source: Google Earth

2.3.2 Equipment and Personnel Transportation

Equipment and materials required to support the drilling operations will be delivered to the drilling rig by Platform Supply Vessels (PSVs) (Figure 2-7). Currently, BPC plans to utilize one primary PSV to make approximately one trip per week between the shore base and drilling location (Figure 2-8). Materials will be loaded and unloaded to/from the PSVs with the rig cranes. Bulk fluids and materials will be pumped or blown from the PSVs to the rig via hoses between the rig and PSVs.

Figure 2-7: Platform Supply Vessel

Source: Hornbeck Offshore

Figure 2-8: Route from Fourchon to the Drill Site

Source: Google Earth

Personnel will crew change to and from the rig via helicopter (Figure 2-9). It is anticipated that one helicopter will be required to support drilling operations conducting approximately 3-5 trips per week. BPC has obtained approval for helicopters to fly from Miami, Florida directly to the rig without stopping in the Bahamas, as approved by The Department of Immigration. The crews will fly into Miami International Airport for bus transport to Miami Executive Airport. Immigration and security checks are to be conducted prior to boarding the helicopter.

Figure 2-9: Typical helicopter for offshore crew changes

Source: ERA

Drill ships are largely self-sufficient rigs and house up to 200 people. A typical rig crew is 100-115, depending on the vessel and includes typically includes:

- 4 – 6 Company supervisors and representatives;
- 60 Rig maintenance crew;
- 20 – 30 Drilling support service crew; and,
- 15 – 20 Catering and support staff.

Personnel will work on rotation (21 days on the rig / 21 days off the rig). Crews will live on the drilling rig during their duty schedule ("hitch" or "rotation"). At the conclusion of a duty schedule, workers will be transferred back to shore by helicopter, and will be replaced by their alternates for the next rotation. Off duty workers generally take commercial flights to their homes to stay until they report back to duty for their next shift.

2.4 Drilling Activities

Drilling activities for each well will occur in three main phases:

- Rig Mobilization
- Drilling of exploration well
- Decommissioning and Abandonment

2.4.1 Rig Mobilization

The drilling rig will mobilize from its previous assignment and arrive in The Bahamas in March 2020 to drill in the BPC exploration well at the "B-North" site in the Cooper block of BPC's license area.

2.4.1.1 Pre-inspection Survey

Prior to mobilization, the seabed will be surveyed by video camera to ensure there are no sensitive receptors or artefacts; BPC may make any necessary adjustments to the final drilling location based on survey findings. Samples of the water and bottom sediment will be taken for analysis of the baseline conditions. This process comprises the Environmental Baseline Survey (EBS) referenced in this document, compliant with Bahamian regulations.

2.4.1.2 Perform Remotely Operated Vehicle (ROV) Survey

Prior to beginning drilling ('spudding' the well), a ROV will be deployed from the drill rig to install transponders for the dynamic positioning system. At the same time, the ROV will perform a further video inspection of the designated drill site and reconfirm the final location.

2.4.2 Drilling

Deepwater offshore drilling is performed through careful advancement of drilling equipment (the 'drill string') to a desired depth beneath the sea floor. Fluids are used to cool the drill bit, carry formation cuttings to surface and control formation pressures. The design of the first well (including fluid program) and associated planned activities for the Project are described in this section.

A schematic illustration of overall well design and drilling methods, including casing configuration is shown in Figure 2-10 and described in detail in the following sections. BPC has contingency casings available if well conditions require additional casing.

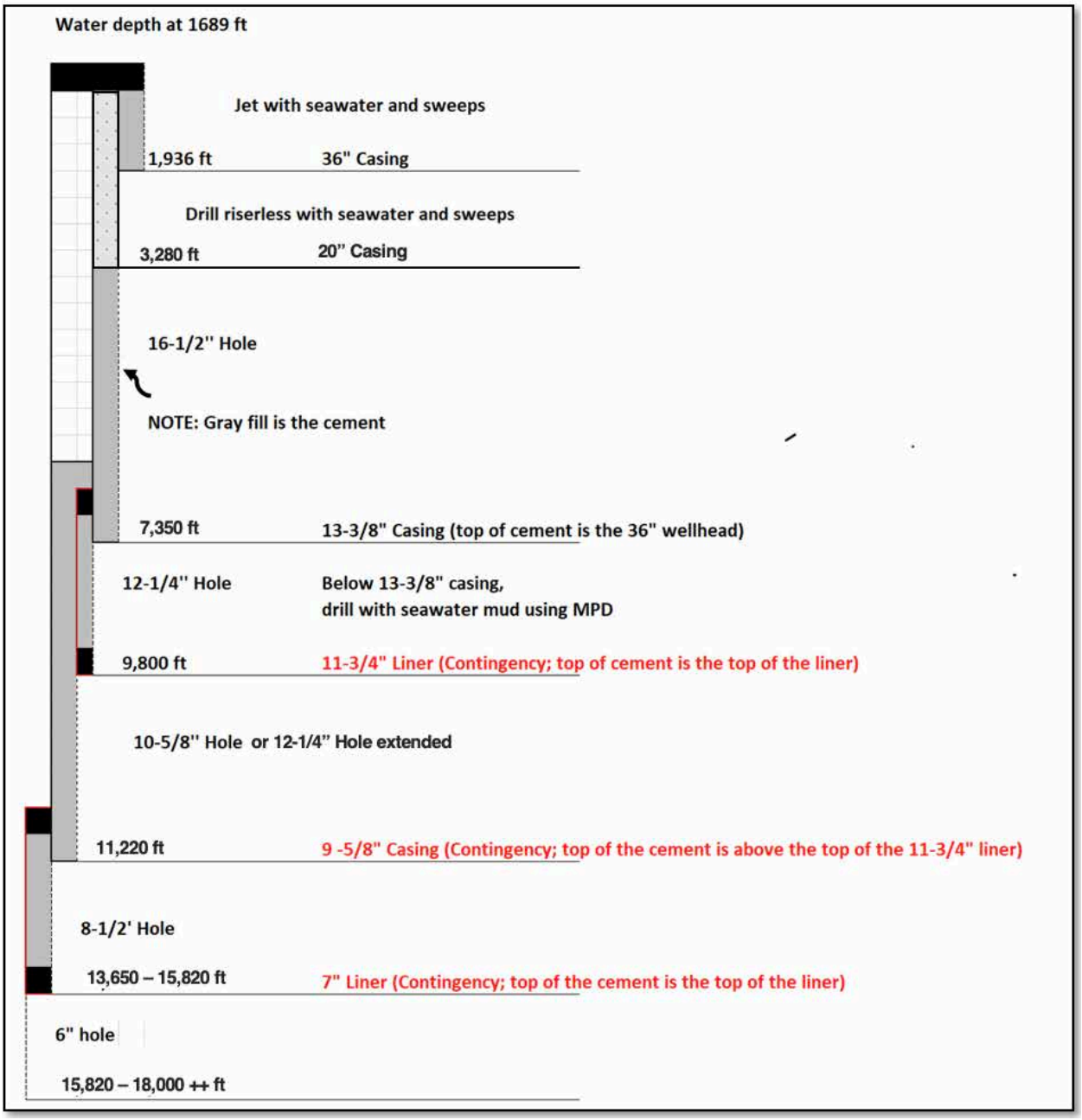

Figure 2-10: Schematic Illustration of Drilling Methods, Casing, and Well Design

2.4.2.1 Well Design and Drilling Program

The initial phase of the drilling operation is commonly referred to as the "riserless" portion of the well drilling operations. The initial step in the riserless drilling phase involves 'jetting-in' the 36" structural casing using water jets to dig into the immediate seabed. The structural casing sticks up above the seabed to prevent shallow sediments from entering the wellbore and provides structural integrity for the next series of casings.

In the drilling assembly, the drill string is connected to the top of a structural pipe by way of a releasable running tool with a J-latch or other release mechanism that lands in a profile of a low pressure wellhead housing (LPWHH) assembly that is mounted on top of the 30" structural pipe.

The drill string continues below the running tool and extends down the entire length of the interior of the drive pipe. The lower end of the drill string terminates with a jetting assembly (generally a large-diameter drill bit on a positive-displacement motor).

The drilling/landing string is initially connected to the top of the structural pipe to enable both elements to be lowered to the sea floor together. Once the structural pipe/landing string assembly touches the sea floor, fluid circulation is initiated down the drilling/landing string with the fluid returns coming up inside the structural pipe and settling to sea/sea floor, and the jetting operations begin. As the jetting assembly penetrates the sea bottom formation, the drill string lowers with the structural pipe falling snugly into the borehole made from the rotating and jetting action of the bit. This drilling/jetting operation continues until the entire section of structural pipe penetrates the same length of formation or until such time as the gravitational forces acting on the conductor pipe will no longer overcome the effect of skin friction. Once this is accomplished, the drill string is disconnected from the structural pipe to enable the drill string to move independently with respect to the structural pipe, where it can facilitate additional drilling operations or can be pulled back to the drilling unit for re-configuration of the drilling assembly.

During the riserless drilling phase, when the structural pipe is penetrating into the formation through gravitational force, seawater is utilized as the drilling fluid. Seawater and periodic water-based gelled sweeps (small volumes of viscous fluid – used if needed) are used to clean the borehole bottom and carry the cuttings up the annulus formed by the exterior of the drill string and the interior of the structural pipe. This fluid then exits the annulus at the top of the drive pipe and is released into the sea and allowed to settle to the sea floor around the bore hole. BPC fully expects to utilize seawater for the riserless drilling program.

The second phase of the riserless drilling phase of the well construction process involves drilling a 16.5” open hole section below the 30” structural pipe using seawater and periodic water-based gelled sweeps. The returns exit the top of the 30” structural pipe with the rock chippings settling around the well location along the sea floor. When drilling operations are finished on the 16.5” open-hole section, the wellbore is displaced with viscous water-based mud and the drilling assembly is removed from the wellbore. A 13-3/8” casing (sometimes referred to as a surface casing) is run in the wellbore and latched into the top of the 36” structural pipe’s LPWHH via an assembly at the top of the 20” surface pipe called a high-pressure well head housing (HPWHH). The 13-3/8” casing is cemented. The fluid returns from inside the wellbore are also discharged to the sea around the well location. This HPWHH assembly mounted at the top of the 13-3/8” surface casing provides the pressure-containing integrity necessary for the remainder of the well construction operations. This assembly is the point to which the Blowout Preventer (BOP) Stack is connected to the well. It has profiles inside of its bore to facilitate the hanging of additional casing strings that will be deployed into the wellbore during the well construction process. After the 13-3/8” surface casing is cemented in place, the BOP stack is deployed on a marine riser assembly and latched up to the HPWHH assembly, and then significant pressure tests are conducted on the BOP. The BOP makes up the bottom portion of the riser for the duration of the well drilling process. It is at this point that the riserless drilling phase of the well construction process is concluded.

After the BOP is installed, crews continue to drill the well below the 13-3/8” casing. The mud is pumped down the drill pipe and a riser pipe (extending through the water column connecting the well head to the drilling rig) provides the conduit for the drilled cuttings to be circulated back with the mud returns to the drill ship facilities. The mud and drilled cuttings are pumped to the rig’s mud processing equipment where drill cuttings will be separated from the drilling fluid.

Figure 2-11 illustrates the drilling process. The flow of the mud and drilled cuttings down the drill string and up the drill string – riser annulus. The BOP is pictured in its position on the ocean floor.

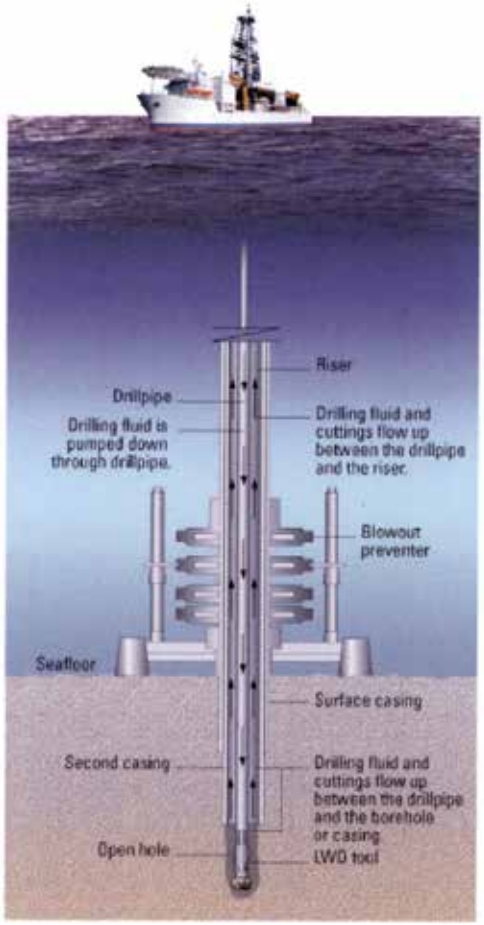

Figure 2-11: Diagram of Well Drilling Mechanics

Source: Schlumberger http://www.glossary.oilfield.slb.com (modified)

2.4.2.2 Drilling Fluid

The primary functions of the drilling fluid are to:

- Lubricate, cool and clean the drill bit
- Carry cuttings out of the wellbore
- Reduce friction between the drill string and the wellbore
- Prevent the inflow of formation fluids by adjusting the density of the drilling fluid
- Form a filter cake to seal off the formation and maintain integrity of the wellbore

Drilling fluids are composed of a number of elements, including weighting agents, viscosity agents and other components. Based on the low-pressure ('normal') reservoirs encountered in past drilling programs in The Bahamas, seawater and sweeps of water-based fluids are expected to be used.

2.4.2.3 Managed Pressure Drilling (MPD)

There have been several other wells drilled offshore the Bahamas. During drilling of these wells, at some stage or other, muds were lost to the formation. In other words, muds flowed into fractured (or 'vuggy') rock, instead of being returned to the surface. If such losses occur in the present program, BPC and its integrated well services provider, Halliburton, will attempt to stop the losses with special lost circulation materials (LCM) or cement. If unacceptable losses continue, an additional casing string will be installed before drilling deeper.

The drilling rig for BPC is equipped with special Managed Pressure Drilling (MPD) equipment which is designed to safely drill with acceptable losses. This equipment uses special computer-controlled chokes and flow meters to adjust the pressures on the well. Trained technicians monitor the progress to verify that the operation is safely conducted. The following schematic of a past MPD project (Figure 2-12) gives an indication of the complexity of the system. None of the wells drilled in The Bahamas to date, all of which have been safely drilled, have had the benefit of this extra tier of safety integrity afforded by the use of this innovative and modern technology.

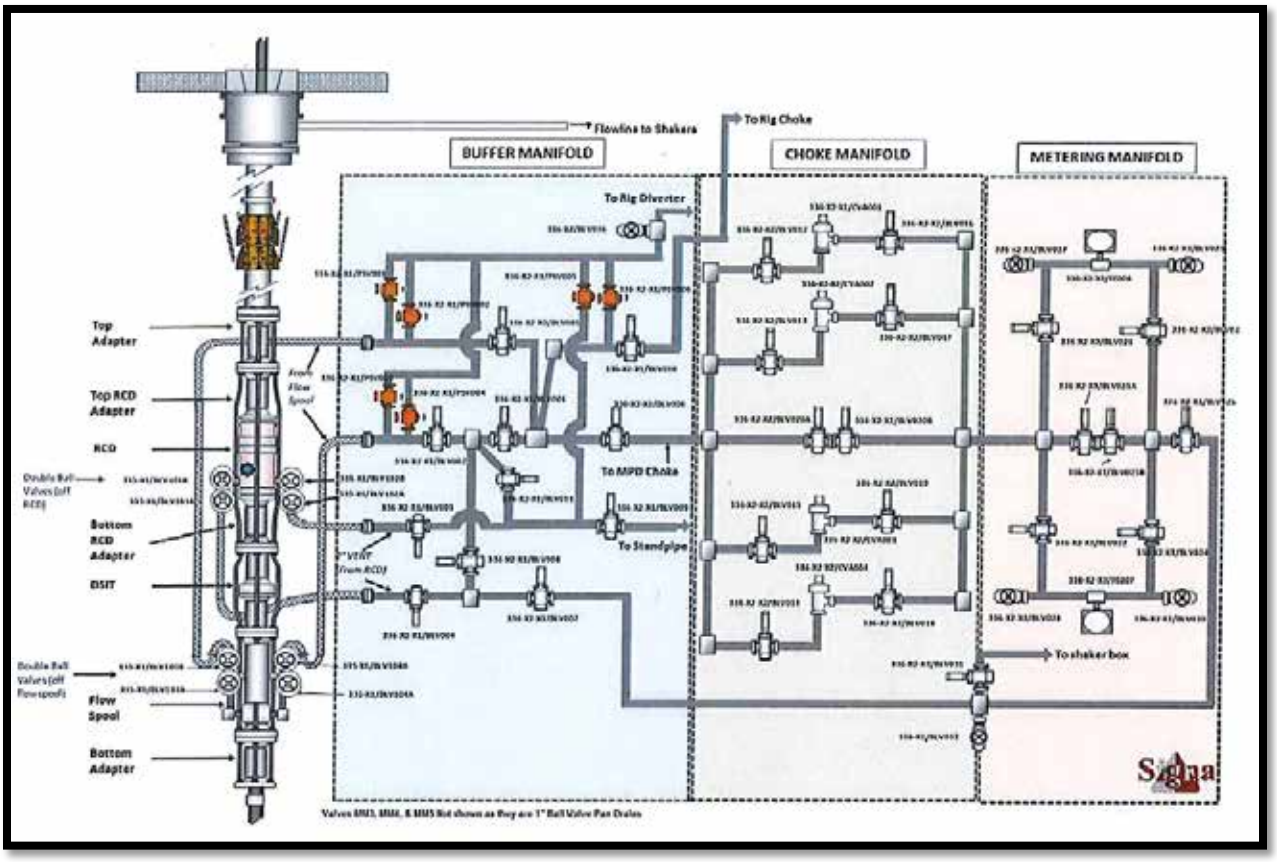

Figure 2-12: Example of MPD surface equipment

2.4.2.4 Well Control

Maintaining pressure control of the well at all times is fundamental to safe drilling operations. Over and above the MPD, instrumentation in the mud pits, the flow lines, and in the downhole gauges monitor the status of the well at all times. Several systems are used to maintain control of the well during the drilling process. Firstly, the hydrostatic pressure of the drilling mud is used to 'overbalance' the pressure in the rock formation to ensure there is positive pressure into the rocks at depth. Barite is used in the mud to increase the density and therefore the weight as necessary

to achieve this balance. Because the subsurface formations are expected to be low ('normal') pressure, only a relatively small quantity of barite is expected to be used in the drilling of this well.

The MPD equipment described in the section above is used to maintain control when relatively low pressures or losses are encountered. The drilling crews have been trained in using this equipment and have been using it in Brazil over a number of years. Trained technicians from the vendor Safekick will monitor the operation using sophisticated models and make adjustments as necessary.

The blowout preventer (BOP) will be activated if the surface pressures exceed the capability of the MPD system. In this case, drilling is stopped until the pressures are reduced by circulating the mud or systematically increasing the density of the mud until the pressure is reduced. Once the pressures are reduced, then drilling can resume. Specialists within the drilling crew maintain and operate the BOP equipment to ensure a completely safe operation. The BOP has redundant operating systems and multiple sealing points. There is never a single seal maintaining control in the well control system. Each system is tested on a periodic basis to ensure that the equipment and the crews are ready.

2.4.2.5 Logging

The drilling assembly includes sophisticated electronic Logging While Drilling (LWD) tools to evaluate the formation parameters in real-time as the well is being drilled. Logs may also be run on electric line to supplement the LWD measurements.

Used together, the logs provide a profile of the entire length of the wellbore by measuring a variety of including electrical, acoustic, and radioactivity parameters of the drilled formation. Analysis of the logs will allow BPC to estimate factors including lithology, porosity, permeability, fluid content, volumes, and which zones within the well are most likely to produce hydrocarbons.

The conventional logs run include:

- Gamma ray – Effectively measures the content of clay minerals;
- Resistivity – Allows the estimation of the type of fluid present in the pore space in the formation;
- Sonic logs – Measure the time it takes an acoustic wave to travel a certain distance; this helps in the estimation of the density and porosity of the formation;
- Density - Measures the apparent density of the formation; needed to estimate the porosity of the formation;
- Neutron – Indicates the content of hydrogen in the formation; this helps identify zones with greater pore space in the formation, in which hydrocarbons may be stored.

2.4.2.6 Coring

During the drilling operations BPC will periodically collect rock samples via sidewall coring. In this process sampling devices are driven into the sidewalls of the well to extract samples of the rock. In addition, in good potential reservoir depths, BPC may elect to extract rock cores through the drilling process.

2.4.3 Decommissioning and Abandonment

Following drilling, the well will be either temporarily or permanently abandoned and the rig will move away to its next assignment. Determination of abandonment type (temporary or permanent) will depend on data collected during the drilling, logging and testing (if any) activities.

2.4.3.1 Well Decommissioning and Abandonment

Once the exploratory drilling has been completed, well abandonment will be performed in accordance with international industry-accepted practices for offshore wells and consistent with the regulations of The Bahamas. If a well is temporarily suspended, cement and mechanical plugs will be used to isolate any hydrocarbon-bearing formations from the seabed. The drill string, riser and BOP equipment will be removed from the wellhead. Wellheads will be left in place, as the water depth precludes damage and allows for future well re-entry at a later date.

Two mechanical barriers will be placed and tested between any identified productive zones and the surface. The well suspension or abandonment program is designed to prevent connection of potential aquifers to hydrocarbon bearing horizons and potential flow of hydrocarbons or other fluids within the wellbore or to the seabed.

2.4.3.2 Perform Remotely Operated Vehicle Survey

Prior to demobilization from the drill site, a seabed site clearance (debris) survey will be undertaken using an. The ROV will be deployed from the drillship to perform a video inspection of the drill site. The survey will be used to check if any equipment or debris has been left in place or if any unexpected potential impacts have occurred, in which case mitigation measures will be undertaken to resolve these issues. A typical ROV can provide video inspections up to 500 ft. (~150 m) down current from the well site to document the extent of any materials deposition on the sea floor.

2.4.3.3 Recover Seafloor Equipment and Release Rig

Once the well has been secured and all necessary equipment retrieved, the drilling rig is prepared for movement to its next drill location.

2.5 Environmental, Health and Safety Management

Programs are in place throughout the Project to manage the health, environment and safety aspects of the drilling program as described in the following sections and as required by the Petroleum Act and associated Regulations.

2.5.1 Waste Management

Wastes, including sanitary, gay water, food, domestic, industrial, and drill cuttings, will be generated during the project. A Waste Management Plan is be in place for the project detailing appropriate storage, handling and disposal practices for each waste. The workforce is trained in a Hazard Communication Program so that potentially hazardous materials transported between the vessel and shore are properly labelled (manifested) and handled. The following sections describe waste handling practices for the project. Discharges will be in compliance with international standards (e.g., International Convention for the Prevention of Pollution from Ships 1973, as modified by the Protocol of 1978 [MARPOL 73/78]).

2.5.1.1 Sanitary and Domestic Liquid Waste

The drilling rig is equipped with a marine sanitary treatment unit (Figure 2-13) with capacity to handle sewage (‘black water’) generated by the expected full crew complement (up to approximately 200 persons). Wastewater from showers, hand basins and kitchens (‘gay water’) is not treated but discharged directly to the sea. Sewage treatment on offshore drilling rigs is typically achieved using a process of aeration, settling and chlorination to break down and sanitize sewage.

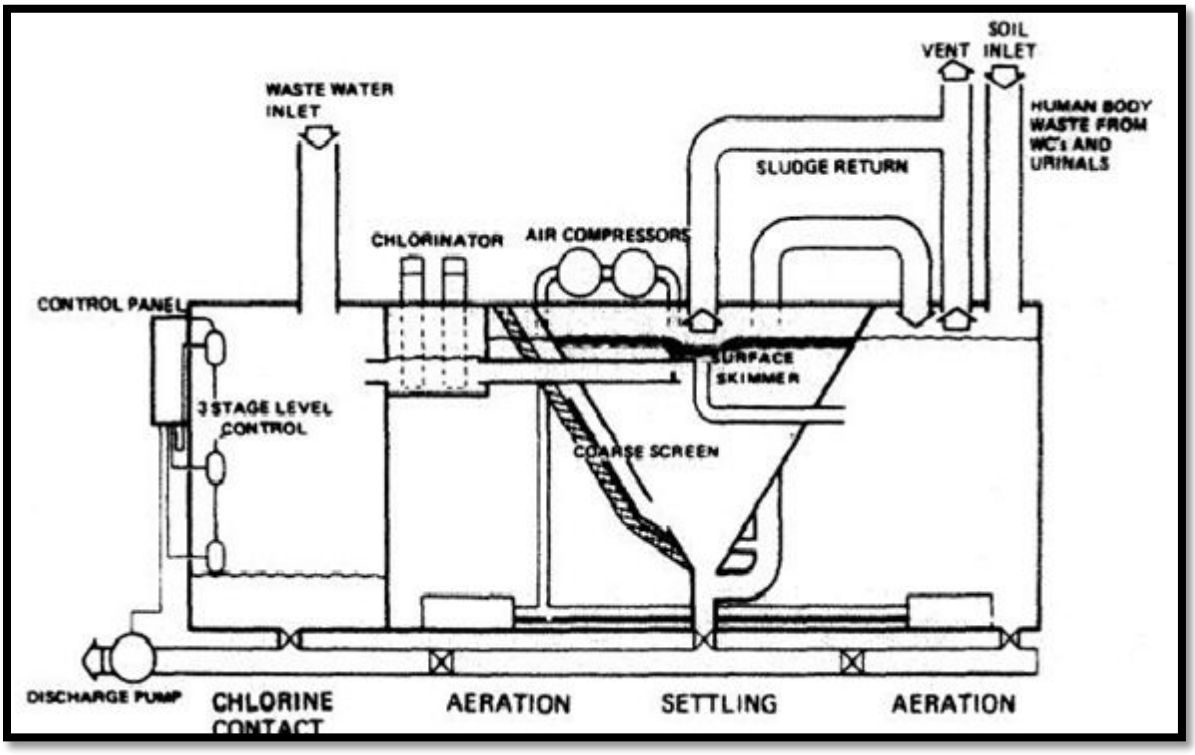

Figure 2-13: Schematic of Typical Marine Sanitary Treatment Unit
Source: Taylor, B.A. 1996.[3]

After treatment, the black waters are permitted to be discharged to sea via a hose or dedicated port in the deck. In accordance with the provisions of MARPOL 73/78 Annex IV, discharges will have no floating solids, will not cause discoloration of the surrounding waters and will have less than 3.33×10^{-4} lb/gal (1 mg/l) of residual chlorine consistent with other maritime vessels in The Bahamas. The sanitary treatment unit and discharge system are monitored and maintained in accordance with the Environmental Management Plan.

Typically, a person generates approximately 30 gallons/day (110 litres/day) of black water and 60 gallons/day (220 litres/day) of gay water. Assuming approximately 200 persons at a time is needed for offshore activities, it is expected that approximately 6,000 gallons (22,700 litres) of black water and approximately 12,000 gallons (45,400 litres) of gay water may be generated and discharged per day. Additional black and gay water produced from the contract PSVs is treated onboard each vessel in accordance with MARPOL 73/78.

2.5.1.2 Food and Domestic Solid Waste

This waste is generated from offices, sleeping areas and recreation areas. It is estimated that approximately 4½ pounds (~2 kg) will be generated per person per day. With a maximum expected crew of 200 persons on board the drilling rig, this amounts to approximately 900 pounds (~400 kg per day). Food wastes are ground up into particles not larger than one inch (25 mm) and disposed of at sea from a discharge pipe located at least 20 feet (6 m) below the water surface, not less than 3 nautical miles (~5.5 km) from the shore, in accordance with MARPOL 73/78.

3 Taylor, B.A. 1996. Introduction to Marine Engineering. Burlington, MA: Elsevier Butterworth-Heinemann.

Domestic solid wastes such as paper, cardboard, aluminium cans, etc., are sorted, compacted, packaged and transported to approved waste management facilities via the shore base for recycling or proper disposal, as appropriate.

2.5.1.3 Industrial Waste

Industrial solid wastes include packaging material, construction materials, rubber, bulk scrap metal, drums, containers and other by-products generated during offshore drilling activities. Industrial wastes are sorted and temporarily stored in appropriately marked containers pending disposal. Additional precautions and safeguards will be used to dispose of special wastes (such as batteries and medical wastes) properly. Once on land, wastes will be packaged and transported by licensed waste management companies for proper handling, treatment and disposal.

Industrial liquid wastes include used oils and other liquids such as paint thinner and lubricants. Hazardous liquids will be stored in tanks, pending treatment, recovery or disposal. On average, the Project will generate approximately 5,300 gallons/well (~20,000 litres/well) of waste oil. BPC has a project specific Waste Management Plan which is to be complied with by the drilling contractor.

2.5.1.4 Drill Cuttings

During drilling activities, rock chippings from the earth, drill cuttings, will be passed through solids control equipment prior to being returned overboard to the seabed. Expected volumes of cuttings that will be generated during different stages of drilling are presented below. Drill cuttings and fluids will pass through solids removal equipment consisting of scalping shakers, primary shakers and centrifuges (see Figure 2-14 for an example of a shaker). Centrifuges use centrifugal force to separate any drilling fluid from smaller solids, allowing the drilling fluid to be returned to the circulating system and the rock solids to be returned overboard to the seabed.

Table 2-3 shows estimated cutting discharges per well. Estimates are expected to vary depending on the well location.

Figure 2-14: Typical Shale Shaker

Source: http://oilfield.gnsolidscontrol.com/

Table 2-3: BPC Drilling Fluid Program and Projected Discharges[4]

Interval	Casing	Measured depth	Boring Depth	Fluid Type	Fluid density	Estimated Cutting Discharges	Discharge Location
36”	36” casing	1968 ft	120 ft	Seawater with viscous sweeps	10 ppg seawater		Seafloor
26”	20” casing	3,280 ft	3,200 ft	Seawater with viscous sweeps	9.0 – 9.5 ppg		Seafloor
16.5”	13-3/8” casing	7,350 ft	4,100 ft	Seawater with viscous sweeps	9.0 – 9.5 ppg		Overboard drillship
12.25”	9-5/8” casing	11,220 ft	3,900 ft.	Inhibited seawater mud	9.0 – 9.5 ppg		Overboard drillship
8.5”	7” casing	13,650’ – 15,820 ft	4,600 ft		9.0 – 9.5 ppg		Overboard drillship
Total			18,000 ft	-		15,800 ft[3]	-

The following tables (Table 2-4, Table 2-5, Table 2-6, Table 2-7, Table 2-8, and Table 2-9) show calculations for estimated drilling mud discharges and constituent components at various well depths and with various anticipated casing types. The program is based on Halliburton mud products.

Table 2-4: Drilling Mud Discharges: 16.5” Hole with Discharge at Seabed

PRODUCT	COMMON NAME	PURPOSE	CONCENTRATION	DISCHARGE
Barazan D Plus	XC Polymer	Viscosifier	1% in seawater	900 pounds
Baroid Bulk ST	Barite	Weighting material	As required	16 tons

Table 2-5: Drilling Mud Discharges for 13-3/8” Casing while Cementing (Mud Discharged at Seabed)

PRODUCT	COMMON NAME	PURPOSE	CONCENTRATION	DISCHARGE
Barazan D Plus	XC Polymer	Viscosifier	1% in seawater	1000 pounds
Baroid Bulk ST	Barite	Weighting material	As required	21 tons

Table 2-6: Mud on Cuttings in 12.25” Hole, Discharge 20’ Below Surface of Water

PRODUCT	COMMON NAME	PURPOSE	CONCENTRATION	DISCHARGE
Barazan D Plus	XC Polymer	Viscosifier	1% in seawater	350 pounds
Baroid Bulk ST	Barite	Weighting material	As required	7 tons
Aldacide G	Antimicrobial	Biocide	.3 ppb	100 pounds
Oxygon	Oxygen scavenger	Oxygen scavenger	.1 ppb	50 pounds
Sourscav	H2S scavenger	H2S scavenger	.25 ppb	100 pounds

[4] This is an example drilling fluid program and does not represent the depth of the well

PRODUCT	COMMON NAME	PURPOSE	CONCENTRATION	DISCHARGE
Baracor 100	Corrosion inhibitor	Corrosion inhibitor	.1 ppb	50 pounds
PAC-L	Cellulose polymer	Fluid loss	1%	400 pounds

Table 2-7: Mud Discharged at the End of the Project (1600 Barrels)

PRODUCT	COMMON NAME	PURPOSE	CONCENTRATION	DISCHARGE
Barazan D Plus	XC Polymer	Viscosifier	1% in seawater	1600 pounds
Baroid Bulk ST	Barite	Weighting material	As required	34 tons
Aldacide G	Antimicrobial	Biocide	.3 ppb	400 pounds
Oxygon	Oxygen scavenger	Oxygen scavenger	.1 ppb	160 pounds
Sourscav	H2S scavenger	H2S scavenger	.25 ppb	400 pounds
Baracor 100	Corrosion inhibitor	Corrosion inhibitor	.1 ppb	160 pounds
PAC-L				2000 pounds

Table 2-8: Mud Pits Cleaned at the End of the Project

PRODUCT	COMMON NAME	PURPOSE	CONCENTRATION	DISCHARGE
Barazan D Plus	XC Polymer	Viscosifier	1% in seawater	250 pounds
Baroid Bulk ST	Barite	Weighting material	As required	2 tons
Aldacide G	Antimicrobial	Biocide	.3 ppb	25 pounds
Oxygon	Oxygen scavenger	Oxygen scavenger	.1 ppb	10 pounds
Sourscav	H2S scavenger	H2S scavenger	.25 ppb	25 pounds
Baracor 100	Corrosion inhibitor	Corrosion inhibitor	.1 ppb	10 pounds
PAC-L				150 pounds
Stoppit	Granular LCM	Lost circulation material (LCM)	As required	
Barablend 665	Particle and foam	LCM	As required	
Baralock 666 M	Foam	LCM	As required	
Baralock 666 C	Foam	LCM	As required	
Wallnut course	Nutplug	LCM	As required	5000 pounds
Steelseal 1000	Graphite LCM	LCM	As required	
Barofibre C	Cellulose fiber	LCM	As required	5000 pounds
Barofibre 150	Cellulose fiber	LCM	As required	5000 pounds
Barocarb 600	Marble	LCM	As required	5000 pounds

Table 2-9: Total Mud Products Discharged for the Project

PRODUCT	COMMON NAME	PURPOSE	CONCENTRATION	DISCHARGE
Barazan D Plus	XC Polymer	Viscosifier	1% in seawater	4100 pounds
Baroid Bulk ST	Barite	Weighting material	As required	80 tons
Aldacide G	Antimicrobial	Biocide	.3 ppb	525 lbs
Oxygon	Oxygen scavenger	Oxygen scavenger	.1 ppb	220 lbs
Sourscav	H2S scavenger	H2S scavenger	.25 ppb	525 lbs
Baracor 100	Corrosion inhibitor	Corrosion inhibitor	.1 ppb	220 lbs
PAC-L				4100 pounds
Stoppit	Granular LCM	Lost circulation material (LCM)	As required	

PRODUCT	COMMON NAME	PURPOSE	CONCENTRATION	DISCHARGE
Barablend 665	Particle and foam	LCM	As required	
Baralock 666 M	Foam	LCM	As required	
Baralock 666 C	Foam	LCM	As required	
Wallnut course	Nutplug	LCM	As required	5000 pounds
Steelseal 1000	Graphite LCM	LCM	As required	
Barofibre C	Cellulose fiber	LCM	As required	5000 pounds
Barofibre 150	Cellulose fiber	LCM	As required	5000 pounds
Barocarb 600	Marble	LCM	As required	5000 pounds

Once the marine riser is installed, cuttings will be discharged via a subsea caisson11.8 m below the surface of the water. Due to the design of the vessel, this discharge point cannot feasibly be adjusted.

2.5.2 Discharges

In addition to discharge of drill cuttings and food waste described in Section 2.5.1, discharges will also be generated from deck drainage and other sources described below. Discharges will meet MARPOL requirements and be consistent with other maritime vessels operating in The Bahamas.

There will be no produced water discharges, as there will be no well testing or production.

2.5.2.1 Deck Drainage

Wastewaters resulting from rainfall, rig washing, deck washing, cleaning operations, and runoff from curbs and gutters, drip pans, and work areas are all collected and directed to water treatment systems. Runoffs are passed through a water drain system that has a sensor to detect oil. If oil is detected, the flow is diverted to an oily water system. This system is designed to avoid any discharges that will create sheen on the ocean surface. Water containing less than 40 milligrams per litre of hydrocarbons on a micro-concentration will be discharged overboard.

The volume of deck drainage varies with the amount of rainfall and the overall dimensions of the drilling rig. A typical drilling rig has an area of 80,700 $ft.^2$ (~7,430 m^2) and The Bahamas receives an average of approximately 50 inches (1270 mm) of rain per year. Assuming a similar rainfall average at the drill sites (though drilling is scheduled to take place at the drier time of year), the total deck drainage volume over a period of one month would be less than 16,375 gallons (62 m^3). In addition, deck washes, tank cleanings and other uses will consume relatively small amounts of water.

2.5.2.2 Bilge Water

Support vessels will occasionally discharge treated bilge water. Consistent with MARPOL requirements, these vessels retain onboard bilge water until it can be discharged offshore or sent to an approved reception facility at the shore base, unless it is treated by approved oily water separators and monitoring equipment before being discharged to the sea. Vessels will employ approved equipment, examined and tested in accordance with the specifications and requirements of the International Maritime Organization Guidelines and Specifications for Pollution Prevention Equipment for Machinery Space Bilges of Ships.

2.5.2.3 Brine

During the drilling program, sea water is extracted from ocean waters surrounding the drillship, desalinated and/or filtered, if needed. The most modern systems generate up to 26,000 gallons (100 m^3) of potable water per day with further potable water being supplied by vessel if needed.

The brine discharge is generally very small and quickly dissipates within the naturally salty sea. The estimated volumes are included in the well-specific Environmental Management Plan. Brine generated from desalination of sea water (through reverse osmosis) will be discharged directly to sea consistent with MARPOL requirements.

2.5.2.4 Ballast Water

Ballast water will be discharged to sea according to the rig specific Ballast Water Discharge Management Plans. These plans will comply with IMO guidelines and be consistent with other maritime vessels operating in The Bahamas.

2.5.2.5 Other Discharges

Water will be used to cool process equipment and engines through a closed loop system. Cooling water discharges are not expected. Additional discharges from boiler blow-down or other miscellaneous sources are possible, but negligible. If needed, these will be treated to meet MARPOL requirements before discharge and be consistent with other maritime vessels operating in The Bahamas.

2.5.3 Air Emissions

Diesel engines that power the drilling rig, diesel engines and generators used on the rig to power drilling and other equipment, and flaring emit carbon monoxide (CO), nitrogen oxides (NOx), sulphur oxides (SOx), and volatile organic compounds (VOC), as well as particulate matter (PM) and greenhouse gases such as carbon dioxide (CO_2) and methane (CH_4). These emissions will be temporary and consistent with other marine vessels in the vicinity. An exploration well drilled to normal depths and of typical duration can produce approximately 4.4 million pounds (2,000 metric tons) of CO_2 equivalent per well, derived almost entirely from diesel-driven electrical generators and equipment consistent with that maintained and operated on other similar maritime vessels operating in The Bahamas.

No well testing of production will occur, so there will be no routine flaring. If needed, flaring may occur to avoid a blowout, but this is unexpected and would be temporary.

Diesel engines used on the drilling rig are certified by manufacturers. BPC will conduct a rig audit prior to commencement of drilling that will include a check of primary diesel engines to confirm equipment is in good working order and within manufacturer's specifications.

2.5.4 Environment, Health, and Safety

BPC has specifically hired a drilling contractor that has strong environmental, health and safety (EHS) track record. Seadrill records historical lost time incidents, first aid cases, safety reporting systems, and other safety statistics. Their policies, guidelines and systems are in place for all EHS areas including spill plans, waste management, well control, training and competency (records), well control training and records, permitting systems, maintenance plant performance management systems, critical equipment list and schedules, marine standards, rig certification and classing.

Plans specific to the project are in place to protect the health and safety of the workforce and the public while reducing potential impacts to the environment.

The most significant environmental impact from offshore drilling operations is assessed as being associated with the potential for an oil spill. Such spills may result from loss of well control or blow-out from within a reservoir. Whilst such losses of control are unlikely, mitigation measures to

manage such an incident are described below. The planned drilling activity is termed exploration and, despite the Company's best efforts, may not actually encounter any oil in place, further mitigating the possibility of such a spill.

2.5.4.1 Spill Prevention and Response

In the event of an accidental spill, the drilling rig and support vessels are outfitted with the necessary safety and emergency response equipment to manage major and minor emergencies.

Standard practice in the oil and gas industry is to utilize a tiered preparedness and response system to ensure that appropriate resources can be mobilized rapidly to provide an effective response to any spill, small or large. The three Tiers are outlined below but described more fully in the Oil Spill Response Plan (OSRP)[5].

Tier 1: Tier 1 events are relatively small and/or affect a localized area. Spills that are considered Tier 1 spills (small, operational-type spills) will be addressed using equipment on board the drill rig and vessels. Supply vessels will maintain equipment to address Tier 1 spills (containment and dispersant) and crews are trained in the use of this equipment.

Tier 2: Tier 2 events are more diverse in their scale and by their nature and involve potentially a broader range of impacts and stakeholders. To respond to a Tier 2 spill, BPC will utilize resources of a contracted third-party oil spill response organization, Oil Spill Response Limited (OSRL). OSRL is a membership organization capable of responding to spills in the Southern Licenses. If needed, additional pollution abatement equipment is available in The Bahamas and in other areas of Florida and the Caribbean, namely in: Miami, Fort Lauderdale, Tampa, and Orlando (under the MSRC organization), Aruba (Valero Refinery N.V.), Bonaire (BOPEC), Curaçao (ISLA), Puerto Rico, St. Croix (under the MSRC organization), St. Eustatius (Statia Terminals), Trinidad and Venezuela.

Management responsibilities in a Tier 2 event are usually shared in a collaborative approach and a critical feature is the integration of all resources and stakeholders in the response efforts.

Tier 3: Tier 3 events are rare but have the potential to cause a widespread impact, affecting many people and overwhelming the capabilities of local, regional and even national resources. Oil Spill Response Limited is available 24-hours per day for a Tier 3 spill and is capable of deploying internationally recognized equipment, personnel, best practices and technologies. These include:

- Dispersant and application equipment;
- In-situ burn equipment;
- Containment boom and anchoring equipment;
- Mechanical recovery / skimming systems;
- Temporary and intermediate storage and pumps;
- Command, control and communications equipment;
- Beach clean-up equipment; and
- Other support supplies.

The resources described above and BPC 's careful planning will help ensure that sensitive coastal resources and local fishing activities are protected even in the event of a spill of this magnitude.

[5] International Petroleum Industry Environmental Conservation Association (IPIECA). 2008. Oil Spill Preparedness and Response: Report Series Summary. Accessed June 5, 2009 from the IPIECA Website: http://www.ipieca.org/

Oil spill trajectory modelling was performed for this Project to help BPC and its drilling contractor prepare for a spill (see Chapter 6). BPC will have an Oil Spill Contingency Plan in place that describes how spills will be prevented, minimized and addressed based on the results of this modelling. In addition to BPC 's plans, there is a Shipboard Oil Pollution Emergency Plan (SOPEP) and an Emergency Response Plan (ERP) for the rig. Both the drilling rig and supply vessels have protocols in place for conducting refuelling in order to prevent spills. BPC will review these procedures prior to drilling. These procedures are included in the well specific environmental management plan.

2.5.4.2 Emergency Response

BPC has an Emergency Response Plan in place to address potential emergencies and threats to the health and safety of personnel and the public. Drilling rig staff have Basic Offshore Survival and Induction Emergency Training (BOSIET) or an internally recognized equivalent. Prior to well spud, and throughout drilling operations, BPC and its contractors will repeatedly carry out exercise drills to ensure preparedness.

No hydrogen sulphide gas (H_2S) is anticipated during the drilling of this well. However, H_2S procedures are in place already prior to commencement of drilling. The drilling rig will always have a minimum level of breathing apparatus sets and H_2S drills will be performed on a regular basis. H_2S monitors onboard the ship will be checked regularly.

H_2S and other gases are not taken on to the rig in an uncontrolled manner. Small amounts of gas can be entrained in the mud or in a "kick". This will be circulated from the well in a controlled manner and vented using the appropriate systems (degasser or diverter systems for example).

If high H_2S levels are detected during any operation, an alarm will be sounded. All non-essential personnel will be moved to accommodation which is positively pressurized. The well will be brought under control. If detected, the gas will be pumped downhole in a process known as 'bullheading'.

While BPC intends to drill outside of hurricane season to avoid potential disruption from hurricanes, the ERP will contain hurricane preparedness and response. In the event that the company is forced to drill during hurricane season, the company will follow standard industry practices for managing this risk (i.e. International Association of Drilling Contractor recommendations), for example closure of the well and mobilization of the rig to a safe area. Time required to close the well and mobilize the drilling rig is approximately 1-3 days depending on the operations underway at the time.

2.6 Project Alternatives

Viable alternatives that can be considered for offshore exploration drilling activities are often limited because of technical requirements for drilling programs. These include the requirement to locate a well above or near a target hydrocarbon reservoir, the requirement to use specific types of equipment and materials (e.g. drilling fluids) techniques based on the water depth and geology of the drill site, and the requirement to carefully schedule drill ships far in advance.

Alternatives considered for the Project are described below.

"No Action" Alternative: If the Project did not take place, the potentially adverse impacts described in Chapter 5 would not occur. However, taking no action would contravene the terms of BPC's licenses and prevent the Government of The Bahamas realizing the substantial potential

economic benefits if commercial quantities of hydrocarbons are discovered and produced as a result of the drilling. These potential benefits include significantly increased revenue to the Commonwealth of The Bahamas and the potential indirect benefit to local businesses that may support the Project. For example, as stated in Chapter 1, oil and gas companies have invested $USD 2.8 billion in exploration and production activities in Cuba since 1991.[6] Based on the fact that the potentially adverse impacts are modest, manageable and the potential benefits of the drilling program far outweigh the alternative, the "No-Action" alternative is not warranted.

Well Location: A number of potential well locations were selected based on review and interpretation of geophysical data. The first well location is identified in Section 2.1 and additional well locations will be identified at a later date as appropriate. When environmental sensitivities are present, companies can use directional drilling (horizontal and extended reach) techniques to avoid sensitive surface areas and to gain access to the reservoir from less sensitive surface areas. No drilling will occur in shallow waters of Grand Bahama Bank, although some seafloor sensitivities were identified in the blocks, even on the channel basin. However, the selected well sites are not in areas of sensitivity, although this needs to be confirmed with ROV survey prior to spud.

Type of Drilling Rig: The drilling rig to be used in this offshore exploration drilling is described in Section 2.2. Given the expected water depth at the proposed drilling locations, two types of drilling units were evaluated: semi-submersibles and drill ships. BPC and its contractors will follow the same practices and procedures for mitigating potential impacts of the Project regardless of the rig and drilling method used. Further, potential impacts of both types of rig are the same.

Types of Drilling Fluids: As discussed in Section 2.4.2, drilling fluids are used to lubricate the drill bit and circulate drilled cuttings out of the well bore. There are three major types of drilling fluids, however, BPC will drill only with seawater and periodic seeps of water-based drilling fluids. BPC will not use synthetic or oil-based muds for this drilling program. Water based fluids consist of freshwater or saltwater, barite, clay, caustic soda, lignite, lignosulfonates, and/or water-soluble polymers.

Shore Base Location: BPC evaluated several locations for a potential shore base.

The integrated service providers like Halliburton (appointed to the project) already have facilities in the Port of Fourchon, Louisiana to support the drilling industry. Mud and cement are stored in quantity at the Port. Other equipment is either stored at Fourchon or in close proximity. While the ports in Florida are closer to the drilling location, it is not practical to send the number of trucks to Florida that would be required and would create a greater holistic impact. Therefore, the primary port will be Fourchon. Fourchon is 719 nautical miles to the rig; at 15 knots, the transit time is 2 days.

Other ports can be considered for smaller shipments, like rental tools, replacement parts etc. if the equipment is required urgently or before the supply boat arrives. The route between Port Fourchon and the drilling site, as well as areas around alternate ports are included in the project's Area of Direct Impact (ADI) and Area of Indirect Impact (AII) (Figure 2-15).

6 "Highlights of Cuban Deepwater Drilling Programs". 2011. Environmental Conference & Exhibition, Trinidad. May 12-13, 2011.

2.7 Areas of Impact

The Area of Direct Impact (ADI) includes:

- All potential drilling sites (portions of the Blocks with water depths greater than 980 ft or 300 m), including a 3-mile (~5 km) buffer that could be affected by emissions, discharges or other drilling related activities;
- Port facilities in Port Fourchon, Louisiana, USA and the Mami Executive Airport in Florida, USA; and
- A transportation corridor, used by supply vessels and helicopters, to/from the Blocks and port facility/airport.

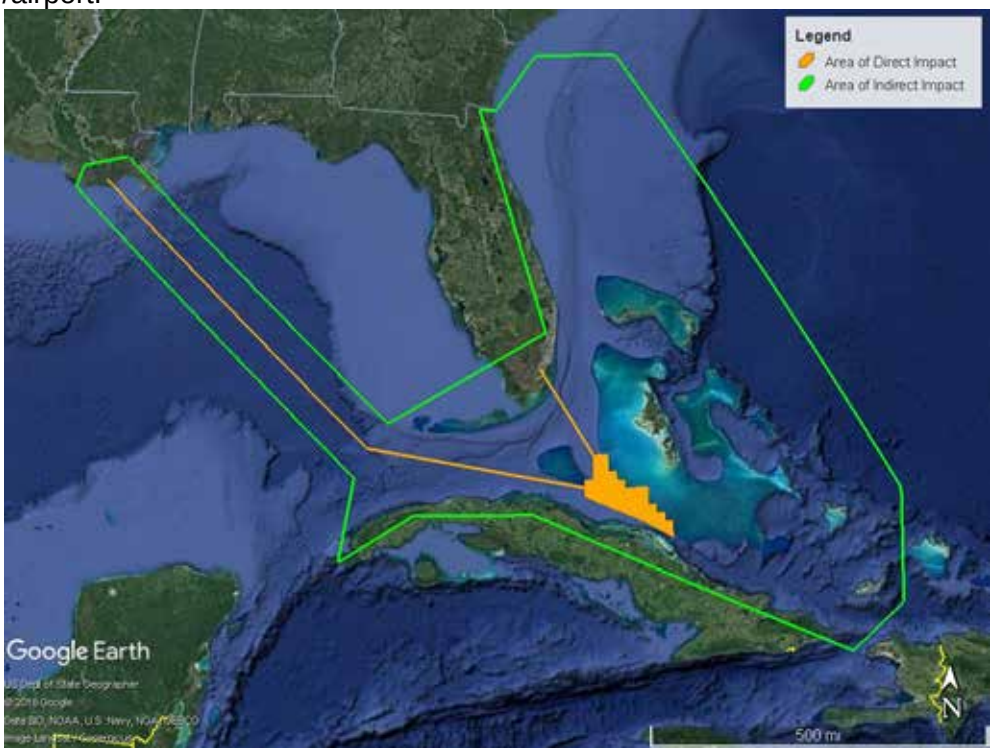

Figure 2-15: Area of Direct and Indirect Impact

The Area of Indirect Impact (AII) encompasses areas where project activities could have indirect or cumulative impacts or be affected in from an unplanned event.

The AII presented in Figure 2-15 is based on oil spill dispersion modelling results of an unmitigated Worst-Case Discharge of oil at the Perseverance well (see spill modelling report in EMP Appendix E, Attachment A). The AII includes:

- All shorelines predicted to have oil >100 microns (µm) thick during a 'worst case' spill
- Approximate ocean surface predicted to have oil at least 1 µm thick during a 'worst case' spill
- Coastal communities (i.e. fishing or tourism dependent) adjacent to oiled coastline, including ports, beaches, protected areas and other coastline features
- Potential transportation corridors to shore base, including a 50-mile buffer zone that could be impacted by a vessel collision and diesel fuel spill
- Shore base location and 30-mile onshore buffer zone surrounding the port

The baseline profile presented in Chapter 4 focuses on areas within the ADI, as these areas are more likely to be impacted by project activities, and presents an overview of all areas within the

entire AII. Areas within the AII are covered at an appropriate level necessary to conduct a thorough impact assessment, but not as detailed as the ADI.

A regional Sensitivity Map was developed and detailed Environmental Sensitivity Index (ESI) maps are available for all potentially affected coasts through the 3rd party oil spill response provider, Oil Spill Response Limited (OSRL).

3. Legislative and Institutional Framework

This section describes the relevant legislative framework (Sections 3.1 – 3.2) and institutional framework (Section 3.3) governing oil and gas exploration activities in The Bahamas. The Bahamas Environment, Science and Technology (BEST) Commission (Section 3.3.1) is the environmental regulatory authority in charge of reviewing EIA and EMP for development projects.

3.1 Local Legislation and Regulations

Relevant legislation and regulations that will be considered for the Bahamas Petroleum Company project include:

Antiquities, Monuments and Museum Act 1998
This Act provides for the preservation, conservation and restoration of historical, paleontological and archaeological resources.

Archipelagic Waters & Maritime Jurisdiction Act 1993
This Act establishes the boundaries of the archipelagic waters that come under the jurisdiction of The Bahamas as prescribed under the Law of the Sea Convention. The Bahamas thus has authority over these waters, the seabed and the resources found therein.

Bahamas National Trust Act 1959
This Act establishes The Bahamas National Trust as the entity that advises the Government on areas for preservation and conservation. It gives the Trust the power to create by-laws to be in effect in the protected areas it establishes. These areas are of environmental, historical and/or cultural importance. The Act was amended in 2010.

Coast Protection Act 1968
This Act serves to regulate construction or alteration of the coastline for the purpose of the protection of land. It also provides for protection against encroachment and erosion by the sea.

Conservation and Protection of the Physical Landscape of The Bahamas Act 1997
This Act prohibits all significant excavation, landfill operation, quarry mining or mining of physical natural resources (such as sand) without permission of the Director of Physical Planning. The Act also gives the Director the authority to request an EIA for any excavation or land reclamation activities. It also provides for the protection of trees that are rare and of historical significance and imposes stiff penalties for violators of this law.

Continental Shelf Act 1970
This Act provides for the protection, exploration and exploitation of the continental shelf. It gives The Bahamas Government sovereignty over the continental shelf.

Environmental Health Services Act 1987
This Act promotes conservation and maintenance of the environment and also addresses the control of contaminants and pollutants that may adversely affect the environment and human health. The Act also outlines regulations with respect to water supplies, solid and liquid waste, beaches, seaports, harbours and marinas.

Environmental Health Services (Collection and Disposal of Waste) Regulations 2004
These regulations provide for the collection and disposal of domestic, commercial and construction waste. Commercial waste includes ashes, refuse and rubbish. Construction waste includes any waste materials from construction, renovation, repairs and demolition.

Fisheries Resources (Jurisdiction & Conservation) Act 1977
This Act establishes the Exclusive Fishery Zone (EFZ). It reflects concern with respect to conservation and management of the marine environment and its resources. It also recognizes traditional fishing rights and provides for the declaration of protected marine areas and regulation of the fishing industry.

Forestry Act 2010
This Act provides for the:

- Setting of royalty fees, permits, leases, and license fees for utilization of forest produce and non–timber forest produce from the forest estate
- Management, conservation, control and development of forests, and the promotion and regulation of forest industries
- Promotion of the conservation and management of wildlife and wildlife habitat in forest reserves, protected forests and conservation forests

The Act also provides for the regulation and management of wetlands as these are classified as forests under the legislation.

Health and Safety at Work Act 2002
The Act provides for:

- Securing the health, safety and welfare of persons at work
- Protecting persons other than persons at work against risks to health or safety arising out of the activities of persons at work
- Controlling the keeping and use of explosive, highly flammable or other dangerous substances and preventing the unlawful acquisition, possession and use of such substances

Marine Mammal Protection Act 2005 and Marine Mammal Protection (General) Regulations 2005
The Act prohibits the taking and harassing of wild occurring marine mammals. It establishes the licensing and permitting system for capture of marine mammals for captive facilities as well as for scientific research on marine mammals.

The Regulations outline the application process for licenses to conduct scientific research on marine mammals and to operate a vessel to engage in or facilitate the observation of wild occurring marine mammals.

Merchant Shipping (Oil Pollution) Act 1976
This Act provides for the proper registration of ships, the control, regulation and orderly development of merchant shipping in The Bahamas, proper qualification of seamen and regulation of employment conditions for seamen. These provisions advocate ship safety and competency which prevent shipping accidents that can be detrimental to the marine environment as well as result in human casualties.

Planning and Subdivision Act 2010
This Act provides for:

- A land use planning based development control system led by policy, land use designations and zoning
- Prevention of indiscriminate division and development of land
- Efficient and orderly provision of infrastructure and services to the built environment
- Promotion of sustainable development in a healthy natural environment
- Maintenance and improvement of the quality of the physical and natural environment
- Protection and conservation of the natural and cultural heritage of The Bahamas
- Planning processes that are fair by making them open, accessible, timely and efficient
- Recognition of the decision-making authority and accountability of the Government in land use planning
- Planning for the development and maintenance of safe and viable communities
- The submission of an Environmental Impact Assessment as part of various types of development projects

The Act provides for regulating activities such as quarrying, mining, road construction and subdivision development.

Petroleum Act 2016
This Act provides for the exploration, boring and getting of petroleum. **The Act establishes a permitting, licensing and leasing system for the exploration, prospecting and mining of petroleum.**

Petroleum Regulations 2016
The Petroleum Regulations provides for applications for permits, licenses and leases, assignment, competitive bidding, lands and submarine area divisions.

Petroleum (Health and Safety) Regulations 2016
The Regulation outlines the duties relating to petroleum operations, duties relating to wells, duties relating to facilities, certification of fitness and inspection bodies, verification schemes for installations and the requirements for an emergency response plan.

Petroleum (Offshore Environmental Protection and Pollution Control) Regulations 2016
The Regulations outlines the components for the environmental impact assessment, the environmental management system, duties related to offshore installations, requirements for an International Oil Pollution Prevention Certificate, liability for environmental damage and the requirements for obtaining environmental authorization.

Port Authorities Act 1962
This Act provides for the regulation and control of ports, harbours and navigational aids throughout The Bahamas as well as pilots and pilotage. It also regulates dredging activities for harbours and ports. The Act prevents dumping of ship ballast water in Bahamian harbours. This can prevent the introduction of exotic species and pollution of waters.

Water and Sewerage Corporation Act 1976
This Act establishes the Water and Sewerage Corporation. Functions of this organization include the application of appropriate standards and techniques for investigation, use, control, protection, management and administration of water. The Corporation is also mandated to oversee waste disposal, water treatment and water quality.

Wild Birds Protection Act 1952
This Act provides for the protection of wild birds. The Act lists several species including the White-Crowned Pigeon, Whistling Duck and Yellow-Crowned Night Heron.

3.1.1 Draft Legislation
Over the years, there have been a number of draft bills for environmental legislation developed that have not yet been enacted including:
- Draft Environmental Protection (Effluent Limitations) Regulations 1995
- Draft Environmental Health Air Emissions Regulations
- Draft Pollution Control and Waste Management Regulations 2000
- Draft Environmental Impact Assessment Regulations 2000

3.2 Regional and International Treaties and Conventions

The international environment-related instruments to which the Bahamas is a contracting party are listed below.

Convention on the International Regulations for Preventing Collisions at Sea
Concluded: London, England, 20 October 1972
Depository: International Maritime Organization
Signed: 22 July 1976

The Convention on the International Regulations for Preventing Collisions at Sea (COLREGs – 1972) was designed to update and replace the Collision Regulations of 1960, which were adopted at the same time as the 1960 SOLAS Convention. The COLREGs include 38 rules divided into five sections: Part A - General; Part B - Steering and Sailing; Part C - Lights and Shapes; Part D - Sound and Light signals; and Part E - Exemptions. There are also four Annexes containing technical requirements concerning lights and shapes and their positioning; sound signalling appliances; additional signals for fishing vessels when operating in close proximity to other vessels, and international distress signals.

One of the most important innovations in the 1972 COLREGs was the recognition given to traffic controls and safe distance requirements. Rule 10 gives guidance in determining safe speed, risk of collision and conduct of vessels operating in or near other vessels. This rule requires vessels to avoid the path of other vessels that have limited manoeuvrability due to the need to stay on position or course as part of an activity requiring precise location or placement. Ships engaged in the drilling and occasional supply/transfer activities in the proposed drilling program are considered to have limited manoeuvrability.

International Convention for the Prevention of Pollution from Ships
Concluded: London, England, 17 February 1978
Depository: International Maritime Organization
Signed: 07 June 1983

The International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. MARPOL 73/78 is a combination of two treaties adopted

in 1973 and 1978, respectively, and updated by amendments through the years. The Bahamas has ratified Annexes I, III, and V. The six annexes are shown in Table 1.

Table 1: MARPOL Annexes

Annex	Description
Annex I	Regulations for the Prevention of Pollution by Oil
Annex II	Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk.
Annex III	Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form.
Annex IV	Prevention of Pollution by Sewage from Ships.
Annex V	Prevention of Pollution by Garbage from Ships.
Annex VI	Prevention of Air Pollution from Ships (entered into force 19 May 2005).

International Convention on Oil Pollution Preparedness, Response and Cooperation
Concluded: London, England, 30 November 1990
Depository: International Maritime Organization
Signed: 04 October 2001

Parties to the International Convention on Oil Pollution Preparedness, Response and Cooperation (OPRC) convention are required to establish measures for dealing with pollution incidents, either nationally or in co-operation with other countries. Ships are required to carry a shipboard oil pollution emergency plan. Operators of offshore units are also required to have oil pollution emergency plans (or similar arrangements) which must be coordinated with national systems for responding promptly and effectively to oil pollution incidents, such as The Bahamas National Oil Spill Contingency Plan and the Caribbean Island Oil Pollution Response and Cooperation Plan.

International Convention for the Safety of Life at Sea
Concluded: Montego Bay, Jamaica, 01 November 1974
Depository: International Maritime Organization
Signed: 16 February 1979

The International Convention for the Safety of Life at Sea (SOLAS, 1974) is widely considered to be the most important international treaty dealing with safety of operations for commercial ships. SOLAS requirements address fire prevention and detection, lifesaving equipment and navigation safety rules.

Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal
Concluded: Basel, 22 March 1989
Depository: United Nations
Signed: 12 August 1992

This Convention is the response of the international community to the problems caused by the annual world-wide production of hundreds of millions of tons of waste. These wastes are hazardous to people or the environment because they are toxic, poisonous, explosive, corrosive, flammable, eco-toxic, or infectious.

This global environmental treaty strictly regulates the transboundary movements of hazardous wastes and provides obligations to its Parties to ensure that such wastes are managed and

disposed of in an environmentally sound manner. The main principles of the Basel Convention are:

- Transboundary movements of hazardous wastes should be reduced to a minimum consistent with their environmentally sound management
- Hazardous wastes should be treated and disposed of as close as possible to their source of generation
- Hazardous waste generation should be reduced and minimized at the source

In order to achieve these principles, the Convention aims to control the transboundary movement of hazardous wastes, monitor and prevent illegal traffic, provide assistance for the environmentally sound management of hazardous wastes, promote cooperation between Parties in this field, and develop technical guidelines for the management of hazardous wastes.

United Nations Convention on the Law of the Sea
Concluded: Montego Bay, Jamaica, 10 December 1982
Depository: United Nations
Signed: 29 July 1983

The Law of the Sea Convention is referred to as "a constitution for the world's oceans". It obligates Contracting Parties to protect and preserve the marine environment and also confirms sovereignty of States in their territorial seas and exclusive economic zones. It addresses issues such as freedom of the high seas, protection of fishery resources, marine pollution and marine scientific research.

United Nations Framework Convention on Climate Change (UNFCCC)
Concluded: New York, 9 May 1992
Depository: United Nations
Signed: 12 June 1992

Global climate change refers to all aspects of the planet's climate that are or might be changing. This Convention was developed due to the concern of countries that human activities were significantly increasing the atmospheric concentrations of greenhouse gases. These increased concentrations are believed to enhance the greenhouse effect leading to additional warming of the planet's atmosphere and the oceans. This warming can cause changes in ocean currents and wind patterns as well as regional and local changes in temperature and precipitation. Such changes can have adverse impacts on natural ecosystems and humankind.

The objective of the UNFCCC is to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous human interference with climate systems of the planet. Achievement of such a level would allow ecosystems to naturally adapt to climate change, ensure that food production is not threatened, and enable economic development to proceed in a sustainable manner.

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
Concluded: Washington, DC, 3 March 1973
Depository: United Nations
Signed: 20 March 1979

The international wildlife trade, worth billions of dollars annually, has caused massive declines in the numbers of many species of animals and plants. The scale of over-exploitation for trade aroused such concern for the survival of species that an international treaty was drawn up to

protect wildlife against such over-exploitation and to prevent international trade from threatening species with extinction.

Known as CITES, this Convention now has a membership of 152 countries. These countries act by banning commercial international trade in an agreed list of endangered species and by regulating and monitoring trade in others that might become endangered.

Convention on Biological Diversity
Concluded: Rio de Janeiro, 5 June 1992
Depository: United Nations
Signed: 12 June 1992

Biological diversity refers to the variability of living organisms in terrestrial, marine and other aquatic ecosystems. The Earth's biological resources are vital to humanity's economic and social development. As a result, there is a growing recognition that biological diversity is a global asset of tremendous value to present and future generations. At the same time, the threat to species and ecosystems has never been as great as it is today. Species extinction caused by human activities continues at an alarming rate.
The main objectives of the CBD are the conservation of biological diversity, sustainable use of its components, and fair and equitable sharing of the benefits arising out of the use of genetic resources. These objectives are to be achieved through:

- Development of national strategies, plans or programs for the conservation and sustainable use of biodiversity
- Establishment of a system of protected areas
- Rehabilitation and restoration of degraded ecosystems
- In-situ and ex-situ conservation of biodiversity [*In-situ conservation* is the conservation of ecosystems and natural habitats, and the maintenance and recovery of species in their natural surroundings. Protected areas and national parks are examples of in-situ conservation sites. *Ex-situ conservation* is the conservation of components of biodiversity, whether it is genes, individuals or populations, outside their natural habitats. Zoos and aquariums are examples of ex-situ conservation facilities.]
- Establishment and maintenance of programs for scientific and technical education and training in measures for the identification, conservation and sustainable use of biodiversity and its components
- Promotion of biodiversity research
- Promotion and encouragement of the understanding of the importance of, and the measures required for, the conservation of biodiversity
- Introduction of appropriate procedures requiring environmental impact assessment of proposed projects that are likely to have significant adverse effects on biodiversity

Vienna Convention for the Protection of the Ozone Layer
Concluded: Vienna, 22 March 1985
Depository: United Nations
Signed: 1 April 1993

The amount of ozone that forms between 49,215 and 180,455 feet above the earth’s surface is known as the ozone layer. The ozone layer shields the earth from harmful solar rays. It protects all life on the earth and acts like a space suit for plants, animals and humans. The layer also affects the temperature distribution of the atmosphere and regulates the earth’s climate.

Ozone depletion is caused by ultraviolet radiation (from the sun's rays) and volcano eruptions. However, man-made chemicals are the main contributors of ozone depletion. The most harmful ones are as follows:

a. Chlorofluorocarbons (CFC's)
b. Hydro fluorocarbons (HCFC's)
c. Carbon tetrachloride
d. Methyl chloroforms
e. Halos
f. Methyl bromide

Ozone depletion can lead to the following effects:

a. Non-melanoma skin cancers
b. Reduction in the defences of the immune system and the effects of vaccination
c. Increased eye damage producing snow blindness that can further develop into cataracts
d. Disruption of the ocean life and the marine food web due to the effect of UV-B radiation on plankton
e. Increased air pollution with the toxic ozone gas in the lower atmosphere
f. Stunted growth in plants
g. Damage to materials like paints

Since the use of ozone depleting substances has been widespread, there had to be some international consensus or agreement to protect the entire earth from these harmful substances. Therefore, the Vienna Convention for the Protection of the Ozone Layer was devised. Parties to the Convention are obligated to adopt legislation or administrative measures to control, reduce or prevent human activities under their jurisdiction that are likely to have an adverse impact on the ozone layer. This includes the control or prevention of the use of ozone-depleting substances.

Montreal Protocol on Substances that Deplete the Ozone Layer
Concluded: Montreal, 16 September 1987
Depository: United Nations
Signed: 4 May 1993

In January of 1989, the Montreal Protocol was fully implemented to control production, consumption and the use of ozone-depleting substances.

As of April 2000, there have been 173 developed and developing countries that have agreed to the policies outlined by the Protocol. The Montreal Protocol dictates that gradually all CFC's and halons will be banned. Specific time frames are set for developed and developing countries to completely phase out use of these substances. The time frame for developing countries is longer than that of developed.

Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks
Concluded: New York, 11 August 1995
Depository: United Nations
Signed: 16 January 1997

It has been recognized that the management of high seas fisheries is inadequate in many areas of the world, resulting in the over-utilization of some resources. This agreement was developed as many countries recognized the need to avoid adverse impacts to the marine environment,

preserve biodiversity, maintain marine ecosystems and minimize the risk of long-term adverse effects of fishing operations. The Agreement serves to ensure the long-term conservation and sustainable use of straddling fish stocks and highly migratory fish stocks through effective implementation of the United Nations Convention on the Law of the Sea.

Mechanisms to achieve this include cooperation between countries to manage fisheries resources and migratory fish stocks, proper scientific assessment of stocks, and effective monitoring and enforcement of fishing operations.

Ramsar Convention on Wetlands
Concluded: Ramsar, Iran, 2 February 1971
Depository: United Nations
Signed: 7 June 1997

The Convention on Wetlands, signed in Ramsar, Iran, is an intergovernmental treaty which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. There are presently 121 Contracting Parties to the Convention, with 1027 wetland sites, totalling 78.1 million hectares, designated for inclusion in the Ramsar List of Wetlands of International Importance.

Wetlands are areas where water is the primary factor controlling the environment and the associated plant and animal life. They occur where the water table is at or near the surface of the land, or where the land is covered by shallow water. Wetlands are among the world's most productive environments. They are cradles of biological diversity, providing the water and primary productivity upon which countless species of plants and animals depend for survival. They support high concentrations of birds, mammals, reptiles, amphibians, fish and invertebrate species.

The Convention's mission is the conservation and wise use of wetlands by national action and international cooperation as a means to achieving sustainable development throughout the world.

Ramsar is the first of the modern global intergovernmental treaties on conservation and wise use of natural resources.

Kyoto Protocol to the United Nations Framework Convention on Climate Change
Concluded: Kyoto, 11 December 1997
Depository: United Nations
Signed: 9 April 1999

This Protocol was developed under the UNFCCC. It provides for the reduction of greenhouse gas emissions to protect the environment.

The Kyoto Protocol includes emissions targets and timetables for industrialized nations and market-based measures for meeting those targets. The Protocol sets binding emissions targets for developed nations. The specific limits vary from country to country, though those for the key industrial powers of the European Union, Japan, and the United States are similar -- 8% below 1990 emissions levels for the EU, 7% for the U.S., 6% for Japan.

The emissions targets for the developed countries are to be achieved over the commitment period 2008 to 2012. The greenhouse gases covered by the Protocol are carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulphur hexafluoride.

Cartagena Protocol on Biosafety
Concluded: Cartagena, 29 January 2000
Depository: United Nations
Signed: 24 May 2000

With modern biotechnology, researchers can now take a single gene from a plant or animal cell and insert it into another plant or animal cell to give the cell a desired characteristic, such as resistance to disease. Organisms resulting from the use of such techniques are referred to as living modified organisms (LMOs). This is sometimes done in the production of crops, such as corn, tomatoes and soybeans. Biosafety refers to efforts to reduce and eliminate the potential risks resulting from biotechnology and its products.

As biotechnology is a fairly new field, there is much about the interaction of LMOs with ecosystems that is still unknown. Countries party to the Convention on Biological Diversity agreed that there was a need to develop appropriate procedures to address the safe transfer, handling and use of LMOs as these could have adverse effects on the conservation and sustainable use of biological diversity. The Cartagena Protocol is the result of the process to develop such procedures. The Protocol also considers the risks these organisms present to human health and focuses specifically on their transboundary movement (i.e. from one country to another).

Countries that are party to the Protocol are obliged to ensure that the development, handling, transport, use, transfer and release of any LMOs are undertaken in a manner that prevents or reduces the risks to biological diversity and to human health.

The United Nations Convention to Combat Desertification and Drought (UNCCD)
Concluded: Paris, 15 October 1994
Depository: United Nations
Signed: 10 November 2000

This Convention offers new hope in the struggle against desertification and drought. Desertification and drought are problems of global dimension as they affect all regions of the world and it is a global effort that is necessary to combat desertification and mitigate the effects of drought.

Desertification is caused by climate variability and human activities. In the past, drylands recovered easily following long droughts and dry periods. Under modern conditions, however, they tend to lose their biological and economic productivity quickly unless they are sustainably managed. Drylands on every continent are being degraded by over cultivation, overgrazing, deforestation, and poor irrigation practices. Such overexploitation is generally caused by economic and social pressure, ignorance, war, and drought.

Desertification is primarily a problem of sustainable development. It is a matter of addressing poverty and human well-being, as well as preserving the environment. Social and economic issues, including food security, migration, and political stability, are closely linked to land degradation. So are such environmental issues as climate change, biological diversity, and freshwater supplies. The Convention emphasizes the need to coordinate research efforts and action programs for combating desertification and drought with these related concerns.

The UNCCD will be implemented through action programs. These programs are the core of the Convention. At the national level, they will address the underlying causes of desertification and

drought and identify measures to prevent and reverse them. Action programs are detailed in the four regional implementation annexes to the Convention - Africa, Asia, Latin America and the Caribbean, and the Northern Mediterranean.

The Bahamas is also party to a number of Conventions under the International Maritime Organization (IMO). These Conventions deal with issues such as ship safety, prevention of marine pollution and prevention of collisions at sea. All these issues relate to protection of the marine environment and its resources. The International Convention for the Prevention of Pollution from Ships (MARPOL) contains a number of Annexes that deal specifically with marine pollution from oil, noxious liquid substances, harmful substances and garbage.

In addition to the above treaties, Bahamas Petroleum Company and its contractors will align emergency response planning with two key national/international plans, namely:
1. The Bahamas National Oil Spill Contingency Plan, 1999
2. Caribbean Island Oil Pollution Response and Cooperation Plan, 2009

3.3 Institutions

3.3.1 Government

Government agencies that will be involved with aspects of approval and permitting of this project include:

Bahamas Environment, Science and Technology (BEST) Commission

The BEST Commission, formed by a directive from the Chief of State in 1994, has in effect been the country's environmental agency since 1995. The BEST Commission, a division of the Ministry of the Environment, is responsible for developing the Government of The Bahamas' (GOB) environmental and natural resource management policies. As mandated, the BEST Commission is responsible for the administration of the EIA process, overseeing the technical review of EIAs, coordinating the public review of EIAs, and providing advice to Cabinet for consideration in their decision-making process.

The BEST Commission is also the lead agency in ensuring that the GOB implements its requirements under the various international Conventions on environmental matters such as biodiversity, climate change, wetlands, land degradation, etc. In this role, The BEST Commission establishes committees, drawing on appropriate staff from different government agencies, for promoting actions to implement the specific requirements of the various conventions. To date, committees have been established on wetlands, climate change and biodiversity.

The BEST Commission also collaborates closely with other agencies with responsibilities for environmental matters such as the Port Department, the Oil Spill Committee, Department of Marine Resources, and The Bahamas National Trust.

Department of Environmental Health Services (DEHS)

Under the *Environmental Health Act* of 1987, and the Environmental Health Regulations, the DEHS mandate is to promote and protect public health and ensure conservation and maintenance of the environment. One role of the DEHS is to regulate, monitor, and control actual and likely contamination and pollution of the environment and establish minimum standards required for a clean, healthy, and pleasing environment. The Environment Monitoring and Risk Assessment (ERMA) Division of DEHS, formerly the Public Analyst Laboratory, has the responsibility for some aspects of environmental monitoring, including monitoring of coastal water quality and potable water quality.

For proposed projects, the DEHS evaluates the effectiveness of pollution control measures and initiatives to protect the health and safety of workers, and the natural environment. DEHS is responsible for solid waste management and also issues effluent discharge and emissions permits.

Department of Labour
The Department of Labour oversees labour relations and occupational health and safety. The Department is the lead agency for regulating occupational health and safety under the *Health and Safety at Work Act* (2002). Through its Inspection Unit, the Department also conducts inspections to ensure adequate worker safety and compliance with regulations.

Department of Marine Resources
The Department is responsible for the management and development of fishery resources as well as the promotion of the growth of fisheries under the principles of sustainable use and integrated management.

Department of Physical Planning
The Department authorizes activities such as dredging, filling, harvesting or removal of protected trees, and any work that will affect coastlines. It also administers the new *Planning and Subdivision Act of 2010*, which includes ensuring the preparation of land use plans and other physical planning activities.

Ministry of the Environment
The Ministry of the Environment oversees conservation of wild animals, birds, and plants, as well as forests. It administers the Wild Birds and Wild Animals Protection Acts.

Ministry of Public Works
The Ministry oversees and maintains physical infrastructure in the country. It is entrusted with the administration of the *Building Control Act* (*BCA*) and Regulations.

Office of the Prime Minister
The Office of the Prime Minister (OPM) is the office responsible for direct foreign investment in the country, the management and disposal of Crown Estate, and trade and industrial policy Development. Petroleum Operations are conducted under the aegis of OPM in accordance with the Petroleum Act 1971 and the Petroleum Regulations and amendments. The Office issues permits of geographical activities and licenses upon the direction of the Cabinet.

Port Department
The Department is responsible for safety and competency of those working at sea including prevention of accidents that can be detrimental to the marine environment. The Port Department is also responsible for regulating the disposal of ship ballast.

Water and Sewerage Corporation (WSC)
The WSC, with its Water Resources Management Unit (WRMU), has responsibility for optimal development of the country's water resources and the control of water quality. It shares (with DEHS) the responsibility for monitoring water quality. WSC issues water supply franchises to developers in areas where the supply of water is impractical for the GOB or its agencies to undertake.

3.3.2 Non-Governmental Organizations

Non-governmental organizations (NGO) that are active in The Bahamas include:

Andros Conservancy and Trust (ANCAT)

ANCAT was founded in 1999 to protect, preserve, enhance and restore the natural resources and marine environment of Andros Island. It works through education, conservation and management efforts.

Bahamas National Trust (BNT)

The BNT was established by an Act of Parliament in 1959, which makes it unique in the NGO community. It represents a unique collaboration of governmental, private sector and scientific interests dedicated to the conservation of the natural and historic resources of The Bahamas for the enjoyment and benefit of the Bahamian people. The major mandate of the Trust is management of the National Parks System of The Bahamas.

Bahamas Reef Environment Educational Foundation (BREEF)

The Bahamas Reef Environment Educational Foundation (BREEF) is concerned primarily with coral reef education and fund-raising for the protection of marine resources of The Bahamas through education. Its mission is to strengthen the symbiosis between the Bahamian people and the reefs, which protect, nourish, and enrich us, by focusing Bahamian and allied minds on this relationship. The Foundation's *raison d'etre* is the restoration of the reefs of The Bahamas to their former glory and abundance.

Bahamas Sportfishing and Conservation Association (BSCA)

The BSCA is dedicated to the preservation of marine and coastal systems in the Caribbean, the protection of the sport fish in this remarkable fishery, and the sustainability of economic benefits the sportfishing industry provides to the Bahamian people. It focuses on increasing education and public sensitivity to marine conservation issues, species and habitat protection, marine conservation and research and sustainability of the sportfishing industry.

Nature's Hope for Southern Andros (NHSA)

NHSA is based in Southern Andros and is focused on promoting environmental stewardship and conservation in that community. Recent activities have involved beach clean-ups and environmental education activities for local school children.

reEarth

reEarth is a non-profit, environmental watch group founded in 1990 and dedicated to increasing public awareness and understanding of environmental issues. It has been involved in increasing public awareness on issues, such as risks to dolphin populations, destruction of tropical rainforests, long-line fishing, coral reefs, and oceans.

San Salvador Living Jewels

SSLJ is working to create protected areas on the San Salvador Island to conserve unique plant and animal biodiversity, including iguanas and the San Salvador woodpecker.

The Nature Conservancy (TNC), Bahamas Office

The Nature Conservancy has been working in The Bahamas for more than 10 years along with the Bahamas Government and a variety of partners to protect natural resources. TNC is working along with the BNT, Department of Marine Resources and the BEST Commission to build political support and garner long term financing for protected areas across the Caribbean through an initiative called The Caribbean Challenge. TNC Bahamas has also completed a number of

assessment and planning activities for the island of Andros including the development of a land and sea use plan under the Integrated Watershed and Coastal Area Management (IWCAM) project.

3.3.3 Other

Small Island Sustainability Program (College of The Bahamas)
The SIS program began at the College of The Bahamas in 2009. It offers bachelor's degrees in sustainability with a focus on agriculture, tourism and ecology. Students are given opportunities to participate in research projects related to environmental issues and natural resource sustainable use and conservation in The Bahamas.

Gerace Research Centre
The Gerace Research Centre (formerly the Bahamian Field Station), which occupies a former US Naval Base on San Salvador Island, has been in operation for over 30 years as an educational and research institution. The Gerace Research Centre provides accommodations, laboratory space, and logistical support for both teachers and researchers interested in the diverse and unique tropical environments available on San Salvador.

3.4 International Guidelines

Bahamas Petroleum Company and its contractors will comply with standard industry best practices for managing environmental, health and safety. For example, the Company will follow guidelines of the International Association of Drilling Contractors (IADC), International Finance Corporation (IFC), World Bank Group EH&S Guidelines – Offshore Oil and Gas Development, and International Association of Oil and Gas Producers (OGP).

3.4.1 International Association of Drilling Contractors

IADC publishes guides to supplement company health, safety and environmental (HSE) programs and operating procedures. The guides based on experience and study over many years by the industry. Bahamas Petroleum Company will work with the drilling contractor to follow key recommendations of IADC, such as those presented in the *HSE Case Guidelines for Mobile Offshore Drilling Units*[1].

The guidelines present best practices for all aspects of managing HSE risk for offshore drilling, including: hurricane response, waste management, management systems, and oil spill preparedness.

3.4.2 International Finance Corporation Performance Standards on Environmental and Social Sustainability

IFC is a sister organization of the World Bank and member of the World Bank Group. The World Bank Group is the largest global development institution focused on the private sector in developing countries. It has set two goals for the world to achieve by 2030: end extreme poverty and promote shared prosperity in every country.

[1] International Association of Drilling Contractors. 2010. Health, Safety and Environment Case Guidelines for Mobile Offshore Drilling Units. Accessed from the IADC website: http://www.iadc.org/hsecase/MODU%20HSE%20Guidelines%20ALL.pdf

IFC's sustainability framework articulates the Corporation's strategic commitment to sustainable development and is an integral part of IFC's approach to risk Management. The policy on Environmental and Social Sustainability describes IFC's commitments, roles, and responsibilities related to environmental and social sustainability. The IFC Performance Standards provide guidance on how to identify, avoid, mitigate, and manage environmental and socioeconomic risks and impacts of complex projects. There are eight Performance Standards, including:

- **Performance Standard 1**: Assessment and Management of Environmental and Social Risks and Impacts
- **Performance Standard 2**: Labour and Working Conditions
- **Performance Standard 3**: Resource Efficiency and Pollution Prevention
- **Performance Standard 4**: Community Health, Safety, and Security
- **Performance Standard 5**: Land Acquisition and Involuntary Resettlement
- **Performance Standard 6**: Biodiversity Conservation and Sustainable Management of Living Natural Resources
- **Performance Standard 7**: Indigenous Peoples
- **Performance Standard 8**: Cultural Heritage

The Company will apply the Performance Standards as a guide to identifying risks and impacts, in an effort to avoid, mitigate and manage risks and impacts as a way to carry out exploration activities in a sustainable way. In addition, the Performance Standards will assist the Company in managing the environmental and social risks to ensure that development opportunities are enhanced.

3.4.3 World Bank Group EH&S Guidelines – Offshore Oil and Gas Development

The Environmental, Health and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology as a reasonable cost.

The Company application of the EHS Guidelines will be tailored to the mitigation of hazards and risks established in the project on the basis of the results of the EIA in which site-specific variables, such as area, assimilative capacity of the environment, and other project factors, are taken into account.

The World Bank EH&S Guidelines for Offshore Oil and Gas Development provide key threshold standards for discharges, emissions and waste.

3.4.4 International Association for Oil and Gas Producers

The International Association for Oil and Gas Producers (OGP) (originally called the E&P Forum) was started to provide a global forum in which members identify and share best practices to achieve improvements in health, safety, the environment, security, social responsibility, engineering and operations. Most of the world's leading publicly traded, private and state-owned oil & gas companies, oil & gas associations and major upstream service companies are members. OGP represents the interests of the upstream industry before international regulators and legislators in UN bodies and is also accredited to a range of regional bodies that include OSPAR, the Helsinki Commission and the Barcelona Convention. OGP develops guidelines to help industry institutionalize the best practices identified by its members. The guidelines and other studies are available on the OGP website (http://www.ogp.org.uk/) on a number of topics, such as:

- Preventing the Next Major Incident, 2005
- Guidelines for Waste Management with Special Focus on Areas with Limited Infrastructure, 2009

3.5 Environmental Impact Assessment Process

While the new Planning and Subdivision Act speaks to criteria for projects that will be required to prepare and submit Environmental Impact Statements (EIS), the EIA process is not standardized and the steps for review of an EIA or EIS varies depending on the agency who has initiated the EIA and is managing the review process. In the past, the most common path for the EIA Process has evolved as described Figure 1. The primary agency responsible for the review of EIA/EIS is the BEST Commission. A key output of the EIA is development of an EMP. An EIA and EMP are the two documents mandated for submission for an Environmental Authorisation under the Petroleum Regulations 2016.

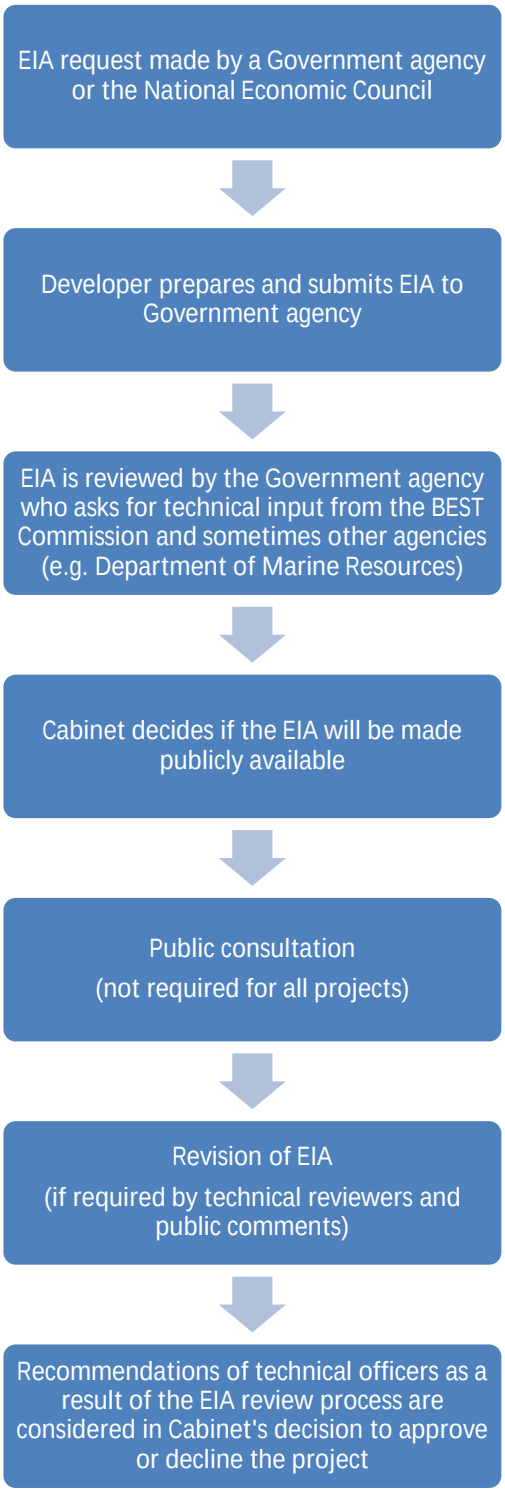

Figure 1: Common EIA Approval Process in The Bahamas

Changes to this process may occur if regulations for the EIA process are developed under the Planning and Subdivision Act.

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4. Baseline Environmental and Socioeconomic Conditions

Bahamas Petroleum Company's Bain, Cooper, Donaldson and Eneas Licenses cover some 3.2 million acres in the southern Bahamas. This section evaluates the current environmental and socioeconomic conditions in the project area of influence. The physical features, such as climate, currents and geology are described as well as biological features, such as protected areas, endangered species and unique habitat.

4.1 Physical Environment

4.1.1 Climate and Meteorology

The climate for the study area is strongly influenced by the trade winds; with The Bahamas generally having warm weather year-round. The climate is sub-tropical, with two distinct seasons: hot wet summers which extend from May to October and warm drier winters which extend from November to April, with winter incursions of polar air. The length of day (interval between sunrise and sunset) varies from 10 hours and 35 minutes in later December to 13 hours and 41 minutes in late June.

4.1.1.1 Temperature

The average temperature in The Bahamas is 77°F (24.8°C) (Table 4-1). The month of August has the highest monthly average temperature of 90°F (32°C). The lowest monthly average temperature is 63°F (17°C) and occurs in January and February[1].

Table 4-1: Average Monthly Temperatures for The Bahamas

Month	Average Minimum Temperatures (°F)	Average Maximum Temperature (°F)	Average Temperature (°F)
January	63	77	70
February	63	77	70
March	66	81	73
April	68	82	75
May	72	84	78
June	75	88	82
July	75	88	82
August	75	90	82
September	75	88	82
October	73	86	80
November	68	81	74
December	64	79	72

Source: Bahamas Meteorology Department, 2011

4.1.1.2 Precipitation

Rainfall varies locally, but there is a gradient of about 60in (1500mm) per annum in the north, to about 30in (750mm) in the south-eastern island of Inagua. The southern islands are rainfall deficient and susceptible to drought, as is reflected by the native vegetation. Most of the rainfall in The Bahamas occurs during the hurricane season from June to November (Table 4-2).

[1] Bahamas Meteorology Department. 2011. Historical Weather Data for The Bahamas. Nassau, Bahamas: Department of Meteorology. Accessed from The Bahamas Meteorology Department website: http://www.bahamasweather.org.bs/index.php.

The Bahamas receive an average of 53.3in (1353mm) of rainfall per year, or 4.4in (113mm) per month. On average, there are 136 days per year with more than 0.004 in (0.1mm) of rainfall. March is the driest month, with an average of 1.4in (35mm) of rainfall (precipitation) occurring across 5 days. June is the wettest month, with an average of 9.2in (234mm) of rainfall (precipitation) occurring across 16 days. The average annual relative humidity is 78.8%, ranging from 77% in April to 82% in September.[2]

Table 4-2: Average Monthly Precipitation for The Bahamas

Month	Average Rainfall (in)	Wet Days (>0.004 in)	Relative Humidity (%)
January	1.9	7	79
February	1.6	6	78
March	1.4	5	78
April	1.9	5	77
May	4.8	12	77
June	9.2	16	79
July	6.1	16	78
August	6.3	17	79
September	7.5	18	82
October	8.7	17	81
November	2.3	9	79
December	1.6	8	78

Source: Bahamas Meteorology Department, 2011

4.1.1.3 Air Quality

The project area is located in an offshore environment away from commercial developments and other point source emissions. Passing vessels contribute to local air emissions, but these are temporary and quickly dispersed in the winds offshore. The contribution of these emissions to air is unlikely to have a significant effect on local air quality.

4.1.1.4 Wind

The Bahamas and Cuba are positioned near the southern border of the Trade wind belt and experience almost constant, moisture-laden breezes from the east or southeast. In the winter, the trade winds shift southward and the winds are less constant. The mean wind speeds do not appear to vary significantly on a monthly basis. The average monthly wind speeds (Table 4-3) vary from 6.2mph (10km/h) in September to 8.9mph (14.3 km/h) in March. The highest average wind speeds are experienced during the late fall and winter months.

[2] Bahamas Meteorology Department, 2011.

Table 4-3: Average Monthly Wind Speed Miles Per Hour (MPH) for The Bahamas[3]

Month	Average Wind Speed (MPH)
January	8.0
February	8.6
March	8.9
April	8.3
May	7.9
June	7.2
July	7.1
August	6.9
September	6.2
October	7.4
November	8.1
December	7.8

Source: Bahamas Meteorology Department, 2011

Because of shifting winds, weather in both Cuba and The Bahamas is influenced by fronts advancing from the North American continent. These fronts result in cooler conditions than average, but the presence of the northerly flowing Gulf Stream prevents temperatures from reaching freezing conditions. Cold fronts, which generate strong winds of 22.9 to 28.6mph (37-46km/h) as well as cooler air, are typically preceded by winds from the southwest, which rotate to the west, then northwest, as the front passes. In general, winds in The Bahamas and northern Cuba are predominantly south-easterly blowing during the summer and north-easterly during the winter. Figure 4-1 below provides information on winds for the years 2004 to 2009 at 80.0W & 24.5N, inclusive of hurricane events for that period.

According to the report provided by Villy Kourafalou in 2011 the “Statistical analysis of surface meteorological data from C-MAN buoy stations off South Florida has shown that point data are representative of the monthly mean wind speed and direction over the Florida Straits, as the fields are fairly coherent and homogeneous”. Kourafalou had selected what they considered to be a characteristic location near the Cay Sal bank to generate the wind data for their report. They extracted time series of 3-hourly wind vectors from the COAMPS atmospheric data set. These data are represented in the Figure 4-1. Figure 4-2 presents a graphic representation of the average climate variables for The Bahamas.

[3] Bahamas Meteorology Department, 2011.

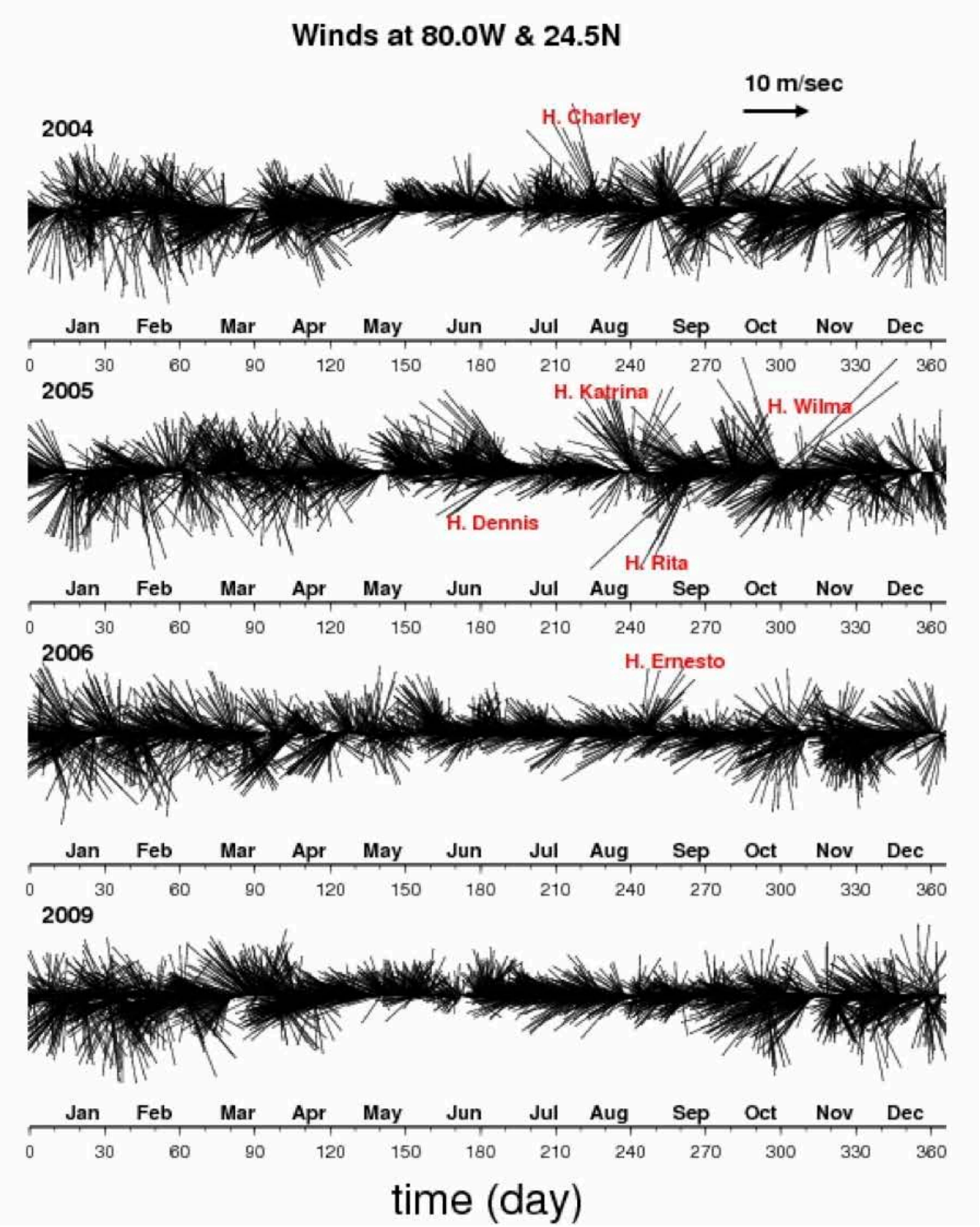

Figure 4-1: Wind Vectors for at 80.0W & 24.5N for 2004, 2005, 2006 & 2009.
Note: Red Letters Mark Hurricanes
Source: Kourafalou, et al., 2011[4]

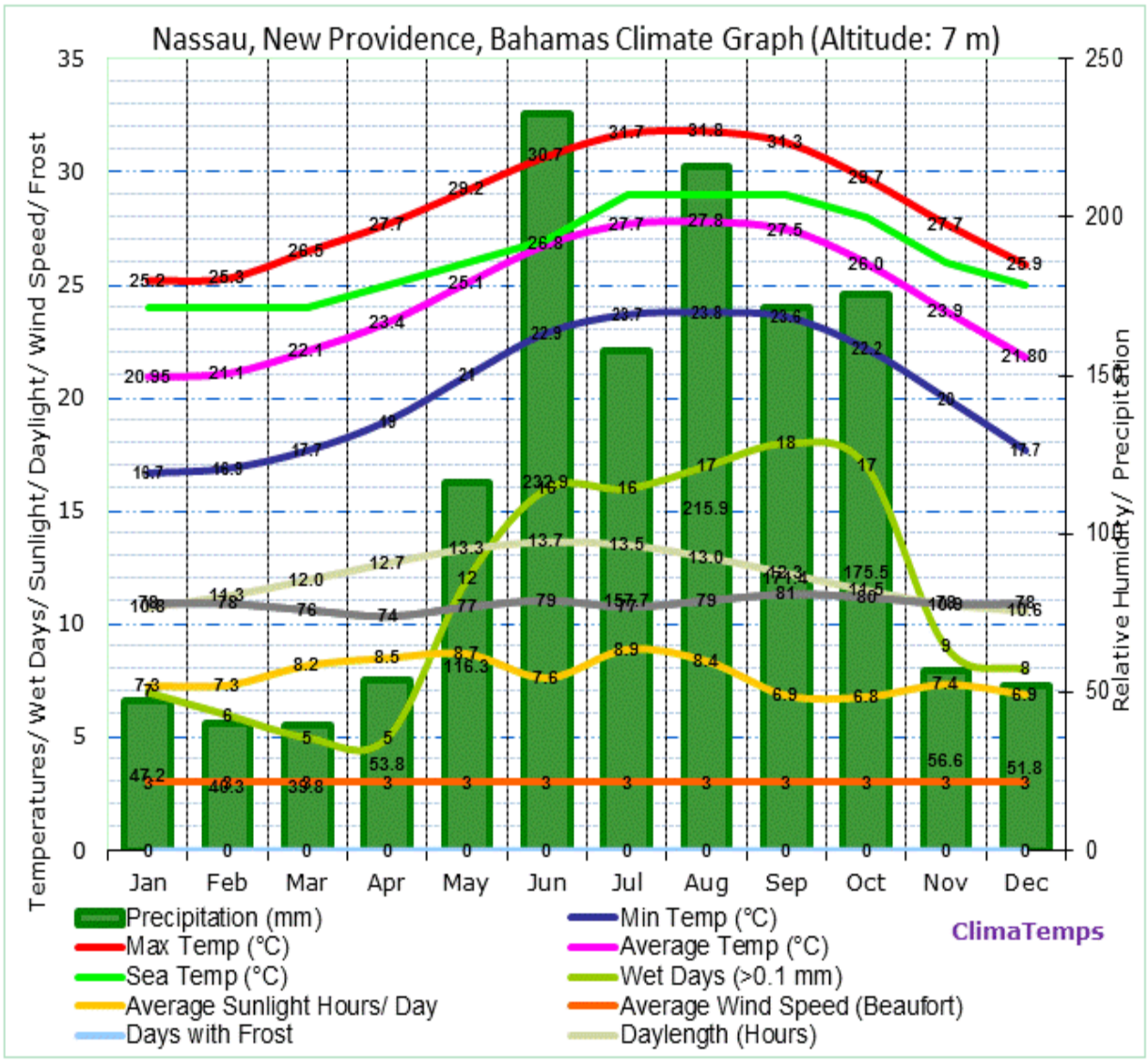

Figure 4-2: Climate Graph for The Bahamas (Imperial)
Source: Climatetemp website, 2011[5]

4.1.1.5 Natural Hazards

The proposed drill sites are within the Atlantic Tropical Cyclone basin. This basin includes much of the North Atlantic, Caribbean Sea, and the Gulf of Mexico. On average, 6 to 8 tropical storms form within this basin each year. The 2004 and 2005 hurricane seasons saw significantly greater than average activity. The 2004 Atlantic hurricane season saw 15 storms formed with 9 becoming hurricanes. During the 2005 Atlantic hurricane season, a record 28 tropical and subtropical storms formed, of which 15 became hurricanes and 7 became major hurricanes (Category 3 or greater on the Saffir-Simpson scale). This year (2005) was the most active Atlantic hurricane season on

[4] Kourafalou, V., Paris, C., Kang, H. and M. Le Henaff. 2011. Transport and Fate of Oil Particles Released in The Bahamas (Unpublished). Bahamas Petroleum Company Final Report August 2011. Miami, Florida.

[5] Climatetemp.info. 2011. Bahamas Climate Guide to the Average Weather and Temperatures Accessed from the Climatetemp website: http://www.bahamas.climatetemp.info/.

record. During the 2019 Atlantic hurricane season, there were 18 named storms, 6 of which became hurricanes, and 3 of which became major hurricanes.[6]

The formation of these storms and possible intensification into mature hurricanes takes place over warm tropical and subtropical waters. Eventual dissipation or modification typically occurs over the colder waters of the North Atlantic or when the storms move over land and away from the sustaining marine environment. This occurs over a period of about 7 to 8 days after formation. The official hurricane season lasts from June 1st to December 1st. Category 1 through 5 hurricane tracks and tropical storm tracks in The Bahamas are shown in Figure 4-3, below.

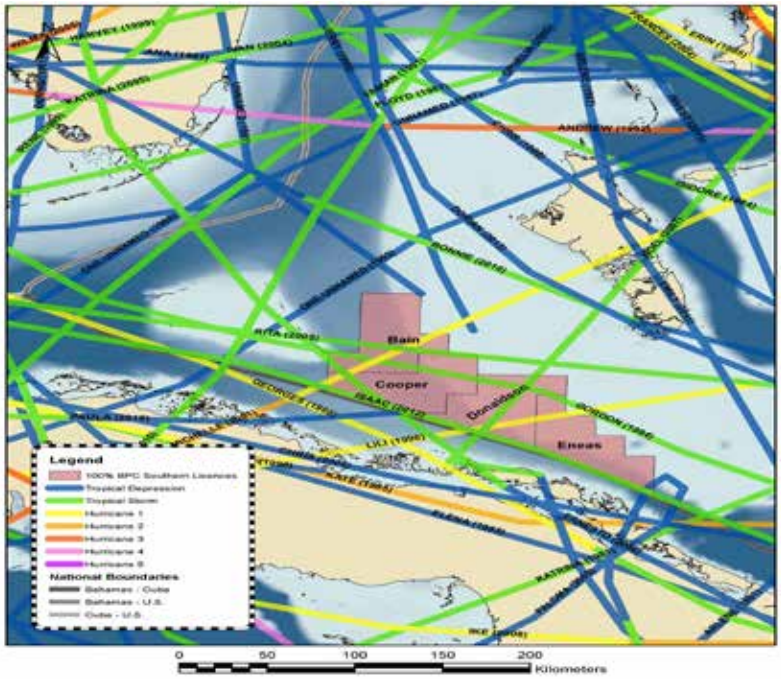

Figure 4-3: Historical Hurricane Tracks for the West Atlantic
Note: Approximate block boundaries shown in white
Source: NOAA, 2019[7]

Category 4 and 5 hurricanes that have impacted the project area of influence over the past century are as follows:

Category 4	Not named	1919
	Not named	1926
	Not named	1929
	Not named	1945
Category 5	Not named	1935
	Hurricane Donna	1960
	Hurricane David	1979
	Hurricane Georges	1998
	Hurricane Rita	2005

[6] National Oceanic and Atmospheric (NOAA). 2019. "Active 2019 Atlantic hurricane season comes to an end". NOAA National Hurricane Center. Accessed from: https://www.noaa.gov/media-release/active-2019-atlantic-hurricane-season-comes-to-end.

[7] National Oceanic and Atmospheric (NOAA). 2019. Historical Hurricane Tracks. Charleston, South Carolina: Coastal Services Center. Accessed from the NOAA website: www.csc.noaa.gov/hurricanes .

Storms of lesser strength that have impacted the project area of influence since 1995 include:

- Hurricane Lili (1996) – Category 2
- Hurricane Michelle (2001) – Category 1
- Tropical Storm Ernesto (2006)
- Tropical Depression Chris (2006)
- Tropical Storm Noel (2007)

There have been 11 storms, which have passed through the project area since 1999.

The entire Bahamas region averages 1 storm every 10 years. Probability of a Category 3, 4 or 5 storm during the months of June to November (based on empirical evidence collected by US National Oceanic and Atmospheric Administration) is shown in Figure 4-4.

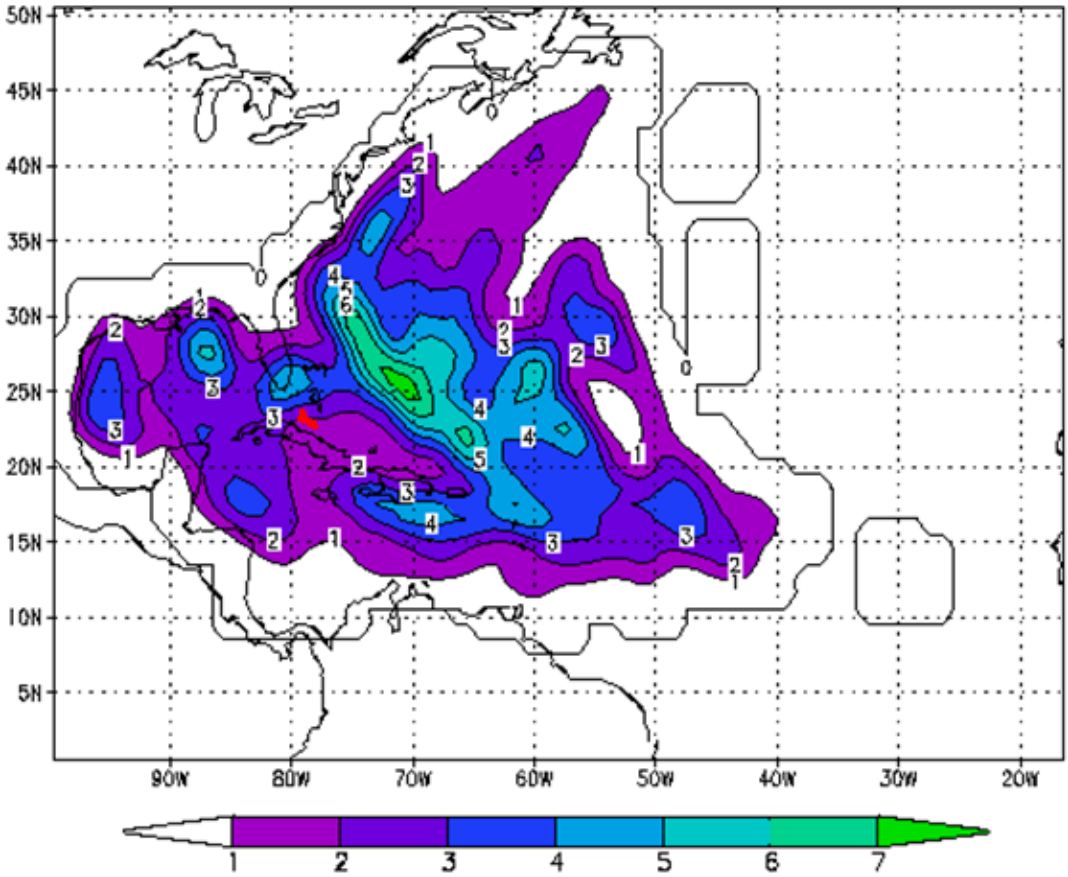

Figure 4-4: Percent (%) Chance of a Category 3, 4 or 5 Hurricane during June to November

Source: National Oceanic and Atmospheric Administration (NOAA), 2011[8]

Recent hurricanes that have impacted other areas of The Bahamas outside of the project area of influence include:

- Hurricane Andrew (1992) - Category 5

[8] National Oceanic and Atmospheric Administration (NOAA). 2011. Hurricane Research Division Frequently Asked Questions. Accessed from the NOAA website: http://www.aoml.noaa.gov/hrd/tcfaq/G11.html

- Hurricane Bertha (1996) - Category 1
- Hurricane Floyd (1999) - Category 4
- Hurricane Frances (2004) - Category 4
- Hurricane Dorian (2019) – Category 5

Hurricane Dorian (2019) made landfall on Abaco Island (The Bahamas) as a Category 5 storm on 1 September 2019. As of late October 2019, 67 people were reported killed and 282 were reported missing. The storm caused US$3.4 billion in economic losses in The Bahamas of which US$2.5 billion was direct damages.[9] The most significant and extensive damages occurred on Abaco Island and Grand Bahama Island.

Figure 4-5: Hurricane Dorian Track (22 August – 9 September 2019)
Source: National Oceanic and Atmospheric Administration (NOAA), Historic Hurricane Tracks[10]

[9] Associated Press. 2019. "Hurricane Dorian Responsible for $3.4 Billion in Losses on Bahamas, Report Says". Available from: https://weather.com/news/news/2019-11-15-hurricane-dorian-bahamas-losses-report

[10] National Oceanic and Atmospheric Administration (NOAA). 2019. Historic Hurricane tracks. Available from: https://coast.noaa.gov/hurricanes/

4.1.2 Geology

4.1.2.1 Tectonic History and Stratigraphy

The Bahamian Archipelago consists of two carbonate banks which were formed by a chain of carbonate platforms. The Bahamas were originally formed by the rifting of Pangea, the super-continent, which resulted in the opening of the North Atlantic basin. The rifting of Pangea was accompanied by volcanic activity due to the collision of the North American and Caribbean plates. The collision was a result of the subduction of one plate sliding under the other. Evidence of volcanic activity is found in the tilted fault blocks of Jurassic volcaniclastics, which are commonly found in the Florida Straits area. In the southern region of The Bahamas, the basement rocks are oceanic crust, showing that the area was not a transitional region during the opening of the North Atlantic basin[11].

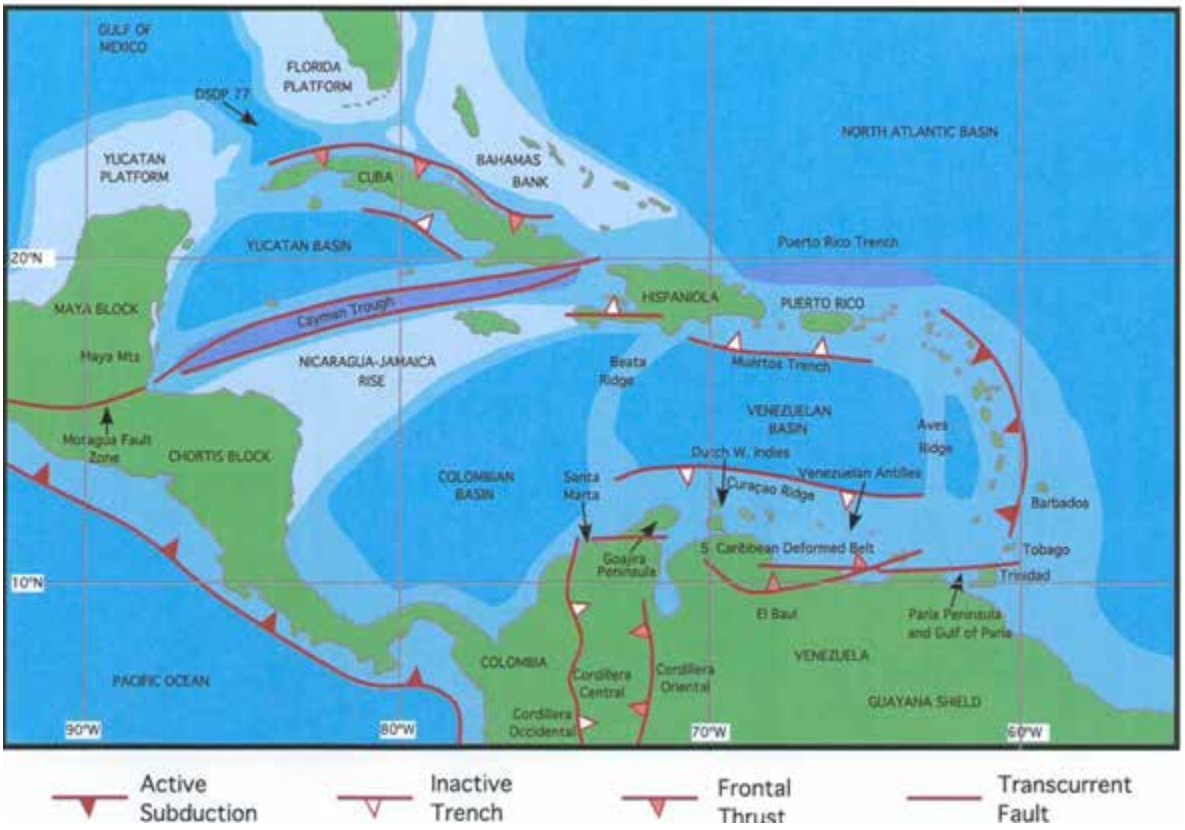

Figure 4-6: Current Regional Tectonic Setting
Source: Eberli 2007[12]

The current regional tectonic setting is shown on Figure 4-6, summarizes the Tectonic events as:

- Opening of North Atlantic (200 million years)
  - Establishment of rift geometry and bank-trough morphology

[11] Curran, H., White, A., and B. White 1995. Terrestrial and Shallow Marine Geology of the Bahamas and Bermuda. Northampton, Massachusetts: Geological Society of America.

[12] Eberli, G. 2007. "Tectonic Evolution and Paleogeography of the Bahamian Archipelago" complied for Bahamas Petroleum Company Limited, March 2007(Unpublished report).

- Passive continental margin stage (180 – 90 million years)
  - Platform growth and expansion, partly filling of rift basins to form large platform (megabank)
- Plate re-organization in Pacific, begin of eastward movement of Caribbean plate
  - Break-up of megabank and formation of new seaways
- Collision of Cuba with America (60 – 35 million years) (Figure 4-7)
  - Back step of platform margins
  - Drowning of portions of the archipelago
  - Evolution of the Cuban fold and thrust belt
- Change of direction of Caribbean plate from SW – NE to W – E
  - Jump of plate boundary south of Cuba
  - Drastic reduction in shortening between Cuba and The Bahamas
  - Renewed platform expansion

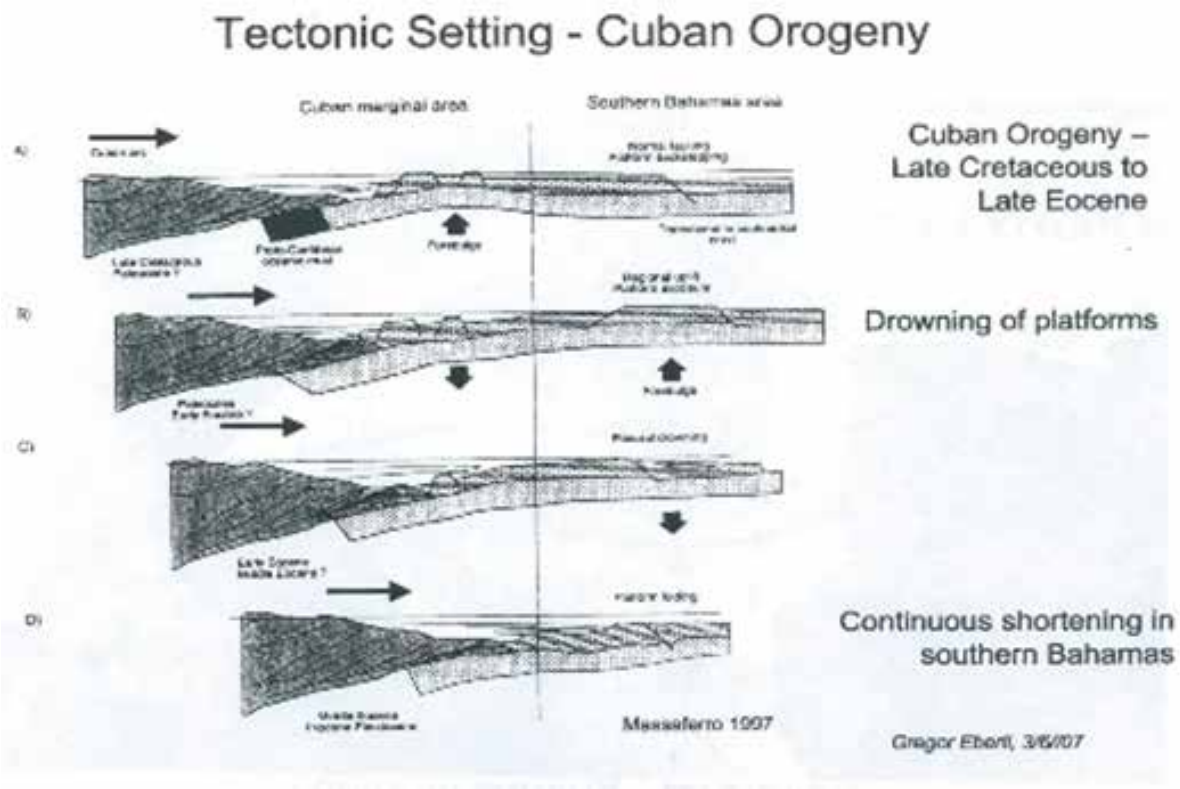

Figure 4-7: Tectonic Settings –Cuban Orogeny[13]
Source: Masaferro, J.l. Bulnes, M., Poblet, J. and G.P. Eberli, 2002

[13] Masaferro, J.L., Bulnes, M., Poblet, J. & G.P Eberli. 2002. Episodic Folding Inferred from Syntectonic Carbonate Sedimentation: the Santaren Anticline, Bahamas Foreland. Sedimentary Geology, 146(1/2): 11-24. ISSN: 0037-0738

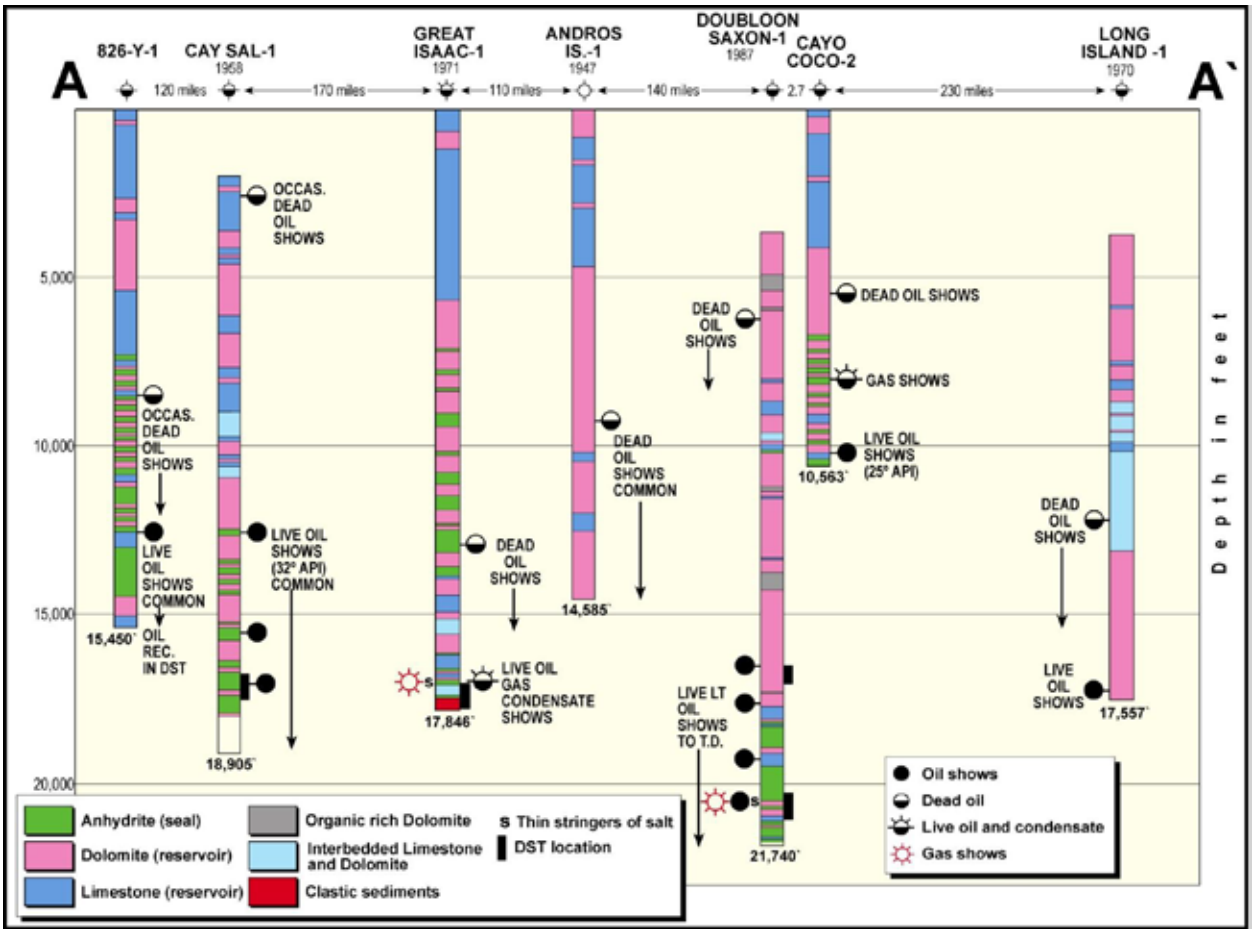

Figure 4-8: Wells Drill throughout The Bahamas
Source: Bahamas Petroleum Company

The banks formed over the horst and graben rift structures created during the break-up and opening of the Atlantic approximately 200 million years ago. The platforms were initiated in latitude with a warm climate that favored carbonate deposition.[14] Limestone, dolomite and anhydrite sediments continued to accumulate through the Jurassic and Cretaceous and reached thicknesses in excess of 20,000 feet as seen in the previous wells drilled in The Bahamas (Figure 4-8).

Bahamas Petroleum acquired modern 2D seismic in 2010 and 2011 (Figure 4-9). These data revealed several large contractional structures within the Bain, Cooper and Donaldson licenses. These large structures represent the Bahamian Foreland of the Cuban Bahamian Fold and Thrust belt initiated by the collision of Cuba with America.

There is an important difference between the geology of The Bahamas and that of the central Gulf of Mexico. In the central and western Gulf of Mexico, the sediments consist of sands and shales which are carried to the Gulf by major river systems and deposited very rapidly. This rapid deposition often leads to the development of high pressure in the sandstones and shales as the sediments are buried faster than the trapped water can escape. These high pressures

[14] Schettino, A. and E. Turco. 2009. Breakup of Pangaea and Plate Kinematics of the Central Atlantic and Atlas Regions. Geophysical Journal International, 178: 1078–1097.

were one of the factors leading to the Macondo spill in 2010. In the Bahamas, the carbonate rocks accumulated slowly over a much longer period of time and high or abnormal pressures are not expected; and were not seen in the wells drilled previously.

4.1.2.2 Geomorphology

The geomorphologic landscapes of the Bahama Islands can be attributed to the accumulation and erosion of carbonate sediments and rocks by currents, waves, and winds. There are two major landforms which dominate landscapes of The Bahamas, including:

- Eolianite ridges that rise from a few meters to 63 meters above sea level.
- Lowlands comprised of marine and terrestrial deposits.

Lands in the interior of the islands are typically below sea level and can contain marine to hypersaline lakes.

Review of the 3D-seismic survey data from the blocks[15] notes that the seabed in the Cooper license block surrounding the B-North drill site is an area with broadly homogenous sediment cover. There are two depositional environments: the basin floor, and distal portion of the channelized slope. There is a large mud wedge area on the slope of Great and Little Bank (up to 90 m thick and comprised primarily of aragonite mud), and boulders, lobes, and channels on the slope of the sea bed. There are several pockmarks within this block that are several hundred meters in diameter and up to 115 m deep. Three types of sediment composition were identified from backscatter surveys: carbonate sand and rubble, coarse-grained to muddy sediment, and mud-dominated sediment. The area is slightly mounded rather than being completely flat, and the southeastern portion is shallower due to deposition of sediment lobes.

The B-North drill site is located in the northern section of the Cooper license block, entirely within the basin floor. Video trawls and baseline environmental sampling at the well site confirm that the seafloor at the well site is generally flat with unconsolidated mineral substrate which appears to be composed of fine sand to very fine sand with some potential silt present. This site is not in the areas of the block that contain pockmarks, lobes of channelized slope, wavy wrinkled slope morphology, or a mass transport complex with boulders covered in cold-water corals.

[15]Jo, A., Eberli, G.P., and Grasmueck, M. 2012. Report of High-Resolution Portion of BPC Lease Areas in the Bahamas. Prepared for BPC by University of Miami CSL.

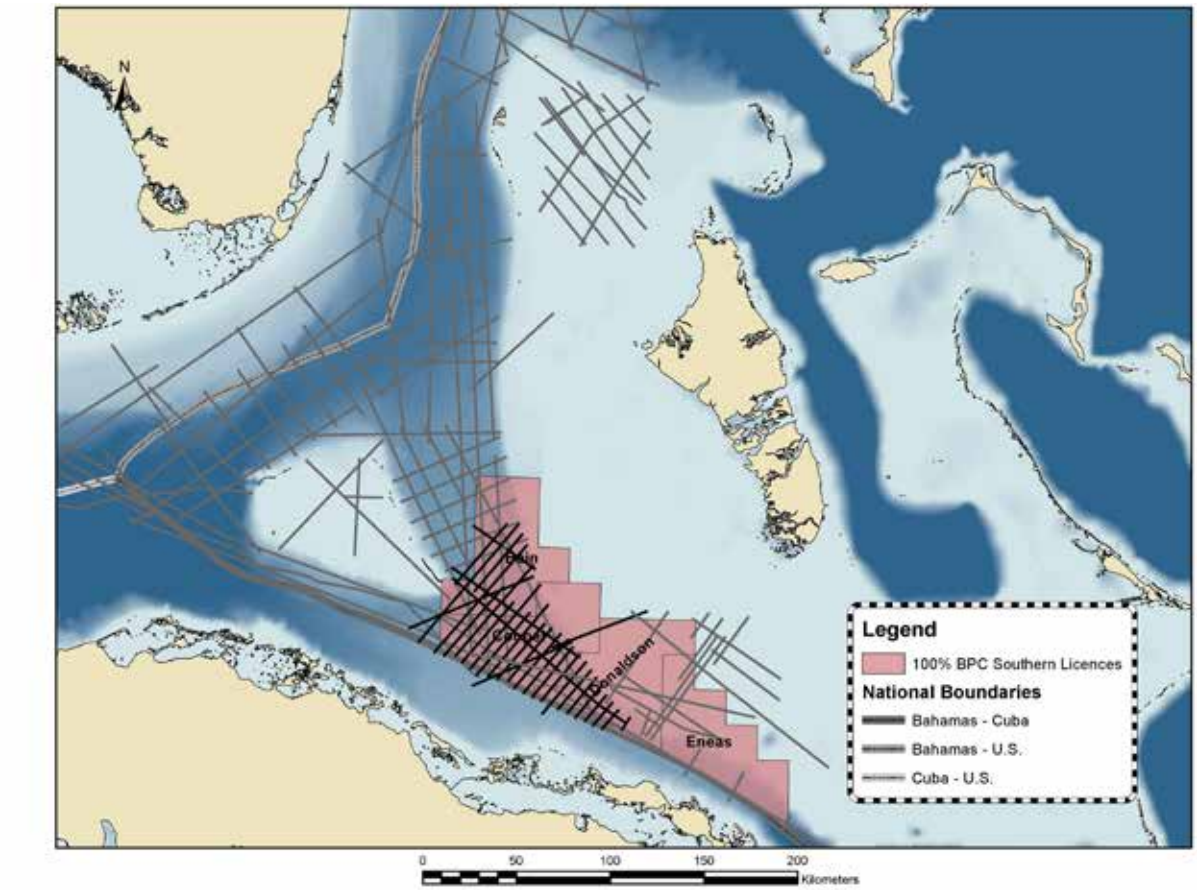

Figure 4-9: Bahamas Petroleum Company Licenses and Location of Seismic Data Lines
Note: New Data Lines Shown in Black
Source: Rowan Consulting, Inc. 2011

4.1.2.3 Bathymetry

Based on the multi-beam survey conducted in August 2011 by Fugro, the bathymetric depth for the project area ranges from 100 meters to 570 meters. This confirms that the depths used in the hydrodynamic model in the *Transport and Fate of Oil Particles Released in The Bahamas* 2011 report by Kourafalou, et al. are correct (Figure 4-10).

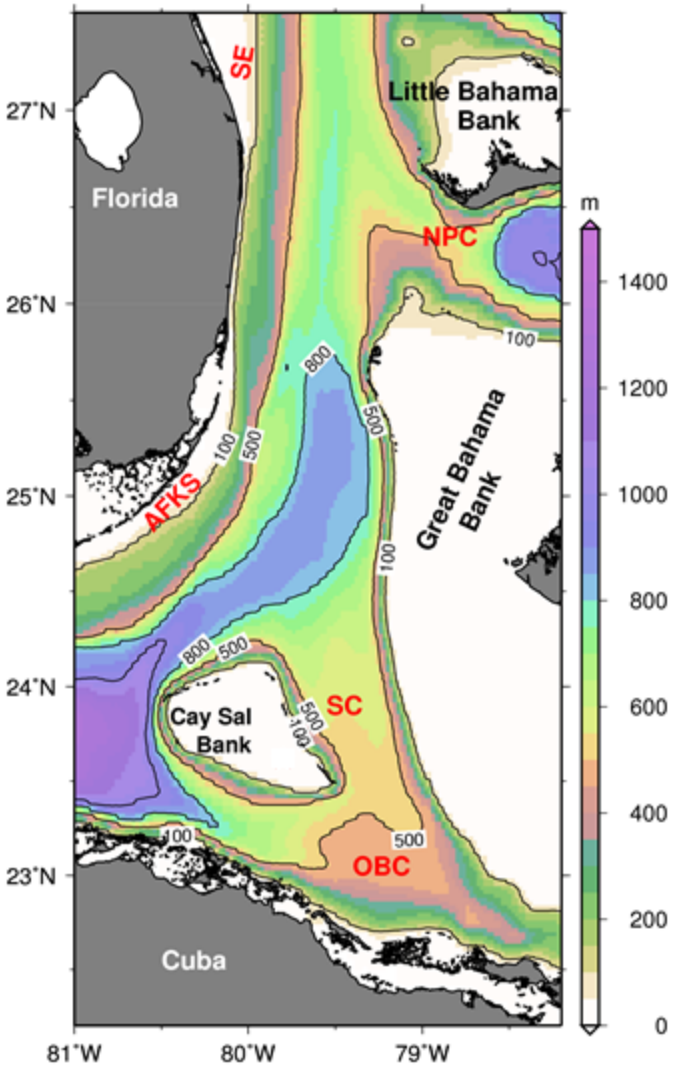

Figure 4-10: Topography in the Florida Straits

Source: Kourafalou, et al., 2011[16]

4.1.2.4 Geologic Hazard

The Bahama Islands occupy a large carbonate platform along the subsiding continental margin of North America. All surficial materials and bedrock are calcareous and most exposed materials are Quaternary in age. The topography is very subdued; most of the islands are nearly flat and the maximum elevation of the archipelago is 206 feet (63 meters). Small slopes, no more than several feet high, can be found along certain coastlines.[17]

[16] Kourafalou, et al. 2011.(unpublished)

[17] Adams, R. W. 1985. General Guide to the Geological Features of San Salvador, in Field Guide to the Geology of San Salvador (3rd Edition), ed. D T Gerace, pp. 1-66. San Salvador, Bahamas: College Center of the Finger Lakes.

Due to the flat topography of the Bahama Islands, landslides are rare and often limited to small rock falls and rock slides along the coasts caused by wave erosion.[18]

Formation of sinkholes and caverns are common.[19] Such phenomenon typically occurs in The Bahamas as a result of chemical dissolution of carbonate rocks (i.e. limestone and dolomite). Sinkholes and caverns emerge as the rocks are weathered by chemical interactions with water. Previous wells drilled in The Bahamas encountered highly fractured carbonate zones and caverns.

4.1.2.5 Seismicity

There are several active fault systems on the southern side of Cuba that produce numerous seismic events each year[20]. While most registered seismic events pass unnoticed, the island of Cuba has been struck by a number of destructive earthquakes over the past four centuries, including several major quakes with a magnitude of 7.0 or above. Figure 4-11 shows the fault lines in the Caribbean.

Figure 4-11: Fault Lines in the Caribbean
Source: DeMets and Wiggins-Grandison, 2007[21]

Approximately 70% of seismic activity in Cuba emanates from the Oriente fault zone located in the Mid-Cayman spreading center also known as the Bartlett-Cayman fault system. This system

[18] Carew, J.L., and J.E. Mylroie, 1985. The Plesitocene and Holocene Stratigraph of San Salvador Island. Bahamas, with Reference to Marine and Terrestrial Lithofacies at French Bay. In H.A. Curran (ed.), Pleistocene and Holocene Carbonate Environments on San Salvador Island, Bahamas. Boulder: Geological Society of America Field Trip Guidebook 2: 1-10.
[19] Mylroie, J.E., 1983. Caves and Karst of San Salvador. In D.T. Gerace (ed.), Field Guide to the Geology of San Salvador (3rd Edition), P. 1-66. San Salvador, Bahamas, College Center of the Finger Lakes Bahamian Field Station.
[20] Cotilla Rodriquez, M.O., H.J. Franzke and D. Cordoba Barba. Seismicity and Sesimoactive Faults of Cuba. Russian Geology and Geophysics 48(6), pp 505-522. 2007.
[21] DeMets, C. and W. Wiggins-Grandison. Deformation of Jamaica and Motions of the Gonave Microplate from GPS and Seismic Data. Geophysical Journal International. 168: 362-378. 2007.

runs along the south-eastern coast of Cuba and marks the tectonic boundary between the North American Plate and the Caribbean Plate. Destructive earthquakes originating from the Oriente fault occurred in 1766 (M_l=7.6), 1852 (M_l=7.2) and 1932 (M_s=6.75). These active zones are not in the immediate area of the Bahamas Petroleum Company Licenses. It is unlikely that the project area would be affected in the event of an earthquake.

4.1.2.6 Tsunamis

A tsunami in the Atlantic Ocean is a rare event, partially due to the lack of active plate boundaries.

The only active plate boundaries are along the eastern edge of the Caribbean and the Cayman trough south of Cuba and the eastern edge of the Scotia Plate in the South Atlantic. The lack of activity accounts for the low incidence of earthquake-generated tsunamis. There are only three recorded tsunami events in the Atlantic basin, and they were all generated by earthquakes:

- 1755 Lisbon Portugal earthquake
- 1918 Puerto Rico earthquake
- 1928 Grand Banks, Canada earthquake[22].

None of these events had any reported significant impacts for The Bahamas or Cuba in the project area of influence.

4.1.3 Oceanography

Oceanography covers a wide range of topics, including marine organisms, ecosystem dynamics, ocean currents, waves and geophysical fluid dynamics. This section will discuss the issues of waves, tides, currents, temperature, salinity and density.

4.1.3.1 Waves and Tides

Waves

The windward (eastern) margins of the Great Bahama Bank (GB) at Long Island and Little Bahama Bank at eastern Abaco, according to Bergman have the highest wave energy due to no structures impeding the movement of waves and swell energy from the open Atlantic whereas, the southwest Great Bahama Bank is shielded by an energy-absorbing environment, resulting in a lower wave energy. Wave energy is seasonal in The Bahamas with the highest wave energy occurring in the winter months (Table 4-4).

Table 4-4: Percent Frequency of Wave Heights at Southwest Great Bahama Bank (GB)

Month	J	F	M	A	M	J	J	A	S	O	N	D
% freq. > 1.5m GB	34	32	28	28	23	21	29	19	20	21	32	39
% freq. > 2.4m GB	3	3	3	4	2	2	2	1	2	2	7	5
% freq. > 4 m GB	0	0	1	0	0	1	0	0	0	0	0	0

Source: Adapted from the National Buoy Data Center, 1973

Based on NOAA buoy observations, wave heights over 2.1moccur most frequently in the winter months (October through January) (Table 4-5). [23] Kourafalou(2019) also indicates a correlation

[22] National Oceanic and Atmospheric Administration. 2011. Tsunami Travel Time Maps for the Atlantic. Accessed from the NOAA website: www.ngdc.noaa.gov/hazard/tsu_travel_time_events.shtml .

[23] Kourafalou, Villy. 2019. Report on Wave Field Variability in response to BPS Inquiry on 8/9/2019: 'significant wave height and period – how frequently does wave height exceed 2.1 m and in which months".

between higher wind speeds and higher wave heights that is most distinct during storm events such as hurricanes.

Table 4-5: Number of days each month when wave height was 2.1 m or higher (2010-2017)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2010	1		1	2			1		1	2	2	3	13
2011	2	1	1					1				2	7
2012	1		4	2	1			3		6			17
2013			1								3		4
2014	1										2	1	4
2015		1								1	3	2	7
2016	3									4	1		8
2017	4		4	1					3				12
Total	12	2	11	5	1	0	1	4	4	13	11	8	72

Waves in the license areas are generated by wind. Wind in the two major ocean channels near the project site, the Old Bahama Channel and the Santaren Channel, are generally out of the east. Waves 50 feet (15 m) high are not unusual during severe storms throughout The Bahamas.

Tides

A study in the project area indicated that tides in the region are predominately influenced by the Old Bahama Channel.[24] Figure 4-12 identifies diurnal frequency currents for the first 20 days in October of 1991. During the period of 1990-1991, large pulses of current flows were recorded in the direction of the Florida Straits at 250 m depth with speeds approaching 200 cm s^{-1}. It is believed that there were large diurnal tidal current shears being generated intermittently when conditions were favorable. According to Bergman, et al., the Great Bahama Bank experiences tidal currents that are generally radially oriented and sweep bankward (0.32 m/s) during flood tides and off bank during ebb tides.[25] Kourafalou and Bergman had the same conclusion that the strongest currents are oriented parallel to, as opposed to the on/off-bank direction of the Great Bahama Bank.[26] [27]

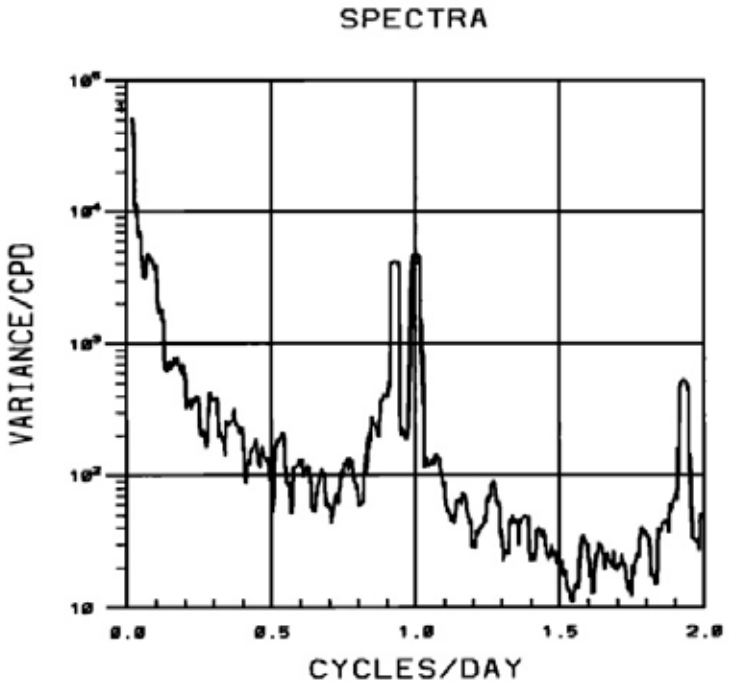

Figure 4-12: Spectra off 3-HLP along-channel Velocity Component showing the Strong Tidal Signals

Note: (1-26 hours; 24-hours – P1/K1; 12.5 hours – M2)
Source: Atkinson, 1995[28]

4.1.3.2 Currents

In general, ocean currents can be divided into two types of flow based on the forces that drive them. Most currents in the upper kilometer of the ocean are driven by the wind. Mixing drives deeper currents, which brings very cold dense water up to the surface.

[24] Atkinson, L.P. 1995. Current Meter Observations in the Old Bahama Channel. Center for Coastal Physical Oceanography. Old Dominion University, Norfolk, Virginia. 1995.
[25] Bergman, K.L., H. Westphal, X. Janson, A. Poiriez, and G. Eberli. 2010. Controlling Parameters on Facies Geometries of the Bahamas, an Isolated Carbonate Platform Environment, In: Carbonate Depositional Systems: Assessing Dimensions and Controlling Parameters. New York: 1st Edition, 2010, VII, 270 p.
[26] Kourafalou, et al. 2011.(unpublished)
[27] Bergman, et al. 2010
[28] Atkinson, 1995.

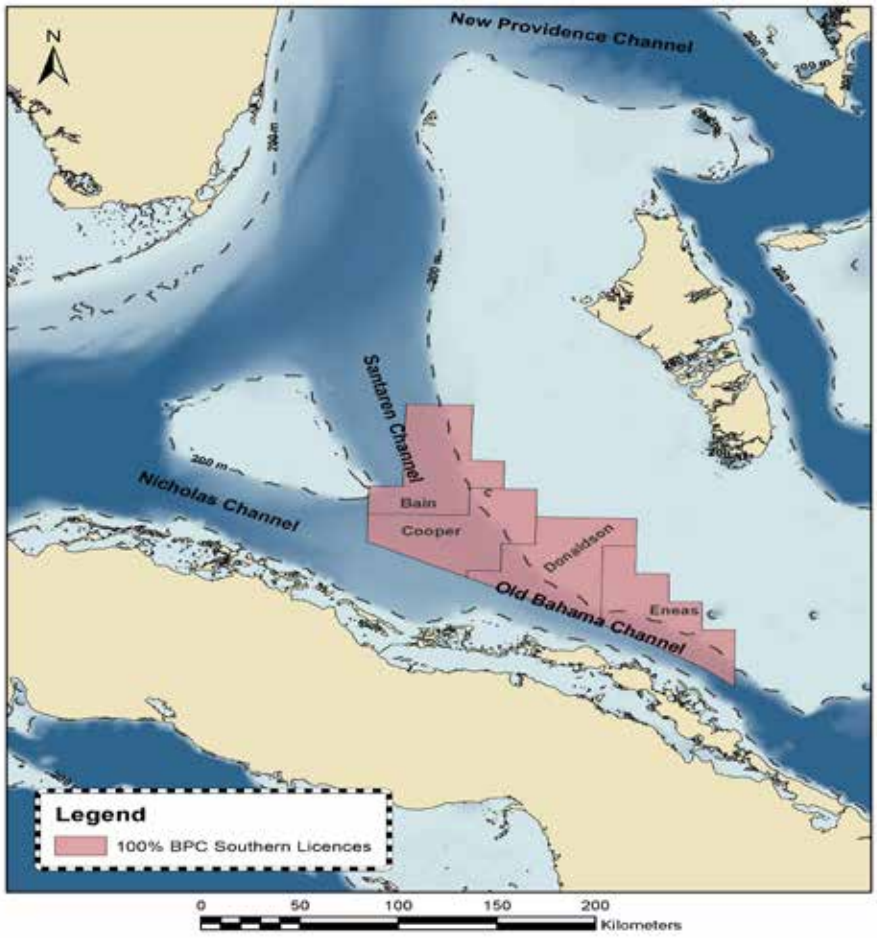

Figure 4-13: Map of Various Channels in the Project Area
Note: Approximate block boundaries shown in red
Source: Atkinson, 1995

The Old Bahama Channel and the Santaren Channel are located adjacent to the Blocks and have a direct influence on current flows for the area (Figure 4-13). Water coming from the Old Bahama Channel has a direct connection to the water flowing northward in the Florida Straits and the subtropical North Atlantic Ocean to the east. Additionally, the Santaren Channel and the Nicholas Channel receive Western Atlantic water through the Old Bahama Channel. It has also been concluded that water reaches the Little Bahama Bank from the Old Bahama Channel by flowing east along the Santaren Channel[29]. Recent research undertaken by Atkinson indicates that the Old Bahama Channel contributes 2 Sverdrup (Sv) [30] to the Florida Current. Water from the Old Bahama Channel, which terminates in the Florida Straits, passes predominately through the Santaren Channel and not the Nicholas Channel[31]. Table 4-6 indicates the flow direction, velocity and volume of Bahamian currents[32]. The negative flow volumes and velocities indicate reversal of mean flow direction.

[29] Wust, G., Stratification and Circulation in the Antillean –Caribbean Basin., Columbia University Press, 1964
[30] Bergman, et al., 2010.
[31] Atkinson, 1995.
[32] Atkinson, 1995.

Table 4-6: Current Direction and Velocities for the Channels near the Licenses[33]

Current or Passageway	Mean flow direction	Mean flow velocity	Max. surface flow velocity	Mean flow vol. (upper 200 m) [SV]	Flow vol. range (upper 200 m) [SV]
Florida Current at 26°N	NNW	--	>170 cm/s	15.5 ±1.4	13.7-17.6
Florida Current at 27°N	N	--	>160 cm/s	16.5 ±2.4	13.1-19.3
Santaren Channel	N	-10-20 cm/s	20 cm/s (300-400 m depth)	1.8	--
Old Bahama Channel	NW	~26 cm/s	193 cm/s (250 m depth)	1.9	6.6- (-2.4)

Data shown in Figure 4-14 through Figure 4-19 provide data on the seasonality of the currents at different depths (surface, 300m, 500m) surrounding and within the project area. Based on the analysis presented by University of Miami the deep currents were found to be generally much weaker and often in the reverse direction than the surface currents. With respect to the Old Bahama Channel, it was discovered that there is a strong tendency for surface inflow to be along Cuba and outflow along the Bahamas.

[33] Bergman, et al., 2010

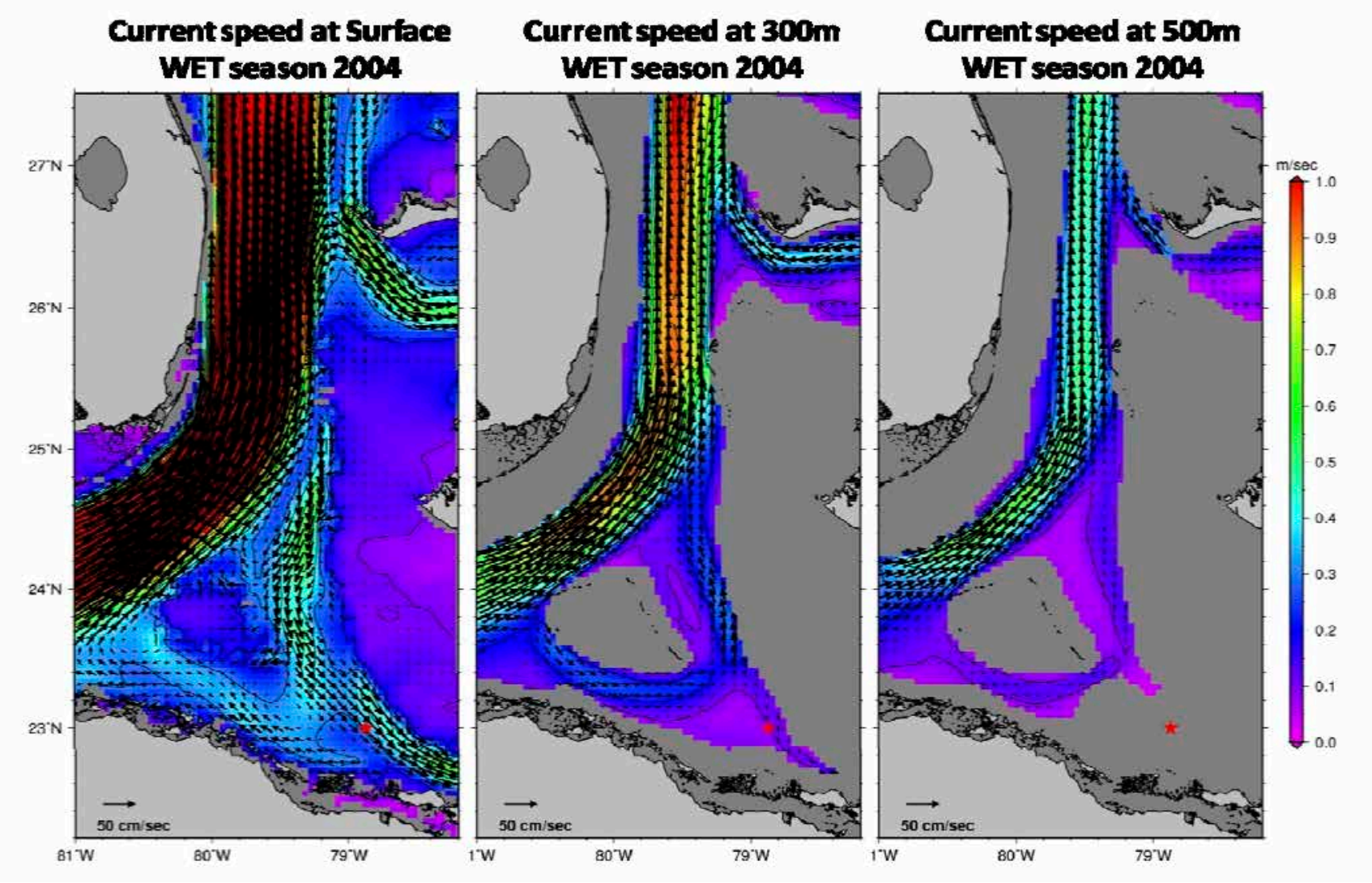

Figure 4-14: Seasonal Mean Current Patterns (Surface, 300m and 500m) in the Florida Straits for Wet Season in 2004

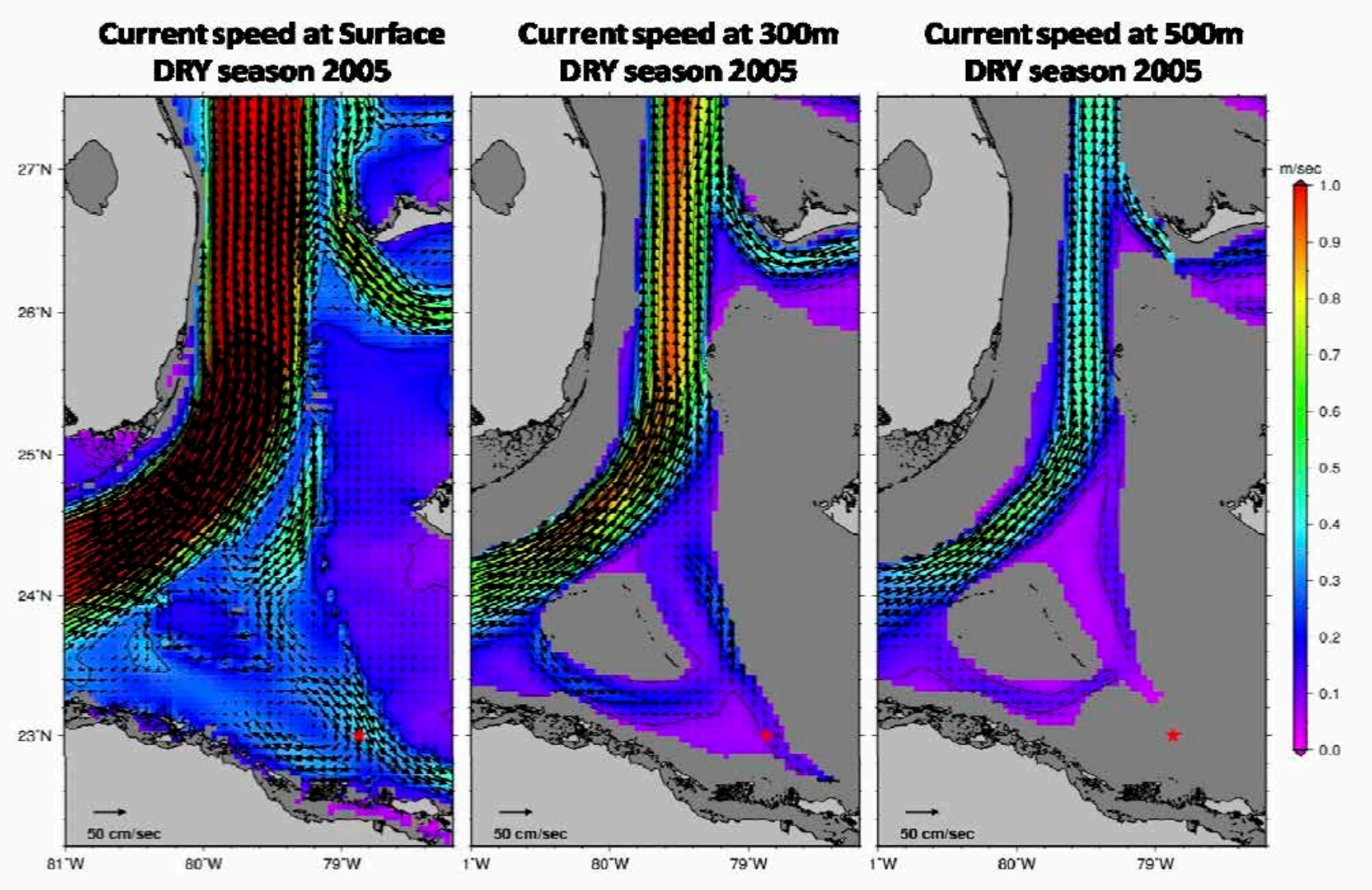

Figure 4-15: Seasonal Mean Current Patterns (Surface, 300m and 500m) in the Florida Straits for Dry Season in 2005[34]

[34] Kourafalou, et al. 2011.

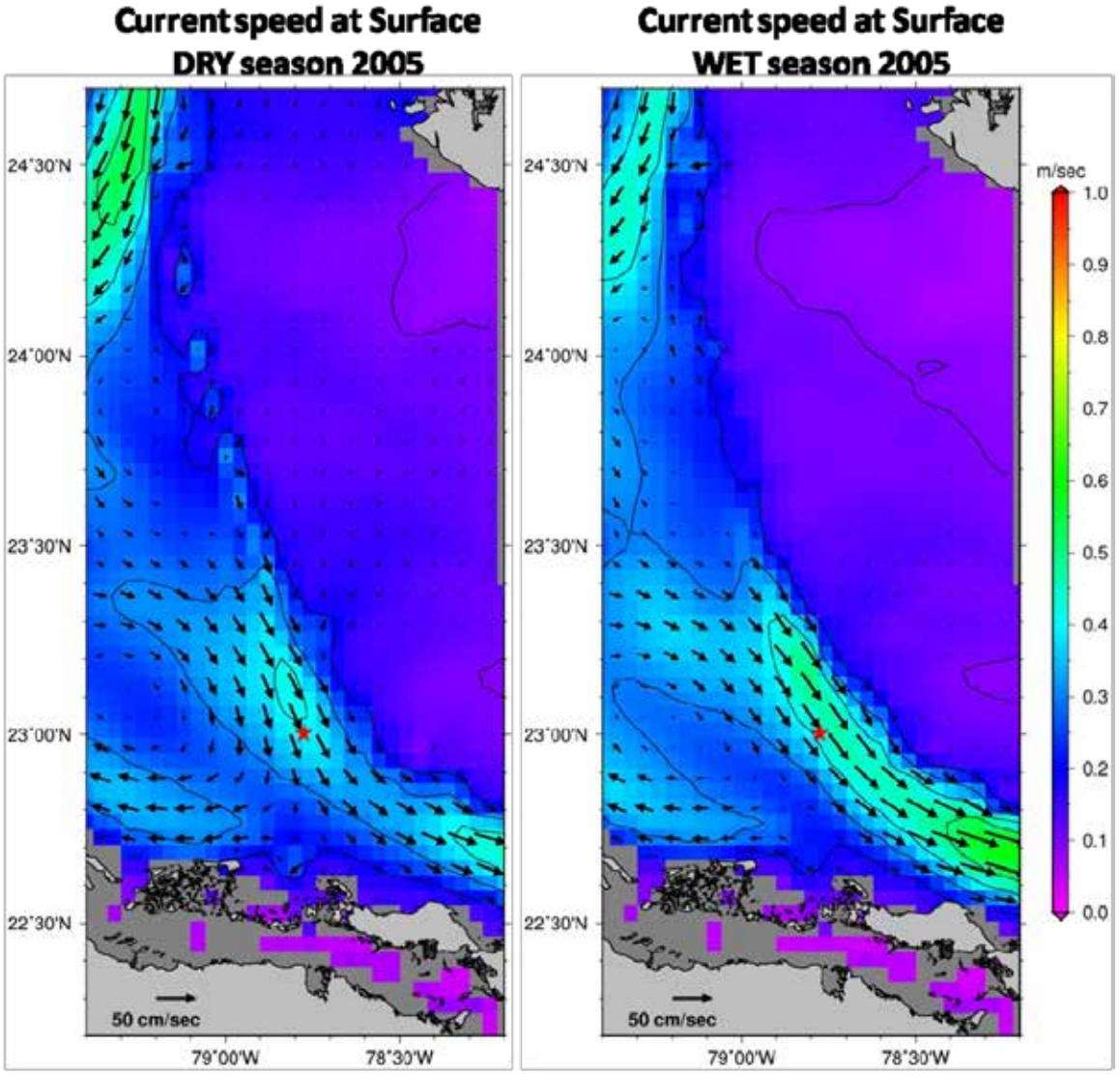

Figure 4-16: Seasonal Mean Current Patterns (Surface) in the Florida Straits for Dry and Wet Season in 2005[35]

[35] Kourafalou, et al. 2011.

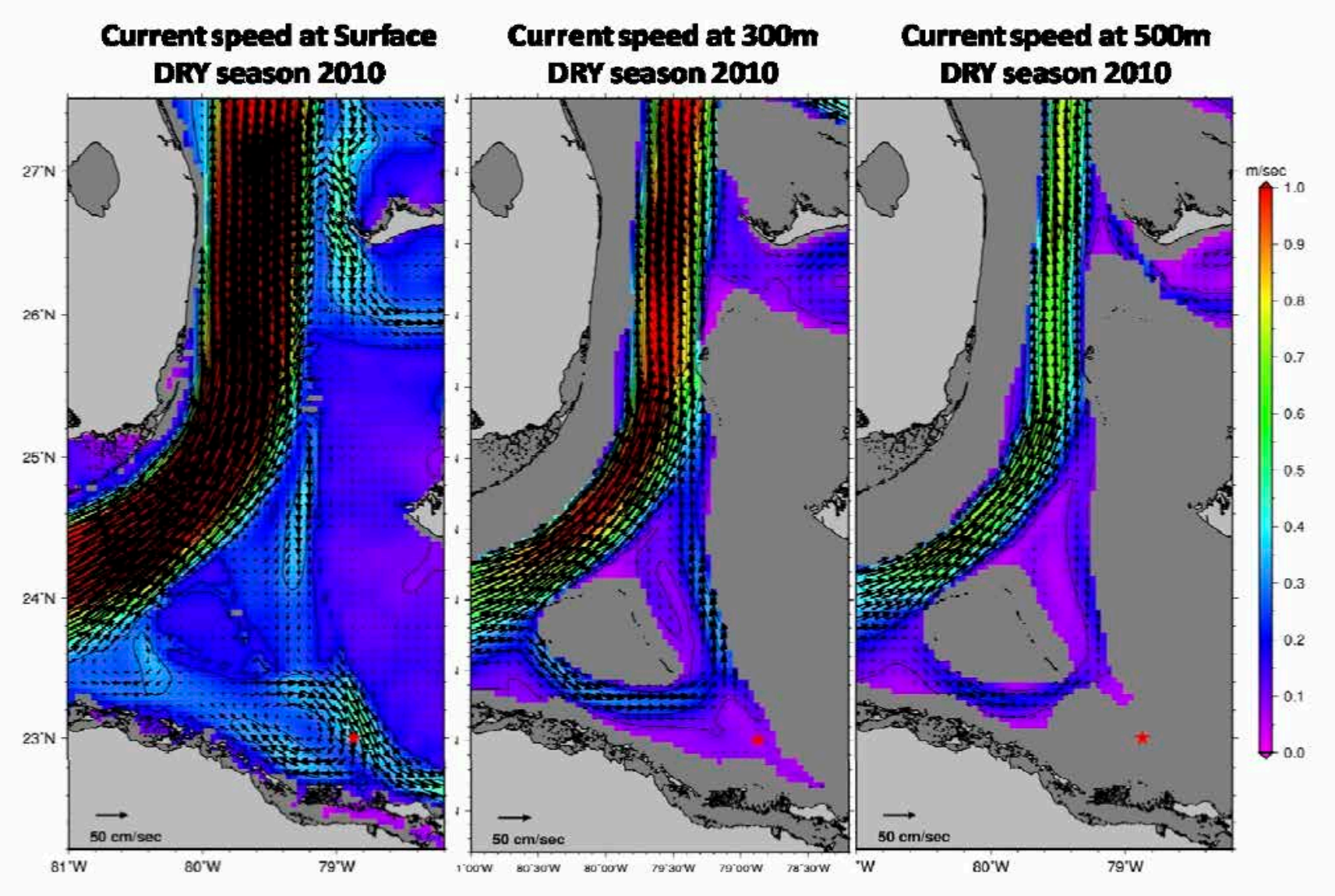

Figure 4-17: Seasonal Mean Current Patterns (Surface, 300m and 500m) in the Florida Straits for Dry Season in 2010[36]

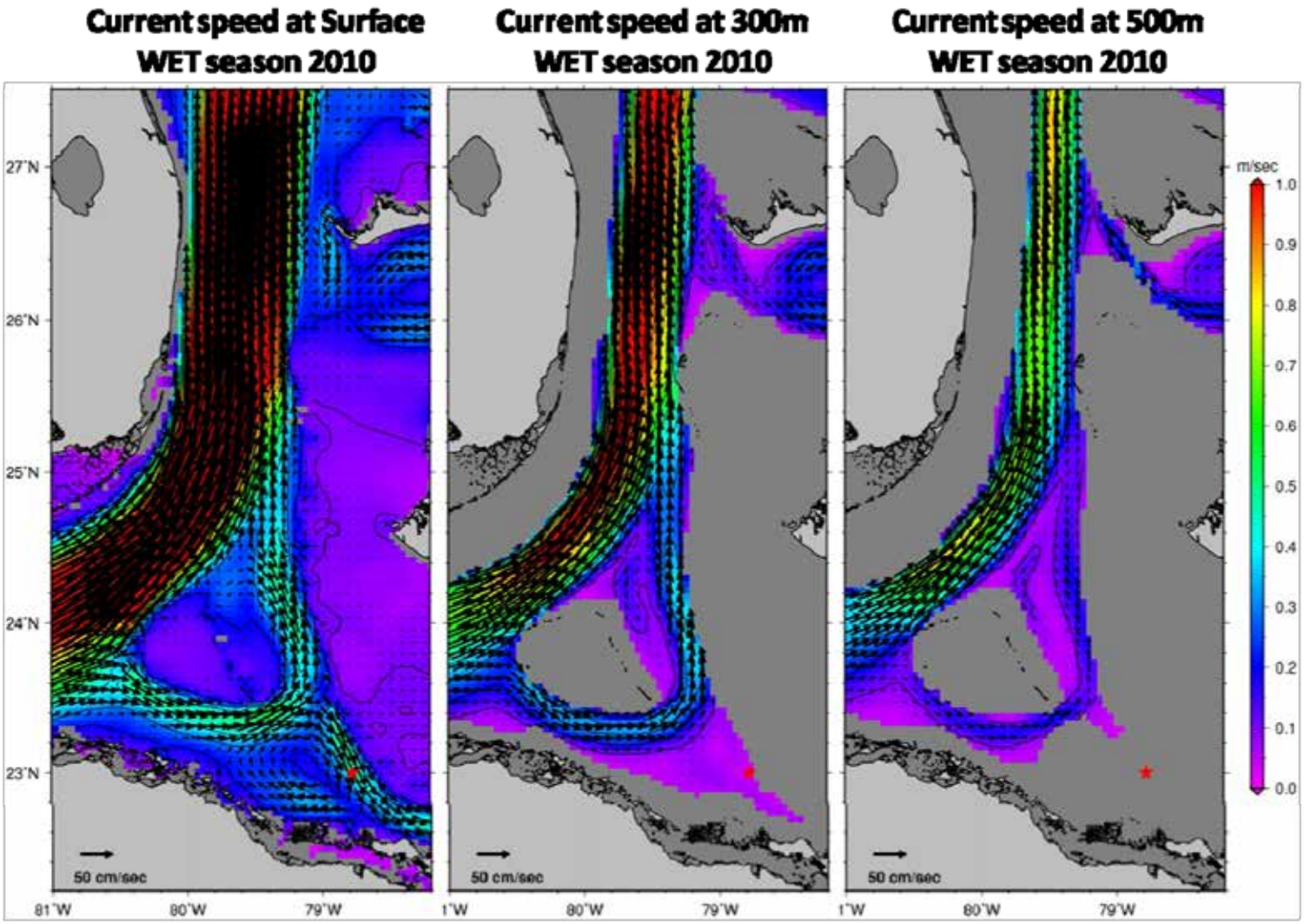

Figure 4-18: Seasonal Mean Current Patterns (Surface, 300m and 500m) in the Florida Straits for Wet Season in 2010[37]

[36] Kourafalou, et al. 2011
[37] Kourafalou, et al. 2011

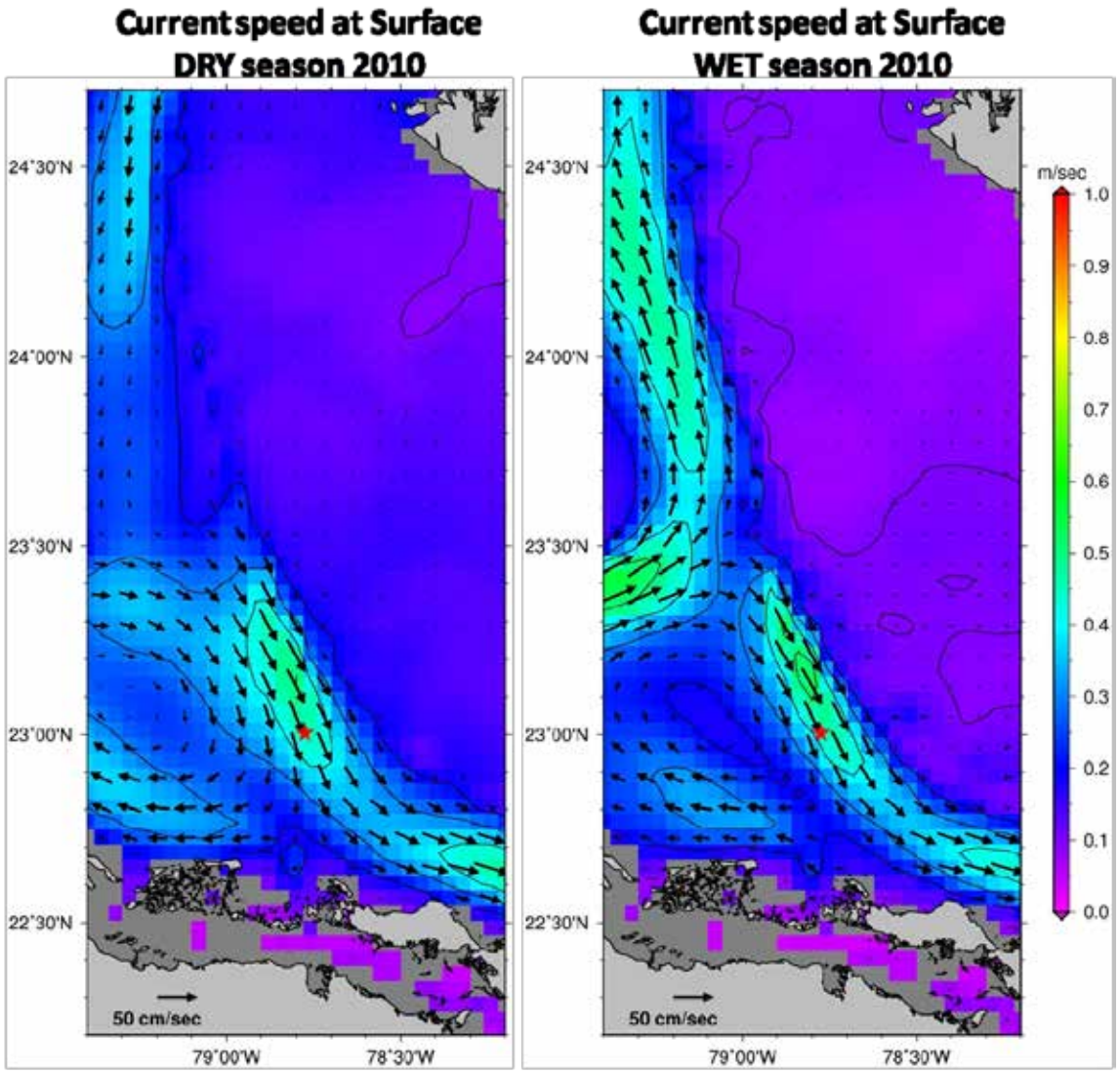

Figure 4-19: **Seasonal Mean Current Patterns (Surface) in the Florida Straits for Dry and Wet Season in 2010**[38]

[38] Kourafalou, et al. 2011

From the University of Miami analysis, Figure 4-14 through Figure 4-19 shows seasonally (long term) averaged currents, therefore it is reasonable to have smaller values than the instantaneous measurements (due to changes in current direction that create positive and negative values that can average out, dropping the mean values) shown in Table 4-6.

4.1.3.3 Marine Water Quality and Baseline Data at the Perseverance Well Location

Hydrographic profiles were collected for temperature, salinity, pH, dissolved oxygen (DO), fluorescence, and turbidity at two stations at the Perseverance Well drill site in December 2019. Table 4-7 provides the minimum and maximum recorded values for hydrographic parameters at both stations. Figure 4-20 and Figure 4-21 visually display the hydrographic profiles for all stations. Overall, hydrographic data at both stations appeared typical of the offshore open ocean environment for the region.

Table 4-7: Minimum and Maximum Values for all Hydrographic Profile Parameters during the BPC Bahamas Environmental Baseline Survey

Drillsite (Station)	Data	Temperature (°C)	Salinity (PSU)	pH	Dissolved Oxygen		Fluorescence (mg m^{-3})	Turbidity (NTU)
					(mg L^{-1})	(%)		
B-North (NF001)	Min	12.8	35.5	7.8	4.1	48.6	0.002	0.029
	Max	27.0	37.0	8.2	6.2	95.6	0.270	0.560
B-North (FF003)	Min	11.9	35.4	7.8	3.9	45.0	0.001	0.004
	Max	27.1	37.1	8.2	6.2	95.3	0.550	0.126

Seawater temperature ranged from 11.9°C to 27.1°C during the survey and was similar between stations. Temperature changed very little in the upper 100 to 120 m of the water column, indicating a well-mixed surface layer. Below 120-m depth, seawater temperature decreased for the remainder of the profile with the lowest temperatures recorded at maximum depth for both stations.

Salinity ranged from 35.4 to 37.1 practical salinity unit (PSU) during the survey and was typically lower at the surface (<140 m) and increased with depth (>350 m) for both stations. The slightly lower salinity observed in the surface waters may have been attributed to the rainfall events observed during the survey.

The water column pH ranged from 7.8 to 8.2, decreasing with depth at both station locations. Fluorescence ranged from 0.001 to 0.55 mg m^{-3} with the fluorescence maximum in the upper 100 m of the water column and within the photic zone at each station. Turbidity was low at all stations and ranged from 0.004 to 0.560 nephelometric turbidity units (NTU) during the survey.

Dissolved Oxygen (DO) concentration ranged from 3.9 to 6.2 mg L^{-1} during the survey and DO saturation ranged from approximately 45% to 95.6%. DO concentration and saturation generally decreased with increasing water depth at all stations. The DO profiles reflect water column processes of primary productivity, respiration, and mineralization. Typically, DO is highest at the near-surface where sunlight allows the highest rates of primary production (resulting in oxygen evolution). DO is greatest not at the surface but just below the water surface due to the actinic effects of sunlight on photosynthesis. Below the surface-mixed layer, decreasing light availability depresses primary productivity, and mineralization of organic matter results in lower DO concentrations due to associated oxygen consumption.

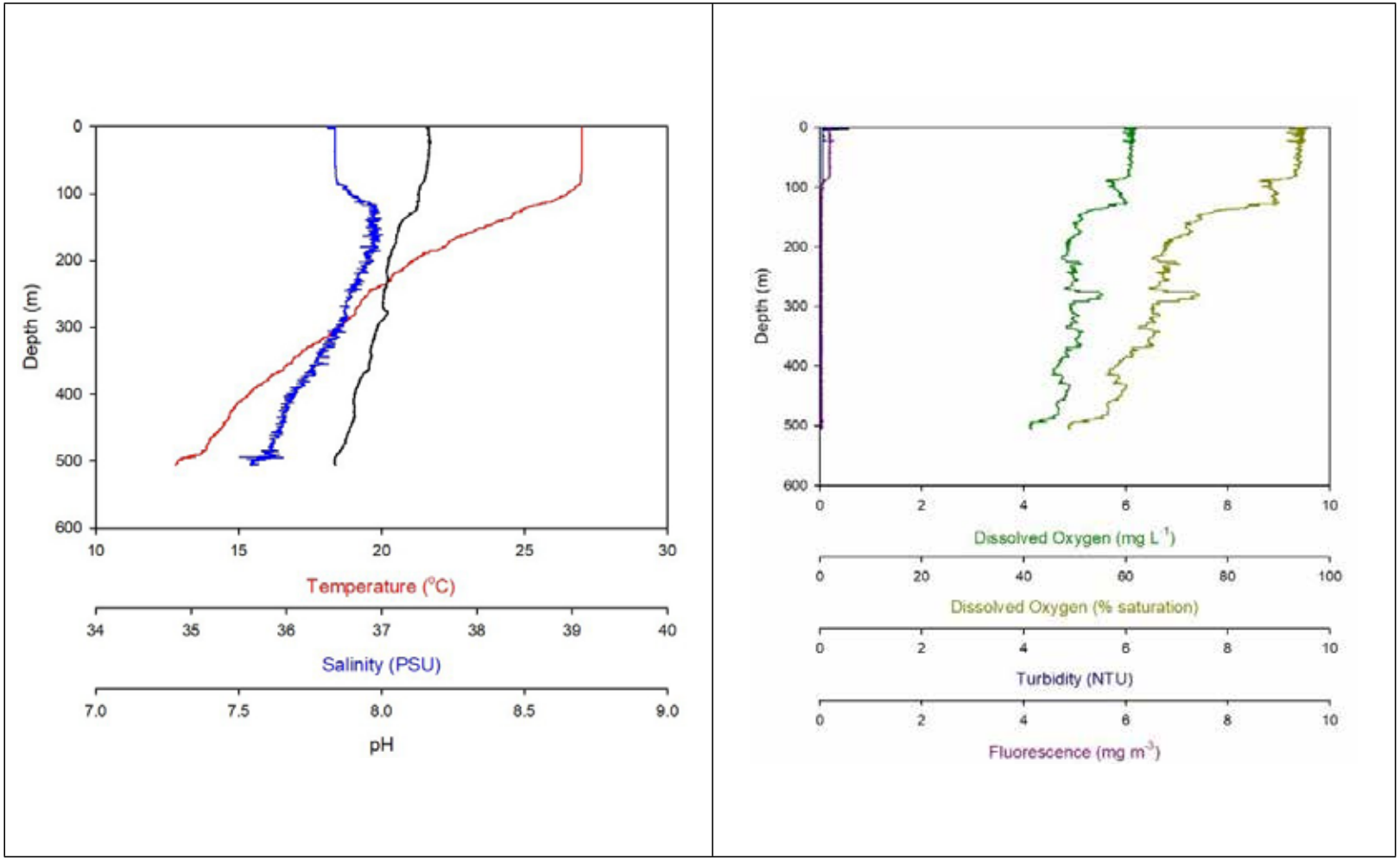

Figure 4-20: Water column profiles for temperature, salinity, pH, dissolved oxygen (concentration and saturation), fluorescence, and turbidity at Station NF-001 at Drillsite B-North during the BPC Bahamas Environmental Baseline Survey.

PSU = practical salinity unit; NTU = nephelometric turbidity unit.

Source: CSA Ocean Sciences, 2020[39]

[39] CSA Ocean Sciences. 2020. Draft Environmental Baseline Survey: Drilling Sites B-North and C Offshore the Commonwealth of the Bahamas. Unpublished report.

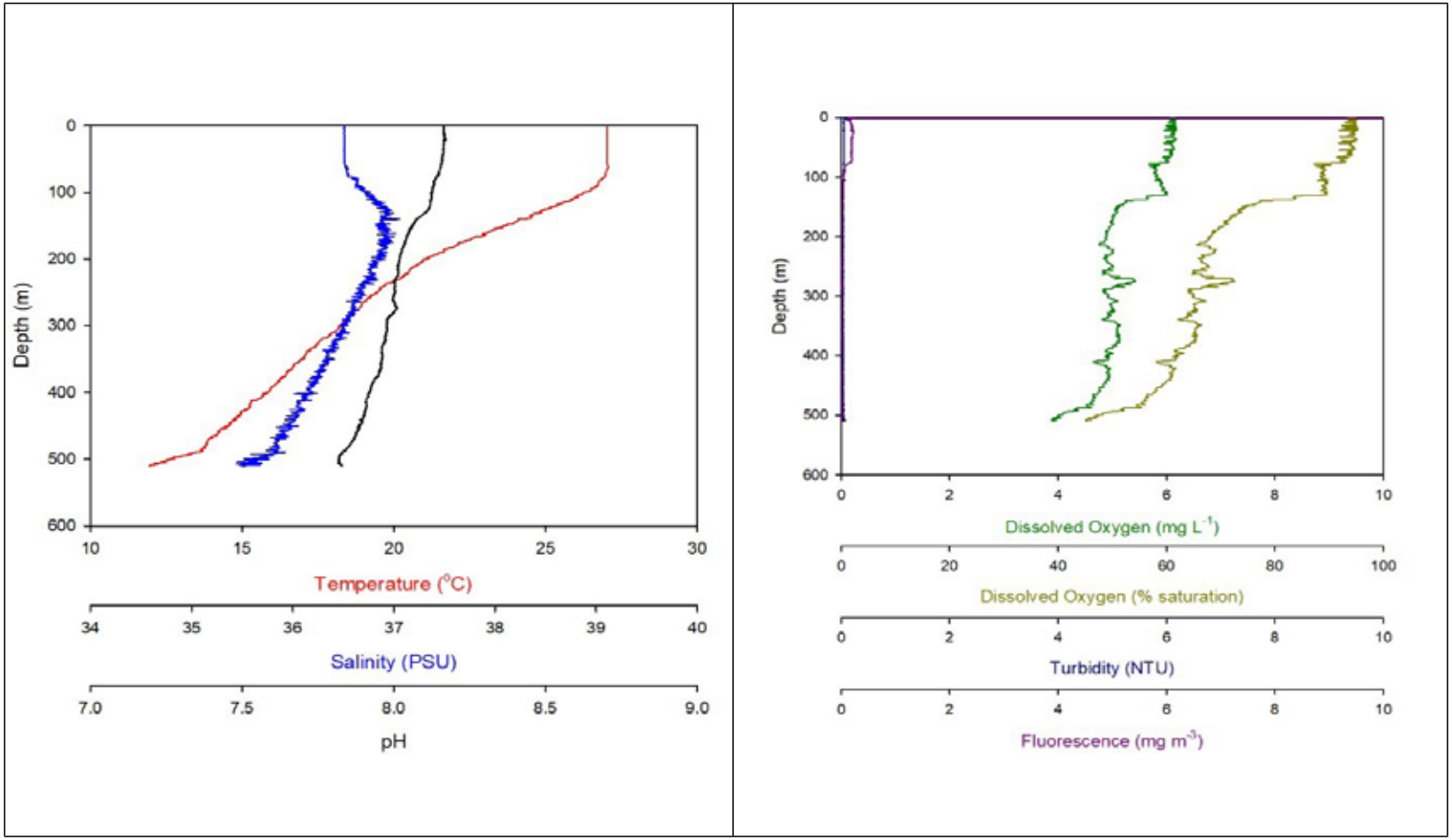

Figure 4-21: Water column profiles for temperature, salinity, pH, dissolved oxygen (concentration and saturation), fluorescence, and turbidity at Station FF-003 at Drillsite B-North during the BPC Bahamas Environmental Baseline Survey.

PSU = practical salinity unit; NTU = nephelometric turbidity unit.

Source: CSA Ocean Sciences, 2020

4.2 Biological Environment

Drilling will only occur in deepwater (depths greater than 300 m) away from beaches, mangrove, sea grass beds and coral reefs (these are predominantly shallow water habitats). However, due to their high intrinsic value (locally and regionally), importance to the marine fauna and local communities and due to their proximity to the drilling area these areas are described below. All information included in Sections 4.2 and 4.3 applies to The Bahamas generally as there is limited information available specific to the project area.

Andros Island is the closest inhabited Bahamian island and is approximately 80 miles (~130 km) from the first proposed well site. Information is provided on the Great Bahama Bank, and Cay Sal Bank and its associated small cays which are approximately 15 miles (25 km) from the blocks. The coastal and marine environment of Bimini is also discussed as it is within the project area of influence.

Information about the northern coast of Cuba and the south-eastern coast of Florida is referenced in Section 4.4 as these locations are within the project area of influence.

4.2.1 Coastal and Marine Ecosystems

Andros is the largest island in The Bahamas at 100 miles long and 45 miles wide. The east side of Andros is bordered by the Tongue of the Ocean, a 6000-foot (1,800 m) deep abyss that separates Andros from New Providence. The third largest barrier reef in the world runs 140 miles (230 km) along the east coast of Andros (Figure 4-22). Figure 4-23 shows a map of Andros Island with respect to the entire Bahamas and also its many settlements and creeks. The west side of Andros is surrounded by the shallow waters of the Great Bahama Bank.

Figure 4-22: Photo of Andros Barrier Reef[40]
Source: The Nature Conservancy, 2003

[40] The Nature Conservancy. 2003. Ecoregional Conservation Plan of the Bahama Archipelago.

Many of the marine and terrestrial habitats on Andros are intimately linked not only above ground through flowing tidal waters, but also underground because of groundwater filtration through porous limestone rock and the extensive system of interconnected inland and marine limestone caves and cavities, known as blue holes. Andros has the highest concentration of blue holes in the Western Hemisphere, and the largest reservoir of freshwater in The Bahamas.

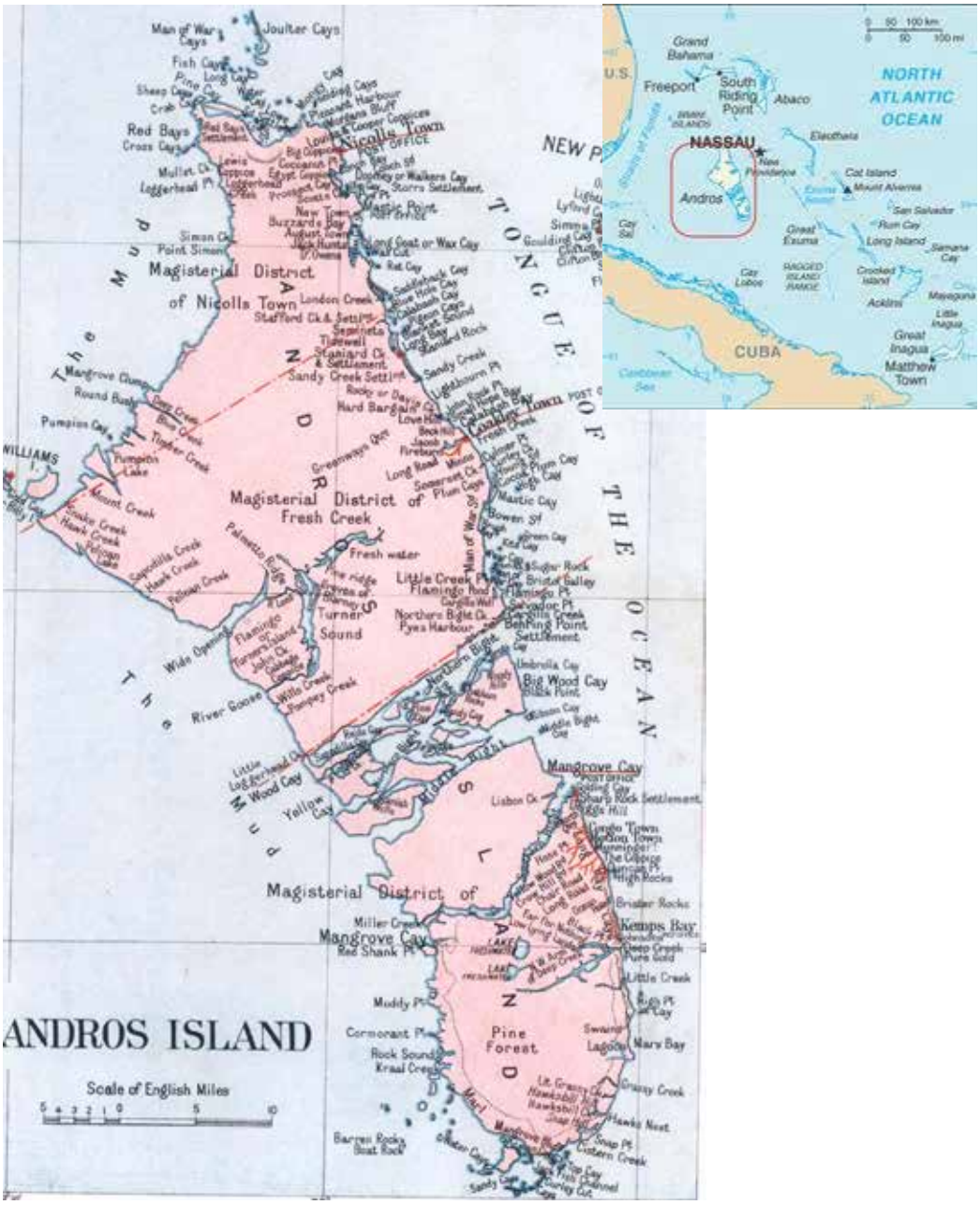

Figure 4-23: Map of Andros Island, The Bahamas
Source: Coldwell Banker Website[41]

[41] Coldwell Banker. 2011. Maps of the Islands of The Bahamas. Accessed from the Coldwell Banker website: www.coldwellbankerbahamas.com; and, Andros Island, The Bahamas. Accessed from www.expatsinthebahamas.com. 2010.

The largest freshwater estuary system in The Bahamas occurs on the west side of Andros Island in the Lake Forsyth/Turner Sound/Wide Opening area. Freshwater inputs support several unique breeding grounds in the area and are essential for ensuring that the west side of Andros will continue to function as one of the most important nursery systems in The Bahamas for several organisms including the Queen conch (*Strombus gigas*) and Nassau grouper (*Epinephelus striatus*). The habitats on the west side of Andros include seagrass beds, creeks and mangroves. See Sensitivity Mapping provided in EMP Appendix E, attachment D.

The bight areas of Andros help to transport larvae and fish to major spawning areas on the east side of the island.

The western Great Bahama Bank is characterized as a sheltered bank with continuous cays. Acroporid corals such as elkhorn and staghorn corals are found in this area of the bank and in 2003[42] were assessed to be in fair condition. This area is also important for:

- Atlantic spotted dolphin
- Queen conch,
- Spiny lobster,
- Nassau grouper,
- Rock iguanas; and
- West Indian flamingos.

The western Great Bahama Bank is classified by The Nature Conservancy as a high priority bank system for protection of biological diversity.

The Cay Sal Bank is the third largest and westernmost of the Bahama Banks. It is approximately 30 miles (~50 km) from Cuba, separated by the Nicholas Channel. Cay Sal Bank is an isolated, submerged platform, roughly triangular in shape, with a base along the south rim of 65 miles (~105 km), and a width of 41 miles (66 km) north-south, with islets along its rim, except along the south side facing Nicholas Channel where it has only numerous rocky coral heads. As such, it is one of the largest atolls in the world. Depths on this bank range from 30-50 ft. (~9–16 m). Figure 4-24 shows a map of Cay Sal Bank with those cays which are above mean sea level, including Anguilla Cays.

Anguilla Cays, near the southeast extremity of Cal Say Bank, consist of several elongated, scrub-covered, sandy islands which are swampy near their southern end, and are demarcated by stunted palm trees. The northern end of Anguilla Cays is marked by a beacon, 5 m high. Anguilla Cay is the name of the northern and second largest of the Anguilla Cays. Cotton Cay, the southern Anguilla Cay, is the largest and southernmost of the Anguilla Cays. Between the two is the much smaller Middle Cay. There are also a number of smaller, unnamed cays or rocks[43].

[42] The Nature Conservancy. 2003.
[43] Bruckner, A. 2011. Quick-Look Field Report. Living Oceans Foundation. May 2011. Accessed from the following website: www.sciencewithoutborders.org

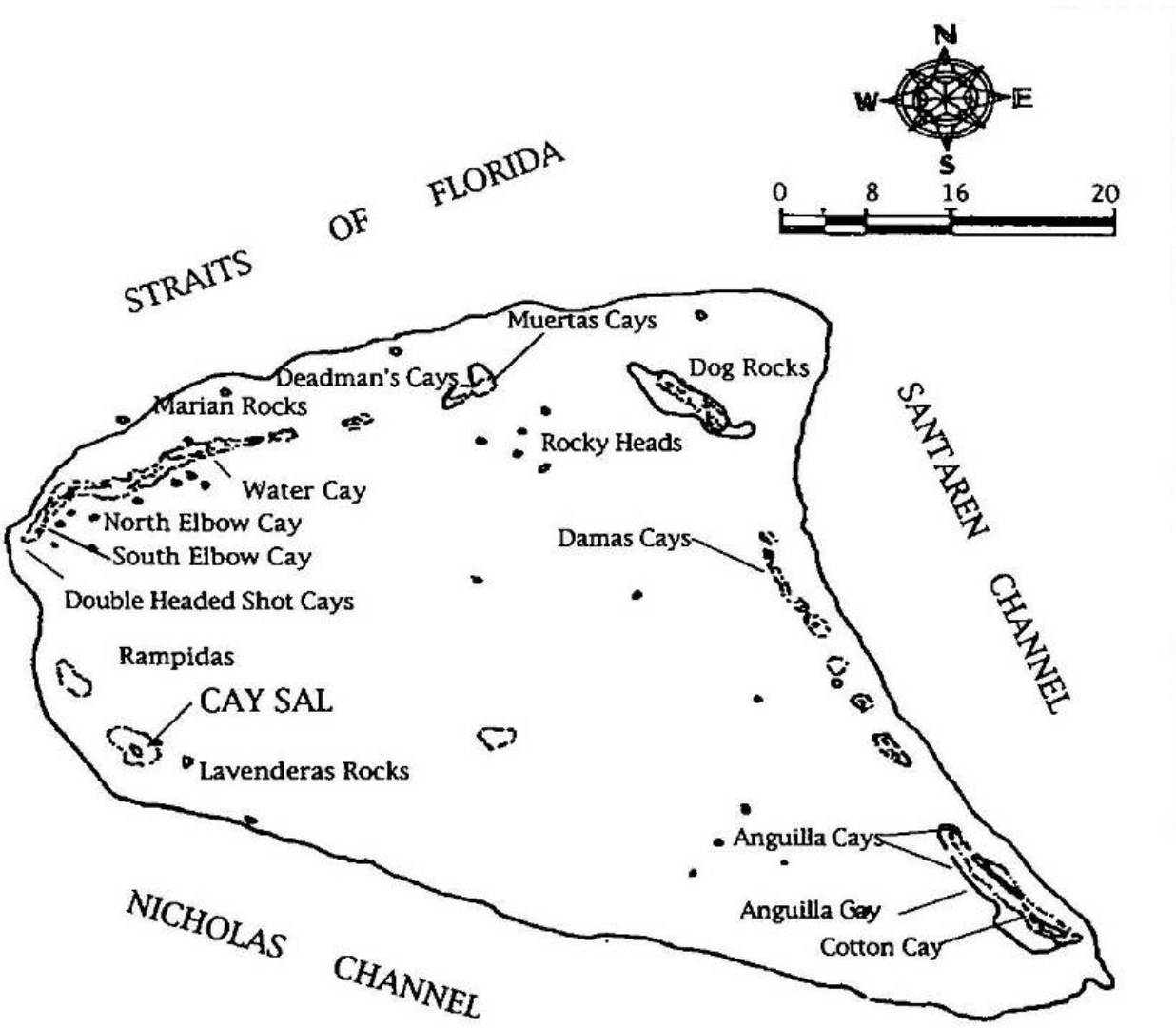

Figure 4-24: Map of Cay Sal Bank
Source: Bradley and Norton, 2011[44]

[44] Bradley, Patricia and Robert Norton. 2011. Maps for an Inventory of Breeding Seabirds of the Caribbean. Accessed from the following website: www.wicbirds.net.

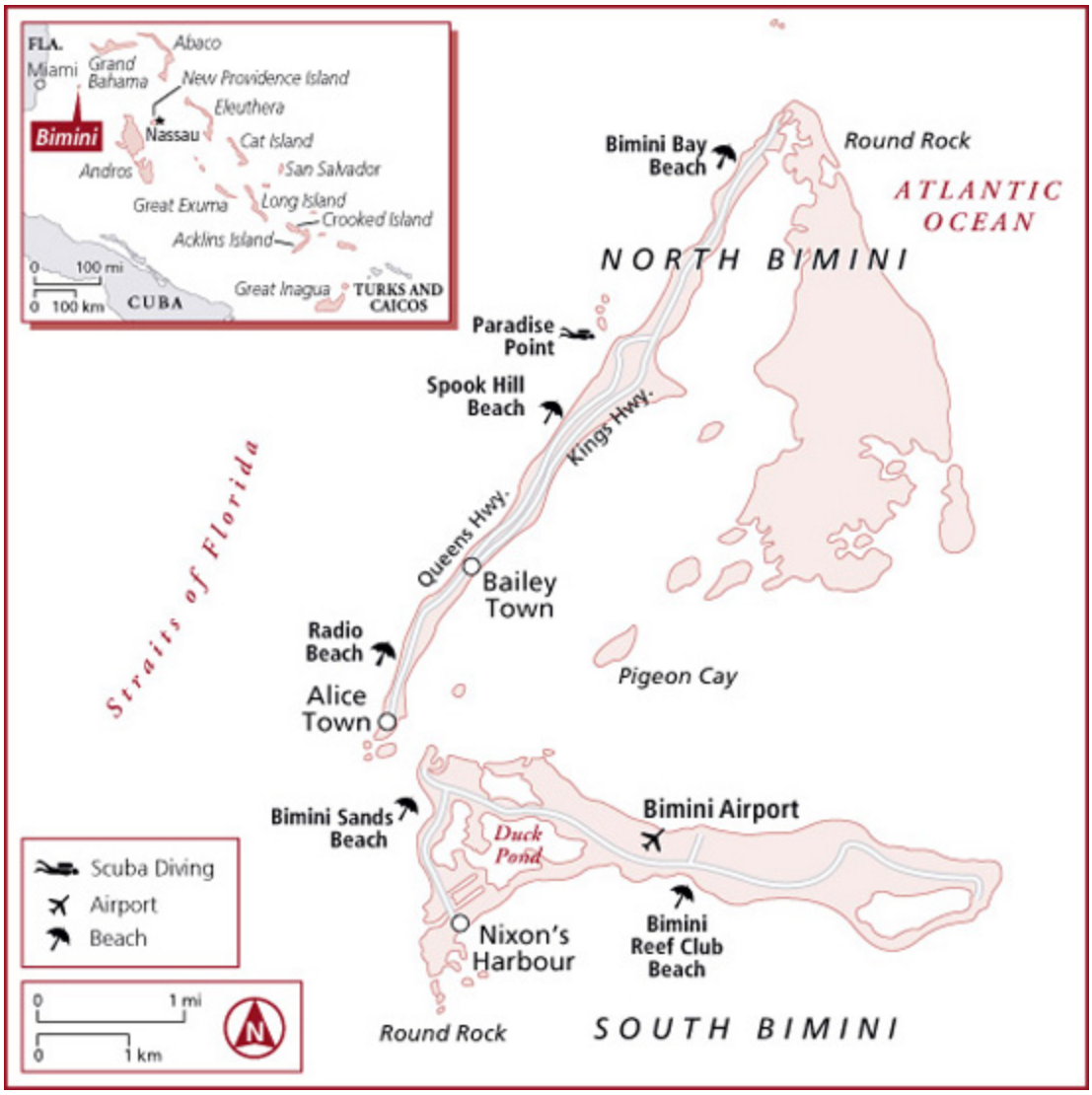

Figure 4-25: Map of Bimini
Source: Bahamas4U.com[45]

Located 50 miles from southern Florida (over 175 miles from the blocks), Bimini actually consists of two small islands – North Bimini and South Bimini as shown in Figure 4-25. Bimini's shoreline is dominated by mangroves and shallow seagrass beds[46]. The warm, clear waters of Bimini flow from the Gulf Stream up onto the Great Bahama Bank.

4.2.1.1 Beaches

No beaches are within Bahamas Petroleum Company's southern license areas, but there are beaches located on Andros Island, within the Cay Sal Bank area and on Bimini. Beaches are found primarily along the east coast of Andros. Beach vegetation includes salt grass (*Distich is spicata*) and inkberry (*Scaevola plumeri*). Beaches provide important habitat for migrating seabirds and nesting habitat for marine turtles.

[45] Bimini Maps. www.bahamas4u.com/biminimaps.html. 2008.

Beaches are found on several of the cays on the Cay Sal bank including the Anguilla Cays, but information is limited on beach type, state and specific locations.

Most beaches in Bimini are found on the west side of North Bimini, stretching from Alice Town to Bailey Town. Bimini's beaches provide nesting sites for loggerhead and hawksbill turtles.

4.2.1.2 Mangroves

Mangrove communities in The Bahamas typically consist of red mangrove (*Rhizophora mangle*), black mangrove (*Avicennia germinans*), white mangrove (*Laguncularia racemosa*) and buttonwood (*Conocarpus erectus*). These species will occur in zones moving from the sea to land as follows:

- Red mangrove – closest to the sea as the most salt tolerant of the four species;
- Black mangrove – found in areas which are periodically flooded by the tides
- White mangrove – follow black mangrove
- Buttonwood – found in the terrestrial zone of the mangrove.

Mangroves provide habitat for numerous species of birds, fish, mollusks, crustaceans and other invertebrates.

On the west side of Andros, tall, thick mangrove areas are found primarily at the mouths of creeks, especially ones with well-defined channels and at various island sites in creek interior areas. See Sensitivity Mapping provided in EMP Appendix E, attachment D.

Mangroves do not occur on Cay Sal Bank, except for a few areas on Cay Sal Island that are not located near the water.

Found within the salt water mangrove swamp which covers 4 miles of North Bimini is the Healing Hole, a natural spring. It is a pool that lies at the end of a network of winding underground tunnels. During outgoing tides, these tunnels pump cool, fresh water laden with minerals into the pool. Lithium and sulfur are two of the minerals found in the pool[47]. The Healing Hole is purported to have healing powers by those who have swam in it. It is a favorite site to visit for tourists.

Mangroves will not be found in the project area since this area is located in water depths greater than 300 m. However, they are included in this report as they are an important habitat type that is in the area of potential impact.

4.2.1.3 Seagrass Beds

This important benthic habitat is found all along the west side of Andros on the northwest and southwest Great Bahama Bank, Cay Sal Bank, Conch Sound, North Bight, and South Bight (Figure 4-26). Seagrass beds and macroalgae assemblages play a valuable role by providing food, shelter and serving as nursery grounds for a diversity of commercially exploited species such as:

- fish,
- crabs,
- sea turtles,
- Queen conch;
- Spiny lobsters, and

[47] The Islands of The Bahamas. 2011. About Bimini Island. Accessed from the following website: www.bahamas.com/out-islands/bimini-island. 2008-2011.

· other marine life.

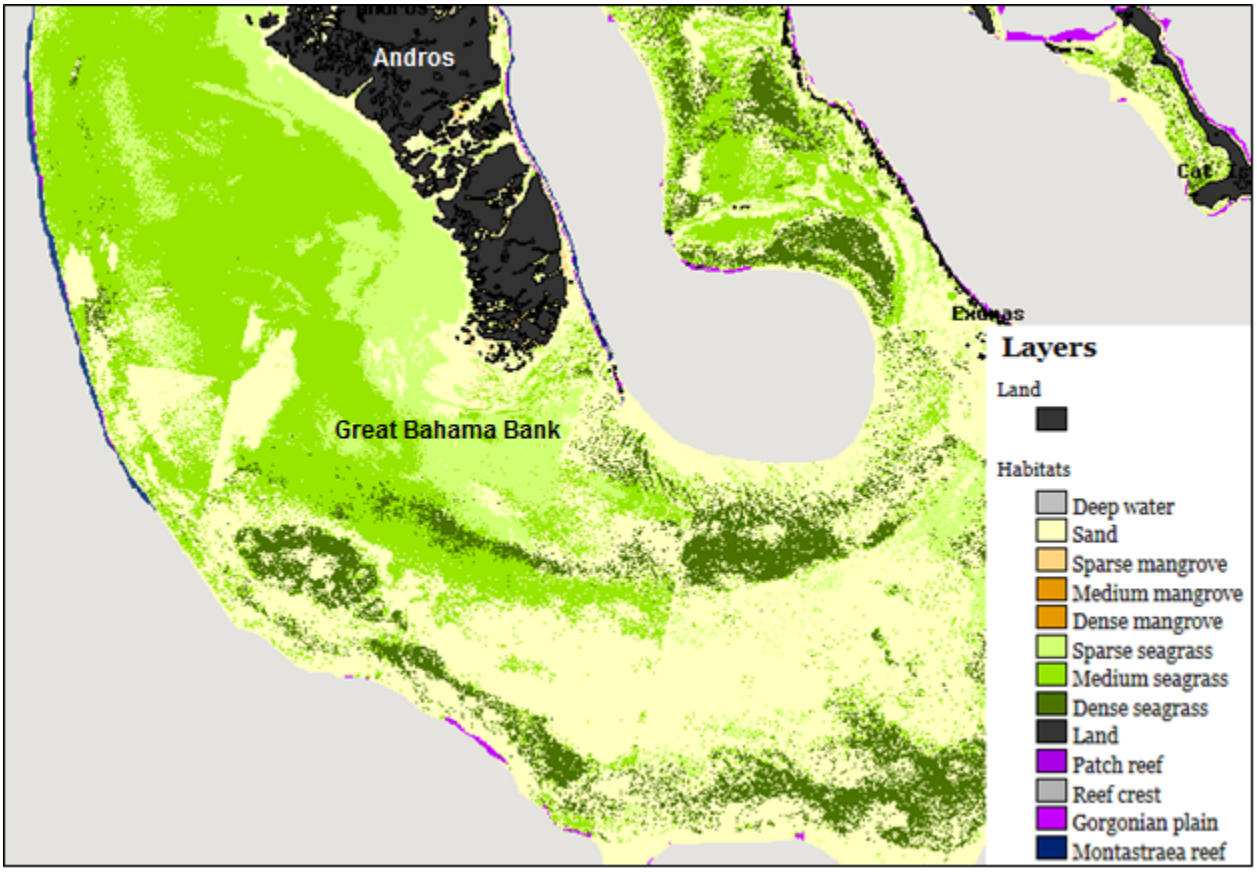

Figure 4-26: Map of Seagrass Distribution on Great Bahama Bank
Source: Adapted from Living Oceans Foundation, 2011[48] [49]

Spiny lobsters also feed on smaller organisms that live in seagrass beds. Seagrasses also stabilize sediments and trap small particles, helping to maintain the clarity of Bahamian waters. When these beds are destroyed, the ocean can become more turbid and less suitable as habitat for some marine organisms.

Goldberg[50] (1983) identified seagrass and algae beds in the Cay Sal Bank. Including shoalweed (*Halodule wrightii*), *Caulerpa* spp., manatee grass (*Syringodium filiforme*), and various species of calcareous chlorophytes. Seagrass found in the north-eastern sector include *Sargassum* spp. Across the bank from Cay Sal to the Damas Cays is an area characterized by turtle grass (*Thalassia testudinum*) which becomes more extensive toward the south-western side. Turtle grass becomes well developed in the lee of larger islands on the bank, particularly Double Headed Shot Cays and the Anguilla Cays. Behind the Anguilla Cays, turtle grass grades into a *Halodule* – calcareous green algae zone.

[48] Living Oceans Foundation. 2011. GIS Data Viewer. Accessed from the Living Oceans Foundation Website: http://www.livingoceansfoundation.org/
[49] see Sensitivity Mapping provided in EMP Appendix E, attachment D includes distribution of seagrass beds from data obtained from the United Nations Environment Program and The Nature Conservancy. Data layers contained in this figure could not be obtained for inclusion in the Appendix.
[50] Goldberg, W. M. 1983. Cay Sal Bank, Bahamas: A Biologically Impoverished, Physically Controlled Environment. Atoll Research Bulletin, No. 271. The Smithsonian Institution. Washington, D.C. USA.

The 2011 Living Oceans Foundation surveys revealed that many of the shallow coral habitats appeared to be biologically impoverished, with little living coral and expansive growth of fleshy seaweeds, also known as macroalgae. Much of the bank benthic area was covered by:

- green, lettuce-like fleshy *Microdictyon* algae,
- brown ruffled *Lobophora* algae, and
- *Sargassum*.

These macroalgae often formed accumulations 10-30cm thick in sandy areas between the reef structures[51].

4.2.1.4 Corals

Corals are ecosystems typically located along coastlines and adjacent to islands, in waters less than fifty meters deep. A multibeam survey completed indicates that there are no deep sea corals in the project area.

The Andros Barrier Reef is the second largest such barrier reef type in the Western Atlantic. It stretches 140 miles along the east coast of Andros Island (Figure 4-27) with Andros Island acting as a barrier between the reef and the Bahamas Petroleum Company southern license areas. The minimum distance between the proposed drilling location and the Andros Barrier reef is approximately 90 miles (145 km). Coral reefs represent one of the main attractions for the tourism industry in The Bahamas.

Behind the reef crest in the protected waters of the lagoon are found numerous habitats including patch reefs, sand flats, seagrass beds and mangroves. Important commercial species supported by this lagoon area include:

- Spiny lobster (Panulirus),
- Queen conch (*Strombus gigas*),
- Snapper (Lutjanidae), and
- Grunts (Haemulidae).

On the reef structure itself, can be found numerous soft corals or gorgonians including sea fans and sea whips. Hard coral species include:

- Elkhorn (*Acropora palmata*),
- Staghorn (*Acropora cervicornis*), and
- Mountainous star (*Montastrea annularis*).

Classic western Atlantic spur-and-groove reef systems have developed around the outer portions of the Cay Sal Bank. The Living Oceans research team also observed unusual coral and sponge patches within the bank, each differing in structure and species assemblages. One area, at depths of 23-30 ft. (~7-8 m), consisted of small coral bommies with many species of reef building corals and dense, colorful sponge assemblages[52].

These coral reefs are important to the fishing communities and are a major contributor to the livelihood of persons in The Bahamas.

[51] Bruckner, 2011.
[52] Bruckner, 2011.

Coral reef health varies throughout the Bahamas. A 2013 report indicates that reefs on Andros reflect average coral health conditions in the Bahamas, with 41% in Fair condition, and 43% Impaired. Cay Sal's reefs are in worse condition, with nearly 60% considered to be in Poor health. Primary threats to Bahamian coral reefs include climate change, illegal fishing, unsustainable legal fishing, and coastal development. Illegal fishing is a "very high" risk in Cay Sal, and in Andros illegal fishing and climate change are "high" risks. [53]

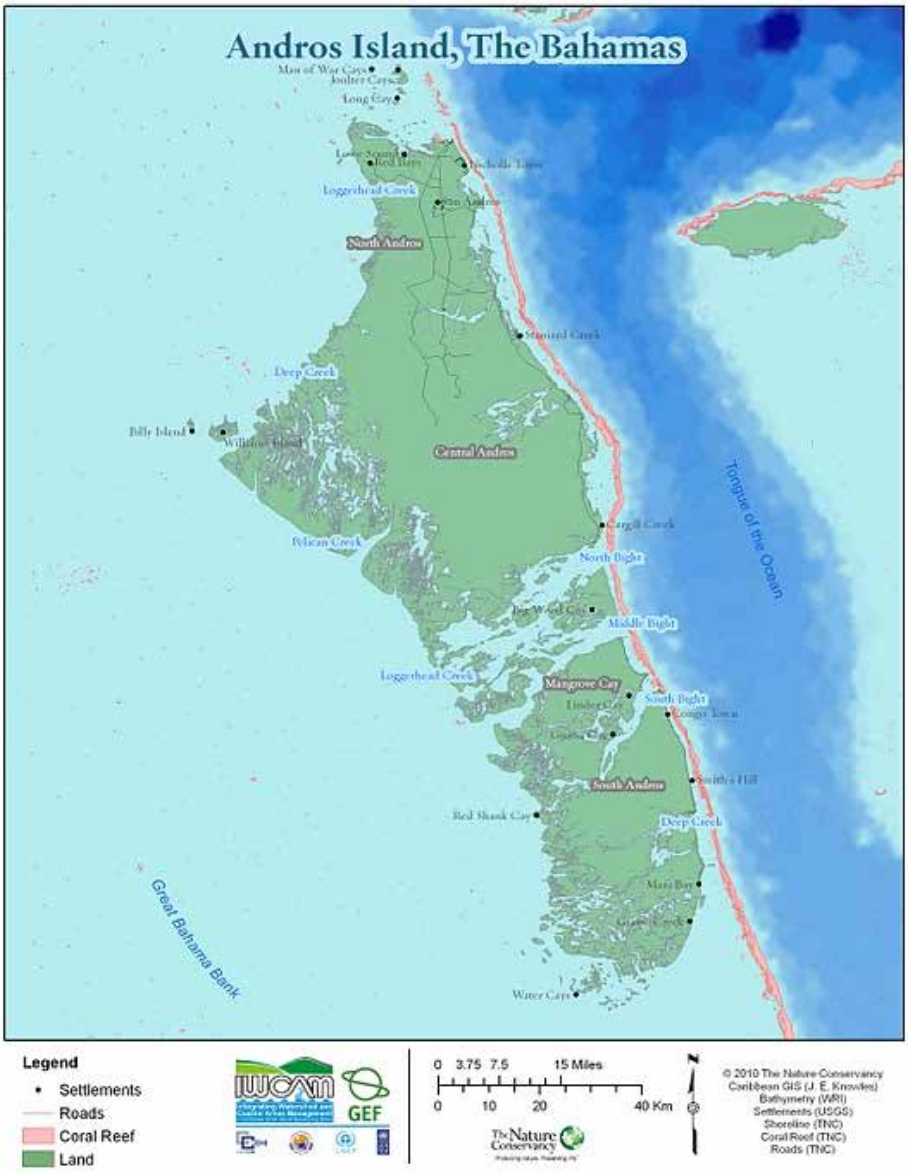

Figure 4-27: Andros Barrier Reef
Source: The Nature Conservancy, 2010[54]

[53] Dahlgren, C., K. Sherman, J. Lang, P.R. Kramer, & K. Marks. 2016.Bahamas Coral Reef Report Card Volume 1: 2011–2013. Available from: https://www.agrra.org/wp-content/uploads/2016/05/Bahamas-2016-Coral-Reef-Report-Card.pdf

[54] Knowles, J.E. 2010. The Nature Conservancy, Northern Caribbean Program. Andros Map, Integrated Watershed and Coastal Area Management Project. Nassau, The Bahamas.

Cold-water corals are slow-growing, reef-forming coral species that can grow in waters as deep as 6600 feet (2000 m) as they do not require symbiotic zooxanthellae to survive. These corals can be impacted by deepwater submarine operations are found throughout The Bahamas and Florida Keys. Desktop data indicate that they might be found in the north-west portion of the BPC exploration blocks (Figure 4-28), however a multi-beam survey did not indicate the presence of these corals in the exploration areas.

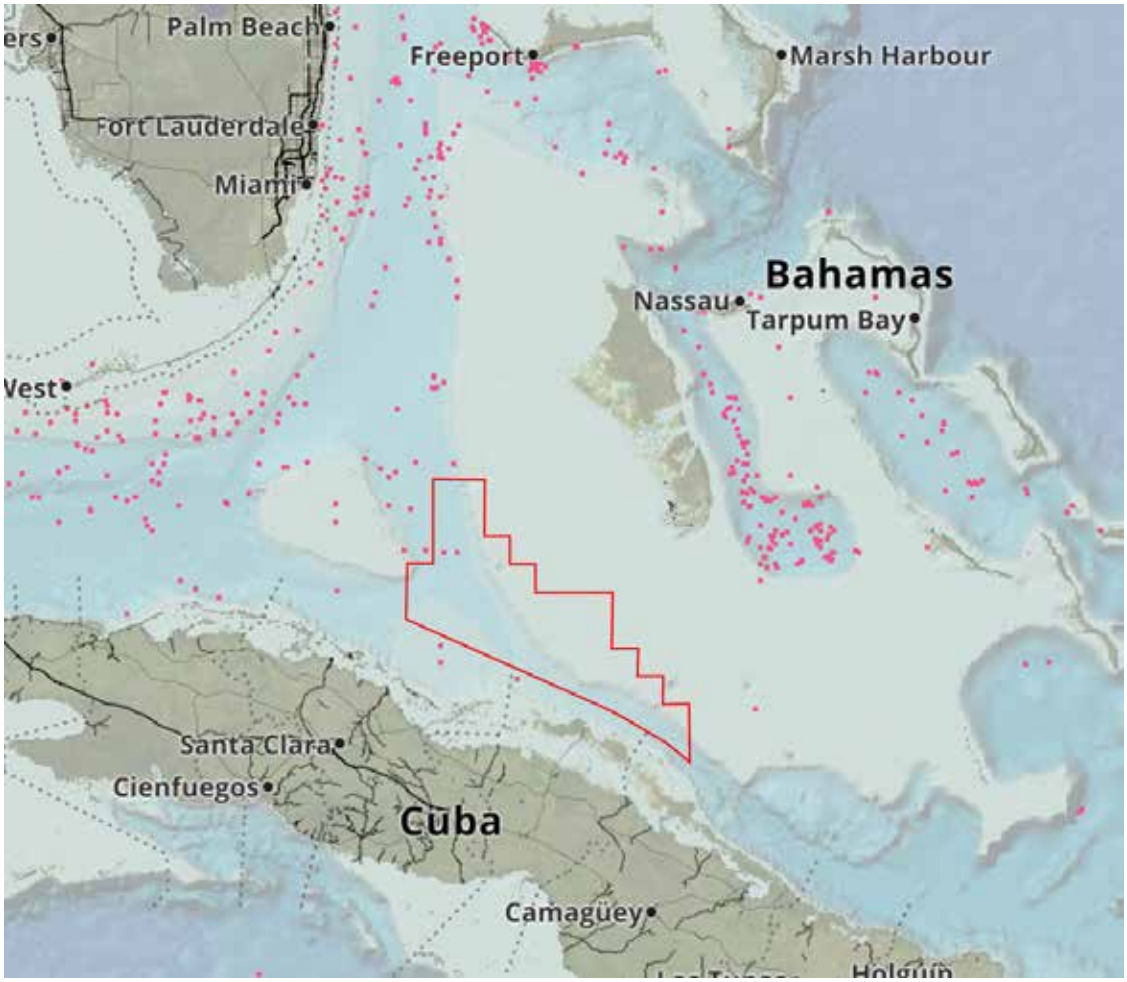

Figure 4-28: Distribution of Cold Water Corals in the Bahamas and Surrounding Areas
Note: BPC Exploration blocks are indicated by red perimeter, but figure is to be considered schematic and not an official delineation of blocks.
Source: UNEP-WCMC Ocean Data Viewer: Global Distribution of Cold Water Corals[55]

4.2.1.5 Blue Holes

Blue holes can be found both inland and in shallow waters on the banks of Andros (Figure 4-29 and Figure 4-30). These holes are the result of carbonate deposition and dissolution cycles, which occurred due to the repeated changes in sea level during the glacial and interglacial periods. There is a clear stratification of distinct biogeochemical layers, which includes the freshwater lens above and the salt water below. The greatest density of blue holes in the world is found in South

[55] Freiwald A, Rogers A, Hall-Spencer J, Guinotte JM, Davies AJ, Yesson C, Martin CS, Weatherdon LV (2017). Global distribution of cold-water corals (version 5.0). Fifth update to the dataset in Freiwald et al. (2004) by UNEP-WCMC, in collaboration with Andre Freiwald and John Guinotte. Cambridge (UK): UN Environment World Conservation Monitoring Centre. URL: http://data.unep-wcmc.org/datasets/3

Bight, Andros. Rare and highly specialized species are found in these blue holes including cave fish and species of shrimp.

There are numerous blue holes on the Cay Sal Bank. Those that have been explored and documented include Big Hole[56], Sistine Chapel and Silversides. Big Hole is 1,600 ft. (0.5 km) in diameter and of unknown depth. Sharks have been seen in this blue hole as well as reef fish and spiny lobsters.

Figure 4-29: Blue Hole in Andros
Source: Baggett, 2008[57]

[56] Brinkerhoff, B. 2010. The Blue Holes of Cay Sal Bank, Advanced Diver Magazine. Accessed at the following website: http://www.advanceddivermagazine.com/articles/caysal/blueholes.html
[57] Baggett, J. 2008. Journey into the Great Blue Hole. Accessed at the following website: www.jaunted.com.

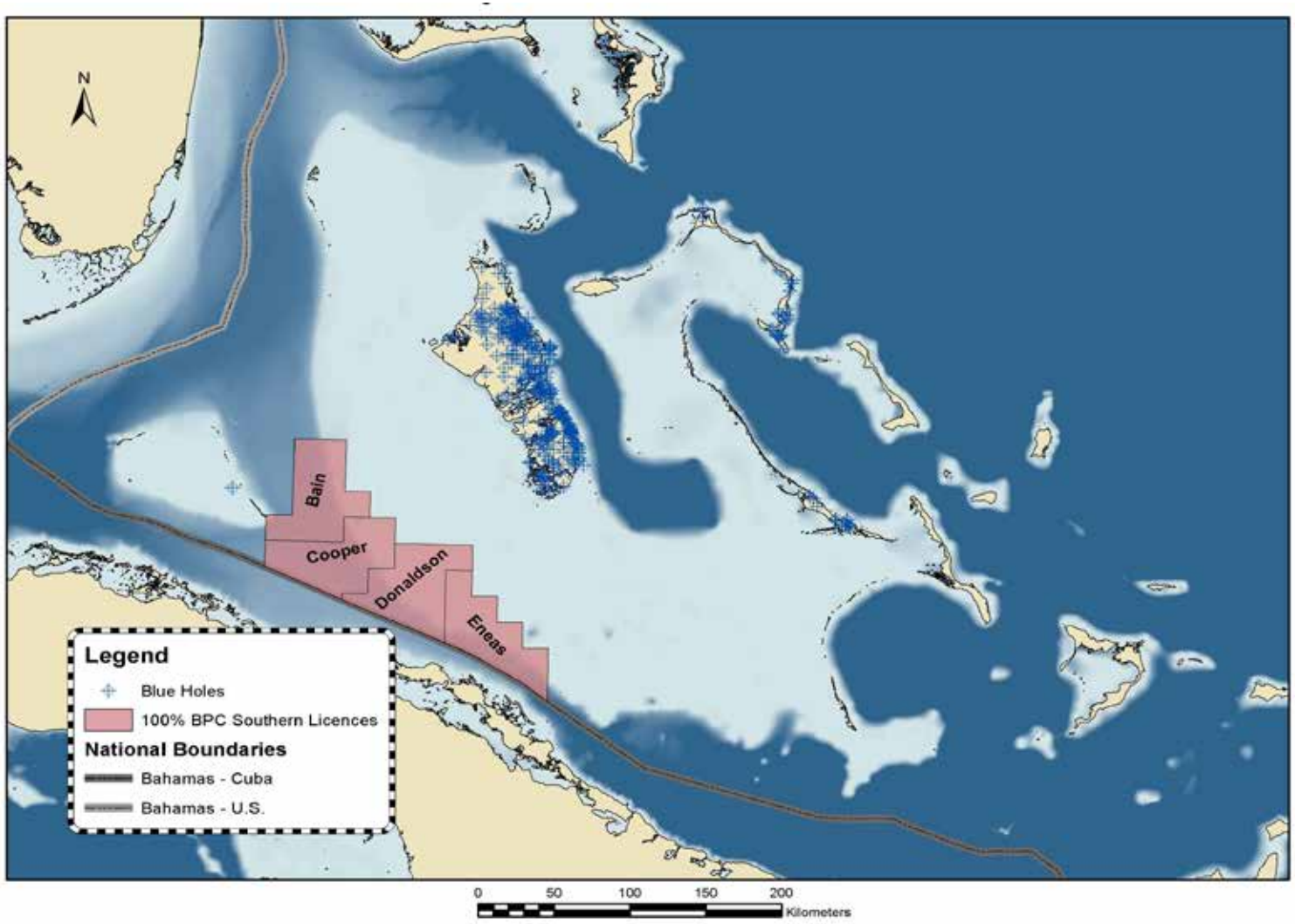

Figure 4-30: Map of Blue Holes in The Bahamas[58]

[58] The Nature Conservancy. 2007. Ecological Gap Assessment.

4.2.2 Marine Life

This section describes marine fauna anticipated at the well site. Primary data includes video and still photography transects at the well site and protected species observer reports from the seismic survey.

4.2.2.1 Overview of Photographic Survey of Well Site

A towed sled system was used to collect video and still photographs around the well site. The video and still cameras and lights mounted on the sled system were positioned to collect forward-looking video imagery and oblique still photographs from a tow altitude of approximately 1 m above the seafloor. The sled was deployed and lowered to the seafloor and towed along at speeds of approximately 0.2 to 0.4 knots within 200 m of the proposed drilling location to document seafloor substrates and associated biological communities. This resulted in perpendicular 400 m transects at the drill site, one towed in a north- south direction and a second in an east-west direction, intersecting at the drill site location. Continuous video imagery was collected at each location along with additional still imagery collected at the viewers discretion. Camera and navigational systems were time-synchronized to ensure positional accuracy.

Key observations form the photographic survey:

- The seafloor could be described as generally flat with unconsolidated mineral substrate which appears to be composed of fine sand to very fine sand with some potential silt present
- Bioturbation is evident, particularly tracks left by various types of echinoderms (urchins and sea stars)
- Echinoid (urchin) species were the most common biota observed throughout the project areas with an occasional fish present
- Small pieces of detrital vegetation are visible throughout the video
- Small shrimp and (likely) amphipods were commonly visible in the water column just above the seafloor
- Free-floating detrital material/"sea snow" is also visible in the water column
- No hard bottom or other sensitive habitats were observed

4.2.2.2 Plankton

Many reef organisms have a planktonic phase as a part of their life cycle. Spiny lobster larvae can spend up to nine months drifting in the pelagic zone while Queen conch larvae can exist as plankton for three to four weeks. Plankton form the base of the food chain in the marine environment with phytoplankton (microscopic marine plants) being eaten by zooplankton (microscopic marine animals) and small fish, and these in turn are eaten by larger fish and organisms.

4.2.2.3 Crustaceans and Mollusks

Substantial conch grounds are found in the Conch Sound area of Andros as well as the North Bight and South Bight areas. Queen conch has a significant impact on the marine benthic composition through their feeding and movement activities. Maintaining natural densities of adult conch (Figure 4-31) may be critical to the continued health of eelgrass habitats in general, as well as an important component of the habitat quality of juvenile conchs.

Figure 4-31: Photo of Queen Conch
Source: BEST Commission, 2001[59]

South Andros is important habitat for spiny lobster (*Panulirus argus*) (Figure 4-32).

Figure 4-32: Photo of Spiny Lobster
Source: Les Fruits de Mer, 2009[60]

White land crabs (*Cardisoma guanahumi*) (Figure 4-33) are found on the island of Andros feeding in burrows among the mangroves and in low-lying broadleaf coppice. Black land crabs (*Gecarcinus ruricola)* are also found in Andros.

[59] BEST Commission. 2001. Bahamas Environmental Handbook.
[60] Les Fruits de Mer. 2010. Accessed from the following website: www.lesfruitsdemer.org.

Figure 4-33: Photo of White Land Crab[61]

4.2.2.4 Other Invertebrates

Other invertebrates found around Andros include sea urchins and sponges.

4.2.2.5 Fish

The west side of Andros support highly productive mangrove fish assemblages and important areas for several species including bonefish and tarpon as well the endangered sawfish. The Rapid Ecological Assessment (REA) of the west side of Andros completed in 2006[62] characterized bonefish populations in the area to be in good condition. Other fish species found in Andros include grouper, snapper, grunts, triggerfish, squirrelfish, jacks and numerous species of sharks. There are a number of grouper spawning aggregations near the Andros barrier reef.

Highly migratory species (HMS) of fish include billfish, tuna, ocean sunfish, and sharks which are considered a high conservation priority due to their wide ranges and dependence on multi-country resources and their importance in several commercial and recreational fisheries. The greatest utilization of the Great Bahama Bank by migratory species is general during winter and fall[63]. Several HMS fish species are likely to transit the project area seasonally. Blue marlin (*Makaira nigricans*) are listed as vulnerable globally by the International Union for the Conservation of Nature and Natural Resources (IUCN)[64] with the Gulf of Mexico population

[61] SEV Consulting Group Limited. 2011.

[62] The Nature Conservancy. 2006. Rapid Ecological Assessment, The West Side of Andros, The Bahamas: Report of Scientific Findings.

[63] Skomal, G.B., Zeeman, S.I., Chisholm, J.H., Summers, E.L., Walsh, H.J., McMahon, K.W. and Thorrold, S.R., 2009. Transequatorial migrations by basking sharks in the western Atlantic Ocean. *Current biology*, *19*(12), pp.1019-1022.

[64] Collette, B., Acero, A., Amorim, A.F., Boustany, A., Canales Ramirez, C., Cardenas, G., Carpenter, K.E., de Oliveira Leite Jr., N., Di Natale, A., Die, D., Fox, W., Fredou, F.L., Graves, J., Guzman-Mora, A., Viera Hazin, F.H., Hinton, M., Juan Jorda, M., Minte Vera, C., Miyabe, N., Montano Cruz, R., Nelson, R., Oxenford, H., Restrepo, V., Salas, E., Schaefer, K., Schratwieser, J., Serra, R., Sun, C., Teixeira Lessa, R.P., Pires Ferreira Travassos, P.E., Uozumi, Y. & Yanez, E. 2011. *Makaira nigricans* . *The IUCN Red List of Threatened Species* 2011: e.T170314A6743776. https://dx.doi.org/10.2305/IUCN.UK.2011-2.RLTS.T170314A6743776.en. Downloaded on 31 January 2020.

listed as endangered. The Gulf of Mexico population is the population most likely to transit through the Bahamas. The Atlantic Bluefin tuna (*Thunnus thynnus*), listed as endangered by the IUCN is also likely to be present in the project area. Satellite-tagged blue marlin routinely moved from the Gulf of Mexico through the Florida straits and along edge of the great Bahama bank and Cuba and occasionally farther north into the Bahamas[65]. Nearly 98% of Satellite-tagged Atlantic bluefin tuna locations occurred throughout the Bahamas between July and September[63].

Basking sharks (*Cetorhinus maximus*) and whale sharks (*Rhincodon typus*), both listed as endangered by the IUCN[66,67], are rarely reported between Andros Island and Cuba; however, have regular occurrences to the east of the Bahamas archipelago. The global population of the oceanic white tip shark (*Carcharhinus longimanus)* is listed as critically endangered by IUCN[68] and has a well-documented presence on the Great Bahama Bank with consistent aggregations during winter and spring[69].

Five species of fish were observed during visual monitoring that was conducted during and before seismic surveys that took place from 9 June 2011 to 18 September 2011[70]. A list of these species is presented in Table 4-8.

Table 4-8: Fish species observed during visual monitoring (June – September 2011)

Common Name	Class	Scientific Name	Number of individuals observed	Number of days species was observed
Flying fish	Actinopterygii	--	665	57
Mahi mahi	Actinopterygii	*Coryphaena hippurus*	5	2
Hammerhead shark	Chondrichthyes		1	1
Stingray	Chondrichthyes		2	2

[65] Rooker, J.R., Dance, M.A., Wells, R.D., Ajemian, M.J., Block, B.A., Castleton, M.R., Drymon, J.M., Falterman, B.J., Franks, J.S., Hammerschlag, N. and Hendon, J.M., 2019. Population connectivity of pelagic megafauna in the Cuba-Mexico-United States triangle. *Scientific reports*, *9*(1), pp.1-13.

[66] Rigby, C.L., Barreto, R., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Herman, K., Jabado, R.W., Liu, K.M., Marshall, A., Romanov, E. & Kyne, P.M. 2019. *Cetorhinus maximus* . *The IUCN Red List of Threatened Species* 2019: e.T4292A2988471. Downloaded on 31 January 2020.

[67] Pierce, S.J. & Norman, B. 2016. *Rhincodon typus* . *The IUCN Red List of Threatened Species* 2016: e.T19488A2365291. https://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T19488A2365291.en. Downloaded on 31 January 2020.

[68] 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://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T39374A2911619.en. Downloaded on 31 January 2020.

[69] Howey-Jordan, Lucy A., Edward J. Brooks, Debra L. Abercrombie, Lance KB Jordan, Annabelle Brooks, Sean Williams, Emily Gospodarczyk, and Demian D. Chapman. "Complex movements, philopatry and expanded depth range of a severely threatened pelagic shark, the oceanic whitetip (Carcharhinus longimanus) in the western North Atlantic." *PloS one* 8, no. 2 (2013).

[70] Swope, A. and Seward, G. 2011. Protected Species Monitoring Report for the Bahamas Petroleum Company, CGG Veritas, M/V Veritas Viking Pearl 3D Broadseis Bahama Bank 9 June 2011 – 18 September 2011. Houston, TX: RPS Group.

Common Name	Class	Scientific Name	Number of individuals observed	Number of days species was observed
Unidentified shark	Chondrichthyes		1	1

Source: Protected Species Monitoring Report for the Bahamas Petroleum Company, CGG Veritas, M/V Veritas Viking Pearl 3D Broadseis Bahama Bank 9 June 2011 – 18 September 2011

Migratory fish (including marlin, tuna and mackerel) do use the area near the lease blocks. These fish likely use this area seasonally to move from northeastern Atlantic to the Caribbean. Large migratory fish are found seasonally off the east coast of Florida: sailfish (*Istiophorus* spp.) are most abundant from November through February, and blue marlin (*Makaira nigricans*) are most abundant from May to July.[71] Blue marlin have been documented spawning in Exuma Sound, The Bahamas.[72] The western Atlantic stock of bluefin tuna (*Thunnus thynnus*) is known to spawn in the winter in the Gulf of Mexico and migrate northwards through the Straits of Florida to summer feeding grounds in the Gulf of St. Lawrence. They can be found in the winter to the west of the 45°W meridian (the eastern Atlantic stock is found to the east of this line), including in Bahamian waters.[73] [74]

4.2.2.6 Turtles

Four species of sea turtles inhabit The Bahamas' coastal waters, namely the green turtle (*Chelonia mydas*), loggerhead (*Caretta caretta*), hawksbill (*Eretmochelys imbricata*) and the leatherback turtle (*Dermochelys coriacea*). The IUCN[75] [76] [77] [78] lists the the green turtle as endangered, the hawksbill turtle as critically endangered, and the loggerhead and leatherback turtles as vulnerable.

[71] Orbesen, E.S., Hoolihan, J.P., Serafy, J.E., Snodgrass, D., Peel, E.M. and Prince, E.D., 2008. Transboundary movement of Atlantic istiophorid billfishes among international and US domestic management areas inferred from mark-recapture studies. *Marine Fisheries Review*, *70*(1), pp.14-23.
[72] Serafy, J.E., Cowen, R.K., Paris, C.B., Capo, T.R. and Luthy, S.A., 2003. Evidence of blue marlin, Makaira nigricans, spawning in the vicinity of Exuma Sound, Bahamas. *Marine and Freshwater Research*, 54(4), pp.299-306.
[73] Rivas, L.R., 1955. A comparison between giant bluefin tuna (Thunnus thynnus) from the Straits of Florida and the Gulf of Maine, with reference to migration and population identity.
[74] Wilson, S.G., Lawson, G.L., Stokesbury, M.J., Spares, A., Boustany, A.M., Neilson, J.D. and Block, B.A., 2011. Movements of Atlantic bluefin tuna from the Gulf of St. Lawrence to their spawning grounds. *Collect. Vol. Sci. Pap. ICCAT*, *66*(3), pp.1247-1256.
[75] Seminoff, J.A. (Southwest Fisheries Science Center, U.S.) 2004. *Chelonia mydas* . *The IUCN Red List of Threatened Species* 2004: e.T4615A11037468. https://dx.doi.org/10.2305/IUCN.UK.2004.RLTS.T4615A11037468.en. Downloaded on 31 January 2020.
[76] Casale, P. & Tucker, A.D. 2017. *Caretta caretta* (amended version of 2015 assessment). *The IUCN Red List of Threatened Species* 2017: e.T3897A119333622. https://dx.doi.org/10.2305/IUCN.UK.2017-2.RLTS.T3897A119333622.en. Downloaded on 31 January 2020.
[77] Mortimer, J.A & Donnelly, M. (IUCN SSC Marine Turtle Specialist Group) 2008. *Eretmochelys imbricata* . *The IUCN Red List of Threatened Species* 2008: e.T8005A12881238. https://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T8005A12881238.en. Downloaded on 31 January 2020.
[78] Wallace, B.P., Tiwari, M. & Girondot, M. 2013. *Dermochelys coriacea* . *The IUCN Red List of Threatened Species* 2013: e.T6494A43526147. https://dx.doi.org/10.2305/IUCN.UK.2013-2.RLTS.T6494A43526147.en. Downloaded on 31 January 2020.

The west side of Andros is important habitat for three sea turtles – green turtles, loggerheads and hawksbills. Sea turtle populations observed in The Bahamas are significant. Given their migratory nature, these turtles are of regional significance to the wider Caribbean[79].

Green turtles (Figure 4-34) primarily reside in Bahamian waters and there are beaches throughout the country where they nest. Important habitats for these turtles include coral reefs, seagrass beds and floating seaweed. Green turtles establish grazing plots in seagrass beds of turtle grass (*Thalassia testudinum*). Turtles may hide in floating seaweed and feed there for long periods of time. They also feed on algae found on coral reefs. Green turtles are reported to nest in Abaco and Inagua. Principal threats to these turtles in The Bahamas are harvesting for their meat and shells, ingestion of marine debris and degradation of their habitat. Hawksbill and loggerhead turtles are similarly threatened.

The largest foraging aggregation of juveniles and adults is found on the extensive seagrass beds along the Caribbean coast of Nicaragua. Tagging and mark-recapture studies showed that out of 742 green turtles tagged in Cuba 76.9% were recaptured along the Nicaraguan coast[80]. However, for green turtles tagged outside of Cuba but recaptured in Cuba; 14.1% originated in the Bahamas[80] and movements between Cuba and Bahamas may represent a significant migratory corridor, particularly across life stages[80]. Smaller foraging aggregations have been documented in Florida, the Yucatán Peninsula, Panama, the Guajira Peninsula of Colombia, the Lesser Antilles, Puerto Rico, Cuba, Jamaica, Grand Cayman, Bermuda and the southern Bahamas[81].

Figure 4-34: **Photograph of a Green Turtle**
Source: Arauz, 2010[82]

[79] The Nature Conservancy. 2003.
[80] Moncada, F., Abreu-Grobois, F.A., Muhlia-Melo, A., Bell, C., Tröeng, S., Bjorndal, K.A., Bolten, A.B., Meylan, A.B., Zurita, J., Espinosa, G. and Nodarse, G., 2006. Movement patterns of green turtles (Chelonia mydas) in Cuba and adjacent Caribbean waters inferred from flipper tag recaptures. *Journal of Herpetology*, *40*(1), pp.22-34.
[81] Carr, A.F., Meylan, A.B., Mortimer, J.A., Bjorndal, K.A. and Carr, T., 1982. Preliminary survey of marine turtle populations and habitats in the western Atlantic. *NOAA Tech. Memor. NMFSSEFC-91*.
[82] Arauz, P. 2010. The Green Turtle. Accessed from the following website: challengeblog2.blogspot.com. 2010.

Hawksbill turtles are closely associated with coral reefs and other hard-bottom habitats as well as adjacent seagrass beds. Important habitat for the hawksbill turtle includes shallow coral reefs and mangrove estuaries for juveniles. Hawksbill turtles forage in shallow reefs, seagrass beds, and in floating algae, particularly Sargassum; however sponges also represent a primary food source for this species. Adults nest exclusively on tropical beaches. Documented hawksbill nesting sites are found in the southern Bahamas on the island of Inagua, which is outside of the project area. Some juvenile hawksbill turtles tagged on Inagua have been recaptured in Cuban waters indicating that there may be some migration through the project site[83]. Figure 4-35 is a photo of a hawksbill turtle.

Figure 4-35: Photograph of a Hawksbill Turtle
Source: Caloyianis, 201[84]

The loggerhead turtle **(**Figure 4-36**)** is well documented throughout the Bahamas**[88]**.

[83] Meylan, A.B., 1999. Status of the hawksbill turtle (Eretmochelys imbricata) in the Caribbean region. *Chelonian Conservation and Biology*, *3*(2), pp.177-184.
[84] Caloyianis, N. 2011. Hawksbill Sea Turtle, National Geographic. Accessed from the following website animals.nationalgeographic.com. 1996-2011.

Figure 4-36: Photograph of a Loggerhead Turtle
Source: Skerry, 2011[85]

The juvenile loggerhead population observed in the waters around the west side of Andros is the only known aggregation of juvenile loggerheads in The Bahamas. Loggerheads (Figure 4-36) are also known to nest on sandy beaches on the Cay Sal Bank[86] [87]. A large satellite tagging effort initiated in the Dry Tortugas showed that loggerheads consistently travel to the Bahamas during July through September (Figure 4-37)[88] along predictable migratory paths (Figure 4-38)[88] and in consistent core residence areas (Figure 4-39)[88] that include the project area**.**

[85] Skerry, B. J. 2011. Loggerhead Sea Turtle, National Geographic. Accessed from the following website animals.nationalgeographic.com. 1996-2011.
[86] Addison, D. 2007. Loggerhead nesting in Cay Sal Bank, Bahamas: Personal communication. In SWOT Report—State of the World's Sea Turtles, vol. 2 (2007). Available at: https://www.seaturtlestatus.org/swot-report-vol-2
[87] Bolten, A. 2007. Log-gerhead nesting in the Bahamas: Personal communication. In SWOT Report—State of the World's Sea Turtles, vol. 2 (2007). Available at: : https://www.seaturtlestatus.org/swot-report-vol-2
[88] Hart, K.M., Sartain, A.R. and Fujisaki, I., 2015. Bahamas connection: residence areas selected by breeding female loggerheads tagged in Dry Tortugas National Park, USA. *Animal Biotelemetry*, *3*(1), p.3.

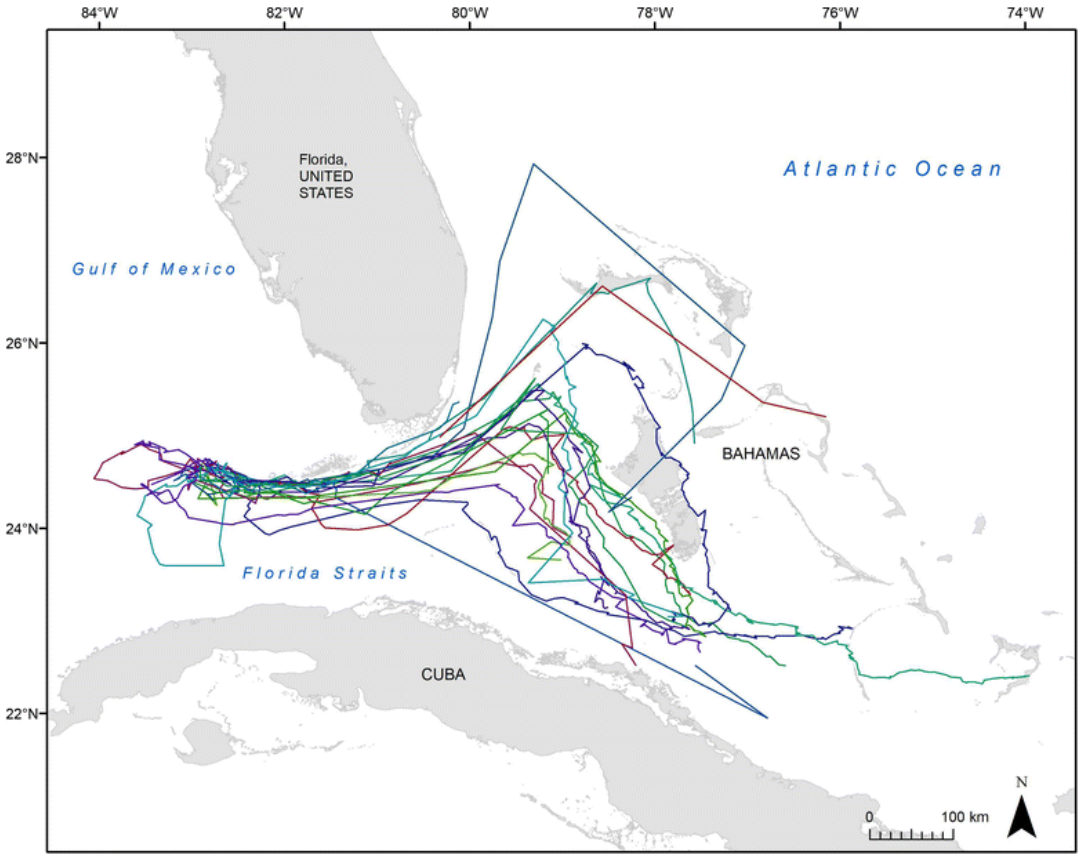

Figure 4-37: Migration Paths for Satellite-tagged Loggerhead Sea Turtles Tagged in Dry Tortugas National Park

Source: Hart et al., 2015[88]

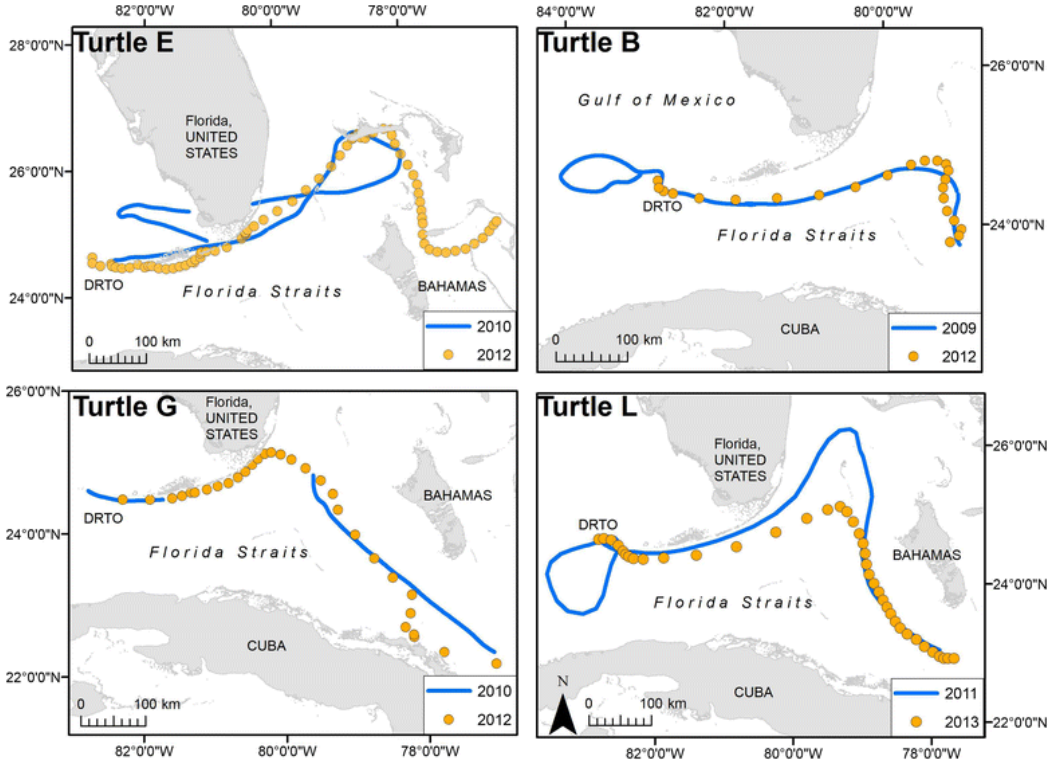

Figure 4-38: Inter-annual Repeatability of Migration Paths for Four Loggerhead Turtles between 2010 and 2013

Source: Hart et al., 2015[88]

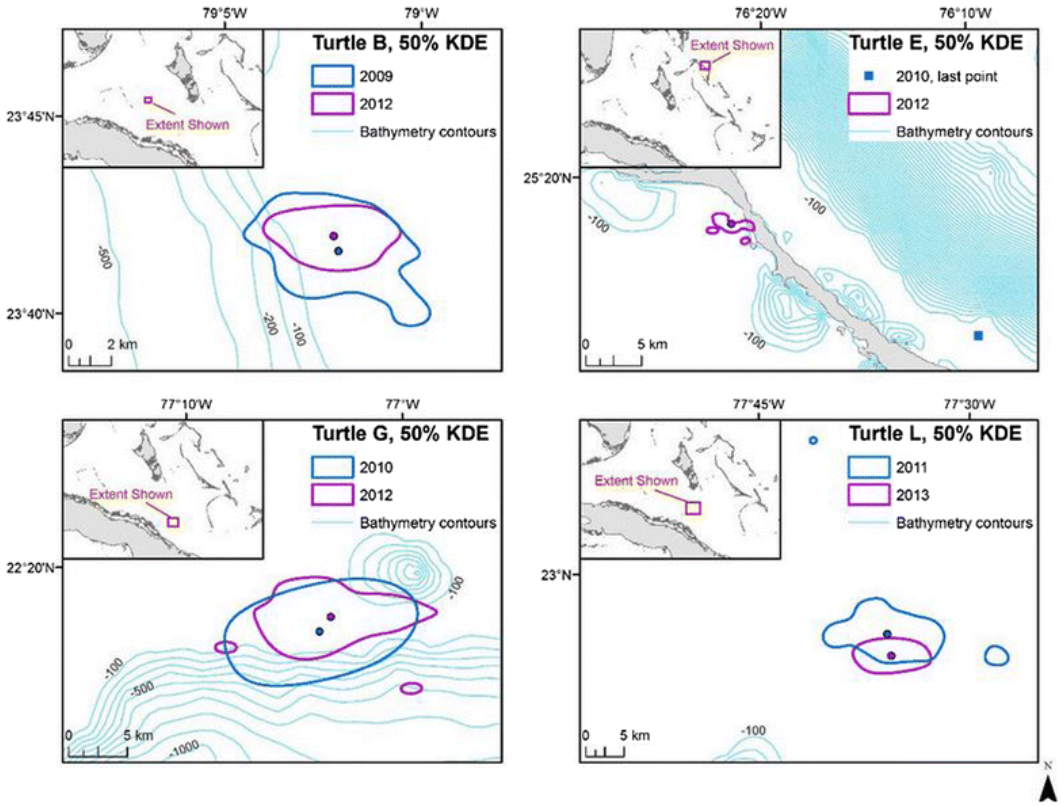

Figure 4-39: Inter-annual Repeatability of Residence Areas for Four Loggerhead Turtles between 2010 and 2013
Source: Hart et al., 2015[88]

From this tagging study, core-use residence areas for 19 loggerhead turtles were calculated and showed some overlap with the project license blocks (Figure 4-40) [88]. One loggerhead turtle was observed by marine mammal observers during seismic surveys of the lease blocks on 10 September 2011[70].

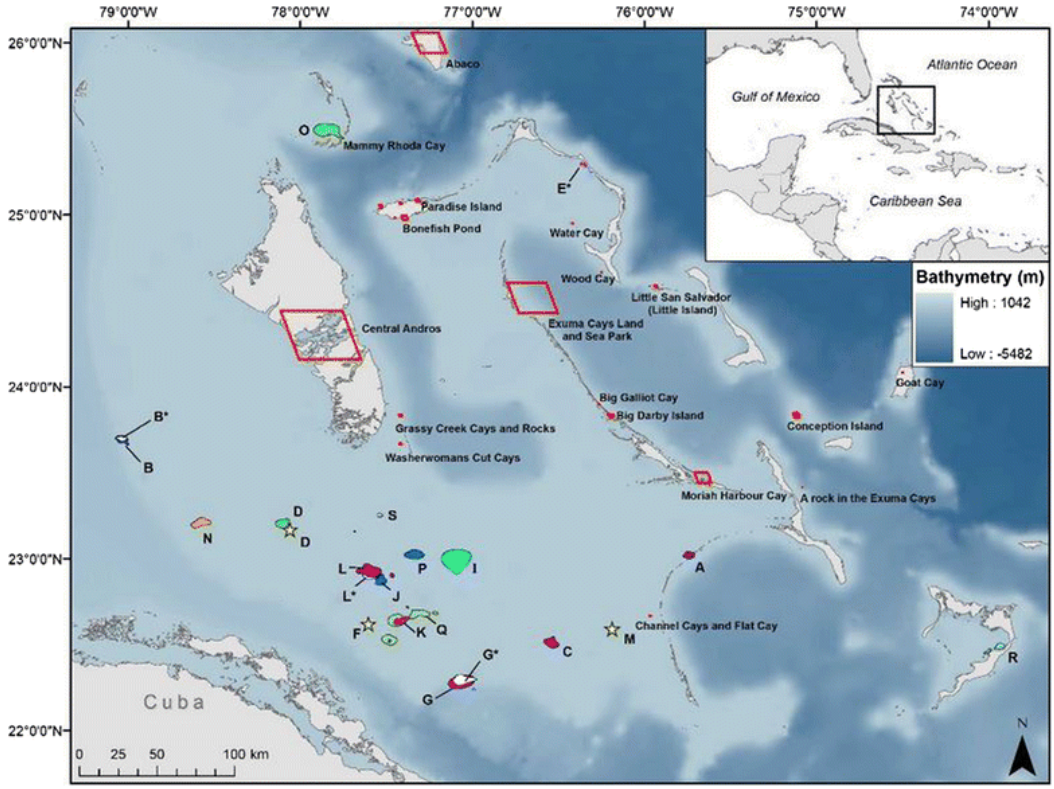

Figure 4-40: Residence Areas for 19 Tagged Female Loggerhead Turtles (colored polygons) and Marine Protected Areas (red boxes) within the Bahamas

Source: Hart et al., 2015[88]

Leatherback turtles (*Dermochelys coriacea*) (Figure 4-41) are pelagic, highly migratory species with distribution throughout the boreal and tropical latitudes[89].

[89] Dodge, K.L., Galuardi, B., Miller, T.J. and Lutcavage, M.E., 2014. Leatherback turtle movements, dive behavior, and habitat characteristics in ecoregions of the Northwest Atlantic Ocean. *PLoS One*, *9*(3).

Figure 4-41: Photograph of a Leatherback Turtle
Source: Theleatherbackseaturtle.com, 2011[90]

Leatherback turtles are thought to migrate through Bahamian waters and there have also been reports of nesting on Abaco[91]. Data on leatherbacks in The Bahamas is limited[92]; however, satellite-tagged leatherbacks show occurrence mainly to the East of the Bahamas archipelago as much of the nesting population travels to and from nesting sites in the southern Caribbean (Figure 4-42).

[90] The Leatherback Sea Turtle. 2011. Accessed from the following website www.theleatherbackturtle.com.
[91] Dow, W., Eckert, K., Palmer, M. and P. Kramer. 2007. An Atlas of Sea Turtle Nesting Habitat for the Wider Caribbean Region: WIDECAST Technical Report No. 6, 2007. Accessed from the OBIS-SEAMAP website: http://seamap.env.duke.edu/seamap2.5/widecast/references/Dow_et_al_2007.pdf.
[92] UNEP/WCMC. October 2003. Report on the Status and Conservation of the Leatherback Turtle.

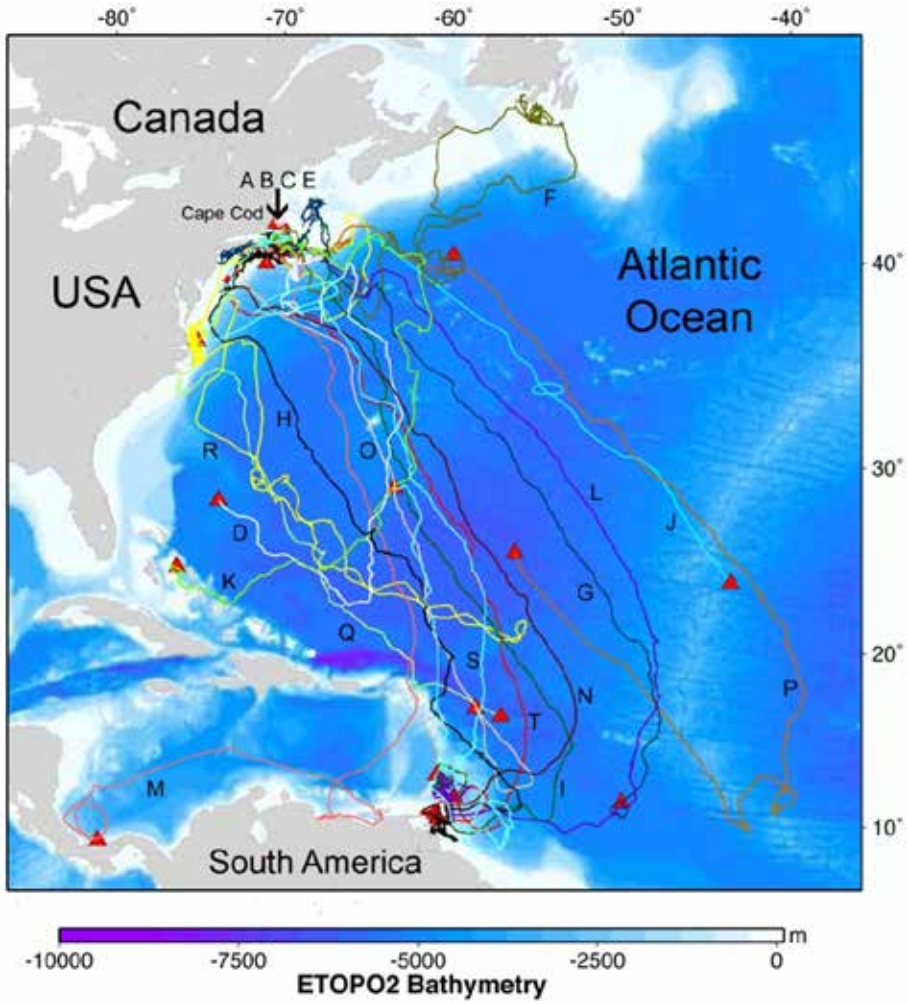

Figure 4-42: Reconstructed Movements of 20 Satellite-tagged Leatherback Turtles in the North Atlantic Ocean, 2007–2010

Source: Didge et al., 2014[89]

Leatherback turtles likely forage along oceanographic fronts, such as upwelling and downwelling zones, but will make use of all oceanographic habitats from deep water to coastal regions. Leatherback, like other pelagic migratory species show a general seasonal sift from temperate and coastal habitat in the summer to subtropical and tropical habitat from late autumn to spring[89]. Given this highly mobile species, leatherback turtles could be expected in the project area in low numbers year-round, but most likely in fall and spring.

All four species have documented nesting habitat in The Bahamas, although the nesting density and consistency will vary by species. Figure 4-43 and Figure 4-44 show nesting habitat for marine turtles in The Bahamas.

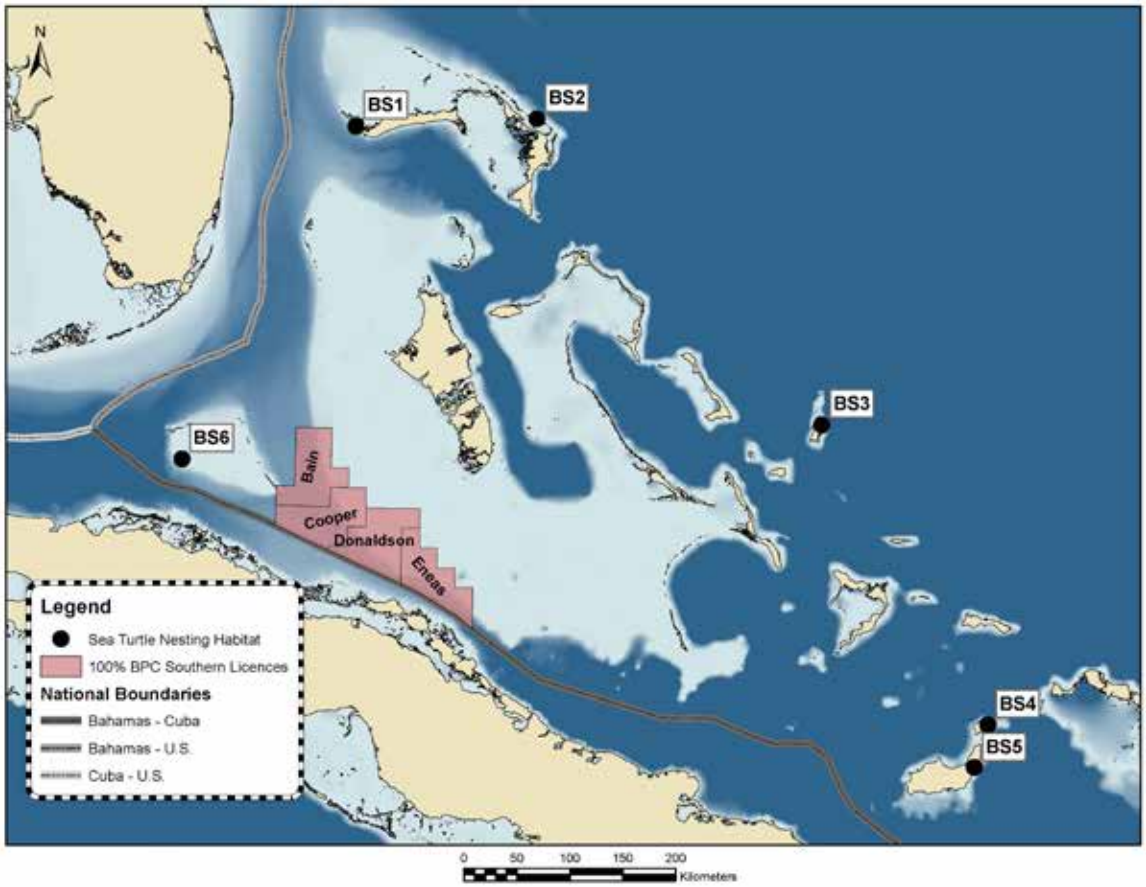

Figure 4-43: Sea Turtle Nesting Habitat in The Bahamas
Note: Approximate block boundaries shown in black
Source: Dow, et al., 2007[93]

[93] Dow, et al., 2007

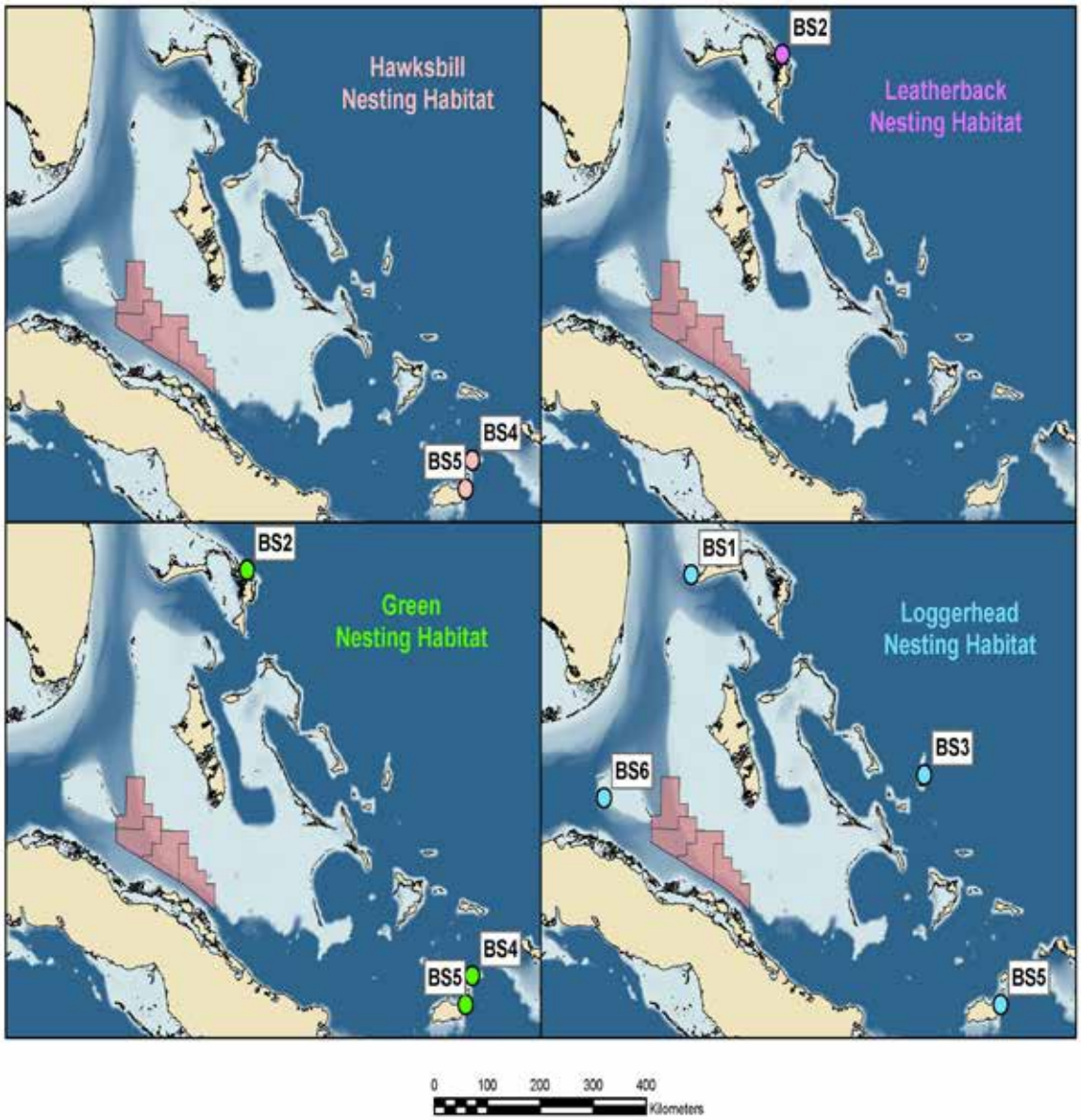

Figure 4-44: Nesting Habitat for Four Species of Sea Turtles in The Bahamas
Note: Approximate block boundaries shown in black
Source: Dow, et al., 2007

Sea turtles movements through the lease blocks are likely associate with seasonal nesting migrations between The Bahamas and the turtles' Caribbean beaches of origin. There is some evidence that Green sea turtles move between the Bahamas and the north coast of Cuba.[94] Loggerhead turtles have been documented moving between beaches in southwest Florida and

[94] Moncada, F., Abreu-Grobois, F.A., Muhlia-Melo, A., Bell, C., Tröeng, S., Bjorndal, K.A., Bolten, A.B., Meylan, A.B., Zurita, J., Espinosa, G. and Nodarse, G., 2006. Movement patterns of green turtles (Chelonia mydas) in Cuba and adjacent Caribbean waters inferred from flipper tag recaptures. *Journal of Herpetology*, *40*(1), pp.22-34.

The Bahamas, traveling along generally indirect routes in oceanic (as opposed to coastal) waters.[95] Additional studies documented Loggerhead turtles migrating between the Dry Tortugas (western Florida Keys) and the Bahamas between July and September and from the east coast of Central Florida and The Bahamas (the Abaco islands and south Grand Bahama Bank) after nesting, between August and November.[96] [97] Some Hawksbill turtles have been documented moving between nesting beaches in the Dominican Republic and the Bahamas.[98] As many studies of sea turtle movements rely on data from transmitters that are attached to female turtles when they come to shore to nest, there is relatively less available data on seasonal turtle movements before the nesting season (approximately May through October), although data do indicate that Loggerhead turtles are commonly observed in the study area (see Table 4-12 below, and discussion above).

4.2.2.7 Marine Mammals

According to the IUCN (2019) the Bahama Islands are home to at least 27 marine mammals. There are limited systematic marine mammal surveys available throughout The Bahamas and in particular a lack of surveys between the Great Bahama Bank and Cuba. However, the surveys and reports that do exist offer sufficient information regarding species content and movements in and around the License blocks:

- Early published vessel-based surveys by Claridge and Balcomb (1998)[99] listed 17 marine mammal species.
- Systematic aerial surveys conducted by the US Navy[100] in 2003 east and northeast of Andros Island yielded 10 marine mammal species. Results from the Navy survey showed that beaked whales, *Kogia* spp., and sperm whales which are all known deep-diving species, were concentrated in the Tongue of the Ocean while dolphin species (family Delphinidae) were concentrated along the Bahama Bank.
- In the 2010 field season, the Bahamas Marine Mammal Research Organization (BMMRO) reported seeing 15 species of marine mammals in The Bahamas[101]. BMMRO scientists collected the majority of these sightings data during surveys conducted off Andros and Abaco Islands, but some of the sightings data were gathered from reports from the public from throughout The Bahamas. The nearest locations were on the opposite side of Andros Island from the project area, approximately 100 miles (160 km) northeast.

All species lists and general distributions in all three surveys complement one another. Acoustic surveys conducted in and around the Tongue of the Ocean since 2000have reported the same

[95] Girard, C., Tucker, A.D. and Calmettes, B., 2009. Post-nesting migrations of loggerhead sea turtles in the Gulf of Mexico: dispersal in highly dynamic conditions. *Marine Biology*, *156*(9), pp.1827-1839.
[96] Hart, K.M., Sartain, A.R. and Fujisaki, I., 2015. Bahamas connection: residence areas selected by breeding female loggerheads tagged in Dry Tortugas National Park, USA. *Animal Biotelemetry*, *3*(1), p.3.
[97] Dodd, C.K. and Byles, R., 2003. Post-nesting movements and behavior of loggerhead sea turtles (Caretta caretta) departing from east-central Florida nesting beaches. *Chelonian Conservation and Biology*, *4*(3), pp.530-536.
[98] Hawkes, L.A., Tomás, J., Revuelta, O., León, Y.M., Blumenthal, J.M., Broderick, A.C., Fish, M., Raga, J.A., Witt, M.J. and Godley, B.J., 2012. Migratory patterns in hawksbill turtles described by satellite tracking. *Marine Ecology Progress Series*, *461*, pp.223-232.
[99] Claridge, D.E., and Balcomb, K.C. (1993). In search of marine mammals. *Bahamas Naturalist*. 7(1), 11-17.
[100] Mobley Jr, J.R., 2004. *Results of marine mammal surveys on US Navy underwater ranges in Hawaii and Bahamas* (No. MMRC-04-01). MARINE MAMMAL RESEARCH CONSULTANTS LTD HONOLULU HI.
[101] Bahamas Marine Mammal Research Organisation. 2010 Preliminary Field Report to Bahamas Department of Fisheries.

species compositions as the listed surveys[102] [103]. Results of the sightings from the 1998, 2003, and 2010 surveys were compiled and are presented in Table 4-9**.**

Table 4-9: Species sighting reports from three comprehensive marine mammal surveys conducted in The Bahamas (21 species)

Species	Number of Reported Sightings		
	Claridge and Balcomb (1998)	U.S. Navy (2003)	BMMRO (2010)[a]
Odontocetes			
Dwarf or pygmy sperm whales *(Kogia spp.)*	4	2	25 (3)
Sperm whale *(Physeter macrocephalus)*	8	3	14 (1)
Beaked whales (Unidentified)	7	1	2
Blainville's beaked whale *(Mesoplodon densirostris)*	5	1	25
Gervais' beaked whale *(Mesoplodon europaeus)*	5	0	6
Cuvier's beaked whale *(Ziphius cavirostris)*	4	0	15
Killer whale *(Orcinus orca)*	2	0	1 (1)
Short-finned pilot whale *(Globicephala macrorhynchus)*	12	2	1 (1)
Melon-headed whale *(Peponocephala electra)*	2	1	8
False killer whale *(Pseudorca crassidens)*	1	0	0
Risso's dolphin *(Gampus griseus)*	6	0	0
Striped dolphin *(Stenella coeruleoalba)*	0	1	0
Common bottlenose dolphin *(Tursiops truncatus)*	316	3	97 (14)
Rough-toothed dolphin *(Steno bredanensis)*	2	1	0
Fraser's dolphin *(Lagenodelphis hosei)*	1	0	1
Atlantic spotted dolphin *(Stenella frontalis)*	30	0	5 (1)
Pantropical spotted dolphin *(Stenella attenuata)*	0	0	1
Dolphins (Unidentified)	17	6	0
Mysticetes			
Humpback whale *(Megaptera novaeangliae)*	13	1 (January)	(1)
Minke whale *(Balaenoptera acutorostrata)*	5	0	0
Sirenians[b]			
Florida manatee *(Trichechus manatus)*	0	0	2

[a] – Number in parentheses denote sighting reported by the general public rather than by survey scientists.
[b] – Manatees are almost exclusively a coastal species and are not expected in the project area.

[102] Hazen, E.L., Nowacek, D.P., Laurent, L.S., Halpin, P.N. and Moretti, D.J., 2011. The relationship among oceanography, prey fields, and beaked whale foraging habitat in the Tongue of the Ocean. *PloS one*, *6*(4).
[103] Morrissey, R.P., Ward, J., DiMarzio, N., Jarvis, S. and Moretti, D.J., 2006. Passive acoustic detection and localization of sperm whales (Physeter macrocephalus) in the tongue of the ocean. *Applied acoustics*, *67*(11-12), pp.1091-1105.

Per the IUCN Red List, 27 species of marine mammals have the possibility of occurrence at the well site (Table 4-10).[104]

Table 4-10: Marine Mammals Potentially Occurring at the Well Site

Common Name	Scientific Name	IUCN Redlist Category
Sei Whale	*Balaenoptera borealis*	Endangered
Blue Whale	*Balaenoptera musculus*	Endangered
Sperm Whale	*Physeter macrocephalus*	Vulnerable
American Manatee	*Trichechus manatus*	Vulnerable
False Killer Whale	*Pseudorca crassidens*	Near Threatened
Pygmy Sperm Whale	*Kogia breviceps*	Data Deficient
Dwarf Sperm Whale	*Kogia sima*	Data Deficient
Blainville's Beaked Whale	*Mesoplodon densirostris*	Data Deficient
Gervais' Beaked Whale	*Mesoplodon europaeus*	Data Deficient
Killer whale	*Orcinus orca*	Data Deficient
Minke Whale	*Balaenoptera acutorostrata*	Least Concern
Bryde's Whale	*Balaenoptera edeni*	Least Concern
Short-beaked Common Dolphin	*Delphinus delphis*	Least Concern
Pygmy Killer Whale	*Feresa attenuata*	Least Concern
Short-finned Pilot Whale	*Globicephala macrorhynchus*	Least Concern
Risso's Dolphin	*Grampus griseus*	Least Concern
Fraser's Dolphin	*Lagenodelphis hosei*	Least Concern
Humpback Whale	*Megaptera novaeangliae*	Least Concern
Melon-headed Whale	*Peponocephala electra*	Least Concern
Pantropical Spotted Dolphin	*Stenella attenuata*	Least Concern
Clymene Dolphin	*Stenella clymene*	Least Concern
Striped Dolphin	*Stenella coeruleoalba*	Least Concern
Atlantic Spotted Dolphin	*Stenella frontalis*	Least Concern
Spinner Dolphin	*Stenella longirostris*	Least Concern
Rough-toothed Dolphin	*Steno bredanensis*	Least Concern
Common Bottlenose Dolphin	*Tursiops truncatus*	Least Concern
Cuvier's Beaked Whale	*Ziphius cavirostris*	Least Concern

Source: IUCN, 2020

Two species of marine mammals were observed from seismic survey vessels in the license areas between 21 July 2011 and 9 September 2011, including 54 individuals comprising 45 common bottlenose dolphins and 9 pantropical spotted dolphins. A summary of these observations is presented in Table 4-11[70].

[104] IUCN. 2019. RedList of Threatened Species. Accessed from the following website: https://www.iucnredlist.org/

Table 4-11: Marine Mammals Sighted by Observers During Seismic Surveys (July – September 2011)

Date	Common Name	Scientific Name	Animals observed
21 July 2011	Pantropical Spotted Dolphin	*Stenella attenuata*	9 individuals, including juveniles
12 August 2011	Common Bottlenose Dolphin	*Tursiops truncatus*	1 individual
8 September 2011	Common Bottlenose Dolphin	*Tursiops truncatus*	14 individuals, including three juveniles
9 September 2011	Common Bottlenose Dolphin	*Tursiops truncatus*	30 animals including 5 juveniles.

Source: RPS. 2011. Protected Species Monitoring Report for the Bahamas Petroleum Company, CGG Veritas, M/V Veritas Viking Pearl 3D Broadseis Bahama Bank 9 June 2011 – 18 September 2011

Observations from the Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations (OBIS SEAMap) (Figure 4-45 and Table 4-12) support the data presented here from BMMRO and RPS that the majority of species in the region will be odontocetes and sea turtles. As most odontocetes show minimal migratory behavior, it is expected that the odontocetes in this area are year-round residents, although there is likely some seasonal shifts in densities following food resources[105].

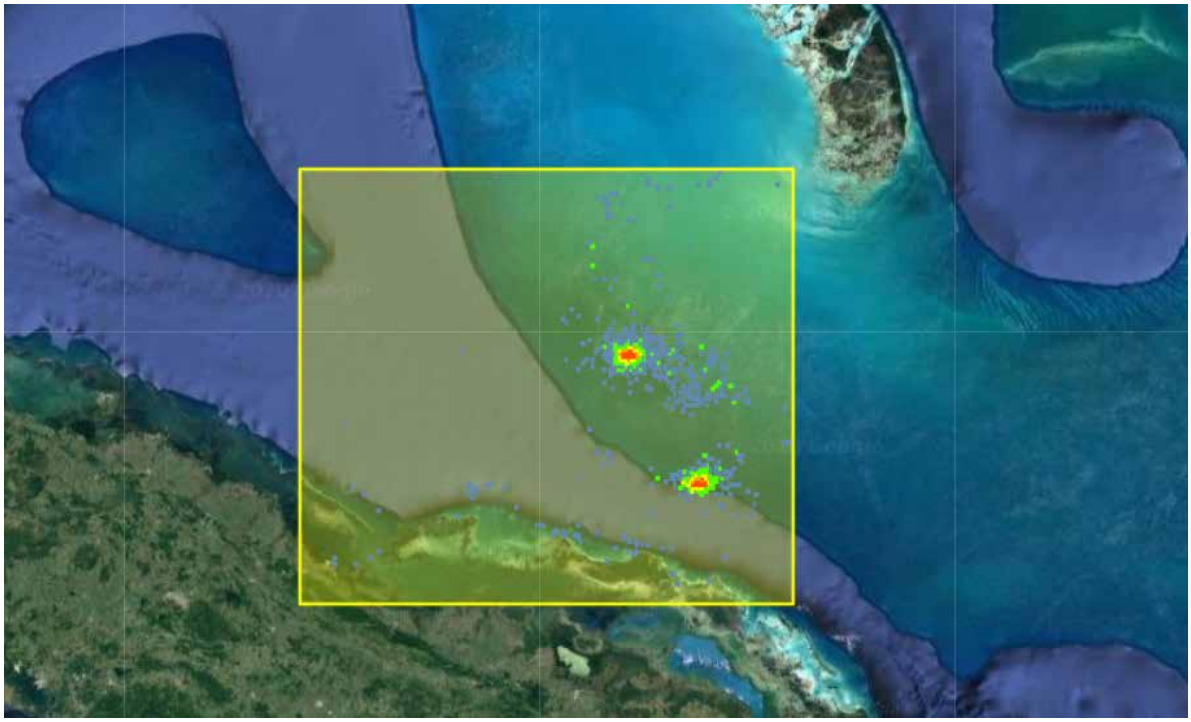

Figure 4-45: Records of Marine Mammal and Sea Turtle Observations near Drill Site
Note: records shown in table below are from the area shown in the yellow box

[105] Roberts, J.J., Best, B.D., Mannocci, L., Fujioka, E., Halpin, P.N., Palka, D.L., Garrison, L.P., Mullin, K.D., Cole, T.V., Khan, C.B. and McLellan, W.A., 2016. Habitat-based cetacean density models for the US Atlantic and Gulf of Mexico. Scientific reports, 6(1), pp.1-12.

Source: Halpin et al., 2009.[106]

Table 4-12: Records of Marine Mammal and Sea Turtle Observations near the Study Area

Species	Common Name	Number of Observations
Balaenoptera acutorostrata	Common Minke Whale	1
Megaptera novaeangliae	Humpback Whale	3
Orcinus orca	Killer Whale	1
Physeter macrocephalus	Sperm Whale	2
Stenella attenuata	Pantropical Spotted Dolphin	1
Stenella frontalis	Atlantic Spotted Dolphin	2
Steno bredanensis	Rough-toothed Dolphin	52
Tursiops truncatus	Bottlenose Dolphin	11
Ziphius cavirostris	Cuvier's Beaked Whale	1
Caretta caretta	Loggerhead Sea Turtle	3,823
Chelonia mydas	Green Sea Turtle	3
Eretmochelys imbricata	Hawksbill Sea Turtle	4

Source: Halpin et al., 2009.[107]

The propensity of marine mammals observed during all surveys are the toothed-whales, or odontocetes. Only two mysticete species (baleen whales) were reported during any of the surveys. In a review of marine mammal records of Cuba which included commercial whaling records, a total of only 3 baleen whale species along with 14 odontocete species, and one sirenian species was reported[108]. This indicates a significant overlap in the expected marine mammal orders in waters between the Great Bahama Bank and Cuba which would include the License block areas and surrounding waters. Additionally, within the OBIS-SEAMAP database, 25 marine mammal species records (minke whale [1 record], sperm whale [2 records], false killer whale [1 record], spinner dolphin [1 record], and rough toothed dolphin [20 record] are reported along the southern boundary of the Great Bahama Bank; again showing that the majority of species identified are in the odontocete group.

Baleen whale migration is well documented in the Western North Atlantic; and Humpback whale migration is well documented from the western North Atlantic to the Caribbean (Figure 4-46). Humpbacks are regularly found, seasonally, east of Andros, but are likely rare in project area[109] [110]. Minke whales show a similar pattern to humpbacks, although vocalizations are more widespread in the Caribbean during winter months.[111] The humpback whale and minke whale are

[106] Halpin, P.N., A.J. Read, E. Fujioka, B.D. Best, B. Donnelly, L.J. Hazen, C. Kot, K. Urian, E. LaBrecque, A. Dimatteo, J. Cleary, C. Good, L.B. Crowder, and K.D. Hyrenbach. 2009. OBIS-SEAMAP: The world data center for marine mammal, sea bird, and sea turtle distributions. Oceanography 22(2):104-115.
[107] Halpin, P.N., A.J. Read, E. Fujioka, B.D. Best, B. Donnelly, L.J. Hazen, C. Kot, K. Urian, E. LaBrecque, A. Dimatteo, J. Cleary, C. Good, L.B. Crowder, and K.D. Hyrenbach. 2009. OBIS-SEAMAP: The world data center for marine mammal, sea bird, and sea turtle distributions. Oceanography 22(2):104-115.
[108] Whitt, A.D., Jefferson, T.A., Blanco, M., Fertl, D. and Rees, D., 2014. A review of marine mammal records of Cuba. *Latin American Journal of Aquatic Mammals*, *9*(2), pp.65-122.
[109] Clapham, P.H. and Mattila, D.K., 1990. Humpback whale songs as indicators of migration routes. Marine Mammal Science, 6(2), pp.155-160.
[110] Whitt, A.D., Jefferson, T.A., Blanco, M., Fertl, D. and Rees, D., 2014. A review of marine mammal records of Cuba. *Latin American Journal of Aquatic Mammals*, *9*(2), pp.65-122.
[111] Risch, D., Castellote, M., Clark, C.W., Davis, G.E., Dugan, P.J., Hodge, L.E., Kumar, A., Lucke, K., Mellinger, D.K., Nieukirk, S.L. and Popescu, C.M., 2014. Seasonal migrations of North Atlantic minke whales: novel insights from large-scale passive acoustic monitoring networks. Movement ecology, 2(1), p.24.

the only mysticetes species that have been identified in any of the Bahamas surveys summarized in Table 4-9.

Odontocete species show minor, seasonal migratory behavior[112] unlike mysticetes which travel to higher feeding latitudes during summer and lower breeding/calving latitudes in winter[5]. Therefore, Odontocetes are the primary guild of marine mammal likely to be found near the project area and will likely be present year-round in low densities. While most odontocetes found in the Bahamas are considered resident, there is some evidence that Killer whales undertake seasonal migrations from the North Atlantic (Canada and New England) to the Caribbean, including passing through Bahamian waters. These whales are thought to prey on migrating fish and on smaller marine mammals (Atlantic spotted dolphins, Fraser's dolphins, dwarf sperm whales, and pygmy sperm whales) while in Bahamian waters.[113] [114] Importantly of oil and gas activities, odontocetes are considered mid- and high- frequency hearing specialists as opposed to the low frequency mysticetes whales that are considered low-frequency hearing specialists[115]. The relevance of each hearing group to impact assessment is discussed in Section 5.4.2.3.

[112] Roberts, J.J., Best, B.D., Mannocci, L., Fujioka, E., Halpin, P.N., Palka, D.L., Garrison, L.P., Mullin, K.D., Cole, T.V., Khan, C.B. and McLellan, W.A., 2016. Habitat-based cetacean density models for the US Atlantic and Gulf of Mexico. *Scientific reports*, *6*(1), pp.1-12.
[113] Mitchell, E. and R. R. Reeves (1988). "Records of killer whales in the western north atlantic with emphasis on eastern canadian waters." Rit Fiskideildar 11: 161-193.
[114] Dunn, C. and Claridge, D., 2014. Killer whale (Orcinus orca) occurrence and predation in the Bahamas. *Journal of the Marine Biological Association of the United Kingdom*, *94*(6), pp.1305-1309.
[115] Southall, B.L., Finneran, J.J., Reichmuth, C., Nachtigall, P.E., Ketten, D.R., Bowles, A.E., Ellison, W.T., Nowacek, D.P. and Tyack, P.L., 2019. Marine mammal noise exposure criteria: Updated scientific recommendations for residual hearing effects. *Aquatic Mammals*, *45*(2), pp.125-232.

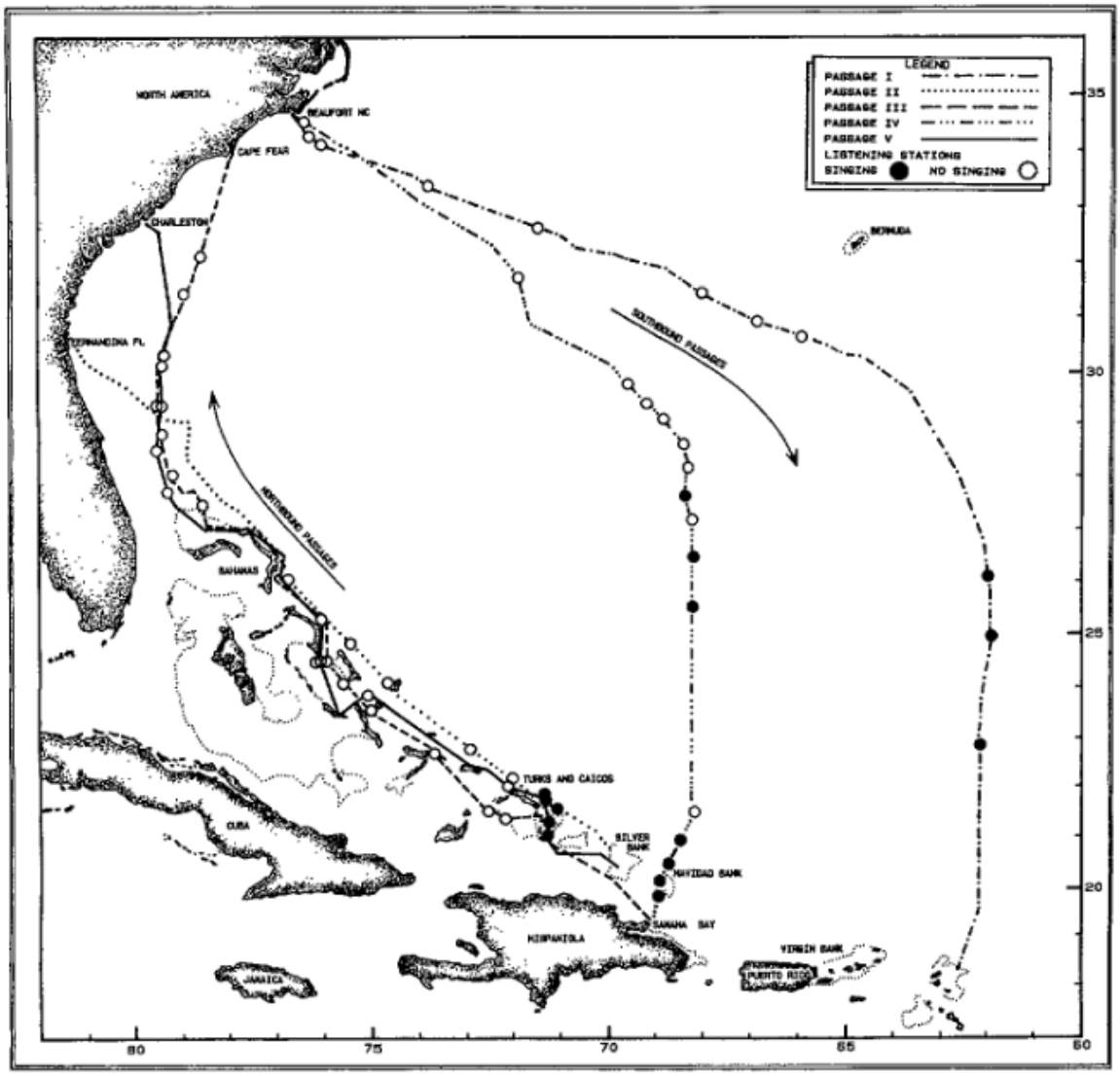

Figure 4-46: Observed Humpback Whale Migration Routes
Source: Clapham and Mattila, 1990.

4.2.2.8 Birds

The diversity and number of seabirds in The Bahamas exceed that of any other country in the Wider Caribbean.

North Andros has a resident non-breeding flock of West Indian flamingos (*Phoenicopterus ruber ruber*) that varies in size from approximately 100 to over 1,000 individuals from year to year. The flamingo is the national bird of The Bahamas. The lake system north of Wide Opening that is more saline than other lake systems on the west side of North Andros appears to be an important resting area for flamingos.

Andros also provides important seabird habitat for:

- White Tailed Tropicbird (*Phaethon lepturus*),
- Audubon Shearwater (*Puffinus lherminieri*),
- Bridled Tern (*Sterna anaethetus*)

- Sooty Tern (*Onychoprion fuscata*), and
- Brown Noddy (*Anous stolidus*)[116].

All the birds listed above are considered resident species of The Bahamas.

Multiple seabird and migrant bird species were recorded by vessel-based observers between June and September 2010 seismic survey operations. A list of these species is presented in Table 4-13.

Table 4-13: Bird Species Observed During Seismic Surveys in Lease Blocks (June to September 2010)

Common Name	Order	Genus	Species	Approximate Number of Individuals Observed	Approximate Number of Days Species Was Observed
Cattle Egret	Ciconiiformes	*Bubulcus*	*ibis*	39	12
Laughing gull	Charadriiformes	*Leucophaeus*	*atricilla*	4	3
Royal tern	Charadriiformes	*Thalasseus*	*maxima*	100	36
Masked Booby	Pelecaniformes	*Sula*	*dactylatra*	5	2
Rock Pigeon	Columbiformes	*Columba*	*livia*	2	34
Brown Booby	Pelecaniformes	*Sula*	*leucogaster*	8	6
Limpkin	Gruiformes	*Aramus*	*guarauna*	1	1
Magnificent frigatebird	Pelecaniformes	*Fregata*	*magnificens*	14	9
Peregrine falcon	Falconiformes	*Falco*	*pergrinus*	1	1
Great egret	Ciconiiformes	*Ardea*	*alba*	5	4
Green heron	Ciconiiformes	*Butorides*	*virescens*	9	7
Yellow-throated warbler	Passeriformes	*Dendroica*	*dominica*	3	3
American redstart	Passeriformes	*Setophaga*	*ruticilla*	7	7
Northern parula	Passeriformes	*Parula*	*americana*	2	2
Cliff swallow	Passeriformes	*Petrochelidon*	*pyrrhonota*	2	2
Prothonotary warbler	Passeriformes	*Protonotaria*	*citrea*	1	1
Audubon's shearwater	Procellariiformes	*Puffinus*	*lherminieri*	1	1
Osprey	Falconiformes	*Pandion*	*haliaetus*	4	4
Pomarine jaeger	Charadriiformes	*Stercorarius*	*Pomarinus*	1	1
Black-throated blue warbler	Passeriformes	*Setophaga*	*caerulescens*	2	2
Louisiana waterthrush	Passeriformes	*Parkesia*	*motacilla*	2	2

[116] The Nature Conservancy. 2007. Andros Island Conservation Assessment.

Common Name	Order	Genus	Species	Approximate Number of Individuals Observed	Approximate Number of Days Species Was Observed
Merlin	Falconiformes	*Falco*	*columbarius*	2	2
Mourning dove	Columbiformes	*Zenaida*	*macroura*	1	1
Gray kingbird	Passeriformes	*Tyrannus*	*dominicensis*	1	1
Herring gull	Charadriiformes	*Larus*	*smithonianus*	1	1
Barn swallow	Passeriformes	*Hirundo*	*rustica*	9	3
Prairie warbler	Passeriformes	*Dendroica*	*discolor*	1	1
Burrowing owl	Strigiformes	*Athene*	*cunicularia*	4	3
Caspian tern	Charadriiformes	*Hydroprogne*	*caspia*	2	2
Bobolink	Passeriformes	*Dolichonyx*	*oryzivorus*	1	1
Baltimore oriole	Passeriformes	*Icterus*	*galbula*	1	1
Snowy egret	Ciconiiformes	*Egretta*	*thula*	14	1
Chuck-will's-widow	Caprimulgiformes	*Caprimulgus*	*carolinensis*	2	1

Source: Protected Species Monitoring Report for the Bahamas Petroleum Company, CGG Veritas, M/V Veritas Viking Pearl 3D Broadseis Bahama Bank 9 June 2011 – 18 September 2011

There are 31 Important Bird Areas (IBAs) in The Bahamas (Figure 4-47). The North Atlantic Abaco Cays IBA (BS005) and Cay Sal IBA (BS025) stand out as supporting the largest numbers of seabirds, while Great Inagua IBA (BS039) is home to the largest congregation of waterbirds[117]. The Bahamian IBAs appear to provide habitat to neotropical migrants during spring and fall migration periods. Drilling rigs in the Gulf of Mexico have been found to provide habitat to migrating birds.[118] It is conceivable that this could also be the case for the proposed drilling program.

[117] Moore, P. & Gape, L. 2009 Bahamas. Pp 71 – 78 in C. Devenish, D. F. Díaz Fernández, R. P. Clay, I. Davidson & I. Yépez Zabala Eds. Important Bird Areas Americas - Priority Sites for Biodiversity Conservation. Quito, Ecuador: Birdlife International (Birdlife Conservation Series No. 16).
[118] Russell, R.W. 2005. Interactions between Migrating Birds and Offshore Oil and Gas Platforms in the Northern Gulf of Mexico: Final Report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2005-009. 348 pp.

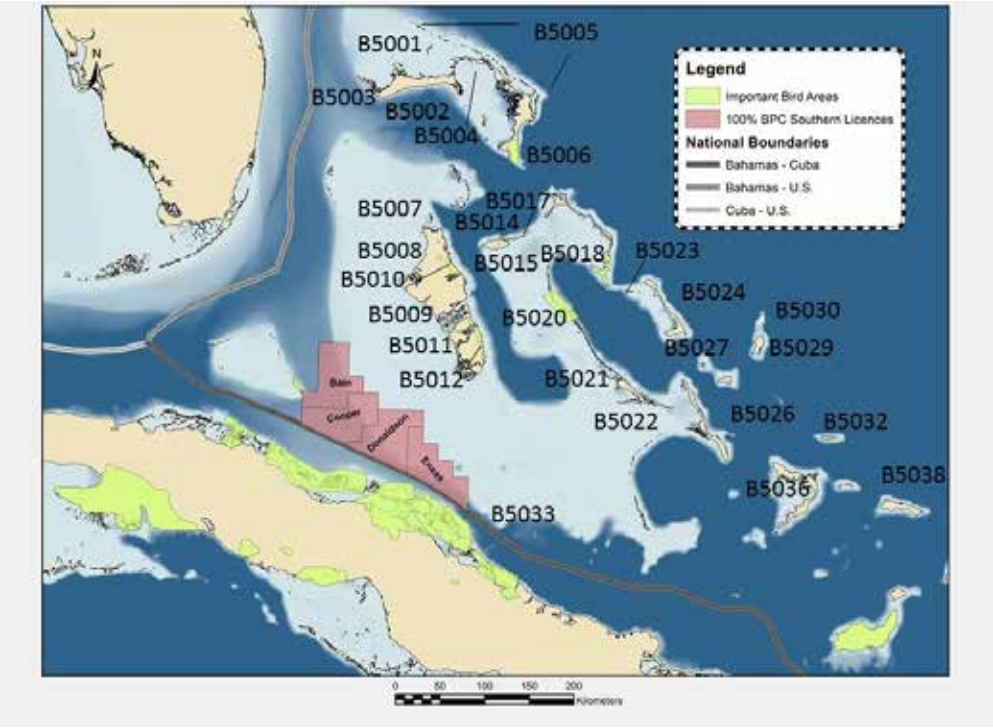

Figure 4-47: Location of Important Bird Areas in The Bahamas
Note: Approximate block boundaries shown in black
Source: Moore, et al., 2009

The closest IBA in The Bahamas to the BPC license blocks is Cay Lobos (BS033), located approximately 80 miles (~128 km) southeast of the first proposed drill site. Cay Lobos is on the southern edge of the Great Bahama bank, approximately 20 miles north of Cayo Romano, Cuba. A part of The Bahamas, Cay Lobos has IBA bird species including:

- Roseate Tern (*Sterna dougallii*),
- Least Tern (*Sternula antillarum*), and
- Bridled Tern (*Onychoprion anaethetus*).

All three species are of least concern under the IUCN categorization. Most of the data for this site is historical, having been collected by a lighthouse keeper for the period of 1899 – 1901[119].

4.2.3 Protected and Sensitive Resources

4.2.3.1 Protected and Sensitive Areas

The closest Bahamian protected area is Westside National Park (Figure 4-48), located approximately 87 miles (140 km) northeast of the Perseverance Well. It was established in 2012 and is 1,981 sq. miles (5,131 km^2). The park encompasses areas of significant wetlands, extensive mangroves, and pine upland habitats that support exceptional natural systems on Andros.[120]

[119] Birdlife International.2011. Important Bird Areas factsheet: Cay Lobos. Accessed from the following website: www.birdlife.org/datazone/sitefactsheet.
[120] IUCN. 2014. *The Andros West Side National Park, home of the national bird of the Bahamas.* Accessed from the following website: https://www.iucn.org/content/andros-west-side-national-park-home-national-bird-bahamas

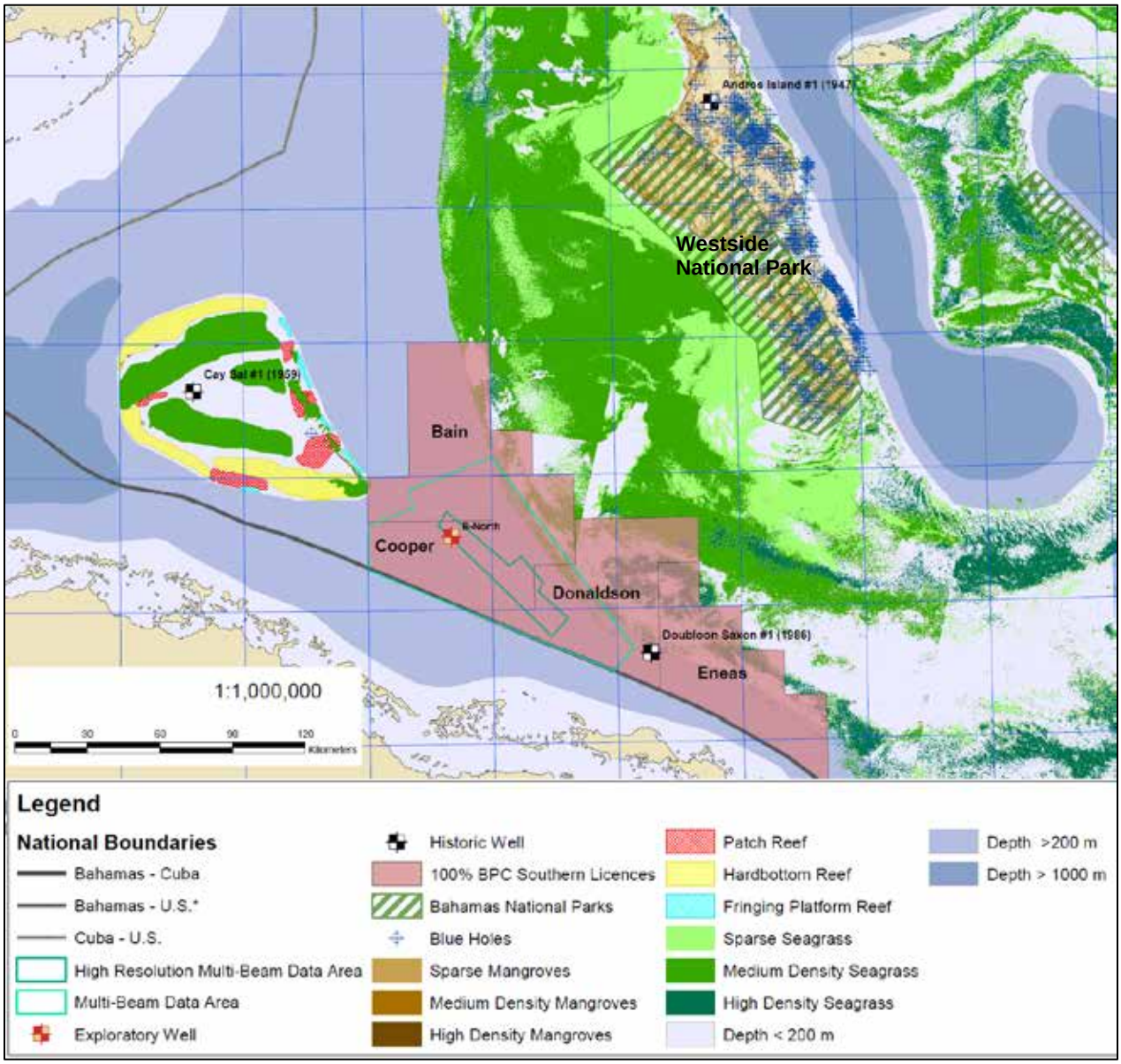

Figure 4-48: Location and Sensitivities of the Westside National Park
Source: Acorn International and BPC

Westside National Park is managed by the Bahamas National Trust (BNT) which was established by an Act of Parliament in 1959. It is a non-governmental, non-profit organization, mandated with the development and management of the National Parks System of The Bahamas.

There is also a proposed protected area approximately 25 miles (40 km) west-northwest of the Perseverance Well that would cover the extent of Cay Sal Bank. The isolated cays on the bank are important habitat for seabirds and provide resting stops for migratory birds. Cay Sal contains important turtle nesting habitats and healthy coral reef systems.[121]

[121] Marine Conservation Institute. 2020. Atlas of Marine Protected Areas: Cay Sal Marine Management Area. Accessed from the following website: http://www.mpatlas.org/mpa/sites/68807601/

As noted in Section 4.2.1, there are many sensitive coastal an marine ecosystems in the region, including extensive seagrass beds, coral reefs, and mangroves, though these are all located in shallow water and/or coastal areas.

As noted in Section 4.2.2, many of the beaches in the region are used for sea turtle nesting and there are a number of Important Bird Areas. Section 4.4 discusses protected and sensitive resources in Cuba, including RAMSAR Wetlands of International Importance.

See Sensitivity Mapping provided in EMP Appendix E, attachment D.

4.2.3.2 Threatened Species

Table 4-14 below outlines the threatened species potentially found at the well site according to IUCN[122].

Table 4-14: Endangered Species Potentially Found at Well Site

Common Name	Scientific Name	IUCN Red List Category
Staghorn Coral	*Acropora cervicornis*	Critically Endangered
Elkhorn Coral	*Acropora palmata*	Critically Endangered
Oceanic Whitetip Shark	*Carcharhinus longimanus*	Critically Endangered
Nassau Grouper	*Epinephelus striatus*	Critically Endangered
Hawksbill Turtle	*Eretmochelys imbricata*	Critically Endangered
Kemp's Ridley Turtle	*Lepidochelys kempii*	Critically Endangered
Smalltooth Sawfish	*Pristis pectinata*	Critically Endangered
Largetooth Sawfish	*Pristis pristis*	Critically Endangered
Scalloped Hammerhead	*Sphyrna lewini*	Critically Endangered
Great Hammerhead	*Sphyrna mokarran*	Critically Endangered
American Eel	*Anguilla rostrata*	Endangered
Sei Whale	*Balaenoptera borealis*	Endangered
Blue Whale	*Balaenoptera musculus*	Endangered
Dusky Shark	*Carcharhinus obscurus*	Endangered
Green Turtle	*Chelonia mydas*	Endangered
Shortfin Mako	*Isurus oxyrinchus*	Endangered
Longfin Mako	*Isurus paucus*	Endangered
Atlantic Devilray	*Mobula hypostoma*	Endangered
Giant Devilray	*Mobula mobular*	Endangered
Sicklefin Devilray	*Mobula tarapacana*	Endangered
Bentfin Devilray	*Mobula thurstoni*	Endangered
Boulder Star Coral	*Montastraea annularis*	Endangered
Mountainous Star Coral	*Montastraea faveolata*	Endangered
Black-capped Petrel	*Pterodroma hasitata*	Endangered
Whale Shark	*Rhincodon typus*	Endangered
Lamarck's Sheet Coral	*Agaricia lamarcki*	Vulnerable
Bigeye Thresher	*Alopias superciliosus*	Vulnerable

[122] IUCN. 2019. RedList of Threatened Species. Accessed from the following website: https://www.iucnredlist.org/

Common Name	Scientific Name	IUCN Red List Category
Common Thresher	*Alopias vulpinus*	Vulnerable
Gray Triggerfish	*Balistes capriscus*	Vulnerable
Silky Shark	*Carcharhinus falciformis*	Vulnerable
Sandbar Shark	*Carcharhinus plumbeus*	Vulnerable
Night Shark	*Carcharhinus signatus*	Vulnerable
Sand Tiger Shark	*Carcharias taurus*	Vulnerable
White Shark	*Carcharodon carcharias*	Vulnerable
Loggerhead Turtle	*Caretta Caretta*	Vulnerable
Barfin Goby	*Coryphopterus alloides*	Vulnerable
Pallid Goby	*Coryphopterus eidolon*	Vulnerable
Glass Goby	*Coryphopterus hyalinus*	Vulnerable
Peppermint Goby	*Coryphopterus lipernes*	Vulnerable
Masked Goby	*Coryphopterus personatus*	Vulnerable
Bartail Goby	*Coryphopterus thrix*	Vulnerable
Patch-reef Goby	*Coryphopterus tortugae*	Vulnerable
Pillar Coral	*Dendrogyra cylindrus*	Vulnerable
Leatherback	*Dermochelys coriacea*	Vulnerable
Elliptical Star Coral	*Dichocoenia stokesii*	Vulnerable
Atlantic Goliath Grouper	*Epinephelus itajara*	Vulnerable
Red Grouper	*Epinephelus morio*	Vulnerable
Lined Seahorse	*Hippocampus erectus*	Vulnerable
Snowy Grouper	*Hyporthodus niveatus*	Vulnerable
White Marlin	*Kajikia albida*	Vulnerable
Hogfish	*Lachnolaimus maximus*	Vulnerable
Olive Ridley	*Lepidochelys olivacea*	Vulnerable
Cubera Snapper	*Lutjanus cyanopterus*	Vulnerable
Giant Manta Ray	*Mobula birostris*	Vulnerable
Ocean Sunfish	*Mola mola*	Vulnerable
Boulder Star Coral	*Montastraea franksi*	Vulnerable
Rough Cactus Coral	*Mycetophyllia ferox*	Vulnerable
Yellowmouth Grouper	*Mycteroperca interstitialis*	Vulnerable
Large Ivory Coral	*Oculina varicosa*	Vulnerable
Smalltooth Sand Tiger	*Odontaspis ferox*	Vulnerable
Sperm Whale	*Physeter macrocephalus*	Vulnerable
Desertas Petrel	*Pterodroma deserta*	Vulnerable
Vermilion Snapper	*Rhomboplites aurorubens*	Vulnerable
Smooth Hammerhead	*Sphyrna zygaena*	Vulnerable
Spiny Dogfish	*Squalus acanthias*	Vulnerable
Bigeye Tuna	*Thunnus obesus*	Vulnerable
American Manatee	*Trichechus manatus*	Vulnerable

Source: IUCN, 2020

4.2.3.3 Commercially and Culturally Significant Species

Commercially and culturally significant species found in the project area of influence include:

- Queen conch
- White and black land crabs

Queen conchs are both culturally and economically important in The Bahamas. Conch supports both commercial and subsistence fisheries, by providing a nutritious and relatively inexpensive food source. They are also collected for their beautiful pinkish shells which are sold as souvenirs. Due to the decline of Queen conch populations throughout the Caribbean, it is now listed on Appendix II of CITES. Appendix II lists species that are not threatened presently with extinction, but may become threatened unless trade of such species is subjected to strict regulations. This protection, however, is limited to conch shells. Any manufactured product (e.g., conch fritters) is not protected, and fishery products (e.g., frozen or fresh conch meat), is not covered under CITES. The Bahamas Government does not currently provide a catch limit or closed season for Queen conch, only minimum size limits.

Land crabs are an important economic and consumptive resource for the people of Andros. During spawning season, Androsians come out in the hundreds to catch crabs as they run across the roads on their way to the sea. It is estimated that about 715 households make around $2,000 each selling land crabs in New Providence.

4.3 Socioeconomic Conditions

4.3.1 Overview of Communities, Employment and other Demographic Conditions

The project is proposed to take place approximately 80 miles (~130 km) offshore to the southwest of Andros Island.

According to the most recent census (2010), the total population of The Bahamas is estimated at approximately 353,658[123]. This represents a growth rate of 16.5% when compared to the 2000 figures. The Bahamian economy is based on tourism and employs directly and indirectly almost half of the archipelago's workforce. Other contributors to the economy are banking, construction, manufacturing, agriculture and fisheries. Agriculture and fisheries contribute 2.12% of the GDP (gross domestic product) of The Bahamas. The government's policy reserves the Bahamian fishing Industry for Bahamian Nationals, fishing vessels must be 100% Bahamian owned. The majority of the population in the potential impact area is involved in agriculture and fisheries. While project activities are only to take place offshore, these activities may potentially affect the on-shore socioeconomic environment on Andros Island and Bimini which fall within the potential impact area.

Andros Island currently supports a small population of 7,400. The people of Andros remain closely connected to the land and sea, which serves as the basis of the local economy and culture.

Predominant industries in Andros include sponging, fishing, crabbing, fly-fishing, tourism, basket weaving, and woodcarving. Economic sectors on the island are mainly related to agriculture, tourism, fishing and general development, with some employment by the Government of The Bahamas and the Water and Sewage Company. The number of visitors to Andros is typically

[123] Department of Statistics, 2010. National Census of The Bahamas. Government of The Bahamas. Nassau, Bahamas.

10,000 per year, with a mean of 85,000 visitor nights from 2006-2008. There are 34 registered hotels (393 hotel rooms)[124].

Residents of Andros have become adept at finding a high quality of life, based largely on the utilization of natural resources. People benefit directly in many varied ways from the flora and fauna, from extraction of crabs, sponge, fish, wood and palm for crafts, medicine and fruits from the forest, as well as water from the ground. They also benefit indirectly in terms of income and employment from nature based tourism, such as guided fishing and diving or visiting blue holes.

The Atlantic Undersea Testing and Evaluation Centre (AUTEC) Base is located in Fresh Creek; it is one of the world's busiest underwater testing facilities. AUTEC's range systems provide underwater and in-air tracking for weapons firing platforms and targets using a variety of acoustic beacons and sensors. The evidence or drop suggests that exposure to intense underwater sound in some settings may cause certain marine mammals to strand and eventually die. Some reports have associated strandings with mid-frequency active military sonars and most have involved beak whales[125].

The Androsia factory also located in Fresh Creek produces batik with unique local designs.

Other settlements on the island are San Andros, Nicholls Town, Lowe Sound, Staniard Creek, Mangrove Cay, Driggs Hill, Kemps Bay, Long Bay Cays, The Bluff, Deep Creek, Little Creek, Pleasant Bay, Mars Bay, Smith's Hill, Black Point, Behring Point, Cargill Creek, Calabash Bay, Love Hill and Stafford Creek.

Bimini Island has a population of approximately 2,000. Predominant industries in Bimini include sportfishing and tourism. It is the closest Bahamian island to the United States and the majority of tourists are Americans. Visitors to the island in 2009 were 50,144[126]. Major resorts in Bimini include the Bimini Bay Resort and Marina and the Bimini Big Game Club Outpost Resort and Marina.

There are a number of historic landmarks in Bimini including the Bimini Road, several sunken Spanish galleons and Sapona, a freighter wreck from World War I.

Settlements in Bimini include Alice Town, Bailey Town, Port Royal and North Bimini.

4.3.2 Fishing

Bahamians depend on marine resources for food, recreation and employment. The fishing industry employs over 9,300 people (7% of the workforce), as well as an estimated 3,800 part-time fishers, 23 vendors, 11 processors and 18 exporters. These numbers have remained largely unchanged since 2000. Fisheries are subsidized through duty free concessions on fishing equipment. Most of the commercial fishing in The Bahamas takes place on the shallow banks – Great Bahama, Little Bahama and Cay Sal. These banks collectively provide about 45,000 square miles of

[124] The Nature Conservancy. 2010. An Economic Valuation of the Natural Resources of Andros Island, Bahamas.

[125] NOAA National Marine Fisheries Services Office of Protected Resources. 2011. Behavioural Response Study on Andros Island, Bahamas. Silver Springs, Maryland.

[126] Tourism Today. 2011. Accessed from the following website: www.tourismtoday.com/home/statistics/stop-overs

relatively productive shallow fishing grounds[127]. The Great Bahama Bank and Cay Sal Bank have the possibility of being impacted.

The total commercial fisheries production in 2015 was estimated at nearly 12,000 tonnes. The total production has fluctuated in recent years. Fluctuations are largely caused by the variations in landings of spiny lobster, which were nearly 10,000 tonnes in 2010 and 2012 and around 6,500 tonnes in 2015.

Spiny lobster stocks in The Bahamas are being fully exploited, while conch, snappers and groupers are, like in the rest of the Caribbean, under heavy fishing pressure and some stocks are probably overexploited.[128]
The three main important commercial fisheries in The Bahamas are[129]:

- Crawfish (Spiny lobster) – Landings in the Bahamas are the fourth largest in the world. In 2007, crawfish accounted for 29% of total fishery product landings by weight and 89% of total fishery exports by value (US$71 million).
- Queen Conch – Less than a quarter of the conch catch is typically exported, so estimates are inaccurate because the rest is traded in local markets for which reliable data - is not available. Populations have been severely depleted. Total conch exports in 2008 amounted to 159 mt with a value of $2.0 million.
- Scalefish – This category includes species of grouper, snapper, jacks, grunts, hogfish, triggerfish and others. In 2008, scalefish landings totaled 1,333 mt and represented 9.4% of the total value of all fishery product landings. Snappers accounted for 20.7% of all scalefish landings (valued at US$4.6 million).

The deepwater fishing industry is not well-developed in The Bahamas due to higher costs and requirements for specialized equipment and technology. As fishermen attempt to diversify their catch, interest is increasing.

The latest (2013) per capita fish supply figures indicate that Bahamians have a supply of fish and fisheries products of some 31 kg/capita per year. In 1990, this was only 23 kg/capita/per year. 10

The increase in supply of fish to the population has largely been achieved through an increase in fish and fishery product imports. Fish and fisheries products provide some 10% of the total protein intake by the Bahamian population.

The Bahamas participates actively in regional collaboration in fisheries management and development, especially within the frameworks provided by the Caribbean Regional Fisheries Mechanism (CRFM) and the Western Central Atlantic Fishery Commission (WECAFC), of which the country is member.[130]

Andros is known as the bonefishing capital of the world. A report in 2009 reported 80 bone fishing guides in Andros and estimated there were 64,441 angler nights on Andros (12,643 guided) and

[127] The Bahamian Commercial Fishing Industry (BREEF) 2006. Accessed from the following website www.breef.org.
[128] *Fisheries and Aquaculture in The Bahamas:* A Review; Food and Agriculture Organization of the United Nations/Department of Marine Resources: Nassau, The Bahamas, 2016
[129] BREEF, 2006.
[130] *Fisheries and Aquaculture in The Bahamas: A Review*; Food and Agriculture Organization of the United Nations/Department of Marine Resources: Nassau, The Bahamas, 2016

that anglers spent an estimated $374 per night (compared to $364 for general tourists)[131]. The sand flats are world-renown for fly fishing and occur on the entire north, south and west coast of the island. Bonefishing is also done within the tidal creeks, cuts and bights which run straight through the island.

Nearshore fishing activities are common along the east coast of Andros.

Bimini is known for big game fishing for species such as:
- Blue marlin (*Makaira nigricans*),
- Bluefin tuna (*Thunnus thynnus*),
- Wahoo (*Acanthocybium solandri*) and
- Swordfish (*Xiphias gladius*).

Fishing sites in or near Bimini include Moselle Shoal, Three Sisters Rock, and Great Isaac Rock. The sand flats in Bimini also have an abundance of bonefish and permit (a type of jack). Bonefishing also occurs on the neighbouring Great Bahama Bank. Charter boats also take tourists out to fish for grouper, snapper and barracuda[132].

4.3.3 Mariculture

There are no mariculture activities currently occurring at the project site or off the coasts of Andros and Bimini. The Cape Eleuthera Institute is conducting a study of offshore cage aquaculture of cobia (*Rachycentron canadum*), but problems have been encountered with sharks congregating at the research sites, attacking the cages and eating the cobia. The study has not moved to the commercial stage, but research continues in collaboration with the University of Miami Rosentiel School of Marine and Atmospheric Science[133].

4.3.4 Tourism/Recreation

There are two principal types of tourism in The Bahamas - cruise ship and overnight. Since 2000, an average of 4.5 million tourists visited The Bahamas each year[134]. Of these, about 1.5 million are overnight visitors and the remaining ones stay a few days on a cruise ship docked in a port. Almost half these visitors had incomes greater than US$100,000.[135] Eighty-one per cent were from the USA, 8% from Canada and 6% from Europe. Overnight visitors stayed an average of 6.6 nights, typically either 5.6 nights in Nassau or 9.5 nights in the out islands. Overnight visitors spent an estimated total of $2.02 billion in aggregate in 2007 and a mean of $1,175 per visit.

Two hundred and fifty-eight thousand (258,000) visitors went to the Family Islands in 2008, spending 2.4 million visitor nights. Thirty-seven per cent of Family Island visitors had chosen The Bahamas due to the beaches, followed by 24% for sporting activities (e.g. snorkeling, fishing, diving, and sailing). Mean expenditure for Family Island overnight visitors was $1,396 per trip in 2007 or US$402 million in aggregate (20% of all tourism expenditure). This includes all those who stayed with friends or on boats and therefore spent nothing on accommodation. Of this, 39% was spent on accommodation, for which the mean price was US$253 per night, 16% on food and drink

[131] BREEF, 2006.
[132] The Islands of The Bahamas. 2011. Fishing. Things to do on Water in Bimini. Accessed from the following website: www.bahamas.com/out-islands/bimini-islamd/fishing. 2008 - 2011.
[133] Cape Eleuthera Institute. 2011. Offshore Aquaculture. Accessed from the following website: www.ceibahamas.org.
[134] Ministry of Tourism. 2011. Accessed from the following website: www.bahamas.gov.bs
[135] B$1 = US$1.

and 4% on sporting activities. The number of visitors to the Family Islands continues to rise each year and could reach 3 million by 2024, given current growth of 2.8% per year.

The number of visitors to Andros is typically 10,000 per year, of whom 90% are from the US, 5% are from Europe and 3% are from Canada. A mean of 85,000 visitor nights were spent in Andros from 2006-2008. Sixty-six percent of visitors came in on commercial flights and 26% on private planes. Fifty percent of visitors stay in hotels, 12% with friends, 10% on private boats, 5% in rental properties and 5% in their own second homes. There were 34 registered hotels and 393 hotel rooms in Andros in 2008 (12% of all the out-island hotels). Sixty-seven per cent of visitors to Andros were repeat visitors.

Bimini is considered one of the world's best dive destinations with dive sites including the Bimini Road with depths of up to 4,000 feet. Other dive sites include coral reefs, several sunken Spanish galleons, a World War I freighter wreck and the concrete hull of the SS Sapona[136]. As mentioned previously, tourists also engage in sportfishing in the waters and shallow banks off Bimini.

4.3.5 Shipping

The Bahamas Petroleum southern licenses are located offshore and are in the vicinity of three shipping channels (Figure 4-49):

- Nicholas Channel
- Santaren Channel
- Old Bahama Channel (most utilized of the three).

The Old Bahama Channel (see Figure 4-49 Figure 4-50 for cross section) of is a strait located between Cuba and the Great Bahama Bank, with a small portion of the channel intersecting the Bahamas Petroleum's southern license areas. This channel is connected at its north-western extremity to the Florida Straits by two arms, enclosing Cay Sal Bank. These two arms comprise the Santaren Channel to the north and the Nicholas Channel to the south. The Old Bahama Channel terminates on the east between Cape Maysi in Cuba and the Bahamian island of Inagua. However, it can also be considered to include the Mona Passage which separates Hispaniola and Puerto Rico. The narrowest portion of the Old Bahama Channel is between 22° and 23° north latitude, where its width rarely exceeds twelve miles. The Old Bahama Channel is used as an alternate shipping route when shipping crude or petroleum to and from the Middle East and Mexico but is frequently avoided during the hurricane season[137]. Density of vessel traffic in these shipping lanes in 2017 relative to the BPC blocks is shown in Figure 4-51.

[136] The Islands of The Bahamas. 2011.

[137] UNEP. 2009. Caribbean Island Oil Pollution Response and Cooperation Plan. IMO/UNEP, Curacao, Netherland Antilles.

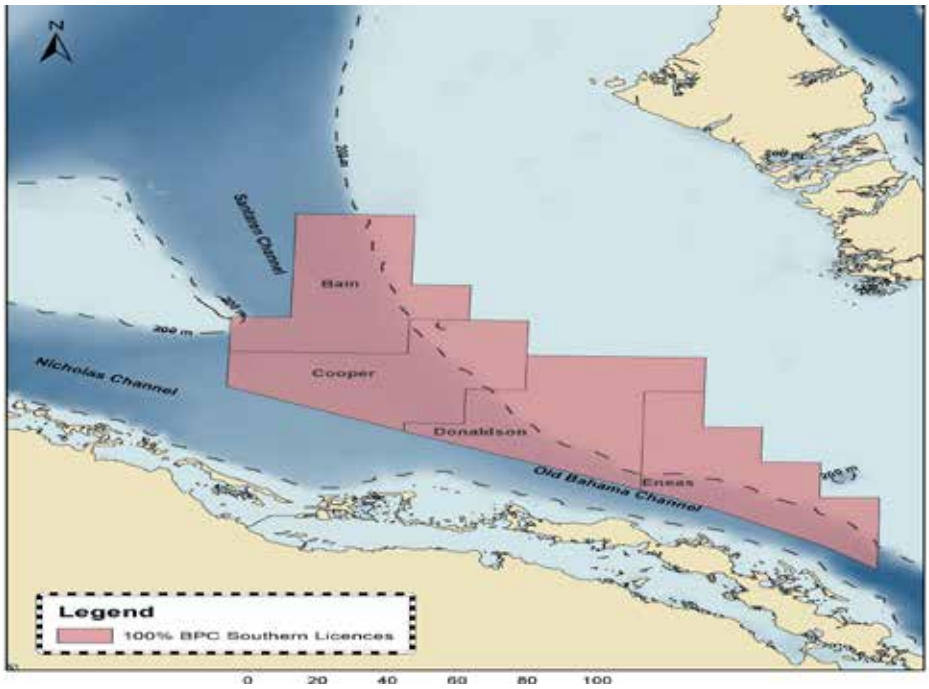

Figure 4-49: Shipping Channels near Bahamas Petroleum Company's Southern Licenses
Note: Approximate block boundaries shown in black
Source: Modified from Google Earth

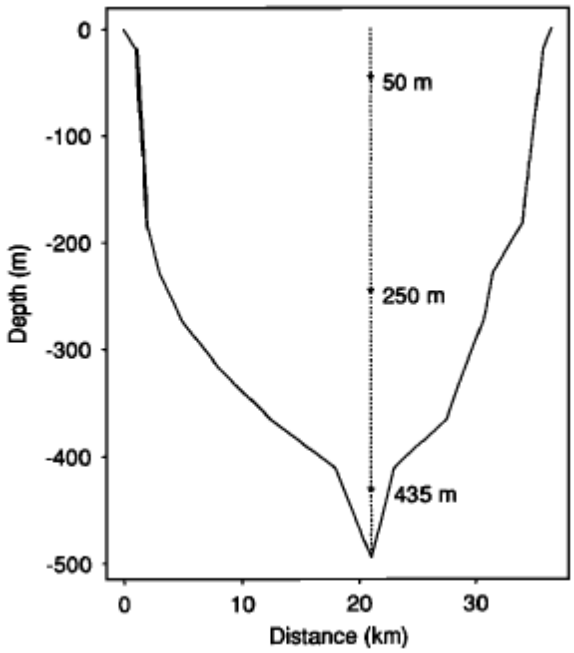

Figure 4-50: Cross section of Old Bahama Channel
Note: Cross section taken at 22° 44.5'N and 78° 31.8'W
Source: Atkinson, 1995[138]

[138] Atkinson, 1995.

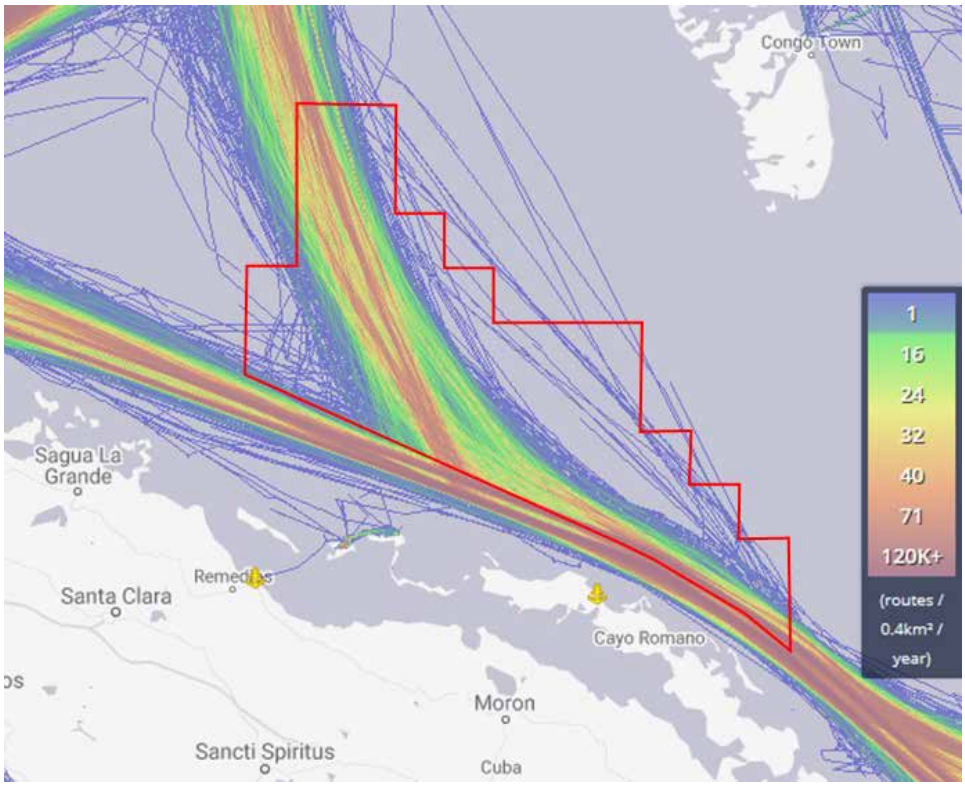

Figure 4-51: Marine Traffic Density (2017) in BPC Exploration Blocks
Note: Block outlines are schematic and do not constitute official delineations.
Source: Modified from marinetraffic.com

Ship registration is a relatively new business in The Bahamas, yet the country has grown from less than one million gross tons to be the world's fifth largest fleet in little more than a decade. Since the passing of the Merchant Shipping Act of 1976, more than 1,500 vessels, representing over 25 million gross tons, have chosen to register in The Bahamas. Many of the most respected international ship-owning companies fly the Bahamian flag, including Exxon International, Maersk Line, Teekay Shipping, and Chevron. Some of the luxury vessels registered include the ships of Norwegian Cruise Lines and Holland-America Cruises; others are cargo steamers, frigates, freighters, tankers and tugboats[139].

Established on July 1, 1995, The Bahamas Maritime Authority (BMA), with its headquarters in London, is a semi-autonomous, Government-owned corporation, specifically designed to be responsive to the needs of the maritime market place. While the BMA will be self-funding from revenues generated from within, the Government has allocated US$1 million 'seed money' to expedite a number of enhancements to present operations. Guided by advice from leading shipowners, the BMA is increasing staff, streamlining registry procedures, and instituting improvements in support systems.

Despite the fact that many vessels and numerous tankers (destined for BORCO and South Riding Point oil storage and transhipment facilities) travel through The Bahamas, there have only been two collisions and zero reported oil spill accidents since 1996.

[139] The Bahamas' Shipping Registry http://www.geographia.com/bahamas/investment/shipng01.htm

4.3.5.1 Port Fourchon Shore Base

Port Fourchon (Louisiana, USA) has been selected as the shore base for project operations. Port Fourchon services over 90% of the Gulf of Mexico's deepwater oil production and accommodates movements of over 400 large supply vessels per day, 15,000 people per month, and 1,200 trucks per day.[140] Vessel arrivals in the port by day and type from 28 November – 11 December 2019 are shown in Figure 4-52. Vessel arrivals and departures (for all vessel types of sufficient size to be equipped with AIS) at Port Fourchon from 12 November – 12 December 2019 are shown in Figure 4-53. The area around Port Fourchon has a significant amount of vessel traffic (Figure 4-54).

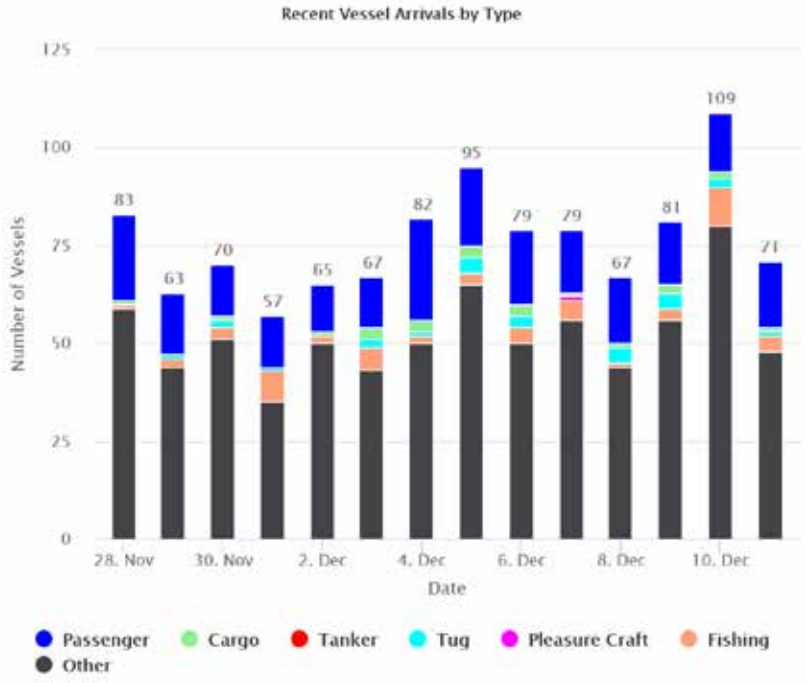

Figure 4-52: Vessel Arrivals by Type at Port Fourchon, Louisiana, USA (28 November – 11 December 2019)

Source: marinetraffic.com

[140] Greater Lafourche Port Commission: Port Facts. https://portfourchon.com/seaport/port-facts/

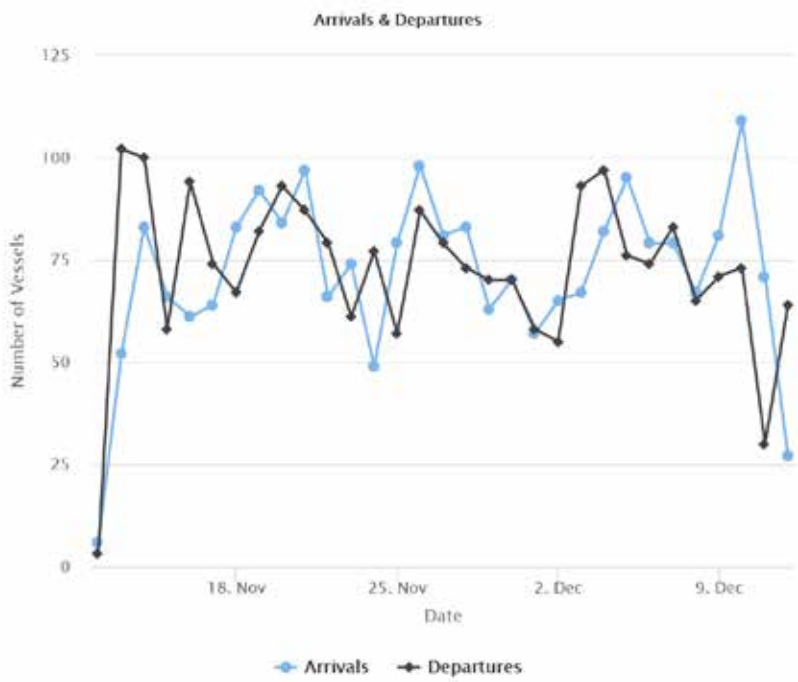

Figure 4-53: Vessel Arrivals and Departures by Day at Port Fourchon, Louisiana, USA (12 November – 12 December 2019)
Source: marinetraffic.com

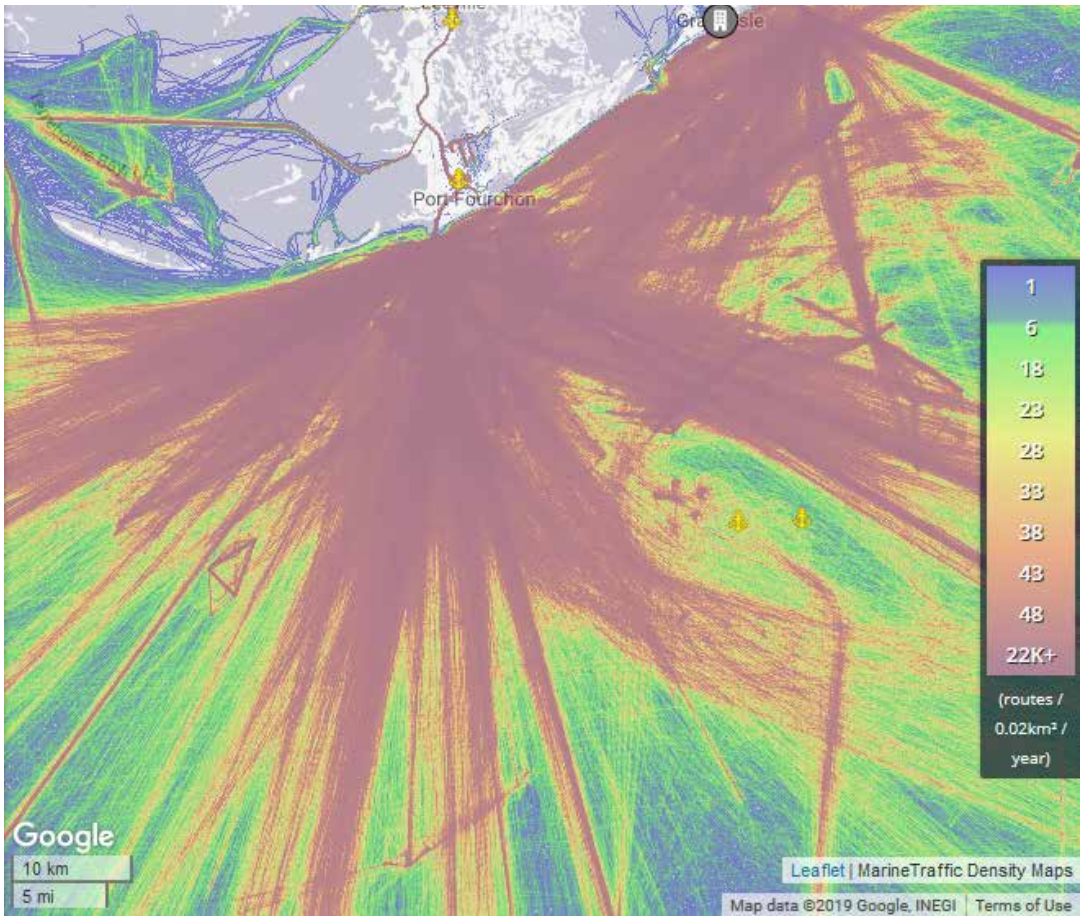

Figure 4-54: Marine Traffic Density Surrounding Port Fourchon, Louisiana, USA (2017)
Source: marinetraffic.com

4.3.6 Infrastructure and Services

The project site is offshore in a remote location where there is no infrastructure or services available but infrastructure and services exist on Andros and Bimini Island which are in the vicinity of the project area.

Infrastructure and services on the island of Andros include:

- Roads - constructed by the Ministry of Public Works
- Potable water - provided by the Water & Sewerage Corporation or private wells
- Telecommunications - provided by the Bahamas Telecommunications Corporation
- Cable television and Internet - provided by Cable Bahamas
- Electricity - provided by the Bahamas Electricity Corporation
- Medical clinics - managed and operated by the Department of Public Health
- Docks/ports - public docking facilities are managed by the Port Department and Local Government; Government docks, ports and private docking facilities occur at Andros Town, Frozen Cay, Morgan's Bluff, Drigg's Hill and Standiard Creek
- Airports - small airports are located in the settlements of Andros Town, Clarence A. Bain, Congo Town, and San Andros

There are no hospitals on Andros or Bimini Island. Persons have to be flown to Grand Bahama, New Providence or the United States if they require hospitalization.

The cays located in the Cay Sal Bank area are not inhabited by people therefore no infrastructure exists.

A subsea cable runs along the outer edge of the Great Bahama Bank, through the license blocks (Figure 4-55). The telecommunications cable is approximately 13,884 feet from the drill site (B-north).

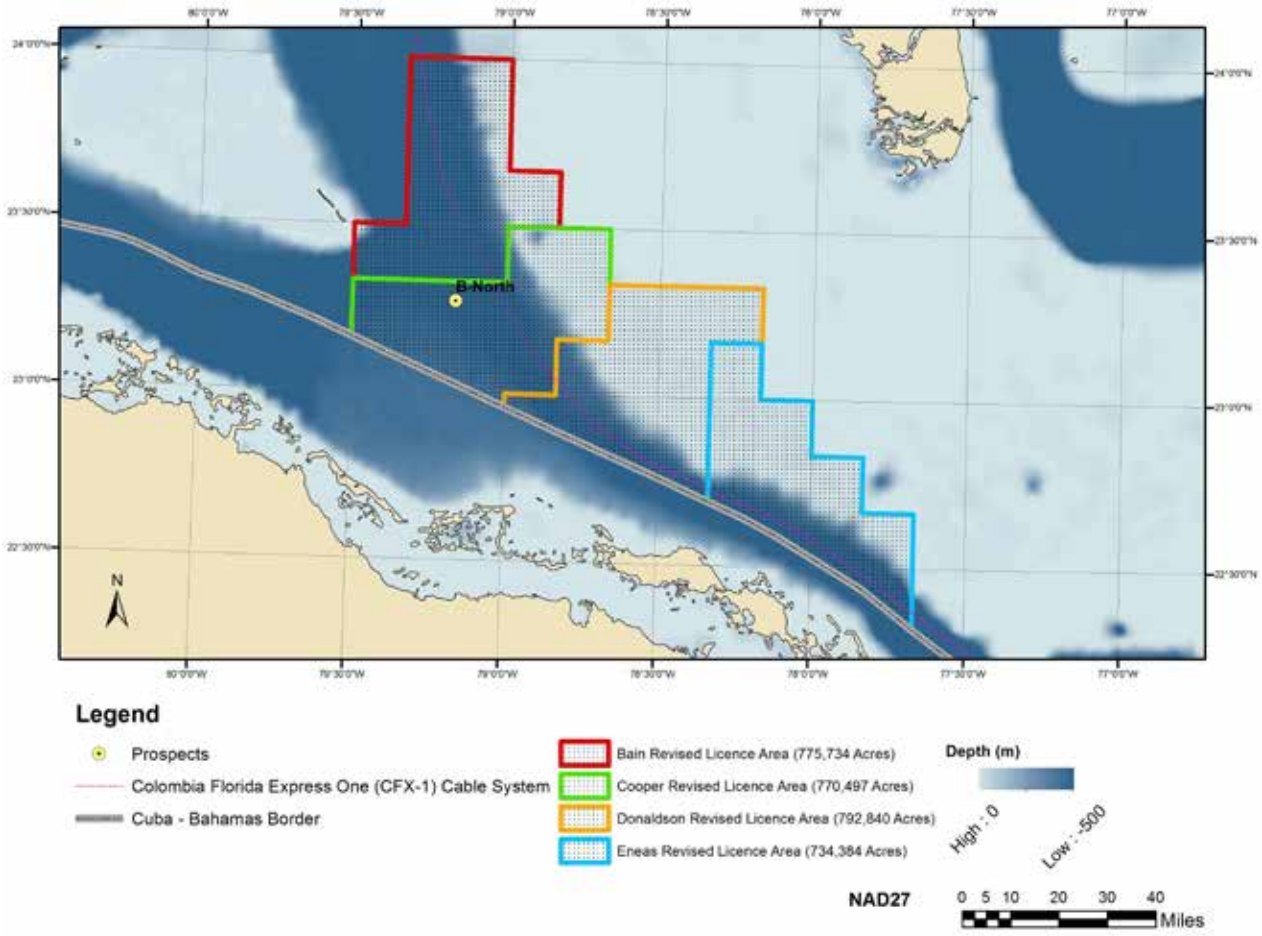

Figure 4-55: Subsea Cable in the Licence Blocks
Note: Approximate block boundaries shown in black
Source: NOAA, 2011. [141]

4.3.7 Archaeological and Historical Resources

In 1992, Captain Herbert Humphreys Jr. and the crew of the research vessel, Beacon recovered an elephant tusk form the circa 1543 shipwreck of the Bronze Cannon on the Great Bahama Bank[142].

[141] National Oceanic and Atmospheric Administration (NOAA). 2011. Modified from the NOAA website: http://www.charts.noaa.gov/OnLineViewer/11013.shtml
[142] www.spanishmainantiques.com

Figure 4-56: Elephant Tusk found on Bronze Cannon Shipwreck on the Great Bahama Bank

Source: Spanishmainantiques.com[143]

Artefacts of broken pottery, trade pipes, household goods, fashion accessories and toys have been collected over a decade (1989-present) from a naturally eroding segment of beach face due south of Forfar Field Station, leeward of Calabash Cay, South Blanket Sound in Andros. The collection consists of more than 1,500 pieces. Most of the artifacts appear to be of English origin, ranging in dates from 1780 to 1890. Investigations suggest that the site may have been a temporary trading centre and launch pad for the final leg of the American Civil War era blockade runners, utilized by the Confederacy, Great Britain and Androsians[144]. This area would not be impacted by the project as they are located on the east side of Andros Island away from the project site.

Lucayan (first known inhabitants of The Bahamas) skeletons and artifacts, including canoes, have been found in inland blue holes on Andros.

The Bimini Road, also referred to as the Bimini Wall, is an underwater rock formation that is 0.5 miles long near North Bimini. The Road is comprised of flat-laying limestone blocks of various shapes. There has been much debate amongst scientists and divers about the origin of these blocks. There is also debate about the age of this rock formation with estimates ranging from 1,900 to 3,500 years[145].

4.4 Cuba and Florida

Bahamas Petroleum Company's southern blocks are approximately 25 miles (40 km) from the Cuban shoreline and approximately 120 miles (195 km) from south-eastern coast of Florida, USA. Also, as described in Chapter 2, Bahamas Petroleum Company could potentially utilize a shore base in Louisiana, USA which would involve transportation of supply vessels between port and the drilling location(s) through the Gulf of Mexico. While the focus of this baseline remains the Bahamian coast adjacent to the Blocks, it is important to note that the Cuban and USA coasts could be affected (i.e. supply boat collision or oil spill).

[143] www.spanishmainantiques.com.

[144] An Investigation into the Origin, Historical and Sedimentological Significance of Archaeological Artifacts, South Blanket Sound, Andros Island, Bahamas. Abbie Wischmeyer and Lawrence A. Wiedman. University of Saint Francis. Proceedings of the 10th Symposium on the Natural History of The Bahamas. 2005

[145] Davaud, E. and A. Strasser.1984. Progradation, Cementation, Erosion, Recent Diagenetic and Sedimentary Evolution in a Carbonate Coastal Environment, Bimini, Bahamas. Eclogae Geologicae Helvetiae. Vol 77, No. 3, p. 449-468. 1984.

An overview of the coastal sensitivities of Cuba and Florida can be found below. See Sensitivity Mapping provided in EMP Appendix E, attachment D.

4.4.1 Beaches

White sand beaches and tourist hot spots can be found along much of the northern coast of Cuba adjacent to Bahamas Petroleum Company's blocks, including: Vardero Beach, Cayo Coco and Playa Santa Lucia.[146] [147]

Beaches also line the Florida coastline adjacent to the Blocks. Southern Florida beaches include Boca Raton, Pompano Beach, Miami Beach, Key Largo, Marathon, Key West, among others.[148]

In addition to tourism, the Cuban beaches south of the Eneas, Donaldson and Cooper blocks, and most of southern and eastern Florida Peninsula are important turtle nesting grounds (see Sensitivity Mapping provided in EMP Appendix E, attachment D).

4.4.2 Mangroves

Mangroves can be found consistently along the Cuban coastline south and southwest of Bahamas Petroleum Blocks, especially within the Cuban archipelagos (i.e. Archipelago de Sabana and Archipelago de Camaguey). Numerous protected areas with mangrove ecosystems are located in these archipelagos, including two Ramsar Wetlands of International Importance: Buenavista and Gran Humedal del Norte de Ciego de Ávila.[149] These areas are described further in Section 4.4.6.

Everglades National Park lies on the westward tip of the Florida Peninsula. This area contains the largest mangrove ecosystem in the western hemisphere and is a significant breeding ground for wading birds, reptiles and threatened species such as the manatee.[150]

4.4.3 Seagrass Beds

The distribution of seagrass beds is generally consistent with the distribution of mangroves. Seagrass beds are concentrated within the northern Cuba archipelagos, southwest of the Blocks, and throughout much of southern and south-western Florida (see Sensitivity Mapping provided in EMP Appendix E, attachment D).

4.4.4 Corals

A fringing coral reef runs along almost the entire northern coast of Cuba, including the areas adjacent to Bahamas Petroleum Company Blocks. Similarly, coral reefs are also found consistently from Ft. Lauderdale to Key West (see Sensitivity Mapping provided in EMP Appendix E, attachment D).

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[146] Destination 360. 2011. Accessed from the following website: http://www.destination360.com/caribbean/cuba/cuba-beaches-map

[147] Captivating Cuba. 2011. Accessed from the following website: http://www.captivatingcuba.com/cuba/top_five_beaches/index.html

[148] Destination 360. 2011. Accessed from the following website: http://www.destination360.com/north-america/us/florida/map-of-florida-beaches

[149] The Ramsar Convention on Wetlands. 2002. The Annotated Ramsar List: Cuba. Accessed from the following website: http://www.ramsar.org/cda/en/ramsar-pubs-annolist-anno-cuba/main/ramsar/1-30-168%5E16473_4000_0__

[150] United Nations Educational, Scientific and Cultural Organization. 2011. Everglades National Park. Accessed from the following website: http://whc.unesco.org/en/list/76

4.4.5 Blue Holes
Blue holes are present along the north side of Cuba; however, locations could not be identified.

4.4.6 Marine Life
The marine life in Florida and Cuba is expected to be similar as that described in Section 4.2.2 above.

The Cuban National Oil Spill Contingency Plan notes that in the Sabana-Camagüey archipelago, found on the adjacent coastline of Cuba approximately 25 miles (41 km) south of the Perseverance Well, that there are 88 species of macroalgae and seaweeds, 447 species of invertebrates and 374 reef-related species. [151]

Whitt et al. (2011) notes that there are "17 species of cetaceans (three baleen whales and 14 toothed whales), one sirenian species, four cetacean genera and one extinct pinniped species have a confirmed occurrence in Cuban waters. The common bottlenose dolphin (Tursiops truncates) and the West Indian manatee (Trichechus manatus) are the most common species with a total of 185 and 261 records, respectively. An additional 11 species of cetaceans and one extant pinniped species (hooded seal) have not been confirmed in Cuban waters but could potentially occur in the Study Area based on known distributions in the Caribbean Sea. Of these, the Blainville's beaked whale has not been documented in the Study Area, but records of this species are confirmed in the nearby Cayman Islands. In addition, the Minke whale is only documented near Cuba in the Old Bahama Channel just north of the EEZ boundary. The common dolphin and True's beaked whale are not documented in the Study Area and are not expected to occur in this region."

Green, hawksbill and loggerhead turtle nesting sites are found on the northern coast of Cuba and the eastern coast of Florida. Leatherback nesting habitat is found all along the eastern coast of Florida, but there have been no observations of leatherback nesting on the northern coast of Cuba. Figure 4-57 through Figure 4-60 provide regional maps of nesting habitat for these four marine turtle species.

[151] Government of Cuba. 2009. Cuban National Contingency Plan and Oil Spill Damage Prevention (Response Measures for Disaster Mitigation Plan).

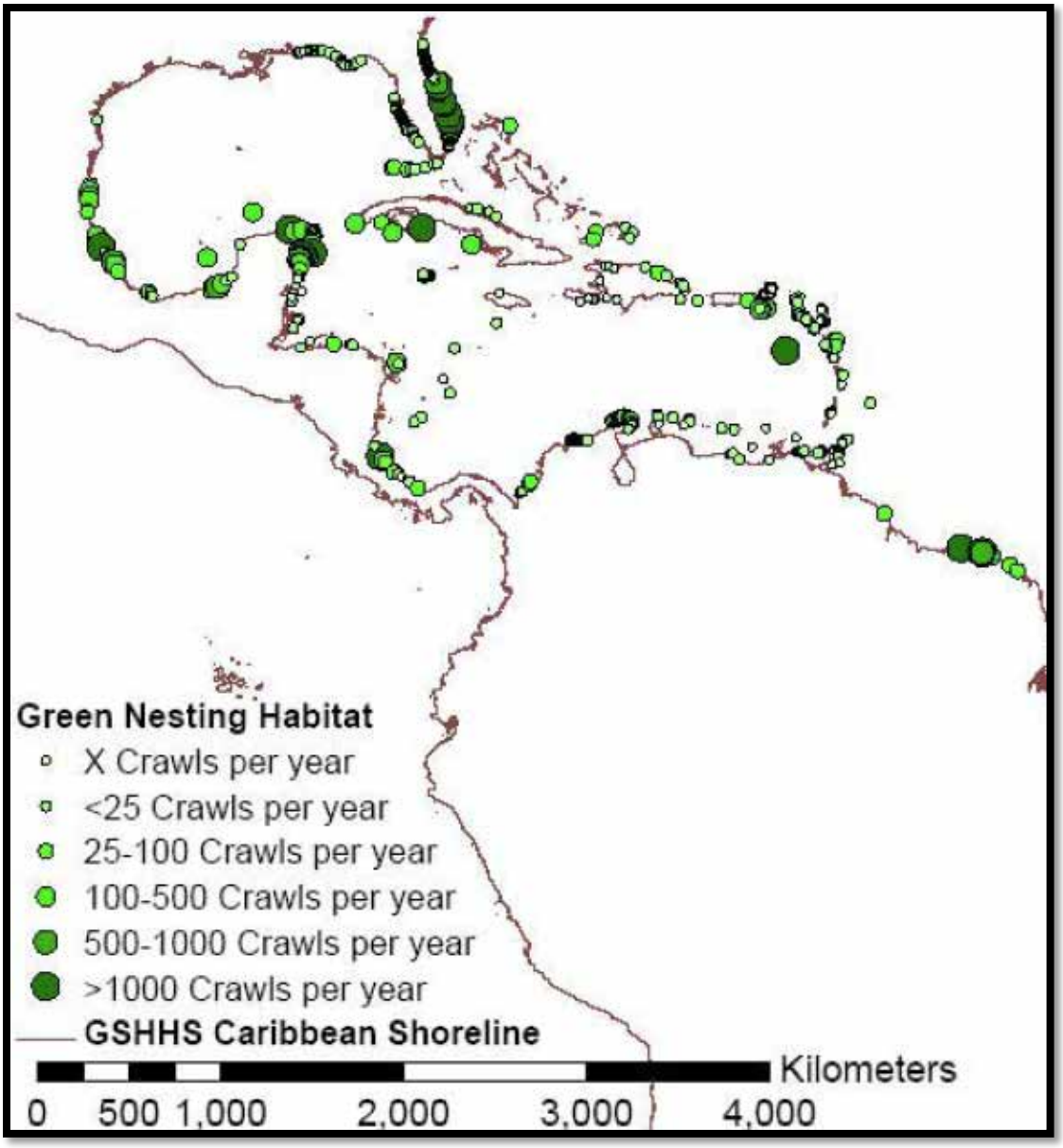

Figure 4-57: Green Turtle Nesting Sites in the Caribbean
Source: Dow, et al., 2007

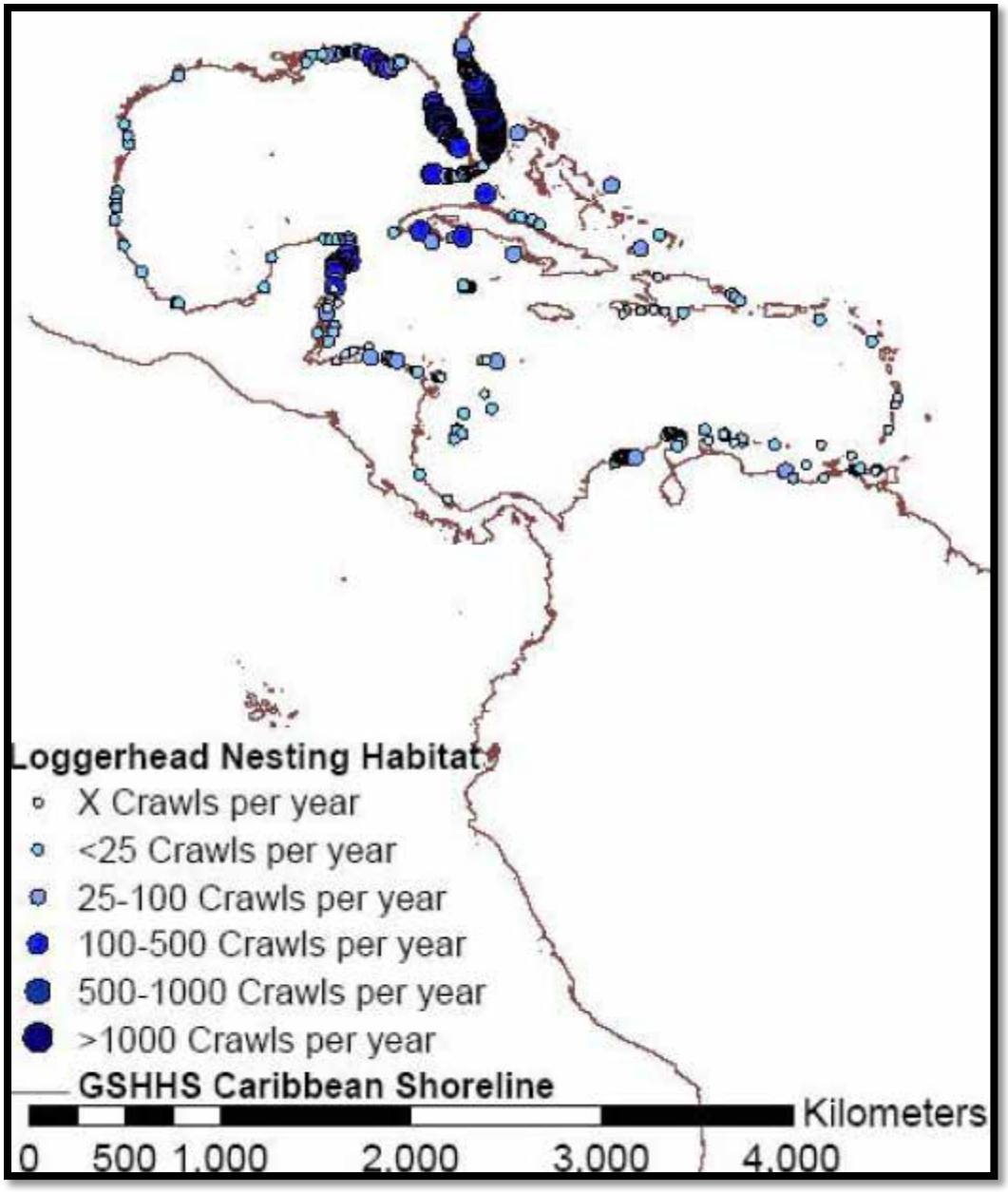

Figure 4-58: Loggerhead Nesting Sites in the Caribbean
Source: Dow, et al., 2007

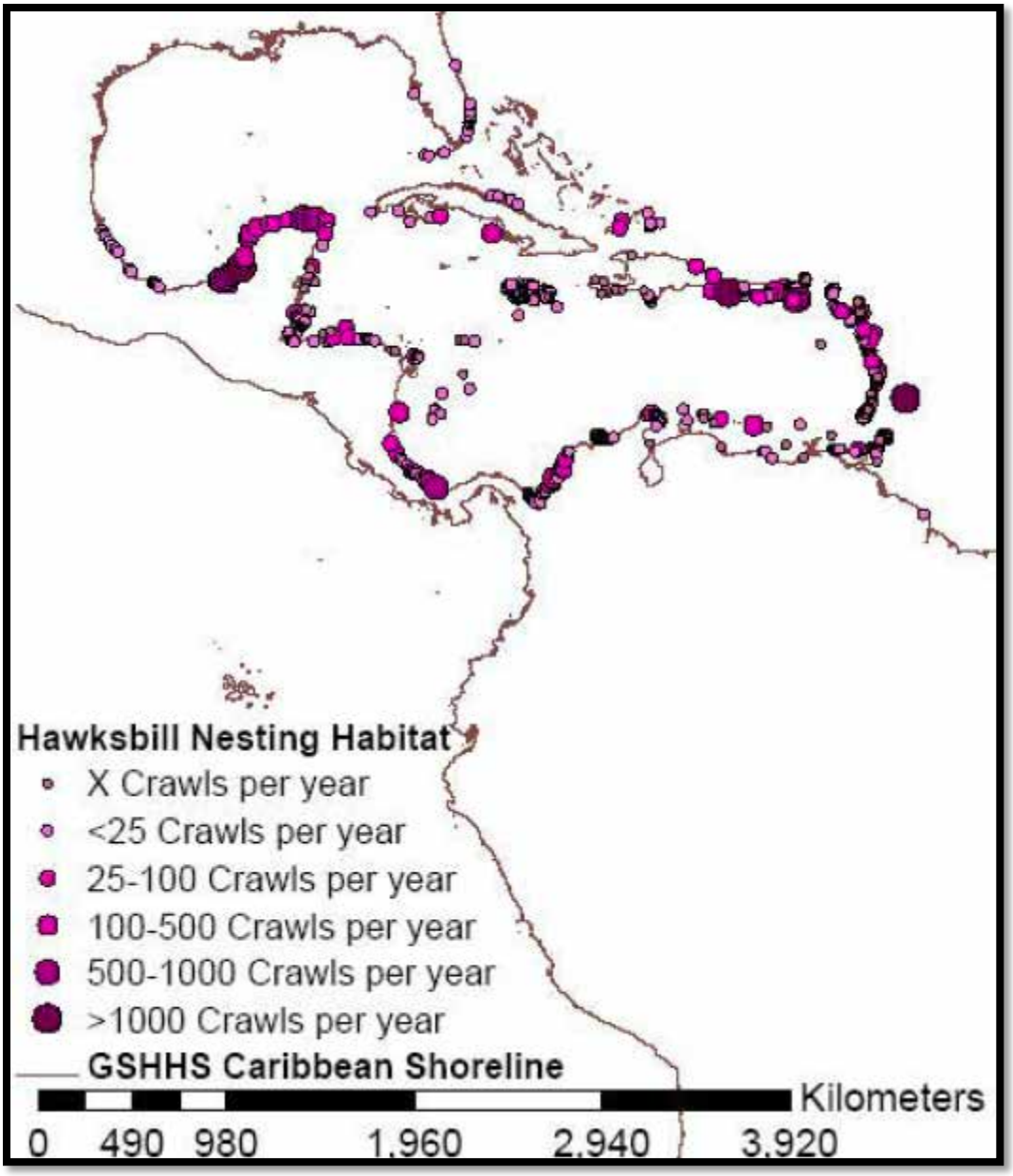

Figure 4-59: Hawksbill Nesting Sites in the Caribbean
Source: Dow, et al., 2007

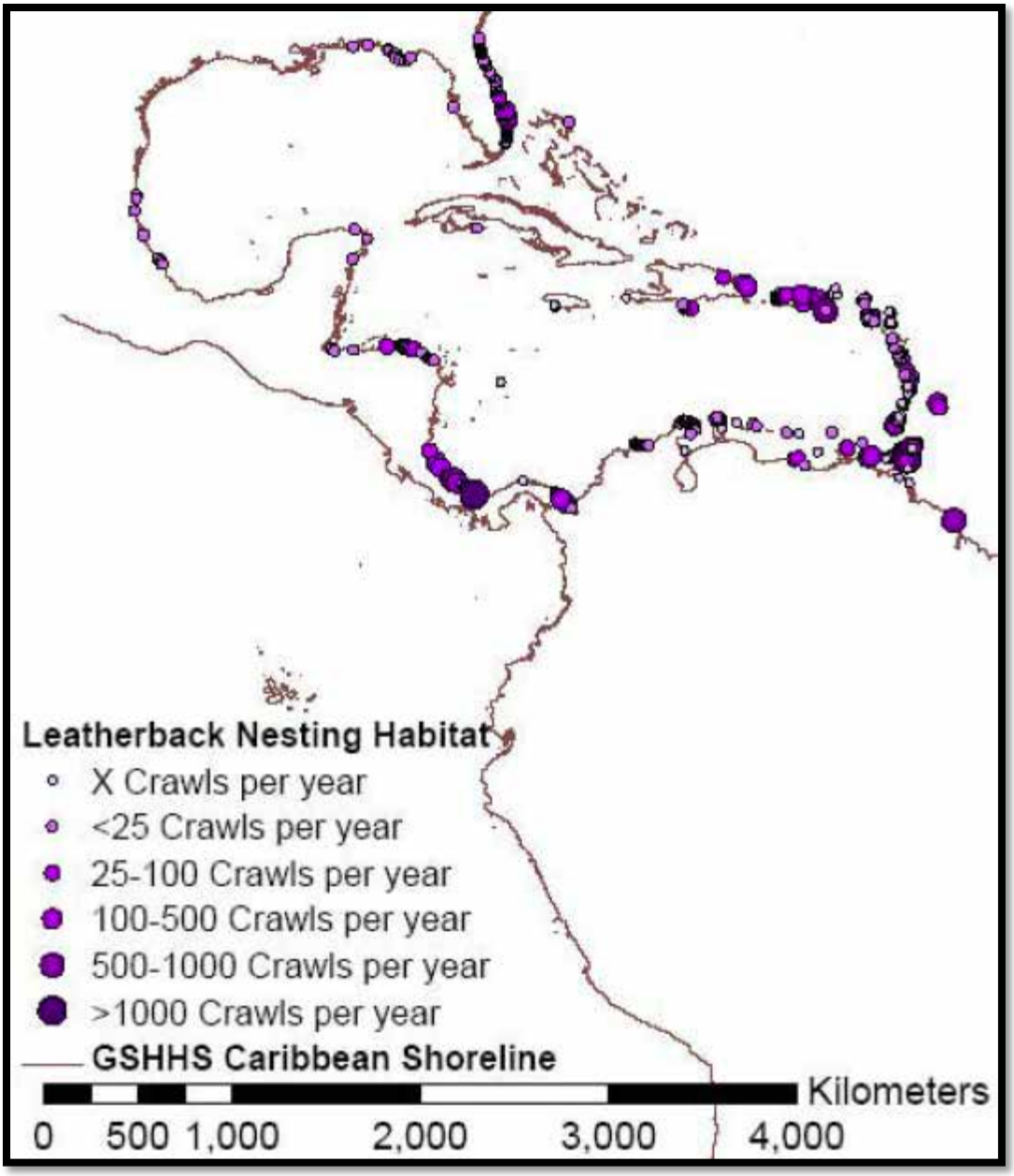

Figure 4-60: Leatherback Nesting Sites in the Caribbean
Source: Dow, et al., 2007

4.4.7 Protected and Sensitive Areas in Cuba and Southern Florida

There are a number of protected and sensitive areas located within the vicinity of the project site in Cuba and Florida, as shown in Figure 4-61.

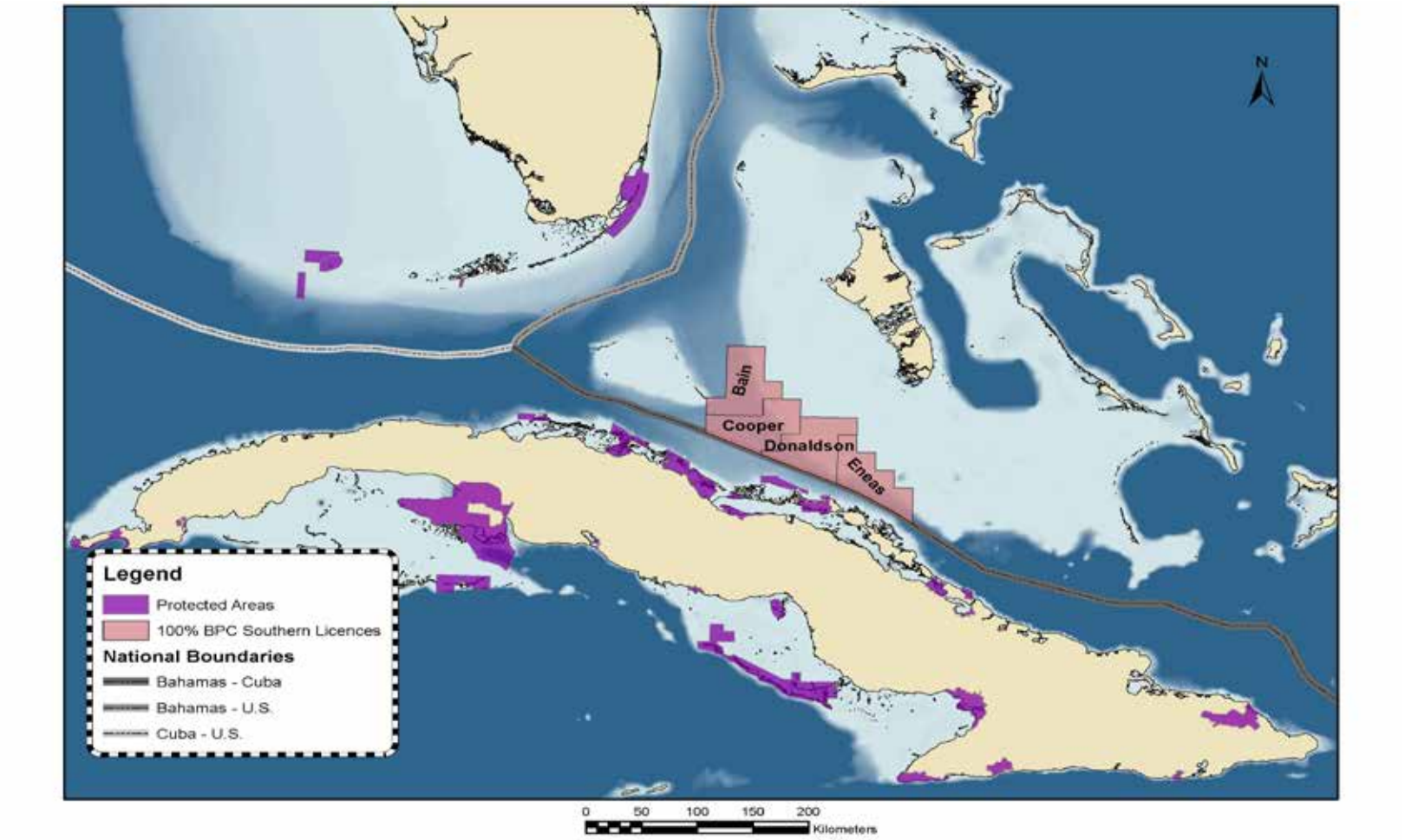

Figure 4-61: Protected Areas in Cuba and Florida Adjacent to the Project Area
Note: Approximate block boundaries shown in black
Source: Adapted from UNEP, 2011[152]

[152] UNEP. 2011. World Data Base on Protected Areas. Accessed from the Protectedplanet website: www.protectedplanet.net

In 1959, the first proposal was made for a national system of protected areas (Sistema Nacional de Areas Protegidas, SNAP) in Cuba. Created in 1995, the Centro Nacional de Areas Protegidas (CNAP) is responsible for the planning and management of the overall national system of protected areas. The system currently consists of 105 protected areas and there are 253 proposed areas. Threats to protected areas in Cuba include habitat destruction and degradation, hunting, invasive species, illegal trade in plants and animals, and pollution.

Cuba's network of 28 Important Bird Areas (IBAs) have been created to protect 69 key bird species including 24 threatened species, 11 restricted-range species, 48-biome-restricted species and 16 congregatory waterbird and seabird species. Key IBAs along the northern coast of Cuba in closest proximity (approximately 25 miles) to the blocks:

- **Las Picua – Cayo del Cristo (CU007)** – This IBA is located in the Sabana-Camaguey Archipelago. These cays and islets are characterized by a muddy-sandy substrate, and are dominated by mangrove forests and dunes with associated shrubby vegetation. The administrative centre of the IBA is in the coastal town of Carahatas, with around 666 residents who mostly work in fishing through a state fishery cooperative, but also in agriculture and cattle farming.[153] Birdlife International (2020) notes that this IBA "supports globally significant breeding colonies of Caribbean Flamingo (*Phoenicopterus ruber)*, Glossy Ibis (*Plegadis falcinellus)* and the Vulnerable West Indian Whistling-duck (*Dendrocygna arborea)*. It represents an important waterbird site with 46 species nesting including herons, ibises, spoonbills, cormorants, and pelicans. More than 17 waterbird species roost communally on several of cays and islets. The Near Threatened White-crowned Pigeon Patagioenas leucocephala breeds in the IBA."

- **Cayeria Centro-Oriental de Villa Clara** (**CU008)** – This IBA is located in the Sabana-Camaguey Archipelago. It supports globally significant breeding colonies of Laughing Gull (*Larus atricilla*) and Royal Tern (*Sterna maxima*). It is also a wintering site for the near threatened Piping Plover (*Charadrius melodus*). This area is also designated as a wildlife refuge, national park and biosphere reserve. The critically endangered eared hutia (*Mesocapromys auritis*) is endemic to a cay within this IBA. The most diverse coral reef of the Sabana-Camaguey Archipelago is also found here.

- **Gran Humedal del Norte Ciego de Avila** (**CU012)** – This IBA is located in the northeastern portion of Ciego de Avila province. It supports globally significant populations of West Indian Whistling Duck, Piping Plover and the near threatened Sandhill Crane (*Grus Canadensis nesiotes*). The endangered Cuban Sparrow (*Torreornis inexpectata varonai*) is an endemic species found here. This area is also designated as an ecological reserve, wildlife refuge and Ramsar site. It provides habitat for the vulnerable American crocodile (*Crocodylus acutus*) as well as hutia and the Cuban ground iguana.

- **Cayos Romano-Cruz-Megano Grande** (**CU015)** – This IBA is located at the eastern end of the Sabana-Camaguey Archipelago off the north coast of the Cuban mainland. It supports a great diversity and density of waterbirds, including the Roseate Spoonbill (*Platalea ajaja*) and White Ibis (*Eudocimus albus*). This area is also designated as a managed resource protected area and faunal refuge. It provides habitat for an endemic snail and 151 Cuban endemic plants of which 23 are threatened.

[153] Birdlife International. 2020. Las Picuas - Del Cristo Cay. Accessed from the following website: http://datazone.birdlife.org/site/factsheet/las-picuas--del-cristo-cay-iba-cuba

Protected areas on the Cuban coastline closest to the Blocks (approximately 25 miles south) are shown in Figure 4-63 and Figure 4-64. The protected areas in this region include two RAMSAR Wetlands of International Importance:

- Humedal del Norte de Ciego de Ávila
- Buenavista (Also a United Nations Educational, Scientific and Cultural Organization (UNESCO) Man and the Biosphere Reserve)

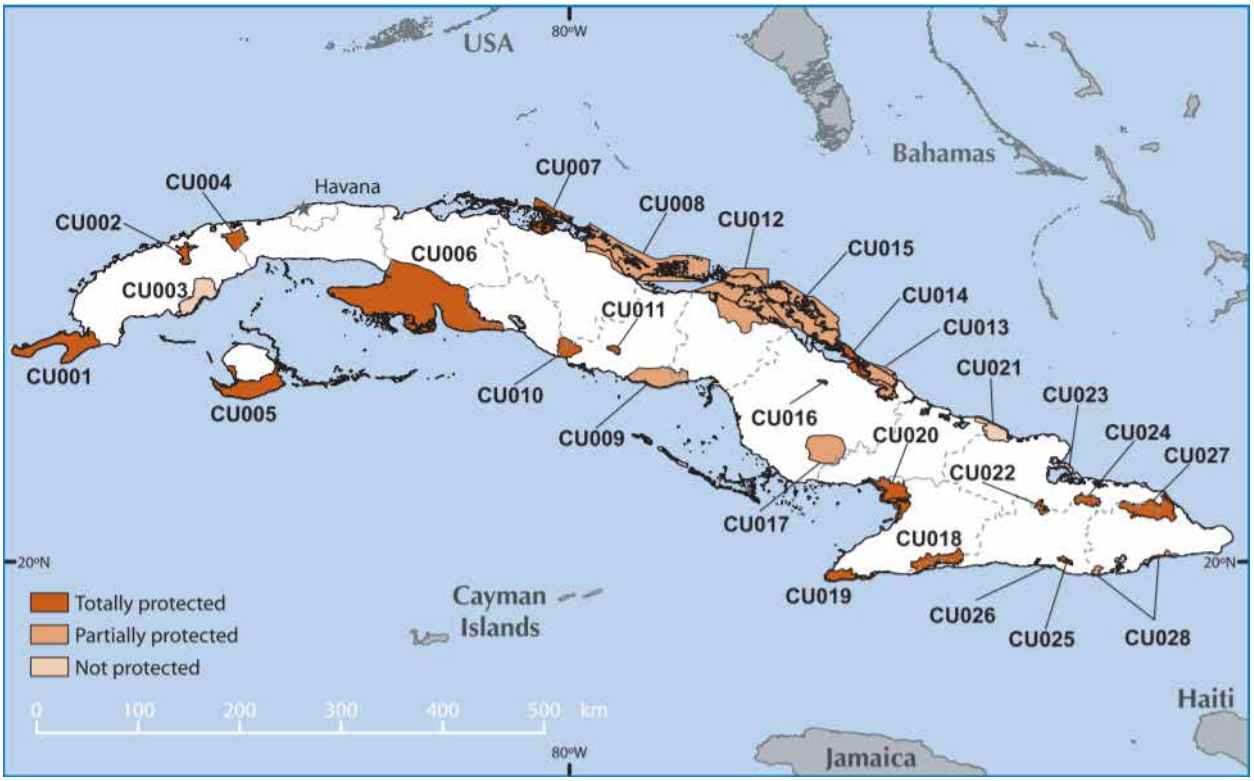

Figure 4-62: Important Bird Areas in Cuba
Source: Mugica, 2009[154]

[154] AGUILAR MUGICA, S. 2009. Cuba. Pp 157 –164 in C. Devenish, D. F. Díaz Fernández, R. P. Clay, I. Davidson & I. Yépez Zabala Eds. Important Bird Areas Americas - Priority sites for biodiversity conservation. Quito, Ecuador: BirdLife International (BirdLife Conservation Series No. 16)

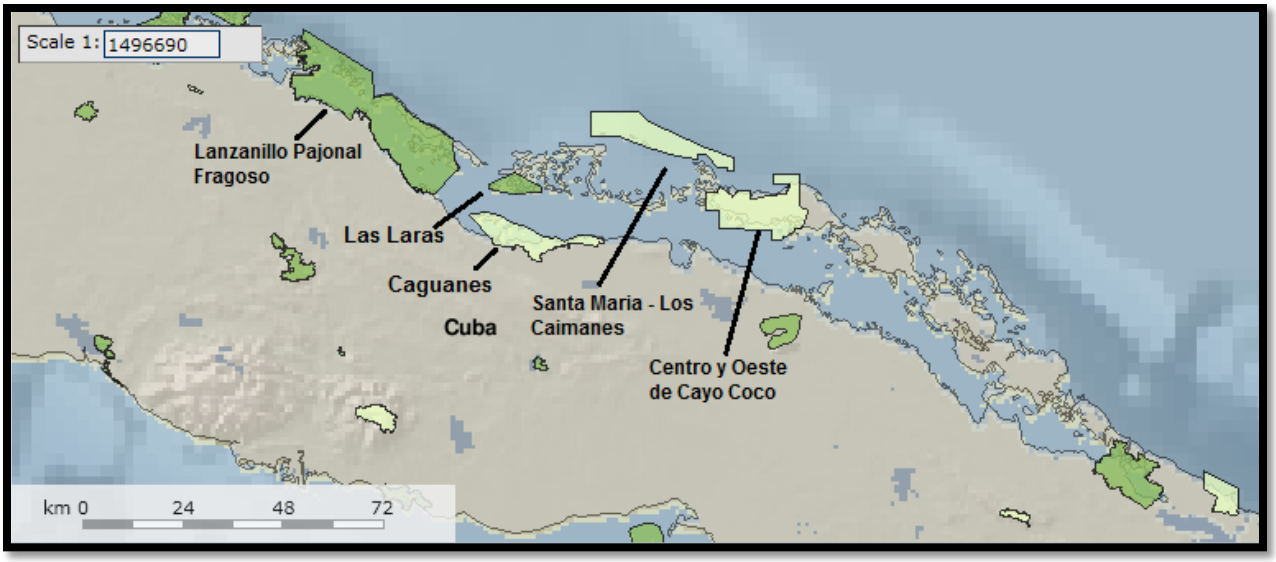

Figure 4-63: Protected Areas (IUCN Category I-IV) on the Central Cuban Coast South of the Blocks

Note: Categories I-II in light green, Categories III- IV in dark green
Source: Adapted from IUCN/Birdlife International/ Conservation International/UNEP/WCMC, 2011

Figure 4-64: Protected Areas (IUCN Category V-VI) on the Central Cuban Coast South of the Blocks

Note: Categories V-VI in dark green, Category "unknown" cross-hatched
Source: Adapted from IUCN/Birdlife International/ Conservation International/UNEP/WCMC, 2011

Both Buena Vista and Humedales del Norte de Ciego de Avila are RAMSAR Wetlands of International Importance.

The south-eastern coast of Florida and Florida Keys are within the area of influence for the project. Important protected and sensitive areas for Florida are described below.

Protected and Sensitive Areas in Southern Florida include:

· **Florida Keys National Marine Sanctuary**[155]

Designated on November 16, 1990, this Sanctuary is one of 14 marine protected areas that comprise the US National Marine Sanctuary System. Administered by NOAA and jointly managed with the State of Florida, Florida Keys National Marine Sanctuary protected 2,900 square nautical miles of ocean surrounding the Florida Keys. It runs south of Miami westward to encompass the Dry Tortugas, but excludes the Dry Tortugas National Park. The shoreward boundary of the Sanctuary is the mean high water mark. Nationally significant marine resources protected here include a barrier reef, extensive seagrass beds, mangrove-fringed islands and more than 6,000 species of marine organisms. Historical artifacts including shipwrecks and treasures are also found in the Sanctuary.

The Sanctuary is divided into five types of marine zones – ecological reserve, sanctuary preservation areas, wildlife management areas, existing management areas and special use areas. This zoning enables protection and preservation of highly sensitive parts of the Sanctuary while allowing activities, like swimming and snorkeling, which are compatible with resource protection.

· **Biscayne National Park**[156]

Biscayne National Park is 172,000 acres, consisting of four primary ecosystems – mangrove forest, Biscayne Bay, northernmost island of the Florida Cays and a portion of a barrier reef. The Park is home to many threatened and endangered species. Threatened species include including the Eastern indigo snake (*Drymarchon corais couperi*), staghorn coral (*Acropora cervicornis*) and loggerhead turtle (*Caretta caretta*). Endangered species include the Schaus' swallowtail butterfly (*Heraclides aristodemus ponceanus*), Key Largo woodrat (*Neotoma floridana smalli*), smalltooth sawfish (*Pristis pectinata*) and Kemp's ridley turtle (*Lepidochlys kempii*).

· **Dry Tortugas National Park**[157]

Almost 70 miles west of Key West lay a cluster of seven islands called the Dry Torgtugas. These islands along with the surrounding shoals and waters as well as coral reefs and sandy beaches comprise the Dry Tortugas National Park. The coral and seagrass communities are among the most vibrant in the Florida Keys. The Sooty Tern (*Sterna anaethetus*) finds its only regular nesting site in the United States in this Park. Large sea turtles nest on the Park's protected beaches. Threatened species found here include the elkhorn coral (*Acropora palmata*), Loggerhead turtle (*Caretta caretta*), Roseate Tern (*Sterna dougallii dougallii*) and Piping Plover (*Charadrius melodus*). Endangered species found in the Park include West Indian manatee (*Trichechus manatus*), Green turtle (*Chelonia mydas*), Leatherback turtle (*Dermochelys coriacea*) and Humpback whale (*Megaptera novaeangliae*).

A Research Natural Area (RNA) was established in the Park in 2007. It is a 46-square mile no-take, no-anchor ecological preserve for species affected by fishing and loss of habitat, including grouper, snapper and grunts. The RNA provides opportunities for boaters, divers, snorkelers and researchers to explore and study this area.

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[155] National Park Service, U.S. Department of the Interior. 2011. Accessed from the USDOI website: www.floridakeys.noaa.gov

[156] National Park Service, U.S. Department of the Interior. 2010. Accessed from the USDOI website: www.nps.gov/bisc.

[157] National Park Service, U.S. Department of the Interior. 2010. Accessed from the USDOI website: www.nps.gov/drto.

- **Everglades National Park**[158]

Established in 1947, the Everglades National Park is 1.5 million acres of diverse habitat. The boundaries of the Park comprise one-fifth of the entire Everglades ecosystem. The Park is also designated as a World Heritage Site, International Biosphere Reserve and Wetland of International Importance under the Ramsar Convention. Habitats found in the Park include pineland, mangroves, freshwater marl prairie and cypress. Threatened species found here include the Arctic Peregrine Falcon (*Falco peregrinus tundrius*) and American alligator (*Alligator mississippiensis*). Engendered species found in the Park include Snail Kite (*Rostrhamus sociabilis*), Florida panther (*Felis concolor coryi*) and Hawksbill turtle (*Eretmochelys imbricata*).

The Florida Keys Complex[159] consists of four wildlife refuges – National Key Deer, Crocodile Lake, Great White Heron and Key West. The Complex covers more than 416,000 acres of land and open water, protecting 22 federally listed threatened and endangered species as well as other native wildlife.

Other protected areas within the project's area of influence include:

- **Big Cypress National Preserve**[160]

This 720,000-acre site was established as a National Preserve in 1974. It borders the Everglades National Park and was created to protect the water quality, natural resources and ecological integrity of the Big Cypress Swamp. The Reserve is dominated by a wet cypress forest and hosts an array of flora and fauna including the endangered Florida Sandhill Crane (*Grus canadensis pratensis*).

- **Canaveral National Seashore**[161]

Situated on a barrier island, Canaveral National Seashore is 24 miles of the longest stretch of undeveloped public beach on the east coast of Florida. Over one million people visit this park every year. Threatened and endangered species that are protected here include the Loggerhead turtle (*Caretta caretta*), Bald Eagle (*Haliaeetus luchocephalus leucocephalus*) and Right whale (*Balaena glacialis*). Adjacent to the Merritt Island National Wildlife Refuge, both areas combine to offer important habitat for water and wetland-dependent bird species including the endangered wood stork (*Mycteria americana*) and Florida scrub jay (*Aphelocoma coerulescens*).

Other National Wildlife Refuges in Florida's southeast region include St. John's, Archie Carr, Pelican Island, Hobe Sound, and Loxahatchee.

[158] National Park Service, U.S. Department of the Interior. Accessed from the USDOI website: www.nps.gov/ever. 2011

[159] U.S. Fish & Wildlife Service. 2002. Florida Keys National Wildlife Refuges. Accessed from the USFWS website: www.fws.gov/southeast/pubs/nkdgen.pdf.

[160] National Park Service, U.S. Department of the Interior. 2011. Accessed from the USDOI website: http://www.nps.gov/bicy/index.htm. 2011.

[161] National Park Service, U.S. Department of the Interior. 2011.

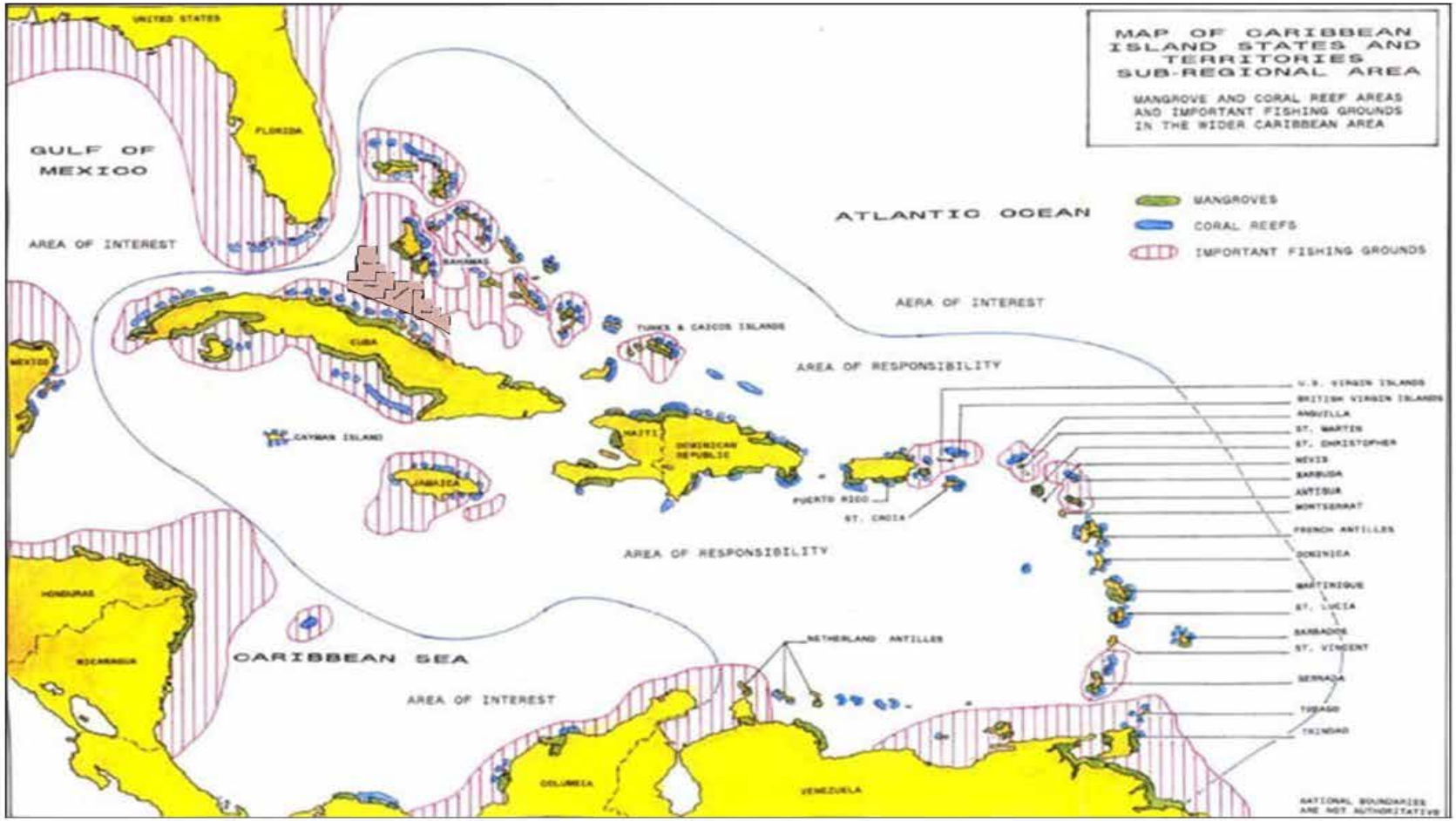

Figure 4-65: Sensitivity Map
Source: UNEP, 2009[162]

[162] United Nations Environment Program (UNEP), Regional Activity Center / Regional Marine Pollution Emergency Information and Training Center- Wider Caribbean Region. 2009. Caribbean Island Oil Pollution Response and Cooperation Plan.

4.4.8 Socioeconomic Conditions

In the Sabana-Camagüey archipelago, approximately 25 miles (41 km) south of the drill site there are many sites important for tourism and the Cuban economy, with more than 14,500 rooms in development.[163] Santa Lucía, Cayo Santa María and Cayo Coco have tourism infrastructure in place that are vulnerable to spills.

The Cuban maritime waters are very rich in species; however, they are characterized by the low abundance of their fishing resources. The fisheries and aquaculture sector of Cuba is an important contributor to food security, (providing 5.5 kg per year per capita in 2011), to economic benefits (with exports and imports of fishery products estimated at 71 and USD 25 million respectively in 2013), and social benefits (7,480 direct jobs in 2013).[164] FAO notes that in 2013 there were a total of 700 vessels in the fishing fleet, with more than half motorized, though the total capture was less than 10% of its peak in 1986 (Figure 4-66).

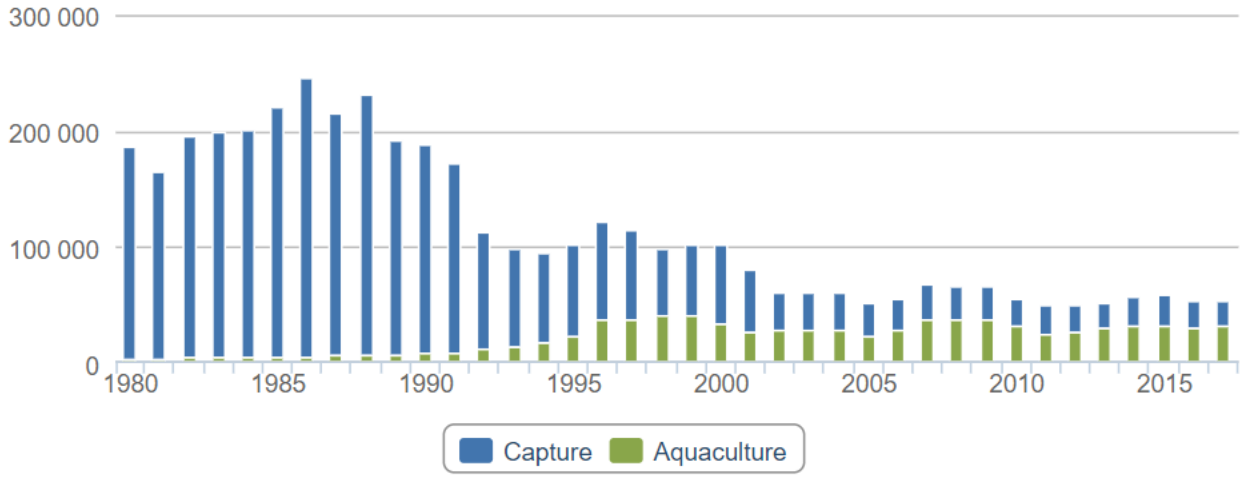

Figure 4-66: Total Production of Fish Capture and Aquaculture in Cuba
Source: FAO, 2015

The largest landings of fish are made in the south of the country for lobster and shrimp, while fish is mainly caught and landed in the south and northeast. The main landing nearest the project is Carahatas. Fishing is conducted using a variety of gear, depending on the species.

As noted in Section 4.3.5, there is a large shipping lane between the drill site and the Cuban coast.

NOAA notes "The most important industry in Monroe County/Florida Keys is the recreation-tourism industry. Recreation-tourism accounts for anywhere between 33% and 75% of the local economy depending on the definition of income (i.e., by place of residence or by place of work)."[165] Commercial fishing is also one of the key export industries in Monroe County/Florida Keys, accounting for between 5-8% of the total income or jobs in the local economy. Both of

[163] Government of Cuba. 2009. Cuban National Contingency Plan and Oil Spill Damage Prevention (Response Measures for Disaster Mitigation Plan).
[164] FAO. 2015. Profiles on fisheries and aquaculture by countries: The Republic of Cuba.
[165] NOAA. 2020. Socioeconomic Research & Monitoring Program for Florida Keys. https://sanctuaries.noaa.gov/science/socioeconomic/floridakeys/

these activities are highly dependent on services provided by the local ecosystem (e.g. beaches and fishing).

4.5 Data Gaps

To properly evaluate the quality and quantity of existing information and to subsequently identify potential data gaps for the physical/chemical, biological, and socioeconomic environment for the study area, a data evaluation process was conducted. The EIA focused on the environmental and social conditions of The Bahamas, and while an overview of environmental and socioeconomic conditions in Cuba and the US is provided, these sections are not exhaustive. Information on Cuba, particularly socioeconomic data, were difficult to obtain. Further, many of the resources were out of date.

None of these gaps represented a great enough impediment to prevent the EIA team from performing a reasonable evaluation of potential project impacts or proposing appropriate mitigation measures to address the potential impacts identified for the drilling program.

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5. Impact Identification and Evaluation

Chapter 2 of this EIA described the proposed activities to be performed during Bahamas Petroleum Company's exploratory drilling program offshore The Bahamas in the Bain, Cooper, Donaldson and Eneas Blocks. Chapter 4 presented relevant aspects of the existing physical, biological and socioeconomic environment in the study area and specific sensitivities in the area. This chapter considers the potential impacts the proposed activities could have on the existing environment. Specifically, this chapter describes the following:

5.1 Methodology
5.2 Sources of Impact
5.3 Identification of Potential Impacts
5.4 Evaluation of Potential Impacts
5.5 Data Gaps and Uncertainties

In the specific case of this project the following factors should be taken into consideration:

- The project is an exploratory activity;
- The first well, Perseverance #1, will be drilled in the Cooper Block during the first quarter, 2020 (subsequent well locations are still being planned);
- The duration of the drilling activity is temporary (40-60 days);
- The designated shore base will be Port Fourchon, Louisiana;
- Workers will crew change out of Miami Executive Airport in Florida; and,
- The geographical scope of this EIA is limited to drilling activities located beyond the 300 m bathymetric line, away from mangroves, seagrass beds and coral reefs and no activities are planned closer to shore.

5.1 Methodology

5.1.1 Analysis of Impacts

To identify potential impacts, the EIA team used a methodology that incorporates lessons learned and oil and gas industry best practices from sources such as the International Petroleum Industry Environmental Conservation Association (IPIECA) and the International Finance Corporation (IFC). This methodology has been applied consistently by the EIA Team on >50 oil and gas exploration program EIAs worldwide and is based on a two-tier impact screening process, as shown in Figure 5-1, that:

1) Evaluates all hypothetical impacts for oil & gas projects, then
2) Evaluates potential impacts that are only applicable to the proposed project.

5.1.1.1 Tier 1 - Evaluation of Hypothetical Impacts

Tier 1 screening evaluation commenced with consideration of a wide range of hypothetical impacts that may be faced by the oil and gas industry in various offshore exploration and production programs. The range of hypothetical impacts considered is based on the experience of the EIA team as well as a variety of oil and gas industry guidelines. Using this list, the Project Team applied a set of simple criteria and/or questions to distinguish possible impacts related to the specific activities proposed from the global list of hypothetical impacts. Criteria-based screening questions used for this first-tier screening evaluation were:

- Are there sensitive resources relative to a hypothetical impact present in or around the study area? (For example, are there archaeological resources present?)
- Could the proposed activities reasonably have any influence in altering the present state (positively or negatively, and directly or indirectly) of conditions relative to the hypothetical

impact? (For example, could the proposed activities result in any change to socioeconomic conditions in communities along the coast?)

- Could the proposed activities reasonably be impacted by the conditions in the affected environment that may represent hazards? (For example, could severe weather conditions influence the project activities or other possible impact areas, such as increasing a risk of water quality or ecological damage from an oil spill?)

Having evaluated the global list and considered other possible impacts to physical, biological and/or socioeconomic conditions, based on the team's experience in evaluating offshore exploration and production programs, a list of possible impacts was determined. These are reported in Section 5.3.

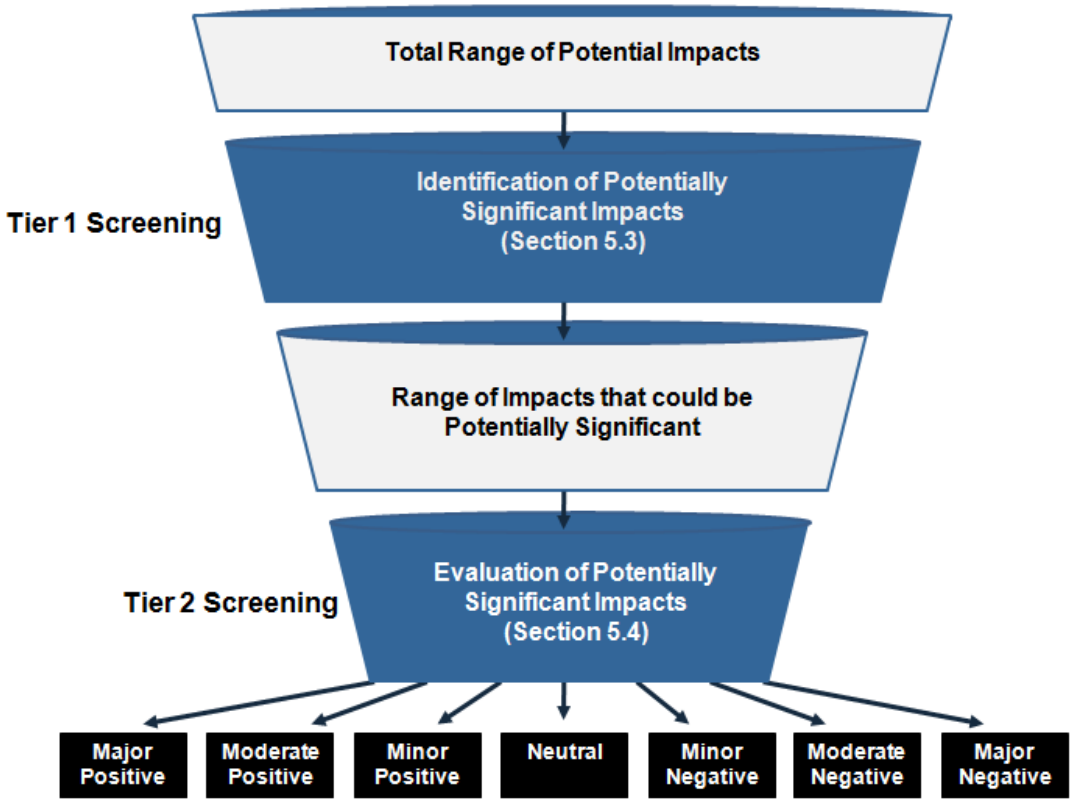

Figure 5-1: Impact Screening Technique Using 2-Tier Significance Criteria

5.1.1.2 Tier 2 - Evaluation of Potential Impacts

Once the Tier 1 screening was complete, a series of more specific (Tier 2) impact significance criteria were used to evaluate the severity and likelihood of the possible impacts and to characterize them in terms of the type of impacts expected. This Tier 2 evaluation took into consideration:

- Nature of the impact: an evaluation of the interaction with the impacted receptor (evaluation described for each impact in Section 5.4)
- Intensity: an evaluation of the reversibility of the impact
  - Reversible impacts are temporary and the affected resource (i.e. marine fauna, water quality, etc.) is expected to return to pre-impact conditions within three to five years

    - Irreversible impacts have permanent affects (i.e. destruction of submerged archaeological resources) that will not return to pre-impact conditions for an extended period (>five years), if ever
- Scope: an evaluation of the physical extent of the impact
    - Localized impacts are limited to a small, defined area (i.e. generally within 1 kilometre of the drill site or supply vessel)
    - Dispersed impacts affect widespread areas, the extent of which are potentially unknown (i.e. in the event of a large oil spill)
- Duration: an evaluation of the length of the impact
    - Short-term impacts are either non-continuous or last up to approximately four to six months
    - Medium-term impacts last approximately six months to approximately one or two years
    - Long-term impacts last longer than two years
- Likelihood: an evaluation of how probable the impact is for the proposed activities (likelihood criteria are defined in Table 5-2)

Based on an evaluation of the nature, intensity, scope and duration of impact, an overall consequence level was assigned. Significance criteria used to evaluate the possible impacts in Tier 2 are listed in Table 5-1, and criteria used to rate the likelihood of those impacts occurring in this project are presented in Table 5-2.

The evaluation of potential impacts is reported in Section 5.4, including a discussion of the potential cumulative and transboundary impacts.

Table 5-1: Impact Significance Criteria

Consequence Level	Significance Criteria
Major (3)	Widespread modification of extraordinary severity in seabed or marine life forms or economic resources (e.g., fishing), lasting more than one year
Moderate (2)	Local modification of measurable severity in seabed forms or marine life forms or economic resources, lasting from a few months to up to one year before recovery; or more widespread modification of lesser severity.
Minor (1)	Localized, relatively isolated change in physical environment or economic resources, lasting only a few days to a few months before recovery, with no observable residual effects; impacts less significant than exerted by nature.
Negligible (0)	Little or no change in physical environment; conditions consistent with background conditions.

Table 5-2: Impact Likelihood Criteria

Likelihood Level	Significance Criteria
Probable (3)	Impact or event can reasonably be expected to result from project, occurs routinely in similar operations.
Occasional (2)	The impact or event has occurred in similar operations in this country/region, or conditions could allow the impact/event to occur in the program.
Seldom (1)	The impact or event has occurred once or twice in the industry (worldwide), but conditions in this program are unlikely to allow the impact/event to occur.
Improbable (0)	The impact or event has never occurred.

Using a standard, semi-quantitative assessment technique, the team applied a matrix to rate the overall impact significance by comparing the severity ranking with the likelihood ranking. This matrix is presented in Figure 5-2. This methodology allows the partitioning of the potential impacts by impact categories: high, medium and low. These categorizations facilitate the identification of the proposed activities that are likely to generate significant impact and the environmental elements that could be most affected. As shown in Figure 5-2, each impact category has distinct environmental management requirements, with:

- High: requiring alternative approach/design and mitigation to minimize potential impacts;
- Medium: requiring mitigation; and
- Low: requiring no mitigation other than common safeguards but acknowledging that the Project Team still needs to proceed with care.

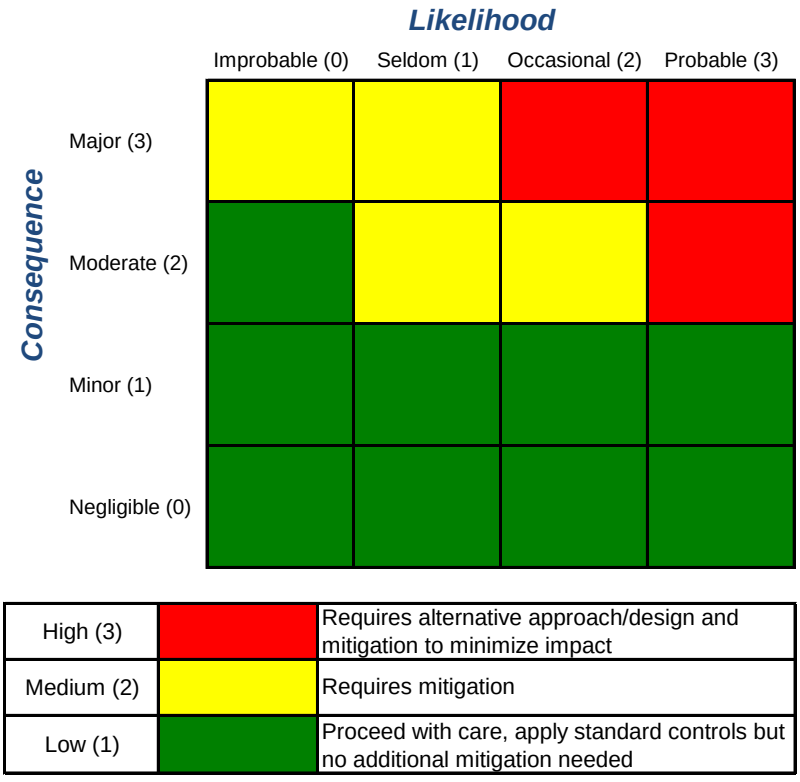

Figure 5-2: Impact Evaluation Matrix

Results of the Tier 2 impact evaluation are presented in Section 5.4 and environmental management and mitigation requirements are detailed in Chapter 6.

5.2 Sources of Impact

Chapter 2 described the activities proposed as part of the exploratory drilling program. These activities are defined according to the following phases of the program:

1. Mobilization and Rigging-up
2. Drilling
3. Decommissioning and Abandonment

In addition, there are activities that occur in each of the above phases that can be discussed together for the purposes of evaluating potential impacts. For example, the generation, grinding, and discharge of food waste will occur throughout all Project phases. These types of activities are categorized and discussed in Phases 4 and 5, rather than being repeated throughout all phases. Phases 4 and 5 are:

4. Vessel operations
5. Ancillary activities (aspects of the design and preoperational phases that could cause potential impacts, such as purchasing goods and services)

Analysis of the work proposed in each of these program elements reveals specific activities that could result in impacts. These activities, referred to as potential "sources of impact" (also known as "aspects" or "factors"), are highlighted in Sections 5.2.1 – 5.2.5 below.

Please refer to Chapter 2 for a detailed description of all proposed activities.

5.2.1 Mobilization and Rigging-up (Phase 1)

Potential sources of impact identified in this phase are:

A. Loading fuel and other materials onto the drilling rig
B. Attaching transponders to the sea floor

Additionally, there are recurrent activities listed under "Vessel Operations" and "Ancillary Activities" below.

5.2.2 Drilling (Phase 2)

Potential sources of impact identified in this phase are:

A. Operation of the drilling rig
B. Storage and use of potentially hazardous materials
C. Use and consumption of natural resources (fuel, sea water, fresh water, etc.)
D. Penetration of and drilling through the seafloor
E. Generation and disposal of drill cuttings and fluids
F. Generation of air emissions
G. Generation of noise
H. Generation of vibration
I. Generation of light source
J. Physical presence of, and exclusion zone around, the drilling rig
K. Routine discharges

Additionally, there are recurrent activities listed under "Vessel Operations" and "Ancillary Activities" below.

5.2.3 Decommissioning and Abandonment (Phase 3)

Potential sources of impact identified in this phase are:

A. Well suspension or abandonment
B. Loading fuel and other materials used in the drilling rig
C. Removing transponders from the sea floor

Additionally, there are recurrent activities listed under "Vessel Operations" and "Ancillary Activities" below.

5.2.4 Vessel Operations (Phase 4)

Potential sources of impact identified in association with this category are:

A. Movement of support vessels and drilling rig
B. Storing fuel and other hazardous liquids on vessels, and refuelling operations
C. Generation, storage, transport and disposal of solid waste
D. Routine discharges
E. Generation of air emissions
F. Generation of noise

Additionally, there are recurrent activities listed under "Ancillary Activities" below.

5.2.5 Ancillary Activities (Phase 5)

Potential sources of impact identified in association with this category are:

A. Demand for public services
B. Purchasing goods and services to support the program

5.3 Identification of Potential Impacts

As noted in Section 5.1, the EIA team used Tier 1 screening criteria to identify the possible impacts of proposed activities described in Chapter 2. To do so, the team considered the possible effects of each potential source of impact identified in Section 5.2 on the baseline environmental and socioeconomic conditions of the affected environment as described in Chapter 4.

The results of this screening revealed an inventory of possible impacts affecting various aspects of the physical, biotic, and social environment. Table 5-3 presents those impacts that have passed the Tier 1 screening as possible impacts that could result from the project activities (impact sources described above in Sections 5.2.1 – 5.2.5).

The impacts numbering system in Table 5-3 is set up to assign a unique identifier to each impact. Using the first impact listed as an example, impact 1A1 may be interpreted as follows:

- First number (1) = project phase (i.e. mobilization and rigging-up, drilling, etc.)
- First letter (A) = source of potential impact; letters are added sequentially with the addition of sources
- Second number (1) = potential impact; number increases sequentially when there is more than one potential impact associated with the same source (i.e. "loading and storing fuel and other materials used in rigging the drilling rig" might potentially generate two impacts, numbered "1A1" and "1A2")

In Table 5-3, each potential impact has also been assigned an impact consequence and likelihood "score" or rating according to the Tier 2 screening, and based on these score a significance ranking has been assigned according to Figure 5-2. The ranking methodology and evaluation of

potential impacts are discussed in Section 5.4. All potential impacts with a medium significance ranking (no impacts were ranked high) will require mitigation to minimize potential impacts. Mitigation measures for each medium level impact in Table 5-3 are discussed in a well specific Environmental Management Plan developed for this project (separate document).

Table 5-3: Identification and Evaluation of Potential Impacts

Impact Identification	Source of Potential Impact	Affected Resource	Nature of Potential Impact	See Section	Intensity	Scope	Duration	Overall Consequence Level and Score	Likelihood Level and Score	Significance
Mobilization and Rigging-up (Phase 1)										
1A1	Loading fuel and other materials onto the drilling rig	Marine water quality	Degradation of water quality from an accidental spill of fuel or other hazardous materials	5.4.1.1	Reversible	Localized	Short-term	**Moderate (2)**	**Seldom (1)**	**Medium**
1A2	Loading fuel and other materials onto the drilling rig	Marine fauna	Potential mortalities or oiling of marine fauna (fish, plankton, mammals, sea birds, or sea turtles) as a result of an accidental fuel or other material spill	5.4.1.2	Reversible (at the habitat level)	Localized	Short-term	**Moderate (2)**	**Seldom (1)**	**Medium**
1B1	Attaching transponders to the sea floor	Marine fauna	Damage to potentially sensitive benthic organisms and their habitat from attaching transponders to the sea floor	5.4.1.2	Reversible	Localized	Medium-term	**Moderate (2)**	**Seldom (1)**	**Medium**
1B2	Attaching transponders to the sea floor	Submerged Archaeologic-al Resources	Potential damage to archaeological resources resulting from attaching transponders to the sea floor	5.4.1.3	Irreversible	Localized	Long-term	**Moderate (2)**	**Seldom (1)**	**Medium**
1B3	Attaching transponders to the sea floor	Marine water quality	Potential degradation of water quality resulting from sediment disruption from attaching transponders to the sea floor	5.4.1.1	Reversible	Localized	Short-term	**Negligible (0)**	**Probable (3)**	**Low**
1B4	Attaching transponders to the sea floor	Sediments	Disruption of sea floor sediments from attaching transponders to the sea floor	5.4.1.4	Reversible	Localized	Short-term	**Negligible (0)**	**Probable (3)**	**Low**
See also Vessel Operations (Phase 4) and Ancillary Activities (Phase 5)										

Impact Identification	Source of Potential Impact	Affected Resource	Nature of Potential Impact	See Section	Intensity	Scope	Duration	Overall Consequence Level and Score	Likelihood Level and Score	Significance
Drilling (Phase 2)										
2A1	Operation of the drilling rig	Marine water quality	Degradation of marine water quality due to potential accidental oil spill (loss of well control)	5.4.2.1	Reversible	Dispersed	Medium-term	**Major (3)**	**Seldom (1)**	**Medium**
2A2	Operation of the drilling rig	Marine fauna	Potential accidental oiling and/or mortality of marine fauna resulting from an oil spill (loss of well control)	5.4.2.3	Reversible (at habitat level)	Dispersed	Medium-term	**Major (3)**	**Seldom (1)**	**Medium**
2A3	Operation of the drilling rig	Sensitive shoreline features	Potential accidental oil spill reaching shoreline fouling habitat (loss of well control)	5.4.2.4	Reversible	Dispersed	Medium to long-term	**Major (3)**	**Seldom (1)**	**Medium**
2A4	Operation of the drilling rig	Seafloor sediments	Degradation of seafloor sediments from accidental oil spill (accumulation on the sea floor)	5.4.2.6	Reversible	Dispersed	Medium-term	**Moderate (2)**	**Seldom (1)**	**Medium**
2A5	Operation of the drilling rig	Local economy / communities	Potential accidental oil spill impacting fish or reaching fishing areas and/or tourism areas, limiting income of the local communities (loss of well control)	5.4.2.8	Reversible	Dispersed	Medium-term	**Major (3)**	**Seldom (1)**	**Medium**
2A6	Operation of the drilling rig	Submerged Archaeologic-al Resources	Potential damage to submerged archaeological resources (e.g., possible shipwrecks) near well site	5.4.2.9	Irreversible	Localized	Long-term	**Moderate (2)**	**Seldom (1)**	**Medium**
2A7	Operation of the drilling rig	Local economy / communities	Potential damage to subsea telecommunications infrastructure	5.4.2.8	Reversible	Dispersed	Medium-term	**Major (3)**	**Improbable (0)**	**Medium**

Impact Identification	Source of Potential Impact	Affected Resource	Nature of Potential Impact	See Section	Intensity	Scope	Duration	Overall Consequence Level and Score	Likelihood Level and Score	Significance
2B1	Storage and use of potentially hazardous materials	Marine water quality	Degradation of water quality from accidental spill of potentially hazardous materials	5.4.2.1	Reversible	Localized	Short-term	**Moderate (2)**	**Seldom (1)**	**Medium**
2B2	Storage and use of potentially hazardous materials	Marine fauna	Degradation harm to marine fauna as a result of accidental release or spill of fuel or other hazardous materials	5.4.2.3	Reversible (at the habitat level)	Localized	Short-term	**Moderate (2)**	**Seldom (1)**	**Medium**
2C1	Use and consumption of natural resources	Environment	Extraction and use of natural resources	5.4.2.10	Reversible	Localized	Short-Term	**Negligible (0)**	**Probable (3)**	**Low**
2D1	Penetration of and drilling through the seafloor	Benthos	Disruption of benthos surrounding location of drill bit	5.4.2.6	Reversible	Localized	Short-term	**Moderate (2)**	**Seldom (1)**	**Medium**
2E1	Generation and disposal of drill cuttings and fluids	Sea floor sediments	Degradation of the quality of seafloor sediments from discharge of drill cuttings	5.4.2.5	Irreversible	Localized	Short-term	**Moderate (2)**	**Seldom (1)**	**Medium**
2E2	Generation and disposal of drill cuttings and fluids	Marine water quality	Degradation of marine water quality from discharge drill cuttings	5.4.2.2	Reversible	Dispersed	Short-term	**Moderate (2)**	**Seldom (1)**	**Medium**
2E3	Generation and disposal of drill cuttings and fluids	Benthos	Degradation of benthic habitat resulting from discharge of drill cuttings and physical smothering.	5.4.2.5	Reversible	Dispersed	Medium-term	**Moderate (2)**	**Seldom (1)**	**Medium**

Impact Identification	Source of Potential Impact	Affected Resource	Nature of Potential Impact	See Section	Intensity	Scope	Duration	Overall Consequence Level and Score	Likelihood Level and Score	Significance
2F1	Generation of air emissions	Air quality	Degradation of air quality from combustion fuels used in mechanized equipment needed to support drilling	5.4.2.7	Reversible	Dispersed	Short-term	**Moderate (2)**	**Seldom (1)**	**Medium**
2G1	Generation of noise	Marine fauna	Potential disruption to marine fauna (esp. marine mammal) behaviour due to generation of noise (both above sea level and sub-marine noise)	5.4.2.3	Reversible	Localized	Short-term	**Minor (1)**	**Probable (3)**	**Low**
2H1	Generation of vibration	Marine fauna	Disruption of marine fauna (esp. benthos) from vibration caused by drilling and associated activities	5.4.2.3	Reversible	Localized	Short-term	**Minor (1)**	**Probable (3)**	**Low**
2I1	Generation of light source	Marine fauna	Potential disruption to marine fauna (esp. sea turtle) behaviour due to lighting	5.4.2.3	Reversible	Dispersed	Short-term	**Minor (1)**	**Occasional (2)**	**Low**
2I2	Generation of light source	Local economy	Potential aesthetic impact of rig due to lighting	5.4.2.8	Reversible	Dispersed	Medium-term	**Negligible (0)**	**Occasional (2)**	**Low**
2J1	Physical presence of, and safety zone around, the drilling rig	Local economy	Potential disruption of fishing (industrial and artisanal) and shipping activities resulting from avoidance of the drilling rig from the safety zone	5.4.2.8	Reversible	Localized	Medium-term	**Moderate (2)**	**Occasional (2)**	**Medium**
2K1	Routine discharges	Marine water quality	Degradation of marine water quality from routine discharges	5.4.2.2	Reversible	Dispersed	Short-term	**Moderate (2)**	**Seldom (1)**	**Medium**
2K2	Routine discharges	Marine fauna	Harm to marine fauna from routine discharges	5.4.2.3	Reversible	Dispersed	Short-term	**Minor (1)**	**Probable (3)**	**Low**
See also Vessel Operations (Phase 4) and Ancillary Activities (Phase 5)										

Impact Identification	Source of Potential Impact	Affected Resource	Nature of Potential Impact	See Section	Intensity	Scope	Duration	Overall Consequence Level and Score	Likelihood Level and Score	Significance
Decommissioning and Abandonment (Phase 3)										
3A1	Well suspension or abandonment	Sediments	Disruption of sea floor sediments during well plugging and abandoning operations	5.4.3.1	Reversible	Localized	Short-term	**Negligible (0)**	**Probable (3)**	**Low**
3A2	Well suspension or abandonment	Marine water quality	Potential degradation of water quality resulting from accidental release of residual formation fluids into the marine environment	5.4.3.2	Reversible	Dispersed	Short-term	**Minor (1)**	**Seldom (1)**	**Low**
3A3	Well suspension or abandonment	Marine fauna	Potential disruption of benthic species during well suspension and abandonment operations	5.4.3.3	Reversible (at the habitat level)	Localized	Short-term	**Minor (1)**	**Seldom (1)**	**Low**
3B1	Loading fuel and other materials used in the drilling rig	Marine water quality	Degradation of water quality from accidental spill of fuel or other hazardous materials	5.4.3.2	Reversible	Dispersed	Short-term	**Moderate (2)**	**Seldom (1)**	**Medium**
3B2	Loading fuel and other materials used in the drilling rig	Marine fauna	Potential mortalities or oiling of marine fauna (fish, plankton, mammals, sea birds, or sea turtles) as a result of an accidental fuel or other material spill	5.4.3.3	Reversible (at the habitat level)	Localized	Short-term	**Moderate (2)**	**Seldom (1)**	**Medium**
3C1	Removing transponders from the sea floor	Sediments	Disruption of sea floor sediments during removal of transponders and/or anchors	5.4.3.1	Reversible	Localized	Short-term	**Negligible (0)**	**Probable (3)**	**Low**

Impact Identification	Source of Potential Impact	Affected Resource	Nature of Potential Impact	See Section	Intensity	Scope	Duration	Overall Consequence Level and Score	Likelihood Level and Score	Significance
3C2	Removing transponders from the sea floor	Marine water quality	Potential degradation of water quality resulting from sediment disruption during removal of transponders and/or anchors	5.4.3.2	Reversible	Localized	Short-term	**Negligible (0)**	**Probable (3)**	**Low**
3C3	Removing transponders from the sea floor	Marine fauna	Damage to benthic organisms and their habitat from removal of transponders and/or anchors	5.4.3.3	Reversible (at the habitat level)	Localized	Short-term	**Negligible (0)**	**Seldom (1)**	**Low**
See also Vessel Operations (Phase 4) and Ancillary Activities (Phase 5)										
Vessel Operations (Phase 4)										
4A1	Movement of support vessels and drilling rig	Marine water quality	Potential degradation of marine water quality due to an accidental fuel or other materials spill.	5.4.4.1	Reversible	Dispersed	Medium-term	**Moderate (2)**	**Seldom (1)**	**Medium**
4A2	Movement of support vessels and drilling rig	Marine fauna	Potential harm to marine fauna (fish, plankton, mammals, sea birds, or sea turtles) as a result of an accidental fuel or other material spill	5.4.4.3	Reversible	Dispersed	Medium-term	**Moderate (2)**	**Seldom (1)**	**Medium**
4A3	Movement of support vessels and drilling rig	Marine fauna	Potential damage to marine fauna from contact with hull or propeller (esp. sea turtles)	5.4.4.3	Reversible	Localized	Medium-term	**Moderate (2)**	**Seldom (1)**	**Medium**
4A4	Movement of support vessels and drilling rig	Sensitive shoreline features (estuaries, beaches, lagoons)	Potential degradation of sensitive coastal feature habitat due to an accidental fuel or other material spill	5.4.4.4	Reversible	Dispersed	Medium-term	**Moderate (2)**	**Seldom (1)**	**Medium**
4A5	Movement of support vessels and drilling rig	Local economy / communities	Potential accidental oil spill impacting fish and potentially reaching and fouling fishing/mariculture areas (vessel fuel tank rupture at sea)	5.4.4.6	Reversible	Dispersed	Medium-term	**Moderate (2)**	**Seldom (1)**	**Medium**

Impact Identification	Source of Potential Impact	Affected Resource	Nature of Potential Impact	See Section	Intensity	Scope	Duration	Overall Consequence Level and Score	Likelihood Level and Score	Significance
4A6	Movement of support vessels and drilling rig	Local economy / communities	Potential disruption of fishing activities (industrial and artisanal) and shipping routes resulting from increased marine traffic and movement of vessels of "limited manoeuvrability"	5.4.4.7	Reversible	Dispersed	Short-term	**Minor (1)**	**Occasional (2)**	**Low**
4B1	Storing fuel and other hazardous liquids on vessels, and refuelling operations	Marine water quality	Potential degradation of water quality due to accidental spill of fuel or other materials at the drill site or at port	5.4.4.1	Reversible	Dispersed	Medium-term	**Moderate (2)**	**Seldom (1)**	**Medium**
4C1	Generation, storage, transport and disposal of solid waste	Marine water quality	Potential degradation of water quality due to accidental release of solid waste to the marine environment	5.4.4.1	Reversible	Localized	Short-term	**Moderate (2)**	**Seldom (1)**	**Medium**
4D1	Routine discharges	Marine water quality	Potential degradation of marine water quality in the immediate vicinity around pipe discharge point	5.4.4.2	Reversible	Localized	Short-term	**Moderate (2)**	**Seldom (1)**	**Medium**
4E1	Generation of air emissions	Air quality	Degradation of local air quality due to the emission of exhausts from combustion engines (program vessels and machinery) and cumulative addition to global greenhouse gas levels	5.4.4.5	Reversible	Dispersed	Short-term	**Minor (1)**	**Probable (3)**	**Low**
4F1	Generation of noise	Local communities	Disruption of local community lifestyles from generation of noise from passing helicopters	5.4.4.6	Reversible	Localized	Short-term	**Minor (1)**	**Occasional (2)**	**Low**

Impact Identification	Source of Potential Impact	Affected Resource	Nature of Potential Impact	See Section	Intensity	Scope	Duration	Overall Consequence Level and Score	Likelihood Level and Score	Significance
4F2	Generation of noise	Marine Fauna	Potential disruption to marine fauna (esp. marine mammal) behaviour due to generation of noise from supply vessel movement	5.4.4.3	Reversible	Dispersed	Short-term	**Minor (1)**	**Probable (3)**	**Low**
See also Ancillary Activities (Phase 5)										
Ancillary Activities (Phase 5)										
5A1	Demand for public services	Local economy / communities	Potential strain to agencies from oversight of project	5.4.5.1	Reversible	Localized	Short-term	**Minor (1)**	**Probable (3)**	**Low**
5B1	Purchasing goods and services to support the program	Local economy / communities	Potential benefit to employment and economy	5.4.5.2	Reversible	Localized	Short-term	**Minor (1)**	**Probable (3)**	**Low**

5.4 Evaluation of Potential Impacts

The possible impacts addressed in Section 5.3 were identified through the Tier 1 screening criteria described in Section 5.1.1. Tier 2 criteria were then used to evaluate and categorize the possible impacts. This evaluation resulted in assigning a "score" or rating of impact consequence (negligible, minor, moderate, major) and likelihood (improbable, seldom, occasional, probable) in order to define the overall impact significance rating (low, medium, or high). Impacts were also characterized in terms of other qualifying criteria, including:

- Positive or negative
- Reversible or irreversible
- Localized or dispersed
- Short or long term

Any impacts rated as low are considered acceptable and do not require mitigation beyond the operational and environmental controls that are already part of the standard methods used in performing offshore drilling programs.

5.4.1 Mobilization and Rigging-up

Impacts of mobilization and rigging-up are described below. Most of the potential impacts are related to:

- Loading/unloading of materials needed to support the drilling operations such as fuel, drilling fluids
- Attaching transponders to the sea floor.

5.4.1.1 Potential Degradation of Marine Water Quality

Potential Impact from Accidental Spill of Fuel or Other Hazardous Material (1A1) – As stated above, the potential to damage marine water quality during the mobilization phase would occur from uncontrolled releases of hazardous liquids (e.g., spills of fuel or hazardous materials or wastes) while loading materials (especially bunkering of fuel oil to the drilling rig or handling of oil / drilling fluid additive drums).

The number of all spills (any kind of substances, such as fuel, chemicals or drilling fluids) from oil and gas activities (not only blowouts) by volume in the US Gulf of Mexico (GoM) offshore continental shelf (OCS) between 1964 and 2013 are provided in Table 5-4. As noted in the table 79.5% of the spills were between 1 and 9 bbl. Causal factors are shown in Figure 5-3.

Table 5-4: Platform spill distribution by spill size category in US GoM OCS, 1964-2013 (excluding Deep water Horizon spill in 2010).

Spill size category	Number of spills	Volume spilled (bbl)	Average spill size (bbl)
1-4 bbl	1,438	3,436	2.39
5-9 bbl	311	1,875	6.03
10-49 bbl	287	5,469	19.06
50-99 bbl	65	4,013	61.72
100-999	83	21,758	262.14
≥1,000 bbl*	17	241,573	14,210.18
All spills	2,201	278,124	126.36

Source: BOEM, 2014[1].
*Deep water Horizon spill resulted in an estimated 4,900,000 bbl.

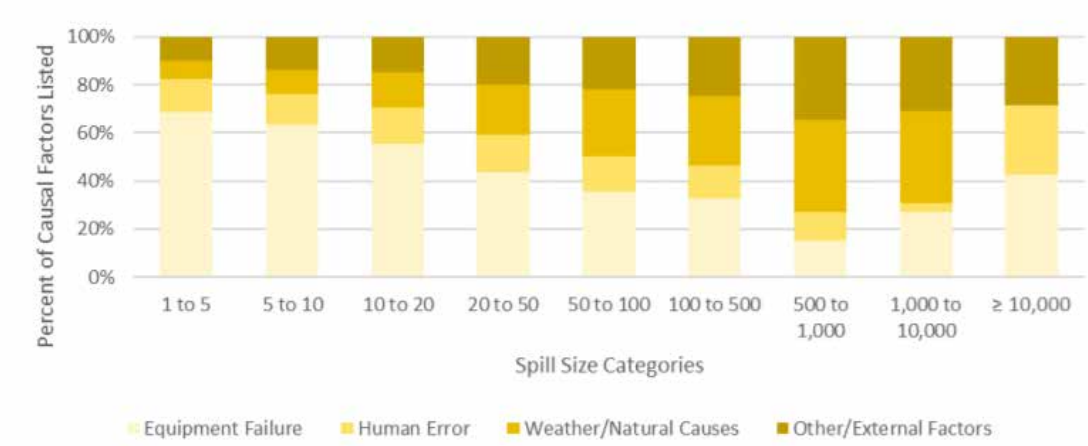

Figure 5-3: Platform spill causal factor summary in US GoM OCS, 1971-2015.
Source: BOEM-BSEE, 2016[2]

A study of chemical spills of offshore oil and gas activities by Boehm et al. reviewed the types and volumes of chemicals used in United States Gulf of Mexico outer continental Shelf[3]. The study determined that while a number of these chemicals exhibit hazardous characteristics, such as corrosivity or toxicity, two chemicals could potentially impact the marine environment if spilled - zinc bromide and ammonium chloride. Most other chemicals are either nontoxic or used in small quantities. Zinc bromide and ammonium chloride are both used for well treatment or completion are needed at the drill site for only a short period of time. Thus, the risk of a spill for these chemicals is very small. Further, Bahamas Petroleum Company will strive to use environmentally friendly fluids, whenever possible. Initial assessments suggest it should be possible to avoid the

[1] BOEM [Bureau of Ocean Energy Management]. 2014. U.S. BOEM Oil Spill Database. Retrieved from: https://www.bsee.gov/sites/bsee.gov/files/reports/oil-spill-response/all-spills-1964-2011.pdf
[2] BOEM [Bureau of Ocean Energy Management] and BSEE [Bureau of Safety and Environmental Enforcement. 2016. Update of Occurrence Rates for Offshore Oil Spills. 2016. Retrieved from: https://www.bsee.gov/sites/bsee.gov/files/osrr-oil-spill-response-research/1086aa.pdf
[3] 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. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2001-011. 326 pp.

use of “heavy brines” (i.e. zinc bromide and ammonium chloride) as the reservoir is not expected to be under high pressure.

A spill of fuel or other hydrocarbon during loading / bunkering would degrade water quality. Impacts of spills is further discussed in Section 5.4.2. The consequence of this impact is considered moderate and the likelihood is seldom, so the impact rating is **medium**, requiring mitigation to manage the risk (C = 2, L = 1, and thus I = medium). In each of these cases, the resulting water quality impacts would be negative, direct, localized, reversible and short-term.

Potential Degradation of Marine Water Quality from Disruption of Seafloor Sediments (1B3) – The dynamic positioning system on the drill ship works in coordination with transponders (acoustic devices) which are placed on the seafloor. This will cause a temporary disruption of sediments that will suspend in the water column near the sea floor. The consequence of this activity could have a negligible impact to water quality as the sediments would quickly settle. The likelihood of this would be probable. The overall impact is **low** (C = 0, L = 3, and thus I = low). This impact would be negative, direct, reversible, localized and short-term.

5.4.1.2 Potential Harm to Marine Fauna

Impacts to Marine Fauna in Phase 1 relate to the potential degradation of marine quality resulting from the spill of fuel or other hazardous materials, as well as attaching transponders to the sea floor. Specifically, these include:

- Potential impact to fish from degradation of marine quality
- Potential impact to plankton from degradation of marine quality
- Potential impact to marine mammals and sea turtles from degradation of marine quality
- Potential impact to birds from degradation of marine quality
- Potential impact to sensitive benthic organisms from placement of transponders on the sea floor

Potential Impact to Fish (1A2) - Impacts to fish would be limited to the potential disruption of habitat as a result of an accidental release of oil or other hazardous liquid to the marine environment. As noted by IPIECA, “Wild fish swim away from oil spills and long-term effects on local populations are avoided. However, fish moving back into an area following a spill may take some time to recover”.[4] A spill during Phase 1 would likely be small and response capabilities would be present to manage a potential spill. Therefore, this potential impact would be negative, direct, localized, reversible (at the habitat level) and short term. The possibility of fish encountering a spill during this phase would be seldom and the consequence would be minor, therefore the impact rating assigned is **low** (C = 1, L = 1, and thus I = low).

Potential Impact to Plankton (1A2) – The potential impacts to plankton from rigging-up and mobilization activities are like those as described above for fish. The only difference is that certain species of plankton inhabit the water surface and would be unable to avoid contact with any oil or hazardous liquid accidently spilled. This potential impact would be localized, reversible (at the habitat level) and short term. Given the ability of crew to contain small spills and the abundance of plankton throughout the marine environment the consequence of a small spill would be minor and the likelihood would be seldom, resulting in a rating of **low** (C = 1, L = 1, and thus I = low). This potential impact would be negative, direct, localized, reversible (at the habitat level) and short term.

[4] International Petroleum Industry Environmental Conservation Association (IPIECA). 2008. Oil Spill Preparedness and Response: Report Series Summary 1990-2008. Retrieved from the IPIECA Website: http://www.ipieca.org .

Potential Impact to Marine Mammals and Sea Turtles (1A2) – Potential impacts of the mobilization activities to marine mammals and sea turtles are considered unlikely. Like fish, whales, dolphins and sea turtles are highly mobile and likely to avoid drill sites because of the noises generated. The likelihood that there would be an oil spill or significant water quality degradation and that these species would surface in the area of such an impact is extremely low. However, given that many of these species are threatened, a spill impacting even one individual would be considered moderate severity. The impact on marine mammals and/or sea turtles as a result of mobilization activities would be negative, direct, localized, reversible (at the habitat level) and medium term (given the reproductive rates of these species). The potential impact of an accidental spill or leak contacting a marine mammal or sea turtle is considered moderate consequence, but the likelihood of this scenario occurring is seldom, resulting in a **medium** impact, requiring mitigation to manage the risk (C = 2, L = 1, and thus I = medium).

Potential Impact to Birds (1A2) – Potential impacts of the mobilization activities to birds are considered unlikely. As with marine mammals above, the likelihood that there would be an oil spill during mobilization and that sea birds would encounter such a spill is low. Any impact to birds as a result of mobilization activities would be negative, direct, localized, reversible (on the habitat level) and short term (given the reproductive rates of these species). The potential impact of an accidental spill or leak contacting a bird is considered moderate consequence, the likelihood of this scenario occurring is seldom, resulting in a **medium** impact, requiring mitigation to manage the risk (C = 2, L = 1, and thus I = medium).

Potential Impact to Benthic Organisms (1B1) – The drill ship will utilize a dynamic positioning system to maintain location and will not anchor to the seabed. However, transponders used as acoustic beacons in the dynamic positioning system will be placed on the seabed. Each transponder is approximately 3x3 meters.

An evaluation by University of Miami of multibeam bathymetry, backscatter, and sub-bottom profiles, and submersible and ROV notes that there are deep-water corals (also known as cold-water corals) in the greater lease area. Specifically, cold-water corals were observed during submersible (2007) and ROV dives (2012), in association with scattered boulders or “peaks”. These structural relief components have associated corals and tend to be associated with the debris fields found at the Bank’s toe-of-slope. Otherwise, the slopes themselves and the broad basin floors tend to be muddy, and void of such structures.[5] A site survey and shallow hazard evaluation of the Perseverance #1 (Appendix A) reviewed the 3D survey data and did not identify any vents, seeps, or other geologic structures associated with seafloor sensitivities (e.g. chemosynthetic communities).

Benthic organisms may be smothered or disrupted by attaching transponders to the seafloor, resulting in a very localized impact on benthic communities. Impacts from disturbance of sediments would be minimal, but placement of the transponder on deepwater corals, which grow very slowly and are associated with high biodiversity, would be considered moderate. The likelihood is considered seldom, thus the overall impact is **medium**, requiring mitigation to manage the risk (C = 2, L = 1, and thus I = medium) and would be negative, direct, reversible and medium-term.

[5] Jo, A., Eberli, G.P., and Grasmueck, M. 2012. Report of High-Resolution Portion of BPC Lease Areas in the Bahamas. Prepared for BPC by University of Miami CSL.

5.4.1.3 Potential Disruption of Submerged Archaeological Resources (1B2)

Attachment of transponders to the seafloor near the drill site during mobilization and rigging-up could possibly disrupt any shipwrecks or other submerged archaeological resources that might exist in this area. The likelihood that one might be in or near the exact locations in which transponders are placed is very low. The level of damage that might be caused to such a resource could be moderate, but the likelihood is seldom and therefore the overall impact rating is **medium** (C = 2, L = 1, thus I = medium) , requiring mitigation to manage the risk. This impact would be negative, direct, irreversible and long-term.

5.4.1.4 Potential Disruption of Seafloor Sediments (1B4)

The dynamic positioning system on the drill ship works in coordination with transponders (acoustic devices) which are placed on the seafloor. This will cause a temporary and minor disruption of sediments in the immediate area around the transponder attachment point. This potential impact would be negative, direct, localized, reversible and short-term. The consequences of these impacts are expected to be negligible with a probable likelihood, leading to a **low** impact rating (C = 0, L = 3, and thus I = low).

5.4.2 Drilling

Potential impacts of the drilling phase are evaluated below. The most significant (based on the combination of likelihood and consequence) are those related to:

- An accidental spill of oil, drilling fluid or other hazardous fluids (especially loss of well control) considering both the physical and social environment
- The discharge of drill cuttings
- The social impacts associated with noise and potential disruption of fishing and marine traffic

Given that standard controls will be in place, none of the identified potential impacts were ranked as high - all are either low or medium. Regardless, certain impact mitigation actions should be taken and integrated into the exploratory drilling program to mitigate and minimize these impacts to the lowest practicable levels.

The most significant potential environmental impacts from offshore drilling operations are typically those associated with accidental events such as oil spills, particularly large spills from a loss of well control or blowout. Blowouts occur when drilling penetrates gas/oil/water pockets that are under such high pressure that the back-pressure of the escaping gas overpowers and ruptures well control equipment, resulting in the free flow of oil and gas from the reservoir, through the well to the surface, until the well is brought back under control. Personnel are trained to recognize signs of high pressures and measures are in place to control unexpected pressures during drilling in order to prevent blowouts. Everyone from the level of Derrickman and above on the rig must undergo training (typically a 1-week intensive course) and certification in “Well Control”. This training includes the onshore engineering and supervisory team. Each must have certification resulting from a mandatory exam every 2 years known as the IWCF (International Well Control Forum). Pass mark for the exam is at least 85%. Persons without the certification or who fail renewals are not allowed to work in a position of significance relating to the drilling operation. Blowouts occurring in offshore well drilling are very rare, but they do occur when there are simultaneous failures of the many technical and operational procedure/training controls in place. Other causes of well control loss are external, for example storms, ship collisions, fires or earthquakes. Potential impacts can range from minor to major depending on the magnitude of the blowout and location of the rig.

The rate of blowouts in the oil and gas industry is very low (0.0048 blowouts per well drilled offshore in the US Outer Continental Shelf between 1996-2009) because of the common use of blowout preventers (BOPs) and rigorous health and safety standards, policies and procedures that are focused on incident prevention.[6] Further, the probability of a blow-out in The Bahamas is expected to be less as the well characteristics are different (reservoirs are expected to be under less pressure in the Bahamas compared to the Gulf of Mexico). While it can never be guaranteed until the actual structure itself is drilled, good indications can be inferred from historical data. Study of the previous wells drilled in The Bahamas near the proposed well site suggest that the reservoirs could be at such a low pressure that reservoir fluids may need to be pumped from the reservoir to the surface using a downhole pump. This means that oil or other liquids may be too heavy and therefore not be able to flow to the surface (although if gas is present it will) reducing the probability of a blowout. While the reservoir pressure is expected to be below what is normally found in the Gulf of Mexico, impact likelihood rankings were assigned using the "Precautionary Principle" and do not take this into consideration (i.e. the likelihood rankings related to blowouts are the same as in a high-pressure environment). Even though blowouts resulting in spills are rare events, should they occur, they would likely result in environmental and social consequences.

The evaluation rankings for impacts relating to potential oil spills are based on oil spill trajectory models conducted for the well site. Bahamas Petroleum Company contracted RPS to conduct oil spill dispersion modelling (see EMP Appendix E, attachment A). Excerpts from the report is provided below[7]:

RPS performed simulations of hypothetical Worst-Case Discharges (WCDs) of oil resulting from one blowout event and two surface events occurring at the Perseverance #1 well site offshore Bahamas. Spills were simulated using wind conditions from two seasons determined based on prevailing wind conditions.

Scenarios modelled are presented in Table 5-5.

Table 5-5: Spill Scenarios Modelled, Offshore Bahamas

ID	Scenario Type	Site	Oil Type	Season	Total Volume Released	Release Duration	Simulation Duration
1	Tier III Scenarios - Worst credible case discharge (WCCD), No Response	B-North Well head (seabed)	Bahamas Medium Crude	Dry: (November-April)	20,000 bopd ($3,200 m^3$/day) Total: 600,000 bbl	30 days	45 days
2				Wet: (May-October)			
3	Tier II Scenarios – Medium surface discharge, No Response	B-North Topside (sea surface)	Bahamas Medium Crude	Dry: (November-April)	15,000 bopd ($3,200 m^3$/day) Total: 15,000 bbl	1 day	45 days
4				Wet: (May-October)			
5	Tier I Scenarios – Low volume surface discharge, No Response	B-North Topside (sea surface)	Bahamas Medium Crude	Dry: (November-April)	40 tonnes* (293 bbl)	1 hr	45 days
6				Wet: (May-October)			

[6] Abbot, J. Measuring OCS Performance. US Department of Interior (DOI), Bureau of Ocean Energy Management, Regulation and Enforcement. Retrieved from the DOI Website: http://www.boemre.gov/perfmeas/index.htm

[7] RPS. 2019. Mini Report for BPC Bahamas Spill Modeling: 19-P-206556 Oil Spill Risk Assessment.

*IPIECA 2013. Oil spill risk assessment and response planning for offshore installations. Oil Spill Response Joint Industry Project (JIP) 6. Final Report

A summary of blowout parameters used in the modelling is provided in Table 5-6.

Table 5-6: Summary of Blowout Parameters

Site	Water Depth of Release (m)	GOR (scf/bbl)	Pipe Opening (in)	Oil Discharge Temperature (°C)
B-North	520	500	12.25	100*

* Note that RPS derived this oil discharge temperature based on further testing based on information provided by the client.

Crude oil characteristics used in the modelling are provided in Table 5-7.

Table 5-7: Bahamas Medium Crude Oil Characteristics

Characteristic	Value
Oil Type	Bahamas Medium Crude
GOR	550 cf/bbl
Density (@ 15.0ºC)	0.863
Viscosity	22cP @ 0C
Max Water Content	66%
Interfacial Surface Tension	14.2
Pour Point	-24
Boiling Point curve (TBP from crude assay):	
Temperature (deg C)	Mass (%)
<180	11.3
180-265	17.3
265-380	17.3
>380	54.1

The unmitigated (i.e., no response action) blowout scenario consisted of 30 days of oil discharge at the wellhead. The WCD (20,000 barrels per day [bpd]) trajectory and fate model simulations were run for 45 days, an additional 15 days past the 30-day discharge period. The surface scenarios, one medium volume discharge and one low volume discharge, were also simulated for 45 days. The medium volume surface discharge scenario simulated a release of 15,000 barrels over 1 day. The low volume surface discharge simulated a release of 293 barrels over 1 hour.

The stochastic approach applied in the spill risk assessment provided an evaluation of the likelihood of exposure to crude oil above socioeconomic and ecological thresholds of concern, expressed as mass per unit area and concentration. The thresholds listed in Table 5-8 were used in the stochastic analysis.

Table 5-8: Oil Thickness Thresholds Applied in the Spill Risk Assessment for Sea Surface, Shoreline, and Water Column Probability Determinations

Threshold Type	Average Concentration Threshold	Rationale	References
Oil on Sea Surface	1 $g/m^2 \approx$ 1 µm (0.001 mm) on average over the grid cell	**Ecological:** a conservative threshold for consideration of sublethal effects on birds, marine mammals, and sea turtles from floating oil.	French McCay 2016

Shoreline Oil	100 g/m^2 ≈ 100 µm (0.1 mm) on average over the grid cell	**Ecological:** This is a screening threshold for potential ecological effects on shoreline flora and fauna, based upon a synthesis of the literature showing that shoreline life has been affected by this degree of oiling. Sublethal effects on epifaunal intertidal invertebrates on hard substrates and on sediments have been observed where oiling exceeds this threshold. Assumed lethal effects threshold for birds on the shoreline.	French et al., 1996; French McCay, 2009; French McCay et al. 2012

The stochastic results for all spill scenarios are summarized in Table 5-9. Although some percentage of oil reaches shore in all cases, only the blowout scenarios results in shoreline oiling above the specified threshold of 0.1 mm, and thus shoreline oiling figures for the surface releases do not show oiling (Figure 5-4 through Figure 5-15.

Table 5-9. Oil Spill Stochastic Results – Shoreline oiling probability and minimum travel time

ID	Scenario	Release Duration	Total Oil Released	Simulations Reaching Shore (%)	Time to reach shore (days)		Volume to reach shore (%)	
					Min.	Ave.	Max.	Ave.
1	600,000 bbl Blowout Dry Season	30 days	600,000 bbl	100	1.1	7.8	1.2%	0.3%
2	600,000 bbl Blowout Wet Season	30 days	600,000 bbl	100	2.1	9.0	2.9%	0.7%
3	15,000 bbl Surface Release Dry Season	1 day	15,000 bbl	28	3.9	5.7	3.0%	0.3%
4	15,000 bbl Surface Release Wet Season	1 day	15,000 bbl	16	2.1	4.9	41.6%	3.2%
5	293 bbl Surface Release Dry Season	1 hr	293 bbl	11	1.3	3.5	2.5%	0.5%
6	293 bbl Surface Release Dry Season	1 hr	293 bbl	6	0.9	1.0	44.1%	6.8%

The figures presented below illustrate the possible spatial extent of surface or shore oiling probabilities (footprint) and associated minimum travel times to reach any point within the footprint. Based on the stochastic modelling results, the following conclusions can be highlighted:

- Due to the nature of the Bahamas Crude Oil, the released oil entrains into the water column readily. Both surface and subsurface oil moves primarily north forced by the Gulf Stream. Surface oil from the modelled blowouts is also predicted to travel to the southeast of the release location along the northern coast of Cuba.

- Shoreline oil contamination occurs primarily along the Cuban coast in each modelled scenario during both Wet and Dry seasons. However, the average percent of released oil ashore is higher in the Dry season compared to the Wet season.
- All (100%) of the modelled blowout simulations reach shore in the Dry and Wet seasons. Less than 30% of the modelled 15,000 bbl surface release simulations reach the shore, while ≤11% of the modelled 293 bbl scenarios reach the shore.

Based on the deterministic modelling results, the following conclusions can be highlighted:

- By the end of the simulation, the majority of the oil is predicted to be entrained in the water column (16-38%), evaporated into the atmosphere (19-26%), degraded (24-41%), or transported outside the model domain (2-30%).
- The environmental conditions (winds and currents) drive both surface and subsurface oil to the north in both Dry and Wet seasons. During the Wet season, for the blowout and medium surface discharge, winds and currents also drive surface and subsurface oil to the east.
- Due to the larger volume of oil spilled, the blowout scenario in both seasons has a larger predicted surface and subsurface footprint than the surface releases in both seasons.

The blowout releases were predicted to have a larger impact to shore than the surface releases, as oil was stranded on the northern shores of Cuba and the smaller islands of the Bahamas (Cay Sal). Both of the surface releases were also predicted to reach the shorelines of the Bahamas or Cuba.

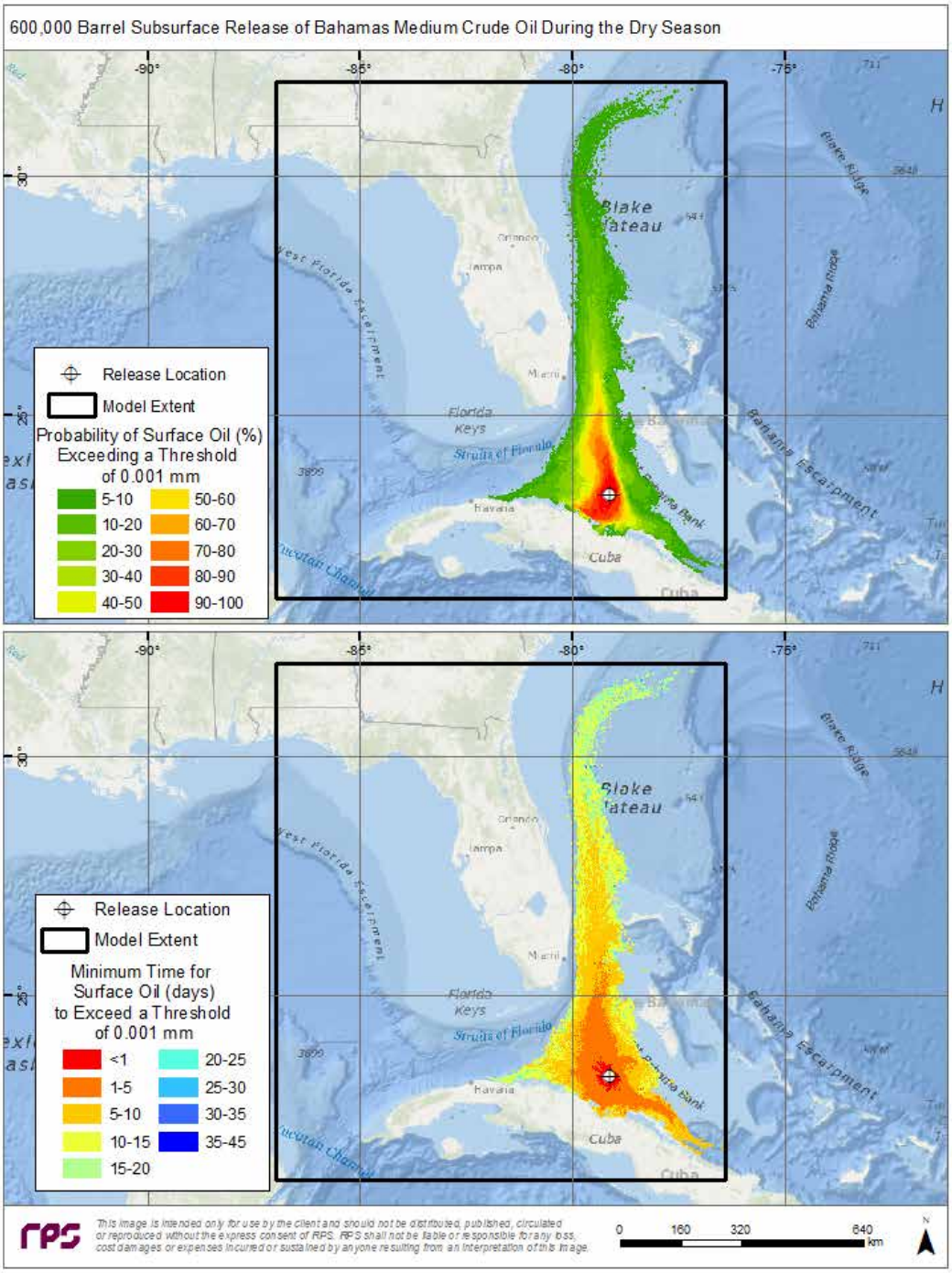

Figure 5-4: Surface stochastic results for a 600,000 bbl crude blowout at B-North in the Dry season; water surface oiling probabilities (top) and minimum travel times (bottom) using a surface oil thickness threshold of 0.001 mm (1 micron)

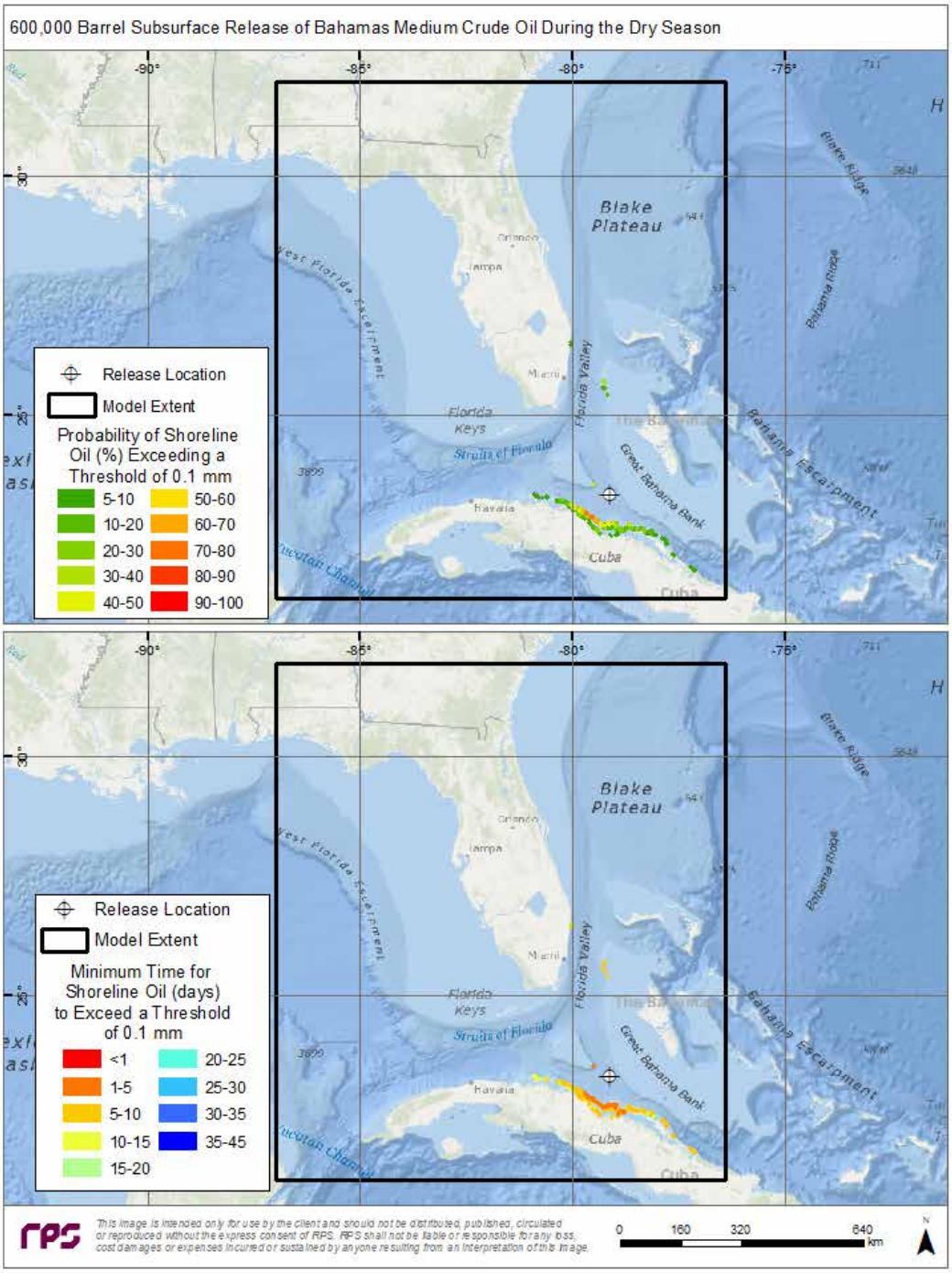

Figure 5-5: Shoreline stochastic results for a 600,000 bbl crude blowout at B-North in the Dry season; shore oiling probabilities (top) and minimum travel times (bottom) using a shore oil thickness threshold of 0.1 mm (100 microns)

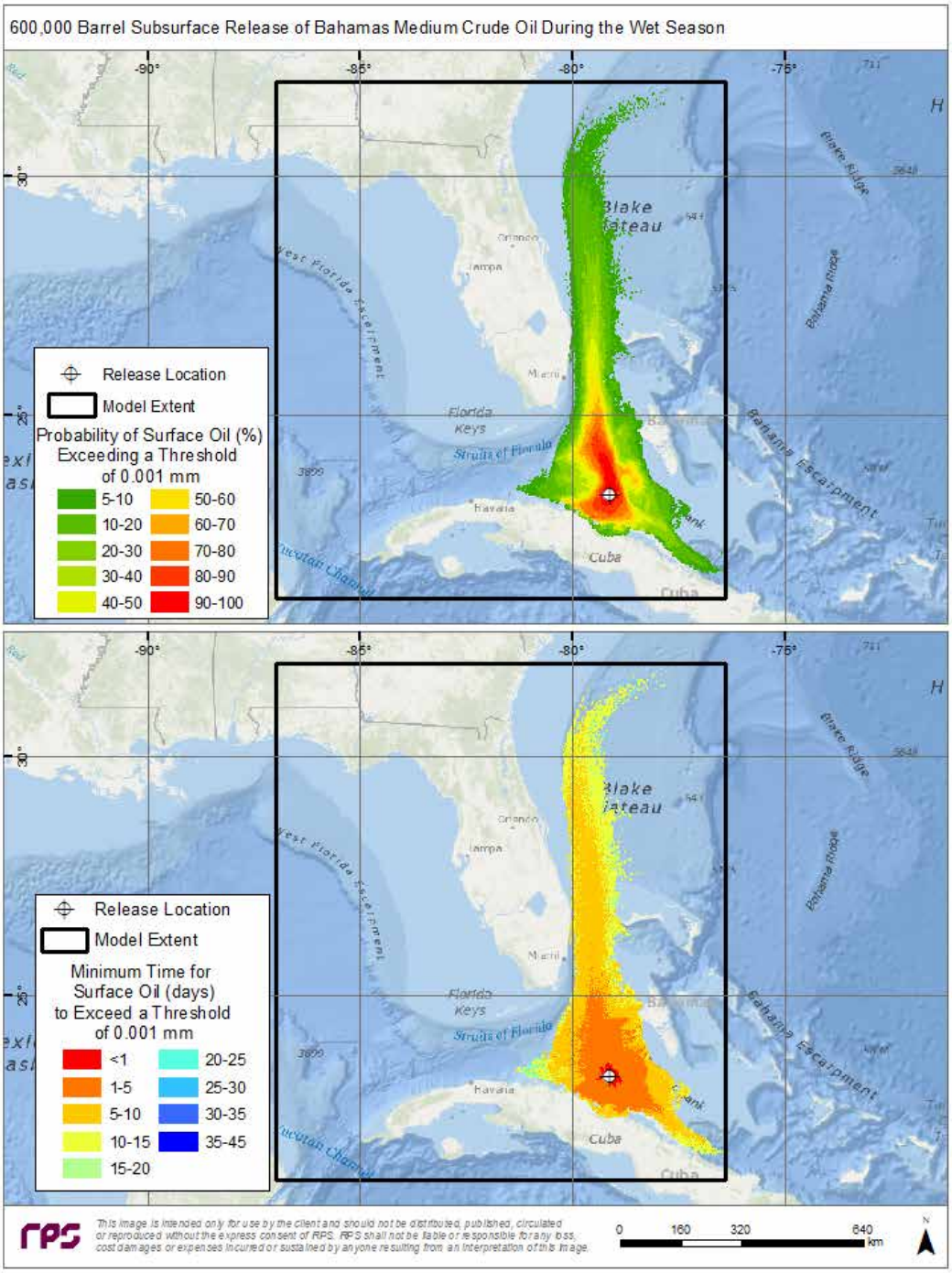

Figure 5-6: Surface stochastic results for a 600,000 bbl crude blowout at B-North in the Wet season; water surface oiling probabilities (top) and minimum travel times (bottom) using a surface oil thickness threshold of 0.001 mm (1 micron)

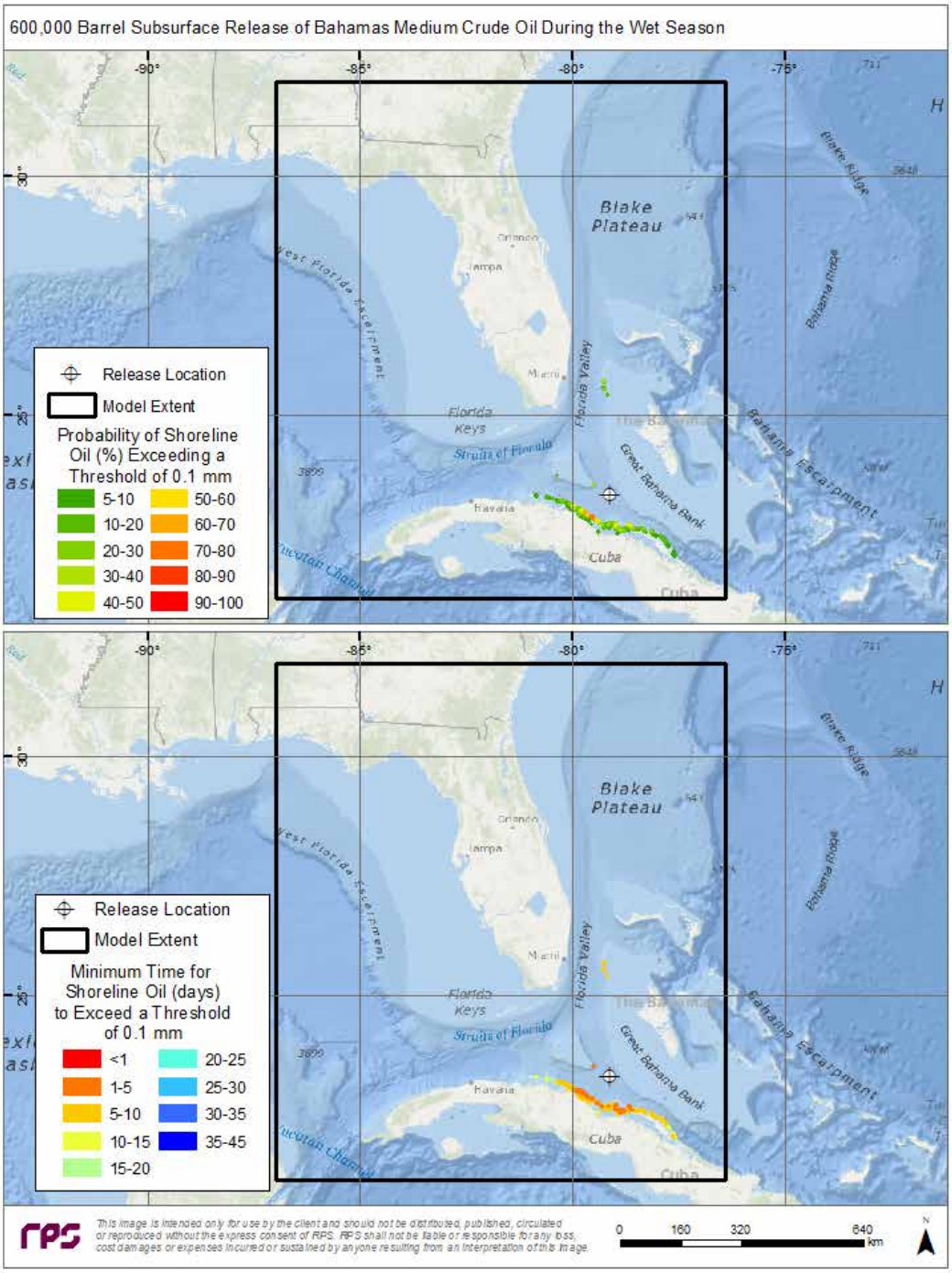

Figure 5-7: Shoreline stochastic results for a 600,000 bbl crude blowout at B-North in the Wet season; shore oiling probabilities (top) and minimum travel times (bottom) using a shore oil thickness threshold of 0.1 mm (100 microns)

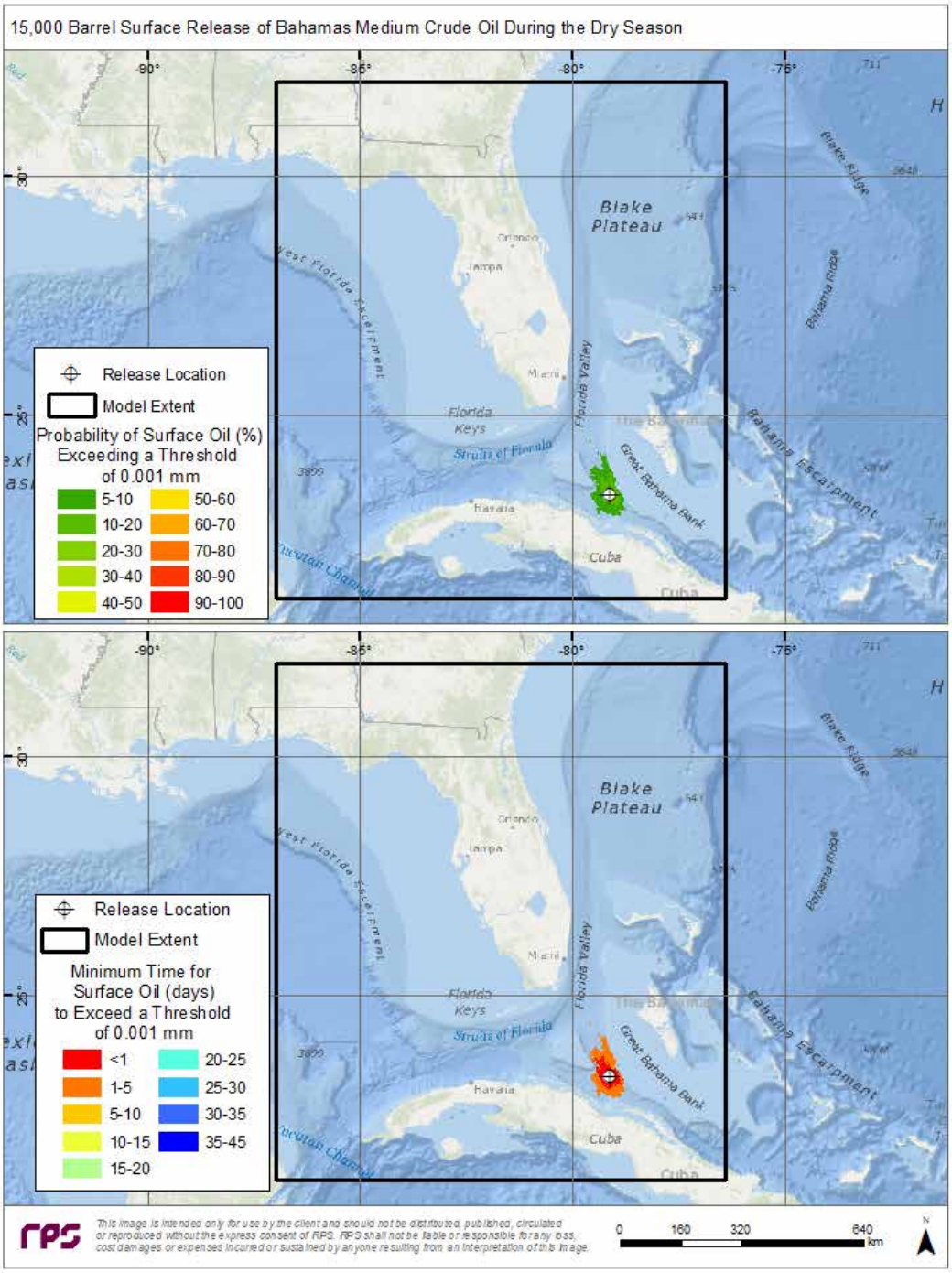

Figure 5-8: Surface stochastic results 15,000 bbl crude surface release at B-North in the Dry season; water surface oiling probabilities (top) and minimum travel times (bottom) using a surface oil thickness threshold of 0.001 mm (1 micron)

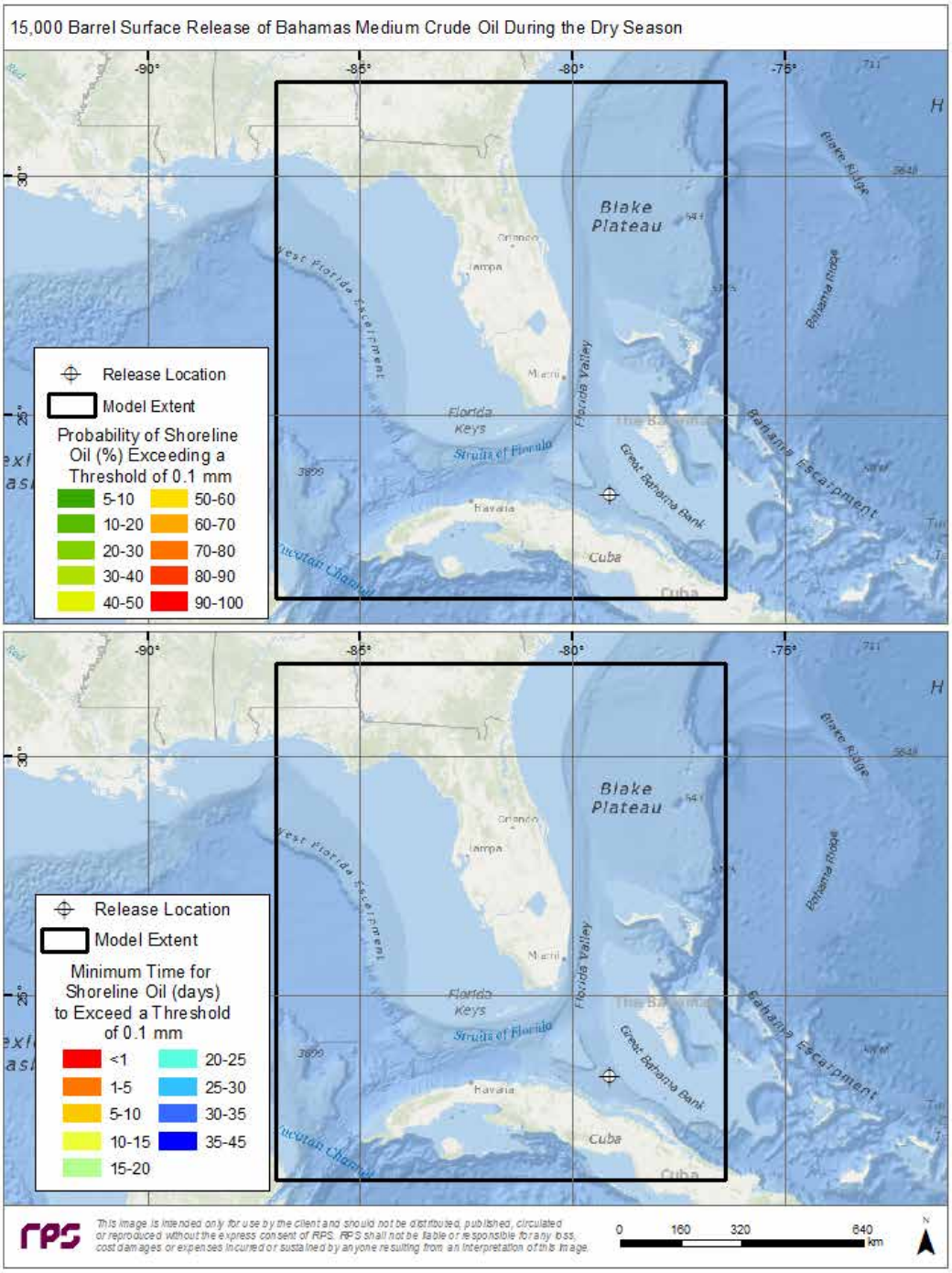

Figure 5-9: Shoreline stochastic results for a 15,000 bbl crude surface release at B-North in the Dry season; shore oiling probabilities (top) and minimum travel times (bottom) using a shore oil thickness threshold of 0.1 mm (100 microns)

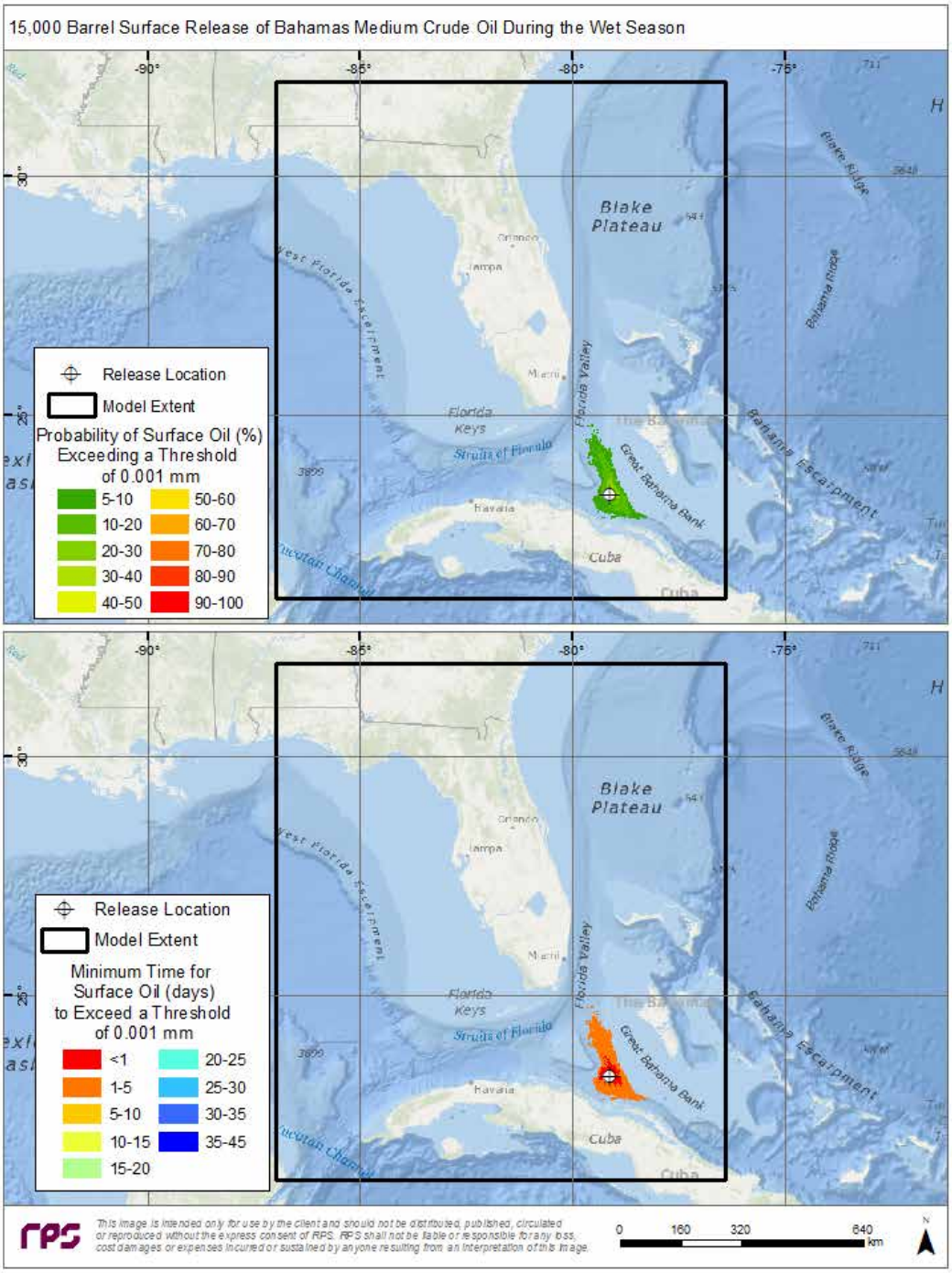

Figure 5-10: Surface stochastic results 15,000 bbl crude surface release at B-North in the Wet season; water surface oiling probabilities (top) and minimum travel times (bottom) using a surface oil thickness threshold of 0.001 mm (1 micron)

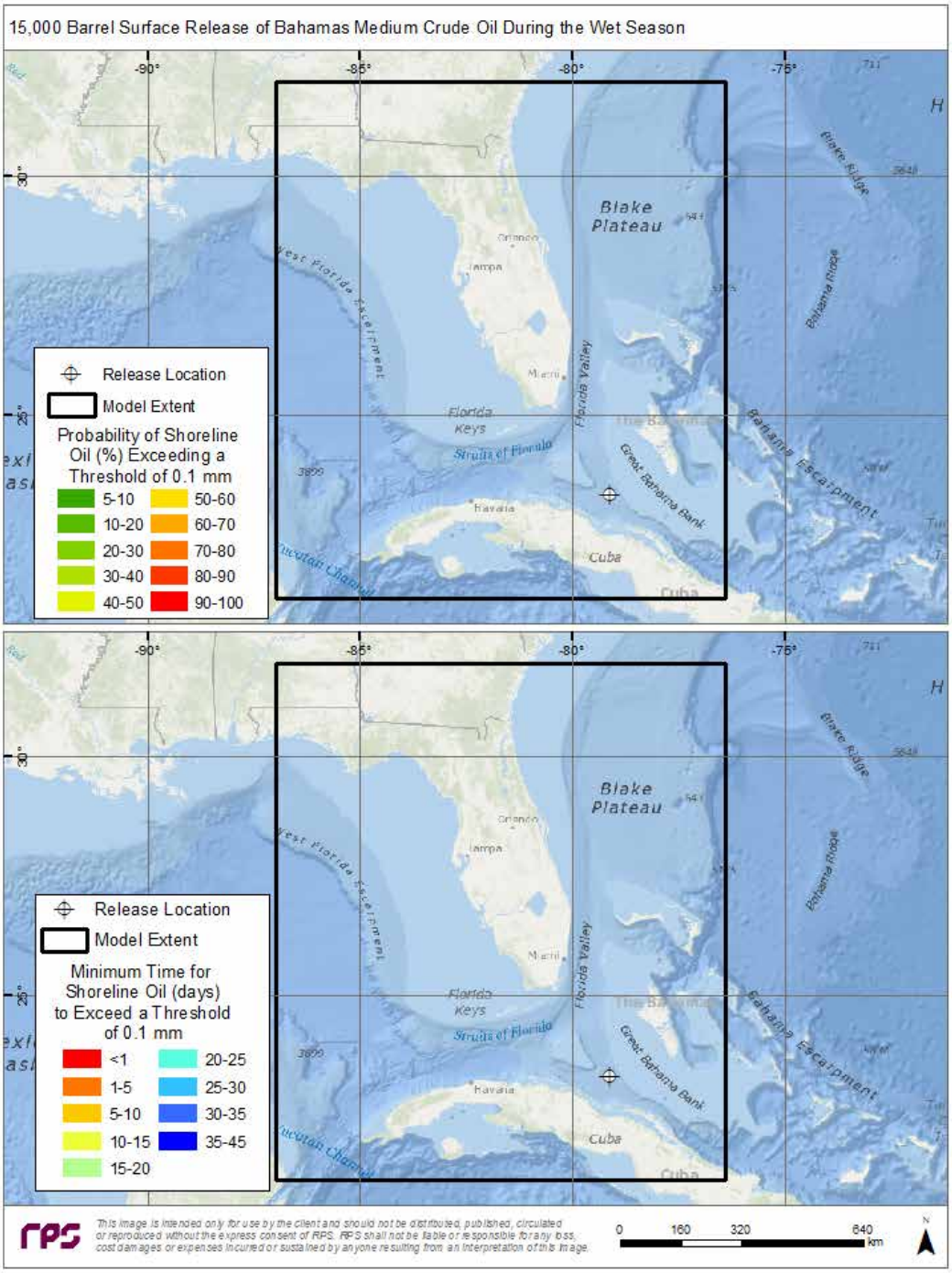

Figure 5-11: Shoreline stochastic results for a 15,000 bbl crude surface release at B-North in the Wet season; shore oiling probabilities (top) and minimum travel times (bottom) using a shore oil thickness threshold of 0.1 mm (100 microns)

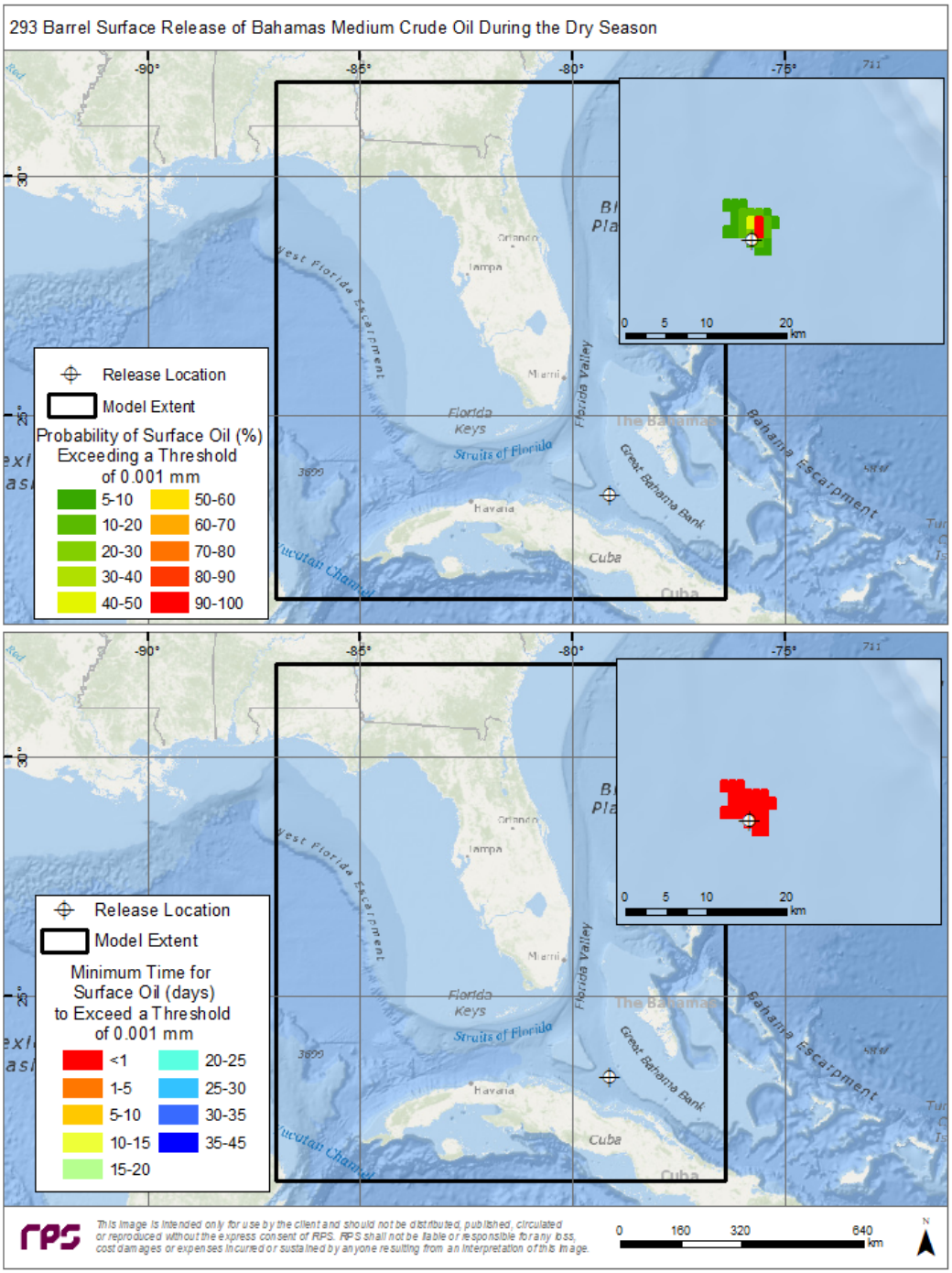

Figure 5-12: Surface stochastic results 293 bbl crude surface release at B-North in the Dry season; water surface oiling probabilities (top) and minimum travel times (bottom) using a surface oil thickness threshold of 0.001 mm (1 micron)

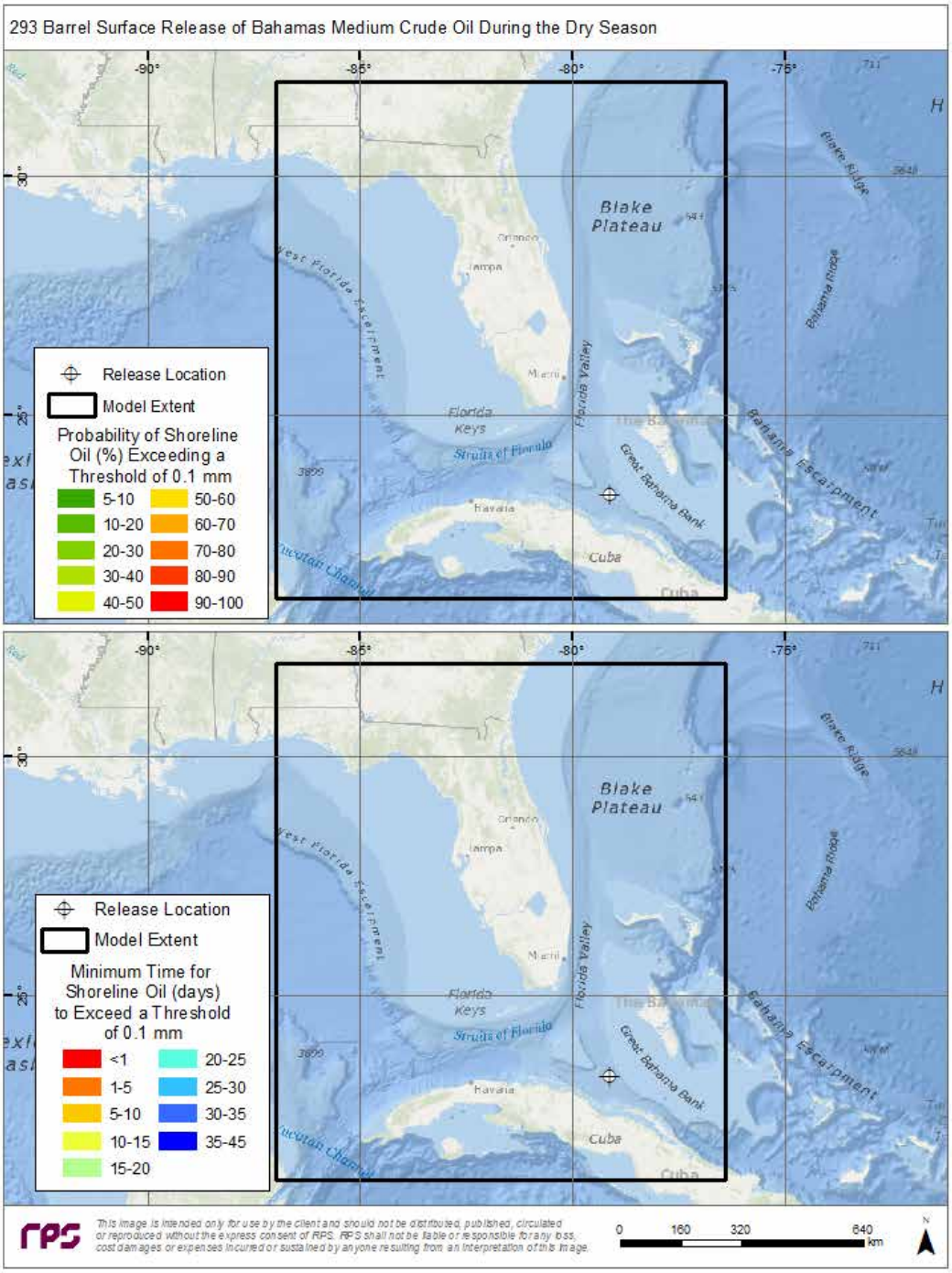

Figure 5-13: Shoreline stochastic results for a 293 bbl crude surface release at B-North in the Dry season; shore oiling probabilities (top) and minimum travel times (bottom) using a shore oil thickness threshold of 0.1 mm (100 microns)

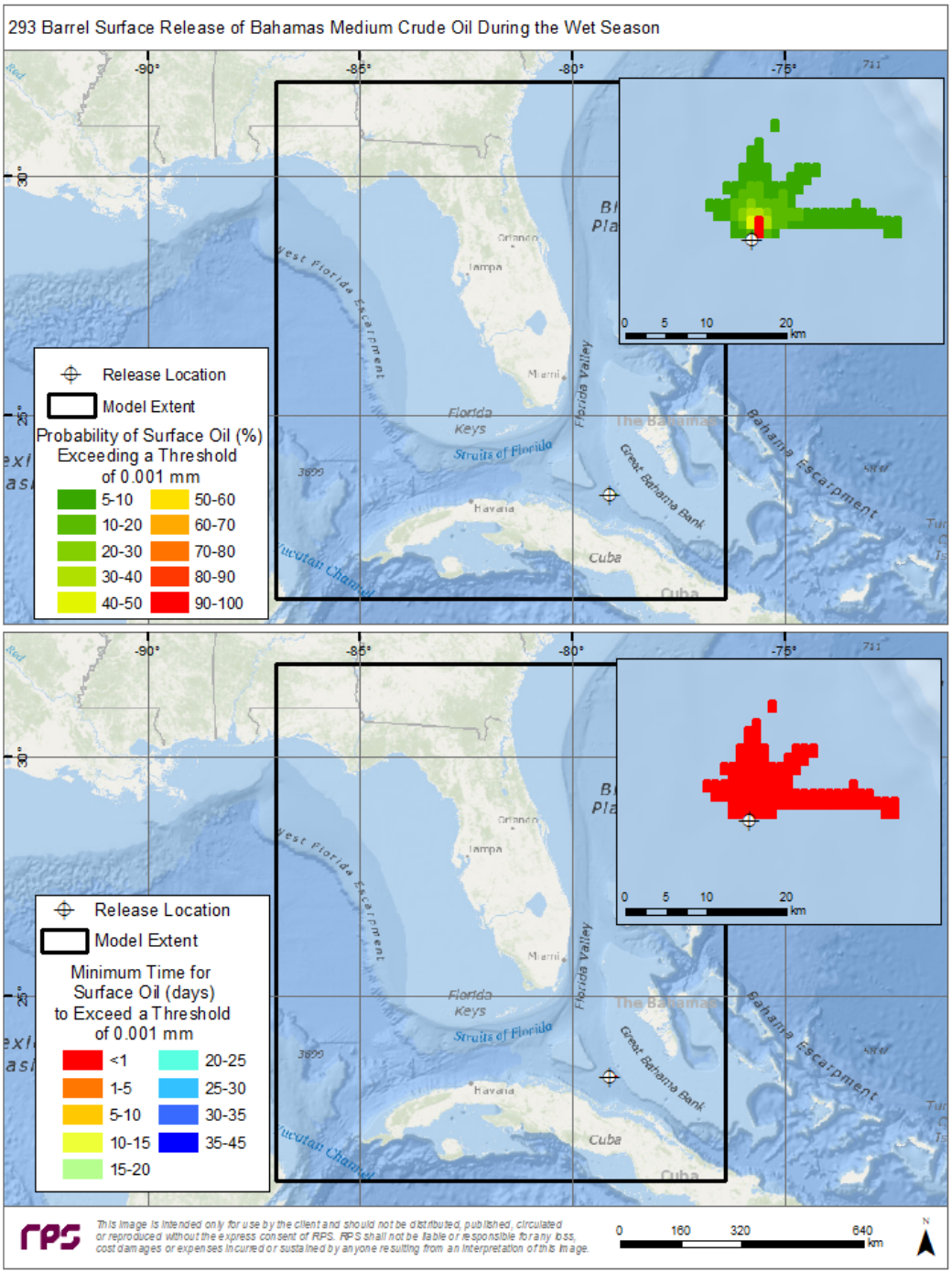

Figure 5-14: Surface stochastic results 293 bbl crude surface release at B-North in the Wet season; water surface oiling probabilities (top) and minimum travel times (bottom) using a surface oil thickness threshold of 0.001 mm (1 micron)

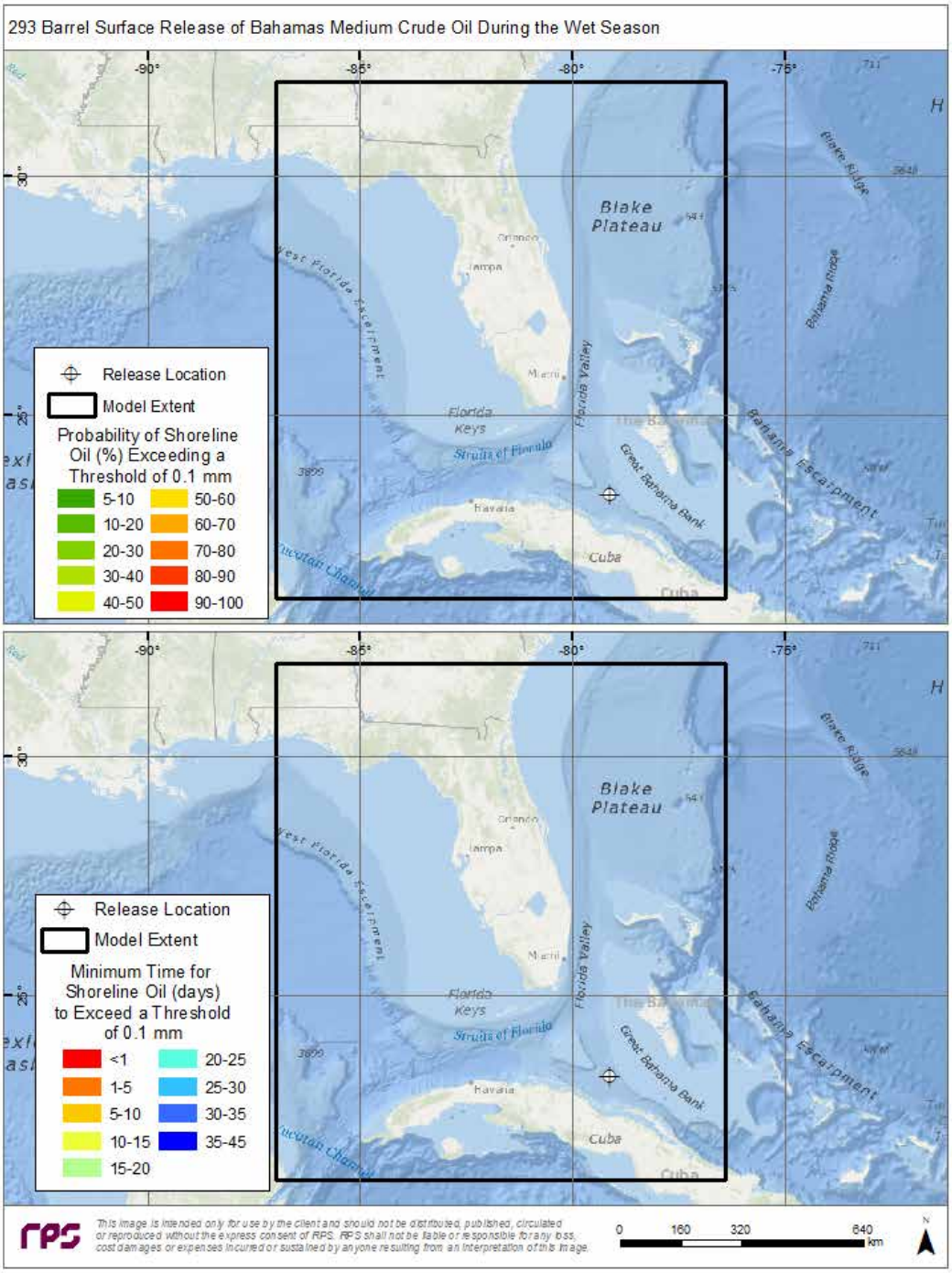

Figure 5-15: Shoreline stochastic results for a 293 bbl crude surface release at B-North in the Wet season; shore oiling probabilities (top) and minimum travel times (bottom) using a shore oil thickness threshold of 0.1 mm (100 microns)

The oil spill modelling results indicate that oil released from a loss of well control in the proposed drilling program could potentially reach shorelines of The Bahamas, Cuba and the United States if there is no intervention.

As noted in Section 4.4, potentially affected shoreline contains sensitive and protected features such as mangroves, estuarine communities, fishing grounds and beaches. These areas provide habitat for endangered species, breeding grounds for vital commercial species and support livelihoods for local communities, recreation activities and ecotourism. Because the potential consequence of an oil spill fouling this area could be major, defining the amount of time for a spill to reach these areas is critical in determining the impact rating and required mitigation measures. The projected minimum time to shoreline impact varies depending on the location but is less than 2 days to northern Cuba in blowout scenarios modelled.

Impacts related to oil spills are evaluated by resource type (i.e. water quality, marine fauna, etc.), along with other impacts below.

5.4.2.1 Potential Degradation of Marine Water Quality – Accidental Oil Spills (2A1, 2B1)

Hydrocarbons released to the marine environment can result from well blowouts or other accidental events. Hydrocarbons spilled into seawater are subject to physical, chemical, and biological processes that change their composition and potential impact to the environment. A conceptual model of the fate of hydrocarbons entering the marine environment is shown in Figure 5-16. Hydrocarbon composition and toxicity will change over time in a process known as 'weathering'. The importance of various weathering [8] [9] components is shown in Figure 5-17.

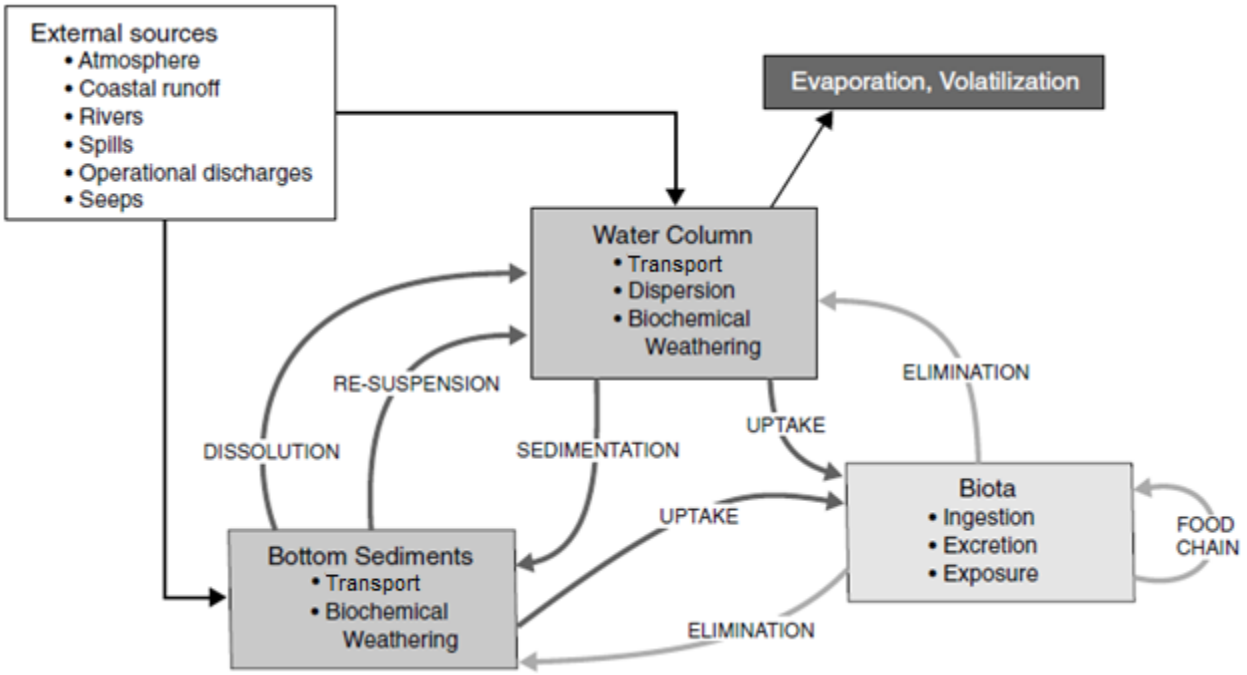

Figure 5-16: Conceptual Model of the Fate of Hydrocarbons in the Marine Environment
Source: Committee on Oil in the Sea, 2003. [10]

[8] Burns et al., 2000
[9] Neff et al., 2000
[10] Committee on Oil in the Sea: Inputs, Fates, and Effects. 2003. Oil in the Sea III: Inputs, Fates, and Effects. The National Academies Press: Washington DC.

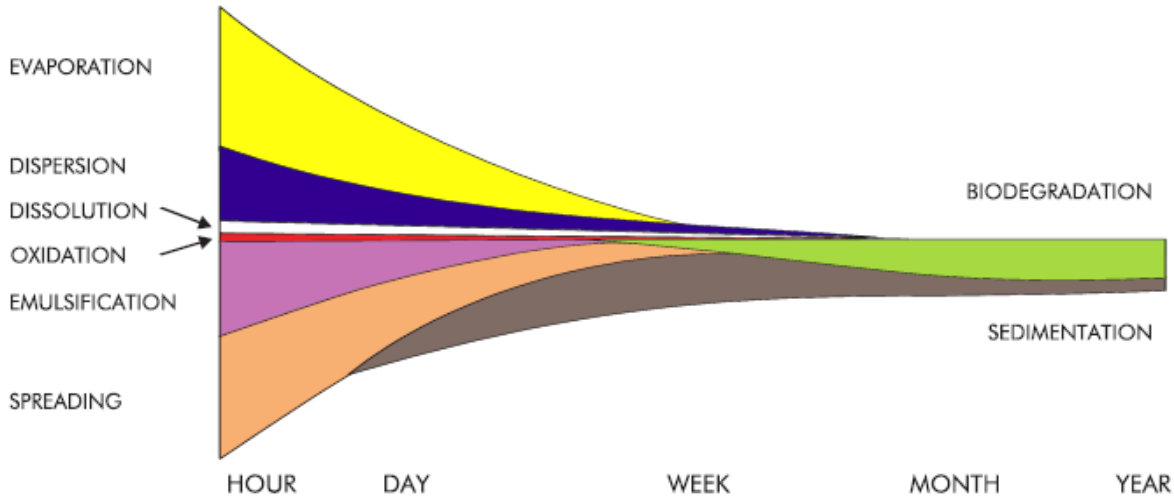

Figure 5-17: Importance of Weathering Components to Crude Oil Spilled into the Marine Environment over Time

Note: Width of each band indicates importance

Source: International Tanker Owner Pollution Federation Limited (ITOPF), 2011[11]

Without mitigation, a worst-case scenario oil spill could cause hydrocarbons to be dissolved or entrained in the water column and/or sea surface. The consequence could have moderate to major impacts to water quality; however, the likelihood of this occurring is considered seldom. Standard industry controls that will be in place to minimize the impact likelihood include careful well design including blowout preventers and other elements to manage risks of blowouts, and an emergency response plan to help respond to a spill quickly and to provide equipment and resources to manage a spill. Response activities will be aligned with the Caribbean Island Oil Pollution Response and Cooperation Plan and The Bahamas Oil Spill Contingency Plan. The consequences of these impacts would be direct, negative, dispersed, reversible (at the habitat level) and medium term. The overall impact to the environment of this activity is **medium**, requiring mitigation to manage the risk (C = 2, L = 1, and thus I = medium). Multiple mitigation and management activities will be implemented to limit oil spill impacts; these actions are described in well specific EMP.

As described in Section 5.4.1.1, the drilling process involves storage and use of potentially hazardous materials (impact category 2B1). While such chemicals are only used in small quantities, spill of hazardous liquids during drilling could result in temporary degradation of marine water quality, but Bahamas Petroleum Company expects to avoid the use of hazardous fluids to the extent possible. Such an impact would be moderate and the likelihood seldom; resulting in a **medium** impact rating (C = 1, L = 1, and thus I = medium) , requiring mitigation to manage the risk.

[11] International Tanker Owner Pollution Federation Limited (ITOPF). 2011. Technical Information Paper No. 2: Fate of Marine Oil Spills. Accessed from the ITOPF Website: http://www.itopf.com/marine-spills/fate/weathering-process/documents/tip2.pdf

5.4.2.2 Potential Degradation of Marine Water Quality – Drilling Discharges (2E2 and 2K1)

Offshore drilling involves sources of impact to marine water quality other than a potential oil spill. In addition to the uncontrolled release described above, there are also controlled releases, such as discharge of:

- Drill cuttings
- Water based drilling mud and fluids, and
- Bilge water
- Deck drainage
- Ballast water

Discharge of sewage and food are discussed in Section 5.4.4.2.

As potential hydrocarbon formations are expected to be low-pressure, Bahamas Petroleum Company expects to drill the wells with seawater and periodic sweeps of water-based drilling mud/fluids (WBM) to clean the well bore. WBMs are relatively cheap compared to other mud types and are generally considered to be relatively benign drilling muds. Bahamas Petroleum Company does not expect to utilize synthetic based drilling fluids (SBM), but these could be used for operational or safety reasons if unexpected formations or pressures are encountered. Bahamas Petroleum Company will not utilize oil or diesel-based muds. Due to the absence of a riser system during the drilling of the uppermost portions of a well, drill cuttings and muds will be discharged directly to the seabed. This discharge to sea is standard industry practice, even in the most environmentally sensitive areas and is largely accepted by environmental protection authorities globally. Once the riser is installed, fluids will be returned to the surface, cleaned and cuttings discharged overboard, assuming they meet pre-agreed limits of contaminants. Any cuttings not meeting these pre-agreed limits, will be stored on-board for transport to the shore base and eventual disposal at an approved, licensed facility.

Discharge of drill cuttings and WBM (if needed) will cause a short term and localized degradation of marine water quality in the direct vicinity of the drill site. WBMs are water-soluble and would be suspended in the water column temporarily. Discharged cuttings will quickly settle to the sea floor. Measurements of plumes of exploratory drilling rigs in the Gulf of Mexico showed less than 10 PPM of suspended solids 24 meters from the discharge pipe and at 100 m concentrations were near background levels.[12] Most suspended solids tend to settle out within 200 m from the discharge point, but thin accumulations can be found 1 km or more depending on the water depth and current speeds. [13]

If SBM are required, no SBM or cuttings containing SBM would be discharged to sea. Due to the increased cost of SBMs and environmental considerations, SBMs would be recovered to the rig for recycling.

Discharges of cuttings will cause a localized (generally less than 200 m radius from well) increase in water turbidity and minor changes in water quality. Oil on cuttings will be measured by a trained lab technician on the drilling rig prior to discharge. Bahamas Petroleum Company will follow good

[12] Shinn, E. A., J. H. Hudson, D. M. Robbin, and C. K. Lee. 1981. Drilling mud plumes from offshore drilling operations-implications for coral survival. Pages 471-496 in R. A. Geyer, ed. Marine environmental pollution I: hydrocarbons. Elsevier/North Holland.

[13] Neff, J. 2005. Composition, Environmental Fates, and Biological Effect of Water Based Drilling Muds and Cuttings Discharged to the Marine Environment: A Synthesis and Annotated Bibliography. Prepared for Petroleum Environmental Research Forum (PERF) and American Petroleum Institute (API). Retrieved from the PERF website: http://www.perf.org/pdf/APIPERFreport.pdf

international industry practice and limit oil on cuttings to less than 1%. As no cuttings associated with SBM will be discharged, the only source of oil would be contaminants from hydrocarbon bearing zones. Drilling fluid pressure will exceed the reservoir pressure ("overbalanced"); therefore, formation fluids returning with the drill cuttings would likely be limited. These impacts are rated as minor given the volume of the surrounding ocean environment where localized temperature increase and low level pollution can be quickly absorbed.[14] The consequence of discharge of cuttings and fluids to water quality is moderate, and the likelihood is occasional (for WBM) or probable (for cuttings), resulting in an impact rating of **medium** (C = 2, L = 2-3, and thus I = medium), requiring mitigation to reduce the risk. This impact would be negative, direct, reversible and short-term.

Bilge water and drainage from machining and engineering areas are likely to contain hydrocarbons and/or chemicals. Waters from these areas will be separated from clean water drainage and routed to the oily water treatment system. Overboard discharge from the oily water treatment system will be monitored periodically to ensure the system is efficiently removing oil prior to discharge. Liquid waste resulting from rainfall, rig washing, deck washings, tank cleaning operations, and runoff from curbs and gutters will also be passed through the oil/water separator. Spillage of drilling fluids would be collected in the deck drainage system on the drilling rig and treated prior to discharge.

Discharge from the oil water treatment system is common for marine activities and is regulated by MARPOL 73/78, Annex I requirements. MARPOL requires all such discharges to have less than 15 mg/l of oil concentration. Similarly, any water required for storage displacement (ballast water) would meet MARPOL requirements and standard controls will be implemented to prevent the introduction/spread of harmful aquatic organisms. The drilling process will also require cooling water. Typical cooling water systems on modern rigs utilize 'closed loop' systems that do not require discharge of heater water to the marine environment.

In some ships, sea water is loaded into ballast tanks to improve stability, balance and trim, particularly in poor weather or rough seas. In required, ballast water will be exchanged in international waters according to IMO requirements, to prevent the introduction of non-native species to Mozambican waters. Ballast water exchange protocols are defined in ship-specific Ballast Water Discharge Management Plans.

Most operational discharges are diluted and dispersed in the ocean waters at the point of discharge. The impact to the environment is minimized by following international requirements (i.e. MARPOL) and other industry practices. The likely impacts on water quality resulting from routine drilling discharges will be adverse, reversible, short term and dispersed. The consequence of these potential disturbances is minor, and the likelihood probable, resulting in an impact rating of **low** (C = 1, L = 3, and thus I = low). However, if systems fail and discharges are released into the environment untreated, the impact consequence could be considered moderate. However, the likelihood of this occurring is considered seldom, resulting in an impact rating of **medium** (C=2, L=1, and thus I=medium), requiring mitigation to reduce the risk.

[14] Motu, U.E and L. Pinturier. 2008. Zero Harmful Impact from Drilling Discharges: Where are the Limits? Society of Petroleum Engineers International Conference on Health, Safety and Environment in Oil and Gas Production; Nice, France.

5.4.2.3 Potential Harm to Marine Fauna

In the rigging-up and mobilization phase, potential impacts were identified to marine fauna from various sources of water quality degradation. During drilling, the primary potential source of water quality degradation would be an accidental oil spill.

Potential Impact to Fish from Oil Spill (2A2) - An accidental oil spill caused by loss of well control could impact marine habitat and lead to localized mortalities of sensitive species directly impacted by a spill. The severity of the impact depends on the type of marine organism and the size of the spill. Most of the oil that would be spilled to the marine environment from a subsea well in the unlikely event of a release would float on the water's surface, but some components may also sink to the seabed or become suspended in the water column.

In the event oil becomes suspended in the water column:[15]

> *"[Fish] may come into direct contact and contaminate their gills; the water column may contain toxic and volatile components of oil that may be absorbed by their eggs, larvae, and juvenile stages; and they may eat contaminated food. Fish that are exposed to oil may suffer from changes in heart and respiratory rate, enlarged livers, reduced growth, fin erosion, a variety of biochemical and cellular changes, and reproductive and behavioral responses. Chronic exposure to some chemicals found in oil may cause genetic abnormalities or cancer in sensitive species. If chemicals such as dispersants are used to respond to a spill, there may be an increased potential for tainting of fish and shellfish by increasing the concentration of oil in the water column."*

However, Hjermann et al. report that because dispersed and dissolved oil typically leaves the water column rapidly following even a large spill, mainly through evaporation, dilution, and microbial degradation, marine pelagic fish rarely are exposed to high enough concentrations of toxic fractions of oil for long enough to result in high levels of lethal and sub-lethal effects.[16] This potential impact would be negative, direct, dispersed, reversible (at the habitat level) and medium term. Potential impacts to fish from oil spill could have moderate effects on the potentially affected organisms, but the likelihood of a spill is seldom, resulting in a **medium** impact (C = 2, L = 1, and thus I = medium). Mitigation is required to manage the risk.

Potential Impact to Plankton, Fish Eggs and Larvae from Oil Spill (2A2) – Plankton, fish eggs and larvae are also abundant in the marine environment. These organisms passively float in the currents, some at the sea surface. A large hydrocarbon spill could cause a die-off of these organisms in the affected area causing a moderate to major environmental consequence with a likelihood of seldom, resulting in a **medium** impact (C = 2/3, L = 1, and thus I = medium). Mitigation is required to manage the risk. This impact would be negative, direct and medium term but reversible given the fast reproductive rates and widely distributed abundance of these species.

Potential Impact to Marine Mammals and Sea Turtles from Oil Spill (2A2) – Species of marine mammals and sea turtles could be affected by oil spills through various pathways: surface contact,

[15] United States Environmental Protection Agency (US EPA), Office of Emergency and Remedial Response, Oil Program Center. 1999. Understanding Oil Spills and Oil Spill Response. Retrieved from the US EPA website: http://www.epa.gov/oem/docs/oil/edu/oilspill_book/chap5.pdf

[16] Hjermann, D.Ø., A. Melsom, G.E. Dingsør, J.M. Durant, A.M. Eikeset, L.P. Røed, G. Ottersen, G. Storvik, and N.C. Stenseth. 2007/. Fish and Oil in the Lofoten-Barents Sea system: Synoptic Review of the Effect of Oil Spills on Fish Populations. Mar. Ecol. Prog. Ser. 330:283-299.

inhalation, ingestion, and baleen fouling.[17] Although marine mammals and sea turtles live and/or migrate through the study area, they are much less common than fish or plankton and are able to avoid potential spills. In the event that marine mammals are directly exposed, "...oil can result in temporary eye problems. Ingestion of oil can result in digestive tract bleeding and in liver and kidney damage. Ingestion of oil is of greater concern for species that groom themselves with their mouth... ".[18]

Sea turtles are particularly vulnerable as they lack avoidance behaviour, indiscriminately feed in convergence zones (sub-sea plumes are likely to be carried to these regions) and take large pre-dive inhalations. "Oil effects on turtles include increased egg mortality and developmental defects, direct mortality due to oiling in hatchlings, juveniles, and adults; and negative impacts to the skin, blood, digestive and immune systems, and salt glands."[19] Further, sea turtles are known to nest along adjacent coastlines[20], and potential oiling of these beaches could reduce sea turtle reproduction rates.

Considering the rarity of many marine mammals and sea turtles, mortality of even a few individuals would be considered a moderate to major consequence, resulting in a **medium** impact requiring mitigation to manage the risk (C = 3, L = 1, and thus I = medium). This potential impact would be negative, direct, dispersed, and reversible (at the habitat level) and medium term (given the reproductive cycles of these species).

Potential Impact to Pelagic and Inshore Seabird Species from Oil Spill (2A2) – Chronic and acute oil pollution is recognized as a significant threat to both pelagic and inshore seabird species. The International Bird Rescue Center describes how seabirds can be impacted by oil spills to water bodies:[21]

> *The majority of deaths attributable to oil pollution amongst seabirds are due to the physical properties of the oil and damage to the water repellent properties of the birds' plumage. This allows water to penetrate, decreasing buoyancy and leading to sinking and drowning. Additionally, thermal insulation capacity is reduced requiring greater use of energy to combat cold. Instinctively, the bird tries to get the oil off its feathers by preening, this results in the animal ingesting the oil. This ingestion can cause severe damage to the bird's internal organs. The focus on preening overrides all other natural behaviors; including feeding and evading predators, making the bird vulnerable to secondary health problems such as severe weight loss, anemia, predation and dehydration*.

The area in which drilling will occur is far from shore; however, there are extensive areas of estuarine marshes and mangroves along the adjacent coastlines. There are a number of wild bird reserves located southeast of Andros and two RAMSAR Wetlands of International Importance

[17] Geraci, J.R. 1990. Physiologic and Toxic Effects on Cetaceans. In: Geraci, J.R. and D.J. St. Aubin, eds. Sea Mammals and Oil: Confronting the Risks. San Diego, CA: Academic Press, Inc. Pp. 167-197.

[18] United States Environmental Protection Agency (US EPA), Office of Emergency and Remedial Response, Oil Program Center.

[19] Shigenaka et. al. 2003. Oil and Sea Turtles: Biology, Planning and Response. National Oceanic and Atmospheric Administration, Office of Response and Restoration. 2003. http://response.restoration.noaa.gov

[20] Dow, W., Eckert, K., Palmer, M. and P. Kramer. 2007. The Wider Caribbean Sea Turtle Conservation Network and The Nature Conservancy. WIDECAST Technical Report No. 6: An Atlas of Sea Turtle Nesting Habitat for the Wider Caribbean Region. Beaufort, North Carolina. 267 pages.

[21] International Bird Rescue Center (IBRC). 2008. How Oil Affects Birds. Retrieved from IBRC Website: http://www.ibrrc.org/oil_affects.html

(Buena Vista and Humedales del Norte de Ciego de Avila) are located on the Cuba coast, approximately 25 miles (~40 km) south of the well site. Worst case oil spill trajectory modelling shows oil making shoreline impact with the Cuban coast near these areas within 2 days. These areas are of particular importance to wading and other shoreline species. This potential impact would be negative, direct, temporary dispersed, reversible (at the habitat level) and medium term. This impact could have a major consequence if sensitive areas are affected, but the likelihood would be seldom resulting in a **medium** impact. Mitigation is required to manage the risk (C = 3, L = 1, and thus I = medium).

Potential Harm to Marine Fauna from Fuel or other Hazardous Material Spill during Storage or Use (2B2) – Drilling involves storage and use of potentially hazardous materials. The largest quantity of hazardous material stored is fuel oil (up to approximately 28,000 bbls). Other potential hazardous materials include brine, base oil, drilling fluid and additives, paint thinner, adhesives and other chemicals used in small quantities.

As described in section 5.4.1.2, a spill of fuel or other hazardous material could have a localized impact in water quality and harm wildlife. The potential impact of an accidental spill or leak on wildlife, in particular threatened species, is considered moderate consequence, but the likelihood of this scenario occurring is seldom, resulting in a **medium** impact, requiring mitigation to manage the risk (C = 2, L = 1, and thus I = medium).

Potential Impact to Marine Fauna from Noise and Vibration (2G1, 2H1) – Studies of the effects of underwater sound on marine life are generally concerned with anthropogenic sounds that overlap in frequencies with the hearing range of marine organisms. An exception is the case of high amplitude impulsive sounds or explosions where peak sound pressure is the important factor.

The potential effects of sound on marine fauna can be broadly categorized as follows:

- **Reduced availability of prey**: Indirect effects from alteration of prey abundance, behaviour and/or distribution.
- **Behavioural disturbance**: Increase stress and change in behaviours in reaction to sounds.
- **Auditory signal masking**: Reduction in an animal's ability to perceive, recognize or decode biologically relevant sounds because of interfering sounds.
- **Temporary and permanent hearing loss**: Physical impacts to an animal's auditory structures from exposure to intense sounds potentially leading to losing hearing sensitivity. A temporary threshold shift (TTS) is hearing loss that persists only for minutes or hours, whereas a permanent threshold shift (PTS) is indefinite. The severity of TTS is expressed as the duration of hearing Impairment (lowered sensitivity in the bandwidths in which the noise was centred) and the magnitude of the shift in hearing sensitivity relative to pre-exposure sensitivity.
- **Physiological trauma and mortality:** Physical harm.

References to TTS, PTS, and behavioural thresholds are described for each fauna type as available and as described by the best available science. The point at which an animal receives enough acoustic energy to incur any of the above impacts is considered the acoustic threshold for that impact. Acoustic thresholds are received sound levels that meet current scientific criteria as sufficient for eliciting the onset of a physiological effect (e.g., injury, mortality) or a behavioural response in a given marine species. Threshold criteria are used to determine impact levels and the potential for acoustic exposures at levels that may constitute a mitigation action. Thresholds are defined for marine mammals, sea turtles, and fish; although the thresholds for each faunal group are defined for different sources and may have a slightly different context and application.

Impulsive source (e.g. airguns, pile driving) criteria are typically presented as two physiological thresholds, one for peak sound pressure level (SPL_{pk}) and one for cumulative sound exposure level (SEL_{cum}), reflecting the different potential exposure characteristics of the sound source which may cause physiological impacts; and one for root-mean-square sound pressure level (SPL_{rms}), which is used for behavioural impact assessments. Non-impulsive sources (e.g drilling, vessel noise) are presented as SEL_{cum} for physiological thresholds and SPL_{rms} as behavioural thresholds as they do not have the characteristic peak (rapid rise and fall times) in energy as seen in impulsive sources.

The mechanism by which marine fauna are impacted by underwater noise varies by taxa. Fish have two different systems to detect sounds, including:

- The ear and the otolith organ of the inner ear that is sensitive to sound pressure
- Interaction between the swim bladder and inner ear
- The lateral line organ that is sensitive to particle motion

Most species of fish are able to detect sounds from below 50Hz to upward of 1,000Hz (Popper et al., 2014)[22]. Within the frequency range of 100 to 1,000Hz at which most fish hear best, hearing thresholds vary considerably (50 and 110dB re 1µPa).

An understanding of sea turtle hearing and acoustic perception is less developed than for other species. Sea turtle hearing is likely restricted to frequencies below 2 kHz (Blackstock et al., 2018)[23] and sea turtles likely respond to acoustic cues for feeding, navigating, and sheltering. Finneran and Jenkins (2012)[24] developed TTS criteria for sea turtles based on criteria for low frequency cetaceans, with the inclusion of an auditory weighting function for sea turtles. However, Popper et al. (2014) concluded that sea turtle hearing is better represented by data from fishes than from marine mammals because the functioning of the inner ear of sea turtles is dissimilar to that of mammals.

Importantly, most of the acoustic thresholds established for fish and sea turtles are based on impulsive sound sources, namely pile driving, and therefore may not be fully applicable in predicting impacts from non-impulsive sources. There are four accepted references for defining acoustics thresholds in sea turtles and fish: Popper et al. (2014), National Marine Fisheries Service (NMFS) Greater Atlantic Fisheries Office pile driving acoustic tool (GARFO, 2019)[25], the Fisheries Hydroacoustic Working Group memorandum (FHWG, 2008)[26], and a recent analysis of acoustic impacts to marine mammals and sea turtles published by the U.S. Navy (Blackstock et

[22] Popper, A.N., AD. Hawkins, R.R. Fay, D. Mann, S. Bartol, T. Carlson, S. Coombs, W.T. Ellison, R. Gentry, M.B. Halvorsen, S. Lokkeborg, P. Rogers, B.L. Southall, D.G. Zeddies, and W.N. Tavolga. 2014. Sound exposure guidelines for fishes and sea turtles: A technical report. Prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI. New York, NY: Springer Press.

[23] Blackstock SA, Fayton JO, Hulton PH, Moll TE, Jenkins K, Kotecki S, Henderson E, Bowman V, Rider S, Martin C. 2018. Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing. Newport, RI: Naval Undersea Warfare Center Division. NUWC-NPT Technical Report. 51 pp.

[24] Finneran, J.J. and Jenkins, A.K., 2012. Criteria and thresholds for US Navy acoustic and explosive effects analysis. SPACE AND NAVAL WARFARE SYSTEMS CENTER PACIFIC SAN DIEGO CA.

[25] NMFS Greater Atlantic Fisheries Office (GARFO). 2019. Acoustic Tool. Available at https://www.fisheries.noaa.gov/webdam/download/97049475

[26] Fisheries Hydroacoustic Working Group, 2008. Memorandum from the Fisheries Hydroacoustic Working Group to Applicable Agency Staff, Regarding Agreement in Principle for Interim Criteria for Injury to Fish from Pile Driving Activities. 3p.

al., 2018). These sources include criteria for physiological effects that may be categorized as injury; however, Popper et al. (2014) concedes that injury includes a very wide spectrum of physiological effects, and even those sound sources that have the potential for injury will likely vary greatly by context and biological conditions.

For non-impulsive sound sources, Popper et al., (2014) provides thresholds for recoverable injury and TTS only for fish with swim bladders involved with hearing (presumably the most sensitive group); but does not present thresholds for fish behavior or any sea turtle thresholds for non-impulsive sounds. For these, we rely on the FHWG (2008) for fish behavioral thresholds; GARFO (2019) sound exposure level (SEL) thresholds for PTS and TTS onset in sea turtles; and on Blackstock et al., (2018) for onset of behavioral responses in sea turtles (Table 5-10).

Table 5-10: Acoustic Threshold Levels for Fish and Sea Turtles

Faunal Group	Acoustic Thresholds for non-impulsive sound sources[a]			
	Recoverable Injury	PTS	TTS	Behavior
Fish with swim bladders involved in hearing[b]	$SPL_{rms,48hr}$ = 170 dB re 1 µPa[d]	--	$SPL_{rms,12hr}$ = 158 dB re 1 µPa[e]	SPL_{rms} = 150 dB re 1 µPa
Adult Sea Turtles[c]	--	SEL = 204 dB re 1 μPa^2s	SEL = 189 dB re 1 μPa^2s	SPL_{rms} = 175 dB re 1 µPa

dB re 1 µPa = decibels reference to 1 micropascal; *dB re 1 μPa^2s* = decibels referenced to 1 micropascal squared seconds; *PTS* = permanent threshold shift; *SPLrms* = root-mean-square sound pressure level; *SEL* = sound exposure level; *TTS* = temporary threshold shift.
[a] There are no PTS,TTS sea turtle thresholds specific to non-impulsive sources; therefore the most recent SEL impulsive thresholds were used.
[b] Injury and TTS thresholds from Popper et al., (2014); behavior thresholds from FHWG, (2008).
[c] PTS and TTS thresholds from GARFO, (2019); behavior threshold from Blackstock et al., (2018).
[d] 48-hour continuous exposure to SPL_{rms} value
[e] 12-hour continuous exposure to SPL_{rms} value

Recognizing that marine mammal species do not have equal hearing capabilities, marine mammals are separated into hearing groups (Southall et al., 2007[27], 2019[28]; NMFS, 2018[29]). To account for these hearing groups, frequency weighting functions are applied when determining acoustic thresholds in order to scale a species' sensitivity to a received sound depending on the spectral content of that sound. In effect, sound energy contained within the frequency hearing range of an animal has the potential to impact a species while sound energy outside an animal's frequency hearing range is unlikely to impact a species. The overall objective in defining hearing groups and deriving frequency weighting functions is to better define the role that frequency content plays in potential auditory injury. Precise hearing ranges of various species groups vary slightly by published source. Hearing ranges published by the NOAA National Marine Fisheries Service (NMFS, 2018) and Southall *et al.* (2007,2019) for species hearing groups that may occur in the project area are presented below (Table 5-11). The most commonly encountered marine mammal species in the Bahamas belong to the mid-frequency cetacean group indicated below.

[27] Southall BJ, Bowles AE, Ellison WT, Finneran JJ, Gentry RL, Greene Jr. CR, Kastak D, Ketten DR, Miller JH, Nachtigall PE, Richardson WJ, Thomas JA, Tyack PL. 2007. Marine mammal noise exposure criteria: Initial scientific recommendations. Aquatic Mammals 33(44):411-521.
[28] National Marine Fisheries Service (NMFS). 2018. 2018 Revisions to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Department of Commerce, National Oceanic and Atmospheric Administration. NOAA Technical Memorandum NMFS-OPR-59. 167 pp.
[29] Southall BL, Finneran JJ, Reichmuth C, Nachtigall PE, Ketten DR, Bowles AE, Ellison WT, Nowacek DP, Tyack PL. 2019. Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects. Aquatic Mammals 45(2):125-232.

Table 5-11: Marine Mammal Hearing Groups

NMFS (2018), Southall (2007) Hearing Groups and Generalized Hearing Range	Southall et al. (2019) Hearing Group Designation	Example Species or Taxonomic Groups that may occur in the project area
LF Cetacean (7 Hz to 35 kHz)	LF Cetaceans	Baleen whales (e.g., fin whale, minke whale, humpback whale)
MF Cetacean (150 Hz to 160 kHz)	HF Cetaceans	Dolphins (e.g., Atlantic spotted dolphin, Pantropical spotted dolphin, spinner dolphin, Risso's dolphin, common bottlenose dolphin) and toothed whales (e.g., beaked whales, sperm whale, blackfish)
HF Cetacean (275 Hz to 160 kHz)	VHF Cetaceans	Porpoises, Kogia spp.

HF = high-frequency; LF = low-frequency; MF = mid-frequency; VHF = very high-frequency.

The PTS onset and behavioural response thresholds resulting from non-impulsive sound sources on marine mammal hearing groups are shown in Table 5-12. PTS thresholds use frequency weighting, while currently, behavioural thresholds are not frequency-weighted, although frequency content of the propagated sound should be considered when assessing impacts.

Table 5-12: Marine Mammal PTS and Behavioral Acoustic Thresholds

Faunal Group	PTS Thresholds		Behavioral Threshold	
	Acoustic Metric	Threshold Value	Acoustic Metric	Threshold Value
LF Cetaceans	$SEL_{cum,24hr}$	199 dB re 1 μPa^2 s	SPL_{rms}	120 dB re 1 µPa
MF Cetaceans	$SEL_{cum,24hr}$	198 dB re 1 μPa^2 s		
HF Cetaceans	$SEL_{cum,24hr}$	173 dB re 1 μPa^2 s		

µPa = micropascal; dB = decibel; HF = high-frequency; LF = low-frequency; MF= mid-frequency; PPW = phocid pinnipeds in water; re = referenced to; $SEL_{cum,24hr}$ = cumulative sound exposure level over a 24 hour period; SPL_{rms} = root-mean-square sound pressure level

Unless otherwise specified, the SEL metric typically assumes a 24-hour accumulation period. Likewise, the SPL_{rms} metric is typically measured over a period of a second; but may have an exposure period that does not account for an accumulation of sound energy. When distances to threshold criteria are estimated based on the sound source and propagation characteristics, the distances are estimated with the assumption that a receiver (i.e., animal) is stationary and exposed to the sound for the entire accumulation period. Therefore, these ranges represent the maximum extent (largest radial distance) possible at which the animal could receive enough sound energy to exceed acoustic thresholds and may overestimate the actual distances at which animals receive exposures meeting the threshold criteria.

Responses of marine mammals exposed to underwater anthropogenic sounds are variable and range from no effect to injury. The magnitude of the effect appears to depend on a combination of various factors, such as spatial relationships between a sound source and the animal, hearing sensitivity of the animal, received sound exposure, duration of exposure, duty cycle, and ambient sound level.[30]

[30] US Dept. of Interior, Bureau of Ocean Energy Management. 2016. Gulf of Mexico OCS Proposed Geological and Geophysical Activities Western, Central and Eastern Planning Areas, Draft Programmatic

The project sound sources that have the potential to result in acoustic impact to marine species include drilling and thruster noise from dynamically positioned vessels. According to Richardson, et al. (1995) , drilling operations often produce noise that includes strong tonal components at low frequencies.[31] Sound and vibration paths to the water are predominantly through either the air or the risers. Underwater noise from drilling ranges from about 20 to 40 dB above background levels within a frequency spectrum of 30-300 hertz (Hz) at a distance of 30 m from the source. These levels vary with rig/platform type and water depth, but are generally below or at the lower end of the hearing range for mid- and high-frequency hearing cetaceans (see Table 5-11).

Shallow water (13- 50m) drilling had frequency composition between 20 Hz and 24 kH with root-mean-square source levels (SL_{rms}) between 142 and 160 dB re 1µPa at 1 m (Erbe and McPherson, 2017)[32]. Drillships produce higher levels of underwater noise than semisubmersibles as their hulls, which contain drilling machinery, are well-connected to the water (more so than semisubmersible or jack-up drilling rigs or fixed platforms). Richardson (1995) reported semisubmersible drilling noise at 10 Hz to 4 Khz with a SL_{rms} up to 154 dB re 1µPa at 1 m; and drilling noise from a drillship with noise centred at 10-600Hz (at the very bottom of MF/HF cetacean hearing) with SL_{rms} of 191 dB 1µPa at 1 m.

The exploratory drilling will be conducted by a dynamically positioned (DP) drillship. DP vessels produce higher levels of underwater noise than fixed platforms. This is due to additional noise from thrusters and propellers as well as the larger surface area in contact with the water, which produces greater vibration into the water column. However, the noise level is similar to that of a tanker or large cargo vessel. In areas with significant shipping traffic, the noise contribution of additional sources such as a DP vessel or drillship to the overall sound scape becomes highly localized and less perceptible because of the already high sound pressure levels within the same frequency ranges. Figure 2-1 shows an annual shipping density map that includes the project area. The close proximity of this high density shipping route to the project area suggests that there is already a very high sound level centred in frequencies below 1000 Hz contributing to the soundscape of the region and the contribution of the project sound sources will reach background conditions in a relatively short distance.

Environmental Impact Statement. Available at: https://www.boem.gov/gulf-of-mexico-geological-and-geophysical-activities-programmatic-eis/

[31] Richardson, W.J., C.R. Greene, C.I. Malme, and D.H. Thomson. 1995. Marine Mammals and Noise. San Diego, CA: Academic Press.

[32] Erbe, C. and McPherson, C., 2017. Underwater noise from geotechnical drilling and standard penetration testing. *The Journal of the Acoustical Society of America*, *142*(3), pp.EL281-EL285.

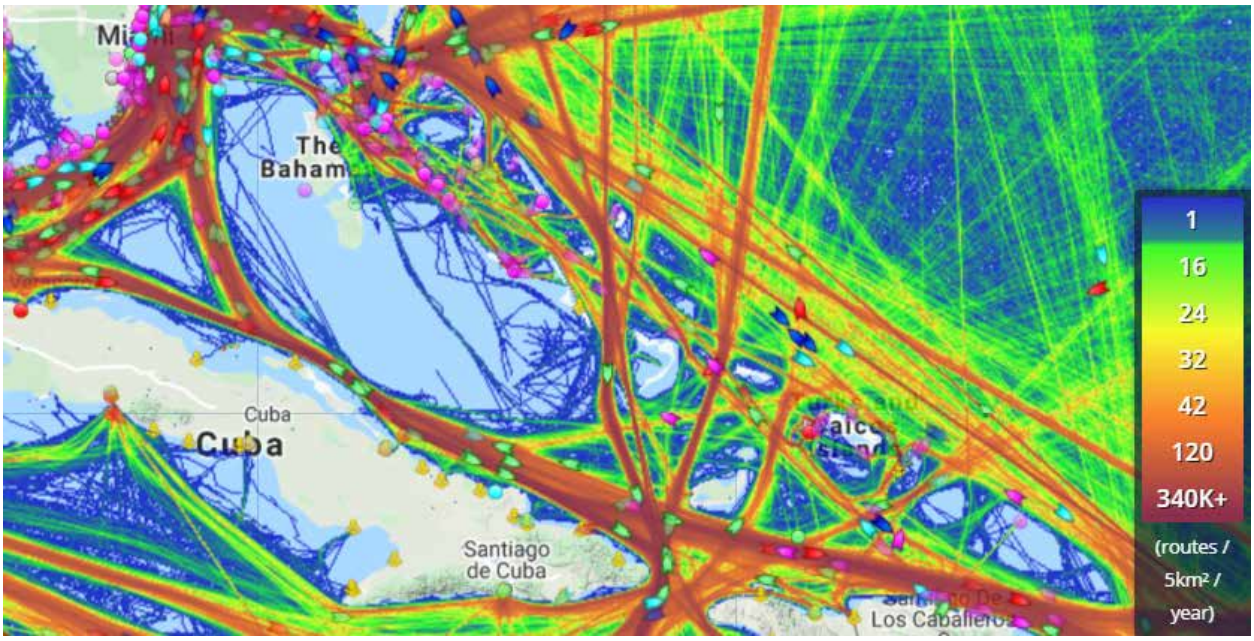

Figure 5-18: Vessel density map based on Automatic Identification System (AIS) data over one year.
Source: MarineTraffic – Global Ship Tracking Intelligence[33]

Underwater noise produced by drillships decreases in intensity with distance from the drillship. When measured offshore Greenland (during drilling operations in ~1600 ft [~500 m] water depth), underwater noise was at approximately ambient levels when measured 8-11 km from the source.[34] When normalized for various cetacean hearing groups (M-weighted sound levels), received sound level (at the source of the drillship sound) is lowest for high- frequency hearers, and highest for low-frequency hearers. However, there is only a small difference in these received sound levels between groups (approximately 5 dB), and all of the received sound levels are well below the injury threshold levels shown above. [34] Drillship-produced underwater noise is generally more intense during maintenance operations than drilling operations, but again, is significantly below the injury threshold for all marine mammal taxa and generally equivalent to sound produced by merchant vessels. [34]

Dynamic positioning systems of drillships also produce underwater sound that is not directly associated with the thruster or propeller activities: transponders placed on the seabed transmit pulses of sound to receivers on the drillship to automatically control the vessel's thrusters and propellers in order to maintain position. A 2011 report on noise produced by a drillship of equivalent specifications to the vessel planned for use in the Bahamas indicates that these transponders produce sounds between 30 and 50 dB re: 1μPa^2/Hz in a frequency range of 21.5 – 30.5 kHz.[34] This sound intensity is well below the injury or behaviour thresholds for marine species.

There are limited data on hearing mechanisms and potential effects of noise on invertebrate prey species (i.e., crustaceans, cephalopods). Invertebrates appear to be able to detect sounds and

[33] MarineTraffic. 2020. Available at: www.marinetraffic.com
[34] Kyhn, L.A., Tougaard, J. & Sveegaard, S. 2011. Underwater noise from the drillship Stena Forth in Disko West, Baffin Bay, Greenland. National Environmental Research Institute, Aarhus University, Denmark. 30 pp. – NERI Technical Report No. 838. http://www.dmu.dk/Pub/FR838.pdf

particle motion (André et al., 2016[35]; Solé et al., 2016[36], 2017[37]) and are most sensitive to low frequency sounds (Budelmann and Williamson, 1994[38]; Mooney et al.,2010[39]). However, the acoustic sensory system of decapods and cephalopods remains poorly studied (Popper et al., 2014). Given the relatively low sound levels and temporary nature of drilling operations, acoustic impacts to plankton, benthos, and fish would be negligible. Injury or death of marine mammals from drillship noise is highly unlikely due to the low sound levels relative to temporary and permanent threshold shift levels. Noise from drilling and drillship operations as described above may interfere with or mask the sounds used and produced by marine mammals and sea turtles and thereby interfere with their natural behaviour.[40] [41] [42] [43] [44] [45] [46] However, the proposed drilling location is at the edge of a busy shipping lane used by commercial vessel traffic, so behavioural changes due to underwater noise are unlikely to be substantially different from behaviour changes these animals currently exhibit in response to large vessels. Blainville's beaked whales [*Mesoplodon densirostris*] have been shown to change their foraging behaviours up to 3.2 miles [5.2 km] from broadband vessel noise sources[47].

Vibrations will be caused by the drilling rig from the use of internal combustion engines, electric motors, pumps, pulling drill strings and other rotating/moving equipment, although use of some of these vibration sources will be short and temporary. It is possible that these vibrations could have a temporary effect on benthic and pelagic life. Vibrations will be minimized by equipment being maintained in good condition.

A number of impacts, ranging from interference with the detection of biologically relevant sound signals, to behavioural disturbance, hearing loss and in the worst cases injury and death have

[35] André M, Kaifu K, Solé M, van der Schaar M, Akamatsu T, Balastegui A, Sánchez AM, Castell JV. 2016. Contribution to the Understanding of Particle Motion Perception in Marine Invertebrates. In: AN Popper, A Hawkins (Eds.), The Effects of Noise on Aquatic Life II. New York, NY: Springer New York. pp. 47-55.

[36] Solé M, Lenoir M, Fortuño JM, Durfort M, van der Schaar M, André M. 2016. Evidence of Cnidarians sensitivity to sound after exposure to low frequency underwater sources. Scientific Reports 6:37979.

[37] Solé M, Sigray P, Lenoir M, van der Schaar M, Lalander E, André M. 2017. Offshore exposure experiments on cuttlefish indicate received sound pressure and particle motion levels associated with acoustic trauma. Scientific Reports 7:45899.

[38] Budelmann BU, Williamson R. 1994. Directional sensitivity of hair cell afferents in the Octopus statocyst. The Journal of Experimental Biology 187(1):245.

[39] Mooney TA, Hanlon RT, Christensen-Dalsgaard J, Madsen PT, Ketten DR, Nachtigall PE. 2010. Sound detection by the longfin squid (*Loligo pealeii*) studied with auditory evoked potentials: sensitivity to low-frequency particle motion and not pressure. The Journal of Experimental Biology 213(21):3748.

[40] Ridgway, S.H., E.G. Wever, J.G. McCormick, J. Palin, and J.H. Anderson. 1969. Hearing in the Giant Sea Turtle, Chelonia mydas. In: Proceedings of the National Academy of Sciences. 64(3):884-890.

[41] Lenhardt, M.L., S. Bellmund, R.A. Byles, S.W. Harkins, and J.A. Musick. 1983. Marine Turtle Reception of Bone-conducted Sound. Journal of Auditory Research 23:119-125.

[42] Moein Bartol, S., J.A. Musick, and M.L. Lenhardt. 1999. Auditory Evoked Potentials of the Loggerhead Sea Turtle (Caretta caretta). Copeia 1999:836-840.

[43] Lenhardt, et al., 1983

[44] Lenhardt, et al., 1983

[45] O'Hara, J. and J.R. Wilcox. 1990. Avoidance Responses of Loggerhead Turtles, Caretta Caretta, to Low Frequency Sounds. Copeia 1990(2):564-567.

[46] McCauley, R.D., J. Fewtrell, A.J. Duncan, C. Jenner, M-N. Jenner, J.D. Penrose, R.I.T. Prince, A. Adhitya, J. Murdoch, and K. McCabe. 2000. Marine Seismic Surveys - a Study of Environmental Implications. APPEA Journal 2000:692-708.

[47] Pirotta E, Milor R, Quick N, Moretti D, Di Marzio N, et al. 2012. Vessel Noise Affects Beaked Whale Behavior: Results of a Dedicated Acoustic Response Study. PLoS ONE 7(8): e42535.

been attributed to underwater sound.[48] However, sound generated during drilling operations is not expected to result in physical harm to any individuals.[49] The consequence of these effects on marine fauna are considered minor and the likelihood is probable, thus resulting in a **low** impact (C = 1, L = 3, and thus I = low). Such impacts would be negative, direct, localized, reversible and short term.

Impacts of noise from vessel operations are discussed in Section 5.4.4.3.

Potential Impact to Marine Fauna from Light (2I1) - Normal drilling operations will be carried out on a continuous 24-hour basis, requiring adequate workspace lighting for a safe work environment during night operations. The lighting will occur at a location where there ordinarily is no light at night, except perhaps for the temporary transition of fishing and other vessels. The Perseverance #1 well is located >40 miles from the nearest coastline (in Cuba) and offshore rigs are typically only visible for ten miles. [50] The new source of light could attract both airborne and seaborne wildlife, especially sea turtles, fish and birds. [51] [52] [53] [54] [55] [56] [57] Sounds generated by the drilling rig are expected to deter marine mammals from approaching the drilling rig; Therefore, they are unlikely to be affected by the lighting.

The likelihood that drilling rig lighting could have a measurable (moderate consequence) impact to marine fauna is negligible. Instead, the impact of lighting is rated for disruption rather than mortality, resulting in a minor consequence, occasional likelihood, and low overall impact rating (C = 1, L = 2, and thus I = low). This potential impact would be negative, direct, dispersed, reversible and short term (over the life of the project).

Potential Impact to Marine Fauna from Operational Discharges (2K2) – As discussed in Section 5.4.2.2, exploration drilling results in numerous routine discharges during operation, such as: drill

[48] OSPAR Commission. 2009. Overview of the Impacts of Anthropogenic Underwater Sound in the Marine Environment.

[49] NCE. 2007. Review of Existing and Future Potential Treatments for Reducing Underwater Sound from Oil and Gas Industry Activities, Report 07-001, prepared for Oil & Gas UK Joint Industry Project on E&P Sound and Marine Life, pp185

[50] Geological Survey of Alabama (GSA). 1998. Governor's Report: Options for Development of Potential Natural Gas Reserves from Central Gulf of Mexico, Mobile Area Blocks 826 and 829.

[51] Russell, R.W. 2005. Interactions between Migrating Birds and Offshore Oil and Gas Platforms in the Northern Gulf of Mexico: Final Report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2005-009. 348 pp.

[52] Owens, D. 1983. Oil and Sea Turtles in the Gulf of Mexico: A Proposal to Study the Problem. In: Keller, C.E. and J.K. Adams, eds. Proceedings, Workshop on Cetaceans and Sea Turtles in the Gulf of Mexico: Study Planning for Effects of Outer Continental Shelf Development. Prepared by the U.S. Dept. of the Interior, Fish and Wildlife Service, for the U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. Pp. 34-39.

[53] Witherington, B.E. and R.E. Martin. 1996. Understanding, Assessing, and Resolving Light-Pollution Problems on Sea Turtle Nesting Beaches. Florida Marine Research Institute Technical Report TR-2, Florida Dept. of Environmental Protection. 73 pp.

[54] Witherington, B.E. 1997. The Problem of Photopollution for Sea Turtles and Other Nocturnal Animals. In: Clemmons, J.R. and R. Buchholz, eds. Behavioral Approaches to Conservation in the Wild. Cambridge, MA: Cambridge University Press. Pp. 303-328.

[55] Chan, E.H. and H.C. Liew. 1988. A Review on the Effects of Oil-based Activities and Oil Pollution on Sea Turtles. In: Proceedings, 11th Annual Seminar of the Malaysian Society of Marine Sciences. Pp. 159-167.

[56] Owens, 1983

[57] Witherington and Martin, 1996

cuttings, water based drilling fluids (if required), deck drainage, macerated food, etc. Most operational discharges are diluted and dispersed in the marine environment at the discharge point. The impact to the environment is minimized through International requirements (i.e. MARPOL) and other industry practices. Studies have shown that impacts to marine life exposed to operational discharges have sub-lethal affects.[58] [59] [60] The likely impacts on marine life resulting from routine drilling discharges will be adverse, reversible, short term and localized. The consequence of these potential disturbances is minor, and the likelihood probable, resulting in an impact rating of **low** (C = 1, L = 3, and thus I = low).

5.4.2.4 Potential Degradation of Sensitive Shoreline Features – Oil Spill (2A3)

As described in Chapter 4, there are a number of areas of coastal sensitivities along the adjacent shorelines. For example, there are mangroves, estuaries, sea grass beds, popular beaches, protected areas, endangered sea turtle nesting sites, and other features important to biodiversity and ecosystem services. Loss of well control can occur, although very infrequently (Section 5.4.2.1). Spill modelling scenarios performed assumed a worst-case spill. Even in a worst case, coastal oiling of most of The Bahamas was unlikely. However, the modelling shows that a spill has the potential to reach sensitive coastal features of Cay Sal and Northern Cuba. Cuba is particularly vulnerable, and oil reaches shores within 2 days (see spill modelling results Section 5.4.2).

Given the distance from shore, existing response capabilities could be mobilized to help limit the potential impact of an oil spill to these sensitive areas. Nonetheless, the possibility exists that the proposed drilling could result in a blowout that would not be able to be contained before fouling the coastline. The likelihood of this impact is best characterized as seldom. However, damage to even small sections of sensitive coastal features could have major consequences. Therefore, the impact rating for this category of impact is **medium** (C = 3, L = 1, and thus I = medium). This impact would be negative, direct, reversible and medium to long-term.

[58] American Petroleum Institute (API). 1989. Effects of Offshore Petroleum Operations on Cold Water Marine Mammals: A Literature Review. Washington, DC: American Petroleum Institute. 385 pp.

[59] National Research Council (NRC). 1983. Drilling Discharges in the Marine Environment. Panel on Assessment of Fates and Effects of Drilling Fluids and Cuttings in the Marine Environment. Marine Board; Commission on Engineering and Technical Systems; National Research Council. Washington, DC: National Academy Press.

[60] Kennicutt II, M.C., ed. 1995. Gulf of Mexico Offshore Operations Monitoring Experiment, Phase I: Sublethal Responses to Contaminant Exposure, Final report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 95-0045. 709 pp.

5.4.2.5 Impact to Benthic Habitat – Cuttings Discharge to the Sea Floor (2E1, 2E3)

While the dispersion of cuttings discharged during drilling depends on a number of factors (water depth and currents, in particular), studies have shown that most settle within 200 m of the well site.[61] Bahamas Petroleum Company plans to drill the wells primarily with sea water with WBM sweeps. Most of the components of the water-based fluids have low toxicity with the exception of some trace metals. Barium is the major element in the mud because of the high barite level, but trace amounts of chromium, copper, cadmium, mercury, lead, and zinc are also present. A study of chronic impacts from oil and gas activities [62] determined that metals from discharges, including mercury and cadmium, were generally localized to within 150 m of the structure, although significant elevations of all these metals except chromium were observed within 500 m of Gulf of Mexico drilling sites.[63]

Use of synthetic based muds (SBMs) is not planned, and SBMs would not be discharged in the unlikely event that they are required for the drilling program. Discharge of drill cuttings to the sea floor could have a minor consequence to the quality of seafloor sediments. The likelihood of impacts to the sea floor sediments is probable. Such impacts would be negative, direct, localized, irreversible and short-term. Therefore, the overall impact to the environment of this activity is **low** (C = 1, L = 2, thus I = low).

Deep-water corals (also known as cold-water corals) have been observed in the greater lease area during past scientific surveys of Grand Bahama Bank. Specifically, cold-water corals were observed during submersible (2007) and ROV dives (2012), in association with scattered boulders or “peaks”. These structural relief components which host corals, tend to be associated with the debris fields found at the Bank’s toe-of-slope. Otherwise, the slopes themselves and the broad basin floors tend to be muddy, and void of such structures.[64]

Discharged cuttings could smother any benthic organisms present that are unable to move from the area. Recovery of macrofauna and other benthic species depends on the thickness of the accumulation and the characteristics of the receiving environment (water depth, temperature and currents).[65]

A study of the effects of cuttings discharges on coral found little impact to growth rates of head corals compared to pre-drilling rates.[66] However, diver observations found a 70-90% reduction in foliose, branching and table-like corals within a 115 x 85-meter ellipse.

Bahamas Petroleum Company will review detailed seafloor mapping and imagery prior to drilling to avoid potential seafloor hazards and sensitivities that might be observed, and cuttings will not

[61] Neff, J. 2005.

[62] Kennicutt II, 1995.

[63] Boothe, P.N. and B.J. Presley. 1989. Trends in Sediment Trace Element Concentrations around Six Petroleum Drilling Platforms in the Northwestern Gulf of Mexico. In: Engelhardt, F.R., J.P. Ray, and A.H. Gillam, eds. Drilling Wastes. New York: Elsevier Applied Science Publishers, Ltd. Pp. 3-20.

[64] Report of high-resolution portion of BPC lease areas in the Bahamas, Jo, Eberli, and Gregor, August 2012

[65] International Association of Oil and Gas Producers (OGP). 2003. Environmental Aspects of the Use and Disposal on Non Aqueous Drilling Fluids Associated with Offshore Oil and Gas Operations: Report No. 342. Retrieved from OGP Website: http://www.ogp.org.uk/pubs/342.pdf

[66] Hudson, J.H., Shinn, E.A, and D.M. Robbin. 1982. Effects of Offshore Oil Drilling on Philippine Reef Corals. Bulletin of Marine Science, 32(4):890-908, 1982.

be discharged to an area of seafloor occupied by a high biodiversity of sensitive benthic communities.

Discharge of drill cuttings to the sea floor could possibly have a moderate consequence impact to benthic communities if sensitive features are located nearby. However, given the controls in place and the localized nature of the cuttings dispersion, the likelihood of this occurring is seldom. Such impacts would be negative, direct, dispersed, reversible and medium term. Therefore, the overall impact to the environment of this activity is **medium**, requiring mitigation to manage the risk (C = 2, L = 1, thus I = medium).

In addition to discharge of cuttings, excess cement used to secure well casings will be deposited on the sea floor during installation of top whole sections (before the marine riser is installed). The amounts of cement are expected to be minimal and will have effects similar to those of cuttings described above (localized smothering).

5.4.2.6 Impact to Benthic Habitat – Disruption of Sediments on the Sea Floor and/or Drill Bit Contact (2D1)

The sea floor will be penetrated by drilling at the well locations. The drill bit could harm any corals or other sensitivities directly at the drill site. Further, the rotation of the drill bit and installation of casing will disrupt sediments at and immediately around the drilling sites and create a very localized and temporary increase in turbidity. This increase in sedimentation and turbidity could adversely impact benthic life forms that cannot move away quickly to avoid the impact. Bahamas Petroleum Company will review detailed seafloor mapping and imagery prior to drilling to avoid potential seafloor hazards and sensitivities that might be observed, and this could help avoid disruption to unusual seafloor features and associated benthic communities that might be more rare or biodiverse than are found elsewhere on the seafloor. This potential impact would be localized, reversible and short term. The consequence of this disturbance is minor, and the likelihood is occasional, resulting in an impact rating of **low** (C = 1, L = 2, and thus I = low).

In addition, a subsea well blow-out could result in the precipitation and accumulation of heavy elements of the oil released (for example, tar balls) on the sea floor. Such impacts could cause localized smothering of benthos and/or contamination of seafloor sediments. This potential impact would likely affect a more expansive area around the well than the sediment disruption from drilling and would have a medium term effect. The consequence of this disturbance is moderate, and the likelihood is seldom, resulting in an impact rating of **medium**, requiring mitigation to manage the risk (C = 2, L = 1, thus I = medium).

5.4.2.7 Degradation of Air Quality (2F1)

Estimated air emissions to be produced from the drilling program are described in Section 2.6.3. Air emissions will be generated from on board equipment such as pumps, generators and diesel engines needed to support the drilling activities. No well testing is planned. Only safety flares will be sued. All emissions produced would be temporary, disperse rapidly in the ocean environment and be located away from the public. Standard procedures will be followed to protect the health and safety of the workforce.

Use of supply vessels and helicopters will also result in emission. Given the distance from shore, harm from emissions to human health is not a concern, given the pollutants will dilute and disperse in the open ocean environment. However, the project will contribute to cumulative additions of global greenhouse gases. In 2009, The Bahamas generated 5,236,000 metric tons of CO_2

emissions.[67] A typical exploration well (not including flaring) produces approximately 2,000 metric tons of CO_2 equivalent per well, mostly from diesel-driven electrical generators and equipment. Drilling of each well would contribute approximately 0.038% to the annual emissions of The Bahamas, plus flaring. World CO_2 emissions from consumption of fossil fuels in 2007 were 2.93914×10^{13} metric tons. [68] Compared to global CO_2 emissions, emissions from drilling of an individual well is negligible. Such an impact would be negative, direct, easily dispersed, reversible and short term. The consequence of any such impact is minor, and the likelihood probable. Therefore, the overall impact rating is **low** (C = 1, L = 3, and thus I = low).

With flaring, the amount of CO_2 increases, and the consequence is raised to moderate, but the likelihood is only seldom to occasional. Therefore, the overall impact rating is **medium** (C = 2, L = 1-2, and thus I = medium).

5.4.2.8 Potential Disruption of Fishing and Other Economic Activities

Potential disruptions to fishing and other economic activities were evaluated both near the drill site and near coastal areas.

Potential Disruption to Fishing and Shipping near Drill Site (2J1) – In accordance with international safety practices, a safety zone will be established for up to a 1 km radius around the drilling rig, within which fishermen and other mariners will not be allowed to pass. As described in Chapter 2, offshore fishing in The Bahamas is concentrated in the shallow waters of Grand Bahama Bank and Little Bahama Bank. Bahamas Petroleum Company is proposing to drill only in deep water areas. Therefore, interruptions to fishing vessels near the drilling sites are expected to be minimal.

The deep-water portions of the blocks are part of Old Bahama Channel (between Grand Bahama Bank and Cuba) and the Santaren Channel (between Great Bahama Bank and Cay Sal Bank). The drilling rig and exclusion zone could interfere with shipping vessels and/or pose a slight risk for collision[69]. A collision with the drilling rig could cause a loss of well control or other significant spills of hazardous materials to the marine environment. Impacts of a blowout are discussed above. The potential intersection with shipping activities may require minor alteration of ship routes, but only to an added distance of up to one kilometre. The drilling contractor and support vessels will follow good international industry practices for notifying mariners and port authorities, establishing an exclusion zone, using markings/lighting and observing marine navigation rules in accordance with the International Maritime Organization's COLREGs standards. Without compliance with mitigation, the impact of the drilling rig on shipping routes is expected to be moderate. The likelihood of this impact is occasional, leading to an impact rating of **medium** (C = 2, L = 2 and thus I = medium). This impact would be negative, direct, localized, reversible and medium-term.

Potential Disruption to Fishing in Near-shore Waters and Tourism (2A5) – Potential oil spills from drilling operations in the license area could reach fishing grounds and cause a disruption to industrial fishing boats, artisanal fishermen and other activities. As noted previously, an oil spill

[67] Energy Information Administration. 2011. International Energy Statistics. Accessed from the Energy Information Administration website: http://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=90&pid=44&aid=8

[68] International Energy Agency (IEA). 2010. CO_2 Emissions from Fuel Combustion Highlights. Accessed from the IEA website: http://www.iea.org/co2highlights/co2highlights.pdf

[69] Hill, P., Crabtree, S., and R. McDonnell. 1999. Collision Avoidance for Deepwater Floating Systems: Report of the NOSAC Subcommittee. Offshore Technology Conference, 3 May-6 May 1999, Houston, Texas

could cause some fish mortality due to direct oiling, reduction in fertility and/or ingestion of oil contained in the water column. Further, fishermen may not be able to realize economic benefit from fishing in the area after a spill because of the potential for their fishing gear to be oiled or the catch to be tainted.[70]

Further, an average of 4.5 million tourists visits The Bahamas each year and tourism is a critical component of the Bahamian economy.[71] Oil spills reaching shore or near shore areas could foul beaches and waterways that are attractive to tourists. A large spill could also lead to cancelled bookings based on a perceived impact to The Bahamas in general. The spill modelling results show that even without intervention there is a negligible chance of reaching shore in most areas of The Bahamas (only Cay Sal). The United States, Norway and Brazil are a few examples of countries where fishing and tourism coexist with significant oil and gas exploration and production activities. Under normal circumstances, the proposed drilling operations are not likely to have an impact on tourism and fishing as drilling will be far from shore and temporary. The project will be located in deepwater away from areas utilized by tourists and most fishermen.

These potential impacts would be negative, direct, dispersed, reversible and medium term. Oil spill impacts to the local economy could have a major consequence, but such a consequence would have a seldom likelihood, resulting in a **medium** impact (C = 3, L = 1, and thus I = medium). Therefore, mitigation will be required to manage the risk.

Potential Disruption to Aesthetic Appeal of Viewshed (2I2) – A study by the Geological Survey of Alabama on aesthetic impacts of fixed structures in the Gulf of Mexico suggests that rigs located more than 10 miles offshore would not be visible from shore under most circumstances.[72] The exploratory wells are expected to be greater than 40 miles from the nearest shoreline, and thus lighting from this operation is not likely to be visible from shore. Additionally, wells will only be located in deep water, away from coral reefs and other tourist attractions. Thus, risk of a social / aesthetic impact would have negligible consequence and occasional likelihood, for an overall **low** social impact rating (C = 0, L = 2, and thus I = low). This impact will be negative, direct, and short-term.

*Potential Damage to Subsea Telecommunications Infrastructure (*2A7*)* – A telecommunications cable runs along the Santaren Channel and Old Bahama Channel in the west – southwest borders of the Blocks in an area where wells could potentially be drilled. Damage to the sub-sea cable due to drilling activities could affect telecommunications services to a broad region. The cost and time to fix such a cable could be expensive and time consuming. The consequence of damage to the cable could be considered major. However, Bahamas Petroleum Company will study the sea floor at and around the drill sites prior to drilling to ensure no hazards or sensitivities are present so the likelihood of this impact is improbable, resulting in a **medium** impact rating (C = 3, L= 0, and thus I=low). Therefore, mitigation will be required to manage the risk. This impact will be negative, direct, reversible, dispersed and medium-term.

[70] IPIECA, 2008
[71] Ministry of Tourism www.bahamas.gov.bs
[72] Geological Survey of Alabama (GSA). 1998.

5.4.2.9 Damage to Submerged Archaeological Resources (2A6)

The potential for impact on possible submerged archaeological resources in the drilling phase is the same as described in the mobilization phase. The extent of damage that could be caused to such a resource would be greater if impacted by the drilling rather than anchor or transponder placement, but the likelihood would still be improbable. This is because there are no known submerged resources in the area and because the drilling will be preceded by a remote operated vehicle seabed survey that would detect and allow avoidance of such a submerged resource. The consequence would be minor to moderate to major but the likelihood improbable, and thus the overall impact rating would be **medium** (C = 2-3, L = 0, and thus I = medium). This impact would be direct, negative, localized, irreversible, and long-term.

5.4.2.10 Use and Extraction of Natural Resources (2C1)

Chapter 2 describes the types and estimated quantities of natural resources to be consumed during the proposed drilling program. Of these, fuel and water consumption are the most significant. Sea water used for the drilling operation, or for cooling water, is expected to be returned to the marine environment. The drilling rig could also desalinate sea water for consumption and domestic uses, the amount of which will depend on the specific drilling rig selected. Brine discharged rates range from 10 – 100 tonnes per day – specific estimates will be included in the well-specific EMPs once the rig has been selected.

A typical drilling rig can hold 37, 793 bbl of fuel oil, 9,132 bbl of potable water plus additional multi-purpose storage tanks. Additional fuel will be purchased at port. Given the plan to desalinate seawater and the wide availability of fuel, the impacts of natural resource use can be considered negligible with a probable likelihood, therefore resulting in a **low** impact (C = 0, L = 3, and thus I = low). This potential impact would be localized, reversible and short term.

5.4.3 Decommissioning and Abandonment

The activities associated with decommissioning and abandonment are similar to those of rigging-up and mobilization, and therefore, the impacts are also similar. The main concerns include potential damage to marine water quality and marine life from a spill of hazardous liquids or other material. However, in this phase the drilled wells also need to be suspended or abandoned. This process involves steps to isolate the hydrocarbon bearing formations and capping the wells. During this process there will be a disruption of sea floor sediments immediately around the well head and increased turbidity that could impact benthic species.

5.4.3.1 Disruption of Sea Floor Sediments (3A1, 3C1)

After the drilling is complete and well characteristics have been determined, the drilled well will need to be suspended or abandoned (depending on the results). This process involves isolating the production zones from the seabed with cement plugs and mechanical barriers to prevent the potential flow of hydrocarbons to the surface. In addition, removal of the transponders will temporarily disrupt seafloor sediments and benthos. This potential impact would be negative, direct, localized, reversible and short term. The consequences of these impacts are expected to be minor with a probable likelihood, leading to a **low** impact rating (C = 1, L = 3, and thus I = low).

5.4.3.2 Potential Degradation of Marine Water Quality

Impacts in this phase will be similar to phase 1 (mobilization and rigging-up) relating to potential impacts from uncontrolled releases and water quality impacts caused by disruption of seafloor sediments.

Potential Degradation of Marine Water Quality from Release of Formation Fluid D (3A2) – Some release of residual formation fluid (i.e. fluids adhering to the interior surfaces of valves, hoses and piping) to the ocean environment near the wellhead is possible during suspension and abandonment. However, controls are in place to manage this, therefore the likelihood of fluids release would be minimal. The consequence of this activity on the marine environment would be minor, and the likelihood is seldom. Therefore, the overall impact is **low** (C = 1, L = 1, and thus I = low). This impact would be negative, direct, dispersed, reversible and short-term.

Potential Degradation of Marine Water Quality from Fuel or other Hazardous Material Spill (3B1) – As described in Section 5.4.1.1, loading and storing fuel and other hazardous materials during decommissioning and abandonment could result in uncontrolled releases. The consequence of such spills is at most moderate and the likelihood is seldom, so the impact rating is **medium**, requiring mitigation to manage the risk (C = 2, L = 1, and thus I = medium). This impact would be negative, direct, dispersed, reversible and short-term.

Potential Degradation of Marine Water Quality from Disruption of Seafloor Sediments (3C2) – As described in Section 5.4.3.1, sediments will be temporarily disrupted from well abandonment/suspension and when removing the transponders. The consequence of this activity could have a minor impact to water quality, and the likelihood of this would be probable. The overall impact is **low** (C = 1, L = 3, and thus I = low). This impact would be negative, direct, localized, reversible and short-term.

5.4.3.3 Potential Harm to Marine Fauna

Two main sources of impact to marine fauna were identified in the decommissioning and abandonment phase and are similar to those described for mobilization and rigging-up. These include accidental release of fuel or other hazardous material and impacts to benthic organisms from removing disruption of seafloor sediments during well abandonment and/or removal of transponders. Accidental releases of hazardous liquids are also possible during well suspension or abandonment.

Potential Harm to Marine Fauna from Fuel or other Hazardous Material Spill (3B2) – Similar to Section 5.4.1.2, a potential spill of fuel or other hazardous materials could occur during decommissioning and abandonment. However, such a spill (particularly during loading) would be relatively small and probably identified and contained/dispersed quickly. Further, both the support vessels and the drilling rig will be equipped, and personnel prepared for immediate response. Some release of formation fluid to the ocean environment near the wellhead is also possible during suspension and abandonment. Accidental releases described above could have moderate consequences to marine fauna with a likelihood of seldom, resulting in a **medium** impact (C = 2, L = 1, and thus I = low). This impact would be negative, direct, reversible (at the habitat level), localized and short-term.

Potential Disruption to Benthos from Disruption of Sea Floor Sediments (3A3, 3C3) – As described in Section 5.4.3.1, seafloor sediments will be temporarily disrupted during well abandonment/suspension and during removal of transponders. These activities could smother or disrupt benthos, causing a very localized and reversible (on the habitat level) impact. The consequence of these activities could have a negligible to minor impact to benthos, although the likelihood of this activity would be seldom. This impact would be negative, direct, reversible (at the habitat level) and short-term. The overall impact is **low** (C = 0-1, L = 1, and thus I = low).

5.4.4 Vessel Operations

As discussed above, impacts related to vessel operations include activities that will be conducted throughout Phases 1-3. For example, these include impacts relate to housing approximately 200 people at sea and movement of the drilling rig and support vessels. Potential impacts related to oil spills from drilling are discussed in Section 5.4.2. This section discussed oil spills that could be caused by transport of the drilling rig to and from the well sites, as well as support vessels traveling to and from port. Similarly, discharges related to drilling were discussed above, whereas grey and black water discharges, and management of other household wastes will be discussed in this section.

5.4.4.1 Potential Degradation of Marine Water Quality – Accidental Spills (4A1, 4B1, 4C1)

Degradation of water quality resulting from operational activities could result from potential fuel or other material spills.

Fuel spills could occur during storage or refuelling or due to a collision at sea that is sufficiently severe to rupture a fuel tank or line on a vessel. From 1995 to 2001, there were 56 vessel collisions in the Gulf of Mexico related to oil and gas exploration.[73] The activity in the Gulf of Mexico is much higher than the proposed program. Most collisions were a result of service vessels colliding with platforms or vessel collisions with risers. Approximately 10 percent of vessel collisions with platforms in the Gulf of Mexico outer continental shelf caused diesel spills. The expected fuel storage capacity of support vessels is approximately 900 m^3 (240,000 gallons) (plus additional storage capacity of other hazardous liquids).

From 2005 – 2010 there were only two reported vessel collisions in The Bahamas, both by pleasure boaters.[74] Despite the numerous tankers that frequent the oil storage and trans-shipment facilities at BORCO and South Riding Point in Grand Bahama, there were no reported incidents from oil related vessel collisions in The Bahamas.

An oil spill while fuelling would likely cause a measurable but short term and reversible degradation of water quality around the point of the spill and, if severe, could spread to surrounding waters.

The cause of such a spill would have to be a collision with another vessel, structure, or shallow feature of such a strong impact that it is capable of puncturing or tearing the steel hull of one of the vessels at the area where fuel is stored.

Diesel fuel is lighter than other oils, and thus quickly disperses and evaporates on the surface of water. Thus, while the impact of such a spill on marine water quality would certainly cause a measurable degradation of water quality, it would be a short term and reversible impact.

Spills of industrial solid waste (trash, building materials, recyclables, etc.) could occur also, although these materials could be retrieved (if floating), and have a localized impact. For these reasons, the consequence of oil spill or release of solid waste on marine water quality is classified as moderate. While the quantities of fuel and other hazardous liquids stored on the drilling rig are larger than quantities stored on support vessels, the chances of a drilling rig tank rupture are less probable. Without mitigation in place, the likelihood of a moderate level spill that will have the impacts described above at either the dock or in open ocean is seldom. Therefore, the overall

[73] United States Minerals Management Service. 2003. Gulf of Mexico OCS Oil and Gas Lease Sales 189 and 197, Eastern Planning Area, Final Environmental Impact Statement.

[74] Rolle, D. 2011. Personal communication with The Bahamas Maritime Authority.

pre-mitigation impact rating is **medium**, requiring mitigation to manage the risk. (C = 2, L = 1, and thus I = medium). These impacts could be considered reversible, dispersed and have short to medium term duration.

5.4.4.2 Potential Degradation of Marine Water Quality – Discharge of Macerated Food and Treated Effluent (4D1)

Each of the vessels working on the program will discharge macerated food and treated wastewater effluent to the ocean in accordance with MARPOL standards[75]. Treatment and disposal of sanitary wastes (include all black [sewage] and grey water [showers and washing facilities]) varies between drilling rigs, however wastewater from the drilling rig will be discharged directly to the sea in accordance with MARPOL. Vessels that require ballast water discharge will follow international standards to avoid introduction of invasive species. Each ship will have a Ballast Water Management Plan to ensure the stability of the vessel and conform with international standards, such as exchanging ballast water at least 200 nautical miles from shore and in waters over 200 meters deep, if required. Plans will be vetted and audited as part of the contracting process and spot audits might be carried out during operations. There will be a qualified Ballast Control Operator 24 hours a day onboard to ensure stability all times. This will be managed particularly during fluids transfer on/off the vessel during bad weather.

Support vessels accompanying the drilling rig will not have wastewater treatment systems (marine sanitary units) onboard but will manage wastewater in accordance with their wastewater plans and MARPOL standards. Neither the food nor the wastewater discharges nor the small amount of untreated wastewater discharge from the support vessels will contain high levels of pollutants, and each of these waste streams will disperse quickly in the open marine environment. As a result, the impact will be consistent with natural conditions, resulting in a consequence classification of negligible. The likelihood that these discharges will occur is probable (certain), and therefore the overall impact rating is **low** (C = 0, L = 3, and thus I = low). This potential impact would be reversible, localized and short term (although it would be repeated over the life of the project).

If untreated or inadequately treated wastewater were to be accidentally discharged in the near-shore environment, either due to equipment failure or operator error from support vessels while passing to and from the port, the resulting consequence on sensitive coastal features could be moderate with a likelihood of seldom, resulting in a **low** overall risk ranking. In the worst case, a moderate consequence to near shore marine ecosystems and habitat from an untreated sewage release would have to be considered to have a seldom likelihood, still resulting in a **medium** overall impact ranking.

5.4.4.3 Potential Harm to Marine Fauna

Potential impacts to marine fauna resulting from vessel operations are related to a potential spill of diesel fuel or other hazardous liquids, physical impact from vessel hull or propellers and generation of noise from support vessel operations. Specifically, these impacts include:

- Potential Impact to Fish from Oil Spill
- Potential Impact to Plankton, Fish Eggs and Larvae from Oil Spill
- Potential Impact to Marine Mammals and Sea Turtles from Oil Spill
- Potential Impact to Pelagic and Seabird Species from Oil Spill
- Potential Disruption of Marine Fauna from Noise Generated by Support Vessels

[75] These include a requirement that vessels certified to carry 15 or more people have an operating wastewater treatment facility, that treated wastewater may not be discharged within three nautical miles of shore, and that untreated wastewater may not be discharged within 12 nautical miles of shore.

· Potential Mechanical Impact to Marine Fauna

Potential Harm to Marine Fauna – Spill of Fuel or other Hazardous Liquids (4A2) – A significant spill of diesel fuel or other hazardous liquid from vessel collision and tank rupture or spill while refuelling could impact marine fauna. Individuals within this category of organisms, including fish, marine mammals, turtles and plankton, could be impaired if they were to come into direct contact with spilled fuel or other hazardous liquids. No harm to benthos is expected during this phase. Except in the case of plankton, only localized impact to a small number of species could be expected before the released diesel fuel rises to the surface and is dispersed or evaporated to ambient conditions. Plankton communities in the direct vicinity of the spill would likely suffer more damage and some die-off as these organisms inhabit the surface and upper levels of the water column. Due to the measurable but potentially dispersed and reversible[76] effect of a diesel fuel spill on pelagic organism habitat, the consequence of this impact is categorized as moderate. The likelihood of a spill is seldom. Therefore, the overall pre-mitigation impact rating is **medium** (C = 2, L = 1, and thus I = low).

Potential Impact to Marine Fauna from Noise from Supply Vessels (4F2) – As discussed in Section 5.4.2.3, human-made sounds from drilling related activities may affect the ability of marine fauna to communicate and to receive information about their environment. Ambient noise in the ocean between the frequency bands of 20Hz to 300Hz is dominated by shipping noise. [77] [78] Figure 5-15 depicts shipping and other anthropogenic activities compared to noise created by natural sources, including marine fauna.

[76] At the habitat level vs. the individual level.

[77] Wyatt, R. 2008. Review of Existing Data on Underwater Sounds Produced by the Oil and Gas Industry. Submitted to Joint Industry Programme on Sound and Marine Life. Accessed from the soundandmarinelife.org website: http://www.soundandmarinelife.org/Site/Products/Seiche_Aug08.pdf .

[78] U.S. Department of Interior, Bureau of Ocean Energy Management. 2011. Outer Continental Shelf Oil and Gas Leasing Program: 2012-2017, Draft Environmental Impact Statement. Accessed from the BOEM website: http://www.boem.gov/uploadedFiles/BOEM/5-Year/2012-2017/PEIS/Combined_2012-2017_OCS_Oil_and_Gas_Leasing_Draft_Programmati.pdf

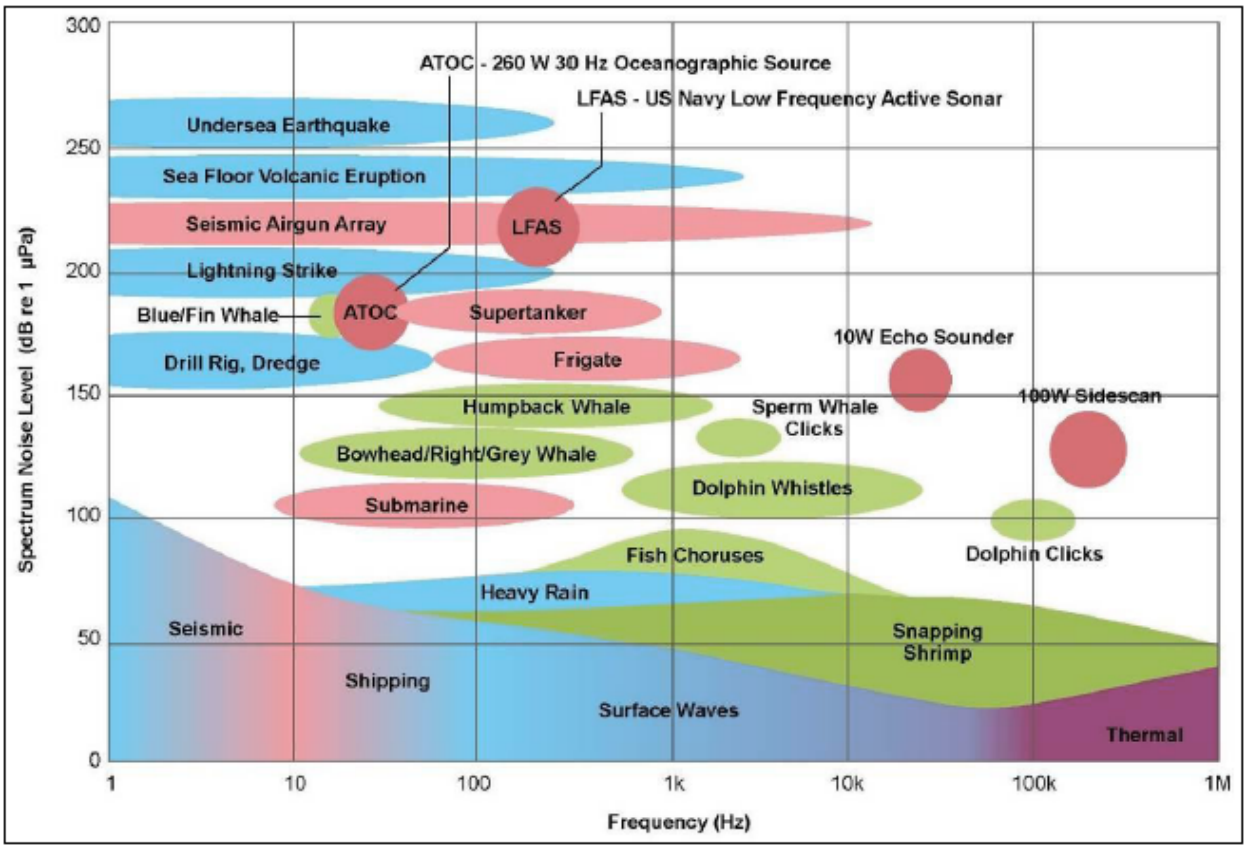

Figure 5-19: Comparison of Frequency and Noise Level of Anthropogenic and Natural Ocean Sounds

Source: Adapted from Richardson, et al., 1995[79] [80]

Impacts to plankton, benthos, and fish would be negligible. Underwater noise from drilling ranges from about 20 to 40 dB above background levels within a frequency spectrum of 30-300 hertz (Hz) at a distance of 30 m from the source. Noise generated by the drilling program may add to current ambient ocean noise and interfere with or mask the sounds used and produced by marine mammals and sea turtles and thereby interfere with their natural behaviour.[81] Pirrota et al. (2012) notes that "…broadband ship noise caused a significant change in beaked whale behavior up to at least 5.2 kilometers away from the vessel. The observed change could potentially correspond to a restriction in the movement of groups, a period of more directional travel, a reduction in the number of individuals clicking within the group, or a response to changes in prey movement."

However, the additional one to three trips per week by supply vessels to port will only produce limited sound disturbance as the vessels are continuously moving. Further, one to three trips to port per week is insignificant compared to the existing vessel traffic in the area from pleasure

[79] Adapted from Richardson, W.J., C.R. Greene, C.I. Malme, and D.H. Thomson. 1995. Marine Mammals and Noise. Academic Press, San Diego, CA, 576 pp

[80] Recent data from the Oil and Gas UK Joint Industry Programme on Sound and Marine Life confirms the data depicted in this graphic.

[81] Bowles, A.E. 1995. Responses of Wildlife to Noise. In: Knight, R.L. and K.J. Gutzwiller, eds. Wildlife and Recreationists: Coexistence through Management and Research. Washington, DC: Island Press. Pp. 109-156.

boats, cruise ship traffic and shipping traffic. As such, the consequence of these effects on marine fauna are considered minor. The likelihood of impact is probable, thus resulting in a **low** impact (C = 1, L = 3, and thus I = low).

Potential Mechanical Impact to Marine Fauna (4A3) – Increased traffic from support vessels involved in survey, service, or shuttle functions could increase the probability of collisions between vessels and marine fauna. Harm to plankton, fish and benthos at the habitat scale would be negligible, but collisions with marine mammals and/or sea turtles could cause major wounds or fatalities to individuals. [82] [83] [84] Debilitating injuries may have negative effects on a population through impairment of reproductive output.

The consequence of this impact (at the habitat scale) could be moderate given that species affected could be endangered and the likelihood would be seldom, resulting in a **medium** overall impact rating (C = 2, L = 1, and thus I = low) and requiring mitigation. This impact would be direct, negative, reversible, localized and medium term (at the species level).

5.4.4.4 Potential Degradation of Sensitive Shoreline Features – Spill of Fuel or other Hazardous Liquid (4A4, 4A5)

As described in Chapter 4, coastal sensitivities exist along the adjacent shorelines. For example, there are popular beaches, protected areas, endangered sea turtle nesting sites, and other features important to biodiversity and ecosystem services. Fuel spills could occur either from an accident while refuelling or due to a collision at sea that is sufficiently severe to rupture a fuel tank or line on a vessel. Refuelling near shore would only occur at the port facilities where nearby coastlines are developed and lack sensitive shoreline features. However, a supply vessel collision could potentially occur near sensitive areas. Diesel fuel is lighter than crude and much would likely disperse in the ocean environment and/or evaporate before reaching shore. However, even small quantities could cause both ecological and economic harm. While the effect of a spill reaching these resources would be considered a moderate consequence, the likelihood that a fuel tank rupture would occur near these areas is seldom, resulting in a **medium** impact (C = 2, L = 1, and thus I = medium). The impact would be negative, direct, reversible, dispersed and medium-term.

5.4.4.5 Degradation of Air Quality (4E1)

Estimated air emissions are shown in Section 2.6.3 and air quality impacts related to drilling are described in Section 5.4.2.7. Air emissions generated during vessel operations will be produced from vessel engines, helicopters and from other combustion fuelled equipment. Most of these emissions will be produced offshore and will be dispersed quickly. The emissions from helicopters passing over coastal sections of the study area will have a barely measurable, dispersed, short term and quickly reversible impact on air quality. The consequence of any such impact is negligible to minor, and the likelihood is probable. Therefore, the overall impact rating is **low**. (C = 0-1, L = 3, and thus I = low)

Cumulative impacts of green-house gas emissions are discussed in Section 5.4.6.1.

[82] Laist, D.W., A.R. Knowlton, J.G. Mead, A.S. Collet, and M. Podesta. 2001. Collisions Between Ships and Whales. Marine Mammal Science 17:35-75.

[83] Kraus, S.D. 1990. Rates and Potential Causes of Mortality in North Atlantic Right Whales (Eubalaena glacialis). Marine Mammal Science 6:278-291.

[84] Waring, G.T., D.L. Palka, K.D. Mullin, J.H.W. Hain, L.J. Hansen, and K.D. Bisack. 1997. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments -- 1996. NOAA Tech. Memo. NMFS-NE-114.

5.4.4.6 Disruption of Local Communities from an Increase in Noise (4F1)
Engines in the support vessels and helicopters being used for the drilling program will generate noise, as will the rotation of the helicopter blades.

Service vessels transmit noise through both air and water. The intensity of noise from service vessels is roughly related to ship size, laden or not, and speed. Sounds from support boats range from 120 to 160 dB at 400-7,000 Hz.[85] Commercial vessel noise is a dominant component of manmade ambient noise in the ocean.[86]

Noise generated from helicopter and service-vessel traffic is transient in nature and extremely variable in intensity. This sound would generally be brief as these sources are typically moving between the drill site and port/shore.

As these vessels pass through coastal areas between the drilling rig and port, the noise could disrupt people who live, work and recreate in these areas. The consequence of this impact is minor, and the likelihood is occasional, for an overall impact level of **low** (C = 1, L = 2, and thus I = low). The impact would be negative, direct, reversible and short-term.

5.4.4.7 Disruption of Fishing, Commercial, and Recreational Marine Vessel Traffic (4A6)
The drilling program is expected to cause a minimal increase in marine vessel traffic to the study area resulting from movement of the drilling rig and transport of personnel and supplies from the support vessels. When possible, these vessels will operate within designated navigation channels, and the supply vessels and drilling rig will navigate in accordance with international marine safety and traffic standards (e.g., COLREGS). Nevertheless, the increase in marine traffic could potentially disrupt commercial or recreational vessels in the area and increase the risk of vessel collisions. This potential impact would be dispersed, reversible and short term (although repeated over the life of the project). The consequence of this impact is categorized as negligible to minor, and the likelihood that such a conflict could occur is occasional. Therefore, the overall impact rating is **low** (C = 1, L = 2, and thus I = low).

5.4.5 Ancillary Activities
Possible impacts resulting from ancillary activities are limited to impacts related to the increase in demand for supporting services onshore and the indirect effects of those activities.

5.4.5.1 Demand for Public Services (5A1)
The supporting services of the drilling activities will generate a demand for review, public vetting, approval and monitoring by officials of the Government of The Bahamas including the BEST Commission and other agencies involved in reviewing and approving the EIA, as well as marine navigation authorities. However, this demand will be localized, short-term and reversible. Thus, the consequence is categorized as minor, the likelihood is probable, and the overall impact rating is **low** (C = 1, L = 3, and thus I = low). The cumulative impacts relating to the increase in demand of public services of this project in combination with other projects in the area is addressed in Section 5.4.6.1.

[85] U.S. Dept. of Commerce. National Marine Fisheries Service. 1984. Endangered; Species Act, Section 7 Consultation – Biological Opinion. Attachment C. In: Science Application, Inc., Revised Draft Environmental Impact Statement/Report, Technical Appendix 8, Marine Biology for Santa Ynez Unit/Las Flores Canyon Development and Production Plan. 34 pp.

[86] Jasny, M. 1999. Sounding the Depths: Supertankers, Sonar and the Rise of Undersea Noise. National Resources Defense Council, March 1999. 75 pp.

5.4.5.2 Impact on Employment and Economy

Potential Positive Impact of Drilling Activities on the Local Economy (5B1) – The proposed drilling activities will have a limited positive impact on the local economy. Given the complex nature of offshore drilling activities, highly specialized and experienced crews of workers are needed on the rigs to ensure timely, well communicated and safe completion of drilling activities. Based on the special skill sets required for the project, Bahamas Petroleum Company may indirectly involve 10 additional Bahamians / Companies in addition to the 3 currently on staff. Given the damage sustained to Freeport, all vessel activity will be based in the USA, therefore local opportunities are further reduced. Further, exploration drilling programs are temporary so the activity would be limited to a few months. This potential impact would be localized, reversible and short term. Any positive impact generated would be categorized as having a minor consequence and a probable likelihood. Therefore, the overall impact rating is **low**. (C = 1, L = 3, and thus I = low). The impact would be reversible, dispersed and short-term.

The impact assessment rating is based on this stage of the hydrocarbon exploration and production process only (a 1 or 2 well drilling campaign). If commercial reserves are identified the impact to the local economy could be significant, both in terms of education, job creation (300-500 positions), infrastructure and revenue to the government.

5.4.6 Potential Cumulative and Transboundary Impacts

5.4.6.1 Potential Cumulative Impacts

The EIA Project Team also evaluated the potential cumulative environmental and social impacts that could result from the proposed project activities in combination with current actions and reasonably expected future developments in the area. Bahamas Petroleum Company currently holds the only active licenses in The Bahamas, although additional license applications are pending. Early exploration activities are also currently underway off western Cuba.

It is currently unknown if commercially exploitable hydrocarbons are present in Bahamas Petroleum Company blocks or other areas in the region. Further, if commercially exploitable reserves are found Bahamas Petroleum Company would complete another EIA prior to any future production activity. Given the uncertainty of future oil and gas activities in The Bahamas and subsequent opportunity to conduct more detailed cumulative impacts analysis once more details are known, discussion of potential cumulative impacts in this study is brief.

Several minor cumulative effects were identified: increased contribution to global greenhouse gas emissions from burning of combustible fuels in ship motors, process equipment and flaring; increased contribution to ambient ocean noise from supply vessels and drilling rig; potential to increase demand for public services and potential for additional socioeconomic impacts.

Cumulative Impacts of Greenhouse Gas (GHG) Emissions – The primary GHGs to be emitted during the proposed drilling program are CO_2 and CH_4. The major sources of GHG emissions include:

- Main power generation systems on the drilling rig which are used to generate electricity
- On board equipment such as pumps, generators and diesel engines needed to support the drilling activities
- Supply boats and helicopters

- Flaring of gas on the drilling rig during well testing and/or due to upset, maintenance and emergency conditions during operations. No continuous flaring of hydrocarbon gases during normal operations is planned.

In 2009, The Bahamas generated 5,236,000 metric tons of CO_2 emissions.[87] A typical exploration well (not including flaring) produces approximately 2,000 metric tons of CO_2 equivalent per well. Drilling of each well would contribute approximately 0.038% to the annual emissions of The Bahamas, plus flaring. The amount of emissions from flaring varies depending on the volume of hydrocarbons flared (if any) and the amount of carbon in the feed. World CO_2 emissions from consumption of fossil fuels in 2007 were 2.93914 X 10^{13} metric tons.[88] Compared to global CO_2 emissions, emissions from drilling of an individual well is negligible. Emissions from downstream activities are not included in the listed sources of greenhouse gas emissions.

If commercially exploitable hydrocarbons are found, another EIA would need to be completed prior to development. This subsequent report would evaluate the cumulative impact of downstream activities, such as: producing, transporting and refining the hydrocarbons.

Cumulative Impacts to Marine Environment from Addition of Submarine Noise
The project will require mobilization of a drilling rig to/from the drill site, drilling, and transport of materials and crew from shore to the drill site. Impacts of marine noise to marine fauna from drilling and vessel operations are described in Sections 5.4.3.2 and 5.4.4.3.

Underwater noise produced by drillships decreases in intensity with distance from the drillship and source levels are relatively low (e.g. < 191 dB re 1µPa) with the highest energy contained in the lower frequency bands (< 1000 Hz). Injury and PTS are unlikely at these levels. Behavioural disturbance is the most likely affect that marine mammals, sea turtles or fish will encounter from drilling and vessel transit during the project. Any behavioural disturbance will be short term and will not result in any population-level impacts. The acoustic characteristics of drillships and Dynamically Positioned (DP) vessels indicate that the most likely species to perceive the sound produced during the project are baleen whales which are expected to occur very rarely in the project area. For the likely species (Odontocetes), the primary frequency content is at the lower end of their hearing sensitivities. Odontocetes may still show some behavioural changes to noise produced by drilling or DP vessels. Pirrota et al. (2012) notes that "…broadband ship noise caused a significant change in beaked whale behaviour up to at least 5.2 kilometres away from the vessel.

Currently, Bahamas Petroleum Company plans to utilize one or two platform supply vessels (PSV), with each making approximately one trip per week between the Port Fourchon, Louisiana shore base and drilling location. When measured offshore Greenland (during drilling operations in ~1600 ft [~500 m] water depth), underwater noise was at approximately ambient levels when measured 8-11 km from the source. [34] Noise from these activities would be similar to those created by other small vessels potentially in the study area, such as fishing and recreational vessels. Large shipping vessels are also likely to pass through the study area and dominate the ambient noise in the ocean between the frequency bands of 20Hz to 300Hz.[89] [90]

[87] Energy Information Administration. 2011. International Energy Statistics. Accessed from the Energy Information Administration website: http://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=90&pid=44&aid=8
[88] International Energy Agency (IEA), 2010.
[89] Wyatt, R. 2008.
[90] U.S. Department of Interior, Bureau of Ocean Energy Management. 2011.

Given the drilling location is already located in a shipping lane, ambient sound levels will be elevated compared to more remote areas. While the project will contribute to that background noise, the impacts on marine mammals, sea turtles, and fish will be minimal due to the expected soundscape already around the project area and the likelihood that drilling program noise will reach background conditions within relatively short distances. The minimal number of sound sources and short-term duration of the project will not contribute significantly to the concomitant soundscape. The bathymetry of the receiving environment is also a key factor in cumulative sound impacts, with bays and other enclosed areas most sensitive to sound as it reflects and leads to increased background levels. The drilling program is located in deepwater and the open ocean where low frequency sound can travel significant distances; however the additive behaviour of sound such as that seen in shallow water (e.g., multipath, reflection, refraction) is not likely due to the bathymetry and it is expected that the sound pressure levels will decrease over distance and not increase due to additive conditions.

Potential Cumulative Impacts of Demand for Infrastructure and Services

As described above, the Project will require review, public vetting, approval and monitoring by government officials. Because there are no other offshore oil exploration and production programs proceeding or planned at present in The Bahamas, the cumulative effect of this demand for government personnel with knowledge of offshore exploration operations is expected to be limited. Likewise, the project preparation and other activities may generate an increased demand for service from marine navigation authorities and other government authorities. However, the consequence of these cumulative impacts is considered minor.

If commercially exploitable hydrocarbons are found, development, production and downstream components (refining and marketing) would likely create a significant demand for new petroleum related infrastructure such as pipelines, storage tanks and related support industries. This new industry could create significant economic and growth but could also increase demand for local port infrastructure, as well as local roads, offices, waste facilities and other supporting infrastructure and services. If commercially exploitable hydrocarbons are found, the subsequent EIA to be completed prior to production would review these cumulative impacts.

Potential Other Cumulative Socioeconomic Impacts

The Project will be completed quickly (2 months per well). It will be performed by skilled workers offshore and will not involve much interaction with communities in The Bahama. The Project by itself is not likely to have significant adverse or beneficial socioeconomic impacts, however over time and in conjunction with additional exploration projects there is the potential for benefits to local businesses. If productive hydrocarbon reserves are identified, then exponentially more significant socioeconomic impacts are likely to be realized and should be studied in the subsequent production EIA, if necessary.

5.4.6.2 Potential Transboundary Impacts

The two potential transboundary impacts identified included:

1. Potential disruption of fishing, shipping and other current uses from increased vessel traffic
2. Potential harm to marine water quality, marine fauna, sensitive coastal resources, and local economies (especially fishing) in the event of a major loss of well-control (i.e. blow-out)

Supply vessels could be traveling to and from the United States to support this drilling program. Transboundary supply vessel traffic would be negligible (1 to 2 trips per week) as the additional traffic would not be noticeable when compared to existing traffic and oil and gas activities in the Gulf of Mexico.

In the very unlikely event of a potential well blow-out there could be transboundary impacts to marine water quality, marine fauna, sensitive coastal resources, and local economies (especially fishing) in Cuba and/ or the United States. As noted previously, historically poor communication between Cuba and The Bahamas and United States increases the need for pre-planning and response readiness – both by operators in the region and the national governments. With regard to the proposed project, mitigation measures that address potential transboundary impacts are warranted. These are described in the site-specific EMP.

5.5 Data Gaps and Uncertainties

In completing the impact assessment, relevant uncertainties and gaps identified are primarily related to lack of primary baseline data for wildlife. However, desktop data available supplemented by a marine mammal observation from the seismic survey in the blocks provides enough information to perform a reasonable evaluation of potential project impacts and proposing appropriate mitigation measures to address the potential impacts identified for the drilling program. These are outlined in the site-specific EMP.

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Bahamas Petroleum Corporation

2020 Exploration Drilling Campaign

Site Survey and Shallow Hazard Evaluation
B North Prospect – Perseverance #1

Site Survey and Shallow Hazard Evaluation
B North Prospect – Proposed Well.

Summary:

A seabed and sub-seabed hazard evaluation have been conducted on Bahamas Petroleum's 2012 3D seismic dataset covering a 130 km2 area of the enhanced PSDM 3D encompassing the proposed well and immediate area.

Proposed well B-North 1 is sited on a flat sea floor at 518 meters ss depth with a dip of 0.19 degrees to the northeast at the crestal position on an low relief, approximately 6 kilometer structural closure with the large dip closed deeper targets. Due to the 4 meter sampling interval of the 3D data, the accuracy of the depth predictions are +/- 2 meters. The resolution of the sea floor features is approximately 10 meters vertically and 20 meters laterally.

There is no evidence of water-flow or gas expulsion features on the sea floor or biohermal build-ups which could also indicate gas seepage identified on the sea floor. The sea floor does not show any evidence of erosion, scars or channelling. There is no evidence of recent or old faults at the sea floor. The extensional faults associated with the growth of the B-North prospect tend to terminate well below the sea floor, approximately 100 meters below the mudline.

The sea floor seismic amplitude response indicates monotonous, uniform sediments and is most likely to be comprised muds. Thus, any shallow water flow risk is considered highly unlikely.

Extensive horizon picking and amplitude analyses from Seafloor to Base Tertiary/Cenomanian (Upper Cretaceous) unconformity (5 events) were conducted. No shallow gas anomalies have been identified in the seabed sediments down to 750 meters. Although this interval is slightly faulted, and extend to the Albian section, the minor fault/dip closed components do not show any evidence of gas accumulations. The final PSDM velocity model also shows mostly compaction effect, no 'gas cloud' related pull-down effect is evident from the seismic data.

A general review of the ~ 3100 km2 3D and the 2D data towards the Bahamas platform has not identified any hydrates, e.g. BSR's (bottom seeking reflectors).

This report has not had access to any documentation on obstructions at the proposed well, met ocean data such as surface, sea floor currents. wind and wave information.

In conclusion, although there is no benthic sampling to precisely identifying the shallow lithologies, drilling through the top hole sediments is considered exceptionally low risk.

Introduction

Available seismic data for the purposes of the shallow hazard/site evaluation have been interpreted by Joe M. Boztas, an independent geophysical consultant based in the UK. Joe was responsible for all BHP's site survey work in the UK & US Gulf of Mexico from 1990 to 2004, Trinidad/Tobago and South Falklands Basin shallow hazard evaluations.

The proposed well location for the well at B-North is sited at 518 meters subsea water depth on very gentle sea floor topography. Figures 1 and 2 show the sea floor topography; the seismic views at some locations are due to the acquisition footprint & seismic coverage variations.

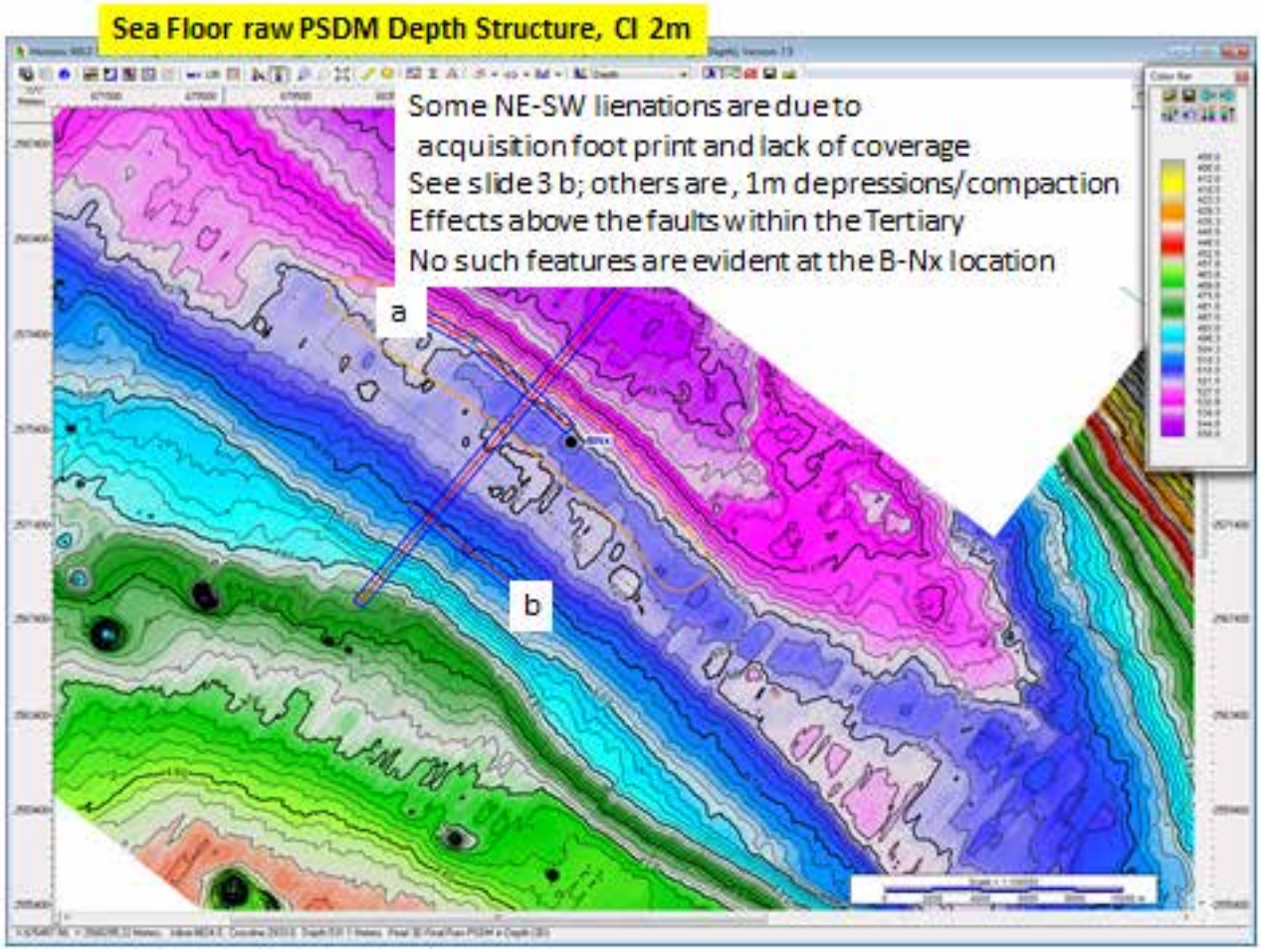

Figure 1: 3D Seismic Depth Map of sea floor topography.

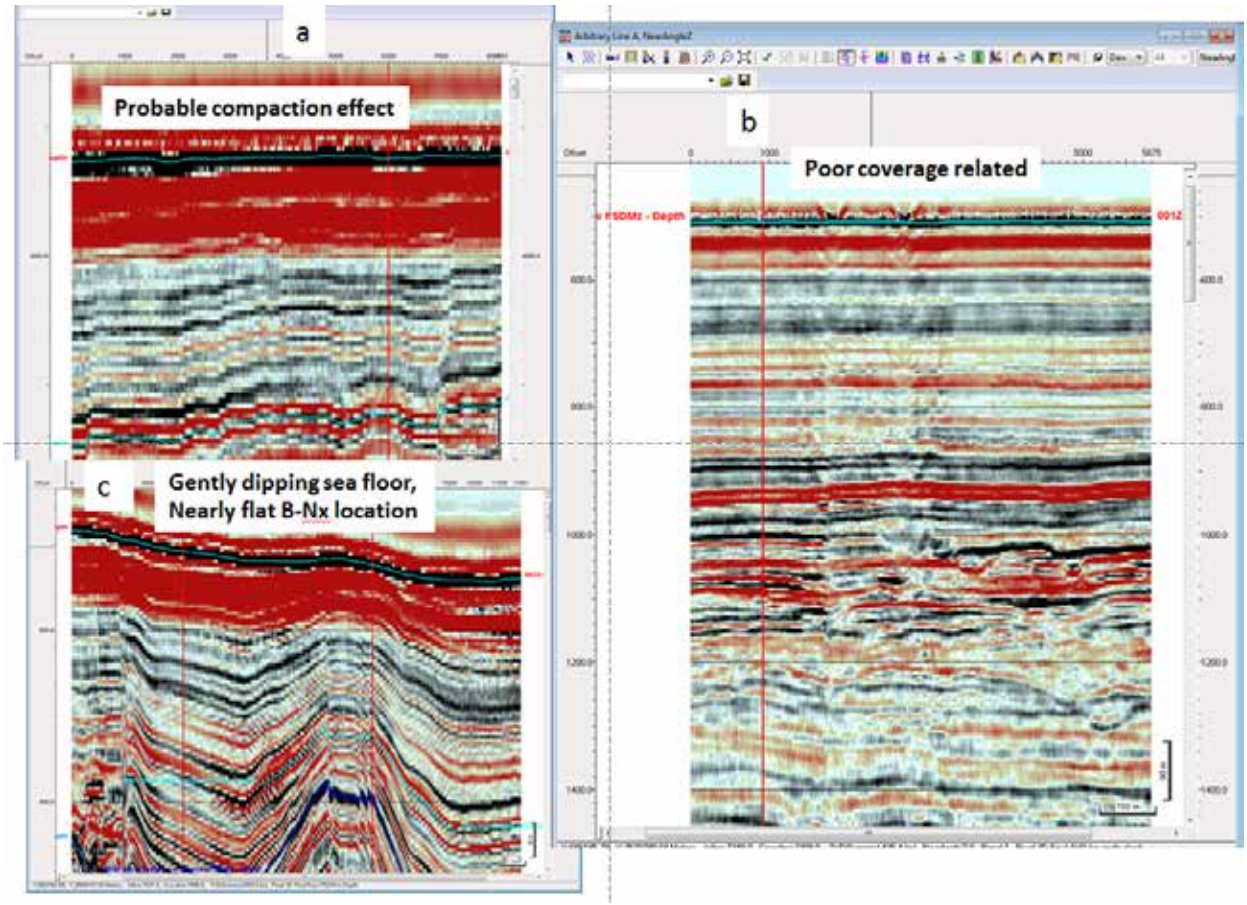

Figure 2: Detailed seismic profiles of the Seafloor.

Data Base

The primary data used is Bahamas Petroleum 3D seismic acquired and processed by CGG in 2012. The 3D covers ~ 3100 km2 and was processed both in the time (PSTM) and depth domains (PSDM) reference: CGG -BPC Pearl BroadSeis Processing Report. Figure 3 shows the outline of the 3D, the main prospects, the proposed well location and a subset volume of 130 km2 used for the detailed shallow hazard evaluation. There are no wells within the 3D data for calibration.

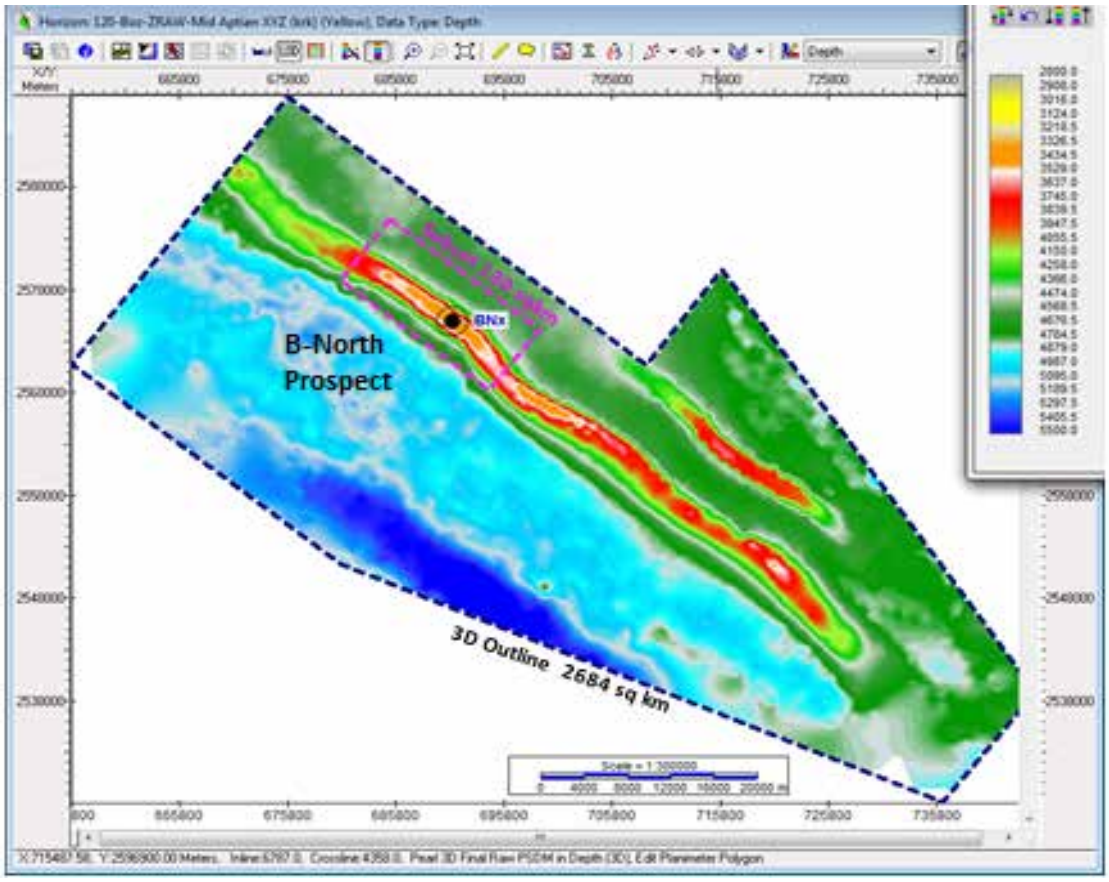

Figure 3: B North Well Location & 3D Outline

The acquisition data density is 12.5 meters x 25 meters. This was reduced to 12.5m x12.5 m for the main PSDM processing. The estimated event positioning error is approximately 2 cell sizes or 25 meters.

The main data sets generated from the processing were: Full, Near, Mid, Far Angle PSDM depth volumes, final modelling ITT interval velocity and an enhanced PSDM volume with post migration noise attenuation and spectral balancing. Enhanced PSDM volume for the shallow section, sea floor to 2500 meters depth, was the main data used in this evaluation using IHS's Kingdom interpretation software. The enhanced PSDM volume has a bandwidth range from 6 Hz) to 65-70 Hz and approximate central frequency of 35 Hz in the shallow section. Figure 4 shows a comparison of bandwidths in the shallow over 0.7 to 1.6 seconds for the Raw and enhanced PSDM volumes. The data is effectively zero phase as evidenced by the sea-floor reflection and other strong reflectors, see Figure 2. The dominant Peak/Positive amplitude is displayed in blue or black, represents a positive impedance contrast.

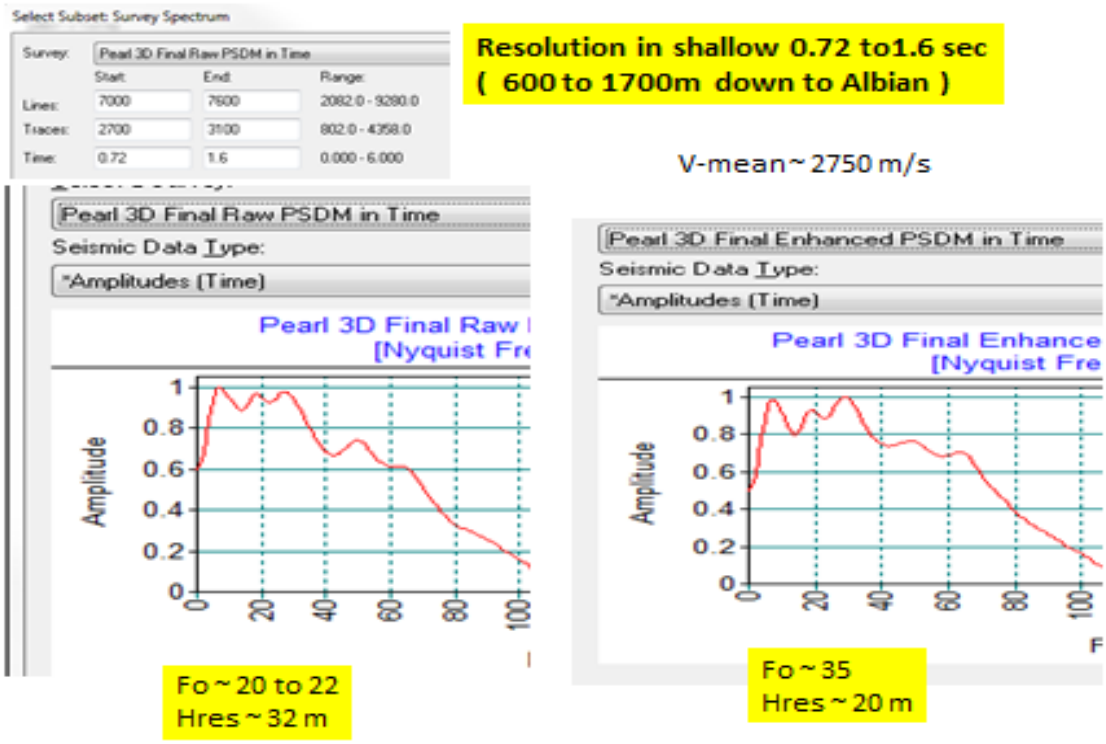

Figure 4: 3D Seismic Bandwidth

The horizontal resolution at or close to the sea floor in the 3D migrated, zero phase data is approximately 20 meters for a 40 Hz dominant frequency and has an interval velocity of 1500 meters /second. This resolution decreases to about 35 meters at a sediment thicknesses below the sea floor of ~ 500 meters where the interval velocities could reach 2500 meters /second. Similarly, the vertical resolution is about 10 meters at the sea floor and 17 meters below mudline at shallow depths.

Shallow horizons were selected on a typical 20 x 20 grid and zapped to match criteria. No smoothing was used for the horizon extractions or velocities, but grids were smoothed via the cell size selection and mild smoothing.

Fig 5 shows the interpreted seismic horizons and faults in the shallow section.

Faults are extensional and associated with the folding of the B-structure. They mostly terminate at or above Top Albian.. The vertical extensions indicate a growth component & the re-activation of these faults however these too terminate approximately 100 meters below the sea floor.

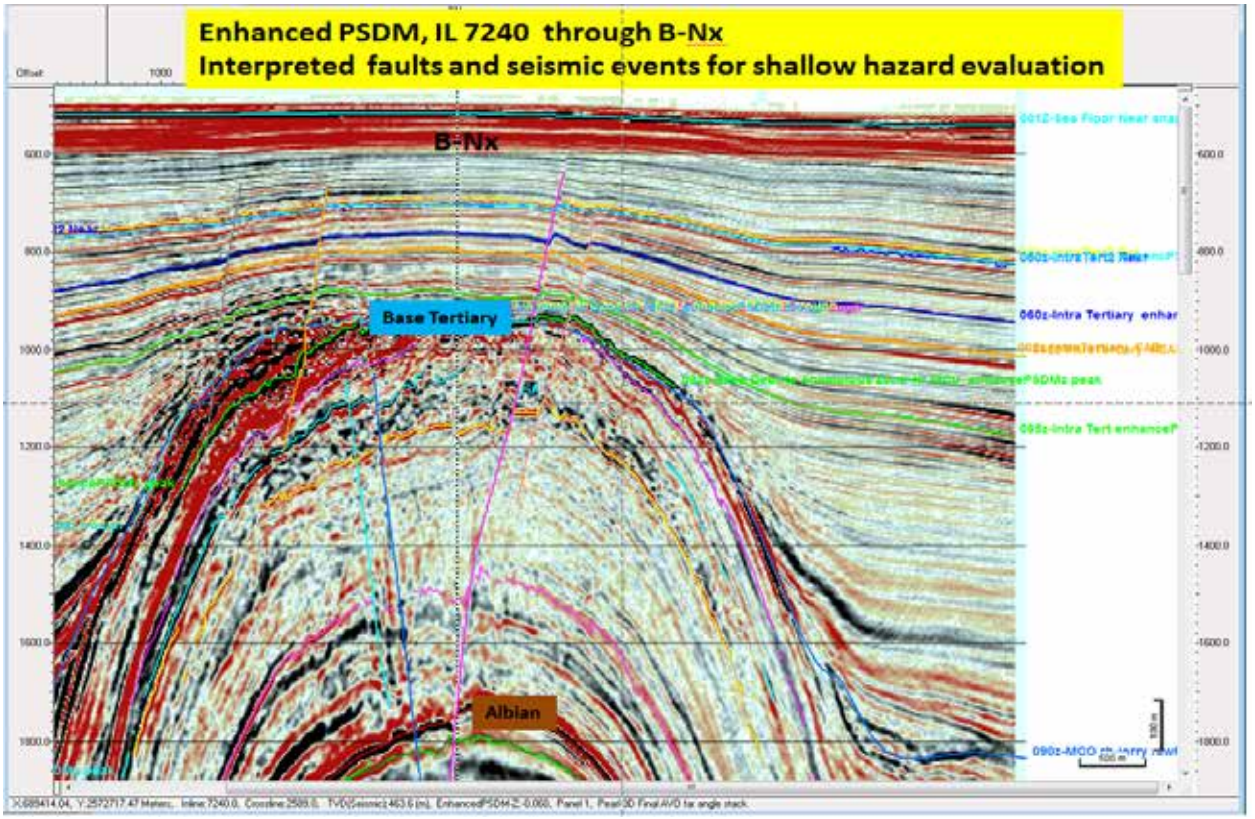

Figure 5: 3D In Line 7240, Enhanced 3D PSDM Volume
Interpreted fault and seismic horizons in the shallow section

Depth Conversions:

No depth conversion is necessary as the 3D data was processed to Prestack Depth (PSDM). Although there are no wells within the 3D area for calibrating to scale the 3D velocity volume, any such calibration is expected to be minimal at the shallow levels down to about 800 meters below mudline. However, corrections or error bars were given for the main horizons in the well prognosis for the deeper horizons.

B-Nx SITE SURVEY EVALUATION

Met Ocean conditions:

No documentation e.g.Environmental Impact Statement or other data, were available for this section.

Sea Floor:

B-North wellsite is positioned at **X= 691085.6 Y=2574857.0**, IL 7240, XL 2806 on a very gently sloping sea floor at 518 meters water depth with a 0.19 degree dip. It is close to the crestal position of an exceptionally low relief culmination, coincident with the large dip closed targets at depth, see Figure 6.

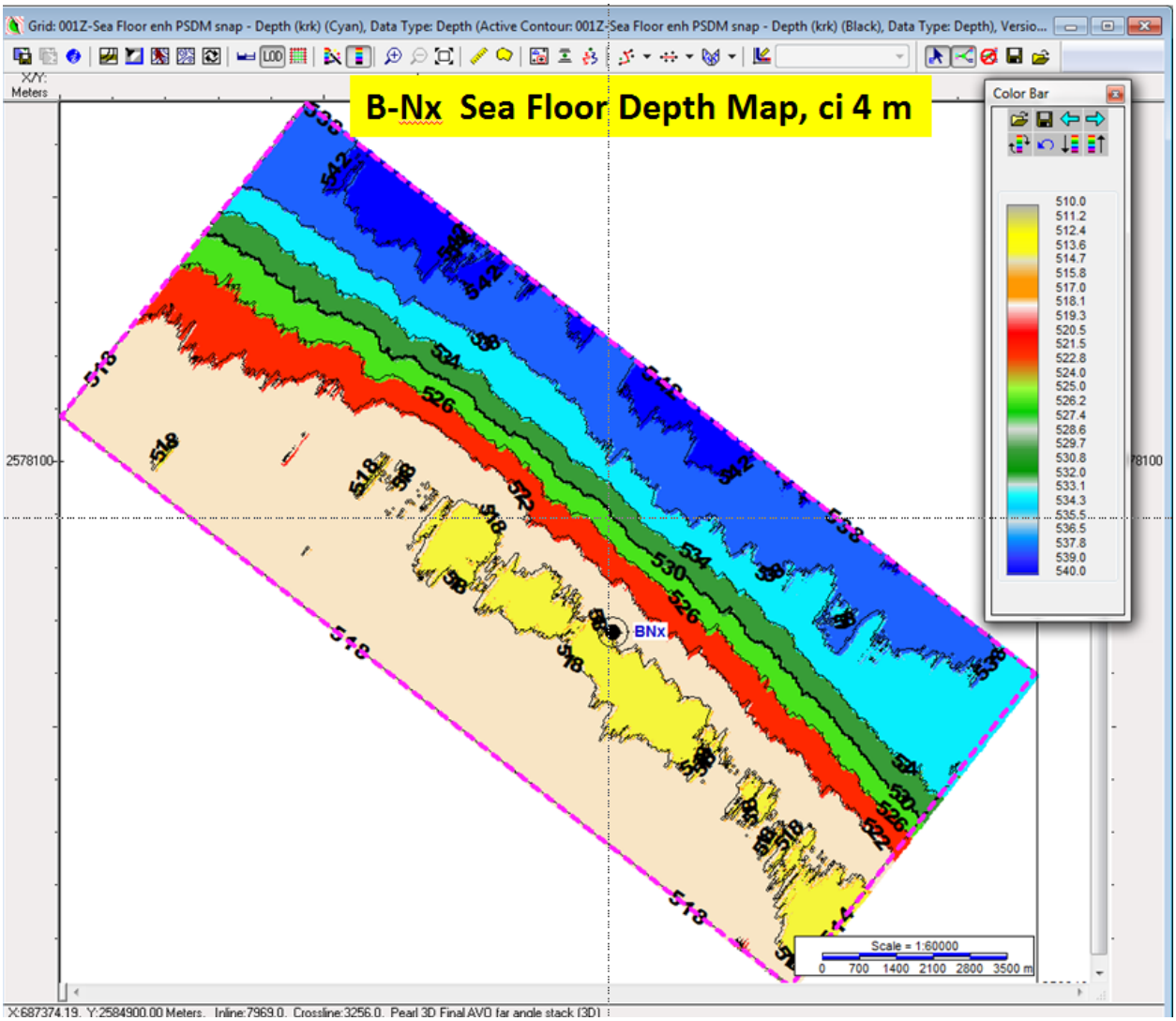

Figure 6: Sea Floor Depth Map

The sea floor amplitude is uniform, other than some East -West acquisition footprint and fold coverage variations, see Figure 7. There are no obvious large mass-flow or geomorphic features. The 3D seismic interpretation has revealed no evidence of recent faulting, pock marks or bioherms at the sea floor around the B-North well location.

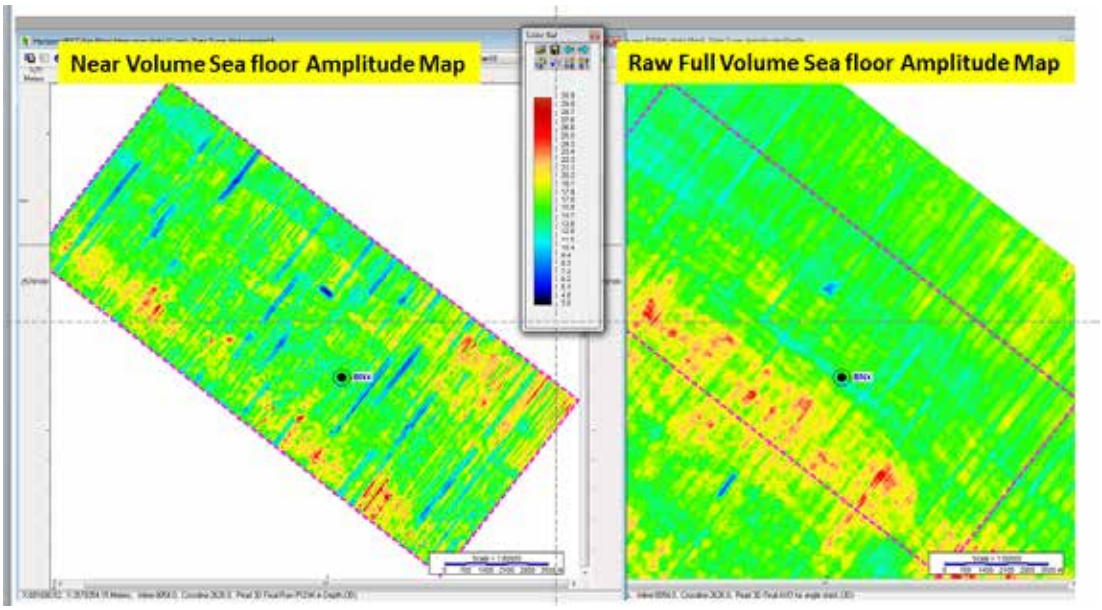

Figure 7: B-North Wellsite - Sea Floor Amplitude Map

The nearest ODP well Sites 1003 A, B, C & D are located on the flank of the Grand Bahama Bank platform. The sea-floor to shallow sediments, Holocene to Pleistocene in age, are poorly lithified carbonate mudstones and wackestone typical of periplatform sediments and fossil debris. Figure 8 shows a long-distance 2D tie from the ODP sites to the BPC 3D area. Compared to the ODP 1003 site, B-North wellsite is more basinal and the shallow sediments are predicted to be pelagic ooze with increasing carbonate content towards the Base Tertiary as indicated by the interval velocities increasing from 1550 meters/second close to sea floor and 2300 meters/second at 830 meter subsea (312 meters below mudline). See Figure 9.

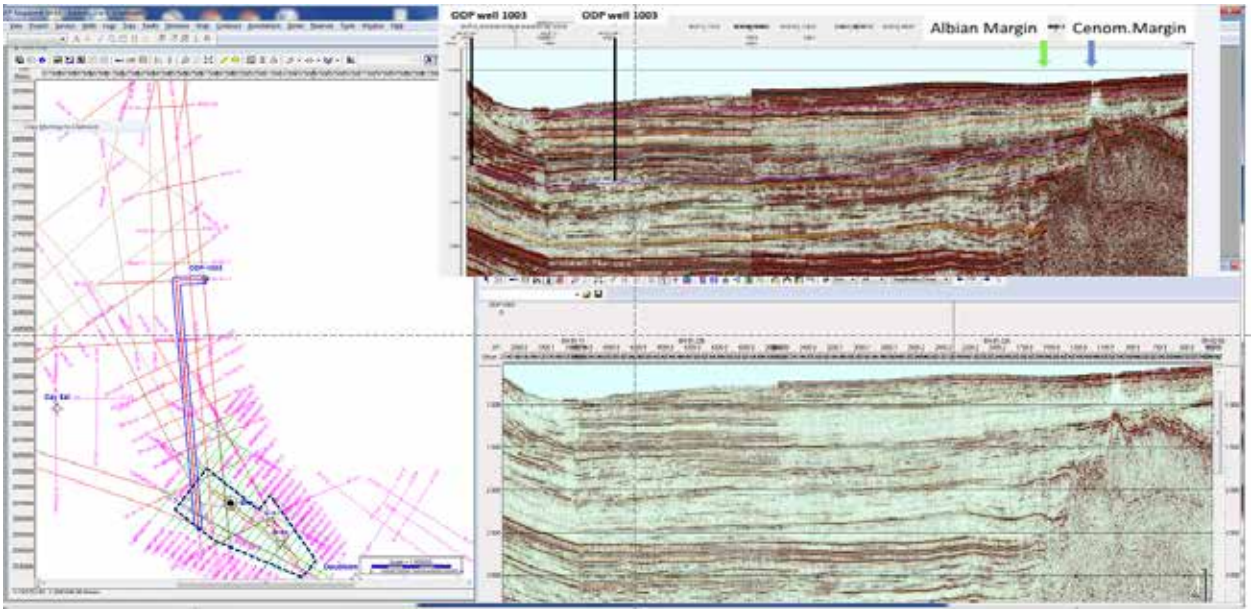

Figure 8: Seismic Profile from ODP Site 1003 in Santaren Channel to BPC 3D

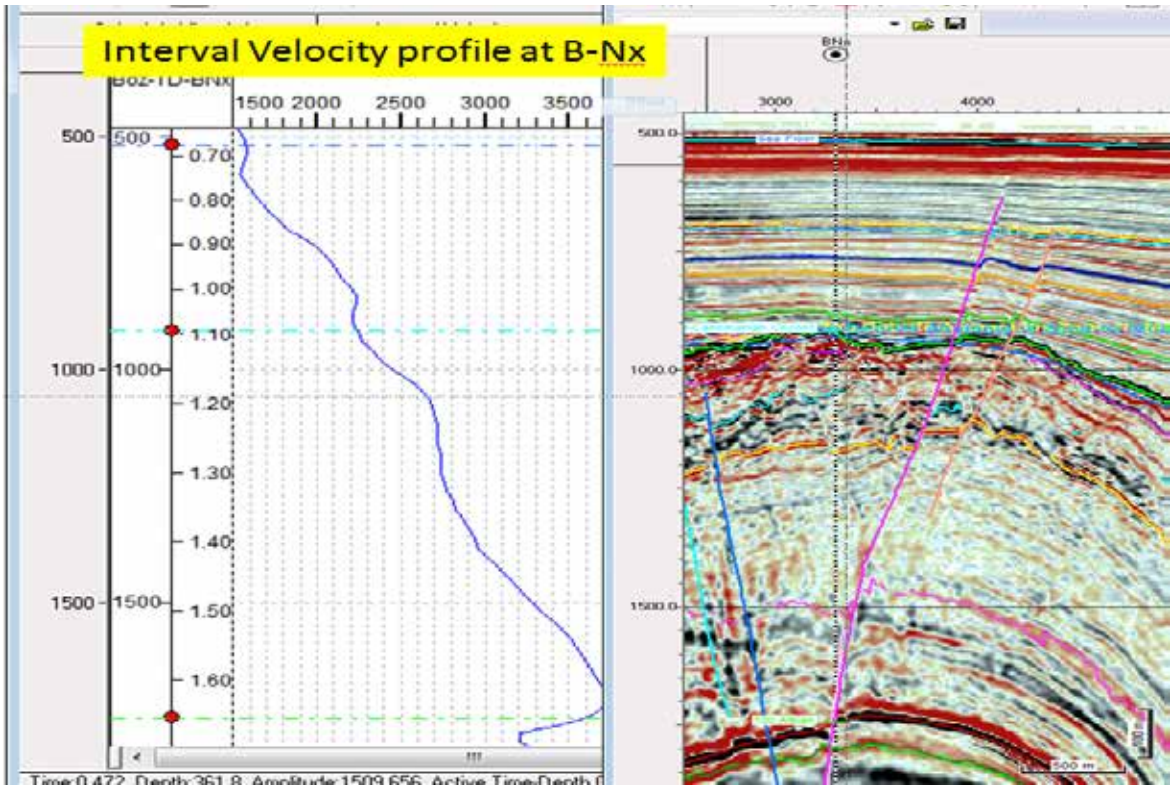

Figure 9: Interval velocity profile at B-North; Base Tertiary is the green reflector;~ 850m ss

Sub-Seabed Evaluation

Five 'shallow' seismic events have been picked from the enhanced PSDM Volume; seismic horizon /event numbers 049z, 050z, 062z,065z and 085z are within the Tertiary and six events covering the Cenomanian (Lower Cretaceous) interval. Near and Far 3D volume offset analyses have also been run on some of these events for amplitude vs. offset (AVO) effect.

Sea Floor to Event 049z is of low reflectivity, parallel bedded and interpreted as pelagic ooze, mudstones. Events 049z and 050z are trough-peak doublets representing a thin layer, 12 meters overlying a parallel bedded sequence. These horizons do not show any gas anomalies but there are a number of paleo pock marks as shown in Figures 10 and 11.

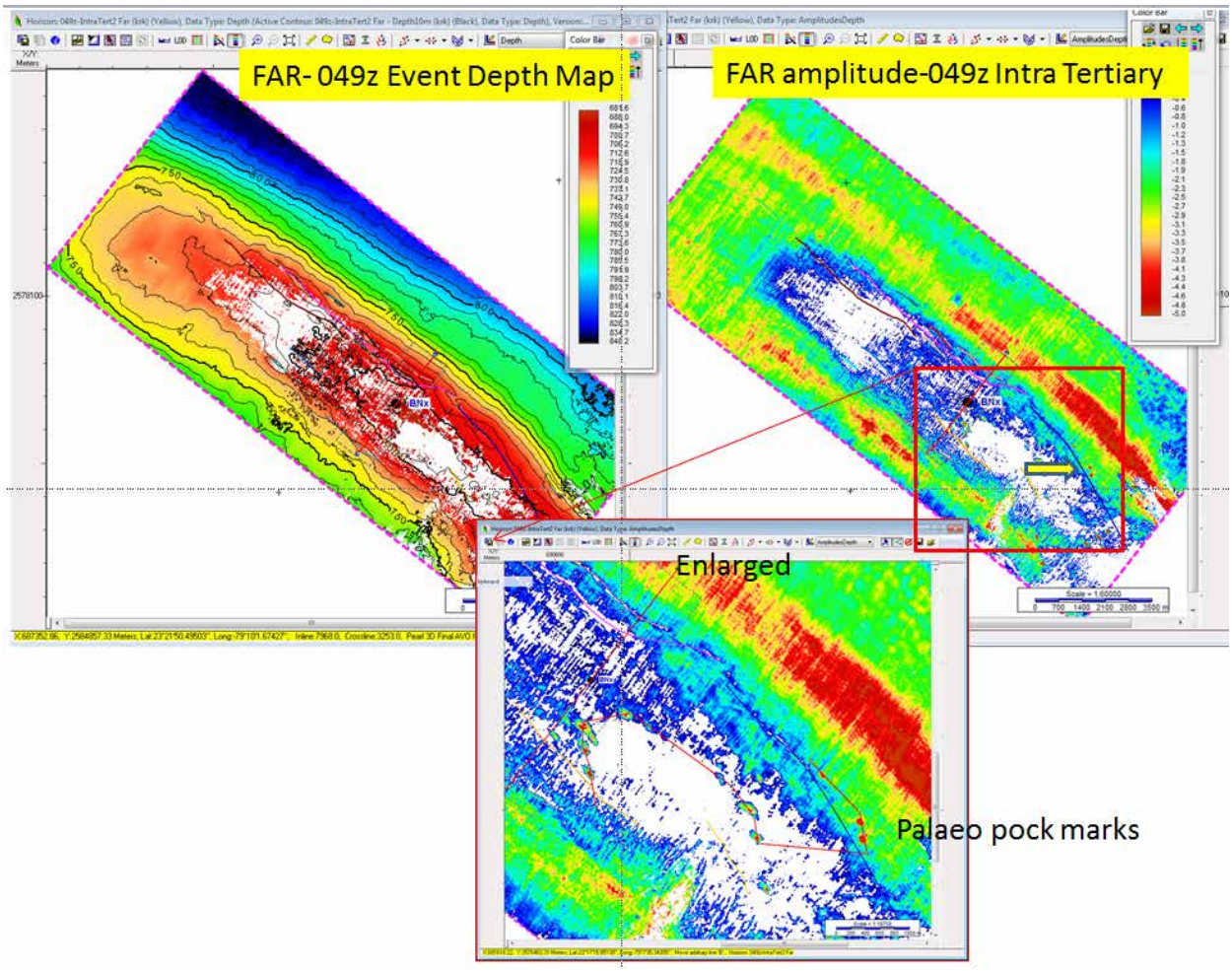

Figure 10: Intra Tertiary Event 049z Structure and Amplitude map.

These pock marks are not associated with faults affecting the lower sections. The seismic horizons below or above are also not affected and therefore are likely to be de-watering features.

Fault traces on the depth surfaces are generally NW to SE trending and shown as short curved surfaces offset in NE to SW direction, implying a conjugate fault network and semi-plastic deformation, see Figures 12A & B.

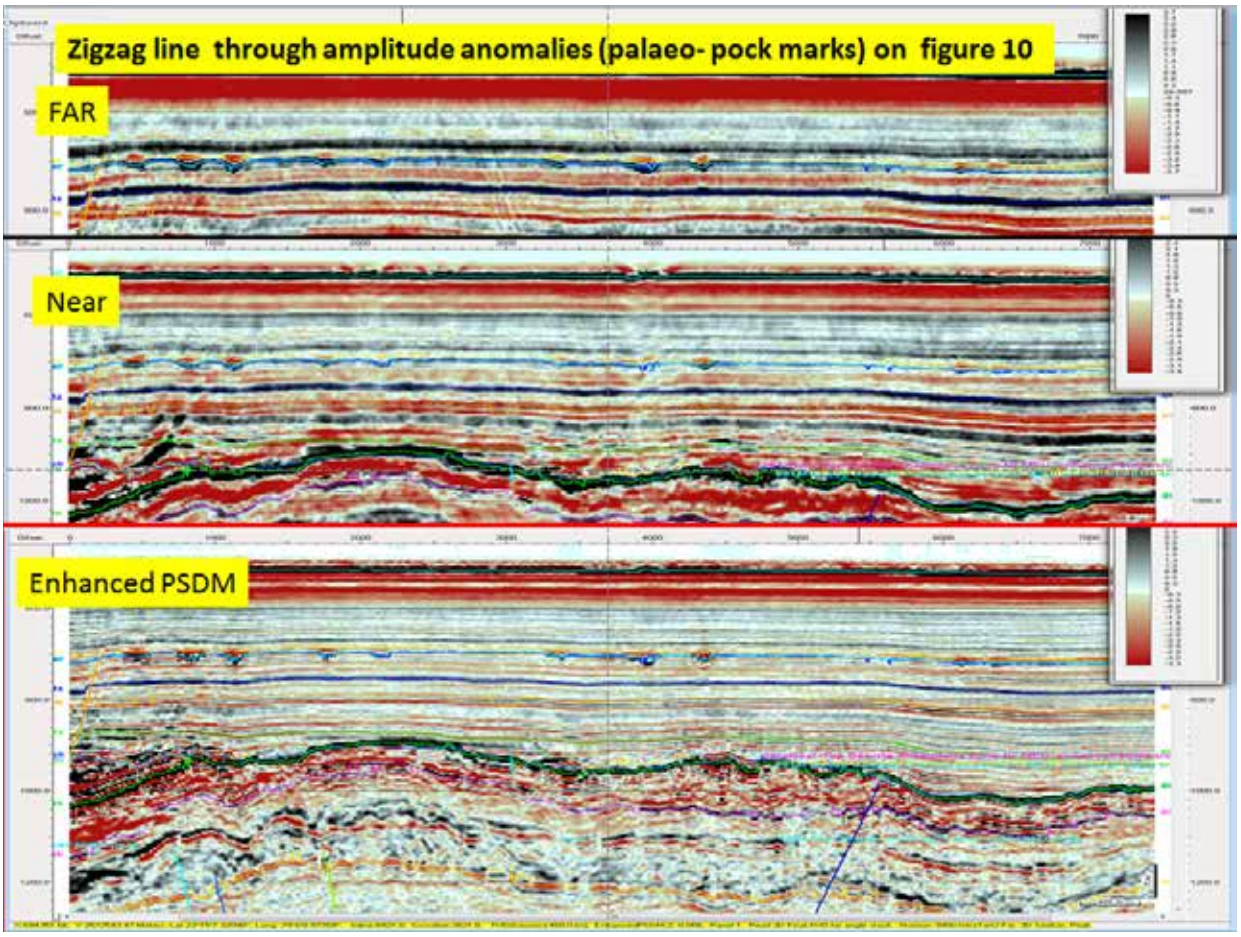

Figure 11: Paleo-pock marks on Far, Near and Enhanced volumes from 3D PSDM

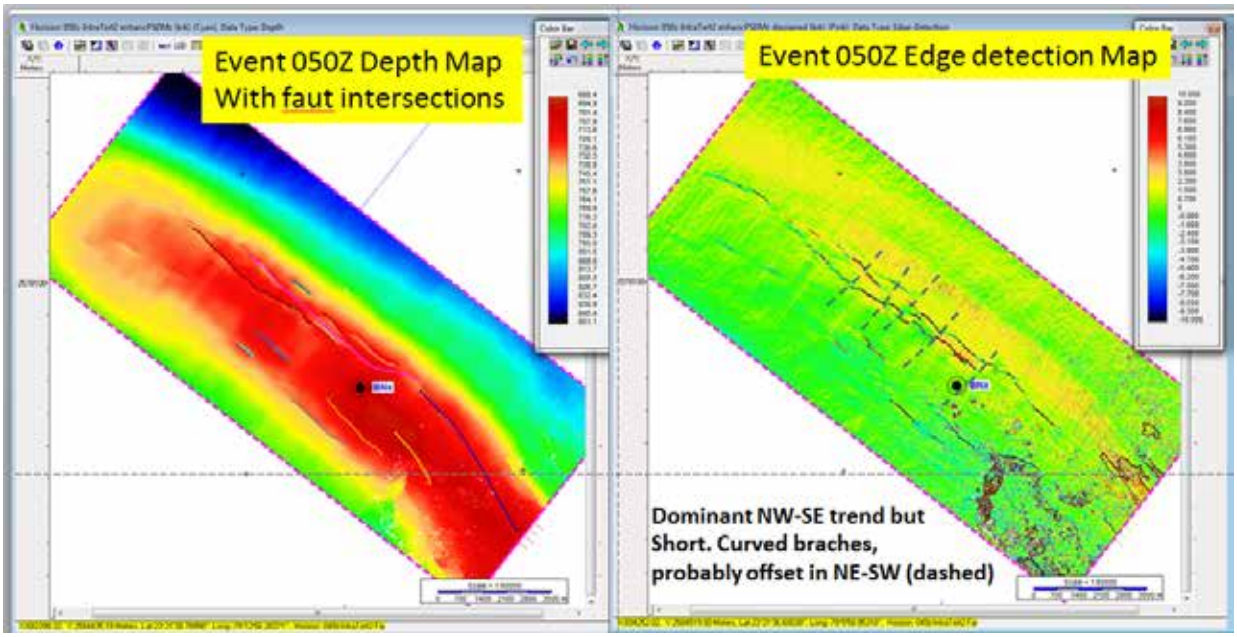

Figure 12A: Event 050z, Structure and Edge detection maps to map fault trends

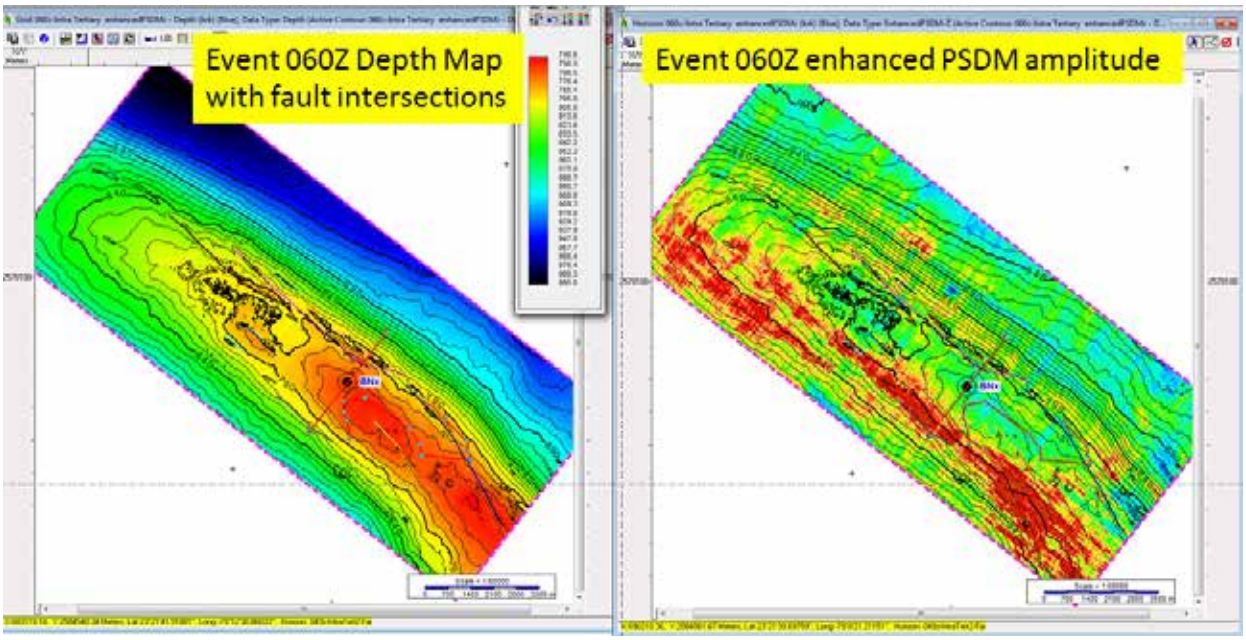

Figure 12B: Event 060z, Structure and Enhanced PSDM Amplitude Maps

Event 060z in the Tertiary is a positive polarity event where the velocity increases relatively rapidly to about 2050 meters/second. The event is similarly faulted but shows no evidence of amplitude anomalies or paleo pock marks.

Similarly, no evidence of anomalies has been observed on the trough Event 062z, approximately 280 meters below mudline, Figure 13.

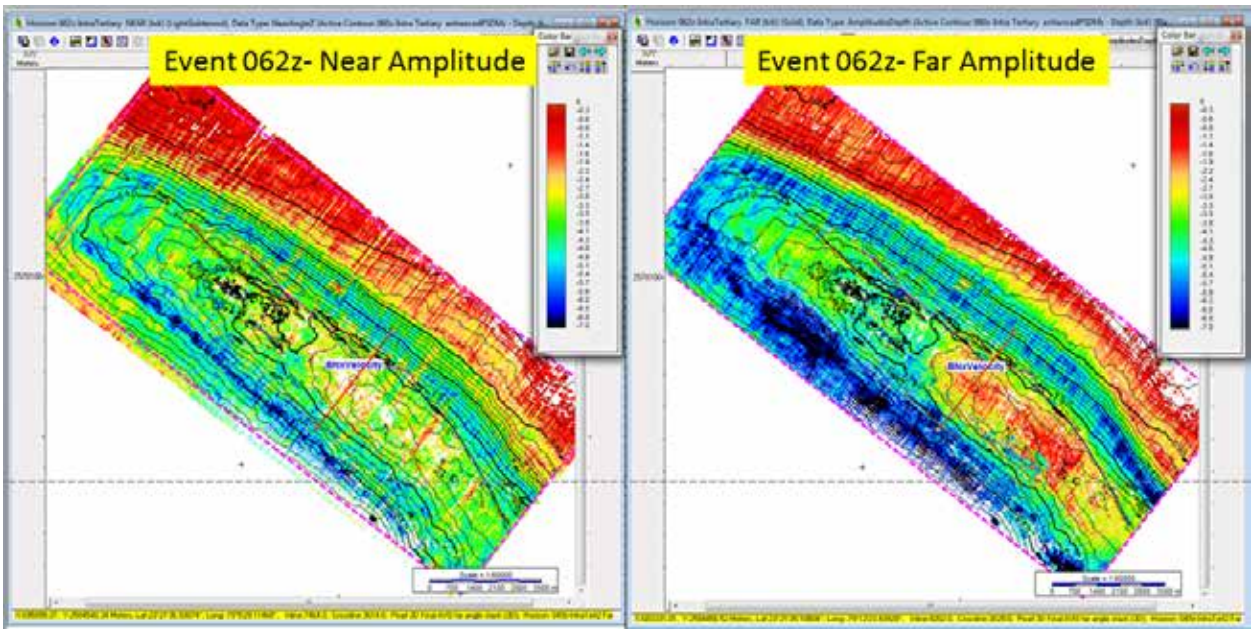

Figure 13: Event 062z – Lower Tertiary Amplitude maps

Closer to the Base Tertiary, the faulting becomes more intense and concentrated, but event 085z similarly shows no evidence of seismic anomalies, see Figure 14.

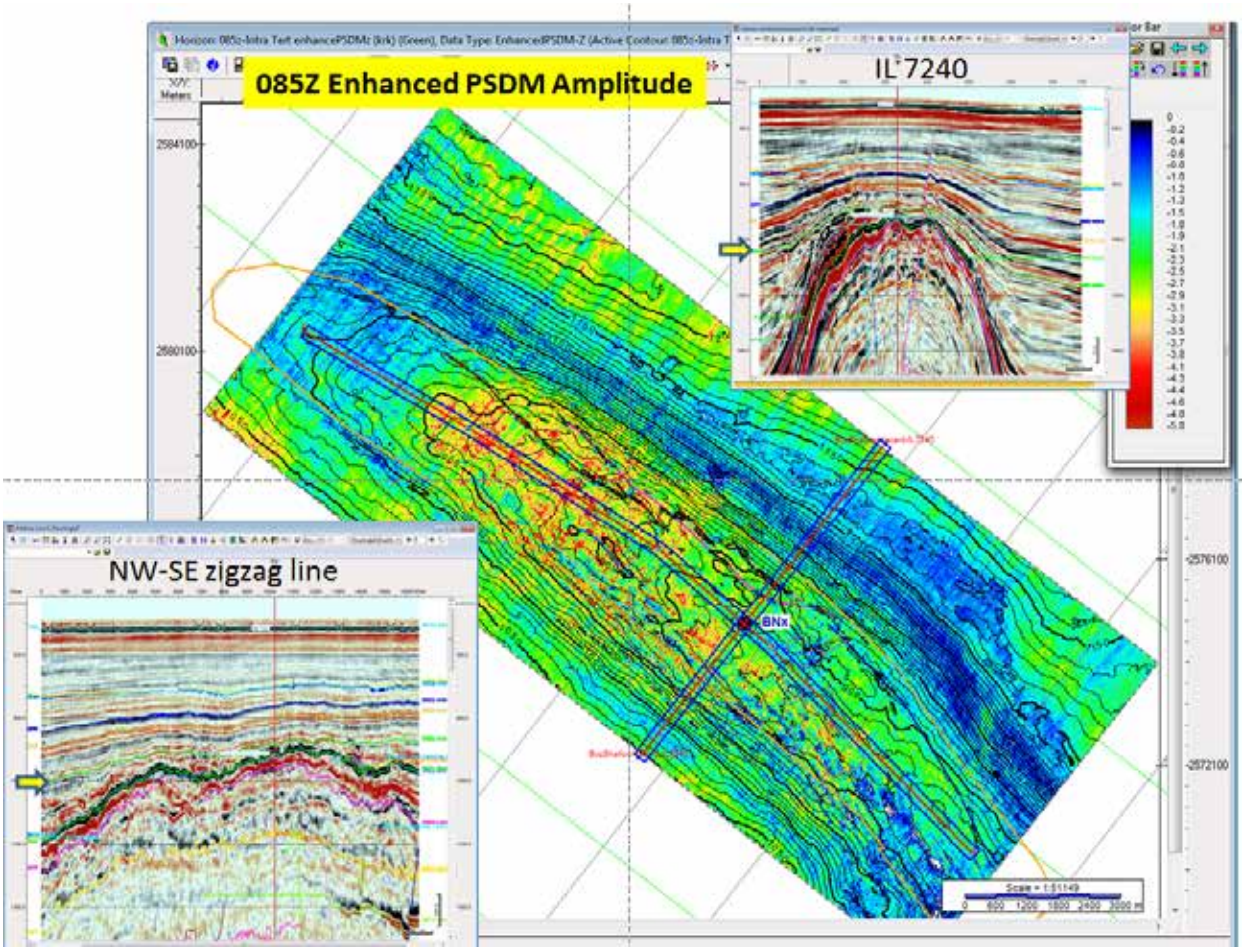

Figure 14: Seismic Marker- Event 085z, Base Tertiary; Enhanced PSDM Amplitude Map

In summary, the Tertiary interval is not expected to present any drilling hazards.

Upper Cretaceous (Cenomanian) Hazard Analysis

The Base Tertiary is a clearly, seismically defined unconformity on the uplifted, faulted and eroded Cretaceous section, Figure 15. Four main seismic units can be identified within the Cenomanian stratigraphic interval.

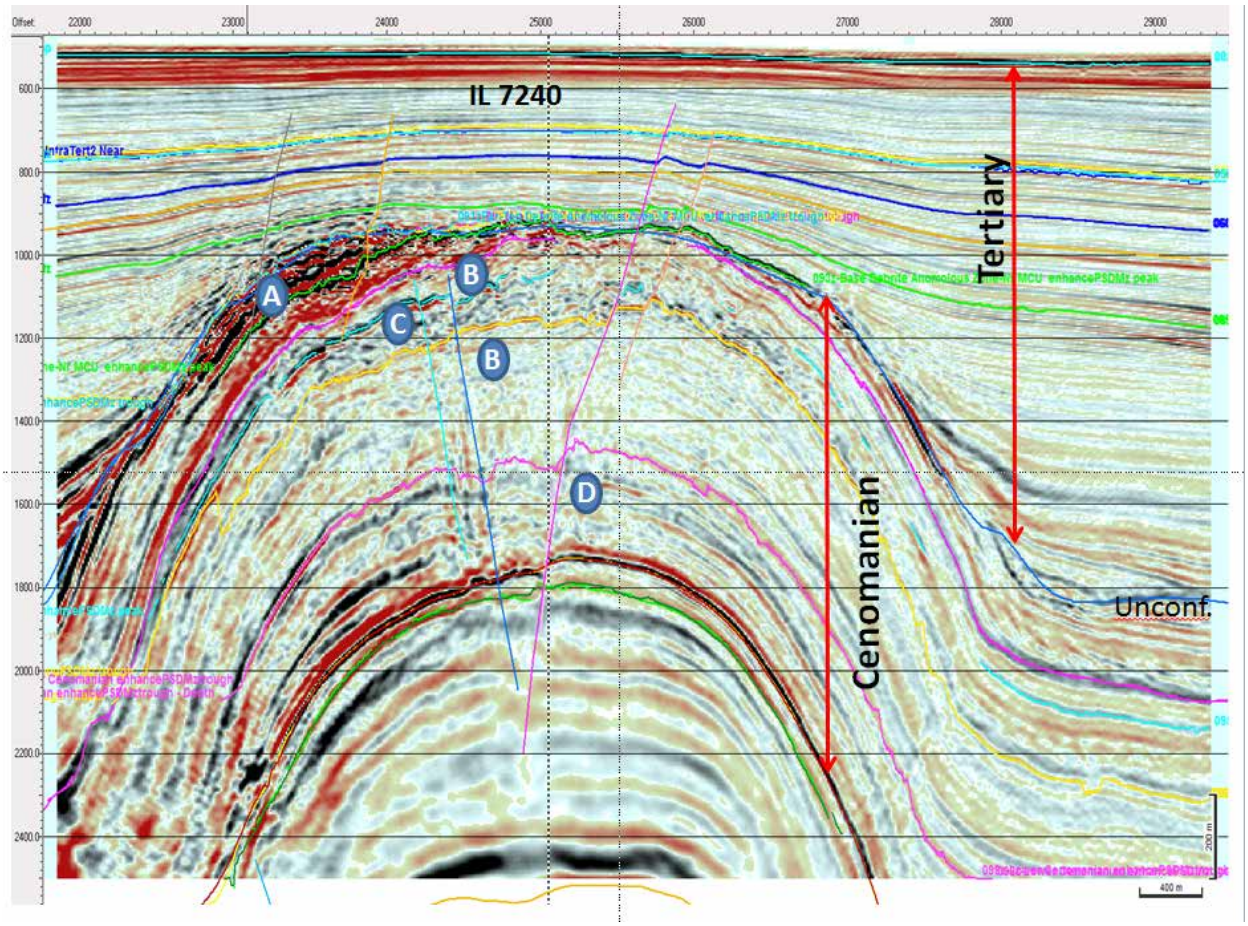

Figure 15: IL 7240, Cenomanian Intervals

Unit A is a low velocity interval which was eroded on the B-North structural high. It is interpreted to be derived from the carbonate platform (Structure A) and is probably reefal or talus debris with porosity. Seismic amplitude analyses of a number of events at top, base and within Unit A strongly suggest hydrocarbon charge, Figures 16 &17. Note however, the well is approximately 750 meters to the northeast, outside the anomaly but base-sealing sediments (Unit B, shales) are within vertical height of the anomaly but can only present risk if fracture porosity exists in the shales.

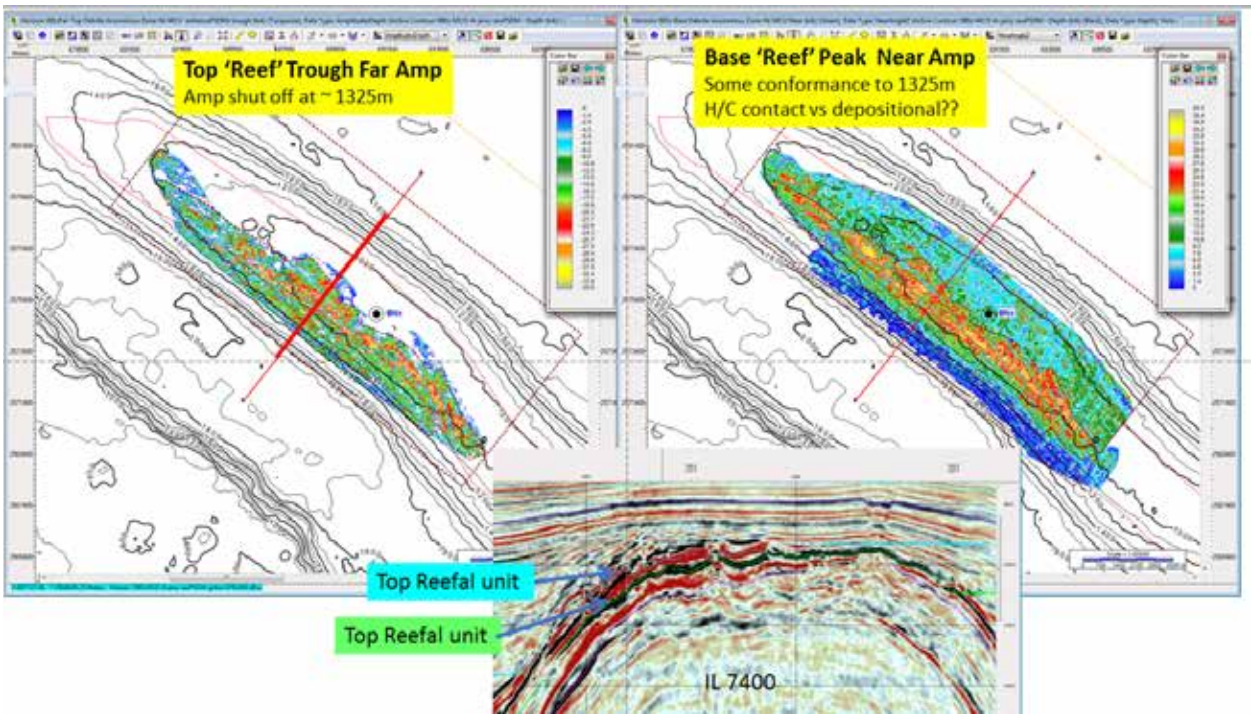

Figure 16: Cenomanian Unit A- Amplitude analysis

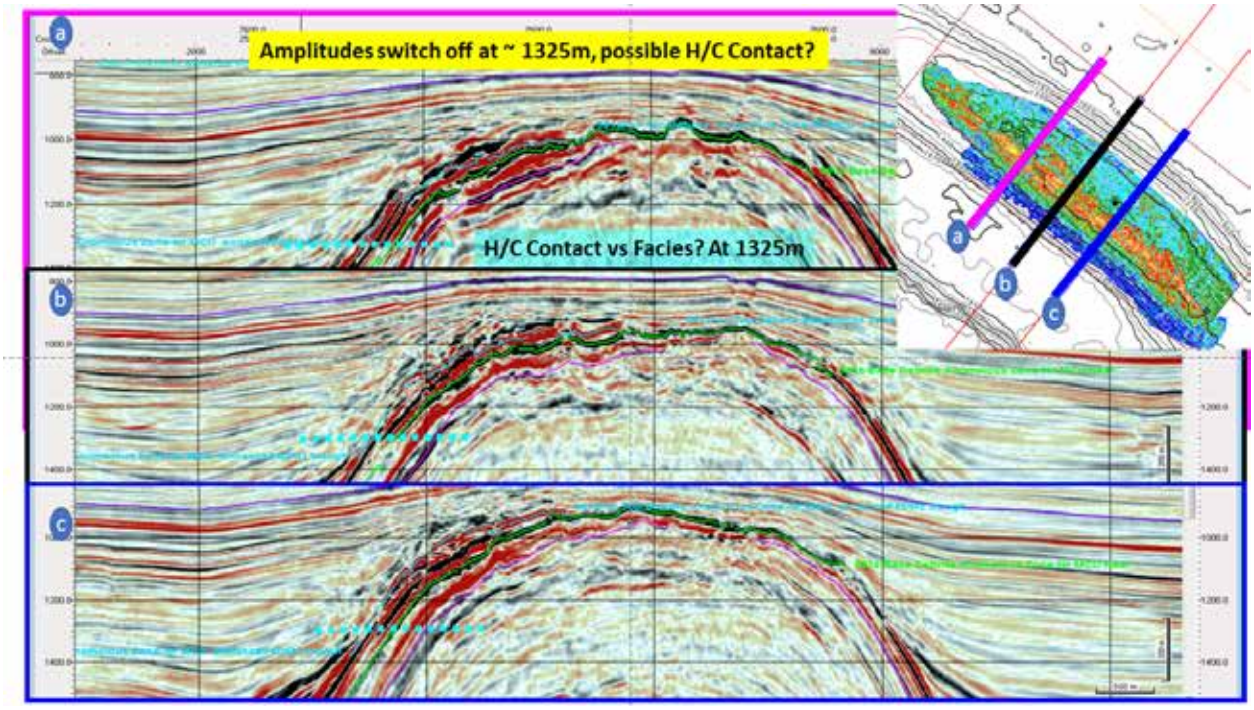

Figure 17: Seismic Profiles across B-North Structure

Unit B is seismically transparent and uniform across the structure with a mean interval velocity of around 2800 meters/second it is considered to be dominantly shales.

Unit C embedded within Unit B has a chaotic seismic character with a rugose top, internally soft sediment deformation features. It is interpreted to be mass-flow sediments from the Bahamas platform, but is not considered to present drilling hazards.

Unit D is a parallel-bedded and is expected to be shale, limestone (carbonate rich shale) intercalations. No seismic anomalies have been identified within this unit.

Finally, a schematic lithological prediction from Sea floor to Albian is shown in Figure 18.

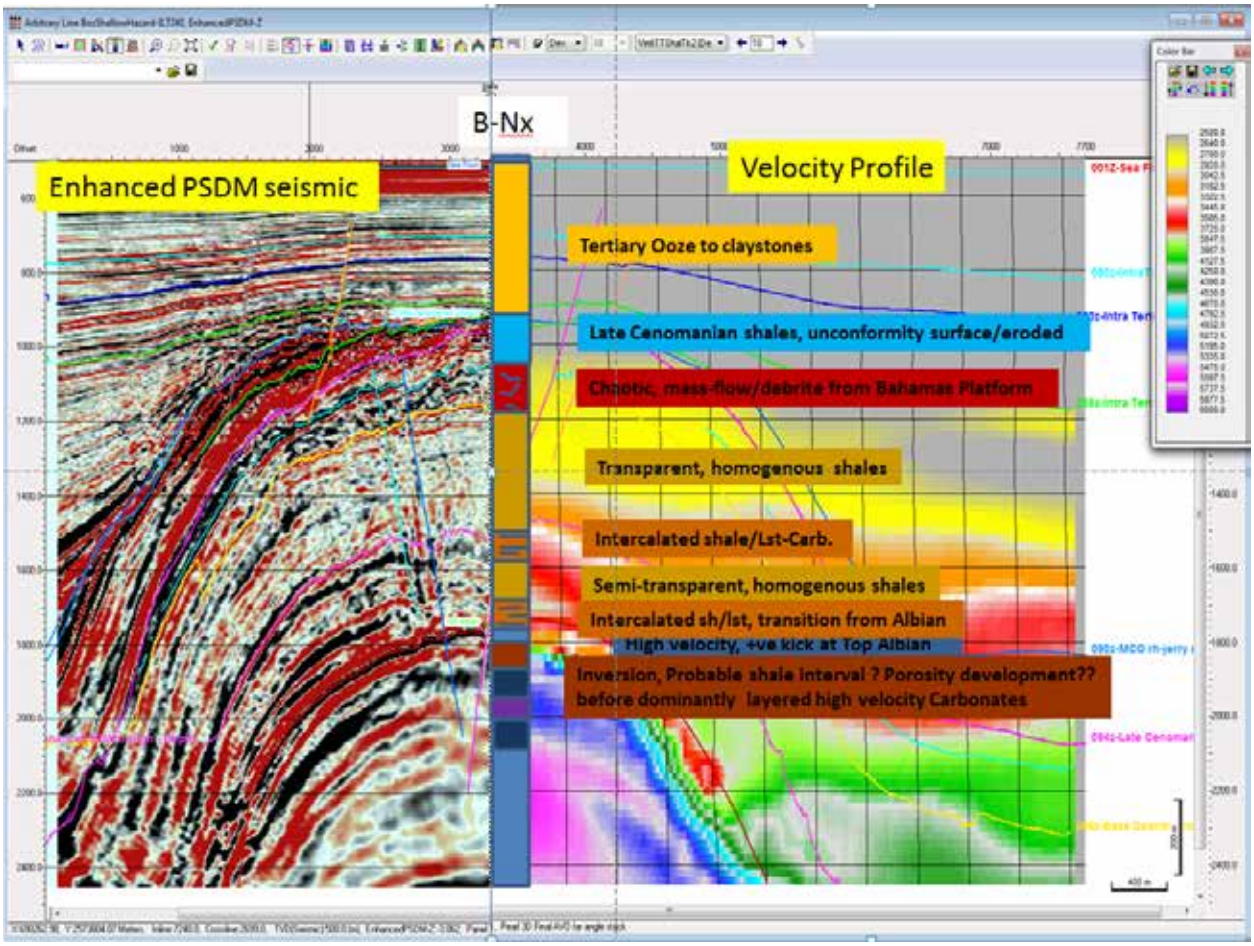

Figure 18: Tertiary & Cenomanian Predicted Well Lithologies.

Conclusions:

B-North well prospect is sited on a flat sea floor at 518 meters subsea with a dip at 0.19 degrees to northeast. No evidence of water-flow, gas expulsion features or biohermal build-ups have been identified on the sea floor. There is no evidence of recent or old faults at the sea floor. The extensional faults affect the sub-seabed section covering the whole of the Tertiary, but no evidence of gas anomalies associated with the faults acting as migration conduits have been identified. The well is 750 meters away from a probable hydrocarbon accumulation at the Top Cenomanian some 430 meters subsea below mudline.

PROTECTED SPECIES MONITORING REPORT

Bahamas Petroleum Company

CGGVeritas

M/V Veritas Viking

Pearl 3D Broadseis

Bahama Bank

9 June 2011 – 18 September 2011

Project No.	**UMS04076**	**RPS**	
Report No.	**1**	**411 N Sam Houston Parkway E**	
Author(s)	**Adam Swope, Greggo Seward**	**Houston, Texas 77060, USA**	
		Tel	**: (281) 448-6188**
Reviewer(s)	**Jessica Mucci**	**Fax**	**: (281) 448-6189**
Submittal Date	**23 September 2011**	**E-mail**	**:MucciJ@rpsgroup.com**
		Web	**: www.rpsgroup.com**

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1. EXECUTIVE SUMMARY

This is the final protected species monitoring report of the Pearl 3D Broadseis seismic survey project for the Bahamas Petroleum Company, PLC by the seismic contractor CGGVeritas Services, SA on the Norwegian vessel *M/V Veritas Viking*. This report covers the reporting period of 9 June through 18 September 2011. During this reporting period a dedicated marine mammal observer (MMO) was utilized, along with crew-marine mammal watchers (CMMW) on the *M/V Veritas Viking* to implement seismic survey mitigation measures based on *JNCC guidelines for minimizing the risk of injury and disturbance to marine mammals from seismic surveys,* effective August 2010. In preparation for the commencement of this project, initial airgun testing was conducted on 9-10 June 2011 with the assistance of two CMMWs, who conducted a pre-watch survey prior to the activation of airguns. On 16 June 2011 one dedicated MMO joined the vessel to assist the seismic crew in operating in accordance with guidelines based on the aforementioned JNCC guidelines. After 16 June 2011 one dedicated MMO was present aboard the vessel at all times for the remainder of the reporting period.

Active seismic survey production for this project began on 16 June 2011 and continued until its completion on 18 September 2011. There were no delays resulting from the implementation of marine mammal mitigation measures.

There were five visual detections of marine mammal and turtle species during the reporting period: four dolphin sightings and one turtle sighting. Two species of dolphin, the pantropical spotted dolphin *(Stenella attenuata)* and common bottlenose dolphin (*Tursiops truncatus*), and one species of marine turtle, the loggerhead sea turtle (*Caretta caretta*), were observed. Two dolphin sightings occurred while the vessel's sound source was at full-volume on a survey line, and the remaining two dolphin sightings in addition to the single marine turtle detection took place while the vessel's sound source was silent and the vessel was conducting a line change between survey transects. No mitigation actions needed to be taken during any of the detection events and no delays in survey production occurred. Please see the Wildlife Overview section for more detailed information regarding the protected species detections as well as other observed wildlife during the report period.

1.1. PROJECT LOCATION AND OPERATION PARAMETERS

The Pearl 3D Broadseis project is a 3D seismic project conducted in a prospect area located approximately 113 nautical miles south/southeast (150°) of Key Largo, Florida at the northern most corner, 133 nautical miles south/southeast (165°) at the western most corner, 166 nautical miles south/southeast (150°) at the southern most corner, and 163 nautical miles south/southeast (148°) at the eastern most corner. The entire prospect area is located in the Bahama Bank region of the Atlantic Ocean (Figure 1), and is divided into three overlapping survey areas.

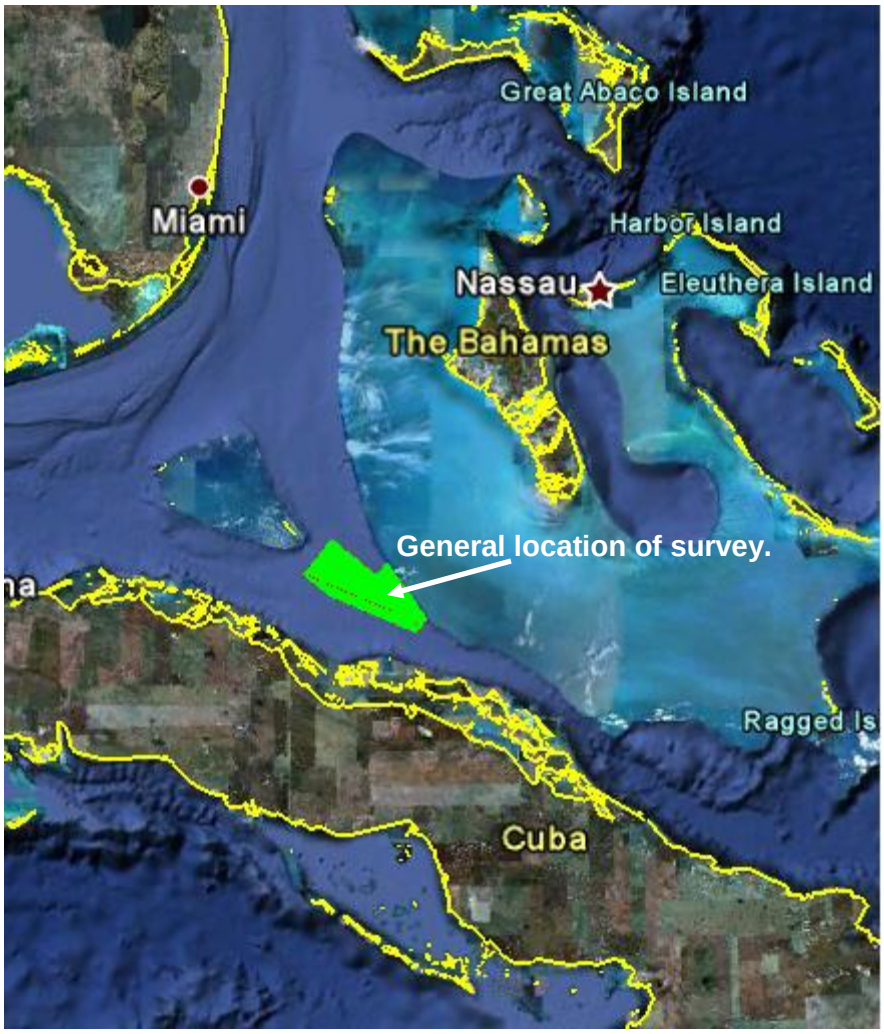

Figure 1. Atlantic Ocean / Bahama Bank map indicating the general location of the survey.

The Pearl 3D Broadseis project began on 16 June 2011, after some initial airgun testing on 9-10 June, and was finished on 18 September 2011. The survey prospect consists of 3 areas, totalling 188 data acquisition lines. Area 1 of the prospect contains 132 data acquisition lines that range from 10 to 34 kilometres in length. These lines are surveyed in northeast and southwest directions with headings of 53° and 233°, respectively, and took between three and four hours to survey with line changes lasting between 2.5 and 3.5 hours on average. The prospect's Area 2 contains 29 data acquisition lines that range from 18 to 43 kilometres in length. These lines are surveyed in northwest and southeast directions with headings of 155° and 335°, respectively. Area 3 of the prospect contains 27 data acquisition lines that range from 28 to 52 kilometres in length. These lines are also surveyed in northwest and southeast directions and have headings of 122° and 302°, respectively. The amount of time to survey data acquisition lines and complete lines changes in *Areas 2* and *3* varied greatly due to the oceanography of the area, currents, and nearby shipping lanes, but averaged 4-6 hours of production for transects in Area 2 and 4-8 hours of production for lines in Area 3, with line changes lasting 3-6 hours on average in both areas.

A single recording vessel, the *M/V Veritas Viking*, which tows 10 streamers approximately 8 kilometres in length astern, is conducting this survey. Throughout this project, two supply

vessels, the *Miss Lilly* and the *Kurt David*, both of which also act as guard vessels, accompanied the *Veritas Viking*. The *Veritas Viking* is 95m in length and is equipped with six gun strings towed approximately 350 meters astern at a depth of 5 meters. The six gun strings each support nine airguns, for a total of 54 airguns. The three port side gun strings (gun strings 4-6) comprise the port airgun array, while the three starboard side gun strings (gun strings 1-3) make up the starboard gun array. Of the 27 airguns per array, 24 are used while in production, with 3 inactive airguns on standby. The maximum source volume of each array is 4450 cubic inches, with a shot point interval of 25 meters. While shooting the airguns at full-volume (i.e. while on a survey line) the arrays are alternately fired, port array then starboard array and back again, in a method described as "flip-flop" shooting. The guns are ramped up by gradually increasing the number of airguns, over a period of time between 20 to 40 minutes, until the full-volume source level is attained. The smallest airgun, also known as a mitigation gun, is used as a mitigation source during line changes at night, and is 70 cubic inches in volume.

Ramp-ups were performed during both daylight hours and after dark. Those conducted during daylight hours followed a one-hour pre ramp-up visual survey when possible, during which time the 500 meter exclusion zone was closely monitored for the presence of marine mammals and sea turtles. All ramp-ups conducted after daylight hours were commenced from a mitigation gun. Although the use of a mitigation gun to allow for night time ramp-ups is not a normal procedure mentioned under JNCC guidelines, it was determined to be an acceptable practice for this project, and was implemented for the duration of the survey.

1.2. VISUAL SURVEY METHODOLOGY

One dedicated MMO, certified in a JNCC Marine Mammal Observer Course, and crew-marine mammal watchers (CMMWs), advised in JNCC guidelines, performed visual monitoring during this reporting period. The start of this reporting period was on 9 June 2011 when two non-dedicated CMMWs, advised on JNCC Guidelines, were utilized to conduct a one-hour pre-watch survey of the exclusion zone to allow for an initial testing of airguns in preparation for the commencement of the project. No further use of the airguns took place until after a dedicated MMO joined the vessel on 16 June 2011.

Throughout the reporting period, visual monitoring was performed daily from dawn until dusk. During daily watches the dedicated MMO works flexible four to five hour shifts, with breaks lasting no more than two hours in order to be available for pre-watch surveys, minimize the use of CMMWs, and to remain under the 12 hour maximum observing hours per day suggested in the JNNC Guidelines. CMMWs are utilized during the one hour pre-watch period prior to ramp up and also to relieve the dedicated MMO at scheduled break points during the day. Only one person is required to be on watch throughout the day, except during the one hour period prior to ramp-up. During the one hour pre-watch period before ramp up, two MMOs/CMMWs are utilized to conduct a visual assessment of the exclusion zone for marine mammals.

Visual monitoring for protected species took place from the bridge wings of the vessel, providing a 360° view of the exclusion zone. The bridge wings are located 20 meters from the water's surface, placing eye level at approximately 21.7 meters above the sea surface. Distance is determined visually using the aid of marine binoculars with 10x magnification, as well as by relating the animals to objects of a known distance, such as the airguns or paravanes behind the vessel.

1.3. SURVEY DATA SUMMARY

Weather conditions for this reporting period were average for this time of year in the Bahamas. Observation conditions were good with few whitecaps on the water allowing marine life to be spotted more easily, if present in the area. Wind speeds ranged from 0-35 knots and averaged approximately 10 knots from the east/southeast. Sea states ranged from B0-4 on the Beaufort scale. Most days were between B1-3; however, rough seas (B4-B5) were observed during the occasional squall or when tropical disturbances were in the vicinity.

During this reporting period the airguns were ramped up a total of 242 times. During the daylight hours the airguns were ramped up a total of 130 times and were preceded by 60 minutes of visual clearance when possible. There were 112 night time ramp-ups, all initiating from the mitigation source. There were a total of 139 ramp-ups from the mitigation source, including all night-time ramp-ups as well as some daylight ramp-ups in which a 1-hour pre-watch visual survey was not able to be conducted before the commencement of airgun firing (i.e. dawn and dusk). The airguns were active for a combined 1607 hours 4 minutes (90 hours 47 minutes conducting ramp-up; 984 hours 36 minutes in production; 153 hours 47 minutes of non-production full-volume firing; 348 hours 26 minutes utilizing the mitigation gun; and 29 hours 28 minutes of gun testing). There was a total of 840 hours 56 minutes of silence during the reporting period. See Figure 2, below, for a visual breakdown of the aforementioned airgun operations.

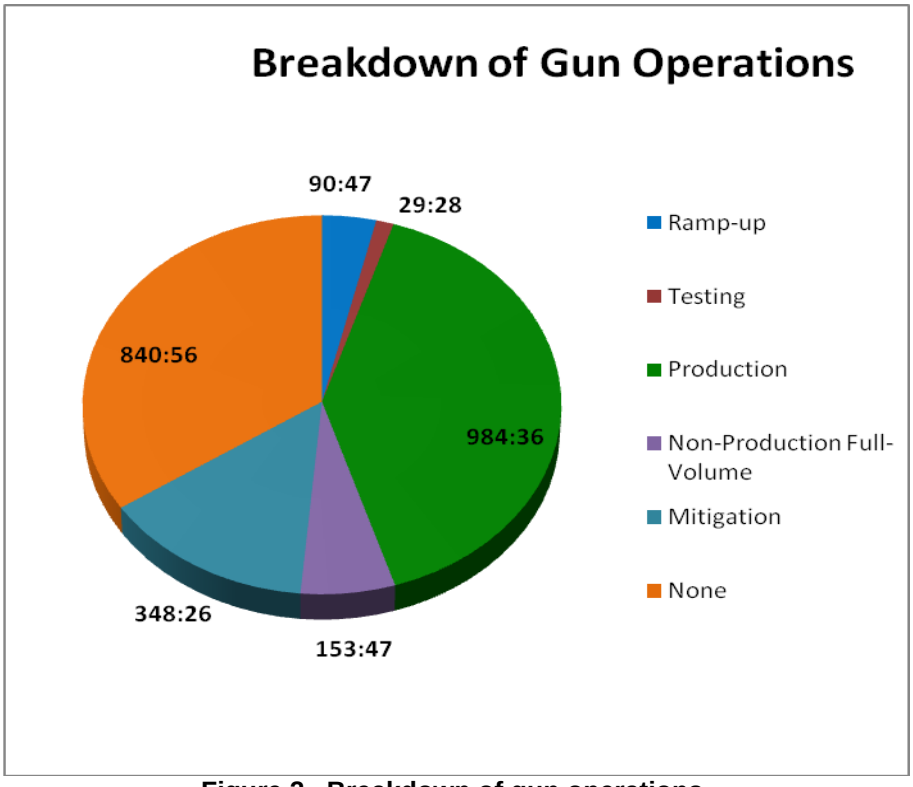

Figure 2. Breakdown of gun operations.

1.3.1. Visual Monitoring Survey Summary

Visual monitoring was conducted on all days during the reporting period in which there was airgun firing. There were a total of 1039 hours 34 minutes of visual monitoring performed during the reporting period, during which time there were 717 hours 56 minutes of visual monitoring during airgun firing and 321 hours 38 minutes of monitoring during airgun silence. Figure 3, below, shows a visual breakdown of visual monitoring hours, including 889 hours 8 minutes of firing without monitoring, and 519 hours 18 minutes of no firing or monitoring.

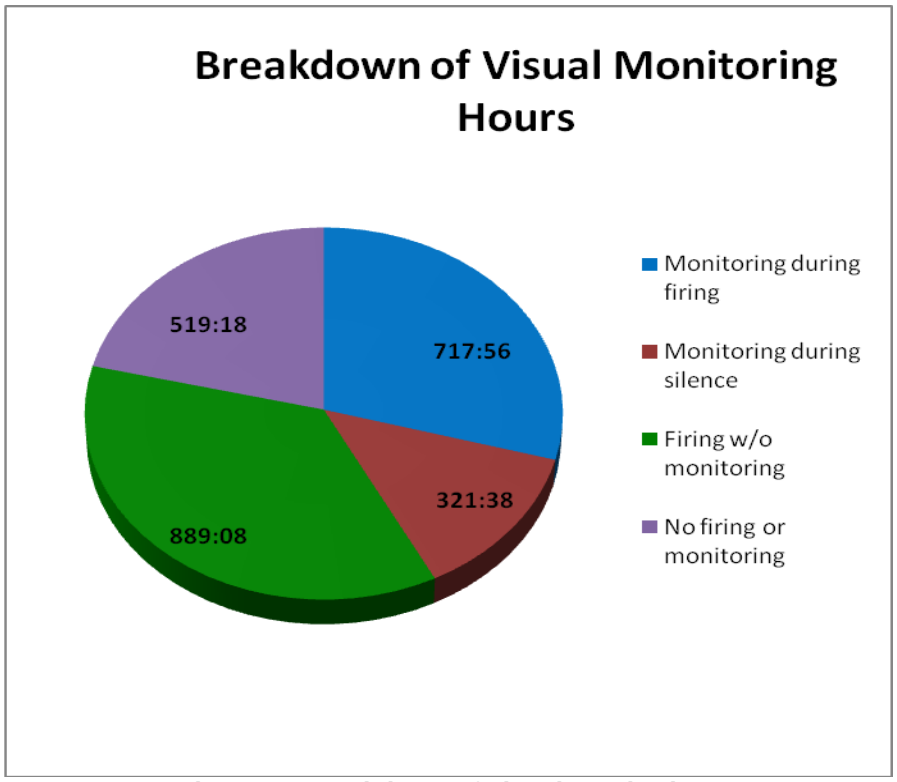

Figure 3. Breakdown of visual monitoring.

1.4. MITIGATION ACTIONS

No mitigation actions were suggested or employed during the whole of this seismic survey. While dolphins were seen within the 500m exclusion zone twice during the 1-hour pre-watch survey prior to airgun firing, neither event occurred within 20 minutes of airgun activity, therefore no delays in airgun firing were required.

2. WILDLIFE SUMMARY

2.1. OVERVIEW

Protected species were observed five times during the reporting period, for a total of 45 dolphins and 1 marine turtle. See the following section for details concerning these protected species detections.

Four types of fish were observed during the reporting period. Flying fish (family Exocoetidae), were observed almost daily throughout the reporting period. Mahi-mahi *(Coryphaena hippurus)* and stingrays (suborder Myliobatoidei) were both observed on two days during the reporting period. There was a single sighting of a hammerhead shark (family Sphyrnidea) and also one sighting of an unidentified shark species (suborder Selachimorpha*)*.

Avifauna was consistent, if not abundant, during the survey. A total of 33 bird species were identified. The most abundant species identified was the royal tern (*Thalasseus maximus*), with 100 individuals seen across 36 non-concurrent days. Other commonly sighted species included the cattle egret (*Bubulcus ibis*), magnificent frigatebird (*Fregata magnificens*), and snowy egret (*Egretta thula*), listed in decreasing frequency. Masked boobies *(Sula dactylatra)* and brown boobies *(Sula leucogaster)* were also seen on multiple days, though less frequently. A limpkin (*Aramus guarauna*) was observed on one day. The species of birds listed above are commonly seen in this region throughout the year. Many migrant species, however, known to fly south through the tropics during the late summer and fall to their wintering grounds in the tropics and South America, were also sighted throughout the period. Notable migrants included many Parulids, such as the American redstart (*Setophaga ruticilla*), yellow-throated warbler (*Dendroica dominica*), Louisiana waterthrush (*Parkesia motacilla*), and black-throated blue warbler (*Setophaga caerulescens*), each seen seldom but on more than one day. Notable birds of prey seen during the survey included the burrowing owl (*Athene cunicularia*), peregrine falcon (*Falco peregrines*), merlin (*Falco columbarius*), and osprey (*Pandion haliaetus*).

No marine invertebrates were observed during the entirety of the seismic survey.

See the Wildlife Summary Tables on the following pages for a complete list of fish (Table 2) and bird (Table 3) species observed during the project. Refer to section 4 (Photographs) for pictures of wildlife taken aboard the vessel during the report period.

2.2. VISUAL PROTECTED SPECIES DETECTIONS

There were five protected species detections during this reporting period, which included 1 sighting of nine pantropical spotted dolphins (*Stenella attenuata*), 3 sightings of common bottlenose dolphins (*Tursiops truncatus*) totalling 45 individuals, and 1 sighting of a loggerhead sea turtle (*Caretta caretta*). No mitigation actions were taken, and as a result there were no production delays due to marine mammal or turtle mitigation measures.

The first detection, of a pod of 9 pantropical spotted dolphins including 6 adults and 3 juveniles, occurred on 21 July 2011 at 21:25 UTC while the vessel was performing a line change and the airguns were silent. The pod was seen travelling away from the vessel in the opposite direction as the vessel's heading and were 400 meters from the airgun arrays at their closest approach.

The second detection, of a single common bottlenose dolphin, took place on 12 August 2011 at 21:30 UTC. The individual was seen briefly beneath the surface near the bow, and then again leaping well off the port bow moments later. The sighting took place while the airguns were firing at full-volume during a survey line and the dolphin was seen 440 meters from the airgun arrays at its closest approach.

The third, fourth, and fifth detections occurred on concurrent days from 8-10 September 2011. The third sighting, at 18:42 UTC on 8 September 2011, happened during a 1-hour pre-watch survey prior to the commencement of airgun firing. A pod of 14 common bottlenose dolphins (11 adults, 3 juveniles) were spotted off the bow. The fourth sighting, of 30 common bottlenose dolphins (25 adults, 5 juveniles) at 19:32 UTC on 9 September 2011, took place while the airguns were firing at full-volume while on a survey line. In both cases, the pods bow-rode the vessel for approximately 20 minutes and were seen 440 meters from the sound source at their closest approach. As the dolphins approached the vessel to bow-ride, several individuals were seen spy-hopping and fluke-slapping. Vocalizations from the animals were audible to observers from the vessel's bow. The fifth and final, protected species detection occurred at 16:08 UTC on 10 September 2011. A single adult loggerhead sea turtle was seen swimming in the opposite direction as the vessel about 40 meters off the vessel's port side. The sighting was very brief and the animal was seen within 360 meters of the center of the sound source, which was inactive.

Please refer to the Wildlife Summary Tables (Table 1, on the following page) and section 3.5 (Record of Detection) for further details regarding the aforementioned protected species sightings.

2.3. WILDLIFE SUMMARY TABLES

2.3.1. Marine Mammals and Turtles

Table 1: Protected species observed during visual monitoring.

Date	Common Name	Genus	Species	Family	Sighting description	Mitigation Actions	Suspected duplicate sightings
21 July 2011	Pantropical spotted dolphin	*Stenella*	*attenuata*	Delphinidae	Nine Pantropical Spotted Dolphins *(Stenella attenuata)* were sighted from 2125 to 2131 UTC, and were observed in the exclusion zone at a distance off 400m from the airguns. The juvenile dolphins were very acrobatic as the pod travelled away from the vessel in the opposite direction.	No	No
12 August 2011	Common bottlenose dolphin	*Tursiops*	*truncatus*	Delphinidae	Single dolphin sighted briefly ~2m below surface off starboard bow swimming parallel to vessel. Animal resighted a few moments later jumping well off the port bow.	No	No
8 September 2011	Common bottlenose dolphin	*Tursiops*	*truncatus*	Delphinidae	Two adults initially sighted approaching from afore the vessel's stbd bow. After swimming afore the bow for 1-2 minutes more individuals approached in groups of 2-3, including 3 juveniles paired with adults, until a total of 14 animals were present. Some joining animals would approach bow, stop 10-30m afore, turn parallel to vessel, and spyhop as the vessel approached, before bowriding. Occasional porpoising and non-acrobatic breaching behaviors were observed. Active vocalizations heard from the bow as the pod swam together. Pod bow rode for ~20 minutes before small groups began to break off and swim away off stbd beam.	No	No
9 September 2011	Common bottlenose dolphin	*Tursiops*	*truncatus*	Delphinidae	Similar to visual detection number 3: a small group of adults initially approached and bow rode momentarily before the rest of the pod, including 5 detected juveniles, joined in small groups. Occasional spy hopping and lob tailing were observed in adults 10-100m off the bow. Animals riding the bow porpoised and sometimes breached, or paced the vessel while swimming on their side. Vocalizations were audible from the vessel's prow while animals were bowriding. After 15-20 minutes of this behavior, animals began to break off in small groups and swim away off the stbd beam.	No	No
10 September 2011	Loggerhead sea turtle	*Caretta*	*caretta*	Cheloniidae	Sighted briefly at surface off vessel's port beam travelling parallel to the vessel in the opposite direction. Animal swam slowly as vessel passed and occasionally raised its head above the surface. No noticeable change in behavior or heading was noted.	No	No

2.3.2. Fish

Table 2: Fish species observed during visual monitoring.

Common Name	Class	Order	Family	Genus	Species	Approximate Number of Individuals Observed	Approximate Number of Days Species Was Observed
Flying fish	Actinopterygii	Beloniformes	Exocoetidae	*n/a*	*n/a*	665	57
Mahi mahi	Actinopterygii	Perciformes	Coryphaenidae	*Coryphaena*	*hippurus*	5	2
Hammerhead shark	Chondrichthyes	Carcharhiniformes	Sphyrnidae	*n/a*	*n/a*	1	1
Stingray	Chondrichthyes	Myliobatiformes	n/a	*n/a*	*n/a*	2	2
Unidentified shark	Chondrichthyes	n/a	n/a	*n/a*	*n/a*	1	1

2.3.3. Birds

Table 3: Bird species observed during visual monitoring.

Common Name	Class	Order	Family	Genus	Species	Approximate Number of Individuals Observed	Approximate Number of Days Species Was Observed
Cattle Egret	Aves	Ciconiiformes	Ardeidae	*Bubulcus*	*ibis*	39	12
Laughing gull	Aves	Charadriiformes	Laridae	*Leucophaeus*	*atricilla*	4	3
Royal tern	Aves	Charadriiformes	Sternidae	*Thalasseus*	*maxima*	100	36
Masked Booby	Aves	Pelecaniformes	Sulidae	*Sula*	*dactylatra*	5	2
Rock Pigeon	Aves	Columbiformes	Columbidae	*Columba*	*livia*	2	34
Brown Booby	Aves	Pelecaniformes	Sulidae	*Sula*	*leucogaster*	8	6
Limpkin	Aves	Gruiformes	Aramidae	*Aramus*	*guarauna*	1	1

Magnificent frigatebird	Aves	Pelecaniformes	Fregatidae	*Fregata*	*magnificens*	14	9
Peregrine falcon	Aves	Falconiformes	Falconidae	*Falco*	*pergrinus*	1	1
Great egret	Aves	Ciconiiformes	Ardeidae	*Ardea*	*alba*	5	4
Green heron	Aves	Ciconiiformes	Ardeidae	*Butorides*	*virescens*	9	7
Yellow-throated warbler	Aves	Passeriformes	Parulidae	*Dendroica*	*dominica*	3	3
American redstart	Aves	Passeriformes	Parulidae	*Setophaga*	*ruticilla*	7	7
Northern parula	Aves	Passeriformes	Parulidae	*Parula*	*americana*	2	2
Cliff swallow	Aves	Passeriformes	Hirundinidae	*Petrochelidon*	*pyrrhonota*	2	2
Prothonotary warbler	Aves	Passeriformes	Parulidae	*Protonotaria*	*citrea*	1	1
Audubon's shearwater	Aves	Procellariiformes	Procellariidae	*Puffinus*	*lherminieri*	1	1
Osprey	Aves	Falconiformes	Pandionidae	*Pandion*	*haliaetus*	4	4
Pomarine jaeger	Aves	Charadriiformes	Stercorariidae	*Stercorarius*	*Pomarinus*	1	1
Black-throated blue warbler	Aves	Passeriformes	Parulidae	*Setophaga*	*caerulescens*	2	2
Louisiana waterthrush	Aves	Passeriformes	Parulidae	*Parkesia*	*motacilla*	2	2
Merlin	Aves	Falconiformes	Falconidae	*Falco*	*columbarius*	2	2
Mourning dove	Aves	Columbiformes	Columbidae	*Zenaida*	*macroura*	1	1
Gray kingbird	Aves	Passeriformes	Tyrannidae	*Tyrannus*	*dominicensis*	1	1
Herring gull	Aves	Charadriiformes	Laridae	*Larus*	*smithonianus*	1	1
Barn swallow	Aves	Passeriformes	Hirundinidae	*Hirundo*	*rustica*	9	3
Prairie warbler	Aves	Passeriformes	Parulidae	*Dendroica*	*discolor*	1	1

Burrowing owl	Aves	Strigiformes	Strigidae	*Athene*	*cunicularia*	4	3
Caspian tern	Aves	Charadriiformes	Sternidae	*Hydroprogne*	*caspia*	2	2
Bobolink	Aves	Passeriformes	Icteridae	*Dolichonyx*	*oryzivorus*	1	1
Baltimore oriole	Aves	Passeriformes	Icteridae	*Icterus*	*galbula*	1	1
Snowy egret	Aves	Ciconiiformes	Ardeidae	*Egretta*	*thula*	14	1
Chuck-will's-widow	Aves	Caprimulgiformes	Caprimulgidae	*Caprimulgus*	*carolinensis*	2	1

3. DATA FORMS

3.1. BASIC DATA FORM

BASIC DATA FORM				
Project Number		UMS04076		
Seismic Contractor		CGGVeritas		
Client		Bahamas Petroleum Company (BPC)		
Area Surveyed During Reporting Period		**Latitude**	**Longitude**	**Block/Number**
	N Corner	23.46667°N	079.33333°W	Bahama Bank
	S Corner	22.83333°N	078.68333°W	Bahama Bank
	E Corner	22.91667°N	078.63333°W	Bahama Bank
	W Corner	23.23333°N	079.46667°W	Bahama Bank
Survey Type		3D Surface Seismic, Broadseis		
Vessel and/or Rig Name		*Veritas Viking*		
Permit Number		n/a		
Location / Distance of Airgun Deployment		350m astern		
Water Depth	**Min**	376m		
	Max	530m		
Dates of project		9 June 2011	THROUGH	18 September 2011
Dates included in reporting period		9 June 2011 – 18 September 2011		
Total time airguns operating – all power levels:		1607:04		
Amount of time airguns operating at full power (N= N1+N2):		1138:23		
Time airguns operating at full power on a survey line:		984:36		
Time airguns operating at full power approaching survey line:		153:47		
Amount of time compliance gun operations:		348:26		
Amount of time in ramp up:		90:47		
Number of daytime ramp ups:		130		
Number of night time ramp ups:		112		
Number of ramp ups from mitigation source:		139		
Number of ramp ups from PAM system:		0		
Amount of time conducted in airgun testing:		29:28		
Duration of visual observations:		1039:34		
Duration of observations while airguns firing:		717:56		
Duration of observation during airgun silence:		321:38		
Duration of acoustic monitoring:		00:00		
Duration of acoustic monitoring while airguns firing:		00:00		
Duration of acoustic monitoring during airgun silence:		00:00		
Visual Observers:		Adam Swope and Greggo Seward (dedicated MMOs); and crew marine mammal watchers (CMMWs) including: Amber Stooksberry, David Bould, Nathan Stewart, Alex Codreanu, Ron Cook, Glen Pangle, Davey Jones, Kathryn Allan, Collin Nichelson, Richard Dort, Bill Davis, Ian Reed, Ari Talbi, Radoslav Kostepski, Jim Nelson, Carl Reugger, Sarah Fisher, Karen Nolan, Trent Lunsford, and others.		
Acoustic Observer:		N/A		
Number of Marine Mammals Visual Detections:		4		
Number of Marine Mammals Acoustic Detections:		0		
Number of acoustic detections confirmed by visual detection:		0		
Number of visual detections confirmed by acoustic detection:		0		
Number of Sea Turtle detections:		1		
List Mitigation Actions (e.g. shutdowns, ramp up delays)		None		
Duration of operational downtime due to mitigation:		00:00		
Flagged Data Forms (list sheet & date)		None		

3.2. COVER DATA SHEET

RPS

PROTECTED SPECIES RECORDING FORM

COVER PAGE

Regulatory Reference Number (e.g. DECC no., MMS permit no., OCS lease no., etc.)	**Country**	**Project Number**
n/a	Commonwealth of the Bahamas	UMS04076
Client	**Seismic Contractor**	**Vessel Name**
Bahamas Petroleum Company	CGGVeritas	*M/V Veritas Viking*
Start Date	**End Date**	**Survey Type**
2011-06-09	2011-09-18	3D

Source Vessel(s)	**Type of Source** (e.g. airguns)	**Number of Airguns** (if used)
Veritas Viking	Airguns	24
Source Depth (metres)	**Source Volume** (cu. in.)	**Shot Point Interval** (metres)
5	4550	25
Frequency (Hz)	**Intensity** (dB re. 1µPa or bar meters)	**Method of Soft Start**
125	120.5	increase number of guns

Visual monitoring equipment used (e.g. binoculars, big eyes, etc.)	**Magnification of optical equipment** (e.g. binoculars)	**Height of eye off water surface** (metres)	**How was distance of animals estimated?**
Binoculars	10x	21.7	[x] by eye [ ] with laser rangefinder [ ] with rangefinder stick / calipers [ ] with reticule binoculars [x] by relating to object at known distance [ ] other

Marine Mammal Observers	**Training of MMOs**
Adam Swope, Greggo Seward	[x] JNCC approved MMO induction course for UK waters [x] PSO training course for the Gulf of Mexico [ ] MMO training course for Irish waters [ ] other [ ] none

Was PAM used?	**PAM Operator(s)**
no	n/a

Description of PAM equipment

n/a

Range of PAM hydrophones from airguns (metres)	**Bearing of PAM hydrophones from airguns relative to direction of travel** (degrees)	**Depth of PAM hydrophones** (metres)
n/a	n/a	n/a

3.3. RECORD OF OPERATIONS

RPS

PROTECTED SPECIES RECORDING FORM

OPERATIONS

Regulatory reference number n/a **Vessel name** *Veritas Viking*

Project number UMS04076 **Operations page number** 1 of 14

Date	Time pre-shooting visual monitoring began	Time pre-shooting visual monitoring ended	Time pre-shooting acoustic monitoring began	Time pre-shooting acoustic monitoring ended	Was it day or night in period prior to firing?	Reason for firing s = survey t = test x = test followed immediately by survey	Time soft start / ramp-up began	Time soft start / ramp-up ended	Time of start of line / test	Time of end of line / test	Time gun disabled after line / test	Time mitigation gun enabled / source output reduced	Time mitigation gun disabled / end of reduced output	Was any mitigation action required?
2011-06-09	20:17	21:17			day	t			21:17					no
2011-06-10										06:11		06:11	06:11	no
2011-06-16	12:35	13:35			day	t	13:35	13:55	13:56	15:00		15:00	16:00	no
2011-06-16	16:22	17:22			day	t	17:22	17:22	17:22	18:04		18:04	18:04	no
2011-06-16	22:33	23:33			day	t	23:33	23:56						no
2011-06-17						t			00:15	02:31	02:31	02:31	04:10	no
2011-06-17					night	s	04:10	04:36	05:05	07:24	07:24	07:24	07:24	no
2011-06-17	22:35	23:35			day	t	23:35	23:57						no
2011-06-18						t			00:27	00:58	00:58	00:58	04:58	no
2011-06-18					night	s	04:58	05:25	06:08	10:42	10:42	10:42	10:42	no
2011-06-18	13:08	14:08			day	s	14:08	14:30	14:51	21:05	21:05	21:05	21:05	no
2011-06-18	22:41	23:41			day	s	23:51							no
2011-06-19						s		00:11	01:00	05:13	05:14	05:14	08:00	no
2011-06-19					night	s	08:00	08:21	08:55	14:00	14:01	14:01	14:01	no
2011-06-19	15:37	16:37			day	s	16:37	16:59	17:30	21:36	21:36	21:36	21:36	no
2011-06-19	22:41	23:41			day	s	23:41							no
2011-06-20						s		00:03	01:30	07:18	07:19	07:19	09:56	no
2011-06-20					night	s	09:56	10:18	10:56	15:35	15:35	15:35	15:35	no
2011-06-20	18:21	19:21			day	s	19:21	19:41	19:56					no
2011-06-21						s				01:31	01:31	01:31	04:19	no
2011-06-21					night	s	04:19	04:41	05:19	09:49	09:49	09:49	09:49	no
2011-06-21	12:17	13:17			day	s	13:17	13:38	14:17	19:16	19:16	19:16	19:16	no
2011-06-21	21:03	22:03			day	s	23:03	23:24	23:55					no
2011-06-22						s				04:25	04:26	04:26	07:54	no
2011-06-22					night	s	07:54	08:23	08:53	13:49	13:49	13:49	13:49	no
2011-06-22	16:05	17:05			day	s	17:05	17:27	18:11	22:39	22:39	22:39		no

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PROTECTED SPECIES RECORDING FORM

OPERATIONS

Regulatory reference number n/a | **Vessel name** *Veritas Viking*

Project number UMS04076 | **Page number** 2 of 14

Date	Time pre-shooting visual monitoring began	Time pre-shooting visual monitoring ended	Time pre-shooting acoustic monitoring began	Time pre-shooting acoustic monitoring ended	Was it day or night in period prior to firing?	Reason for firing s = survey t = test x = test followed immediately by survey	Time soft start / ramp-up began	Time soft start / ramp-up ended	Time of start of line / test	Time of end of line / test	Time gun disabled after line / test	Time mitigation gun enabled / source output reduced	Time mitigation gun disabled / end of reduced output	Was any mitigation action required?
2011-06-23						s							01:09	no
2011-06-23					night	s	01:09	01:32	02:12	07:19	07:20	07:20	09:37	no
2011-06-23					night	s	09:37	10:04	10:39	15:05	15:05	15:05	15:05	no
2011-06-23	16:29	17:29			day	s	17:29	17:55	18:34	23:29	23:29	23:29		no
2011-06-24						s							01:57	no
2011-06-24					night	s	01:57	02:18	02:43	06:43	06:44	06:44	09:04	no
2011-06-24					night	s	09:04	09:25	10:10	15:02	15:02	15:02	15:02	no
2011-06-24	16:22	17:22			day	s	17:22	17:44	18:22	22:24	22:24	22:24		no
2011-06-25						s							00:46	no
2011-06-25					night	s	00:46	01:07	01:46	06:42	06:43	06:43	10:00	no
2011-06-25					night	s	10:00	10:21	10:47	15:10	15:10	15:10	15:10	no
2011-06-25	21:08	22:08			day	s	22:08	22:30	22:53	23:33	23:34	23:34		no
2011-06-26						s							03:22	no
2011-06-26					night	s	03:22	03:43	04:19	08:40	08:42	08:42	11:10	no
2011-06-26					day	s	11:10	11:32	12:07	17:05	17:05	17:05	17:05	no
2011-06-26	18:25	19:25			day	s	19:25	19:45	20:21					no
2011-06-27						s				00:35	00:36	00:36	03:00	no
2011-06-27					night	s	03:00	03:21	03:49	08:26	08:27	08:27	10:51	no
2011-06-27					day	s	10:51	11:16	11:45	15:55	15:55	15:55	15:55	no
2011-06-27	17:53	18:53			day	s	18:53	19:13	19:18					no
2011-06-28						s				00:26	00:26	00:26	02:43	no
2011-06-28					night	s	02:43	03:07	03:51	08:20	08:21	08:21	11:09	no
2011-06-28					day	s	11:09	11:36	12:04	16:34	16:34	16:34	16:34	no
2011-06-28	17:37	18:37			day	s	18:37	18:58	19:43	23:47	23:47	23:47		no
2011-06-29						s							01:47	no
2011-06-29					night	s	01:47	02:08	02:39	07:25	07:25	07:25	09:45	no

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PROTECTED SPECIES RECORDING FORM

OPERATIONS

Regulatory reference number n/a | **Vessel name** *Veritas Viking*

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Date	Time pre-shooting visual monitoring began	Time pre-shooting visual monitoring ended	Time pre-shooting acoustic monitoring began	Time pre-shooting acoustic monitoring ended	Was it day or night in period prior to firing?	Reason for firing s = survey t = test x = test followed immediately by survey	Time soft start / ramp-up began	Time soft start / ramp-up ended	Time of start of line / test	Time of end of line / test	Time gun disabled after line / test	Time mitigation gun enabled / source output reduced	Time mitigation gun disabled / end of reduced output	Was any mitigation action required?
2011-06-29					night	s	09:45	10:06	10:34	14:54	14:54	14:54	14:54	no
2011-06-29	16:26	17:26			day	s	17:26	17:47	17:58	22:43	22:43	22:43		no
2011-06-30						s							00:57	no
2011-06-30					night	s	00:57	01:20	01:56	06:17	06:18	06:18	08:44	no
2011-06-30					night	s	08:44	09:05	09:40	14:18	14:18	14:18	14:18	no
2011-06-30	17:35	18:35			day	s	18:35	18:57	19:31	23:58	23:58	23:58		no
2011-07-01						s							02:09	no
2011-07-01					night	s	02:09	02:30	03:07	07:34	07:34	07:34	09:57	no
2011-07-01					night	s	09:57	10:22	10:57	15:27	15:27	15:27	15:27	no
2011-07-01	16:54	17:54			day	s	17:54	18:18	18:36	22:43	22:43	22:43		no
2011-07-02						s							01:03	no
2011-07-02					night	s	01:03	01:23	02:09	06:51	06:51	06:51	08:49	no
2011-07-02					night	s	08:49	09:11	09:45	13:58	13:59	13:59	13:59	no
2011-07-02	16:03	17:03			day	s	17:03	17:24	17:46	23:03	23:03	23:03		no
2011-07-03						s							01:19	no
2011-07-03					night	s	01:19	01:42	02:03	05:53	05:53	05:53	08:28	no
2011-07-03					night	s	08:28	08:50	09:25	15:13	16:00	16:00	16:00	no
2011-07-03	16:20	17:20			day	s	17:20	17:41	18:21	22:39	22:39	22:39		no
2011-07-04						s							01:00	no
2011-07-04					night	s	01:00	01:22	02:04	08:05	08:06	08:06	10:07	no
2011-07-04					night	s	10:07	10:28	11:08	15:12	15:12	15:12	15:12	no
2011-07-04	16:09	17:09			day	s	17:09	17:30	18:26	23:19	23:19	23:19		no
2011-07-05						s							02:08	no
2011-07-05					night	s	02:08	02:30	03:07	07:15	07:16	07:16	09:35	no
2011-07-05					night	s	09:35	09:56			10:04	10:04	10:45	no
2011-07-05	13:01	14:01			day	s	14:01	14:22	16:24	17:04	17:04	17:04	17:04	no

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PROTECTED SPECIES RECORDING FORM

OPERATIONS

Regulatory reference number n/a | **Vessel name** *Veritas Viking*

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Date	Time pre-shooting visual monitoring began	Time pre-shooting visual monitoring ended	Time pre-shooting acoustic monitoring began	Time pre-shooting acoustic monitoring ended	Was it day or night in period prior to firing?	Reason for firing s = survey t = test x = test followed immediately by survey	Time soft start / ramp-up began	Time soft start / ramp-up ended	Time of start of line / test	Time of end of line / test	Time gun(s) disabled after line / test	Time mitigation gun enabled / source output reduced	Time mitigation gun disabled / end of reduced output	Was any mitigation action required?
2011-07-05	18:30	19:30			day	s	19:30	19:50	20:11					no
2011-07-06						s				00:20	00:20	00:20	02:30	no
2011-07-06					night	s	02:30	02:56	03:39	08:50	08:51	08:51	11:01	no
2011-07-06					day	s	11:01	11:24	12:01	16:13	16:13	16:13	16:13	no
2011-07-06	17:22	18:22			day	s	18:22	18:45	19:30					no
2011-07-07						s				00:25	00:25	00:25	02:36	no
2011-07-07					night	s	02:36	02:57	03:33	07:36	07:36	07:36	10:26	no
2011-07-07					dawn	s	10:26	10:50	11:20	16:17	16:17	16:17	16:17	no
2011-07-07	17:19	18:19			day	s	18:19	18:42	19:23	23:53	23:53	23:53		no
2011-07-08						s							02:05	no
2011-07-08					night	s	02:05	02:27	03:21	08:17	08:18	08:18	10:33	no
2011-07-08					dawn	s	10:33	10:55	11:29	16:00	16:00	16:00	16:00	no
2011-07-08	17:19	18:19			day	s	18:19	18:39	19:29					no
2011-07-09						s				00:29	00:29	00:29	02:34	no
2011-07-09					night	s	02:34	02:57	03:35	07:48	07:49	07:49	10:30	no
2011-07-09					dawn	s	10:30	10:52	11:28	16:30	16:30	16:30	16:30	no
2011-07-09	22:29	23:29			day	s						23:29		no
2011-07-10						s							02:14	no
2011-07-10					night	s	02:14	02:34	03:20	07:53	07:53	07:53	10:18	no
2011-07-10					dawn	s	10:18	10:41	11:13	15:37	15:37	15:37	15:37	no
2011-07-10	17:09	18:09			day	s	18:09	18:45	19:11					no
2011-07-11						s				00:11	00:13	00:13	02:48	no
2011-07-11					night	s	02:48	03:08	03:25	07:36	07:37	07:37	09:57	no
2011-07-11					night	s	09:57	10:18	10:52	15:26	15:26	15:26	15:26	no
2011-07-11	16:30	17:30			day	s	17:30	17:54	18:29	22:47	22:48	22:48		no
2011-07-12					night	s							01:12	no

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PROTECTED SPECIES RECORDING FORM

OPERATIONS

Regulatory reference number n/a | **Vessel name** *Veritas Viking*

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Date	Time pre-shooting visual monitoring began	Time pre-shooting visual monitoring ended	Time pre-shooting acoustic monitoring began	Time pre-shooting acoustic monitoring ended	Was it day or night in period prior to firing?	Reason for firing s = survey t = test x = test followed immediately by survey	Time soft start / ramp-up began	Time soft start / ramp-up ended	Time of start of line / test	Time of end of line / test	Time gun(s) disabled after line / test	Time mitigation gun enabled / source output reduced	Time mitigation gun disabled / end of reduced output	Was any mitigation action required?
2011-07-12					night	s	01:12	01:48	02:12	06:49	06:50	06:50	09:11	no
2011-07-12					night	s	09:11	09:33	10:06	14:33	14:33	14:33	14:33	no
2011-07-12	16:20	17:20			day	s	17:20	17:42	18:07	22:48	22:49	22:49		no
2011-07-13						s							01:09	no
2011-07-13					night	s	01:09	01:33	02:04	06:20	06:21	06:21	08:57	no
2011-07-13					night	s	08:57	09:18	09:53	14:24	14:24	14:24	14:24	no
2011-07-12					night	s	01:12	01:48	02:12	06:49	06:50	06:50	09:11	no
2011-07-12					night	s	09:11	09:33	10:06	14:33	14:33	14:33	14:33	no
2011-07-12	16:20	17:20			day	s	17:20	17:42	18:07	22:48	22:49	22:49		no
2011-07-13						s							01:09	no
2011-07-13					night	s	01:09	01:33	02:04	06:20	06:21	06:21	08:57	no
2011-07-13					night	s	08:57	09:18	09:53	14:24	14:24	14:24	14:24	no
2011-07-12					night	s	01:12	01:48	02:12	06:49	06:50	06:50	09:11	no
2011-07-12					night	s	09:11	09:33	10:06	14:33	14:33	14:33	14:33	no
2011-07-12	16:20	17:20			day	s	17:20	17:42	18:07	22:48	22:49	22:49		no
2011-07-13						s							01:09	no
2011-07-13					night	s	01:09	01:33	02:04	06:20	06:21	06:21	08:57	no
2011-07-13					night	s	08:57	09:18	09:53	14:24	14:24	14:24	14:24	no
2011-07-12					night	s	01:12	01:48	02:12	06:49	06:50	06:50	09:11	no
2011-07-12					night	s	09:11	09:33	10:06	14:33	14:33	14:33	14:33	no
2011-07-13	16:06	17:06			day	s	17:06	17:27	17:44	22:01	22:01	22:01		no
2011-07-14						s							00:40	no
2011-07-14					night	s	00:40	01:01	01:35	06:19	06:20	06:20	08:36	no
2011-07-14					night	s	08:36	08:59	09:30	13:53	13:53	13:53	13:53	no
2011-07-14	22:34	23:34			day	s						23:34		no
2011-07-15						s							01:40	no

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Date	Time pre-shooting visual monitoring began	Time pre-shooting visual monitoring ended	Time pre-shooting acoustic monitoring began	Time pre-shooting acoustic monitoring ended	Was it day or night in period prior to firing?	Reason for firing s = survey t = test x = test followed immediately by survey	Time soft start / ramp-up began	Time soft start / ramp-up ended	Time of start of line / test	Time of end of line / test	Time gun(s) disabled after line / test	Time mitigation gun enabled / source output reduced	Time mitigation gun disabled / end of reduced output	Was any mitigation action required?
2011-07-15					night	s	01:40	02:02	04:54	07:17	07:17	07:17	07:17	no
2011-07-15	20:23	21:23			day	s	21:23	21:44	22:29					no
2011-07-16						s				03:27	03:27	03:27	05:41	no
2011-07-16					night	s	05:41	06:03	06:43	11:08	11:08	11:08	11:08	no
2011-07-16	17:54	18:54			day	s	18:54	19:21	20:03					no
2011-07-17						s				00:59	01:00	01:00	03:15	no
2011-07-17					night	s	03:15	03:36	04:17	08:24	08:25	08:25	10:30	no
2011-07-17					dawn	s	10:30	10:52	11:17	16:23	16:23	16:23	16:23	no
2011-07-17	17:33	18:33			day	s	18:33	18:59	19:26	23:35	23:36	23:36		no
2011-07-18						s							02:06	no
2011-07-18					night	s	02:06	02:28	02:59	07:41	07:42	07:42	10:13	no
2011-07-18					dawn	s	10:13	10:40	11:00	15:07	15:07	15:07	15:07	no
2011-07-18	16:53	17:53			day	s	17:53	18:18	18:38	23:48	23:49	23:49		no
2011-07-19						s							01:54	no
2011-07-19					night	s	01:54	02:15	02:52	06:47	06:48	06:48	09:14	no
2011-07-19					night	s	09:14	09:36	10:14	15:03	15:03	15:03	15:03	no
2011-07-19	18:04	19:04			day	s	19:04	19:28	19:57	20:15	20:16	20:16		no
2011-07-20						s							00:17	no
2011-07-20					dusk	s	00:17	00:39	01:08	05:48	05:48	05:48	08:20	no
2011-07-20					night	s	08:20	08:42	09:08	13:08	13:08	13:08	13:08	no
2011-07-20	14:29	15:29			day	s	15:29	15:53	16:26	21:02	21:03	21:03	23:01	no
2011-07-20	22:01	23:01			day	s	23:01	23:25						no
2011-07-21						s			00:04	04:19	04:19	04:19	06:48	no
2011-07-21					night	s	06:48	07:13	07:38	12:22	12:22	12:22	12:22	no
2011-07-21	13:25	14:25			day	s	14:25	14:50	15:30	19:44	19:45	19:45	19:45	no
2011-07-21	21:05	22:05			day	s	22:05	22:29	22:53					no

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Date	Time pre-shooting visual monitoring began	Time pre-shooting visual monitoring ended	Time pre-shooting acoustic monitoring began	Time pre-shooting acoustic monitoring ended	Was it day or night in period prior to firing?	Reason for firing s = survey t = test x = test followed immediately by survey	Time soft start / ramp-up began	Time soft start / ramp-up ended	Time of start of line / test	Time of end of line / test	Time gun(s) disabled after line / test	Time mitigation gun enabled / source output reduced	Time mitigation gun disabled / end of reduced output	Was any mitigation action required?
2011-07-22						s				03:23	03:24	03:24	05:40	no
2011-07-22					night	s	05:40	06:05	06:29	10:30	10:30	10:30	10:30	no
2011-07-22	11:02	12:02			day	s	12:02	12:25	13:10	16:52	16:53	16:53	16:53	no
2011-07-22	18:05	19:05			day	s	19:05	19:26	20:15					no
2011-07-23						s				00:50	00:50	00:50	02:12	no
2011-07-23					night	s	02:12	02:38	03:24	06:47	06:47	06:47	09:15	no
2011-07-23					night	s	09:15	09:36	10:13	12:30	12:30	12:30	12:30	no
2011-07-24						s						07:56	09:45	no
2011-07-24					night	s	09:45	10:06	10:42	14:25	14:25	14:25	14:25	no
2011-07-24	22:29	23:29				s						23:29		no
2011-07-25													00:25	no
2011-07-25					night	s	00:25	00:46	01:25	05:48	05:48	05:48	07:34	no
2011-07-25					night	s	07:34	07:55	08:30	11:50	11:50	11:50	11:50	no
2011-07-25	13:05	14:05			day	s	14:05	14:25	15:05	19:31	22:33			no
2011-07-25					day	s	22:33	22:33	22:33					no
2011-07-26					night	s				01:57	01:57	01:57	04:14	no
2011-07-26					night	s	04:14	04:35	05:13	09:30	09:30	09:30	11:44	no
2011-07-26	10:44	11:44			day	s	11:44	12:04	12:18	15:35	15:35	15:35	15:35	no
2011-07-26	16:39	17:39			day	s	17:39	18:02	18:52	23:22	23:22	23:22		no
2011-07-27													01:16	no
2011-07-27					night	s	01:16	01:41	02:16	05:31	05:31	05:31	07:42	no
2011-07-27					night	s	07:42	08:05	08:42	13:08	13:08	13:08	13:08	no
2011-07-27	13:58	14:58			day	s	14:58	15:23	15:50	19:06	19:06	19:06	19:06	no
2011-07-27	20:24	21:24			day	s	21:24	21:45	22:21					no
2011-07-28										02:43	02:44	02:44	04:32	no
2011-07-28					night	s	04:32	04:54	05:25	08:25	08:25	08:25	10:34	no

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Date	Time pre-shooting visual monitoring began	Time pre-shooting visual monitoring ended	Time pre-shooting acoustic monitoring began	Time pre-shooting acoustic monitoring ended	Was it day or night in period prior to firing?	Reason for firing s = survey t = test x = test followed immediately by survey	Time soft start / ramp-up began	Time soft start / ramp-up ended	Time of start of line / test	Time of end of line / test	Time gun(s) disabled after line / test	Time mitigation gun enabled / source output reduced	Time mitigation gun disabled / end of reduced output	Was any mitigation action required?
2011-07-28					dawn	s	10:34	10:57	11:41	16:03	16:03	16:03	16:03	no
2011-07-28	16:38	17:38			day	s	17:38	18:00	18:39	21:46	21:47	21:47		no
2011-07-29						s							00:02	no
2011-07-29					dusk	s	00:02	00:24	00:55	05:29	05:29	05:29	07:10	no
2011-07-29					night	s	07:10	07:32	08:02	11:06	11:06	11:06	11:06	no
2011-07-29	12:17	13:17			day	s	13:17	13:40	14:20	19:05	19:05	19:05	19:05	no
2011-07-29	19:41	20:41			day	s	20:41	21:04	21:37					no
2011-07-30										00:41	00:42	00:42	02:40	no
2011-07-30					night	s	02:40	03:02	03:51	08:40	08:40	08:40	10:19	no
2011-07-30					dawn	s	10:19	10:45	11:19	14:30	14:30	14:30	14:30	no
2011-07-30	16:01	17:01			day	s	17:01	17:23	17:59	22:33	22:34	22:34		no
2011-07-31													00:01	no
2011-07-31					night	s	00:01	00:23	01:07	04:16	04:16	04:16	06:40	no
2011-07-31					night	s	06:40	07:03	07:39	12:09	12:09	12:09	12:09	no
2011-08-01	16:23	17:23			day	s	17:23	17:48	19:33	23:51	23:52	23:52		no
2011-08-02					night	s							01:48	no
2011-08-02					night		01:48	02:12	02:49	06:10	06:11	06:11	08:46	no
2011-08-02					night	s	08:46	09:08	09:38	13:41	13:41	13:41	13:41	no
2011-08-02	14:35	15:35			day	s	15:35	15:57	16:35	20:06	20:06	20:06	20:06	no
2011-08-02	21:56	22:56			day	s	22:56	23:19	23:47					no
2011-08-03										03:59	03:59	03:59	05:52	no
2011-08-03					night	s	05:52	06:15	06:51	09:56	09:56	09:56	09:56	no
2011-08-08					night	t						06:33	07:26	no
2011-08-08					night	t	07:26	07:59	07:59	08:20	08:20	08:20	10:50	no
2011-08-08					night	s	10:50	11:12	11:51	15:46	15:46			no
2011-08-08	16:31	17:31			day	s	17:31	17:54	18:28	21:05	21:05			no

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Date	Time pre-shooting visual monitoring began	Time pre-shooting visual monitoring ended	Time pre-shooting acoustic monitoring began	Time pre-shooting acoustic monitoring ended	Was it day or night in period prior to firing?	Reason for firing s = survey t = test x = test followed immediately by survey	Time soft start / ramp-up began	Time soft start / ramp-up ended	Time of start of line / test	Time of end of line / test	Time gun(s) disabled after line / test	Time mitigation gun enabled / source output reduced	Time mitigation gun disabled / end of reduced output	Was any mitigation action required?
2011-08-08	22:39	23:39			day	s						23:39		no
2011-08-09													02:08	no
2011-08-09					night	s	02:08	02:32	03:09	07:19	07:19	07:19	08:56	no
2011-08-09					night	s	08:56	09:17	09:55	12:32	12:32			no
2011-08-09	16:28	17:28			day	s	17:28	17:50	18:37	22:26	22:26	22:26	23:37	no
2011-08-09	22:37	23:37			day	s	23:37							no
2011-08-10								00:02	00:51	03:09	03:36	03:36	08:01	no
2011-08-10					night	s	08:01	08:23	08:53	12:54	12:54			no
2011-08-10	13:24	14:24			day	s	14:24	14:46	15:21	17:35	17:35			no
2011-08-10	21:39	22:39			day	s	22:39	23:00	23:33					no
2011-08-11										03:32	03:33	03:33	04:59	no
2011-08-11					night	s	04:59	05:20	05:57	07:57	07:57			no
2011-08-11	11:23	12:23			day	s	12:23	12:44	13:27	17:23	17:23			no
2011-08-11	18:08	19:08			day	s	19:08	19:29	19:59	22:05	22:05			no
2011-08-11	22:33	23:33			day	s						23:33		no
2011-08-12													03:07	no
2011-08-12					night	s	03:07	03:28	04:06	08:01	08:02	08:02	09:33	no
2011-08-12					night	s	09:33	09:56	10:36	12:36	12:36			no
2011-08-12	17:00	18:00			day	s	18:00	18:26	18:52	22:37	22:37	22:37		no
2011-08-13													00:26	no
2011-08-13					night	s	00:26	00:49	01:24	03:21	03:21	03:21	07:57	no
2011-08-13					night	s	07:57	08:21	08:57	12:36	12:36			no
2011-08-13	13:19	14:19			day	s	14:19	14:42	15:16	17:13	17:13			no
2011-08-13	21:44	22:44			day	s	22:44	23:06	23:28					no
2011-08-14										02:59	02:59	02:59	04:40	no
2011-08-14					night	s	04:40	05:01	05:38	07:22	07:22			no

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Date	Time pre-shooting visual monitoring began	Time pre-shooting visual monitoring ended	Time pre-shooting acoustic monitoring began	Time pre-shooting acoustic monitoring ended	Was it day or night in period prior to firing?	Reason for firing s = survey t = test x = test followed immediately by survey	Time soft start / ramp-up began	Time soft start / ramp-up ended	Time of start of line / test	Time of end of line / test	Time gun(s) disabled after line / test	Time mitigation gun enabled / source output reduced	Time mitigation gun disabled / end of reduced output	Was any mitigation action required?
2011-08-14	10:40	11:40			day	s	11:40	12:10	13:11	16:32	16:32			no
2011-08-14	21:31	22:31			day	s	22:31	22:51	23:16					no
2011-08-15										00:36	00:36	00:36	02:39	no
2011-08-15					night	s	02:39	02:59	03:36	04:52	04:52	04:52	09:34	no
2011-08-15					night	s	09:34	09:56	10:35	10:48	10:48	10:48	11:56	no
2011-08-15					day	s	11:56	12:17	12:49	13:02	13:02			no
2011-08-15	15:49	16:49			day	s	16:49	17:10	17:48	19:39	19:39			no
2011-08-15	21:41	22:41			day	s	22:41	23:02						no
2011-08-16									00:04	00:21	00:21	00:21	05:40	no
2011-08-16					night	s	05:40	06:01	06:39	07:54	07:54	07:54	11:32	no
2011-08-16					day	s	11:32	11:54	12:30	12:42	12:42			no
2011-08-16	16:17	17:17			day	s	17:17	17:37	18:15	18:29	18:29			no
2011-08-16	22:10	23:10			day	s	23:10	23:32						no
2011-08-17											00:06	00:06	04:00	no
2011-08-17					night	s	04:00	04:24	04:57	05:15	05:15	05:15	09:29	no
2011-08-17					night	s	09:29	09:51	10:24	10:39	10:39	10:39	11:00	no
2011-08-17					day	s	11:00	11:21	11:53	13:31	13:31			no
2011-08-17	14:45	15:54			day	s	15:54	16:15	17:12	19:00	19:00			no
2011-08-17	21:34	22:34			day	s	22:34	22:56	23:38					no
2011-08-18										01:18	01:18	01:18	05:11	no
2011-08-18					night	s	05:11	05:33	06:13	06:54	06:54	06:54	08:54	no
2011-08-18					night	s	08:54	09:15	09:56	16:35	16:35			no
2011-08-18	20:26	21:27			day	s	21:27	21:48	22:39					no
2011-08-19										02:08	02:08	02:08	04:41	no
2011-08-19					night	s	04:41	05:01	05:38	12:35	12:35			no
2011-08-19	16:22	17:24			day	s	17:24	17:46	18:21	22:04	22:04	22:04		no

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2011-08-20													00:42	no
2011-08-20					night	s	00:42	01:07	01:42	09:07	09:07			no
2011-08-20	13:03	14:03			day	s	14:03	14:25	15:07	19:09	19:09			no
2011-08-20	20:00	21:19			day	s	21:19	21:42	22:36					no
2011-08-21										06:29	06:29	06:29	11:30	no
2011-08-21					day	s	11:30	11:52	12:26	16:42	16:42			no
2011-08-21	19:21	20:21			day	s	20:21	20:42	21:19					no
2011-08-22										05:09	05:09	05:09	10:09	no
2011-08-22					night	s	10:09	10:31	11:11	15:36	15:36			no
2011-08-27	10:45	11:45			day	t	11:45	12:07	12:29	12:38	12:41			no
2011-08-27						x			12:41	20:40	20:40			no
2011-08-27	22:32	23:32			day	s						23:32		no
2011-08-28													01:59	no
2011-08-28					night	s	01:59	02:21	02:50	08:30	08:30	08:30	10:55	no
2011-08-28					dawn	s	10:55	11:17	11:43	17:37	17:37			no
2011-08-28	21:49	22:49			day	s	22:49	23:10	23:45					no
2011-08-29										05:33	05:33	05:33	07:57	no
2011-08-29					night	s	07:57	08:19	08:54	15:09	15:09			no
2011-08-29	19:23	20:23			day	s	20:23	20:43	21:11					no
2011-08-30										03:14	03:14	03:14	05:36	no
2011-08-30					night	s	05:36	05:58	06:37	13:02	13:02			no
2011-08-30	16:52	17:52			day	s	17:52	18:13	18:45					no
2011-08-31										00:44	00:45	00:45	03:05	no
2011-08-31					night	s	03:05	03:26	03:58	10:17	10:17			no
2011-08-31	13:34	14:34			day	s	14:34	14:54	15:30	21:31	21:31			no
2011-08-31	22:29	23:29			day	s						23:29		no

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2011-09-01													00:08	no
2011-09-01					night	s	00:08	00:29	01:03	07:56	07:56			no
2011-09-01	11:07	12:07			day	s	12:07	12:38	13:04	19:26	19:26			no
2011-09-01	21:41	22:41			day	s	22:41	23:11			23:33			no
2011-09-01					dusk		23:34	23:34	23:47					no
2011-09-02										05:43	05:43			no
2011-09-02					night		05:45	05:45	05:45	07:33	07:33			no
2011-09-02					night		07:34	07:34	07:34	07:37	07:37	07:37	11:27	no
2011-09-02					dawn	s	11:27	11:43			11:43	11:43	11:53	no
2011-09-02					day	s	11:53	12:20	12:49	19:15	19:15			no
2011-09-02	20:48	21:48			day	s	21:48	22:10	22:51					no
2011-09-03					night	s				06:45	06:45	06:46	09:41	no
2011-09-03					night	s	09:41	10:03	10:41	17:36	17:36	17:41	18:07	no
2011-09-03					day	t	18:07	18:28	18:28	19:58	19:58	19:58	20:06	no
2011-09-03					day	s	20:06	20:28	21:11					no
2011-09-04										04:42	04:42	04:42	08:45	no
2011-09-04					night	s	08:45	09:08	09:46	12:40	12:40			no
2011-09-04	13:59	15:05			day	s	15:05	15:30	16:07	22:11	22:11	22:11	22:22	no
2011-09-04					day	t	22:22	22:44	22:44					no
2011-09-05										03:01	03:01	03:01	04:11	no
2011-09-05					night	s	04:11	04:18						no
2011-09-05					night	s	04:19	04:20						no
2011-09-05					night	s	04:20	04:42	05:15	08:22	08:22	08:22	10:53	no
2011-09-05					dawn	s	10:53	11:15	11:50	17:15	17:20	17:20	17:27	no
2011-09-05					day	t	17:27	17:48	17:48	20:12	20:12			no
2011-09-05	22:28	23:30			day	s	23:30	23:51						no

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Date	Time pre-shooting visual monitoring began	Time pre-shooting visual monitoring ended	Time pre-shooting acoustic monitoring began	Time pre-shooting acoustic monitoring ended	Was it day or night in period prior to firing?	Reason for firing s = survey t = test x = test followed immediately by survey	Time soft start / ramp-up began	Time soft start / ramp-up ended	Time of start of line / test	Time of end of line / test	Time gun(s) disabled after line / test	Time mitigation gun enabled / source output reduced	Time mitigation gun disabled / end of reduced output	Was any mitigation action required?
2011-09-06									00:18	03:52	03:52	03:52	06:12	no
2011-09-06					night	s	06:12	06:33	07:10	13:01	13:01			no
2011-09-06	18:37	19:42			day	s	19:42	20:20	20:31					no
2011-09-07										00:14	00:17	00:17	02:38	no
2011-09-07					night	s	02:38	02:59	03:37	10:03	10:03	10:03	12:02	no
2011-09-07					day	x	12:02	12:24	12:24	21:17	21:17			no
2011-09-07	22:42	23:45			day	s	23:47							no
2011-09-08								00:08	00:39	06:56	06:56	06:56	11:33	no
2011-09-08					dawn	s	11:33	11:58	12:40	16:56	16:56			no
2011-09-08	18:22	19:33			day	s	19:33	19:55	20:30					no
2011-09-09										02:36	02:38	02:38	06:49	no
2011-09-09					night	s	06:49	07:10	07:51	12:24	12:24			no
2011-09-09	13:51	14:51			day	s	14:51	15:12	15:46	21:21	21:21			no
2011-09-09	22:31	23:35			day	s						23:35		no
2011-09-10													01:12	no
2011-09-10					night	s	01:12	01:33	02:11	06:57	06:57	06:57	09:21	no
2011-09-10					night	s	09:21	09:43	10:21	16:06	16:06			no
2011-09-10	18:23	19:39			day	s	19:39	20:00	20:24					no
2011-09-11										01:34	01:35	01:35	04:11	no
2011-09-11					night	s	04:11	04:32	05:10	11:28	11:28			no
2011-09-11	13:00	14:01			day	s	14:01	14:23	15:00	20:15	20:15			no
2011-09-11					day	x	21:08	21:33	21:33	23:37				no
2011-09-12										05:39	05:39	05:39	08:22	no
2011-09-12					night	s	08:22	08:43	09:06	14:30	14:30			no
2011-09-12	15:55	16:57			day	s	16:57	17:22	17:55					no
2011-09-13										00:16	00:17	00:17	03:20	no

RPS

PROTECTED SPECIES RECORDING FORM

OPERATIONS

Regulatory reference number n/a | **Vessel name** *Veritas Viking*

Project number UMS04076 | **Page number** 14 of 14

Date	Time pre-shooting visual monitoring began	Time pre-shooting visual monitoring ended	Time pre-shooting acoustic monitoring began	Time pre-shooting acoustic monitoring ended	Was it day or night in period prior to firing?	Reason for firing s = survey t = test x = test followed immediately by survey	Time soft start / ramp-up began	Time soft start / ramp-up ended	Time of start of line / test	Time of end of line / test	Time gun(s) disabled after line / test	Time mitigation gun enabled / source output reduced	Time mitigation gun disabled / end of reduced output	Was any mitigation action required?
2011-09-13					night	s	03:20	03:41	04:10	09:53	09:54	09:54	10:55	no
2011-09-13	11:16	12:21			day	s	12:21	12:42	13:19	19:39	19:39			no
2011-09-13	22:14	23:17			day	s	23:17	23:38						no
2011-09-14									00:08	05:50	05:51	05:51	08:11	no
2011-09-14					night	s	08:11	08:32	09:12	15:30	15:30			no
2011-09-14	18:07	19:07			day	s	19:07	19:28	20:05					no
2011-09-15										01:42	01:44	01:44	03:57	no
2011-09-15					night	s	03:57	04:18	05:03	10:57	10:57			no
2011-09-15	13:55	14:55			day	s	14:55	15:16	15:51	21:41	21:41			no
2011-09-15	22:40	23:41			day	s						23:41		no
2011-09-16													00:03	no
2011-09-16					night	s	00:03	00:25	00:59	06:57	06:57	06:57	10:54	no
2011-09-16					dawn	s	10:54	11:15	11:48	17:53	17:53			no
2011-09-16	20:19	21:21			day	s	21:21	21:44	22:21					no
2011-09-17										00:32	00:34	00:34	06:02	no
2011-09-17					night	s	06:02	06:22	06:55	09:07	09:07			no
2011-09-17	11:33	12:42			day	s	12:42	13:03	13:44	14:35	14:35			no
2011-09-17	15:57	16:57			day	s	16:57	17:17	17:49	18:45	18:45			no
2011-09-17	22:23	23:23			day	s						23:23		no
2011-09-18													00:32	no
2011-09-18					night	s	00:32	00:52	01:24	01:33	01:34	01:34	06:13	no
2011-09-18					night	s	06:13	06:33	07:11	07:26	07:26			no

3.4 LOCATION AND EFFORT

RPS

PROTECTED SPECIES RECORDING FORM

EFFORT

Regulatory reference number n/a
Project number UMS04076
Vessel name *Veritas Viking*
Effort page number 1 of 4

Date	Visual or PAM	Observers' initials	Start of watch				End of watch				Wind speed (knots)	Wind direction	Beaufort scale	Swell (m)	Visibility (km)	Glare severity
			Time	Latitude	Longitude	Depth (m)	Time	Latitude	Longitude	Depth (m)						
2011-06-09	visual	AS/DB	20:15	24.44139°N	079.71944°W	740	21:20	24.38333°N	079.73694°W	750	16	NE	4	2-4	>5	none
2011-06-16	visual	AS	12:30	23.46806°N	079.02944°W	426	00:25	23.72278°N	079.25056°W	562	9	E	3	<2	>5	moderate
2011-06-17	visual	AS	10:05	23.24472°N	079.25667°W	475	00:25	23.76111°N	079.14694°W	476	11	E	3	<2	>5	severe
2011-06-18	visual	AS	10:10	23.20250°N	079.41639°W	460	00:25	23.46000°N	079.18417°W	524	7	S	2	<2	>5	moderate
2011-06-19	visual	AS	10:10	23.30778°N	079.42222°W	493	00:25	23.20083°N	079.50278°W	479	8	S	2	<2	>5	mild
2011-06-20	visual	AS	10:10	23.46667°N	079.17111°W	523	00:25	23.44472°N	079.29528°W	520	12	E	3	<2	>5	moderate
2011-06-21	visual	AS	10:10	23.10583°N	079.51000°W	467	00:25	23.39389°N	079.22194°W	521	8	E	2	<2	>5	severe
2011-06-22	visual	AS	10:10	23.30889°N	079.40333°W	486	13:51	23.50278°N	079.24139°W	519	9	SE	2	<2	>5	severe
2011-06-22	visual	AS	16:05	23.50750°N	079.12306°W	515	00:30	23.13528°N	079.52278°W	475	7	SE	2	<2	>5	severe
2011-06-23	visual	AS	10:10	23.43167°N	079.17444°W	524	14:08	23.20667°N	079.36000°W	462	8	S	2	<2	>5	severe
2011-06-23	visual	AS	16:29	23.12750°N	079.51056°W	471	00:30	23.52972°N	079.17056°W	519	5	E	1	<2	>5	severe
2011-06-24	visual	AS	10:10	23.01611°N	079.46028°W	472	15:02	23.48389°N	079.22250°W	513	9	SE	2	<2	>5	severe
2011-06-24	visual	AS	16:22	23.51833°N	079.15111°W	520	00:30	23.16611°N	079.50972°W	471	9	SE	2	<2	>5	severe
2011-06-25	visual	AS	10:10	23.43889°N	079.15000°W	521	15:15	23.15306°N	079.40667°W	451	8	S	2	<2	>5	severe
2011-06-25	visual	AS	21:08	23.32583°N	079.39083°W	495	00:30	23.46889°N	079.25917°W	525	14	SE	3	<2	>5	moderate
2011-06-26	visual	AS	10:10	23.12583°N	079.50806°W	472	00:30	23.14472°N	079.38722°W	447	14	SE	3	<2	>5	moderate
2011-06-27	visual	AS	10:10	23.48611°N	079.12167°W	510	15:55	23.11972°N	079.41111°W	445	9	SE	2	<2	>5	mild
2011-06-27	visual	AS	17:53	23.15444°N	079.50278°W	470	00:30	23.47250°N	079.22028°W	521	10	E	2	<2	>5	moderate
2011-06-28	visual	AS	10:10	23.13083°N	079.49806°W	471	00:30	23.10389°N	079.43722°W	453	13	SE	3	<2	>5	moderate
2011-06-29	visual	AS	10:10	23.40278°N	079.15139°W	521	14:58	23.13361°N	079.38028°W	449	8	SE	2	<2	>5	none
2011-06-29	visual	AS	16:26	23.13389°N	079.48444°W	483	00:30	23.48056°N	079.10250°W	506	5	E	1	<2	>5	mild
2011-06-30	visual	AS	10:10	23.24194°N	079.35222°W	478	14:18	23.46972°N	079.20500°W	522	14	E	3	<2	>5	mild
2011-06-30	visual	AS	17:35	23.48917°N	079.08611°W	491	24:00	23.10083°N	079.40111°W	444	11	SE	3	<2	>5	moderate
2011-07-01	visual	AS	00:00	23.10083°N	079.40111°W	444	00:30	23.10083°N	079.40111°W	444	12	SE	2	<2	>5	none
2011-07-01	visual	AS	10:10	23.40444°N	079.12028°W	509	15:40	23.12861°N	079.37639°W	452	12	SE	2	<2	>5	moderate
2011-07-01	visual	AS	16:50	23.08444°N	079.46639°W	457	00:30	23.47139°N	079.09361°W	497	12	E	2	<2	>5	moderate
2011-07-02	visual	AS	10:10	23.23694°N	079.38361°W	465	13:58	23.47167°N	079.18667°W	523	16	E	3	<2	>5	severe
2011-07-02	visual	AS	16:03	23.46028°N	079.08611°W	495	00:30	23.09194°N	079.45222°W	460	12	E	3	<2	>5	severe
2011-07-03	visual	AS	10:10	23.33583°N	079.18028°W	516	00:30	23.43444°N	079.06667°W	477	18	NE	4	2-4	>5	none
2011-07-04	visual	AS	10:10	23.03889°N	079.29056°W	424	15:15	23.31306°N	079.03556°W	484	19	E	4	2-4	>5	none
2011-07-04	visual	AS	16:09	23.40722°N	079.02139°W	447	00:30	23.07889°N	079.37389°W	437	14	E	3	<2	>5	mild
2011-07-05	visual	AS	10:10	23.37917°N	079.12750°W	517	00:30	23.33944°N	079.01083°W	478	9	E	2	<2	>5	none
2011-07-06	visual	AS	10:10	23.00556°N	079.33556°W	432	16:15	23.32944°N	079.00972°W	480	12	SE	2	<2	>5	moderate
2011-07-06	visual	AS	17:22	23.32944°N	079.00972°W	488	00:30	23.09861°N	079.35083°W	437	14	SW	3	<2	>5	mild
2011-07-07	visual	AS	10:15	23.41083°N	079.08528°W	493	16:20	23.08556°N	079.35306°W	436	15	S	3	<2	>5	none
2011-07-07	visual	AS	17:19	23.04694°N	079.32111°W	435	00:30	23.36083°N	078.99667°W	480	12	SE	3	<2	>5	mild
2011-07-08	visual	AS	10:15	23.00583°N	079.27667°W	423	16:01	23.32056°N	079.00111°W	473	14	SE	3	<2	>5	moderate
2011-07-08	visual	AS	17:19	23.40861°N	079.01167°W	444	00:30	23.09806°N	079.34389°W	434	11	SE	3	<2	>5	severe
2011-07-09	visual	AS	10:15	23.40889°N	079.06694°W	484	00:30	23.33556°N	079.00500°W	474	12	S	3	<2	>5	moderate

RPS

PROTECTED SPECIES RECORDING FORM

EFFORT

Regulatory reference number n/a **Vessel name** *Veritas Viking*

Project number UMS04076 **Effort page number** 2 of 4

Date	Visual or PAM	Observers' initials	Start of watch				End of watch				Wind speed (knots)	Wind direction	Beaufort scale	Swell (m)	Visibility (km)	Glare severity
			Time	Latitude	Longitude	Depth (m)	Time	Latitude	Longitude	Depth (m)						
2011-07-10	visual	AS	10:15	23.00083°N	079.25639°W	442	00:30	23.07111°N	079.33333°W	433	15	E	4	<2	>5	severe
2011-07-11	visual	AS	10:15	23.37833°N	079.07528°W	501	00:30	23.40278°N	079.00639°W	431	16	SE	4	<2	>5	severe
2011-07-12	visual	AS	10:15	23.06778°N	079.18528°W	431	14:33	23.30278°N	078.98806°W	477	8	SE	2	<2	>5	mild
2011-07-12	visual	AS	16:00	23.40500°N	079.00611°W	431	00:30	23.98556°N	079.29167°W	441	8	SE	2	<2	>5	severe
2011-07-13	visual	AS	10:15	23.32028°N	079.11583°W	525	00:30	23.38444°N	079.03722°W	479	9	E	2	<2	>5	severe
2011-07-14	visual	AS	10:15	23.09194°N	079.13333°W	441	14:00	23.30750°N	078.97306°W	467	6	E	1	<2	>5	severe
2011-07-14	visual	AS	16:00	23.39861°N	079.02278°W	460	20:00	23.21694°N	079.19139°W	479	4	SW	1	<2	>5	none
2011-07-14	visual	AS	22:00	23.12444°N	079.27139°W	439	00:30	22.98861°N	079.28778°W	422	4	w	1	<2	>5	severe
2011-07-15	visual	AS	16:00	23.57583°N	079.32778°W	530	00:30	23.22889°N	079.17556°W	489	7	SE	2	<2	>5	severe
2011-07-16	visual	AS	10:15	23.25417°N	079.00556°W	509	14:00	23.42861°N	079.00056°W	390	4	SW	1	<2	>5	severe
2011-07-16	visual	AS	17:39	23.44083°N	079.08667°W	488	00:30	23.09722°N	079.28750°W	436	4	S	1	<2	>5	severe
2011-07-17	visual	AS	10:15	23.38778°N	079.01361°W	457	00:30	23.33778°N	078.95139°W	389	4	SE	1	<2	>5	moderate
2011-07-18	visual	AS	10:15	23.00528°N	079.20028°W	422	00:30	23.01722°N	079.31000°W	425	6	S	1	<2	>5	moderate
2011-07-19	visual	AS	10:15	23.31389°N	079.07333°W	520	00:30	23.35000°N	079.03389°W	482	6	S	1	<2	>5	moderate
2011-07-20	visual	AS	10:15	23.10556°N	079.10472°W	448	00:30	23.05306°N	079.13583°W	433	3	N	1	<2	>5	moderate
2011-07-21	visual	AS	10:15	23.16000°N	079.19194°W	453	15:44	23.27861°N	078.94083°W	464	9	E	2	<2	>5	none
2011-07-22	visual	AS	21:05	23.36861°N	079.96083°W	376	00:30	23.22083°N	079.13361°W	494	3	E	1	<2	>5	severe
2011-07-22	visual	AS	10:15	23.26417°N	078.95250°W	480	00:30	23.26667°N	078.94056°W	461	15	E	3	<2	>5	moderate
2011-07-23	visual	AS	10:15	23.03306°N	079.14139°W	429	16:00	23.24056°N	079.01667°W	513	18	E	3	<2	>5	severe
2011-07-24	visual	AS	10:15	23.05361°N	079.12583°W	433	14:25	22.96500°N	079.18389°W	417	21	E	4	<2	>5	severe
2011-07-25	visual	AS	10:15	23.04306°N	078.97056°W	474	00:30	23.03833°N	078.96417°W	475	20	E	4	<2	>5	severe
2011-07-26	visual	AS	10:20	23.25889°N	078.84333°W	265	00:25	23.25722°N	078.84306°W	270	21	SE	4	<2	>5	moderate
2011-07-27	visual	AS	10:20	23.11556°N	079.03806°W	490	00:25	23.13806°N	079.01000°W	504	20	SE	4	<2	>5	mild
2011-07-28	visual	AS	10:20	22.93722°N	079.16389°W	417	00:25	22.98556°N	079.13444°W	420	22	E	4	<2	>5	severe
2011-07-29	visual	AS	10:20	22.98833°N	078.97083°W	449	00:25	22.97194°N	078.98556°W	439	20	E	4	<2	>5	severe
2011-07-30	visual	AS	10:20	22.98833°N	078.97083°W	449	00:25	22.97194°N	078.98556°W	439	20	E	4	<2	>5	severe
2011-07-31	visual	AS	10:20	23.19472°N	078.91833°W	498	13:00	23.22917°N	078.83389°W	304	12	SE	3	<2	>5	severe
2011-08-01	visual	AS	16:00	23.03694°N	079.30611°W	428	00:25	23.24028°N	078.84083°W	381	11	E	3	<2	>5	moderate
2011-08-02	visual	AS	10:20	23.05000°N	079.04667°W	452	00:25	23.04000°N	079.05611°W	448	8	E	2	<2	>5	moderate
2011-08-08	visual	AS	10:25	22.93917°N	079.14861°W	419	00:15	23.00833°N	079.17694°W	422	9	SE	2	<2	>5	severe
2011-08-09	visual	AS	10:25	23.07944°N	078.85806°W	502	00:15	23.13778°N	078.80111°W	404	5	NE	1	<2	>5	severe
2011-08-10	visual	AS, GS	10:25	23.07861°N	078.99000°W	490	20:00	23.03413°N	079.01420°W	453	4	NE	1	<2	>5	severe
2011-08-10	visual	GS	22:00	22.92410°N	079.12543°W	417	00:20	23.03413°N	079.01420°W	453	4	NE	1	<2	>5	moderate
2011-08-11	visual	GS	10:25	22.99775°N	079.11483°W	427	00:15	22.98493°N	079.06625°W	432	8	SE	2	<2	>5	moderate
2011-08-12	visual	GS	10:30	23.08150°N	078.81248°W	449	14:00	22.96598°N	079.00105°W	437	6	S	2	<2	>5	severe
2011-08-12	visual	GS	16:00	22.98155°N	079.14100°W	420	00:15	23.14502°N	078.77153°W	315	4	SE	1	<2	>5	severe
2011-08-13	visual	GS	10:30	23.07840°N	078.95485°W	504	20:00	22.98723°N	079.07148°W	433	6	SSW	1	<2	>5	severe
2011-08-13	visual	GS	21:44	22.93538°N	079.14458°W	420	00:15	23.03652°N	078.98750°W	454	6	NE	2	<2	>5	severe
2011-08-14	visual	GS	10:30	22.99722°N	079.11957°W	426	18:30	23.09627°N	078.78038°W	416	6	S	2	<2	>5	moderate
2011-08-14	visual	GS	20:30	23.04155°N	078.92433°W	502	00:10	23.20355°N	078.89498°W	468	4	NW	1	<2	>5	severe

RPS

PROTECTED SPECIES RECORDING FORM

EFFORT

Regulatory reference number n/a
Project number UMS04076
Vessel name *Veritas Viking*
Effort page number 3 of 4

Date	Visual or PAM	Observers' initials	Start of watch				End of watch				Wind speed (knots)	Wind direction	Beaufort scale	Swell (m)	Visibility (km)	Glare severity
			Time	Latitude	Longitude	Depth (m)	Time	Latitude	Longitude	Depth (m)						
2011-08-15	visual	GS	10:30	23.05787°N	079.14135°W	434	14:00	23.29417°N	079.01007°W	498	6	E	2	<2	>5	severe
2011-08-15	visual	GS	15:30	23.42385°N	079.04945°W	948	20:00	23.22000°N	079.28432°W	493	6	S	2	<2	>5	mild
2011-08-15	visual	GS	21:40	23.18720°N	079.44148°W	476	00:10	23.31760°N	079.40752°W	497	5	NE	1	<2	>5	moderate
2011-08-16	visual	GS	10:35	23.52238°N	079.12167°W	521	14:00	23.17710°N	079.26073°W	455	5	S	1	<2	>5	severe
2011-08-16	visual	GS	15:53	23.12195°N	079.40460°W	446	20:00	23.31343°N	079.26262°W	503	6	E	2	<2	>5	mild
2011-08-16	visual	GS	21:55	23.37045°N	079.13050°W	522	00:10	23.23367°N	079.16552°W	494	6	E	2	<2	<2	moderate
2011-08-17	visual	GS	10:35	23.31540°N	079.18437°W	503	14:00	23.08843°N	079.34210°W	436	6	S	2	<2	>5	mild
2011-08-17	visual	GS	14:45	23.03217°N	079.30733°W	430	20:00	24.56590°N	079.04677°W	516	9	NE	3	<2	>5	mild
2011-08-17	visual	GS	21:33	23.30167°N	079.12500°W	521	00:10	23.19763°N	079.27030°W	457	9	E	3	<2	>5	moderate
2011-08-18	visual	GS	10:40	23.22222°N	078.89702°W	460	20:00	22.91605°N	078.65405°W	451	12	SE	3	<2	>5	mild
2011-08-18	visual	GS	20:26	22.92167°N	078.69067°W	470	00:00	23.10213°N	078.88647°W	484	12	SE	3	<2	>5	severe
2011-08-19	visual	GS	10:45	22.97447°N	078.70892°W	438	14:00	22.83962°N	078.54693°W	458	12	S	3	<2	>5	moderate
2011-08-19	visual	GS	16:00	22.91383°N	078.66353°W	462	00:05	23.35225°N	078.99283°W	496	2	E	2	<2	>5	moderate
2011-08-20	visual	GS	10:35	22.83595°N	078.54290°W	462	00:10	23.19680°N	078.86043°W	435	6	E	2	<2	>5	moderate
2011-08-21	visual	GS	10:40	22.90660°N	078.69215°W	480	00:10	23.13953°N	078.81207°W	419	9	E	2	<2	>5	moderate
2011-08-22	visual	GS	10:40	22.94558°N	078.74828°W	473	15:36	23.26845°N	078.98558°W	500	9	E	2	<2	>5	moderate
2011-08-27	visual	GS	10:42	23.52095°N	079.10437°W	493	20:40	22.88102°N	078.61735°W	456	12	SSW	3	<2	>5	moderate
2011-08-27	visual	GS	22:30	22.84930°N	078.52738°W	435	23:55	22.88697°N	078.60003°W	438	8	S	2	<2	>5	mild
2011-08-28	visual	GS	10:40	23.35538°N	078.35538°W	411	20:00	22.87268°N	078.53400°W	404	6	S	2	<2	>5	severe
2011-08-28	visual	GS	21:47	22.89140°N	078.64835°W	472	23:45	22.95987°N	078.74742°W	462	30	SW	4	<2	2-5	mild
2011-08-29	visual	GS	10:45	23.16777°N	078.81532°W	395	15:09	22.88433°N	078.60817°W	447	12	S	3	<2	>5	moderate
2011-08-29	visual	GS	16:00	22.82138°N	078.59162°W	487	23:55	23.09902°N	078.84255°W	463	12	SE	3	<2	>5	mild
2011-08-30	visual	GS	10:45	23.02805°N	078.70683°W	380	14:00	22.87900°N	078.53593°W	384	12	SE	3	<2	>5	severe
2011-08-30	visual	GS	16:00	22.80938°N	078.56783°W	482	23:40	23.22280°N	078.92697°W	482	12	SE	3	<2	>5	mild
2011-08-31	visual	GS	10:45	22.87868°N	078.56980°W	432	21:32	23.24000°N	078.95000°W	457	12	SE	3	<2	>5	moderate
2011-08-31	visual	GS	22:00	22.30752°N	079.00232°W	487	23:55	23.36233°N	078.94192°W	351	12	E	3	<2	>5	mild
2011-09-01	visual	GS	10:45	22.81607°N	078.58038°W	482	19:26	23.28545°N	078.96990°W	479	12	E	3	<2	>5	moderate
2011-09-01	visual	GS	21:25	23.37830°N	078.98672°W	432	23:47	23.30395°N	078.89237°W	332	8	E	2	<2	>5	moderate
2011-09-02	visual	GS	10:50	22.82830°N	078.59938°W	486	20:00	23.32038°N	079.00252°W	487	8	E	2	<2	>5	moderate
2011-09-02	visual	GS	20:38	23.36333°N	079.00333°W	451	23:55	23.25240°N	078.84765°W	304	6	N	2	<2	>5	mild
2011-09-03	visual	GS	10:45	22.91672°N	078.68005°W	468	23:55	23.25240°N	078.84765°W	304	8	SE	2	<2	>5	moderate
2011-09-04	visual	GS	10:45	23.06903°N	078.90370°W	490	23:50	22.84777°N	078.51732°W	450	6	SE	2	<2	>5	severe
2011-09-05	visual	GS	10:45	23.07470°N	079.11372°W	444	20:15	22.83917°N	078.60833°W	485	12	SE	3	<2	>5	moderate
2011-09-05	visual	GS	22:00	22.92420°N	078.67113°W	455	23:50	23.00703°N	078.77212°W	442	8	N	2	<2	>5	moderate
2011-09-06	visual	GS	10:45	22.94120°N	078.79192°W	488	14:00	22.88250°N	078.54185°W	393	8	SE	2	<2	>5	severe
2011-09-06	visual	GS	16:00	22.81173°N	078.58150°W	482	23:55	23.09893°N	079.01165°W	494	4	SE	1	<2	>5	moderate
2011-09-07	visual	GS	10:50	22.88162°N	078.57215°W	427	23:55	23.05097°N	079.09277°W	438	4	NE	1	<2	>5	moderate
2011-09-08	visual	GS	10:50	22.92360°N	078.62055°W	395	23:50	22.94142°N	078.81778°W	499	8	SE	2	<2	>5	moderate

RPS

PROTECTED SPECIES RECORDING FORM

EFFORT

Regulatory reference number n/a
Project number UMS04076
Vessel name *Veritas Viking*
Effort page number 4 of 4

Date	Visual or PAM	Observers' initials	Start of watch				End of watch				Wind speed (knots)	Wind direction	Beaufort scale	Swell (m)	Visibility (km)	Glare severity
			Time	Latitude	Longitude	Depth (m)	Time	Latitude	Longitude	Depth (m)						
2011-09-09	visual	GS	22:00	22.82633°N	078.60477°W	488	23:50	22.88795°N	078.55042°W	350	12	E	3	<2	>5	severe
2011-09-10	visual	GS	10:50	23.00760°N	079.01863°W	445	23:50	23.04412°N	078.93930°W	503	12	E	3	<2	>5	moderate
2011-09-11	visual	GS	10:50	22.86667°N	078.67593°W	493	23:40	23.01240°N	079.05543°W	434	12	E	3	<2	>5	mild
2011-09-12	visual	GS	10:50	22.98012°N	078.80180°W	482	14:30	23.08383°N	079.06067°W	450	12	SE	3	<2	>5	severe
2011-09-12	visual	GS	15:55	23.09537°N	079.14832°W	445	23:45	22.85837°N	078.67880°W	495	10	E	3	<2	>5	moderate
2011-09-13	visual	GS	10:50	23.10707°N	079.12618°W	446	20:00	22.82942°N	078.62325°W	490	8	E	2	<2	>5	mild
2011-09-13	visual	GS	22:00	22.83802°N	078.50913°W	451	23:45	22.89740°N	078.61970°W	441	12	NE	3	<2	>5	severe
2011-09-14	visual	GS	10:45	22.96262°N	078.96458°W	445	15:30	22.83917°N	078.65112°W	496	12	NE	3	<2	>5	severe
2011-09-14	visual	GS	16:00	22.82725°N	078.62262°W	490	23:45	23.01660°N	078.92467°W	502	12	N	3	<2	>5	severe
2011-09-15	visual	GS	10:45	22.84182°N	078.66520°W	495	21:42	23.06942°N	079.07217°W	452	6	N	2	<2	>5	moderate
2011-09-15	visual	GS	22:41	23.09867°N	079.13602°W	447	23:45	23.03685°N	079.15642°W	429	4	N	1	<2	>5	moderate
2011-09-16	visual	GS	10:50	22.87455°N	078.59052°W	453	17:53	23.06550°N	079.07190°W	449	8	E	2	<2	>5	moderate
2011-09-16	visual	GS	20:19	23.00003°N	079.04490°W	434	23:40	23.14530°N	078.87792°W	469	10	E	2	<2	>5	severe
2011-09-17	visual	GS	10:50	22.82035°N	078.53122°W	467	14:35	22.96630°N	078.72190°W	445	8	E	2	<2	>5	mild
2011-09-17	visual	GS	15:57	23.02708°N	078.79777°W	451	20:00	23.24370°N	078.88815°W	426	12	E	3	<2	>5	none
2011-09-17	visual	GS	22:00	23.13017°N	078.79288°W	400	23:40	23.03223°N	078.72635°W	407	8	E	2	<2	>5	mild

3.5. RECORD OF DETECTION

RPS

PROTECTED SPECIES RECORDING FORM

DETECTION

Date	**Project number**	**Time at first detection** (UTC)	**Time at last detection** (UTC)	**Visual detection number**	**Acoustic detection number**
2011-07-21	UMS04076	21:25	21:31	1	n/a

Regulatory reference number	**Vessel name**	**Survey type**	**Observer(s)**
n/a	*Veritas Viking*	3D	Adam Swope, Sarah Fisher

Detection was made	**Detection was first made**
Visually	visually by observer keeping a continuous watch

Latitude of vessel	**Longitude of vessel**	**Bearing of vessel** (degrees)	**Water depth** (metres)
23.36972°N	078.97667°W	270	432

Swell height (metres)	**Beaufort scale**	**Precipitation**	**Visibility** (km)	**Cloud cover** (%)	**Glare severity and direction**
<2m	1	none	>5km	40	severe from W

Common name	**Scientific name**	**Certainty of identification**
Pantropical spotted dolphin	*Stenella attenuata*	definite

Total number	**Number of adults**	**Number of juveniles**	**Bearing to animal(s) when first detected** (degrees)	**Range to animal(s) when first detected** (metres)
9	6	3	90	25

Description (include features such as overall size; shape of head; colour and pattern; size, shape, and position of dorsal fin; height, direction, and shape of blow; etc.)	**Visual sighting and/or Acoustic detection details** (note behavior, especially changes in relation to gun activity and distance from gun array)
Dolphins were dark grey in color with distinct light grey capes extending along their sides with many visible spots on the adults. Beaks were narrow with white tips. Bodies were slender, 2.4m in overall length, and dorsal fins were falcate.	At 21:25 UTC 6 adult and 3 juvenile Pantropical Spotted Dolphins (Stenella attenuata) were spotted 25m off the starboard beam of the vessel heading away from the vessel in the opposite direction. The juvenile dolphins were very acrobatic; jumping completely out of the water as the pod traveled away from the vessel. The dolphins were last sighted at 21:31 700m off the starboard stern.

Direction of travel / first approach (relative to vessel)	**Initial compass heading** (degrees)	**Final compass heading** (degrees)
away in opposite direction	50	50

Closest distance of animals to airguns/source (metres)	**Closest distance of animals to vessel** (metres)	**Source activity at initial detection**	**Source activity at final detection**
400	20	not firing	not firing

Time at closest approach (UTC)	**Distance during soft start** (m) **First**	**Closest**	**Last**	**Source mitigation action(s) required**	**Strike avoidance maneuvers required**
21:26	n/a	n/a	n/a	none	no

Total duration of mitigation action(s) (HH:MM)	**Total duration of production loss due to mitigation** (HH:MM)
n/a	n/a

Other notes or comments

RPS

PROTECTED SPECIES RECORDING FORM

DETECTION

Date	**Project number**	**Time at first detection** (UTC)	**Time at last detection** (UTC)	**Visual detection number**	**Acoustic detection number**
2011-08-12	UMS04076	21:30	21:35	2	n/a

Regulatory reference number	**Vessel name**	**Survey type**	**Observer(s)**
n/a	*Veritas Viking*	3D	Sarah Fisher, Sebastian Rådlund

Detection was made	**Detection was first made**
Visually	visually by observer keeping a continuous watch

Latitude of vessel	**Longitude of vessel**	**Heading of vessel** (degrees)	**Water depth** (metres)
23.14833°N	078.89667°W	40	468

Swell height (metres)	**Beaufort scale**	**Precipitation**	**Visibility** (km)	**Cloud cover** (%)	**Glare severity and direction**
<2m	1	none	>5km	30	severe from W

Common name	**Scientific name**	**Certainty of identification**
Common bottlenose dolphin	*Tursiops truncatus*	possible

Total number	**Number of adults**	**Number of juveniles**	**Bearing to animal(s) when first detected** (degrees)	**Range to animal(s) when first detected** (metres)
1	1	0	30	10

Description (include features such as overall size; shape of head; colour and pattern; size, shape, and position of dorsal fin; height, direction, and shape of blow; etc.)	**Visual sighting and/or Acoustic detection details** (note behavior, especially changes in relation to gun activity and distance from gun array)
Single large dolphin, with a brown overall wash and no distinguishable patterns.	Single dolphin sighted briefly ~2m below surface off starboard bow swimming parallel to vessel. Animal resighted a few moments later jumping well off the port bow.

Direction of travel / first approach (relative to vessel)	**Initial compass heading** (degrees)	**Final compass heading** (degrees)
parallel in same direction as vessel	40	40

Closest distance of animals to airguns/source (metres)	**Closest distance of animals to vessel** (metres)	**Source activity at initial detection**	**Source activity at final detection**
440	10	full power while on survey line	full power while on survey line

Time at closest approach (UTC)	**Distance during soft start** (m)			**Source mitigation action(s) required**	**Strike avoidance maneuvers required**
	First	**Closest**	**Last**		
21:30	n/a	n/a	n/a	none	no

Duplicate detection? If yes, provide duplicate detection number	**Total duration animals observed in exclusion zone** (HH:MM)	**Total duration of production loss due to mitigation action** (HH:MM)
no	00:05	00:00

Other notes or comments

RPS

PROTECTED SPECIES RECORDING FORM

DETECTION

Date	**Project number**	**Time at first detection** (UTC)	**Time at last detection** (UTC)	**Visual detection number**	**Acoustic detection number**
2011-09-08	UMS04076	18:42	19:08	3	n/a

Regulatory reference number	**Vessel name**	**Survey type**	**Observer(s)**
n/a	*Veritas Viking*	3D	Greggo Seward, Kat Allan

Detection was made	**Detection was first made**
Visually	visually by observer keeping a continuous watch

Latitude of vessel	**Longitude of vessel**	**Heading of vessel** (degrees)	**Water depth** (metres)
23.07398°N	079.13955°W	140	438

Swell height (metres)	**Beaufort scale**	**Precipitation**	**Visibility** (km)	**Cloud cover** (%)	**Glare severity and direction**
<2m	2	none	>5km	10	mild from W

Common name	**Scientific name**	**Certainty of identification**
Common bottlenose dolphin	*Tursiops truncatus*	definite

Total number	**Number of adults**	**Number of juveniles**	**Bearing to animal(s) when first detected** (degrees)	**Range to animal(s) when first detected** (metres)
14	11	3	170	20

Description (include features such as overall size; shape of head; colour and pattern; size, shape, and position of dorsal fin; height, direction, and shape of blow; etc.)	**Visual sighting and/or Acoustic detection details** (note behavior, especially changes in relation to gun activity and distance from gun array)
~2m long with robust bodies, deep tail stock, and short, thick rostrum anterior to pronounced melon. Grey overall in colour with lighter lateral and almost white ventral sides. Faint blaze posterior of dorsal fin visible on some adults. Juveniles more uniformly dark grey in colour.	Two adults initially sighted approaching from afore the vessel's stbd bow. After swimming afore the bow for 1-2 minutes more individuals approached in groups of 2-3, including 3 juveniles paired with adults, until a total of 14 animals were present. Some joining animals would approach bow, stop 10-30m afore, turn parallel to vessel, and spyhop as the vessel approached, before bowriding. Occasional porpoising and non-acrobatic breaching behaviors were observed. Active vocalizations heard from the bow as the pod swam together. Pod bow rode for ~20 minutes before small groups began to break off and swim away off stbd beam.

Direction of travel / first approach (relative to vessel)	**Initial compass heading** (degrees)	**Final compass heading** (degrees)
towards vessel	350	230

Closest distance of animals to airguns/source (metres)	**Closest distance of animals to vessel** (metres)	**Source activity at initial detection**	**Source activity at final detection**
440	1	not firing	not firing

Time at closest approach (UTC)	**Distance during soft start** (m) **First**	**Closest**	**Last**	**Source mitigation action(s) required**	**Strike avoidance maneuvers required**
18:43	n/a	n/a	n/a	none	no

Duplicate detection? If yes, provide duplicate detection number	**Total duration animals observed in exclusion zone** (HH:MM)	**Total duration of production loss due to mitigation action** (HH:MM)
no	00:26	00:00

Other notes or comments

RPS

PROTECTED SPECIES RECORDING FORM

DETECTION

Date	**Project number**	**Time at first detection** (UTC)	**Time at last detection** (UTC)	**Visual detection number**	**Acoustic detection number**
2011-09-09	UMS04076	19:32	19:54	4	n/a

Regulatory reference number	**Vessel name**	**Survey type**	**Observer(s)**
n/a	*Veritas Viking*	3D	Greggo Seward

Detection was made	**Detection was first made**
Visually	visually by observer keeping a continuous watch

Latitude of vessel	**Longitude of vessel**	**Heading of vessel** (degrees)	**Water depth** (metres)
22.90072°N	078.73465°W	115	487

Swell height (metres)	**Beaufort scale**	**Precipitation**	**Visibility** (km)	**Cloud cover** (%)	**Glare severity and direction**
<2m	2	none	>5km	20	mild from W

Common name	**Scientific name**	**Certainty of identification**
Common bottlenose dolphin	*Tursiops truncatus*	definite

Total number	**Number of adults**	**Number of juveniles**	**Bearing to animal(s) when first detected** (degrees)	**Range to animal(s) when first detected** (metres)
30	25	5	135	10

Description (include features such as overall size; shape of head; colour and pattern; size, shape, and position of dorsal fin; height, direction, and shape of blow; etc.)	**Visual sighting and/or Acoustic detection details** (note behavior, especially changes in relation to gun activity and distance from gun array)
~2m long with robust bodies, deep tail stock, and short, thick rostrum anterior to pronounced melon. Grey overall in colour with lighter lateral and almost white ventral sides. Faint blaze posterior of dorsal fin visible on some adults. Juveniles more uniformly dark grey in colour.	Similar to visual detection number 3: a small group of adults initially approached and bow rode momentarily before the rest of the pod, including 5 detected juveniles, joined in small groups. Occasional spy hopping and lob tailing were observed in adults 10-100m off the bow. Animals riding the bow porpoised and sometimes breached, or paced the vessel while swimming on their side. Vocalizations were audible from the vessel's prow while animals were bowriding. After 15-20 minutes of this behavior, animals began to break off in small groups and swim away off the stbd beam.

Direction of travel / first approach (relative to vessel)	**Initial compass heading** (degrees)	**Final compass heading** (degrees)
towards vessel	315	275

Closest distance of animals to airguns/source (metres)	**Closest distance of animals to vessel** (metres)	**Source activity at initial detection**	**Source activity at final detection**
440	1	full power while on survey line	full power while on survey line

Time at closest approach (UTC)	**Distance during soft start** (m) **First**	**Closest**	**Last**	**Source mitigation action(s) required**	**Strike avoidance maneuvers required**
19:32	n/a	n/a	n/a	none	no

Duplicate detection? If yes, provide duplicate detection number	**Total duration animals observed in exclusion zone** (HH:MM)	**Total duration of production loss due to mitigation action** (HH:MM)
no	00:22	00:00

Other notes or comments

RPS

PROTECTED SPECIES RECORDING FORM

DETECTION

Date	Project number	Time at first detection (UTC)	Time at last detection (UTC)	Visual detection number	Acoustic detection number
2011-09-10	UMS04076	16:08	16:09	5	n/a

Regulatory reference number	Vessel name	Survey type	Observer(s)
n/a	*Veritas Viking*	3D	Greggo Seward

Detection was made	Detection was first made
visually	visually by observer keeping a continuous watch

Latitude of vessel	Longitude of vessel	Heading of vessel (degrees)	Water depth (metres)
22.84962°N	078.62862°W	130	488

Swell height (metres)	Beaufort scale	Precipitation	Visibility (km)	Cloud cover (%)	Glare severity and direction
<2m	3	none	>5km	30	mild from SE

Common name	Scientific name	Certainty of identification
Loggerhead sea turtle	*Caretta caretta*	definite

Total number	Number of adults	Number of juveniles	Bearing to animal(s) when first detected (degrees)	Range to animal(s) when first detected (metres)
1	1	0	40	40

Description (include features such as overall size; shape of head; colour and pattern; size, shape, and position of dorsal fin; height, direction, and shape of blow; etc.)	Visual sighting and/or Acoustic detection details (note behavior, especially changes in relation to gun activity and distance from gun array)
Ruddy-brown carapace estimated to be 0.5-1.0m in length with scutes visible. Large head and scute pattern characteristic of this species observed. Yellow-brown body with scaling and forelimb claws visible.	Sighted briefly at surface off vessel's port beam travelling parallel to the vessel in the opposite direction. Animal swam slowly as vessel passed and occasionally raised its head above the surface. No noticeable change in behavior or heading was noted.

Direction of travel / first approach (relative to vessel)	Initial compass heading (degrees)	Final compass heading (degrees)
parallel in opposite direction as vessel	310	310

Closest distance of animals to airguns/source (metres)	Closest distance of animals to vessel (metres)	Source activity at initial detection	Source activity at final detection
360	40	not firing	not firing

Time at closest approach (UTC)	Distance during soft start (m) First	Closest	Last	Source mitigation action(s) required	Strike avoidance maneuvers required
16:08	n/a	n/a	n/a	none	no

Duplicate detection? If yes, provide duplicate detection number	Total duration animals observed in exclusion zone (HH:MM)	Total duration of production loss due to mitigation action (HH:MM)
no	00:02	00:00

Other notes or comments

4. PHOTOGRAPHS

Figure 4. Adult common bottlenose dolphins spy-hopping as the vessel approaches.

Figure 5. An adult common bottlenose dolphin begins a low breach from the water's surface.

Figure 6. A pod of common bottlenose dolphin's bowride directly in front of the vessel.

Figure 7. An adult loggerhead sea turtle swims at the surface, occasionally lifting its head above.

Figure 8. An adult burrowing owl perches on the vessel's forward crane.

Figure 9. A royal tern flies off the vessel's beam, occasionally diving at the surface.

Figure 10. A male American redstart perched on the vessel's Fast Rescue Boat (FRB).

Figure 11. A female northern parula perched on a railing behind the vessel's wheelhouse.

Figure 12. An adult peregrine falcon perched on the vessel's bow with its most recent prey.

5. JNCC OBSERVER LOGS

JNCC Observer Log Key				
Source Activity	**Sea State**	**Swell**	**Visibility**	**Sun glare**
f = full power (from start of line)	g = glassy (like a mirror)	o = low (<2m)	p = poor (<1km)	n = no glare
s = soft start (and run-in to line)	s = slight (no of few whitecaps)	m = medium (2-4m)	m = moderate (1-5km)	wf = weak glare forward
r = reduced power (other than soft-start)	c = choppy (many whitecaps)	l = large (>4m)	g = good (>5km)	sf = strong glare forward
n = not active	r = rough (large waves, foam crests, spray)			wb = weak glare behind
v = variable (e.g. test firing)				sb = strong glare behind

Date	Observer's / operator's name(s)	Time of start of watch (UTC)	Time of end of watch (UTC)	Depth of water at start position (metres)	Depth of water at end position (metres)	Speed of vessel (knots)	Source activity	Wind direction	Wind force (Beaufort)	Sea state	Swell	Visibility (visual watch only)	Sun glare (visual watch only)
6/9/2011	Amber Stooksberry / David Bould	20:15	21:20	740.0	750.0	3.8	n	ne	4	c	m	g	n
6/16/2011	Adam Swope / Nathan Stewart	12:30	20:30	426.0	552.0	4.1	n	ne	2	s	o	g	vf
6/16/2011	Adam Swope	20:30	22:00	552.0	579.0	3.9	v	ne	3	s	o	g	sf
6/16/2011	Adam Swope / Alex Codreanu	22:00	23:33	579.0	568.0	4.4	s	se	3	s	o	m	sb
6/16/2011	Adam Swope	23:33	0:25	568.0	562.0	4.4	v	se	3	s	o	p	n
6/17/2011	Adam Swope	10:05	11:05	475.0	503.0	4.0	n	nw	2	s	o	p	n
6/17/2011	Adam Swope	11:05	12:05	503.0	524.0	4.1	n	ne	1	s	o	g	sf
6/17/2011	Adam Swope	12:05	13:05	524.0	525.0	4.3	n	e	1	s	o	g	sf
6/17/2011	Adam Swope	13:05	14:05	525.0	521.0	4.1	n	ne	1	s	o	g	sf
6/17/2011	Alex Codreanu	14:05	15:05	521.0	525.0	4.0	n	ne	2	s	o	g	sf
6/17/2011	Ron Cook	15:05	16:05	525.0	540.0	4.0	n	ne	2	s	o	g	sf
6/17/2011	Adam Swope	16:05	17:05	540.0	553.0	4.1	n	ne	2	s	o	g	sf
6/17/2011	Adam Swope	17:05	18:05	553.0	562.0	4.1	n	e	2	s	o	g	n
6/17/2011	Adam Swope	18:05	19:05	562.0	565.0	4.0	n	e	2	s	o	g	n
6/17/2011	Adam Swope	19:05	20:05	565.0	568.0	3.9	n	e	3	s	o	g	n
6/17/2011	Adam Swope	20:05	21:05	568.0	559.0	3.9	n	e	3	c	o	m	wf
6/17/2011	Adam Swope	21:05	22:05	559.0	417.0	4.5	n	ne	4	c	o	m	sb
6/17/2011	Adam Swope / Glen Pangle	22:05	23:05	417.0	435.0	4.4	n	se	4	c	o	m	sb
6/17/2011	Adam Swope / Glen Pangle	23:05	23:32	435.0	456.0	4.2	n	se	4	c	o	m	sb
6/17/2011	Adam Swope	23:32	23:55	456.0	466.0	4.1	s	se	4	c	o	m	sb
6/17/2011	Adam Swope	23:55	0:25	466.0	476.0	4.1	f	se	4	c	o	p	n
6/18/2011	Adam Swope	10:10	10:42	460.0	458.0	4.1	f	se	3	s	o	p	n
6/18/2011	Adam Swope	10:42	11:42	458.0	465.0	4.1	n	se	3	s	o	g	n
6/18/2011	Adam Swope	11:42	12:42	465.0	454.0	4.1	n	se	3	s	o	g	n
6/18/2011	Adam Swope	12:42	13:10	454.0	441.0	4.2	n	e	3	s	o	g	wf
6/18/2011	Adam Swope / Davey Jones	13:10	14:10	441.0	453.0	4.0	n	se	3	s	o	g	wf
6/18/2011	Adam Swope / Davey Jones	14:10	14:32	453.0	464.0	4.0	s	se	3	s	o	g	wf
6/18/2011	Davey Jones	14:32	16:00	464.0	492.0	4.1	f	se	3	s	o	g	wf
6/18/2011	Adam Swope	16:00	17:00	492.0	507.0	4.1	f	se	3	s	o	g	n
6/18/2011	Adam Swope	17:00	18:00	507.0	510.0	4.2	f	se	3	s	o	g	n
6/18/2011	Adam Swope	18:00	19:00	510.0	514.0	4.4	f	se	3	s	o	g	n

6/18/2011	Adam Swope	19:00	20:00	514.0	520.0	4.4	f	se	3	s	o	g	n
6/18/2011	Adam Swope	20:00	21:11	520.0	523.0	4.1	f	se	3	s	o	g	wb
6/18/2011	Nathan Stewart	21:11	22:00	523.0	522.0	4.1	n	se	3	s	o	m	sb
6/18/2011	Adam Swope / Nathan Stewart	22:00	23:00	522.0	521.0	4.1	n	e	2	s	o	m	sb
6/18/2011	Adam Swope / Nathan Stewart	23:00	23:40	521.0	514.0	4.1	n	se	2	s	o	m	n
6/18/2011	Adam Swope	23:40	0:25	514.0	524.0	4.3	s	nw	1	s	o	m	n
6/19/2011	Adam Swope	10:10	11:10	493.0	505.0	4.1	f	se	1	s	o	p	n
6/19/2011	Adam Swope	11:10	12:10	505.0	511.0	4.4	f	se	1	s	o	g	wf
6/19/2011	Adam Swope	12:10	13:10	511.0	518.0	4.3	f	se	2	s	o	g	wf
6/19/2011	Adam Swope	13:10	14:01	518.0	526.0	4.6	f	e	2	s	o	m	sf
6/19/2011	Adam Swope	14:01	14:01	526.0	526.0	4.7	n	e	2	s	o	g	wf
6/19/2011	Adam Swope / Davey Jones	15:30	16:34	522.0	522.0	4.7	n	se	2	s	o	g	sf
6/19/2011	Adam Swope	16:34	16:59	522.0	525.0	4.5	s	se	2	s	o	g	n
6/19/2011	Adam Swope	16:59	17:59	525.0	517.0	4.5	f	se	2	s	o	g	n
6/19/2011	Adam Swope	17:59	18:59	517.0	504.0	4.5	f	s	3	s	o	g	n
6/19/2011	Adam Swope	18:59	19:59	504.0	473.0	4.6	f	s	3	s	o	g	n
6/19/2011	Alex Codreanu	19:59	20:59	473.0	466.0	4.7	f	se	3	s	o	g	n
6/19/2011	Alex Codreanu	20:59	21:36	466.0	457.0	4.7	f	se	3	s	o	g	n
6/19/2011	Adam Swope	21:36	22:36	457.0	465.0	4.7	n	se	3	s	o	g	wf
6/19/2011	Adam Swope / Nathan Stewart	22:36	23:36	465.0	480.0	4.7	n	e	3	s	o	g	n
6/19/2011	Adam Swope	23:36	23:43	480.0	480.0	4.5	n	ne	3	s	o	g	n
6/19/2011	Adam Swope	23:43	0:03	480.0	479.0	4.5	s	ne	3	s	o	g	n
6/19/2011	Adam Swope	0:03	0:25	479.0	479.0	4.6	f	ne	3	s	o	m	n
6/20/2011	Adam Swope	10:10	11:10	523.0	523.0	4.6	f	se	3	s	o	p	n
6/20/2011	Adam Swope	12:10	13:10	523.0	506.0	4.4	f	se	4	c	o	g	n
6/20/2011	Adam Swope	13:10	14:10	506.0	482.0	4.5	f	se	4	c	o	g	n
6/20/2011	Adam Swope	14:10	15:10	482.0	476.0	4.4	f	se	4	c	o	g	n
6/20/2011	Kathryn Allan	15:10	15:40	476.0	473.0	4.4	f	se	4	c	o	g	n
6/20/2011	Alex Codreanu	15:40	16:40	473.0	468.0	4.5	n	se	4	c	o	g	n
6/20/2011	Adam Swope	16:40	17:40	468.0	477.0	4.6	n	e	4	c	o	g	n
6/20/2011	Adam Swope / Nathan Stewart	17:40	18:40	477.0	478.0	4.4	n	e	3	c	o	g	n
6/20/2011	Adam Swope / Nathan Stewart	18:40	19:21	478.0	480.0	4.4	n	e	3	s	o	g	wb
6/20/2011	Adam Swope	19:21	19:41	480.0	481.0	4.4	s	e	3	s	o	g	wb
6/20/2011	Adam Swope	19:41	20:41	481.0	489.0	4.4	f	e	3	s	o	g	wb
6/20/2011	Glen Pangle	20:41	21:41	489.0	496.0	4.6	f	e	3	s	o	g	n
6/20/2011	Adam Swope	21:41	22:41	496.0	509.0	4.5	f	e	3	s	o	g	wb
6/20/2011	Adam Swope	22:41	23:41	509.0	511.0	4.5	f	ne	3	s	o	g	sb
6/20/2011	Adam Swope	23:41	0:25	511.0	520.0	4.5	f	ne	3	s	o	g	wb
6/21/2011	Adam Swope	11:10	12:10	467.0	479.0	4.4	n	se	3	s	o	g	wb
6/21/2011	Adam Swope / Davey Jones	12:10	13:17	479.0	478.0	4.5	n	se	3	s	o	m	sf
6/21/2011	Adam Swope	13:17	13:38	478.0	478.0	4.5	s	e	3	s	o	m	sf
6/21/2011	Adam Swope	13:38	14:38	478.0	485.0	4.5	f	e	3	s	o	g	sf
6/21/2011	Collin Nichelson	14:38	15:38	485.0	496.0	4.2	f	se	2	s	o	g	wf
6/21/2011	Alex Codreanu	15:38	16:38	496.0	503.0	4.2	f	e	2	s	o	g	n
6/21/2011	Adam Swope	16:38	17:38	503.0	513.0	4.2	f	e	2	s	o	g	n
6/21/2011	Adam Swope	17:38	18:38	513.0	518.0	4.1	f	e	2	s	o	g	n
6/21/2011	Adam Swope	18:38	19:17	518.0	524.0	4.1	f	e	2	s	o	g	n
6/21/2011	Adam Swope	19:17	19:17	524.0	524.0	4.1	n	e	2	s	o	g	n
6/21/2011	Adam Swope / Nathan Stewart	22:03	23:03	510.0	523.0	4.1	n	e	2	s	o	g	sf
6/21/2011	Adam Swope	23:03	23:24	523.0	524.0	4.1	s	e	2	s	o	g	sf
6/21/2011	Adam Swope	23:55	0:25	524.0	521.0	4.1	f	e	2	s	o	g	wf
6/22/2011	Adam Swope	10:10	11:10	486.0	498.0	4.4	f	e	2	s	o	p	n
6/22/2011	Adam Swope	11:10	12:10	498.0	509.0	4.4	f	e	3	s	o	g	wf

6/22/2011	Adam Swope	12:10	13:10	509.0	521.0	4.4	f	e	3	s	o	g	n
6/22/2011	Adam Swope	13:10	13:51	521.0	519.0	4.5	f	se	3	c	o	m	sf
6/22/2011	Adam Swope	13:51	13:51	519.0	519.0	4.0	n	se	3	c	o	m	sf
6/22/2011	Adam Swope / Glen Pangle	16:05	17:05	515.0	514.0	4.1	n	se	3	s	o	g	wf
6/22/2011	Adam Swope	17:05	17:25	514.0	524.0	4.2	s	se	3	s	o	g	n
6/22/2011	Adam Swope	17:25	18:25	524.0	523.0	4.2	f	s	2	s	o	g	n
6/22/2011	Adam Swope	18:25	19:25	523.0	509.0	4.5	f	s	2	s	o	g	n
6/22/2011	Adam Swope	19:25	20:25	509.0	497.0	4.3	f	s	2	s	o	g	wf
6/22/2011	Adam Swope	20:25	21:25	497.0	471.0	4.3	f	s	2	s	o	g	wf
6/22/2011	Ron Cook	21:25	22:25	471.0	456.0	4.5	f	e	2	s	o	g	sf
6/22/2011	Adam Swope	22:25	22:39	456.0	450.0	4.3	f	e	3	s	o	g	sf
6/22/2011	Adam Swope	22:39	23:39	450.0	465.0	4.3	r	se	3	c	o	g	sf
6/22/2011	Adam Swope	23:39	0:30	465.0	475.0	4.5	r	s	3	c	o	g	n
6/23/2011	Adam Swope	10:10	10:39	524.0	523.0	4.7	s	s	3	s	o	m	n
6/23/2011	Adam Swope	10:39	11:39	523.0	505.0	4.5	f	s	3	s	o	g	sb
6/23/2011	Adam Swope	11:39	12:39	505.0	488.0	4.6	f	s	3	s	o	g	sb
6/23/2011	Adam Swope	12:39	13:39	488.0	468.0	4.4	f	s	2	s	o	g	sb
6/23/2011	Adam Swope	13:39	14:08	468.0	462.0	4.7	f	s	2	s	o	g	wb
6/23/2011	Adam Swope	14:08	14:08	462.0	462.0	4.7	n	s	2	s	o	g	wb
6/23/2011	Adam Swope / Glen Pangle	16:29	17:29	471.0	473.0	4.7	n	s	2	s	o	g	n
6/23/2011	Adam Swope	17:29	17:55	473.0	474.0	4.8	s	e	2	s	o	g	n
6/23/2011	Adam Swope	17:55	18:55	474.0	478.0	4.8	f	e	2	s	o	g	n
6/23/2011	Adam Swope	18:55	19:55	478.0	482.0	4.9	f	e	2	s	o	g	n
6/23/2011	Adam Swope	19:55	20:55	482.0	496.0	4.9	f	e	2	s	o	g	wb
6/23/2011	Adam Swope	20:55	21:55	496.0	509.0	4.8	f	e	2	s	o	g	wb
6/23/2011	Adam Swope	21:55	22:55	509.0	522.0	4.8	f	e	2	s	o	g	sb
6/23/2011	Adam Swope	22:55	23:29	522.0	520.0	4.7	f	e	2	s	o	g	sb
6/23/2011	Adam Swope	23:29	0:30	520.0	519.0	4.7	r	e	2	s	o	g	sb
6/24/2011	Adam Swope	10:10	11:10	472.0	479.0	4.6	f	se	2	s	o	m	n
6/24/2011	Adam Swope	11:10	12:10	479.0	482.0	4.4	f	se	3	s	o	g	wf
6/24/2011	Adam Swope	12:10	13:10	482.0	506.0	4.6	f	se	3	s	o	g	sf
6/24/2011	Adam Swope	13:10	14:10	506.0	512.0	4.7	f	se	3	s	o	g	sf
6/24/2011	Kathryn Allan	14:10	15:02	512.0	513.0	4.6	f	se	3	s	o	g	sf
6/24/2011	Kathryn Allan	15:02	15:02	513.0	513.0	4.6	n	se	3	s	o	g	sf
6/24/2011	Adam Swope / Nathan Stewart	16:22	17:22	520.0	521.0	4.1	n	se	3	s	o	g	n
6/24/2011	Adam Swope	17:22	17:44	521.0	524.0	4.6	s	se	3	s	o	g	n
6/24/2011	Adam Swope	17:44	18:44	524.0	522.0	4.6	f	se	3	s	o	g	n
6/24/2011	Adam Swope	18:44	19:44	522.0	503.0	4.6	f	se	3	s	o	g	wf
6/24/2011	Adam Swope	19:44	20:44	503.0	490.0	4.6	f	se	3	s	o	g	wf
6/24/2011	Glen Pangle	20:44	21:44	490.0	471.0	4.6	f	se	3	c	o	g	sf
6/24/2011	Alex Codreanu	21:44	22:23	471.0	448.0	4.6	f	se	3	c	o	g	sf
6/24/2011	Adam Swope	22:23	23:23	448.0	465.0	4.6	r	se	4	c	o	g	sf
6/24/2011	Adam Swope	23:23	0:30	465.0	471.0	4.6	r	se	3	c	o	g	wf
6/25/2011	Adam Swope	10:10	10:47	521.0	523.0	4.6	s	s	3	s	o	m	n
6/25/2011	Adam Swope	10:47	11:47	523.0	508.0	4.8	f	s	2	s	o	g	sb
6/25/2011	Adam Swope	11:47	12:47	508.0	481.0	4.4	f	s	3	s	o	g	sb
6/25/2011	Adam Swope	12:47	13:47	481.0	465.0	4.8	f	s	3	s	o	g	sb
6/25/2011	Adam Swope	13:47	14:47	465.0	449.0	4.8	f	s	3	s	o	g	sb
6/25/2011	Kathryn Allan	14:47	15:15	449.0	451.0	4.7	f	s	3	s	o	g	wb
6/25/2011	Kathryn Allan	15:15	15:15	451.0	451.0	4.7	n	s	3	s	o	g	wb
6/25/2011	Adam Swope / Nathan Stewart	21:08	22:08	495.0	503.0	3.8	n	se	3	c	o	g	wb
6/25/2011	Adam Swope	22:08	22:30	503.0	507.0	3.9	s	se	4	c	o	g	sb
6/25/2011	Adam Swope	22:30	23:30	507.0	518.0	4.6	f	se	3	c	o	g	sb

6/25/2011	Adam Swope	23:30	0:30	518.0	525.0	4.6	f	se	3	c	o	g	n
6/26/2011	Adam Swope	10:10	11:10	472.0	470.0	4.6	r	e	3	s	o	p	n
6/26/2011	Adam Swope	11:10	11:32	470.0	470.0	4.6	s	ne	3	s	o	g	n
6/26/2011	Adam Swope	11:32	11:50	470.0	471.0	4.6	f	ne	3	s	o	g	n
6/26/2011	Adam Swope	11:50	12:50	471.0	478.0	4.6	f	ne	3	s	o	g	n
6/26/2011	Adam Swope	12:50	13:50	478.0	486.0	4.7	f	e	3	s	o	g	n
6/26/2011	Kathryn Allan	13:50	14:50	486.0	503.0	4.8	f	e	3	s	o	g	n
6/26/2011	Kathryn Allan	14:50	15:50	503.0	520.0	4.7	f	e	3	c	o	g	wf
6/26/2011	Adam Swope	15:50	16:50	520.0	525.0	4.6	f	e	3	c	o	g	wf
6/26/2011	Adam Swope	16:50	17:50	525.0	525.0	4.7	f	e	4	c	o	g	wf
6/26/2011	Adam Swope	17:50	17:50	525.0	525.0	4.7	n	e	4	c	o	g	n
6/26/2011	Adam Swope / Nathan Stewart	18:26	19:26	510.0	517.0	4.5	n	se	4	c	o	g	wf
6/26/2011	Adam Swope	19:25	19:45	517.0	515.0	4.6	s	se	4	c	o	g	wf
6/26/2011	Adam Swope	19:45	20:45	515.0	523.0	4.6	f	se	4	c	o	g	wf
6/26/2011	Adam Swope	20:45	21:45	523.0	518.0	4.8	f	se	4	c	o	g	wf
6/26/2011	Nathan Stewart	21:45	22:45	518.0	470.0	4.7	f	se	4	c	o	g	sf
6/26/2011	Adam Swope	22:45	23:45	470.0	455.0	4.6	f	se	4	c	o	g	sf
6/26/2011	Adam Swope	23:45	0:30	455.0	447.0	4.6	f	se	4	c	o	g	wf
6/27/2011	Adam Swope	10:10	10:51	510.0	520.0	4.3	r	se	4	c	o	m	n
6/27/2011	Adam Swope	10:51	11:16	520.0	523.0	4.8	s	se	3	c	o	g	n
6/27/2011	Adam Swope	11:16	12:16	523.0	514.0	4.7	f	se	3	c	o	g	n
6/27/2011	Adam Swope	12:16	13:16	514.0	482.0	4.7	f	se	3	c	o	g	sb
6/27/2011	Kathryn Allan	13:16	14:16	482.0	464.0	4.7	f	se	3	c	o	g	n
6/27/2011	Kathryn Allan	14:16	15:16	464.0	459.0	4.7	f	se	3	c	o	g	wb
6/27/2011	Adam Swope	15:16	15:55	459.0	445.0	4.6	f	se	3	c	o	g	wb
6/27/2011	Adam Swope	15:55	15:55	445.0	445.0	4.6	n	se	3	c	o	g	n
6/27/2011	Adam Swope / Nathan Stewart	17:53	18:53	470.0	468.0	4.6	n	e	3	c	o	g	n
6/27/2011	Adam Swope	18:53	19:13	468.0	471.0	4.6	s	e	3	c	o	g	wb
6/27/2011	Adam Swope	19:13	20:13	471.0	477.0	4.6	f	e	3	c	o	g	wb
6/27/2011	Adam Swope	20:13	21:13	477.0	489.0	4.7	f	e	3	c	o	g	wb
6/27/2011	Adam Swope	21:13	22:13	489.0	506.0	4.6	f	e	3	c	o	g	sb
6/27/2011	Adam Swope	22:13	23:13	506.0	520.0	4.6	f	e	3	c	o	g	sb
6/27/2011	Adam Swope	23:13	0:13	520.0	522.0	4.7	f	e	4	c	o	g	wb
6/27/2011	Adam Swope	0:13	0:30	522.0	521.0	4.7	f	e	4	c	o	g	n
6/28/2011	Adam Swope	10:10	11:10	471.0	465.0	4.4	r	se	3	s	o	p	n
6/28/2011	Adam Swope	11:09	11:36	465.0	467.0	4.4	s	se	4	c	o	g	wf
6/28/2011	Adam Swope	11:36	12:36	467.0	470.0	4.5	f	se	4	c	o	g	wf
6/28/2011	Adam Swope	12:36	13:36	470.0	480.0	4.6	f	se	4	c	o	g	wf
6/28/2011	Adam Swope	13:36	14:36	480.0	489.0	4.7	f	se	4	c	o	g	sf
6/28/2011	Kathryn Allan	14:36	15:36	489.0	509.0	4.7	f	se	4	c	o	g	sf
6/28/2011	Kathryn Allan	15:36	16:36	509.0	520.0	4.7	f	se	4	c	o	g	wf
6/28/2011	Adam Swope	16:36	16:36	520.0	520.0	4.7	f	e	3	c	o	g	n
6/28/2011	Adam Swope / Nathan Stewart	17:37	18:37	504.0	508.0	4.5	n	se	3	s	o	g	wf
6/28/2011	Adam Swope	18:37	18:58	508.0	512.0	4.5	s	se	3	c	o	g	n
6/28/2011	Adam Swope	18:58	19:58	512.0	510.0	4.6	f	se	3	c	o	g	n
6/28/2011	Adam Swope	19:58	20:58	510.0	502.0	4.6	f	se	3	c	o	g	wf
6/28/2011	Adam Swope	20:58	21:58	502.0	470.0	4.6	f	se	3	c	o	g	sf
6/28/2011	Adam Swope	21:58	22:58	470.0	453.0	4.5	f	se	4	c	o	g	sf
6/28/2011	Adam Swope	22:58	23:47	453.0	444.0	4.6	f	se	4	c	o	g	wf
6/28/2011	Adam Swope	23:47	0:30	444.0	453.0	4.6	r	se	4	c	o	g	wf
6/29/2010	Adam Swope	10:10	11:10	521.0	507.0	4.7	f	se	3	c	o	m	n
6/29/2011	Adam Swope	11:10	12:10	507.0	498.0	4.7	f	se	3	c	o	g	n
6/29/2011	Adam Swope	12:10	13:10	498.0	460.0	4.6	f	se	3	c	o	g	n

6/29/2011	Adam Swope	13:10	14:10	460.0	452.0	4.5	f	se	3	c	o	g	n
6/29/2011	Kathryn Allan	14:10	14:58	452.0	449.0	4.8	f	se	3	c	o	g	n
6/29/2011	Kathryn Allan	14:58	14:58	449.0	449.0	4.7	f	se	3	c	o	g	n
6/29/2011	Adam Swope / Glen Pangle	16:26	17:26	483.0	467.0	4.7	n	se	2	s	o	g	n
6/29/2011	Adam Swope	17:26	17:47	467.0	467.0	4.6	s	se	2	s	o	g	n
6/29/2011	Adam Swope	17:47	18:47	467.0	473.0	4.2	f	e	2	s	o	g	n
6/29/2011	Adam Swope	18:47	19:47	473.0	488.0	4.7	f	e	2	s	o	g	n
6/29/2011	Adam Swope	19:47	20:47	488.0	506.0	4.8	f	e	2	s	o	g	n
6/29/2011	Glen Pangle	20:47	21:47	506.0	524.0	4.7	f	e	2	s	o	g	wb
6/29/2011	Adam Swope	21:47	22:43	524.0	521.0	4.7	f	e	2	s	o	g	wb
6/29/2011	Adam Swope	22:43	23:43	521.0	517.0	4.7	r	e	2	s	o	g	n
6/29/2011	Adam Swope	23:43	0:30	517.0	506.0	4.6	r	e	2	s	o	g	n
6/30/2011	Adam Swope	10:10	11:10	478.0	489.0	4.7	f	e	3	s	o	m	n
6/30/2011	Adam Swope	11:10	12:10	489.0	505.0	4.6	f	e	3	s	o	g	wf
6/30/2011	Adam Swope	12:10	13:10	505.0	520.0	4.6	f	e	3	s	o	g	wf
6/30/2011	Adam Swope	13:10	14:18	520.0	522.0	4.6	f	e	3	s	o	g	wf
6/30/2011	Adam Swope / Nathan Stewart	17:35	18:35	491.0	505.0	4.6	n	se	4	c	o	g	wf
6/30/2011	Adam Swope	18:35	18:55	505.0	516.0	4.7	s	se	3	c	o	g	wf
6/30/2011	Adam Swope	18:55	19:55	516.0	523.0	4.5	f	se	3	c	o	g	wf
6/30/2011	Adam Swope	19:55	20:55	523.0	510.0	4.6	f	se	3	c	o	g	wf
6/30/2011	Adam Swope	20:55	21:55	510.0	483.0	4.7	f	se	3	c	o	g	sf
6/30/2011	Adam Swope	21:55	22:55	483.0	467.0	4.7	f	se	3	c	o	g	sf
6/30/2011	Adam Swope	22:55	23:55	467.0	442.0	4.7	f	e	3	c	o	g	sf
6/30/2011	Adam Swope	23:55	23:58	442.0	444.0	4.6	r	e	3	c	o	m	n
7/1/2011	Adam Swope	10:10	10:22	509.0	522.0	4.6	s	se	3	s	o	p	n
7/1/2011	Adam Swope	10:22	11:22	522.0	522.0	4.6	f	se	3	s	o	g	n
7/1/2011	Adam Swope	11:22	12:22	522.0	502.0	4.7	f	se	3	s	o	g	wb
7/1/2011	Adam Swope	12:22	13:22	502.0	468.0	4.7	f	se	3	s	o	g	sb
7/1/2011	Adam Swope	13:22	14:22	468.0	461.0	4.7	f	se	3	s	o	g	wb
7/1/2011	Kathryn Allan	14:22	15:40	461.0	452.0	4.7	f	se	3	s	o	g	wb
7/1/2011	Kathryn Allan	15:40	15:40	452.0	452.0	4.7	n	se	3	s	o	g	n
7/1/2011	Adam Swope / Alex Codreanu	16:50	17:54	457.0	460.0	4.7	n	e	2	s	o	g	n
7/1/2011	Adam Swope	17:54	18:54	460.0	465.0	4.6	s	e	3	s	o	g	n
7/1/2011	Adam Swope	18:54	19:54	465.0	478.0	4.6	f	e	3	s	o	g	n
7/1/2011	Glen Pangle	19:54	20:54	478.0	499.0	4.5	f	e	3	s	o	g	wb
7/1/2011	Bill Davis	20:54	21:54	499.0	523.0	4.6	f	e	3	s	o	g	wb
7/1/2011	Adam Swope	21:54	22:43	523.0	520.0	4.6	f	e	3	s	o	g	sb
7/1/2011	Adam Swope	22:43	23:43	520.0	512.0	4.6	r	e	3	s	o	g	sb
7/1/2011	Adam Swope	23:43	0:30	512.0	497.0	4.5	r	e	4	s	o	g	wb
7/2/2011	Adam Swope	10:10	11:10	465.0	482.0	4.6	f	e	4	c	o	m	n
7/2/2011	Adam Swope	11:10	12:10	482.0	507.0	4.6	f	e	4	c	o	g	wf
7/2/2011	Adam Swope	12:10	13:10	507.0	524.0	4.7	f	e	4	c	o	g	sf
7/2/2011	Adam Swope	13:10	13:58	524.0	523.0	4.7	f	ne	3	c	o	g	sf
7/2/2011	Adam Swope	13:58	13:58	523.0	523.0	4.6	n	e	3	c	o	g	sf
7/2/2011	Adam Swope / Nathan Stewart	16:03	17:03	495.0	512.0	4.4	n	se	3	c	o	g	n
7/2/2011	Adam Swope	17:03	17:25	512.0	522.0	4.5	s	se	3	c	o	g	n
7/2/2011	Adam Swope	17:25	18:25	522.0	513.0	4.5	f	se	3	c	o	g	n
7/2/2011	Adam Swope	18:25	19:25	513.0	499.0	4.8	f	se	3	c	o	g	n
7/2/2011	Glen Pangle	19:25	20:25	499.0	480.0	4.1	f	e	3	c	o	g	wf
7/2/2011	Alex Codreanu	20:25	21:25	480.0	458.0	4.6	f	e	3	c	o	g	wf
7/2/2011	Adam Swope	21:25	22:25	458.0	442.0	4.7	f	e	3	c	o	g	sf
7/2/2011	Adam Swope	22:25	23:03	442.0	444.0	4.6	f	e	3	c	o	g	sf
7/2/2011	Adam Swope	23:03	0:03	444.0	453.0	4.7	r	e	3	c	o	g	wf

7/2/2011	Adam Swope	0:03	0:30	453.0	460.0	4.8	r	e	3	c	o	m	n
7/3/2011	Adam Swope	10:10	11:10	516.0	502.0	4.8	f	e	3	c	o	m	n
7/3/2011	Adam Swope	11:10	12:10	502.0	475.0	4.8	f	e	3	c	o	g	n
7/3/2011	Adam Swope	12:10	13:10	475.0	458.0	4.7	f	e	3	c	o	g	n
7/3/2011	Adam Swope	13:10	14:10	458.0	448.0	4.7	f	e	3	c	o	g	wb
7/3/2011	Kathryn Allan	14:10	15:15	448.0	446.0	4.7	f	e	3	c	o	g	wb
7/3/2011	Richard Dort	15:15	16:04	446.0	436.0	4.4	v	e	3	c	o	g	n
7/3/2011	Richard Dort	16:04	16:04	436.0	436.0	4.4	n	e	3	c	o	g	n
7/3/2011	Adam Swope / Nathan Stewart	16:20	17:20	433.0	427.0	4.5	n	e	3	c	o	g	n
7/3/2011	Adam Swope	17:20	18:20	427.0	431.0	4.5	s	e	4	c	o	g	n
7/3/2011	Adam Swope	18:20	18:32	431.0	436.0	3.8	s	e	5	c	o	g	n
7/3/2011	Adam Swope	18:32	19:32	436.0	453.0	4.5	f	e	4	c	o	g	n
7/3/2011	Adam Swope	19:32	20:32	453.0	473.0	4.6	f	ne	5	c	o	g	n
7/3/2011	Glen Pangle	20:32	21:32	473.0	499.0	4.6	f	ne	4	c	o	g	n
7/3/2011	Bill Davis	21:32	22:39	499.0	483.0	4.6	f	ne	4	c	o	g	n
7/3/2011	Adam Swope	22:39	23:39	483.0	447.0	4.6	r	ne	5	c	o	g	n
7/3/2011	Adam Swope	23:39	0:30	447.0	477.0	4.6	r	ne	3	c	o	g	n
7/4/2011	Adam Swope	10:10	11:08	424.0	433.0	4.6	s	e	4	c	o	g	n
7/4/2011	Adam Swope	11:08	12:08	433.0	449.0	4.6	f	e	5	c	o	g	wf
7/4/2011	Adam Swope	12:08	13:08	449.0	486.0	4.6	f	e	4	c	o	g	wf
7/4/2011	Adam Swope	13:08	14:08	486.0	512.0	4.6	f	e	4	c	o	g	n
7/4/2011	Kathryn Allan	14:08	15:10	512.0	484.0	4.5	f	e	4	c	o	g	n
7/4/2011	Kathryn Allan	15:10	15:10	484.0	484.0	4.5	n	e	4	c	o	g	n
7/4/2011	Adam Swope	16:09	17:09	447.0	489.0	4.5	n	ne	4	c	o	g	n
7/4/2011	Adam Swope	17:09	18:09	489.0	520.0	4.7	s	e	3	c	o	g	n
7/4/2011	Adam Swope	18:09	19:09	520.0	514.0	4.7	s	e	3	c	o	g	n
7/4/2011	Adam Swope	19:09	20:09	514.0	502.0	4.7	f	e	3	c	o	g	n
7/4/2011	Glen Pangle	20:09	21:09	502.0	478.0	4.8	f	e	3	c	o	g	wf
7/4/2011	Bill Davis	21:09	22:09	478.0	454.0	4.7	f	e	3	c	o	g	wf
7/4/2011	Adam Swope	22:09	23:09	454.0	442.0	4.7	f	e	3	c	o	g	wf
7/4/2011	Adam Swope	23:09	0:01	442.0	440.0	4.6	f	e	3	c	o	g	n
7/5/2011	Adam Swope	0:01	0:30	440.0	437.0	4.7	r	e	3	c	o	g	n
7/5/2011	Adam Swope	10:10	10:45	517.0	524.0	3.8	s	e	3	c	o	m	n
7/5/2011	Adam Swope	10:45	10:45	524.0	524.0	3.7	n	e	3	c	o	g	n
7/5/2011	Adam Swope / Collin Nichelson	12:44	13:44	501.0	474.0	4.1	n	e	3	c	o	g	wb
7/5/2011	Adam Swope / Collin Nichelson	13:44	14:03	474.0	471.0	3.8	n	e	3	c	o	g	wb
7/5/2011	Adam Swope	14:03	15:03	471.0	454.0	3.7	s	e	3	c	o	g	wb
7/5/2011	Kathryn Allan	15:03	16:03	454.0	445.0	3.8	v	e	2	s	o	g	n
7/5/2011	Adam Swope	16:03	17:03	445.0	472.0	3.8	v	e	2	s	o	g	n
7/5/2011	Adam Swope	17:04	18:04	472.0	472.0	4.6	n	e	2	s	o	g	n
7/5/2011	Adam Swope / Ian Reed	18:30	19:30	432.0	424.0	4.8	n	e	2	s	o	g	n
7/5/2011	Adam Swope	19:30	20:12	424.0	427.0	4.6	s	e	2	s	o	g	n
7/5/2011	Glen Pangle	20:12	21:12	427.0	461.0	4.6	f	e	2	s	o	g	n
7/5/2011	Bill Davis	21:12	22:12	461.0	488.0	4.6	f	ne	1	s	o	g	n
7/5/2011	Adam Swope	22:12	23:12	488.0	518.0	4.6	f	ne	1	s	o	g	n
7/5/2011	Adam Swope	23:12	0:20	518.0	487.0	4.7	f	se	1	s	o	g	n
7/5/2011	Adam Swope	0:20	0:30	487.0	478.0	4.6	f	se	1	s	o	g	n
7/6/2011	Adam Swope	10:10	11:10	432.0	422.0	4.3	r	se	3	s	o	m	n
7/6/2011	Adam Swope	11:10	12:03	422.0	422.0	4.4	s	se	3	s	o	g	sf
7/6/2011	Adam Swope	12:03	13:03	422.0	450.0	4.7	f	se	3	s	o	g	sf
7/6/2011	Adam Swope	13:03	14:03	450.0	483.0	4.7	f	se	3	s	o	g	sf
7/6/2011	Ari Talbi	14:03	15:03	483.0	484.0	4.8	f	se	3	s	o	g	wf
7/6/2011	Ari Talbi	15:03	16:03	484.0	486.0	4.7	f	se	3	s	o	g	n

7/6/2011	Adam Swope	16:03	16:15	486.0	480.0	4.8	f	se	3	s	o	g	n
7/6/2011	Adam Swope	16:15	16:15	480.0	480.0	4.8	f	se	3	s	o	g	n
7/6/2011	Adam Swope / Jason	17:22	18:22	488.0	489.0	4.7	n	se	3	s	o	g	n
7/6/2011	Adam Swope	18:22	19:22	489.0	520.0	4.7	s	se	3	s	o	g	n
7/6/2011	Adam Swope	19:22	19:30	520.0	524.0	4.6	s	s	2	s	o	g	wf
7/6/2011	Adam Swope	19:30	20:30	524.0	520.0	4.7	f	s	2	s	o	g	wf
7/6/2011	Bill Davis	20:30	21:30	520.0	478.0	4.7	f	sw	3	s	o	g	wf
7/6/2011	Glen Pangle	21:30	22:30	478.0	457.0	4.7	f	sw	4	s	o	g	n
7/6/2011	Adam Swope	22:30	23:30	457.0	442.0	4.7	f	sw	4	s	o	g	n
7/6/2011	Adam Swope	23:30	0:25	442.0	437.0	4.6	f	w	3	s	o	g	n
7/6/2011	Adam Swope	0:25	0:30	437.0	437.0	4.6	r	w	3	s	o	m	n
7/7/2011	Adam Swope	10:15	10:30	493.0	506.0	4.2	r	s	4	s	o	m	n
7/7/2011	Adam Swope	10:30	11:20	506.0	521.0	4.5	s	s	4	s	o	g	n
7/7/2011	Adam Swope	11:20	12:20	521.0	501.0	4.6	f	s	4	s	o	g	n
7/7/2011	Adam Swope	12:20	13:20	501.0	489.0	4.7	f	s	3	s	o	g	n
7/7/2011	Adam Swope	13:20	14:20	489.0	479.0	4.7	f	s	3	s	o	g	n
7/7/2011	Kathryn Allan	14:20	15:20	479.0	444.0	4.7	f	s	3	s	o	g	n
7/7/2011	Jim Nelson	15:20	16:20	444.0	436.0	4.6	f	s	3	s	o	g	n
7/7/2011	Adam Swope	16:20	16:20	436.0	436.0	4.5	f	s	3	s	o	g	n
7/7/2011	Adam Swope	17:19	18:19	435.0	430.0	4.5	n	s	3	c	o	g	n
7/7/2011	Adam Swope / Radoslav Kostepski	18:19	19:23	430.0	427.0	4.6	s	s	4	c	o	g	n
7/7/2011	Adam Swope	19:23	20:23	427.0	454.0	4.6	f	se	4	c	o	g	n
7/7/2011	Glen Pangle	20:23	21:23	454.0	466.0	4.6	f	se	3	c	o	g	n
7/7/2011	Bill Davis	21:23	22:23	466.0	504.0	4.6	f	se	3	s	o	g	wb
7/7/2011	Adam Swope	22:23	23:23	504.0	506.0	4.6	f	se	3	s	o	g	wb
7/7/2011	Adam Swope	23:23	23:53	506.0	483.0	4.6	f	e	4	c	o	g	n
7/7/2011	Adam Swope	23:53	0:30	483.0	480.0	4.6	r	e	3	c	o	g	n
7/8/2011	Adam Swope	10:15	10:35	423.0	427.0	4.3	r	se	4	s	o	m	n
7/8/2011	Adam Swope	10:35	11:32	427.0	430.0	4.3	s	se	4	s	o	g	n
7/8/2011	Adam Swope	11:32	12:32	430.0	449.0	4.6	f	se	3	s	o	g	wf
7/8/2011	Adam Swope	12:32	13:32	449.0	464.0	4.7	f	se	4	c	o	g	sf
7/8/2011	Jason	13:32	14:32	464.0	465.0	4.7	f	se	4	c	o	g	sf
7/8/2011	Jim Nelson	14:32	15:32	465.0	469.0	4.7	f	se	3	c	o	g	wf
7/8/2011	Adam Swope	15:32	16:01	469.0	473.0	4.7	f	se	3	c	o	g	n
7/8/2011	Adam Swope	16:01	16:01	473.0	473.0	4.7	f	se	3	c	o	g	n
7/8/2011	Adam Swope / Radoslav Kostepski	17:19	18:19	444.0	491.0	4.6	n	se	3	c	o	g	n
7/8/2011	Adam Swope	18:19	19:19	491.0	520.0	4.6	s	se	3	c	o	g	n
7/8/2011	Adam Swope	19:19	19:28	520.0	524.0	4.8	s	se	3	c	o	g	wf
7/8/2011	Glen Pangle	19:28	20:28	524.0	504.0	4.8	f	se	3	c	o	g	wf
7/8/2011	Bill Davis	20:28	21:28	504.0	482.0	4.7	f	se	3	c	o	g	sf
7/8/2011	Adam Swope	21:28	22:28	482.0	459.0	4.7	f	se	3	c	o	g	sf
7/8/2011	Adam Swope	22:28	23:28	459.0	442.0	4.8	f	se	3	c	o	g	sf
7/8/2011	Adam Swope	23:28	0:30	442.0	434.0	4.6	f	se	3	c	o	g	wf
7/9/2011	Adam Swope	10:15	10:40	484.0	502.0	4.4	r	se	3	c	o	m	n
7/9/2011	Adam Swope	10:40	11:28	502.0	520.0	4.5	s	se	3	c	o	g	n
7/9/2011	Adam Swope	11:28	12:28	520.0	501.0	4.8	f	se	4	c	o	g	sb
7/9/2011	Adam Swope	12:28	13:28	501.0	487.0	4.7	f	se	4	c	o	g	sb
7/9/2011	Kathryn Allan	13:28	14:28	487.0	479.0	4.8	f	s	3	c	o	g	sb
7/9/2011	Kathryn Allan	14:28	15:28	479.0	449.0	4.7	f	s	3	s	o	g	wb
7/9/2011	Adam Swope	15:28	16:23	449.0	433.0	4.7	f	s	3	s	o	g	n
7/9/2011	Adam Swope	16:23	16:23	433.0	433.0	4.8	n	s	3	s	o	g	n
7/9/2011	Adam Swope	17:23	18:23	428.0	424.0	4.6	n	se	2	s	o	g	n
7/9/2011	Adam Swope / Radoslav Kostepski	18:23	19:23	424.0	427.0	4.5	n	e	3	s	o	g	n

7/9/2011	Adams Swope / Jim Nelson	19:23	20:23	427.0	457.0	4.5	n	e	3	s	o	g	n
7/9/2011	Jeff / Adrian	20:23	21:23	457.0	480.0	4.5	n	e	3	s	o	g	wb
7/9/2011	Adrian / Radoslav Kostepski	21:23	22:23	480.0	505.0	4.5	n	e	3	s	o	g	sb
7/9/2011	Adam Swope / Glen Pangle	22:23	23:30	505.0	505.0	3.8	n	e	3	s	o	g	sb
7/9/2011	Adam Swope	23:30	0:30	505.0	474.0	4.5	r	e	4	s	o	g	wf
7/10/2011	Adam Swope	10:15	10:25	442.0	423.0	4.2	r	e	4	c	o	m	n
7/10/2011	Adam Swope	10:25	11:15	423.0	430.0	4.3	s	e	4	c	o	g	n
7/10/2011	Adam Swope	11:15	12:15	430.0	449.0	4.5	f	e	4	c	o	g	sf
7/10/2011	Adam Swope	12:15	13:15	449.0	490.0	4.6	f	e	5	c	o	g	sf
7/10/2011	Adam Swope	13:15	14:15	490.0	485.0	4.6	f	e	4	c	o	g	sf
7/10/2011	Adam Swope	14:15	15:15	485.0	463.0	4.6	f	e	3	c	o	g	wf
7/10/2011	Jim Nelson	15:15	15:37	463.0	462.0	4.6	f	e	3	c	o	g	wf
7/10/2011	Jim Nelson	15:37	15:37	462.0	462.0	4.6	n	e	3	c	o	g	n
7/10/2011	Adam Swope / Alex Codreanu	17:09	18:09	429.0	490.0	4.7	n	e	3	c	o	g	n
7/10/2011	Adam Swope	18:09	19:09	490.0	519.0	4.7	s	n	1	c	o	g	n
7/10/2011	Adam Swope	19:09	20:09	519.0	517.0	4.7	f	se	3	c	o	g	wf
7/10/2011	Radoslav Kostepski	20:09	21:09	517.0	496.0	4.7	f	se	3	c	o	g	wf
7/10/2011	Bill Davis	21:09	22:09	496.0	455.0	4.7	f	se	3	c	o	g	sf
7/10/2011	Adam Swope	22:09	23:09	455.0	440.0	4.6	f	se	4	c	o	g	sf
7/10/2011	Adam Swope	23:09	0:10	440.0	432.0	4.6	f	s	3	c	o	g	wf
7/10/2011	Adam Swope	0:10	0:30	432.0	433.0	4.7	r	se	3	c	o	g	n
7/11/2011	Adam Swope	10:15	11:15	501.0	519.0	4.8	f	se	4	c	o	m	n
7/11/2011	Adam Swope	11:15	12:15	519.0	501.0	4.8	f	se	3	c	o	g	wb
7/11/2011	Adam Swope	12:15	13:15	501.0	480.0	4.7	f	se	4	c	o	g	sb
7/11/2011	Adam Swope	13:15	14:15	480.0	444.0	4.7	f	se	3	c	o	g	sb
7/11/2011	Carl Reugger	14:15	15:15	444.0	434.0	4.7	f	se	3	c	o	g	sb
7/11/2011	Kathryn Allan	15:15	15:27	434.0	432.0	4.7	f	se	3	c	o	g	wb
7/11/2011	Kathryn Allan	15:27	15:27	432.0	432.0	4.7	f	se	3	c	o	g	wb
7/11/2011	Adam Swope / Larry	16:30	17:30	425.0	420.0	4.7	n	se	4	c	o	g	n
7/11/2011	Adam Swope	17:30	18:30	420.0	430.0	4.6	s	e	4	c	o	g	n
7/11/2011	Adam Swope	18:30	19:30	430.0	448.0	4.7	f	e	4	c	o	g	n
7/11/2011	Jeff	19:30	20:30	448.0	490.0	4.7	f	e	4	c	o	g	wb
7/11/2011	Glen Pangle	20:30	21:30	490.0	501.0	4.7	f	e	4	c	o	g	sb
7/11/2011	Adam Swope	21:30	22:30	501.0	497.0	4.7	f	e	4	c	o	g	sb
7/11/2011	Adam Swope	22:30	22:47	497.0	479.0	4.7	f	e	4	c	o	g	sb
7/11/2011	Adam Swope	22:47	23:47	479.0	420.0	4.7	r	e	4	c	o	g	sb
7/11/2011	Adam Swope	23:47	0:30	420.0	431.0	4.5	r	e	3	c	o	g	sf
7/12/2011	Adam Swope	10:15	11:15	431.0	448.0	4.6	f	e	3	c	o	g	n
7/12/2011	Adam Swope	11:15	12:15	448.0	494.0	4.6	f	e	3	c	o	g	n
7/12/2011	Adam Swope	12:15	13:15	494.0	514.0	4.7	f	e	3	c	o	g	wf
7/12/2011	Adam Swope	13:15	14:15	514.0	491.0	4.7	f	se	3	c	o	g	wf
7/12/2011	Adam Swope	14:15	14:33	491.0	477.0	4.7	f	se	2	c	o	g	wf
7/12/2011	Adam Swope	14:33	14:33	477.0	477.0	4.7	f	e	3	c	o	g	wf
7/12/2011	Adam Swope / Larry	16:22	17:22	431.0	489.0	4.7	n	se	2	c	o	g	n
7/12/2011	Adam Swope	17:22	18:06	489.0	520.0	4.7	s	se	2	c	o	g	n
7/12/2011	Adam Swope	18:06	19:06	520.0	499.0	4.7	f	se	2	c	o	g	n
7/12/2011	Adam Swope	19:06	20:06	499.0	487.0	4.7	f	se	2	s	o	g	wf
7/12/2011	Larry	20:06	21:06	487.0	480.0	4.6	f	se	2	s	o	g	wf
7/12/2011	Alex Cordenau	21:06	22:06	480.0	454.0	4.6	f	se	2	s	o	g	sf
7/12/2011	Adam Swope	22:06	22:51	454.0	433.0	4.6	f	se	2	s	o	g	sf
7/12/2011	Adam Swope	22:51	23:51	433.0	425.0	4.7	r	se	2	s	o	g	sf
7/12/2011	Adam Swope	23:51	0:30	425.0	441.0	4.5	r	e	2	s	o	g	wb
7/13/2011	Adam Swope	10:15	11:15	525.0	502.0	4.7	f	se	3	s	o	g	n

7/13/2011	Adam Swope	11:15	12:15	502.0	459.0	4.8	f	se	3	s	o	g	sb
7/13/2011	Adam Swope	12:15	13:15	459.0	439.0	4.8	f	se	3	s	o	g	sb
7/13/2011	Adam Swope	13:15	14:15	439.0	432.0	4.7	f	se	2	s	o	g	sb
7/13/2011	Adam Swope	14:15	14:24	432.0	431.0	4.6	f	se	2	s	o	g	sb
7/13/2011	Adam Swope / Radoslav Kostepski	16:06	17:06	420.0	423.0	4.3	n	se	3	s	o	g	n
7/13/2011	Adam Swope	17:06	18:06	423.0	434.0	4.0	s	e	2	s	o	g	n
7/13/2011	Adam Swope	18:06	19:06	434.0	450.0	4.7	f	e	2	s	o	g	n
7/13/2011	Adam Swope	19:06	20:06	450.0	502.0	4.1	f	e	2	s	o	g	n
7/13/2011	Jeff	20:06	21:06	502.0	496.0	4.7	f	e	2	s	o	g	wb
7/13/2011	Glen Pangle	21:06	22:02	496.0	475.0	4.6	f	e	2	s	o	g	sb
7/13/2011	Adam Swope	22:02	23:02	475.0	415.0	4.7	f	e	2	s	o	g	sb
7/13/2011	Adam Swope	23:02	0:02	415.0	447.0	4.0	r	e	2	s	o	g	sf
7/13/2011	Adam Swope	0:02	0:30	447.0	479.0	4.7	r	n	1	s	o	g	n
7/14/2011	Adam Swope	10:15	11:15	441.0	481.0	4.7	f	e	2	s	o	m	n
7/14/2011	Adam Swope	11:15	12:15	481.0	501.0	4.7	f	e	2	s	o	g	sf
7/14/2011	Adam Swope	12:15	13:15	501.0	509.0	4.7	f	e	2	s	o	g	sf
7/14/2011	Adam Swope	13:15	13:53	509.0	467.0	4.6	f	e	2	s	o	g	sf
7/14/2011	Adam Swope	13:53	13:53	467.0	467.0	4.7	n	e	2	s	o	g	sf
7/14/2011	Adam Swope	16:00	17:00	460.0	502.0	3.9	n	sw	2	s	o	g	n
7/14/2011	Adam Swope	17:00	18:00	502.0	524.0	4.0	n	sw	1	s	o	g	n
7/14/2011	Adam Swope	18:00	19:00	524.0	502.0	4.2	n	sw	1	s	o	g	n
7/14/2011	Adam Swope	19:00	20:00	502.0	479.0	4.1	n	w	1	s	o	g	n
7/14/2011	Adam Swope	20:00	20:00	479.0	439.0	4.2	n	w	1	s	o	g	wf
7/14/2011	Adam Swope / Glen Pangle	22:00	21:00	439.0	432.0	4.5	n	sw	2	s	o	g	sf
7/14/2011	Adam Swope / Glen Pangle	21:00	21:34	432.0	427.0	4.7	n	sw	2	s	o	g	sf
7/14/2011	Adam Swope	21:34	0:30	427.0	422.0	4.8	r	e	3	s	o	g	sb
7/15/2011	Adam Swope	16:00	17:00	530.0	529.0	3.8	n	s	1	s	o	g	n
7/15/2011	Adam Swope	17:00	18:00	529.0	524.0	4.7	n	s	2	s	o	g	n
7/15/2011	Adam Swope	18:00	19:00	524.0	506.0	3.9	n	s	2	s	o	g	n
7/15/2011	Adam Swope	19:00	20:00	506.0	498.0	4.1	n	se	3	s	o	g	n
7/15/2011	Adam Swope	20:00	21:00	498.0	463.0	4.1	n	se	2	s	o	g	wf
7/15/2011	Adam Swope	21:00	21:22	463.0	482.0	4.0	n	se	2	s	o	g	sf
7/15/2011	Adam Swope / Glen Pangle	21:22	22:22	482.0	518.0	4.1	s	se	2	s	o	g	sf
7/15/2011	Adam Swope / Glen Pangle	22:22	22:30	518.0	523.0	4.6	s	se	2	s	o	g	sf
7/15/2011	Adam Swope	22:30	23:30	523.0	500.0	4.6	f	se	2	s	o	g	sf
7/15/2011	Adam Swope	23:30	0:30	500.0	489.0	4.5	f	se	2	s	o	g	sf
7/16/2011	Adam Swope	10:15	11:08	509.0	475.0	4.8	f	s	2	s	o	g	n
7/16/2011	Adam Swope	11:08	12:08	475.0	437.0	4.1	n	s	2	s	o	g	sf
7/16/2011	Adam Swope	12:08	13:08	437.0	417.0	4.0	n	sw	2	s	o	g	sf
7/16/2011	Adam Swope	13:08	14:00	417.0	390.0	3.8	n	sw	2	s	o	g	sf
7/16/2011	Adam Swope	14:00	14:00	390.0	390.0	3.7	n	sw	2	s	o	g	sb
7/16/2011	Adam Swope / Ari Talbi	17:39	18:39	488.0	469.0	4.6	n	ne	1	g	o	g	n
7/16/2011	Adam Swope / Alex Codreanu	18:39	18:57	469.0	479.0	4.0	n	s	1	g	o	g	n
7/16/2011	Adam Swope	18:57	19:57	479.0	517.0	4.4	s	s	1	g	o	g	n
7/16/2011	Adam Swope	19:57	20:03	517.0	517.0	4.8	s	s	1	g	o	g	n
7/16/2011	Adam Swope	20:03	21:03	517.0	490.0	4.8	f	s	1	g	o	g	n
7/16/2011	Adam Swope	21:03	22:03	490.0	487.0	4.8	f	s	1	g	o	g	sf
7/16/2011	Jeff	22:03	23:03	487.0	454.0	4.8	f	s	1	g	o	g	sf
7/16/2011	Adam Swope	23:03	0:03	454.0	438.0	4.9	f	s	1	g	o	g	sf
7/17/2011	Adam Swope	0:03	0:30	438.0	436.0	4.8	f	s	2	s	o	g	n
7/17/2011	Adam Swope	10:15	10:35	457.0	481.0	4.7	n	s	3	s	o	g	n
7/17/2011	Adam Swope	10:35	11:27	481.0	528.0	3.7	s	s	3	s	o	g	n
7/17/2011	Adam Swope	11:27	12:17	528.0	502.0	4.8	f	s	3	s	o	g	sb

7/17/2011	Adam Swope	12:27	13:27	502.0	485.0	4.8	f	sw	3	s	o	g	sb
7/17/2011	Adam Swope	13:27	14:27	485.0	449.0	4.7	f	sw	2	s	o	g	wb
7/17/2011	Carl Reugger	14:27	15:27	449.0	434.0	4.8	f	w	1	s	o	g	n
7/17/2011	Glen Pangle	15:27	16:22	434.0	431.0	4.8	f	w	1	g	o	g	n
7/17/2011	Adam Swope	16:22	17:22	431.0	425.0	4.8	n	w	1	g	o	g	n
7/17/2011	Adam Swope / Radoslav Kostepski	17:22	18:22	425.0	422.0	4.7	n	se	1	g	o	g	n
7/17/2011	Adam Swope / Radoslav Kostepski	18:22	18:30	422.0	425.0	4.7	n	se	1	g	o	g	n
7/17/2011	Adam Swope	18:30	19:26	425.0	428.0	4.7	s	se	1	g	o	g	n
7/17/2011	Adam Swope	19:26	20:26	428.0	433.0	4.7	f	ne	1	g	o	g	n
7/17/2011	Jeff	20:26	21:26	433.0	457.0	4.6	f	ne	2	g	o	g	wf
7/17/2011	Jeff	21:26	22:26	457.0	511.0	4.6	f	ne	2	g	o	g	wf
7/17/2011	Adam Swope	22:26	23:26	511.0	484.0	3.7	f	ne	3	s	o	g	wf
7/17/2011	Adam Swope	23:26	23:35	484.0	483.0	4.7	f	ne	2	s	o	g	wf
7/17/2011	Adam Swope	23:35	0:30	483.0	389.0	4.7	r	ne	2	s	o	g	wf
7/18/2011	Adam Swope	10:15	11:00	422.0	428.0	4.8	s	e	1	g	o	g	n
7/18/2011	Adam Swope	11:00	12:00	428.0	447.0	4.7	f	e	1	g	o	g	wf
7/18/2011	Adam Swope	12:00	13:00	447.0	501.0	4.8	f	e	1	g	o	g	wf
7/18/2011	Adam Swope	13:00	14:00	501.0	511.0	4.9	f	se	2	s	o	g	wf
7/18/2011	Carl Reugger	14:00	15:11	511.0	455.0	4.7	f	se	2	s	o	g	wf
7/18/2011	Carl Reugger	15:11	16:11	455.0	495.0	4.7	f	se	2	s	o	g	n
7/18/2011	Adam Swope / Larry	16:11	17:11	495.0	443.0	4.7	n	w	2	s	o	g	n
7/18/2011	Adam Swope / Glen Pangle	17:11	18:05	443.0	502.0	4.6	n	sw	2	s	o	g	n
7/18/2011	Adam Swope	18:05	18:37	502.0	523.0	4.4	s	sw	2	s	o	g	n
7/18/2011	Adam Swope	18:37	19:37	523.0	503.0	4.0	f	sw	2	s	o	g	n
7/18/2011	Adam Swope	19:37	20:37	503.0	490.0	4.0	f	sw	2	s	o	g	n
7/18/2011	Jim Nelson	20:37	21:37	490.0	454.0	4.6	f	s	2	s	o	g	wf
7/18/2011	Alex Cordenau	21:37	22:37	454.0	438.0	4.7	f	s	2	s	o	g	sf
7/18/2011	Adam Swope	22:37	23:37	438.0	429.0	4.7	f	n	1	s	o	g	sf
7/18/2011	Adam Swope	23:37	23:48	429.0	432.0	4.7	f	n	1	s	o	g	wf
7/18/2011	Adam Swope	23:48	0:30	432.0	425.0	4.7	n	n	1	s	o	g	wf
7/19/2011	Adam Swope	10:15	11:15	520.0	500.0	4.6	f	w	2	s	o	g	n
7/19/2011	Adam Swope	11:15	12:15	500.0	477.0	4.8	f	w	2	s	o	g	n
7/19/2011	Adam Swope	12:15	13:15	477.0	453.0	4.7	f	sw	2	s	o	g	sb
7/19/2011	Adam Swope	13:15	14:15	453.0	449.0	4.8	f	sw	2	s	o	g	wb
7/19/2011	Carl Reugger	14:15	15:03	449.0	432.0	4.7	f	sw	2	s	o	g	wb
7/19/2011	Carl Reugger	15:03	16:00	432.0	423.0	4.7	f	s	1	g	o	g	n
7/19/2011	Adam Swope	16:00	17:00	423.0	422.0	4.7	n	se	1	g	o	g	n
7/19/2011	Adam Swope	17:00	18:00	422.0	434.0	4.1	n	ne	1	g	o	g	n
7/19/2011	Adam Swope / Jeff	18:00	19:04	434.0	453.0	4.1	n	ne	1	g	o	g	n
7/19/2011	Adam Swope	19:04	19:57	453.0	455.0	4.0	s	ne	2	g	o	g	n
7/19/2011	Adam Swope	19:57	20:15	455.0	454.0	4.1	f	ne	2	s	o	g	wf
7/19/2011	Jeff	20:15	21:15	454.0	453.0	4.5	r	ne	2	s	o	g	sf
7/19/2011	Jeff	21:15	22:15	453.0	440.0	4.7	r	ne	3	s	o	g	sf
7/19/2011	Adam Swope	22:15	23:15	440.0	374.0	4.6	r	n	3	s	o	g	sf
7/19/2011	Adam Swope	23:15	0:15	374.0	471.0	4.3	s	n	1	s	o	g	n
7/19/2011	Adam Swope	0:15	0:30	471.0	482.0	4.3	s	n	1	s	o	g	n
7/20/2011	Adam Swope	10:15	11:15	448.0	504.0	4.7	f	ne	1	g	o	g	n
7/20/2011	Adam Swope	11:15	12:15	504.0	511.0	5.0	f	ne	1	g	o	g	sf
7/20/2011	Adam Swope	12:15	13:08	511.0	472.0	4.7	f	ne	1	g	o	g	sf
7/20/2011	Adam Swope	13:08	14:00	472.0	396.0	4.8	n	ne	1	g	o	g	sf
7/20/2011	Adam Swope	14:00	14:30	396.0	380.0	4.4	n	ne	1	g	o	g	n
7/20/2011	Adam Swope / Jersey	14:30	15:33	380.0	467.0	4.4	n	nw	0	g	o	g	n
7/20/2011	Daryle	15:33	16:26	467.0	519.0	4.4	s	nw	0	g	o	g	n

7/20/2011	Adam Swope	16:26	17:26	519.0	500.0	4.5	f	sw	0	g	o	g	n
7/20/2011	Adam Swope	17:26	18:26	500.0	472.0	4.8	f	sw	0	g	o	g	n
7/20/2011	Adam Swope	18:26	19:26	472.0	450.0	4.8	f	sw	0	g	o	g	n
7/20/2011	Adam Swope	19:26	20:26	450.0	445.0	4.7	f	sw	1	s	o	g	n
7/20/2011	Josh	20:26	21:02	445.0	422.0	4.7	f	sw	1	s	o	g	wf
7/20/2011	Josh	21:02	22:02	422.0	420.0	4.7	r	ne	1	s	o	g	sf
7/20/2011	Adam Swope	22:02	23:02	420.0	421.0	4.8	r	ne	1	s	o	g	sb
7/20/2011	Adam Swope	23:02	0:04	421.0	427.0	4.5	s	ne	2	s	o	g	sb
7/20/2011	Adam Swope	0:04	0:30	427.0	433.0	4.5	f	ne	3	s	o	g	n
7/21/2011	Adam Swope	10:15	11:15	453.0	439.0	4.7	f	s	2	s	o	m	n
7/21/2011	Adam Swope	11:15	11:21	439.0	428.0	4.6	f	se	2	s	o	g	n
7/21/2011	Adam Swope	11:21	12:21	428.0	420.0	4.5	n	s	4	s	o	g	n
7/21/2011	Adam Swope	12:21	13:21	420.0	420.0	4.7	n	s	1	s	o	g	n
7/21/2011	Adam Swope / Marious	13:21	14:21	420.0	419.0	4.7	n	se	2	s	o	g	n
7/21/2011	Adam Swope / Marious	14:21	14:27	419.0	419.0	4.6	n	e	3	s	o	g	n
7/21/2011	Jeff	14:27	11:31	419.0	427.0	4.6	s	e	3	s	o	g	n
7/21/2011	Jeff	11:31	12:31	427.0	447.0	4.7	f	e	2	s	o	g	n
7/21/2011	Adam Swope	12:31	13:31	447.0	503.0	4.7	f	e	2	s	o	g	n
7/21/2011	Adam Swope	13:31	14:31	503.0	508.0	4.4	f	e	2	s	o	g	n
7/21/2011	Adam Swope	14:31	15:31	508.0	484.0	4.5	f	ne	2	s	o	g	n
7/21/2011	Adam Swope	15:31	15:44	484.0	464.0	4.4	f	ne	2	s	o	g	n
7/21/2011	Adam Swope	15:44	15:44	464.0	464.0	4.4	n	ne	2	s	o	g	n
7/21/2011	Adam Swope / Sarah	21:05	22:05	376.0	471.0	4.7	n	n	2	s	o	g	sf
7/21/2011	Adam Swope	22:05	22:53	471.0	522.0	4.7	s	e	1	s	o	g	sf
7/21/2011	Adam Swope	22:53	23:53	522.0	502.0	4.8	f	s	1	s	o	g	sf
7/21/2011	Adam Swope	23:53	0:30	502.0	494.0	4.7	f	s	1	s	o	g	wf
7/22/2011	Adam Swope	10:15	10:30	480.0	455.0	4.8	f	se	2	s	o	g	n
7/22/2011	Adam Swope / Trent	10:30	11:30	455.0	341.0	4.7	n	se	2	s	o	g	n
7/22/2011	Adam Swope / Trent	11:30	12:02	341.0	310.0	4.1	n	se	3	s	o	g	sf
7/22/2011	Adam Swope	12:02	13:02	310.0	456.0	4.1	s	se	3	s	o	g	sf
7/22/2011	Adam Swope	13:02	13:10	456.0	456.0	4.7	s	se	3	s	o	g	sb
7/22/2011	Adam Swope	13:10	14:10	456.0	493.0	4.7	f	se	2	s	o	g	sb
7/22/2011	Camron	14:10	15:10	493.0	440.0	4.7	f	s	2	s	o	g	n
7/22/2011	Camron	15:10	16:10	440.0	436.0	4.7	f	s	1	s	o	g	n
7/22/2011	Adam Swope	16:10	16:52	436.0	420.0	4.7	f	s	1	s	o	g	n
7/22/2011	Adam Swope	16:52	17:52	420.0	415.0	4.6	n	s	1	s	o	g	n
7/22/2011	Adam Swope / Jersey	17:52	18:52	415.0	417.0	4.7	n	s	2	s	o	g	n
7/22/2011	Adam Swope / Jersey	18:52	19:05	417.0	419.0	4.8	n	ne	2	s	o	g	n
7/22/2011	Adam Swope	19:05	20:05	419.0	424.0	4.7	s	ne	3	s	o	g	n
7/22/2011	Josh	20:05	20:16	424.0	430.0	4.5	s	ne	3	s	o	g	wb
7/22/2011	Josh	20:16	21:16	430.0	454.0	4.6	s	ne	3	s	o	g	wb
7/22/2011	Josh	21:16	22:16	454.0	503.0	4.6	s	ne	4	c	o	g	sb
7/22/2011	Adam Swope	22:16	23:16	503.0	510.0	4.6	f	ne	5	c	o	g	sb
7/22/2011	Adam Swope	23:16	0:16	510.0	482.0	4.7	f	e	5	c	o	g	wb
7/22/2011	Adam Swope	0:16	0:30	482.0	461.0	4.6	f	ne	4	c	o	g	n
7/23/2011	Adam Swope	10:15	11:15	429.0	450.0	4.7	f	e	3	c	o	m	n
7/23/2011	Adam Swope	11:15	12:15	450.0	496.0	4.1	f	e	3	c	o	g	wf
7/23/2011	Adam Swope	12:15	12:32	496.0	505.0	4.1	f	e	3	c	o	g	sf
7/23/2011	Adam Swope	12:32	13:32	505.0	508.0	4.0	n	e	3	c	o	g	sf
7/23/2011	Adam Swope	13:32	14:00	508.0	513.0	3.9	n	e	3	c	o	g	sf
7/24/2011	Adam Swope	10:15	10:42	433.0	444.0	4.8	s	e	4	c	o	m	n
7/24/2011	Adam Swope	10:42	11:42	444.0	491.0	4.8	f	e	4	c	o	g	n
7/24/2011	Adam Swope	11:42	12:42	491.0	501.0	4.7	f	e	4	c	o	g	sf
7/24/2011	Adam Swope	12:42	13:42	501.0	487.0	4.7	f	e	5	c	o	g	sf

7/24/2011	Adam Swope	13:42	14:25	487.0	421.0	4.7	f	e	4	c	o	g	sf
7/24/2011	Jeff / Simon	14:25	15:25	421.0	296.0	4.3	n	e	5	c	o	g	sf
7/24/2011	Adam Swope	15:25	16:25	296.0	327.0	4.9	n	e	3	c	o	g	n
7/24/2011	Adam Swope	16:25	17:25	327.0	386.0	4.9	n	e	4	c	o	g	n
7/24/2011	Adam Swope	17:25	18:25	386.0	455.0	4.7	n	e	4	c	o	g	n
7/24/2011	Adam Swope	18:25	19:25	455.0	492.0	4.3	n	e	3	c	o	g	n
7/24/2011	Adam Swope / Josh	19:25	20:25	492.0	502.0	4.6	n	e	3	c	o	g	n
7/24/2011	Adam Swope / Sarah Fisher	20:25	21:18	502.0	435.0	4.2	n	e	3	c	o	g	wf
7/24/2011	Sarah Fisher	21:18	21:29	435.0	422.0	4.6	s	e	3	c	o	g	sf
7/24/2011	Adam Swope / Larry	21:39	22:39	422.0	415.0	4.7	n	e	3	c	o	g	sf
7/24/2011	Adam Swope / Larry	22:39	23:30	415.0	415.0	4.7	n	e	3	c	o	g	sf
7/24/2011	Adam Swope	23:30	0:30	415.0	417.0	4.5	r	ne	2	c	o	g	sf
7/25/2011	Adam Swope	10:15	11:15	474.0	434.0	4.8	f	se	2	c	o	m	n
7/25/2011	Adam Swope	11:15	11:50	434.0	440.0	4.8	f	se	2	c	o	g	n
7/25/2011	Adam Swope	11:50	12:50	440.0	413.0	4.8	n	se	2	c	o	g	wb
7/25/2011	Adam Swope / Trent Lundford	12:50	13:50	413.0	416.0	4.8	n	se	1	s	o	g	wb
7/25/2011	Adam Swope / Trent Lunsford	13:50	14:05	416.0	418.0	4.7	n	e	4	c	o	g	wb
7/25/2011	Kari Nolan	14:05	15:07	418.0	430.0	4.7	s	e	4	c	o	g	n
7/25/2011	Jeff Harrison	15:07	16:07	430.0	449.0	4.7	f	e	3	c	o	g	n
7/25/2011	Adam Swope	16:07	17:07	449.0	504.0	4.7	f	e	3	c	o	g	n
7/25/2011	Adam Swope	17:07	18:07	504.0	510.0	4.4	f	e	4	c	o	g	n
7/25/2011	Adam Swope	18:07	19:07	510.0	471.0	4.7	f	e	3	c	o	g	n
7/25/2011	Adam Swope	19:07	19:31	471.0	408.0	4.7	f	e	5	c	o	g	n
7/25/2011	Josh Ross	19:31	20:31	408.0	395.0	4.4	f	e	5	c	o	g	n
7/25/2011	Jeff Harrison	20:31	21:31	395.0	397.0	4.4	f	e	5	c	o	g	n
7/25/2011	Adam Swope	21:31	22:24	397.0	463.0	4.4	f	se	5	c	o	g	n
7/25/2011	Adam Swope	22:24	23:24	463.0	490.0	4.6	f	se	5	c	m	g	n
7/25/2011	Adam Swope	23:24	0:30	490.0	475.0	4.6	f	se	5	c	m	g	n
7/26/2011	Adam Swope / Trent Lunsford	10:20	11:25	265.0	394.0	4.8	n	se	6	c	m	m	n
7/26/2011	Adam Swope / Trent Lunsford	11:25	11:44	394.0	417.0	4.6	n	se	3	c	o	g	sb
7/26/2011	Adam Swope	11:44	12:18	417.0	476.0	4.6	s	se	4	c	o	g	sb
7/26/2011	Adam Swope	12:18	13:18	476.0	497.0	4.6	f	se	4	c	o	g	sb
7/26/2011	Adam Swope	13:18	14:18	497.0	456.0	4.7	f	se	4	c	o	g	sb
7/26/2011	Adam Swope	14:18	15:18	456.0	434.0	4.7	f	se	4	c	o	g	wb
7/26/2011	Adam Swope	15:18	15:34	434.0	425.0	4.7	f	se	4	c	o	g	n
7/26/2011	Adam Swope	15:34	16:34	425.0	412.0	4.7	n	se	4	c	o	g	n
7/26/2011	Adam Swope / Larry Hastings	16:34	17:39	412.0	416.0	4.6	n	se	3	c	o	g	n
7/26/2011	Adam Swope	17:39	18:52	416.0	426.0	4.6	s	se	3	c	o	g	n
7/26/2011	Adam Swope	18:52	19:52	426.0	451.0	4.6	f	e	4	c	o	g	wb
7/26/2011	Adrian Tagacay	19:52	20:52	451.0	466.0	4.5	f	e	4	c	o	g	wb
7/26/2011	Adrian Tagacay	20:52	21:52	466.0	507.0	4.5	f	e	4	c	o	g	n
7/26/2011	Adam Swope	21:52	22:52	507.0	455.0	4.5	f	e	4	c	o	g	n
7/26/2011	Adam Swope	22:52	23:23	455.0	461.0	4.5	f	e	3	c	o	g	n
7/26/2011	Adam Swope	23:23	0:25	461.0	270.0	4.5	r	e	3	c	o	g	n
7/27/2011	Adam Swope	10:20	11:20	490.0	487.0	4.7	f	se	4	c	o	m	n
7/27/2011	Adam Swope	11:20	12:20	487.0	486.0	4.7	f	se	4	c	o	m	wf
7/27/2011	Adam Swope	12:20	13:10	486.0	407.0	4.7	f	se	5	c	o	g	wf
7/27/2011	Adam Swope / Jerzy Azur	13:10	14:10	407.0	277.0	4.4	n	se	5	c	o	g	sf
7/27/2011	Jerzy Azur / Camron	14:10	14:55	277.0	322.0	4.6	n	se	5	c	o	g	sf
7/27/2011	Camron	14:55	15:50	322.0	463.0	4.6	f	se	3	c	o	g	n
7/27/2011	Adam Swope	15:50	16:50	463.0	490.0	4.6	f	se	3	c	o	g	n
7/27/2011	Adam Swope	16:50	17:50	490.0	455.0	4.5	f	se	3	c	o	g	n
7/27/2011	Adam Swope	17:50	18:50	455.0	432.0	4.6	f	se	3	c	o	g	n

7/27/2011	Adam Swope	18:50	19:10	432.0	421.0	4.8	f	se	3	c	o	g	wf
7/27/2011	Adam Swope	19:10	20:10	421.0	412.0	4.8	n	se	3	c	o	g	wf
7/27/2011	Josh Ross / Larry Hastings	20:10	21:21	412.0	420.0	4.8	n	se	3	c	o	g	wf
7/27/2011	Josh Ross / Larry Hastings	21:21	22:21	420.0	428.0	4.5	s	se	3	c	o	g	sf
7/27/2011	Adam Swope	22:21	23:21	428.0	452.0	4.6	f	e	4	c	o	g	sb
7/27/2011	Adam Swope	23:21	0:25	452.0	504.0	4.5	f	e	4	c	o	g	wb
7/28/2011	Adam Swope	10:20	10:40	417.0	418.0	4.6	n	se	4	c	o	m	n
7/28/2011	Adam Swope	10:40	11:40	418.0	430.0	4.5	s	se	4	c	o	g	n
7/28/2011	Adam Swope	11:40	12:40	430.0	452.0	4.8	f	e	4	c	o	g	sf
7/28/2011	Adam Swope	12:40	13:40	452.0	504.0	4.6	f	e	5	c	o	g	sf
7/28/2011	Adam Swope	13:40	14:40	504.0	499.0	4.6	f	e	5	c	o	g	sf
7/28/2011	Kari Nolan	14:40	15:40	499.0	442.0	4.6	f	e	5	c	o	g	wf
7/28/2011	Jeff Harrison	15:40	16:02	442.0	405.0	4.6	f	e	5	c	o	g	wf
7/28/2011	Adam Swope	16:02	17:02	405.0	247.0	4.6	n	e	5	c	o	g	wf
7/28/2011	Adam Swope / Larry Hastings	17:02	17:38	247.0	320.0	4.7	n	e	5	c	o	g	n
7/28/2011	Adam Swope	17:38	18:39	320.0	457.0	4.7	s	e	3	c	o	g	n
7/28/2011	Adam Swope	18:39	19:39	457.0	490.0	4.6	f	se	3	c	o	g	n
7/28/2011	Adam Swope	19:39	20:39	490.0	461.0	4.7	f	se	3	c	o	g	wf
7/28/2011	Josh Ross	20:39	21:46	461.0	417.0	4.7	f	e	3	c	o	g	sf
7/28/2011	Sarah Fisher	21:46	23:46	417.0	412.0	4.7	r	e	3	c	o	g	sf
7/28/2011	Adam Swope	23:46	23:50	412.0	419.0	4.7	r	e	3	c	o	g	sf
7/28/2011	Adam Swope	23:50	0:25	419.0	420.0	4.5	s	ne	4	c	o	g	n
7/29/2011	Adam Swope	10:20	11:05	449.0	425.0	4.7	f	se	3	c	o	m	n
7/29/2011	Adam Swope	11:05	12:05	425.0	413.0	4.7	n	se	2	c	o	g	n
7/29/2011	Adam Swope / Camron	12:05	13:05	413.0	420.0	4.7	n	e	3	c	o	g	sb
7/29/2011	Adam Swope	13:05	13:17	420.0	419.0	4.5	n	e	3	c	o	g	sb
7/29/2011	Adam Swope	13:17	14:21	419.0	428.0	4.5	s	e	3	c	o	g	sf
7/29/2011	Kari Nolan	14:21	15:21	428.0	490.0	4.6	f	e	3	c	o	g	sf
7/29/2011	Jeff Harrison	15:21	16:21	490.0	503.0	4.5	f	e	3	c	o	g	n
7/29/2011	Adam Swope	16:21	17:21	503.0	501.0	4.6	f	e	3	c	o	g	n
7/29/2011	Adam Swope	17:21	18:21	501.0	480.0	4.6	f	e	5	c	o	g	n
7/29/2011	Adam Swope	18:21	19:04	480.0	393.0	4.7	f	e	5	c	o	g	n
7/29/2011	Adam Swope / Larry Hastings	19:04	20:38	393.0	466.0	4.6	n	e	5	c	o	g	wb
7/29/2011	Simon Watts / Larry Hastings	20:38	21:38	466.0	475.0	4.6	s	e	3	c	o	g	sf
7/29/2011	Sarah Fisher	21:38	22:38	475.0	493.0	4.6	f	e	3	c	o	g	sf
7/29/2011	Adam Swope	22:38	23:38	493.0	464.0	4.7	f	e	4	c	o	g	sf
7/29/2011	Adam Swope	23:38	0:25	464.0	439.0	4.6	f	e	4	c	o	g	sf
7/30/2011	Adam Swope	10:20	11:19	347.0	461.0	4.8	s	e	3	c	o	m	n
7/30/2011	Adam Swope	11:19	12:19	461.0	490.0	4.7	f	e	3	c	o	g	wb
7/30/2011	Adam Swope	12:19	13:19	490.0	464.0	4.7	f	e	3	c	o	g	sb
7/30/2011	Adam Swope	13:19	14:30	464.0	445.0	4.8	f	e	3	c	o	g	sb
7/30/2011	Kari Nolan	14:30	16:30	445.0	416.0	4.7	n	e	3	c	o	g	sb
7/30/2011	Adam Swope / Jeff Harrison	16:30	17:01	416.0	419.0	4.5	n	e	3	c	o	g	n
7/30/2011	Adam Swope / Larry Hastings	17:01	17:59	419.0	430.0	4.6	s	e	4	c	o	g	n
7/30/2011	Adam Swope	17:59	18:59	430.0	451.0	4.7	f	e	4	c	o	g	n
7/30/2011	Adam Swope	18:59	19:59	451.0	502.0	4.7	f	e	4	c	o	g	n
7/30/2011	Simon Watts	19:59	20:59	502.0	495.0	4.5	f	e	4	c	o	g	wb
7/30/2011	Sarah Fisher	20:59	21:59	495.0	472.0	4.5	f	e	4	c	o	g	sb
7/30/2011	Adam Swope	21:59	22:31	472.0	408.0	4.5	f	e	4	c	o	g	sb
7/30/2011	Adam Swope	22:31	23:31	408.0	286.0	4.4	r	e	4	c	o	g	sb
7/30/2011	Adam Swope	23:31	0:25	286.0	384.0	4.6	r	se	4	c	o	g	n
7/31/2011	Adam Swope	10:20	11:20	498.0	488.0	4.9	f	se	3	s	o	m	n
7/31/2011	Adam Swope	11:20	12:09	488.0	380.0	4.2	f	se	3	s	o	g	sf

7/31/2011	Adam Swope	12:09	13:00	380.0	304.0	4.5	n	se	3	s	o	g	sf
8/1/2011	Adam Swope / Adrian Tagacay	16:00	17:00	428.0	423.0	4.5	n	se	3	s	o	g	n
8/1/2011	Adam Swope / Adrian Tagacay	17:00	17:23	423.0	418.0	4.7	n	se	3	s	o	g	n
8/1/2011	Adam Swope	17:23	18:23	418.0	421.0	4.1	s	se	3	s	o	g	n
8/1/2011	Adam Swope	18:23	19:33	421.0	432.0	4.2	v	e	3	s	o	g	n
8/1/2011	Adam Swope	19:33	20:33	432.0	452.0	4.4	f	e	3	s	o	g	wb
8/1/2011	Adam Swope	20:33	21:33	452.0	503.0	4.5	f	e	3	s	o	g	sb
8/1/2011	Sarah Fisher	21:33	22:33	503.0	499.0	4.4	f	e	3	s	o	g	sb
8/1/2011	Adam Swope	22:33	23:33	499.0	455.0	4.5	f	e	3	s	o	g	sb
8/1/2011	Adam Swope	23:33	23:51	455.0	404.0	4.5	f	e	3	s	o	g	sb
8/1/2011	Adam Swope	23:51	0:25	404.0	381.0	4.3	r	e	3	s	o	g	n
8/2/2011	Adam Swope	10:20	11:20	452.0	501.0	4.7	f	e	2	s	o	m	n
8/2/2011	Adam Swope	11:20	12:20	501.0	496.0	4.6	f	e	2	s	o	g	wf
8/2/2011	Adam Swope	12:20	13:20	496.0	458.0	4.6	f	e	2	s	o	g	sf
8/2/2011	Adam Swope	13:20	13:41	458.0	405.0	4.5	f	e	2	s	o	g	sf
8/2/2011	Jerry	13:41	14:41	405.0	412.0	4.4	n	e	2	s	o	g	n
8/2/2011	Jeff Harrison	14:41	15:35	412.0	414.0	4.4	n	e	2	s	o	g	n
8/2/2011	Adam Swope	15:35	16:35	414.0	457.0	4.4	s	e	2	s	o	g	n
8/2/2011	Adam Swope	16:35	17:35	457.0	465.0	4.5	f	s	1	s	o	g	n
8/2/2011	Adam Swope	17:35	18:35	465.0	503.0	4.5	f	s	1	s	o	g	n
8/2/2011	Adam Swope	18:35	19:35	503.0	449.0	4.5	f	s	1	s	o	g	n
8/2/2011	Adam Swope	19:35	20:07	449.0	441.0	4.6	f	se	1	s	o	g	n
8/2/2011	Simon Watts	20:07	21:07	441.0	425.0	4.4	f	se	1	s	o	g	wf
8/2/2011	Sarah Fisher	21:07	22:07	425.0	422.0	4.4	f	se	1	s	o	g	sf
8/2/2011	Adam Swope / Adrian Tagacay	22:07	22:55	422.0	417.0	4.4	n	se	2	s	o	g	sf
8/2/2011	Adam Swope / Adrian Tagacay	22:55	23:47	417.0	439.0	4.5	s	ne	3	s	o	g	sf
8/2/2011	Adam Swope	23:47	0:25	439.0	448.0	4.3	f	ne	3	s	o	g	wf
8/8/2011	Adam Swope	10:25	10:54	419.0	418.0	4.2	r	se	3	s	o	m	n
8/8/2011	Adam Swope	10:54	11:54	418.0	432.0	4.3	s	se	3	s	o	g	n
8/8/2011	Adam Swope	11:54	12:54	432.0	454.0	4.4	f	se	3	s	o	g	sf
8/8/2011	Adam Swope	12:54	13:54	454.0	499.0	4.3	f	se	3	s	o	g	sf
8/8/2011	Adam Swope	13:54	14:54	499.0	487.0	4.1	f	se	3	s	o	g	sf
8/8/2011	Jeff Harrison	14:54	15:48	487.0	382.0	4.3	f	se	2	s	o	g	wf
8/8/2011	Adam Swope / Adrian Tagacay	15:48	16:48	382.0	312.0	4.3	n	se	2	s	o	g	n
8/8/2011	Adam Swope / Adrian Tagacay	16:48	17:31	312.0	366.0	4.3	n	se	2	s	o	g	n
8/8/2011	Adam Swope	17:31	18:28	366.0	457.0	4.2	s	se	2	s	o	g	n
8/8/2011	Adam Swope	18:28	19:28	457.0	489.0	4.1	f	sw	2	s	o	g	n
8/8/2011	Adam Swope	19:28	20:28	489.0	501.0	4.2	f	sw	1	g	o	g	wf
8/8/2011	Sarah Fisher	20:28	21:05	501.0	477.0	4.2	f	sw	1	s	o	g	sf
8/8/2011	Sarah Fisher	21:05	22:05	477.0	429.0	4.2	n	sw	1	s	o	g	sf
8/8/2011	Adam Swope	22:05	23:05	429.0	429.0	4.5	n	nw	2	s	o	g	sf
8/8/2011	Adam Swope / Larry Hastings	23:05	23:39	429.0	425.0	4.2	n	nw	3	s	o	g	sf
8/8/2011	Adam Swope	23:39	0:15	425.0	422.0	4.4	r	n	2	s	o	g	n
8/9/2011	Adam Swope	10:20	11:20	471.0	502.0	4.5	f	s	3	s	o	m	n
8/9/2011	Adam Swope	11:20	12:31	502.0	446.0	4.4	f	s	3	s	o	g	sb
8/9/2011	Adam Swope	12:31	13:31	446.0	432.0	4.4	n	s	3	s	o	g	sb
8/9/2011	Adam Swope	13:31	14:31	432.0	429.0	4.6	n	s	3	s	o	g	sb
8/9/2011	Adam Swope	14:31	16:00	429.0	422.0	4.0	n	sw	2	s	o	g	sb
8/9/2011	Adam Swope / Adrian Tagacay	16:00	17:00	422.0	417.0	4.5	n	sw	1	g	o	g	n
8/9/2011	Adam Swope / Adrian Tagacay	17:00	17:28	417.0	417.0	4.7	n	e	1	g	o	g	n
8/9/2011	Adam Swope	17:28	18:36	417.0	433.0	4.6	s	ne	1	g	o	g	n
8/9/2011	Adam Swope	18:36	19:36	433.0	452.0	4.7	f	ne	1	g	o	g	n

8/9/2011	Josh Ross	19:36	20:36	452.0	455.0	4.6	f	ne	1	g	o	g	n
8/9/2011	Sarah Fisher	20:36	21:36	455.0	459.0	4.6	f	ne	1	g	o	g	sb
8/9/2011	Adam Swope	21:36	22:26	459.0	402.0	4.6	f	ne	1	g	o	g	sb
8/9/2011	Adam Swope	22:26	23:36	402.0	287.0	4.5	r	ne	1	g	o	g	sb
8/9/2011	Adam Swope	23:26	23:50	287.0	317.0	4.6	r	ne	1	g	o	g	wb
8/9/2011	Adam Swope	23:50	0:15	317.0	404.0	4.5	s	ne	1	g	o	g	n
8/10/2011	Adam Swope	10:25	11:25	490.0	497.0	4.5	f	se	2	s	o	m	n
8/10/2011	Adam Swope	11:25	12:25	497.0	468.0	4.5	f	s	2	s	o	g	wf
8/10/2011	Adam Swope	12:25	13:00	468.0	404.0	4.6	f	s	2	s	o	g	sf
8/10/2011	Adam Swope / Kari Nolan	13:00	14:00	404.0	296.0	4.5	n	s	2	s	o	g	sf
8/10/2011	Adam Swope / Kari Nolan	14:00	14:24	296.0	349.0	4.7	n	s	1	s	o	g	sf
8/10/2011	Darrell	14:24	15:20	349.0	422.0	4.4	s	s	2	s	o	g	wb
8/10/2011	Trent Lunsford	15:20	16:20	422.0	491.0	4.6	f	sw	0	g	o	g	n
8/10/2011	Adam Swope	16:20	17:20	491.0	463.0	4.6	f	sw	0	g	o	g	n
8/10/2011	Adam Swope	17:20	17:35	463.0	449.0	4.6	f	sw	0	g	o	g	n
8/10/2011	Adam Swope	17:35	18:20	449.0	437.0	4.4	n	sw	1	g	o	g	n
8/10/2011	Adam Swope, Greggo Seward	18:20	19:20	437.0	429.0	4.6	n	sw	1	g	o	g	n
8/10/2011	Greggo Seward	19:20	20:00	429.0	429.0	4.5	n	nw	1	g	o	g	n
8/10/2011	Greggo Seward, Bruno	21:40	22:39	417.0	420.0	4.5	n	ne	2	s	o	g	sb
8/10/2011	Greggo Seward	22:39	23:40	420.0	435.0	4.5	s	ne	2	s	o	g	sb
8/10/2011	Greggo Seward	23:40	0:20	435.0	453.0	4.5	f	ne	1	s	o	g	wb
8/11/2011	Greggo Seward	10:25	11:25	427.0	418.0	4.4	n	w	2	s	o	g	vb
8/11/2011	Greggo Seward, Cari Nolan, Davey	11:25	12:25	418.0	417.0	4.4	n	w	2	s	o	g	sf
8/11/2011	Greggo Seward, Davey	12:25	13:27	417.0	434.0	4.5	s	e	2	s	o	g	sf
8/11/2011	Greggo Seward	13:27	14:30	434.0	453.0	4.5	f	e	2	s	o	g	sf
8/11/2011	Kari, Ali	14:30	16:00	453.0	494.0	4.5	f	ne	1	g	o	g	n
8/11/2011	Greggo Seward	16:00	16:40	494.0	476.0	4.5	f	ne	1	g	o	g	n
8/11/2011	Greggo Seward	16:45	17:23	476.0	409.0	4.5	n	e	1	g	o	g	n
8/11/2011	Greggo Seward	17:23	17:53	409.0	323.0	4.5	n	se	1	g	o	g	n
8/11/2011	Greggo Seward	17:53	18:08	323.0	314.0	4.6	v	se	1	g	o	g	n
8/11/2011	Greggo Seward, Jerry, Bruno	18:08	19:08	314.0	375.0	4.4	n	s	2	s	o	g	wf
8/11/2011	Greggo Seward	19:08	20:00	375.0	450.0	4.4	s	s	1	s	o	g	wf
8/11/2011	Greggo Seward, DP, Sarah	20:00	22:05	450.0	473.0	4.4	f	s	1	s	o	g	wf
8/11/2011	Greggo Seward	22:05	22:30	473.0	446.0	4.4	n	s	1	s	o	g	wf
8/11/2011	Greggo Seward, Bruno	22:30	23:30	446.0	432.0	4.4	n	s	1	s	o	g	wf
8/11/2011	Greggo Seward	23:30	0:15	432.0	432.0	4.3	r	e	2	s	o	g	n
8/12/2011	Greggo Seward	10:30	10:36	449.0	450.0	4.4	s	s	2	s	o	g	n
8/12/2011	Greggo Seward	10:36	11:30	450.0	491.0	4.4	f	s	2	s	o	g	n
8/12/2011	Greggo Seward	11:30	12:36	491.0	474.0	4.4	f	s	2	s	o	g	sb
8/12/2011	Greggo Seward	12:36	13:30	474.0	444.0	4.4	n	s	2	s	o	g	sb
8/12/2011	Greggo Seward	13:30	14:00	444.0	437.0	4.4	n	sw	2	s	o	g	sb
8/12/2011	Greggo Seward	16:00	17:00	420.0	417.0	4.4	n	sw	1	g	o	g	n
8/12/2011	Greggo Seward, Simon	17:00	18:00	417.0	417.0	4.4	n	sw	1	g	o	g	n
8/12/2011	Greggo Seward	18:00	18:52	417.0	433.0	4.1	s	sw	1	g	o	g	n
8/12/2011	Greggo Seward	18:52	20:00	433.0	483.0	4.3	f	ne	1	g	o	g	n
8/12/2011	Greggo Seward, DP, Sarah	20:00	22:00	483.0	466.0	4.4	f	ne	1	g	o	g	wb
8/12/2011	Greggo Seward	22:00	22:37	466.0	411.0	4.4	f	ne	1	g	o	g	sb
8/12/2011	Greggo Seward	22:37	23:30	411.0	283.0	4.1	r	ne	1	g	o	g	sb
8/12/2011	Greggo Seward	23:30	0:15	283.0	315.0	4.1	r	ne	1	g	o	g	sb
8/13/2011	Greggo Seward	10:30	11:30	504.0	492.0	4.5	f	s	1	g	o	g	n
8/13/2011	Greggo Seward	11:30	12:00	492.0	466.0	4.6	f	s	1	g	o	g	wf
8/13/2011	Greggo Seward	12:00	12:36	466.0	426.0	4.5	f	s	2	s	o	g	sf
8/13/2011	Greggo Seward	12:36	13:14	426.0	303.0	4.6	n	s	2	s	o	g	sf

8/13/2011	Greggo Seward, Colin, Trent	13:14	14:14	303.0	354.0	4.6	n	s	2	s	o	g	sf
8/13/2011	Greggo Seward, Trent, Ali	14:14	16:00	354.0	471.0	4.5	s	s	1	g	o	g	sb
8/13/2011	Greggo Seward	16:00	17:00	471.0	503.0	4.6	f	s	2	s	o	g	n
8/13/2011	Greggo Seward	17:00	17:13	503.0	490.0	4.5	f	s	2	s	o	g	n
8/13/2011	Greggo Seward	17:13	18:00	490.0	447.0	4.6	n	s	2	s	o	g	n
8/13/2011	Greggo Seward	18:00	19:00	447.0	434.0	4.5	n	sw	1	g	o	g	n
8/13/2011	Greggo Seward	19:00	20:00	434.0	433.0	4.6	n	w	1	g	o	g	wf
8/13/2011	Greggo Seward, Sarah, Bruno	21:44	22:44	420.0	419.0	4.5	n	e	2	s	o	g	sb
8/13/2011	Greggo Seward	22:44	23:28	419.0	433.0	4.6	s	ne	2	s	o	g	sb
8/13/2011	Greggo Seward	23:28	0:15	433.0	454.0	4.5	f	ne	2	s	o	g	sb
8/14/2011	Greggo Seward	10:30	10:39	426.0	423.0	4.5	n	se	2	s	o	g	n
8/14/2011	Greggo Seward, Ken	11:39	12:39	423.0	425.0	4.4	s	se	2	s	o	g	vf
8/14/2011	Greggo Seward	12:39	13:12	425.0	437.0	4.5	s	e	2	s	o	g	sf
8/14/2011	Greggo Seward	13:12	14:00	437.0	445.0	4.6	f	e	2	s	o	g	vf
8/14/2011	Trent, Ali	14:00	16:00	445.0	464.0	4.4	f	se	2	s	o	g	vf
8/14/2011	Greggo Seward	16:00	16:31	464.0	418.0	4.7	f	s	1	g	o	g	wb
8/14/2011	Greggo Seward	16:31	16:45	418.0	366.0	4.6	n	s	1	g	o	g	wf
8/14/2011	Greggo Seward, Simon	16:45	17:45	366.0	345.0	4.4	n	se	1	g	o	g	wf
8/14/2011	Greggo Seward	17:45	18:30	345.0	416.0	4.4	n	s	1	g	o	g	n
8/14/2011	Greggo Seward	20:30	21:30	502.0	453.0	4.6	v	sw	1	g	o	g	vf
8/14/2011	Greggo Seward, Sarah, Jerry	21:30	22:31	453.0	504.0	4.6	n	nw	1	g	o	g	sf
8/14/2011	Greggo Seward	22:31	23:16	504.0	498.0	4.2	s	ne	1	g	o	g	sb
8/14/2011	Greggo Seward	23:16	0:10	498.0	468.0	4.5	f	ne	1	g	o	g	sb
8/15/2011	Greggo Seward	10:30	10:35	434.0	434.0	4.5	s	e	2	s	o	g	n
8/15/2011	Greggo Seward	10:35	10:55	434.0	464.0	4.5	f	e	2	s	o	g	n
8/15/2011	Greggo Seward, Cari	10:55	11:55	464.0	493.0	4.4	n	e	2	s	o	g	wf
8/15/2011	Greggo Seward	11:55	12:49	493.0	506.0	4.5	s	e	2	s	o	g	sf
8/15/2011	Greggo Seward	12:49	13:02	506.0	512.0	4.5	f	e	2	s	o	g	sf
8/15/2011	Greggo Seward	13:02	14:00	512.0	498.0	4.5	n	e	2	s	o	g	sf
8/15/2011	Greggo Seward, Cari, Ilya	15:45	16:49	948.0	512.0	4.5	n	s	2	s	o	g	wb
8/15/2011	Greggo Seward	16:49	17:48	512.0	524.0	4.4	s	s	2	s	o	g	n
8/15/2011	Greggo Seward	17:48	18:40	524.0	502.0	4.4	f	sw	2	s	o	g	wf
8/15/2011	Greggo Seward	18:40	19:39	502.0	471.0	4.3	f	s	2	s	o	g	wf
8/15/2011	Greggo Seward	19:39	20:00	471.0	493.0	4.4	n	s	2	s	o	g	wf
8/15/2011	Greggo Seward, Sarah, DP, Chris	21:40	22:41	493.0	482.0	4.5	n	n	1	g	o	g	sf
8/15/2011	Greggo Seward	22:41	23:40	482.0	489.0	4.5	s	ne	2	s	o	g	sf
8/15/2011	Greggo Seward	23:40	0:05	489.0	494.0	4.4	s	ne	1	g	o	g	vb
8/15/2011	Greggo Seward	0:05	0:10	494.0	497.0	4.4	f	ne	1	g	o	g	n
8/16/2011	Greggo Seward	10:35	11:32	521.0	496.0	4.5	r	se	2	s	o	g	n
8/16/2011	Greggo Seward	11:32	12:30	496.0	498.0	4.5	s	s	2	s	o	g	sb
8/16/2011	Greggo Seward	12:30	12:42	498.0	487.0	4.5	f	s	2	s	o	g	sb
8/16/2011	Greggo Seward	12:42	13:42	487.0	456.0	4.4	n	s	2	s	o	g	sb
8/16/2011	Greggo Seward	13:42	14:00	456.0	455.0	4.3	n	s	2	s	o	g	sb
8/16/2011	Greggo Seward, Ilya	15:53	16:53	446.0	461.0	4.7	n	w	2	s	o	g	wb
8/16/2011	Greggo Seward	16:53	17:45	461.0	464.0	4.4	s	e	2	s	o	g	wb
8/16/2011	Greggo Seward	17:45	18:15	464.0	471.0	4.3	s	e	1	g	o	g	n
8/16/2011	Greggo Seward	18:15	18:29	471.0	473.0	4.4	f	e	1	g	o	g	n
8/16/2011	Greggo Seward	18:29	19:29	473.0	484.0	4.4	n	e	1	g	o	g	n
8/16/2011	Greggo Seward	19:29	20:00	484.0	503.0	4.5	n	ne	1	g	o	g	wb
8/16/2011	Greggo Seward, Ilya	21:55	23:10	522.0	524.0	4.4	n	e	2	s	o	g	sb
8/16/2011	Greggo Seward	23:10	0:07	524.0	496.0	4.7	s	e	2	s	o	g	sb
8/16/2011	Greggo Seward	0:07	0:10	496.0	494.0	4.0	n	e	2	s	o	g	sb
8/17/2011	Greggo Seward	10:35	10:39	503.0	501.0	4.5	f	s	2	s	o	g	n

8/17/2011	Greggo Seward	10:39	11:30	501.0	489.0	4.5	r	s	2	s	o	g	n
8/17/2011	Greggo Seward	11:30	11:53	489.0	473.0	4.4	s	s	2	s	o	g	wb
8/17/2011	Greggo Seward	11:53	12:50	473.0	452.0	4.5	f	s	2	s	o	g	wb
8/17/2011	Greggo Seward	12:50	13:31	452.0	441.0	4.5	f	s	1	g	o	g	wb
8/17/2011	Greggo Seward	13:31	14:00	441.0	436.0	4.6	n	s	1	g	o	g	vb
8/17/2011	Greggo Seward, Colin, Ali	14:45	15:54	430.0	424.0	4.5	n	n	1	g	o	g	vb
8/17/2011	Greggo Seward	15:54	16:30	424.0	426.0	4.6	s	ne	1	g	o	g	n
8/17/2011	Greggo Seward	16:30	17:12	426.0	435.0	4.4	s	ne	1	g	o	g	n
8/17/2011	Greggo Seward	17:12	18:00	435.0	447.0	4.5	f	ne	2	s	o	g	n
8/17/2011	Greggo Seward	18:00	19:00	447.0	494.0	4.3	f	ne	3	s	o	g	n
8/17/2011	Greggo Seward	19:00	20:00	494.0	516.0	4.4	n	e	3	s	o	g	wb
8/17/2011	Greggo Seward. Sarah, DP, Bruno	21:33	22:33	521.0	503.0	4.4	n	e	3	s	o	g	sf
8/17/2011	Greggo Seward	22:33	23:38	503.0	475.0	4.6	s	e	3	s	o	g	sf
8/17/2011	Greggo Seward	23:38	0:10	475.0	457.0	4.5	f	e	3	s	o	g	n
8/18/2011	Greggo Seward	10:40	11:40	460.0	450.0	4.5	f	s	3	s	o	g	n
8/18/2011	Greggo Seward	11:40	12:10	450.0	444.0	4.5	f	s	3	s	o	g	n
8/18/2011	Greggo Seward	12:10	12:30	444.0	442.0	4.4	f	se	4	c	o	m	n
8/18/2011	Greggo Seward	12:30	13:30	442.0	436.0	4.4	f	se	3	s	o	g	n
8/18/2011	Greggo Seward	13:30	14:00	436.0	436.0	4.5	f	se	3	s	o	g	n
8/18/2011	Greggo Seward, Trent, Ali	14:00	16:00	436.0	469.0	4.4	f	se	3	s	o	g	n
8/18/2011	Greggo Seward	16:00	16:36	469.0	481.0	4.5	f	se	3	s	o	g	n
8/18/2011	Greggo Seward	16:36	17:30	481.0	487.0	4.4	n	se	3	s	o	g	n
8/18/2011	Greggo Seward	17:30	18:30	487.0	441.0	4.2	n	se	3	s	o	g	n
8/18/2011	Greggo Seward	18:30	19:30	441.0	429.0	4.1	n	se	3	s	o	g	wb
8/18/2011	Greggo Seward	19:30	20:00	429.0	451.0	4.7	n	se	3	s	o	g	wf
8/18/2011	Sarah Fisher, Ron	20:26	21:26	470.0	481.0	4.5	n	se	3	s	o	g	vf
8/18/2011	Greggo Seward	21:26	22:00	481.0	478.0	4.5	s	e	3	s	o	g	sf
8/18/2011	Greggo Seward	22:00	22:39	478.0	478.0	4.5	s	e	3	s	o	g	sf
8/18/2011	Greggo Seward	22:39	23:30	478.0	480.0	4.5	f	e	3	s	o	g	sf
8/18/2011	Greggo Seward	23:30	0:00	480.0	484.0	4.5	f	e	3	s	o	g	n
8/19/2011	Greggo Seward	10:45	11:45	438.0	461.0	4.5	f	s	4	c	o	g	n
8/19/2011	Greggo Seward	11:45	12:35	461.0	481.0	4.5	f	s	3	s	o	g	wf
8/19/2011	Greggo Seward	12:35	13:30	481.0	476.0	4.5	n	s	3	s	o	g	wf
8/19/2011	Greggo Seward	13:30	14:00	476.0	458.0	4.4	n	s	3	s	o	g	sf
8/19/2011	Greggo Seward	16:00	16:22	462.0	471.0	4.6	n	s	3	s	o	g	wb
8/19/2011	Greggo Seward	16:22	17:24	471.0	482.0	4.4	n	s	3	s	o	g	sb
8/19/2011	Greggo Seward	17:24	18:21	482.0	474.0	4.4	s	se	3	s	o	g	wb
8/19/2011	Greggo Seward	18:21	19:00	474.0	475.0	4.6	f	e	2	s	o	g	wb
8/19/2011	Greggo Seward	19:00	20:00	475.0	484.0	4.5	f	e	2	s	o	g	wf
8/19/2011	Greggo Seward, DP, Sarah	20:00	22:00	484.0	508.0	4.5	f	e	2	s	o	g	sf
8/19/2011	Greggo Seward	22:00	22:05	508.0	508.0	4.6	f	e	2	s	o	g	wf
8/19/2011	Greggo Seward	22:05	23:05	508.0	507.0	4.5	r	e	2	s	o	g	wf
8/19/2011	Greggo Seward	23:05	0:05	507.0	496.0	4.6	r	e	2	g	o	g	sf
8/20/2011	Greggo Seward	10:35	11:30	462.0	370.0	4.6	n	se	2	s	o	g	n
8/20/2011	Greggo Seward	11:30	12:30	370.0	457.0	4.5	n	se	2	s	o	g	sb
8/20/2011	Greggo Seward	12:30	13:03	457.0	474.0	4.5	n	se	2	s	o	g	sb
8/20/2011	Greggo Seward, Colin, Mariusz	13:03	14:03	474.0	482.0	4.6	n	e	2	s	o	g	sb
8/20/2011	Greggo Seward, Mariusz, Ali	14:03	16:00	482.0	470.0	4.5	s	se	2	s	o	g	sb
8/20/2011	Greggo Seward	16:00	17:00	470.0	485.0	4.6	f	e	2	s	o	g	wb
8/20/2011	Greggo Seward	17:00	18:00	485.0	499.0	4.5	f	e	2	s	o	g	n
8/20/2011	Greggo Seward	18:00	19:09	499.0	504.0	4.6	f	e	2	s	o	g	n
8/20/2011	Greggo Seward	19:09	20:00	504.0	504.0	4.6	n	e	2	s	o	g	wf
8/20/2011	DP, Mark, Sarah	20:00	22:00	504.0	428.0	4.4	n	e	2	s	o	g	wf

8/20/2011	Greggo Seward	22:00	22:36	428.0	431.0	4.5	s	e	2	s	o	g	sb
8/20/2011	Greggo Seward	22:36	23:30	431.0	437.0	4.4	f	e	2	s	o	g	sb
8/20/2011	Greggo Seward	23:30	0:10	437.0	345.0	4.4	f	e	2	s	o	g	wb
8/21/2011	Greggo Seward	10:40	11:40	480.0	476.0	4.5	r	e	2	s	o	g	n
8/21/2011	Greggo Seward	11:40	12:26	476.0	463.0	4.4	s	e	2	s	o	g	vb
8/21/2011	Greggo Seward	12:26	13:20	463.0	463.0	4.5	f	e	2	s	o	g	sb
8/21/2011	Greggo Seward	13:20	14:00	463.0	474.0	4.5	f	se	2	s	o	g	sb
8/21/2011	Mark, Ali	14:00	16:00	474.0	500.0	4.7	f	se	2	s	o	g	sb
8/21/2011	Greggo Seward	16:00	16:42	500.0	503.0	4.5	f	e	2	s	o	g	n
8/21/2011	Greggo Seward	16:42	17:40	503.0	508.0	4.5	n	e	2	s	o	g	n
8/21/2011	Greggo Seward	17:40	18:40	508.0	475.0	3.6	n	e	2	s	o	g	wb
8/21/2011	Greggo Seward	18:40	19:03	475.0	444.0	4.5	n	e	2	s	o	g	wb
8/21/2011	Greggo Seward, Ron	19:03	20:03	444.0	419.0	4.4	n	e	2	s	o	g	wb
8/21/2011	Greggo Seward, Ali, Sarah	20:03	22:00	419.0	427.0	3.2	s	e	2	s	o	g	sb
8/21/2011	Greggo Seward	22:00	23:00	427.0	427.0	4.4	f	e	3	s	o	g	sb
8/21/2011	Greggo Seward	23:00	0:10	427.0	419.0	4.4	f	e	3	s	o	g	sb
8/22/2011	Greggo Seward	10:40	11:11	473.0	460.0	4.4	s	e	2	s	o	g	n
8/22/2011	Greggo Seward	11:11	12:00	460.0	456.0	4.4	f	e	2	s	o	g	sb
8/22/2011	Greggo Seward	12:00	13:00	456.0	473.0	4.4	f	e	2	s	o	g	sb
8/22/2011	Greggo Seward	13:00	14:00	473.0	488.0	4.4	f	e	2	s	o	g	sb
8/22/2011	Greggo Seward, Mark, Ali	14:00	15:20	488.0	498.0	4.4	f	e	2	s	o	g	vb
8/22/2011	Greggo Seward	15:20	15:36	498.0	500.0	4.4	f	ne	2	s	o	g	wb
8/27/2011	Greggo Seward, Mark	10:42	11:45	493.0	435.0	4.4	n	sw	3	s	o	g	n
8/27/2011	Greggo Seward	11:45	12:45	435.0	441.0	4.3	s	sw	3	s	o	g	sf
8/27/2011	Greggo Seward	12:45	13:45	441.0	420.0	4.5	v	sw	3	s	o	g	sf
8/27/2011	Greggo Seward	13:45	14:00	420.0	411.0	4.4	s	sw	3	s	o	g	sf
8/27/2011	Ken, Jerry	14:00	16:00	411.0	415.0	4.5	s	sw	3	s	o	g	sf
8/27/2011	Greggo Seward	16:00	17:00	415.0	412.0	4.4	f	sw	3	s	o	g	wf
8/27/2011	Greggo Seward	17:00	18:00	412.0	410.0	4.5	f	sw	3	s	o	g	n
8/27/2011	Greggo Seward	18:00	19:00	410.0	413.0	4.5	f	sw	3	s	o	g	n
8/27/2011	Greggo Seward	19:00	20:00	413.0	437.0	4.5	f	s	2	s	o	g	wb
8/27/2011	Greggo Seward	20:00	20:40	437.0	456.0	4.5	f	s	2	s	o	g	wb
8/27/2011	Greggo Seward, Kat	22:30	23:30	435.0	440.0	4.6	n	s	2	s	o	g	wb
8/27/2011	Greggo Seward	23:30	23:55	440.0	438.0	4.4	r	s	2	s	o	g	n
8/28/2011	Greggo Seward	10:40	11:44	411.0	402.0	4.4	s	s	2	s	o	g	n
8/28/2011	Greggo Seward	11:44	12:45	402.0	408.0	4.5	f	s	3	s	o	g	sb
8/28/2011	Greggo Seward	12:45	13:30	408.0	407.0	4.4	f	s	3	s	o	g	Sf
8/28/2011	Greggo Seward	13:30	14:00	407.0	406.0	4.4	f	s	3	s	o	g	Sf
8/28/2011	Mark, Colin	14:00	16:00	406.0	406.0	4.4	f	s	3	s	o	g	Sf
8/28/2011	Greggo Seward	16:00	17:00	406.0	437.0	4.5	f	s	3	s	o	g	Wf
8/28/2011	Greggo Seward	17:00	17:37	437.0	457.0	4.4	f	s	3	s	o	g	Wf
8/28/2011	Greggo Seward	17:37	18:30	457.0	485.0	4.4	n	s	3	s	o	g	Wf
8/28/2011	Greggo Seward	18:30	19:30	485.0	437.0	4.6	n	s	3	s	o	g	Wb
8/28/2011	Greggo Seward	19:30	20:00	437.0	404.0	4.6	n	s	3	s	o	g	Wf
8/28/2011	Greggo Seward, Jason, Rad	21:47	22:49	472.0	482.0	4.4	n	e	2	s	o	g	Sf
8/28/2011	Greggo Seward	22:49	23:45	482.0	462.0	4.7	s	sw	4	c	o	m	N
8/29/2011	Greggo Seward	10:45	11:45	395.0	391.0	4.4	f	s	3	s	o	g	N
8/29/2011	Greggo Seward	11:45	12:45	391.0	393.0	4.5	f	s	3	s	o	g	Vf
8/29/2011	Greggo Seward	12:45	13:45	393.0	403.0	4.4	f	s	3	s	o	g	Sf
8/29/2011	Greggo Seward	13:45	14:00	403.0	412.0	4.4	f	s	3	s	o	g	Sf
8/29/2011	Colin	14:00	15:09	412.0	447.0	4.4	f	s	3	s	o	g	Sf
8/29/2011	Greggo Seward	16:00	17:00	487.0	455.0	4.2	n	se	2	s	o	g	Wf
8/29/2011	Greggo Seward	17:00	18:00	455.0	386.0	4.3	n	se	2	s	o	g	N

8/29/2011	Greggo Seward	18:00	19:00	386.0	461.0	4.6	n	se	3	s	o	g	Wf
8/29/2011	Greggo Seward, Glenn	19:00	20:00	461.0	486.0	4.4	n	se	3	s	o	g	Wf
8/29/2011	Greggo Seward, Glenn, Rad	20:00	22:00	486.0	445.0	4.1	s	se	3	s	o	g	Vf
8/29/2011	Greggo Seward	22:00	23:00	445.0	449.0	4.5	f	se	3	s	o	g	Wf
8/29/2011	Greggo Seward	23:00	23:55	449.0	463.0	4.4	f	se	3	s	o	g	Wf
8/30/2011	Greggo Seward	10:45	11:45	380.0	396.0	4.4	f	se	2	s	o	g	N
8/30/2011	Greggo Seward	11:45	13:02	396.0	439.0	4.3	f	se	3	s	o	g	Sf
8/30/2011	Greggo Seward	13:02	14:00	439.0	384.0	4.4	n	se	3	s	o	g	Sf
8/30/2011	Greggo Seward	16:00	16:48	482.0	487.0	4.4	n	se	3	s	o	g	Wb
8/30/2011	Greggo Seward, Ian	16:48	17:52	487.0	486.0	4.6	n	se	3	s	o	g	Wb
8/30/2011	Greggo Seward	17:52	18:46	486.0	469.0	4.6	s	se	3	s	o	g	Wb
8/30/2011	Greggo Seward	18:46	19:45	469.0	442.0	4.7	f	se	3	s	o	g	Wf
8/30/2011	Greggo Seward	19:45	20:00	442.0	442.0	4.5	f	se	3	s	o	g	Sf
8/30/2011	Rad, Jason	20:00	22:00	442.0	461.0	4.5	f	se	3	s	o	g	Sf
8/30/2011	Greggo Seward	22:00	23:00	461.0	475.0	4.6	f	e	2	s	o	g	Sf
8/30/2011	Greggo Seward	23:00	23:40	475.0	482.0	4.4	f	w	3	c	o	g	Wf
8/31/2011	Greggo Seward	10:45	11:45	432.0	448.0	4.4	n	e	3	s	o	g	N
8/31/2011	Greggo Seward	11:45	12:45	448.0	483.0	4.4	n	se	3	s	o	g	Sb
8/31/2011	Greggo Seward, Ron	12:45	13:27	483.0	484.0	4.5	n	se	3	s	o	g	Sb
8/31/2011	Greggo Seward, Ron, Mark, Glenn	13:27	16:00	484.0	450.0	4.3	n	se	3	s	o	g	Sb
8/31/2011	Greggo Seward	16:00	17:00	450.0	440.0	4.6	f	se	3	s	o	g	Wb
8/31/2011	Greggo Seward	17:00	18:00	440.0	454.0	4.6	f	se	3	s	o	g	N
8/31/2011	Greggo Seward	18:00	19:00	454.0	462.0	4.6	f	se	3	s	o	g	Wb
8/31/2011	Greggo Seward	19:00	20:00	462.0	478.0	4.6	f	se	3	s	o	g	Vf
8/31/2011	Rad, Robin	20:00	21:32	478.0	457.0	4.5	f	se	3	s	o	g	Vf
8/31/2011	Greggo Seward	22:00	22:29	487.0	480.0	4.5	n	e	3	s	o	g	Vf
8/31/2011	Greggo Seward, Kat	22:29	23:29	480.0	389.0	4.4	n	e	3	s	o	g	Vf
8/31/2011	Greggo Seward	23:29	23:55	389.0	351.0	4.2	r	e	3	s	o	g	N
9/1/2011	Greggo Seward	10:45	11:04	482.0	485.0	4.4	n	e	3	s	o	g	N
9/1/2011	Greggo Seward, Bill	11:04	12:07	485.0	490.0	4.5	n	e	3	s	o	g	Vb
9/1/2011	Greggo Seward	12:07	13:04	490.0	472.0	4.5	s	e	3	s	o	g	Sb
9/1/2011	Greggo Seward	13:04	14:00	472.0	441.0	4.4	f	e	3	s	o	g	Sb
9/1/2011	Colin, Mark	14:00	16:00	441.0	455.0	4.5	f	e	3	s	o	g	Sb
9/1/2011	Greggo Seward	16:00	17:00	455.0	461.0	4.5	f	e	3	s	o	g	Wb
9/1/2011	Greggo Seward	17:00	18:00	461.0	476.0	4.5	f	e	3	s	o	g	Wb
9/1/2011	Greggo Seward	18:00	19:00	476.0	479.0	4.5	f	e	3	s	o	g	Wf
9/1/2011	Greggo Seward	19:00	19:26	479.0	479.0	4.6	f	e	3	s	o	g	Wf
9/1/2011	Greggo Seward, Glenn, Rad	21:25	22:41	432.0	324.0	3.5	n	e	3	s	o	g	Sb
9/1/2011	Greggo Seward	22:41	23:34	324.0	316.0	4.8	s	e	2	s	o	g	N
9/1/2011	Greggo Seward	23:34	23:47	316.0	332.0	4.2	s	e	2	s	o	g	N
9/2/2011	Greggo Seward	10:50	11:53	486.0	487.0	4.5	r	se	2	s	o	g	N
9/2/2011	Greggo Seward	11:53	12:49	487.0	471.0	3.9	s	se	2	s	o	g	Sb
9/2/2011	Greggo Seward	12:49	14:00	471.0	441.0	4.9	f	se	2	s	o	g	Wb
9/2/2011	Rob, Mark	14:00	16:00	441.0	451.0	4.4	f	se	2	s	o	g	Wb
9/2/2011	Greggo Seward	16:00	17:00	451.0	459.0	4.6	f	n	2	s	o	g	N
9/2/2011	Greggo Seward	17:00	18:00	459.0	473.0	4.5	f	n	2	s	o	g	N
9/2/2011	Greggo Seward	18:00	19:00	473.0	475.0	4.5	f	n	2	g	o	g	Wb
9/2/2011	Greggo Seward	19:00	19:15	475.0	473.0	4.6	f	e	2	g	o	g	Wb
9/2/2011	Greggo Seward	19:15	20:00	473.0	487.0	4.5	n	e	2	g	o	g	Wb
9/2/2011	Glenn, Rad	20:38	22:00	451.0	298.0	4.5	n	e	2	g	o	g	Wb
9/2/2011	Greggo Seward	22:00	22:51	298.0	289.0	4.3	s	n	2	g	o	g	Wb
9/2/2011	Greggo Seward	22:51	23:55	289.0	304.0	4.3	f	n	2	g	o	g	Wb
9/3/2011	Greggo Seward	10:45	11:50	468.0	440.0	4.3	f	s	2	s	o	g	N

9/3/2011	Greggo Seward	11:50	12:55	440.0	437.0	4.3	f	s	2	s	o	g	Sb
9/3/2011	Greggo Seward	12:55	14:00	437.0	446.0	4.4	f	s	2	s	o	g	Sb
9/3/2011	Carl, Glenn, Mark	14:00	16:00	446.0	469.0	4.4	f	s	2	s	o	g	Sb
9/3/2011	Greggo Seward	16:00	17:00	469.0	467.0	4.4	f	s	2	s	o	g	Wb
9/3/2011	Greggo Seward	17:00	17:37	467.0	463.0	4.1	f	s	2	s	o	g	Wb
9/3/2011	Greggo Seward	17:37	18:07	463.0	485.0	4.2	r	s	2	s	o	g	N
9/3/2011	Greggo Seward	18:07	18:28	485.0	479.0	4.4	s	s	2	s	o	g	N
9/3/2011	Greggo Seward	18:28	19:25	479.0	422.0	4.3	v	s	2	s	o	g	N
9/3/2011	Greggo Seward	19:25	20:00	422.0	328.0	4.3	v	se	2	s	o	g	Wb
9/3/2011	Rad, Ali	20:00	22:00	328.0	279.0	4.3	v	se	2	s	o	g	Wb
9/3/2011	Greggo Seward	22:00	23:00	279.0	265.0	4.4	f	se	2	s	o	g	Sb
9/3/2011	Greggo Seward	23:00	23:50	265.0	468.0	4.2	f	se	2	s	o	g	Wf
9/4/2011	Greggo Seward	10:45	11:45	490.0	503.0	4.4	f	w	2	s	o	g	N
9/4/2011	Greggo Seward	11:45	12:41	503.0	494.0	4.3	f	w	2	s	o	g	Sb
9/4/2011	Greggo Seward	12:41	13:40	494.0	481.0	4.3	n	w	1	g	o	g	Sb
9/4/2011	Greggo Seward	13:40	14:00	481.0	468.0	4.4	n	w	1	g	o	g	Wb
9/4/2011	Carl, Glenn, Mark	14:00	16:00	468.0	458.0	4.3	n	w	1	g	o	g	Wb
9/4/2011	Greggo Seward	16:00	16:07	458.0	454.0	4.1	s	e	2	s	o	g	N
9/4/2011	Greggo Seward	16:07	17:00	454.0	457.0	4.0	f	e	2	s	o	g	N
9/4/2011	Greggo Seward	17:00	18:00	457.0	504.0	4.4	f	e	2	s	o	g	N
9/4/2011	Greggo Seward	18:00	19:00	504.0	502.0	4.4	f	e	2	s	o	g	N
9/4/2011	Greggo Seward	19:00	20:00	502.0	483.0	4.4	f	e	2	s	o	g	Sf
9/4/2011	Rad, Glenn	20:00	22:00	483.0	461.0	4.4	f	s	2	s	o	g	Wf
9/4/2011	Greggo Seward	22:00	22:11	461.0	457.0	4.4	f	e	2	s	o	g	Sb
9/4/2011	Greggo Seward	22:11	23:10	457.0	359.0	4.3	r	e	2	s	o	g	Sb
9/4/2011	Greggo Seward	23:10	23:50	359.0	450.0	4.3	v	e	2	s	o	g	Sb
9/5/2011	Greggo Seward	10:45	11:50	444.0	453.0	4.4	s	se	3	s	o	g	N
9/5/2011	Greggo Seward	11:50	12:50	453.0	460.0	4.3	f	se	3	s	o	g	Sf
9/5/2011	Greggo Seward	12:50	14:00	460.0	503.0	4.4	f	se	3	s	o	g	Sf
9/5/2011	Colin, Carl	14:00	16:00	503.0	480.0	4.3	f	se	3	s	o	g	Sf
9/5/2011	Greggo Seward	16:00	17:00	480.0	469.0	4.3	f	se	3	s	o	g	Wf
9/5/2011	Greggo Seward	17:00	17:14	469.0	458.0	4.4	f	se	3	s	o	g	Wf
9/5/2011	Greggo Seward	17:14	17:31	458.0	442.0	4.3	r	se	3	s	o	g	Wf
9/5/2011	Greggo Seward	17:31	18:30	442.0	423.0	4.4	s	se	2	s	o	g	Wb
9/5/2011	Greggo Seward	18:30	19:30	423.0	483.0	3.9	v	se	2	s	o	g	Wf
9/5/2011	Greggo Seward, Rad	19:30	20:15	483.0	485.0	4.4	v	se	2	s	o	g	Wf
9/5/2011	Greggo Seward	22:00	22:28	455.0	445.0	4.5	n	ne	2	s	o	g	Sf
9/5/2011	Greggo Seward, Glenn	22:28	23:30	445.0	439.0	4.5	n	ne	2	s	o	g	Sf
9/5/2011	Greggo Seward	23:30	23:50	439.0	442.0	4.3	s	w	2	s	o	g	N
9/6/2011	Greggo Seward	10:45	11:45	488.0	482.0	4.3	f	se	2	s	o	g	N
9/6/2011	Greggo Seward	11:45	12:45	482.0	470.0	4.3	f	se	2	s	o	g	Sf
9/6/2011	Greggo Seward	12:45	13:01	470.0	460.0	4.4	f	se	2	s	o	g	Sf
9/6/2011	Greggo Seward	13:01	14:00	460.0	393.0	4.3	n	se	2	s	o	g	Sf
9/6/2011	Greggo Seward	16:00	17:00	482.0	463.0	4.4	n	sw	2	s	o	g	Wb
9/6/2011	Greggo Seward	17:00	18:00	463.0	460.0	4.3	n	se	1	s	o	g	wb
9/6/2011	Greggo Seward	18:00	18:37	460.0	447.0	4.3	n	e	1	s	o	g	wb
9/6/2011	Greggo Seward, Kat, Bruno	18:37	19:42	447.0	440.0	4.3	n	e	1	s	o	g	wb
9/6/2011	Greggo Seward	19:42	20:00	440.0	441.0	4.3	s	w	1	g	o	g	wf
9/6/2011	Rad, Robin	20:00	22:00	441.0	490.0	4.3	s	w	1	g	o	g	wf
9/6/2011	Greggo Seward	22:00	23:00	490.0	504.0	4.3	f	n	1	g	o	g	sf
9/6/2011	Greggo Seward	23:00	23:55	504.0	494.0	4.2	f	n	1	g	o	g	wf
9/7/2011	Greggo Seward	10:50	12:00	427.0	432.0	4.2	r	e	2	s	o	g	n
9/7/2011	Greggo Seward	12:00	12:15	432.0	466.0	4.2	r	e	2	s	o	g	wb
9/7/2011	Greggo Seward	12:15	12:30	466.0	463.0	4.3	s	e	2	s	o	g	sb

9/7/2011	Rob, Ron	12:30	14:30	463.0	463.0	4.3	v	e	2	s	o	g	sb
9/7/2011	Greggo Seward	14:30	15:30	463.0	440.0	4.3	v	se	2	s	o	g	wb
9/7/2011	Greggo Seward, Kat	15:30	16:30	440.0	441.0	4.3	v	se	2	s	o	g	wb
9/7/2011	Greggo Seward	16:30	17:25	441.0	453.0	4.3	s	se	2	s	o	g	wb
9/7/2011	Greggo Seward	17:25	18:30	453.0	490.0	4.3	f	se	2	s	o	g	wb
9/7/2011	Kat, Bruno, Rad	18:30	20:30	490.0	498.0	4.3	f	se	2	s	o	g	wb
9/7/2011	Greggo Seward	20:30	21:17	498.0	482.0	4.3	f	nw	1	g	o	g	sf
9/7/2011	Greggo Seward	21:17	22:15	482.0	470.0	4.2	n	nw	1	g	o	g	sf
9/7/2011	Greggo Seward	22:15	22:42	470.0	447.0	4.2	n	nw	1	g	o	g	sf
9/7/2011	Greggo Seward, Bruno	22:42	23:47	447.0	438.0	4.3	n	nw	1	g	o	g	sf
9/7/2011	Greggo Seward	23:47	23:55	438.0	438.0	4.4	s	nw	1	g	o	g	n
9/8/2011	Greggo Seward	10:50	11:33	395.0	441.0	4.3	r	n	1	g	o	g	n
9/8/2011	Greggo Seward	11:33	12:41	441.0	447.0	4.3	s	n	1	g	o	g	sb
9/8/2011	Greggo Seward	12:41	13:30	447.0	475.0	4.4	f	s	2	s	o	g	sb
9/8/2011	Greggo Seward	13:30	14:00	475.0	491.0	4.4	f	s	2	s	o	g	sb
9/8/2011	Colin, Mark	14:00	16:00	491.0	496.0	4.4	f	s	2	s	o	g	sb
9/8/2011	Greggo Seward	16:00	16:56	496.0	477.0	4.3	f	s	2	s	o	g	wb
9/8/2011	Greggo Seward	16:56	17:50	477.0	477.0	3.8	n	s	2	s	o	g	wb
9/8/2011	Greggo Seward	17:50	18:22	477.0	448.0	4.3	n	s	2	s	o	g	wf
9/8/2011	Greggo Seward, Kat	18:22	19:33	448.0	436.0	4.2	n	s	2	s	o	g	wf
9/8/2011	Greggo Seward	19:33	20:00	436.0	439.0	4.5	s	se	2	s	o	g	wb
9/8/2011	Rad, Robin	20:00	22:00	439.0	459.0	4.4	s	se	2	s	o	g	wb
9/8/2011	Greggo Seward	22:00	23:00	459.0	500.0	4.4	f	e	2	s	o	g	sb
9/8/2011	Greggo Seward	23:00	23:50	500.0	499.0	4.3	f	e	2	s	o	g	sb
9/9/2011	Greggo Seward	10:50	11:50	504.0	477.0	4.3	f	s	2	s	o	g	n
9/9/2011	Greggo Seward	11:50	12:24	477.0	471.0	4.4	f	s	2	s	o	g	sb
9/9/2011	Greggo Seward	12:24	13:20	471.0	467.0	4.3	n	s	2	s	o	g	sb
9/9/2011	Greggo Seward	13:20	13:51	467.0	448.0	4.4	n	se	2	s	o	g	sb
9/9/2011	Greggo Seward, Colin	13:51	14:51	448.0	434.0	4.4	n	se	2	s	o	g	sb
9/9/2011	Greggo Seward	14:51	15:10	434.0	435.0	4.4	s	se	1	g	o	g	wf
9/9/2011	Mark, Glenn	15:10	17:00	435.0	451.0	4.4	s	se	1	g	o	g	wf
9/9/2011	Greggo Seward	17:00	18:00	451.0	494.0	4.2	f	se	2	s	o	g	wf
9/9/2011	Greggo Seward	18:00	19:00	494.0	498.0	4.3	f	se	2	s	o	g	wb
9/9/2011	Greggo Seward	19:00	20:00	498.0	488.0	4.3	f	se	2	s	o	g	wb
9/9/2011	Rad, Robin	20:00	21:30	488.0	486.0	4.3	f	se	2	s	o	g	sb
9/9/2011	Greggo Seward	22:00	22:31	488.0	480.0	4.2	n	e	3	s	o	g	sb
9/9/2011	Greggo Seward, Glenn, Bruno	22:31	23:32	480.0	406.0	4.3	n	e	3	s	o	g	sb
9/9/2011	Greggo Seward	23:32	23:50	406.0	350.0	4.3	r	e	2	s	o	g	n
9/10/2011	Greggo Seward	10:50	11:50	445.0	452.0	4.3	f	e	3	s	o	g	n
9/10/2011	Greggo Seward	11:50	12:50	452.0	494.0	4.2	f	e	3	s	o	g	sf
9/10/2011	Greggo Seward	12:50	14:00	494.0	495.0	4.3	f	e	3	s	o	g	sf
9/10/2011	Kendall, Mark	14:00	16:00	495.0	491.0	4.3	f	e	3	s	o	g	sf
9/10/2011	Greggo Seward	16:00	16:06	491.0	493.0	4.3	f	se	3	s	o	g	wf
9/10/2011	Greggo Seward	16:06	17:00	493.0	481.0	4.2	n	se	3	s	o	g	wf
9/10/2011	Greggo Seward	17:00	18:00	481.0	393.0	4.5	n	e	3	s	o	g	wb
9/10/2011	Greggo Seward	18:00	18:23	393.0	353.0	4.3	n	e	3	s	o	g	wb
9/10/2011	Greggo Seward, Ali	18:23	19:39	353.0	439.0	4.4	n	e	2	s	o	g	wf
9/10/2011	Greggo Seward	19:39	20:00	439.0	450.0	4.5	s	e	2	s	o	g	sf
9/10/2011	Rad, Glenn	20:00	22:00	450.0	484.0	4.5	s	e	2	s	o	g	sf
9/10/2011	Greggo Seward	22:00	23:00	484.0	499.0	4.2	f	e	2	s	o	g	sf
9/10/2011	Greggo Seward	23:00	23:50	499.0	503.0	4.5	f	e	2	s	o	g	n
9/11/2011	Greggo Seward	10:50	11:28	493.0	494.0	4.4	f	e	3	s	o	g	n
9/11/2011	Greggo Seward	11:28	12:30	494.0	472.0	4.4	n	e	3	s	o	g	n
9/11/2011	Greggo Seward	12:30	13:00	472.0	445.0	4.4	n	e	3	s	o	g	sf

9/11/2011	Greggo Seward, Ron	13:00	14:01	445.0	421.0	4.3	n	e	2	s	o	g	sf
9/11/2011	Carl, Mark	14:01	16:00	421.0	462.0	4.3	s	e	2	s	o	g	sb
9/11/2011	Greggo Seward	16:00	17:00	462.0	494.0	4.4	f	s	3	s	o	g	wb
9/11/2011	Greggo Seward	17:00	18:00	494.0	500.0	4.4	f	s	3	s	o	g	wb
9/11/2011	Greggo Seward	18:00	19:00	500.0	483.0	4.4	f	e	3	s	o	g	n
9/11/2011	Greggo Seward	19:00	20:00	483.0	452.0	4.4	f	s	3	s	o	g	n
9/11/2011	Rad, Ron	20:00	22:00	452.0	437.0	4.4	f	s	3	s	o	g	n
9/11/2011	Greggo Seward	22:00	23:00	437.0	432.0	4.2	v	e	3	s	o	g	n
9/11/2011	Greggo Seward	23:00	23:40	432.0	434.0	4.2	s	e	3	s	o	g	n
9/12/2011	Greggo Seward	10:50	12:00	482.0	503.0	4.4	f	se	3	s	o	g	n
9/12/2011	Greggo Seward	12:00	13:00	503.0	486.0	4.2	f	se	3	s	o	g	sb
9/12/2011	Greggo Seward	13:00	14:00	486.0	453.0	4.2	f	se	3	s	o	g	sb
9/12/2011	Colin	14:00	14:30	453.0	450.0	4.3	f	se	3	s	o	g	sb
9/12/2011	Greggo Seward, Kat	15:55	16:57	445.0	431.0	4.3	n	se	3	s	o	g	wb
9/12/2011	Greggo Seward	16:57	17:55	431.0	432.0	4.3	s	e	3	s	o	g	wf
9/12/2011	Greggo Seward	17:55	19:00	432.0	445.0	4.2	f	e	2	s	o	g	vb
9/12/2011	Greggo Seward	19:00	20:00	445.0	451.0	4.1	f	e	2	s	o	g	wb
9/12/2011	Rad, Robin	20:00	22:00	451.0	496.0	4.1	f	e	2	s	o	g	sb
9/12/2011	Greggo Seward	22:00	23:00	496.0	492.0	4.1	f	ne	3	s	o	g	sb
9/12/2011	Greggo Seward	23:00	23:45	492.0	495.0	4.1	f	ne	3	s	o	g	wb
9/13/2011	Greggo Seward	10:50	11:16	446.0	441.0	4.3	r	e	2	s	o	g	n
9/13/2011	Greggo Seward, Bill	11:16	12:21	441.0	430.0	4.3	n	e	2	s	o	g	sb
9/13/2011	Greggo Seward	12:21	13:22	430.0	433.0	4.2	s	e	2	s	o	g	sf
9/13/2011	Greggo Seward	13:22	14:00	433.0	437.0	4.2	f	e	2	s	o	g	n
9/13/2011	Colin, Mark	14:00	16:00	437.0	461.0	4.2	f	e	2	s	o	g	wf
9/13/2011	Greggo Seward	16:00	17:00	461.0	495.0	4.2	f	e	2	s	o	g	n
9/13/2011	Greggo Seward	17:00	18:00	495.0	491.0	4.2	f	e	2	s	o	g	n
9/13/2011	Greggo Seward	18:00	19:00	491.0	495.0	4.0	f	ne	2	s	o	g	wb
9/13/2011	Greggo Seward	19:00	19:39	495.0	495.0	4.2	f	ne	2	s	o	g	wb
9/13/2011	Greggo Seward	19:39	20:00	495.0	490.0	4.2	n	ne	2	s	o	g	wb
9/13/2011	Greggo Seward	22:00	22:14	451.0	423.0	4.2	n	ne	3	s	o	g	sf
9/13/2011	Greggo Seward, Rad	22:14	23:14	423.0	434.0	4.3	n	ne	3	s	o	g	sf
9/13/2011	Greggo Seward	23:14	23:45	434.0	441.0	4.3	s	ne	3	s	o	g	n
9/14/2011	Greggo Seward	10:45	11:55	445.0	465.0	4.4	f	ne	3	s	o	g	n
9/14/2011	Greggo Seward	11:55	13:00	465.0	495.0	4.3	f	ne	3	s	o	g	sf
9/14/2011	Greggo Seward	13:00	14:00	495.0	491.0	4.4	f	ne	2	s	o	g	sf
9/14/2011	Bill, Mark	14:00	15:30	491.0	496.0	4.4	f	ne	2	s	o	g	sf
9/14/2011	Greggo Seward	16:00	17:10	490.0	475.0	4.4	n	ne	3	s	o	g	wf
9/14/2011	Greggo Seward	17:10	18:07	475.0	405.0	4.3	n	ne	3	s	o	g	wb
9/14/2011	Greggo Seward, Kat	18:07	19:07	405.0	441.0	4.3	n	n	3	s	o	g	wb
9/14/2011	Greggo Seward	19:07	20:00	441.0	460.0	4.3	s	n	3	s	o	g	wf
9/14/2011	Rad, Trent	20:00	22:00	460.0	480.0	4.4	s	n	3	s	o	g	sf
9/14/2011	Greggo Seward	22:00	23:00	480.0	504.0	4.4	f	n	3	s	o	g	sf
9/14/2011	Greggo Seward	23:00	23:45	504.0	502.0	4.5	f	n	3	s	o	g	sf
9/15/2011	Greggo Seward	10:45	10:57	495.0	495.0	4.4	f	ne	2	s	o	g	n
9/15/2011	Greggo Seward	10:57	12:00	495.0	483.0	4.4	n	ne	2	s	o	g	n
9/15/2011	Greggo Seward	12:00	13:00	483.0	464.0	4.4	n	ne	2	s	o	g	vf
9/15/2011	Greggo Seward	13:00	13:55	464.0	363.0	3.7	n	ne	2	s	o	g	sf
9/15/2011	Greggo Seward, Jean	13:55	14:55	363.0	450.0	4.1	n	n	2	s	o	g	sb
9/15/2011	Greggo Seward	14:55	15:00	450.0	440.0	4.4	s	n	1	g	o	g	wb
9/15/2011	Jerzy, Rad	15:00	16:40	440.0	477.0	4.4	s	n	1	g	o	g	wb
9/15/2011	Greggo Seward	16:40	17:40	477.0	484.0	4.4	f	n	1	g	o	g	wb
9/15/2011	Greggo Seward	17:40	18:40	484.0	504.0	4.4	f	n	1	g	o	g	wb
9/15/2011	Greggo Seward	18:40	19:40	504.0	492.0	4.4	f	n	1	g	o	g	n

9/15/2011	Greggo Seward	19:40	20:40	492.0	543.0	4.5	f	n	1	g	o	g	wf
9/15/2011	Trent	20:40	21:42	543.0	452.0	4.4	f	n	1	g	o	g	sf
9/15/2011	Greggo Seward, Larry, Kat	22:41	23:41	447.0	430.0	4.5	n	n	1	g	o	g	sf
9/15/2011	Greggo Seward	23:41	23:45	430.0	429.0	4.4	r	n	1	g	o	g	n
9/16/2011	Greggo Seward	10:50	11:48	453.0	468.0	4.4	s	e	2	s	o	g	n
9/16/2011	Greggo Seward	11:48	12:45	468.0	476.0	4.4	f	e	2	s	o	g	wb
9/16/2011	Greggo Seward	12:45	13:45	476.0	484.0	4.4	f	e	2	s	o	g	sb
9/16/2011	Greggo Seward	13:45	14:00	484.0	491.0	4.3	f	e	2	s	o	g	sb
9/16/2011	Jean, Jerzy	14:00	16:00	491.0	475.0	4.4	f	e	2	s	o	g	sb
9/16/2011	Greggo Seward	16:00	17:00	475.0	453.0	4.4	f	e	2	s	o	g	wb
9/16/2011	Greggo Seward	17:00	17:53	453.0	449.0	4.4	f	e	2	s	o	g	wb
9/16/2011	Greggo Seward, Rad, Kat	20:19	21:21	434.0	455.0	4.2	n	ne	3	c	o	g	sb
9/16/2011	Greggo Seward	21:21	22:21	455.0	495.0	4.4	s	ne	3	c	o	g	sb
9/16/2011	Greggo Seward	22:21	23:00	495.0	491.0	4.4	f	ne	2	s	o	g	sb
9/16/2011	Greggo Seward	23:00	23:40	491.0	469.0	4.3	f	ne	2	s	o	g	sb
9/17/2011	Greggo Seward	10:50	11:33	467.0	488.0	4.4	n	e	2	s	o	g	n
9/17/2011	Greggo Seward, Bill	11:33	12:42	488.0	490.0	4.4	n	e	2	s	o	g	sb
9/17/2011	Greggo Seward	12:42	13:44	490.0	470.0	4.4	s	e	2	s	o	g	vb
9/17/2011	Greggo Seward	13:44	14:35	470.0	470.0	4.4	f	e	2	s	o	g	n
9/17/2011	Greggo Seward, Liam	15:57	16:57	451.0	474.0	4.5	n	e	3	c	o	g	n
9/17/2011	Greggo Seward	16:57	17:49	474.0	483.0	4.4	s	se	4	c	o	g	n
9/17/2011	Greggo Seward	17:49	18:45	483.0	495.0	4.4	f	se	3	s	o	g	n
9/17/2011	Greggo Seward	18:45	19:45	495.0	453.0	4.3	n	se	2	s	o	g	n
9/17/2011	Greggo Seward	19:45	20:00	453.0	426.0	4.4	n	se	2	s	o	g	n
9/17/2011	Greggo Seward	22:00	22:23	400.0	401.0	4.4	n	e	2	s	o	g	wb
9/17/2011	Greggo Seward, Mihow	22:23	23:23	401.0	407.0	4.3	n	e	2	s	o	g	wb
9/17/2011	Greggo Seward	23:23	23:40	407.0	407.0	4.4	r	e	2	s	o	g	n