CNOOC INTERNATIONAL
FLEMISH PASS EXPLORATION DRILLING (2018 – 2028)

Environmental Impact Statement Addendum (Revised) Responses to Information Requirements and Required Clarifications

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Appendix B Trajectory Modelling in Support of the CNOOC International Flemish Pass Exploration Drilling Project (2018-2028) Relief Well Modelling Scenario

Appendix C CNOOC International Flemish Pass Exploration Drilling Project (2018-2028); Environmental Impact Statement; Section 16 Accidental Events: Environmental Effects Assessment (REVISED)

ACRONYMS AND SHORT FORMS

ADM	Advection Dispersion Model
ADW	Application to Drill a Well
Agency	Canadian Environmental Assessment Agency
BoF	Bay of Fundy
BOP	Blowout Preventer
CEAA	*Canadian Environmental Assessment Act*
CEPA	*Canadian Environmental Protection Act*
CO_2	Carbon Dioxide
C-NLOPB	Canada-Newfoundland and Labrador Offshore Petroleum Board
CBD	Convention on Biological Diversity
CNOOC	CNOOC Petroleum North America ULC. (formerly Nexen Energy ULC)
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWS	Canadian Wildlife Services
DFO	Fisheries and Oceans Canada
DP	Dynamically Positioned
DND	Department of National Defence
DWH	Deepwater Horizon
EA	Environmental Assessment
EBSA	Ecologically and Biologically Significant Area
ECCC	Environment and Climate Change Canada
ECMP	Environmental Compliance Monitoring Plan
ECMWF	European Centre for Medium-Range Weather Forecasts
ECRC	Eastern Canada Response Corporation
EEZ	Exclusive Economic Zone
EIS	Environmental Impact Statement
EL	Exploration Licence
EO	Environmental Observer
EPCMP	Environmental Protection and Compliance Monitoring Plan
EPP	Environmental Protection Plan
FAD	Fish Aggregation Device
FCAs	Fishing Closure Areas

FTWT	Formation Testing While Tripping
GB	Grand Bank
GHG	Greenhouse Gas
GPS	Global Positioning System
IBA	Important Bird Area
iBoF	Inner Bay of Fundy
ICOADS	International Comprehensive Ocean-Atmosphere Data Set
IR	Information Requirement
IUCN	International Union for Conservation of Nature
LOMA	Large Ocean Management Area
LSA	Local Study Area
MAH	Major Accident Hazards
MMO	Marine Mammal Observer
MODU	Mobile Offshore Drilling Unit
MSC	Meteorological Service of Canada
MSW	Multi-Sea-Winter
MTI	Mi'gmawe'l Tplu'taqnn Incorporated
NAFO	Northwest Atlantic Fisheries Organization
NEBA	Net Environmental Benefit Analysis
NL	Newfoundland and Labrador
NOBE	Newfoundland Offshore Burn Experiment
NO_x	Nitrogen Oxide
NRCan	Natural Resources Canada
OA	Operations Authorization
oBoF	Outer Bay of Fundy
OCSG	Offshore Chemical Selection Guidelines for Drilling and Production Activities on Frontier Lands
ODI	Ocean Data Inventory
OSR	Oil Spill Response
OSRP	Oil Spill Response Plan
OWTG	Offshore Waste Treatment Guidelines
PAH	Polycyclic Aromatic Hydrocarbons
PAM	Passive Acoustic Monitoring
PB	Placentia Bay

PNET	Predicted No Effect Threshold
PSV	Platform Supply Vessel
RMS	Root Mean Square
ROV	Remotely Operated Vehicle
RSA	Regional Study Area
SA	Subscription Agreement
SAR	Species at Risk
SARA	*Species at Risk Act*
SBM	Synthetic Based Mud
SDL	Significant Discovery Licence
SHP	Seabird Handling Permit
SIMA	Spill Impact Mitigation Assessment
SSDI	Subsea Dispersant Injection
SST	Sea Surface Temperature
THC	Total Hydrocarbon Concentrations
TNASS	Trans North Atlantic Sightings Survey
TTS	Temporary Threshold Shift
UD	Utilization Distributions
UK	United Kingdom
UN	United Nations
UNB	University of New Brunswick
UXO	Unexploded Ordnance
VC	Valued Component
VME	Vulnerable Marine Ecosystem
VOC	Volatile Organic Compounds
VSP	Vertical Seismic Profile
WBM	Water Based Mud
WMP	Waste Management Plan

1 INTRODUCTION

CNOOC Petroleum North America ULC (formerly Nexen Energy ULC), a wholly-owned subsidiary of CNOOC Limited (CNOOC), is planning to conduct a program of petroleum exploration drilling and associated activities in the eastern portion of the Canada-Newfoundland and Labrador Offshore Area over the period 2018 to 2028. The Project Area as assessed includes two Exploration Licences (EL 1144 and EL 1150) in the Flemish Pass region for which CNOOC is currently the Operator and sole interest holder, and which have not yet been subject to exploration drilling activity pursuant to these licences. In support of this project, CNOOC has filed a Project Description (April 13, 2017) and an Environmental Impact Statement (February 21, 2018) (the EIS Report) with the Canadian Environmental Assessment Agency (the Agency).

The Agency has initiated its technical review of the EIS Report and has received submissions from government experts, the public and Indigenous groups and has analyzed their comments. The Agency has determined that additional information (IRs) or clarifications (CLs) are required as part of their technical review. The Agency consolidated the preliminary IRs and CLs and provided them to CNOOC on June 08, 2018 as "Round One Information Requirements and Required Clarifications for the Nexen Energy ULC Flemish Pass Exploration Drilling Project".

This EIS Addendum Report (the EIS Addendum) is provided as a supplement to the EIS Report and provides responses to address the IRs or CLs required by government departments and agencies and other organizations as part of the technical review, The EIS Addendum is a cumulative document that will be updated with any subsequent IR and CL responses during the technical review of the EIS Report.

Some of the Round One IRs or CLs required additional oil spill modelling work to be completed. As a result, the responses provided by CNOOC to the Round One IRs and CLs were to be provided in two parts (Part One and Part Two). CNOOC submitted the "Round One Part One" responses to CEAA in September 2018. In October 2018, CEAA identified three IRs (IR-04, IR-17, and IR-45) from the Round One Part One package that required additional information. This revised EIS addendum (February 2019) submission includes the original Round One Part One responses, the revised responses to IR-04, IR-17, and IR-45, plus the additional "Round One Part Two" responses which encompass the additional oil spill modelling work that has been completed. The report from the additional oil spill modelling work is also included in an accompanying appendix to this revised addendum document.

In order to facilitate readability, and in keeping with other such documents prepared for recent projects and their assessments, this EIS Addendum is presented in a "question and answer" format in the numerical order established by the Agency. To aide the reader to understand which responses were already included in previously submitted EIS Addendum documents, each IR and CL has been "tagged" as "Part One Response – September 2018", "Text Corrected – February 2019", or "Revised Response – February 2019" and these tags show up in the compiled table of contents. Any subsequent versions of the EIS Addendum that are submitted to the Agency will include suitably named tags to identify the revised or new IRs or CLs at that time.

2 RESPONSES TO INFORMATION REQUIREMENTS

2.1 Project Description

2.1.1 Information Requirement: IR-01 (Part One Response – September 2018)

External Reviewer(s): KMKNO-02-Nx

Project Effects Link to CEAA 2012: Section 5 – All

Reference to EIS Guidelines: Part 2, Section 3 Project Description

Reference to EIS: Section 2.1 Project Scope and Overview; Section 2.5.2.2 Offshore Well Drilling; Section 4.1 Scope of the Environmental Assessment and Factors Considered

Context and Rationale: The EIS states that the Project may at times have multiple drilling units operating simultaneously (Sections 2.1 and 4.1). It is unclear throughout the effects analysis how simultaneous drilling was considered. For example, potential overlapping effects of dual sources of noise or light was not assessed in the analysis of effects; in contrast, Section 13.3.3 of the EIS provides an analysis of the maximum percentage of Project Area and RSA that would be excluded to commercial fisheries if up to three MODUS were operating at the same time.

The EIS states that batch drilling, which is the process of consecutively drilling the top hole portions of a well for multiple wells, may occur (e.g. Sections 2.5.2.2). No further information is provided, nor does the effects analysis consider project effects from batch drilling.

Specific Question or Information Requirement: Provide the following information on the proposed Project and associated environmental effects:

- Clarify circumstances under which simultaneous drilling and batch drilling could occur.
- Provide additional information on how batch drilling is undertaken, including an explanation of how the integrity of the wellbore is secured prior to moving to the next well.
- Provide additional information assessing the environmental effects of simultaneous drilling and batch drilling on relevant VCs.

Update proposed mitigation and follow-up, as well as significance predictions, as applicable.

Response:

Simultaneous Drilling Operations

The purpose of exploration drilling is to identify the presence and appraise size and commercial viability of potential hydrocarbon resources. Due to the uncertainty around the presence of a resource, the number of wells and timelines has been estimated based on a notional maximum level of activity that could be experienced during the exploration-appraisal phase of the Project. Simultaneous drilling operations have been considered for the purposes of the Environmental Impact Statement (EIS) as a conservative estimate of the volume of drilling activity that can potentially occur in the Project Area.

The potential for simultaneous operations with multiple mobile offshore drilling units (MODUs) would depend on a variety of factors such as exploration drilling success, project timing, MODU availability, as well as the complexity of the characterization of the subsurface. Multiple MODUs operating simultaneously might be employed to complete a scope of work in a shorter timeframe.

CNOOC Petroleum North America ULC (CNOOC) is not planning to use more than one MODU given the regulatory requirements for individual MODU certification and the planned scope of the exploratory drilling program. CNOOC will not have multiple MODUs operating simultaneously as part of this project. The noise modelling assessment described in the EIS remains valid.

Batch Drilling
Batch drilling would be considered if the plan involved drilling multiple close proximity wells with similar well designs. With the necessary regulatory approvals in place for each of the wells, the drilling operations would occur using a single MODU, working on similar sections of each well in a consecutive fashion. Moving off a well location would only occur when the well is properly secured. One common industry practice is to batch drill the riserless top hole sections of close proximity wells. These sections are drilled using water based drilling fluid systems, large diameter casing, wellheads, similar cementing systems and drilling techniques. Batch drilling of wells is employed when there are practical points in the well construction operations to stop drilling and secure the well. There are several points during well construction where barriers are naturally in place and / or can be readily installed prior to moving the MODU.

The well would be secured according to the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) Drilling and Production Guidelines, industry best practices, and CNOOC corporate policies. In all instances, appropriate barriers would be in place and verified prior to moving to the next well. Regulatory approval is required to leave the well in a temporarily suspended / secured state prior to moving to another well.

CNOOC is not planning to use more than one MODU given the regulatory requirements for individual MODU certification and the planned scope of the exploratory drilling program.

Environmental effects of simultaneous drilling and batch drilling on relevant valued components (VCs). Update proposed mitigation and follow-up, as well as significance predictions, as applicable.
By executing common sections of wells consecutively using batch drilling, the Project should see a reduction in the overall time to drill an individual well. The benefits of batch drilling should include:

- Health and safety- through the enhanced crew efficiency working on similar hole sections and equipment and reduction in the swapping of fluid systems.
- Environment– reduced time on each well, reduced vessel activity and reduction in the swapping of fluid systems; shorter periods of noise or other disruption at each well site.
- Equipment similarities – crew familiarity with well equipment reducing the time to conduct drilling operations.
- Conducting weather sensitive operations in favorable conditions reducing potential time where drilling activity is waiting for weather to dissipate.

CNOOC will not conduct simultaneous drilling for this project. If batch drilling is considered, it will reduce the duration of several activities (time on well, vessel movement, fluids swapping, and noise), thus reducing disturbance to VCs. With the application of mitigation presented in the EIS, the effects predictions on VCs presented in the EIS remain valid.

References:
No additional references.

2.1.2 Information Requirement: IR-02 (Part One Response – September 2018)

External Reviewer(s): Unknown

Project Effects Link to CEAA 2012: Section 5 – All

Reference to EIS Guidelines: Part 2, Section 3.2 Project Activities

Reference to EIS: Section 2.7 Project Schedule

Context and Rationale: Section 2.7 of the EIS indicates that it will take 5 to 20 days for pre-drill site investigation and site preparation.

Section 2.7 of the EIS indicates approximately 45 to 160 days will be required for drilling, evaluation (including sidetracking and potential well testing, if required) and well abandonment or suspension.

Specific Question or Information Requirement: Provide a description of what is included in pre-drill site investigation and site preparation, including potential timeframes.

Provide clarification on the 45 to 160 day time frame for each of drilling, evaluation, and well abandonment or suspension, including information on the minimum and maximum timeframes for each step (i.e. drilling, evaluation and well abandonment or suspension).

Explain how batch drilling may affect drilling timelines.

Response:

Provide a description of what is included in pre-drill site investigation and site preparation, including potential timeframes.

The pre-drill seabed investigation referenced in Section 2.7 of the Environmental Impact Statement (EIS) is conducted in advance of drilling operations and involves the acquisition of wellsite specific video or still picture data of the seabed at and immediately surrounding the wellsite. This seabed data is usually acquired using a drop camera / video system that can be deployed from a separate support vessel or from the Mobile Offshore Drilling Unit (MODU). The seabed investigation is completed prior to drilling and the data collection can usually be completed within a day. The results of the seabed investigation are provided to the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) and Fisheries and Oceans Canada (DFO). The actual length of a seabed investigation can vary depending on equipment capabilities, sea state, and the number of well sites investigated.

Provide clarification on the 45 to 160 day time frame for each of drilling, evaluation, and well abandonment or suspension, including information on the minimum and maximum timeframes for each step (i.e. drilling, evaluation and well abandonment or suspension).

Each well is unique and has different characteristics that will influence the overall drilling duration including: total / reservoir depth, well specific lithology, temperature gradient, pore pressure / fracture gradient, water depth, technical / well design, and formation evaluation, physical environment / weather conditions. The low side of the estimated 45 to 160 day range (45 days) would represent the duration of an unsuccessful shallow exploration well with minimal formation evaluation and permanent abandonment. The high side of the estimated 45 to 160 day range (160 days) would represent a successfully completed deep exploration well which undergoes detailed formation evaluation (wireline logging, coring, and well testing), a geological sidetrack, and permanent abandonment. The following table summarizes possible activities and a range of

potential durations that could make up the total drilling duration for an individual exploration well (Table IR-02.1).

Table IR-02.1 Possible Exploration Well Activities and a Range of Potential Drilling Durations

Activity	Estimated Minimum Duration (Days)	Estimated Maximum Duration (Days)
Drilling	37	81
Evaluation	1	55
Permanent Abandonment	7	24
DURATION	45	160

Explain how batch drilling may affect drilling timelines.

Batch drilling, if utilized, could reduce the drilling duration of the main wellbore, thus optimizing / reducing the overall schedule. As outlined in the response to Information Requirement (IR)-01, by executing common sections of close proximity wells consecutively, there should be a reduction in the overall time to drill an individual well through crew efficiency / familiarity with the well section. Batch drilling would be expected to affect the drilling portion of the durations noted above.

References:

No additional references.

2.1.3 Information Requirement: IR-03 (Part One Response – September 2018)

External Reviewer(s): MMS-01-Nx; NunatuKavut-12-Nx

Project Effects Link to CEAA 2012: Section 5 – All

Reference to EIS Guidelines: Part 2, Section 3.2.3 Decommissioning, Suspension or Abandonment of Wells

Reference to EIS: Section 2.5.2.5 Well Abandonment or Suspension

Context and Rationale: With respect to well abandonment and/or suspension, the EIS states that if removal of equipment extending above the mudline is required, the casing will be cut just below the mudline and upper sections of the casing and the wellhead will be recovered to the surface. Section 2.5.2.5 states that after removal of equipment, an ROV or other equipment will be used to inspect the seabed to ensure that no equipment or obstructions remain, however, Indigenous groups have noted that there is no information provided regarding whether ongoing follow-up inspections will be undertaken to ensure the integrity of the well abandonment and/or suspension.

It is stated that well abandonment will adhere to the requirements set out in the Newfoundland Offshore Petroleum Drilling and Production Regulations, as well as Nexen's internal governance. In addition, Section 2.5.2.5 of the EIS states that "[i]n the event that planned, conventional well abandonment techniques such as those described above are ineffective for a particular well, alternative approaches may be required and will be investigated and implemented in consultation with relevant regulatory authorities and in compliance with applicable authorizations." However, the alternatives are not presented or discussed.

The NunatuKavut Community Council has suggested that to ensure safety and protection of the marine environment, there must be frequent monitoring and inspection after the decommissioning occurs. Similarly, the MMS indicated the need to ensure that the techniques used for well decommissioning or suspension are sustainable over time.

Specific Question or Information Requirement: With respect to the activities associated with well abandonment and/or suspension, provide the following information:

- Specify the lifespan of the well abandonment and suspension techniques. Explain whether they would be sustainable to ensure the long-term protection of the environment, describing how integrity of the abandoned or suspended well is ensured.
- Provide information on frequency of inspection.
- Provide a description of Nexen's internal requirements for well abandonment that are additional to those required by the Newfoundland Offshore Petroleum Drilling and Production Regulations.
- Provide a discussion on the alternative approaches that may be taken if conventional well abandonment techniques are not effective, including if there are potential environmental effects and applicable mitigation.

Response: Well abandonment or suspension will adhere to the requirements set out under the Newfoundland Offshore Petroleum Drilling and Production Regulations (the Regulations), as well as CNOOC Petroleum North America ULC's (CNOOC's) internal policies, to ensure long-term environmental protection. CNOOC policies stipulate that wells are abandoned or suspended with a minimum of two barriers to any hydrocarbon formation in place. All elements of these barriers must be verified after placement. The lifespan of the abandonment measures is intended to be infinite.

There is no regulatory requirement for monitoring / inspecting abandoned wells. For suspended wells, a visual observation program would be established and the frequency of the observations would depend on a well integrity assessment which considers the well status, the subsurface conditions, and marine activity levels. A monitoring plan for suspended wells would be provided to the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) for their review and comment.

The alternative techniques referenced in Section 2.5.2.5 of the Environmental Impact Statement (EIS) include different wellhead recovery and annular cement placement tools that are currently in various stages of industry development. Conventional mechanical wellhead cutting tools have had varying success in open water. Alternatively, there are now abrasive jet and innovative swivel-free mechanical cutters on the market that can be deployed with a Platform Supply Vessel (PSV) or other type of vessel that could potentially have a higher success under varying open water conditions. New annular cement placement tools have been developed that can place an annular barrier that extends across the full cross section of the well (as an alternative to the conventional perforate and cement squeeze operation). As new technology emerges, CNOOC will continue to evaluate industry alternatives for permanent well abandonment and wellhead removal techniques that could increase reliability and effectiveness.

References:

Government of Canada. 2014. Newfoundland Offshore Petroleum Drilling and Production Regulations. SOR/2009-316. Published by the Minister of Justice. Current to June 10, 2018. Last amended on December 31, 2014. Available online: http://laws-lois.justice.gc.ca/PDF/SOR-2009-316.pdf. Accessed June 2018.

2.1.4 Information Requirement: IR-04 (Revised Response – February 2019)

External Reviewer(s): C-NLOPB-1-Nx; Ekuan-07-nx; MFN-11-Nx; MFN-12-Nx; MFN- 19-Nx

Project Effects Link to CEAA 2012: Section 5 – All

Reference to EIS Guidelines: Part 2, Section 2.2 Alternative Means of Carrying Out the Project

Reference to EIS: Section 2.5.1 MODU Selection Process and Possible Drilling Units; Section 2.9.4 Other Liquid and Solid Waste Materials; 2.10 Identification and Evaluation of Alternatives; Section 2.9 Potential Environmental Emissions and Waste Management.

Context and Rationale: The EIS Guidelines indicate that the EIS should describe the management or disposal of wastes (e.g. type and constituents of waste, quantity, treatment, and method of disposal). The EIS refers to storage capacity needed for drilling materials and equipment, as well as reagents used for drilling. The C-NLOPB stated that insufficient information on the volume of stored fluids and solids is provided, and it is not clear what the significance of the effects of stored agents could be without an adequate description.

Likewise, the composition and quantity of liquid wastes such as fire control water, produced water, bilge and deck drainage water, ballast water, grey/black water, cooling water, food waste, testing fluids and liquid wastes such as waste chemicals, cooking oils or lubricating oils, are not discussed.

The EIS Guidelines also state that the proponent should include a discussion on how wastes and potential associated toxic substances would be minimized, any alternatives that would enable the proponent to achieve waste management objectives, and adopt best practices in waste management and treatment. Section 2.10 discusses how the waste will be treated in order to comply with guidelines and/or requirements, but provides no clear discussion of how the Proponent would minimize waste or possible alternatives that would allow achievement of defined objectives.

Furthermore, Section 2.9.4 of the EIS states that biocides may be used in cooling water to control growth of microorganisms in drilling machinery. Miawpukek First Nation has expressed concern that the EIS does not discuss the use of biocides in the effects analysis. It is unclear what biocides would be used and in what volumes.

Section 2.9 of the EIS states that a comprehensive Waste Management Plan similar to those used by the other Operators for comparable activities would be developed and implemented for the Project.

Specific Question or Information Requirement: Provide a general description of the Waste Management Plan, including the nature and scope of the proposed plan. Provide additional information on the alternatives that may have been examined with respect to waste management, and the measures that were considered with respect to minimizing waste generated.

With respect to waste generated and disposed of from the exploration activity:

- clarify the agents that may be used as part of the Project and assess associated environmental effects, including accidents and malfunctions, as applicable;
- clarify the volumes of liquid waste that may be generated, as well as the constituents of the waste;

- provide additional information on the treatment process prior to ocean discharge and explain whether treatment to acceptable levels for ocean discharge can be accomplished on the drilling installation and how it would be determined that all wastes meet guidelines before discharge; and
- provide further information on the types and amounts of biocides to be used, assessing the environmental effects of biocides on relevant VCs, and discussing potential effects of routine use and discharge, as well as accidental spills.

Update the effects analysis, proposed mitigation and follow-up, as well as significance predications, as applicable.

Response:

Provide a general description of the Waste Management Plan, including the nature and scope of the proposed plan. Provide additional information on the alternatives that may have been examined with respect to waste management, and the measures that were considered with respect to minimizing waste generated.

CNOOC Petroleum North America ULC (CNOOC) has not completed an exploration drilling program in the region so is unable to draw on its own regional experience for the various parts of this response. However, the proposed CNOOC activities and well designs are expected to be similar to other operator wells in the region. Therefore, CNOOC has summarized relevant information obtained from Equinor Canada Ltd. (Equinor) based on its 2017 exploration drilling programs completed in the region and has integrated that information as relevant examples in this response. The Equinor exploration drilling program executed May-2017 to Jul-2017 (i.e., 63 days) consisted of drilling two exploration wells. It should be noted that the initial CNOOC wells are expected to be deeper than the two Equinor wells drilled in 2017 which will take a longer period to complete and will alter the amounts of different waste streams. However, the Equinor waste streams are informative as to the types of waste streams that may be produced during an exploratory drilling program in the region.

As described in Section 1.3.2.2 of the Environmental Impact Statement (EIS), prior to drilling activities commencing, CNOOC is required to obtain an Operations Authorization (OA) from the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB). To obtain the OA, as outlined in Sections 6(d) and 9 of the Offshore Newfoundland Drilling and Production Regulations (Government of Canada 2014), CNOOC is required to prepare a number of detailed plans including an Environmental Protection Plan (EPP), which will include detailed information regarding waste management. The EPP will be prepared in accordance with the issued EPP Guidelines (NEB, et al 2010). The EPP will detail procedures and processes for handling, storage, transfer, and disposal of all wastes during the Project, and a comprehensive Waste Management Plan (WMP), similar to those used by other companies operating in the region for comparable activities, will be developed and implemented for the Project. Further details regarding waste minimization initiatives will be included in the EPPs or WMPs and will include reduction, re-use, recycling, and treatment.

The EIS provides additional information regarding each potential alternative including:

- Section 2.10.1 – Drilling Fluids Selection – Although specific drilling fluids have not yet been identified for the Project, the final selection of drill fluids will be conducted in accordance with the OSCG and their management will be carried out in accordance with the Offshore Waste Treatment Guidelines (NEB, et al 2010) (OWTG).

- Section 2.10.3 – Drilling Waste Management – Drilling wastes will be managed as per the OWTG. The preferred management option will depend on the drilling fluid selected and will either be disposed at sea, treated and then disposed at sea, or shipped to shore for disposal.
- Section 2.10.4 – Water Management and Location of Final Effluent Discharge Point – It is not feasible to change or reconfigure the location of effluent discharge points as MODUs will be provided by third party contractors. However, a MODU Certificate of Fitness is required to be submitted to the C-NLOPB during the OA application phase.
- Section 2.10.7 – Chemical Selection – The chemicals used for drilling operations will adhere to the regulatory requirements under the Offshore Chemical Selection Guidelines for Drilling & Production Activities on Frontier Land (NEB et al 2009) (OCSG). Chemicals that have the potential to be discharged to the marine environment will be selected in accordance with the OSCG to ensure they have a minimal effect on the receiving environment.

With respect to waste generated and disposed of from the exploration activity:

- **Clarify the agents that may be used as part of the Project and assess associated environmental effects, including accidents and malfunctions, as applicable:**

The reagents to be used for the Project have not been determined at this time. However, they are expected to be similar or the same as those used by other operators in the region. As outlined in Section 2.10.7 (Chemical Selection) of the Environmental Impact Statement (EIS), products that have the potential to be discharged to the marine environment will be selected in accordance with the Offshore Chemical Selection Guidelines for Drilling & Production Activities on Frontier Land (NEB et al 2009) (OCSG). The purpose of the OCSG is to minimize the potential environmental impacts from the discharge of chemicals used in offshore drilling and production operations (NEB et al 2009). Assessing the potential environmental effects of drilling reagents is not required as environmental protection elements are already embedded into the OCSG.

As previously noted, the initial CNOOC wells are expected to be deeper than the two Equinor wells drilled in 2017 which may alter the amounts of specific chemicals to be used. However, the Equinor 2017 information is a useful listing of the types of agents that may be used during an exploratory drilling program in the region. Equinor noted that the chemicals were screened as per the OCSG. The types of chemicals used for the Equinor 2017 exploration drilling program included:

- lime;
- caustic soda;
- soda ash;
- bentonite;
- barite;
- tannin-based thinner;
- Synthetic Isoalkane Drilling Mud Base;
- calcium chloride;
- glass-fibre cement additive;
- cellulose fibre;
- cement class G; and
- cement retarder.

CNOOC will keep records of its chemicals screened and will make them available to the C-NLOPB upon request.

With respect to waste generated and disposed of from the exploration activity:

- **Clarify the volumes of liquid waste that may be generated, as well as the constituents of the waste:**

The amount of liquid waste generated during exploration drilling activities are well-specific and depend on a number of variables including: the type of MODU, well design, weather, duration of activity, and number of personnel on board the MODU and standby vessel. Since the selection of well sites, facilities, equipment, and chemicals has not been completed by CNOOC at this stage of the project, specific volumes associated with the CNOOC Project were not included in the Environmental Impact Statement (EIS) and are not included in the response to this Information Requirement. As outlined in Section 1.4.2 of the Offshore Waste Treatment Guidelines (OWTG) (NEB et al 2010), CNOOC must submit monthly compliance reports to the C-NLOPB, which will include volumes of liquid wastes discharged to the marine environment. As detailed in the EIS, any waste discharged to the marine environment from the drilling installation will be in accordance with the OWTG (NEB et al 2010), while liquid wastes generated from vessels will be managed in accordance with the Ballast Water Control and Management Regulations (Government of Canada 2017), and the requirements from the International Maritime Organization (IMO).

The types of wastes generated by CNOOC activities are expected to be similar to those generated by other operators in the region but the volumes are expected to vary based on different well requirements. The types and amounts of liquid wastes generated by Equinor during its 2017 exploration drilling programs in the region are provided below for information purposes (Table IR-04.1). The liquid waste streams permitted to be discharged to the marine environment under the OWTG (NEB et al 2010) are further discussed in the next response below. Equinor included this waste information in its 2017 Drilling Campaign Environmental Report to the C-NLOPB, which is required under paragraph 87(2) of the Newfoundland Offshore Petroleum Drilling and Production Regulations (Government of Canada 2014). CNOOC will be required to submit annual environmental reports, including volumes of liquid waste, to the C-NLOPB for any future exploration drilling programs.

Table IR-04.1 Liquid Wastes Generated by Equinor During 2017 Exploration Drilling Program

Waste Category/Type	Unit	May 2017	June 2017	July 2017
Liquid Waste Discharged to the Marine Environment under OWTG				
Ballast Water	-	NA-Note 1	NA-Note 1	NA-Note 1
Bilge Water	L	13,800	8,900	9,200
BOP Testing Fluids	L	2,934	19,695	4,636
Cooling Water	-	NA-Note 2	NA-Note 2	NA-Note 2
Deck Drainage Water	L	451,500	1,002,000	338,500
Ecomac associated BOP Testing Fluids	L	88	985	232
Food Waste	-	NA-Note 3	NA-Note 3	NA-Note 3
Glycol associated with BOP Testing Fluids	L	147	1,970	464
Grey/Black Water	-	NA-Note 3	NA-Note 3	NA-Note 3
Produced Water	-	NA-Note 4	NA-Note 4	NA-Note 4
Water for testing fire control systems	-	NA-Note 5	NA-Note 5	NA-Note 5
Well treatment fluids	-	NA-Note 6	NA-Note 6	NA-Note 6
Liquid Waste Transferred to Shore for Treatment/Disposal				
Antifreeze/Glycol	L	410	0	0
Corrosives	L	0	0	0
Empty Drum with Residual	L	0	180	108

Flammable Liquids	L	0	0	0
Lean Liquids	L	0	0	0
Non-Hazardous Sludge	L	205	205	0
Paint/Paint Sludge	L	0	820	0
Solvents	L	0	0	0
Waste Drill Mud	L	28,400	165,220	216,600
Waste Oil	L	4,431	18,706	63,022
Waste Oil and Fuel	L	0	0	0
Wastewater	L	3,630	6,300	131,000

Notes:
1. As outlined in Section 2.7 of the OWTG, ballast water is permitted to be discharged without treatment or monitoring, provided it is segregated from bilge water. In the Equinor 2017 program, ballast water for the drilling installation was kept in segregated tanks and not mixed with drilling process water or runoff, therefore volumes were not required to be tracked.
2. As outlined in Section 2.11 of the OWTG, cooling water is permitted to be discharged, and there are no specific compliance monitoring or reporting requirements in the OWTG, and therefore volumes were not required to be tracked.
3. As outlined in Section 2.13 of the OWTG, sewage and food waste are macerated prior to discharge. There are no specific compliance monitoring or reporting requirements in the OWTG associated with this waste stream, and therefore volumes were not required to be tracked.
4. Produced water was not generated during Equinor's 2017 exploration drilling programs.
5. As outlined in Section 2.14 of the OWTG, water for testing fire control systems is permitted to be discharged without treatment. There are no specific compliance monitoring or reporting requirements in the OWTG associated with this waste stream, and therefore volumes were not required to be tracked.
6. Well treatment fluids were not used during Equinor's 2017 exploration drilling program.

With respect to waste generated and disposed of from the exploration activity:

- **Provide additional information on the treatment process prior to ocean discharge and explain whether treatment to acceptable levels for ocean discharge can be accomplished on the drilling installation and how it would be determined that all wastes meet guidelines before discharge:**

Section 9(j) of the Newfoundland Offshore Petroleum Drilling and Production Regulations (Government of Canada 2014) requires the EPP to include a description of the system for monitoring compliance of discharges to the natural environment. The EPP Guidelines (NEB et al 2011) refers to Section 9 of the Newfoundland Offshore Petroleum Drilling and Production Regulations (Government of Canada 2014) and indicates that operators may choose to prepare a separate document (e.g., Environmental Protection and Compliance Monitoring Plan (EPCMP) or similar) that provides an overview of the compliance monitoring system.

As outlined in Section 18.4.2 of the EIS, CNOOC will incorporate compliance monitoring into their EPP plans, which will be submitted to the C-NLOPB for review and approval as part of its OA application. The plans will contain detailed information regarding waste streams that are expected to be discharged to the marine environment including, but not limited to, discharge limits, treatment processes, compliance monitoring requirements, and non-compliance reporting requirements.

All waste discharges from drilling installations are regulated by the C-NLOPB. If waste streams listed in the OWTG (NEB et al 2010) are not in compliance with the discharge limits and/or requirements, then the waste

stream will not be discharged to the marine environment. The waste stream would either be re-treated offshore until the waste meets the approved discharge criteria and is then discharged or the waste would be transported back to shore for disposal.

The details on waste discharges are subject to change for each exploration drilling program as they depend on various factors including, but not limited to, the MODU selected, well design, third party service contractors selected, other third party equipment selected, and activities completed. The information outlined below on waste discharges is based on Equinor's 2017 experience with its exploration drilling programs in the region. The information is a summary of the waste streams that were discharged to the marine environment, and compliance monitoring and/or reporting requirements, when applicable. Equinor provided this information to the C-NLOPB in its 2017 Drilling Campaign Environmental Report, which is required under paragraph 87(2) of the Newfoundland Offshore Petroleum Drilling and Production Regulations (Government of Canada 2014), as well as the monthly compliance reports. CNOOC will be required to submit monthly compliance and annual environmental reports, including volumes of liquid waste, to the C-NLOPB for any future exploration drilling programs.

Ballast Water: On the Equinor 2017 exploration drilling program, ballast water on the MODU was kept in segregated tanks and not mixed with drilling process water, and therefore it did not need to be treated or monitored, which aligns with Section 2.7 of the OWTG. If the MODU does not keep the ballast water in segregated tanks, then the ballast water would need to be treated in a similar manner as bilge water (see below). The volumes of bilge water discharged are required to be included in the monthly compliance reports and annual environmental report submitted to the C-NLOPB.

Bilge Water from Contaminated Areas: During the Equinor 2017 exploration drilling program, bilge water was sent through an oil-water separator (OWS) prior to discharging to the marine environment. The OWS was designed to treat the bilge water to meet the OWTG requirements of oil in water concentration of less than or equal to (≤) 15 milligrams per litre (mg/L). To ensure that the discharge limit was met, the OWS was equipped with an oil in water analyzer which functioned on a continuous basis, and was also equipped with a detection and high-level alarm.

The discharge of treated water from the OWS was through a dedicated, hard piped, overboard valve and line on the port forward side of the MODU machinery space. Accumulated sludge in the OWS was removed and transported to shore for treatment/disposal by an approved waste management contractor.

Equinor reported volumes of bilge water discharged to the marine environment in the monthly compliance reports and its 2017 Drilling Campaign Environmental Report, which were submitted to the C-NLOPB. The volume of accumulated sludge removed from the OWS and transferred back to shore for treatment/disposal was also reported.

BOP Testing Fluids: During the Equinor 2017 exploration drilling program, routine testing of the BOP was completed to ensure it was functioning properly. A function test was completed every 7 days, while a pressure test was completed every 14 to 21 days, depending on the ongoing operations. There are no treatment or discharge limits associated with BOP testing fluids under the OWTG. However, volumes of BOP testing fluids and additives (i.e., Ecomac and glycol in the case of the Equinor 2017 exploration drilling program) were reported in the monthly compliance reports and its 2017 Drilling Campaign Environmental Report, which were submitted to the C-NLOPB.

Cooling Water: During the Equinor 2017 exploration drilling program, cooling water was extracted from the sea and used for cooling purposes before being returned to the sea. The OWTG does not outline any treatment, discharge limits or monitoring requirements associated with cooling water.

Deck Drainage Water: During the Equinor 2017 exploration drilling program, deck drainage water was sent through an OWS prior to discharging to the marine environment. The OWS was designed to treat the deck drainage water to meet the requirements in Section 2.6 of the OWTG (i.e., oil in water concentration of ≤15 mg/L). To ensure that the discharge limit was met, the OWS was equipped with an oil in water analyzer which functioned on a continuous basis, and was also equipped with a detection and high-level alarm.

The discharge of treated water from the OWS was through a dedicated, hard piped, overboard valve and line on the port forward side of the MODU machinery space. Accumulated sludge in the OWS was removed and transported to shore for treatment/disposal by an approved waste management contractor.

Equinor reported volumes of deck drainage water discharged to the marine environment in the monthly compliance reports and its 2017 Drilling Campaign Environmental Report, which were submitted to the C-NLOPB. The volume of accumulated sludge removed from the OWS and transferred back to shore for treatment/disposal was also reported.

Food Waste and Grey/Black Water: During the Equinor 2017 exploration drilling program, food waste and grey/black water were macerated to 6 millimetres (mm) and discharged to the marine environment, in accordance with Section 2.13 of the OWTG.

Produced Water: Well testing was not completed during the Equinor 2017 exploration drilling program, therefore produced water was not generated.

Water for Testing Fire Control Systems: As outlined in Section 2.14 of the OWTG, water for testing fire control systems is permitted to be discharged without treatment, and there are no monitoring or discharge limits outlined in the OWTG.

Well Treatment Fluids: Well treatment fluids were not used during the Equinor 2017 exploration drilling programs.

With respect to waste generated and disposed of from the exploration activity:

- **Provide further information on the types and amounts of biocides to be used, assessing the environmental effects of biocides on relevant VCs, and discussing potential effects of routine use and discharge, as well as accidental spills.**

As discussed in Section 2.9.4 of the Environmental Impact Statement (EIS), products that have the potential to be discharged to the marine environment will be selected in accordance with the Offshore Chemical Selection Guidelines for Drilling & Production Activities on Frontier Lands (NEB et al 2009) (OCSG). The OCSG provide a procedure and criteria for offshore chemical selection, and the objective is to promote the selection of lower toxicity chemicals to reduce the potential environmental effects of a discharge where technically feasible.

The type of biocides that could potentially be used for future exploration drilling programs is subject to change as it will be specific to the equipment selected and specific operational requirements. The Equinor information provided below, based on its 2017 exploration drilling programs in the region, is provided for information purposes. A biocide (i.e., Myacide™GA25) was screened by Equinor under the OCSG process but was not used during the 2017 exploration program so a volume is not applicable.

Sections 2.11 of the OWTG (NEB et al 2010) outlines the requirement to identify any biocide, and concentrations, that may be discharged to the sea in cooling water, in the EPP that will be filed with the C-NLOPB for review. Section 2.13 of the OWTG (NEB et al 2010) also requires that the operator describe any biocide, and concentrations, that may be discharged to the sea in sewage; this section does not specifically state that the information must be included in the EPP, however, CNOOC expects to incorporate it into the EPP, if applicable.

Further assessing the potential environmental effects of cooling water containing biocides would be duplicative as environmental protection elements are already embedded into the OCSG and OWTG (NEB). Therefore, the proposed mitigation measures and follow-up measures discussed in the EIS do not need to be updated.

References:

Canada-Newfoundland and Labrador Offshore Petroleum Board Government of Canada. 2014. Newfoundland Offshore Petroleum Drilling and Production Regulations. SOR/2009-316. Published by the Minister of Justice. Current to June 10, 2018. Last amended on December 31, 2014. Available online: http://laws-lois.justice.gc.ca/PDF/SOR-2009-316.pdf. Accessed August 2018.

Government of Canada. 2017. Ballast Water Control and Management Regulations. Available online: http://laws-lois.justice.gc.ca/PDF/SOR-2011-237.pdf. Accessed August 2018.

IMO (International Maritime Organization). 2017. International Convention for the Prevention of Pollution from Ships (MARPOL), Consolidated Edition. Accessed August 2018.

NEB, Canada-Nova Scotia Offshore Petroleum Board and Canada-Newfoundland and Labrador Offshore Petroleum Board. 2010. Offshore Waste Treatment Guidelines. Available online: http://www.cnlopb.ca/pdfs/guidelines/owtg1012e.pdf?lbisphpreq=1. Accessed August 2018.

NEB (National Energy Board), Canada-Nova Scotia Offshore Petroleum Board and Canada-Newfoundland and Labrador Offshore Petroleum Board. 2009. Offshore Chemical Selection Guidelines for Drilling & Production Activities on Frontier Lands. Available online: http://www.cnlopb.ca/pdfs/guidelines/ocsg.pdf?lbisphpreq=1. Accessed August 2018.

NEB, Canada-Nova Scotia Offshore Petroleum Board and Canada-Newfoundland and Labrador Offshore Petroleum Board. 2011. Environmental Protection Plan Guidelines. Available online: http://www.cnlopb.ca/pdfs/guidelines/env_pp_guide.pdf?lbisphpreq=1. Accessed August 2018.

2.1.5 Information Requirement: IR-05 (Part One Response – September 2018)

External Reviewer(s): Unknown

Project Effects Link to CEAA 2012: Section 5 – All

Reference to EIS Guidelines: Part 2, Section 3.1 Project Components

Reference to EIS: Section 2.5 Project Components and Activities; Section 2.9.4 Other Liquid and Solid Waste Materials; Section 2.1 Project Scope and Overview

Context and Rationale: Section 2.1 of the EIS states that up to 10 wells (exploration or delineation) could be drilled. It is not clear from the description that the delineation wells would be drilled in relation to the exploration wells in ELs 1144 and 1150.

As well, the EIS does not describe if there are any differences between the environmental effects of delineation wells and exploration wells.

Specific Question or Information Requirement: Clarify the following:

- how many exploration wells could be drilled within Nexen-operated ELs 1144 and 1155; and
- how many delineation/appraisal wells could be drilled within ELs 1144 and 1155 in relation to proposed exploration wells on those same licences.

Describe whether there are differences between the activities associated with exploration and delineation drilling and the associated environmental effects.

Response: As discussed in Sections 1.2.2 and 2.1 of the Environmental Impact Statement (EIS) and Part 1, Section 3.1 of the EIS Guidelines, the total number of proposed wells that could be drilled is 10. Section 1.2.2 of the EIS states that CNOOC Petroleum North America ULC (CNOOC) is proposing that a maximum of 10 wells (exploration and delineation) would be drilled. As defined within Section 1.2.2 of the EIS, these 10 wells represent surface (seabed) wellhead locations and not subsurface bottom hole locations which may be associated with sidetracking from the main wellbore. The number of delineation/appraisal wells which could be drilled within ELs 1144 and 1150 is dependent on the results of the exploration wells. Delineation/appraisal wells are only required should the exploration wells identify potential hydrocarbons. In such cases, the number of delineation/appraisal wells will depend on the geologic characteristics including oil/water and/or gas/oil contacts, and faulting and segmentation of the reservoir.

The methods and equipment to drill exploration and delineation/appraisal wells are the same, and so there is no difference in the potential environmental effects.

References:
No additional references.

2.1.6 Information Requirement: IR-06 (Part One Response – September 2018)

External Reviewer(s): Unknown

Project Effects Link to CEAA 2012: Section 5 – All

Reference to EIS Guidelines: Part 2, Section 3.1 Project Components

Reference to EIS: Section 1.2.2 Key Project Components and Activities; Section 2.9.4 Other Liquid and Solid Waste Materials

Context and Rationale: Section 1.2.2 of the EIS states sidetracking of the lower portions of the main wellbore may be required for geological or mechanical reasons. No further description is provided in the EIS.

Section 2.9.4 of the EIS states that a well test could involve acid stimulation and that spent acid would be captured at surface and shipped to shore. There is no description provided of how this activity would be carried out, in what circumstances, reagent requirements, etc.

A full description is required of proposed activities in order to understand the associated potential for environmental effects.

Specific Question or Information Requirement: Provide a description of project components and activities, including acid stimulation and sidetracking.

Update the effects analysis as appropriate.

Response:
Section 1.2.2 of the Environmental Impact Statement (EIS) provides a discussion of the key Project Components and activities. These are also covered off in sections 3.1 and 3.2 of the EIS Guidelines.

Acid Stimulation
Acid stimulation is a localized downhole activity that is performed to increase a reservoir's ability to produce hydrocarbons. Sometimes a well initially exhibits low permeability and stimulation is performed to initiate production. The acid is used to dissolve soluble substances in the formation thereby increasing the permeability of a reservoir. The effect of the acid would be constrained within close proximity at significant depths below the seabed, therefore not interacting with the marine environment.

The acid is deployed downhole using steel tubing allowing it to be placed in a specific location where the reservoir formation is exposed, typically by directed perforations through steel casing and cement into the reservoir. After an acid stimulation job is performed, the used acid and sediments removed from the reservoir are washed out of the well in a process called backflush. This backflush will consist of largely consumed or neutralized acid due to its reaction with formation materials. The backflush material would be collected and transported onshore for proper disposal.

Not all reservoirs require acid stimulation to flow and currently there are currently no plans to employ this technique on the Project. However, it has been included in the EIS to ensure all potential activities are identified and assessed.

Sidetracking of the Wellbore

Sidetracking of the wellbore is an industry term for re-drilling a portion of the wellbore that has either been drilled to the planned total depth or partially drilled. This would involve permanently abandoning the section of wellbore below the start point from where the sidetrack well would be directionally drilled. Sidetracking might be done to either avoid an obstruction in the original wellbore or to reach another bottom hole location of geologic significance (i.e., geologic target). The impact on waste streams would be that a section of the wellbore would be drilled twice therefore generating additional drill cuttings that would be processed for discharge.

In the event of a sidetrack, the upper portions of the well would remain intact (i.e., no additional seabed penetrations, wellheads, or repositioning of the mobile offshore drilling unit (MODU)). Although sidetracking is currently not a planned activity, the additional time and associated waste streams have already been considered in the EIS (Section 2.9.2.3 and Appendix D).

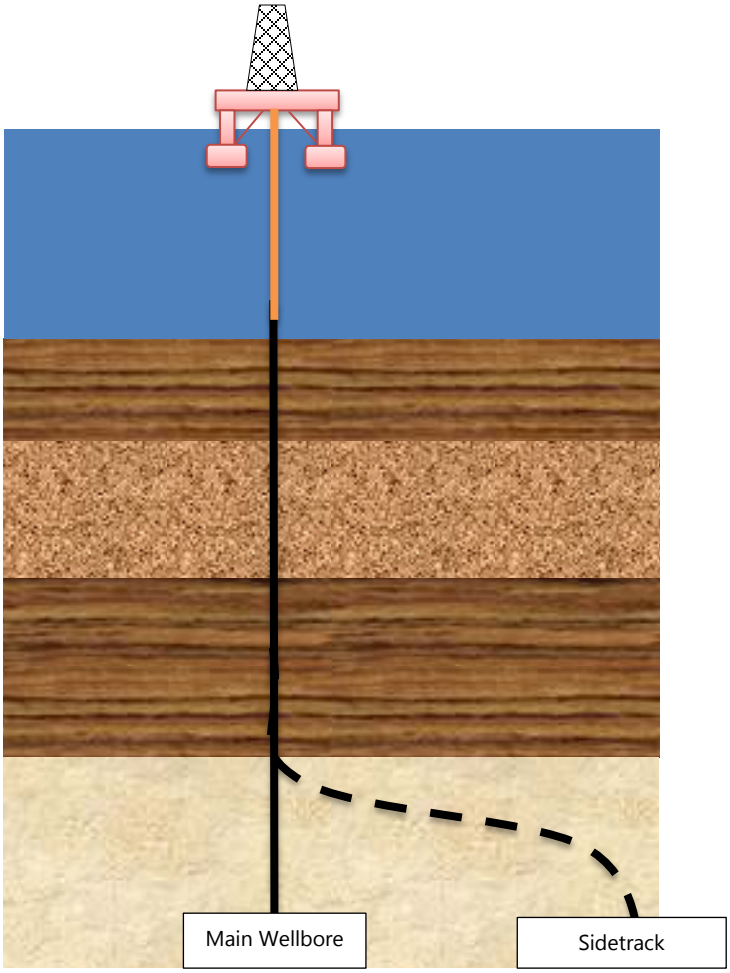


Figure IR-06.1 Simple Depiction of Main Wellbore and Sidetrack Wellbore

The discussion above indicates that there are no plans to employ acid stimulation, and sidetracking is currently not a planned activity. However, both have been considered in the EIS, and the effects predictions presented in the EIS remain valid.

References:
No additional references.

2.1.7 Information Requirement: IR-07 (Part One Response – September 2018)

External Reviewer(s): MFN-21-Nx

Project Effects Link to CEAA 2012: Section 5 – All

Reference to EIS Guidelines: Part 2, Section 3.2. Project Activities

Reference to EIS: Section 2.5.2.6 Supply and Servicing

Context and Rationale: Section 2.2.5 of the EIS Summary states "(s)upporting vessels that are involved in project activities will travel in an essentially straight line between the drilling installation in the Project Area and an established port facility in Eastern Newfoundland, a practice which is common in the oil and gas industry that has been active in this region for several decades."

Elsewhere, the EIS illustrates or refers to transit routes specifically from St. John's (e.g. Figure 2-5, Figure 5.3).

Specific Question or Information Requirement: Confirm that potential transit routes would originate only in St. John's, not in other ports in Eastern Newfoundland. If other ports and transit routes are to be included, update the effects analysis and mitigation, as appropriate.

Response: CNOOC Petroleum North America ULC (CNOOC) is expected to undertake a competitive bid process to select its shore base facility. St. John's, Newfoundland and Labrador (NL) has been the shore base for a majority of previous and existing offshore operations and projects. For the purposes of the environmental assessment, and consistent with past practice, St. John's, NL is proposed to be the Project shore base facility. The transit routes from the selected shore base facility to the wellsite(s) will remain consistent with established marine practice. It should only be necessary to utilize an alternate port if the contracted shore base facility or port become temporarily unavailable due to unforeseen circumstances (e.g., sea ice).

References:
No additional references.

2.2 Alternative Means

2.2.1 Information Requirement: IR-08 (Part One Response – September 2018)

External Reviewer(s): KMKNO-1-Nx; Nunatukavut-16-Nx

Project Effects Link to CEAA 2012: Section 5 – All

Reference to EIS Guidelines: Part 2, Section 2.2 Alternative Means of Carrying Out the Project

Reference to EIS: Section 2.10 Alternative Means Carrying Out the Project,

Context and Rationale: Section 2.10.6 outlines alternatives to night time flaring during well testing.

With respect to the "no flaring" alternative, the EIS states that flaring is a required activity during a formation flow test to safely and efficiently dispose of hydrocarbons that may come to surface, and thus the option of no flaring is not considered to be a feasible option. It is not clearly explained why flaring is the only option to safely and efficiently dispose of hydrocarbons that come to surface.

Clarification is required on the technical feasibility of reduced flaring. Section 2.10.6 indicates that reduced flaring was considered as an alternative for night time flaring, and states that it is not technically feasible as testing can last several days so night time flaring cannot be avoided. EISs related to recent projects in the region and in the Nova Scotia offshore indicated, that while it is not the preferred option, reduced flaring is technically feasible, but has the potential to result in compromised data from formation flow testing and increased safety risk.

Other offshore exploration projects within the region have identified (depending on the type of data required) formation testing while tripping as an alternative to well testing, which does not require flaring. This has not been presented by Nexen as an alternative.

Section 2.5.2.4 of the EIS states that alternative well flow testing technologies such as a drill pipe conveyed test assembly, which would result in only a small volume of produced water being sent to flare, may also be proposed. These are not included in the Section 2.10.6 analysis.

NunatuKavut Community Council has recommended use of alternatives with less environmental effects, if they are available, for testing with flaring.

Specific Question or Information Requirement: In accordance with Agency guidance on evaluation of alternative means, provide the following:

- clarification on the technical feasibility of reduced flaring; and
- clarification if well testing while tripping or a drill pipe conveyed test assembly approach were considered as alternative means. If they were considered, provide additional information on the alternative means: how they are carried out, how they might interact with the environment, and potential environmental effects. If well testing while tripping and drill pipe conveyed test assembly approaches were not considered, provide a justification as to why they were not identified as an alternate to well testing with flaring.

Response: As discussed in Sections 2.5.2.4 and 9.3.6 of the Environmental Impact Statement (EIS), flaring is required as a component of well flow testing. In order to obtain a Significant Discovery Licence (SDL), the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) requires flowing the well to validate the presence of hydrocarbons. Mobile offshore drilling units (MODUs) are not equipped to deal with large volumes of produced hydrocarbons and so the vast majority of the hydrocarbons produced during a well test must be flared. Flaring will be kept to the minimum amount necessary to characterize the hydrocarbon accumulation.

Formation Testing While Tripping (FTWT) is a pipe conveyed well flow test technology that is patented by Schlumberger and Statoil (now Equinor). For this reason, this particular technology was not specifically mentioned in the CNOOC Petroleum North America ULC (CNOOC) EIS. Section 2.5.2.4 of the EIS leaves open the possibility of utilizing similar alternative testing technologies that may be available to the entire industry. A direct quote from the EIS: "A formation flow test may, for example, be carried out using a drill pipe conveyed test assembly". In such cases, the hydrocarbons are circulated to surface and recovered with only a small volume of produced water sent to a flare." Some advantages of FTWT include no requirement for surface well testing equipment, minimal flaring, and reduced personnel exposure to pressurized, hydrocarbon bearing equipment. Wellbore fluids are circulated within a cased well to the enclosed surface equipment so there is no interaction with the environment.

References:
No additional references.

2.3 Air Quality

2.3.1 Information Requirement: IR-09 (Part One Response – September 2018)

External Reviewer(s): NRCan-02-Nx; NRCan-08Nx

Project Effects Link to CEAA 2012: 5(2)(b) Federal Lands/Transboundary 5(2) (C-NLOPB)

Reference to EIS Guidelines: Part 2, Section 3.1, Project Components; and 3.2.1, Drilling and Testing Activities

Reference to EIS: Section 14.3.2 Summary of Key Mitigations

Context and Rationale: The EIS notes that the use of high-efficiency burners for flaring the gas will be a key mitigation measure. The NRCan has indicated that the flare efficiency would impact the presented greenhouse gas emissions and would also determine the validity of the emission factors used to estimate criteria air contaminant emissions.

Specific Question or Information Requirement: Provide the combustion efficiency rating of the high–efficiency burner given that this information affects overall emissions. Specifically, include procedures in place to ensure high efficiency of the burner.

Response: The burners used for flaring are supplied by a third party well testing contractor and form part of the well test surface equipment package which is temporarily installed on the mobile offshore drilling unit (MODU) in advance of a well test. The selection of facilities and equipment to be used have not been completed at this stage of the Project. Thus, CNOOC Petroleum North America ULC (CNOOC) is unable to provide objective data pertaining to equipment that could be used by the Project including the combustion efficiency rating of the selected burner(s). Suppliers of well testing equipment have burner technology that has been tested for liquid fallout and emissions and there are documented combustion efficiencies for burners being marketed by oilfield suppliers that are in the range of 99.9%.

As noted in the Environmental Impact Statement (EIS), CNOOC will endeavor to use high efficiency burners if technically and safely feasible. This mitigation measure will be included in CNOOC's commitment register and will be incorporated into the contracting / planning documents / procedures when and if well test planning commences.

The EIS indicates that the emissions from flaring (Section 14.3.4) were calculated based on US EPA AP-42 emission factors for combustion of natural gas and fuel oil. These numbers will give the most conservative estimate as burner efficiency was not taken into account. The mitigation measure to use high efficiency burners if technically and safely feasible is standard and to ensure that Project emissions are less than conservatively estimated in the EIS.

References:
No additional references.

2.3.2 Information Requirement: IR-10 (Part One Response – September 2018)

External Reviewer(s): ECCC-01-Nx

Project Effects Link to CEAA 2012: 5(1)(b) Federal Lands /Transboundary 5(2) (C-NLOPB)

Reference to EIS Guidelines: Part 2, Section 3.1. Project Components; 3.2.1. Drilling and Testing Activities

Reference to EIS: Section 2.5.2.4 Well Testing; Section 2.10.6 Well Testing – Nighttime Flaring

Context and Rationale: Section 2.5.2.4 of the EIS states that if a significant amount of water is produced from the formation, then the water will be treated and disposed rather than flared.

Specific Question or Information Requirement: Explain what is considered to be a significant amount of produced water from formation flow testing and under what circumstances it would be treated, shipped to shore, or flared.

Describe the potential effects of flaring produced water.

Response: Options for produced water during a well test can include flaring the water along with produced hydrocarbons, capturing the water for treatment and disposal offshore (in accordance with the Offshore Waste Treatment Guidelines (NEB, 2010) and the relevant regulatory requirements) or capturing the water and transferring it onshore for disposal.

Typically, when testing exploration wells, only a small amount of produced water is generated and it is flared along with the produced hydrocarbons. In general, exploration wells will not undergo flow testing if the amount of produced water is expected to exceed the technical capabilities of the flaring equipment. It is difficult to predict in advance the potential volume of water that might be produced and flared because of the high dependence on the reservoir properties (which are uncertain until the well is drilled and evaluated) and the capability of the third party supplied well test surface equipment package (which has not been identified/ contracted). There are flare burners on the market which are documented to handle up to 25% produced water. The Environmental Impact Statement (EIS) notes that during well flow testing, any produced hydrocarbons and small amounts of produced water will be flared using high-efficiency burners if technically and safely feasible. If the predicted volume of produced water is expected to exceed the technical capabilities of the selected flare burners, then the well test will likely not go ahead. The additional two options for produced water noted above require additional equipment to be contracted and staged and involve additional handling of the produced water and are generally not selected.

A higher percentage of water makes the flare combustion process less efficient. A high percentage of water heading to the flare is a very unlikely scenario as data acquired during drilling operations should result in a decision to not go ahead with the flow test.

References:

C-NLOPB and CNSOPB. 2017. Drilling and Production Guidelines. ISBN# 978-1-927098-76-9. Published by the Canada-Newfoundland and Labrador Offshore Petroleum Board and Canada-Nova Scotia Offshore Petroleum Board. Last amended on August 2017. Available online: http://www.cnlopb.ca/pdfs/guidelines/drill_prod_guide.pdf?lbisphpreq=1. Accessed June 2018.

NEB (National Energy Board), Canada-Nova Scotia Offshore Petroleum Board, and Canada-Newfoundland and Labrador Offshore Petroleum Board. Last amended Dec 2010. Offshore Waste Treatment Guidelines. Available online: http://www.cnlopb.ca/pdfs/guidelines/owtg1012e.pdf?lbisphpreq=1 Accessed July 2018.

2.3.3 Information Requirement: IR-11 (Part One Response – September 2018)

External Reviewer(s): ECCC-27-Nx

Project Effects Link to CEAA 2012: Air Quality CEAA 5; 5(1)(b) Federal Lands/Transboundary.

Reference to EIS Guidelines: Part 2, Section 6.3.8.1, Air Quality and Greenhouse Gas (GHG) Emissions

Reference to EIS: Section 14.3.3.1 Semi-Submersible MODU Option

Context and Rationale: The reported fuel usage for the MODU, 56 m3/day, seems approximately 1/3 to 1/2 of what would be expected based on the engines' power output. Documentation indicates that the drill rig would be a 24 hour per day operation. For 8 x 6312 horsepower engines on the MODU (note this excludes the standby vessel – no horsepower was given for it), for a 24 hour operation, a fuel usage about double to three times the reported value would seem more reasonable. ECCC advised that if fuel consumption were double to three times the reported value (greater than that which was reported) there would be a difference between projected CO2 emissions and actual CO2 emissions of 137 kt for the 920 days of operation for the Project.

The calculated greenhouse gas emissions from the MODU and supply vessels are approximately the same, although the MODU and supply vessel horsepower's are 50,496 and 16,665 respectively, so MODU greenhouse gas emissions would be expected to be higher for the MODU assuming similar operating periods.

Specific Question or Information Requirement: Provide information and supporting evidence for the MODU fuel use calculation, indicating the average daily hours of MODU operation. Update the predicted greenhouse gas emissions, if appropriate.

Response: The semi- submersible mobile offshore drilling unit (MODU) fuel usage of 56 m^3/day cited in the Environmental Impact Statement (EIS) was based upon the average fuel consumption for that type of diesel engine.

A more conservative fuel usage could be estimated using the output rating of the engines. There are a total of eight 6312 hp engines (8 x 6312 hp = 50496 hp = 37.66 MW). The Wartsila technical specifications cite a fuel consumption of 171 g/kWh; based on this data, the maximum fuel usage considering all eight engines operating at 100% load is 190 m^3/day.

The fuel usage for the standby vessel is accounted in supply vessel emission calculations shown in the revised EIS Section 14 (Appendix A; Section 14.3.5.1).

Fuel usage of the drill ship MODU is also updated using the output rating of the engines, following the same approach as outlined above for the semi- submersible MODU. There are a total of six 10299 hp engines (6 x 10299 hp = 61794 hp = 46.08MW) for the Stena IceMAX drill ship. The Wartsila technical specifications cite a fuel consumption of 174 g/kWh; based on this data, the maximum fuel usage considering all six engines operating at 100% load is 238 m^3/day.

The revised daily GHG emissions, based on the revised fuel usage approach outlined above, would be 529 tCO_2e/day for the semi-submersible MODU Option and 659 tCO_2e/day for the drill ship MODU option (Table IR-11.1).

Table IR-11.1 Revised Daily GHG Emissions

Activity	Daily Emission Rate (t/day)			
	CO_2	CH_4	N_2O	CO_2e
Semi-submersible MODU	508	0.025	0.08	529
Drill Ship MODU	633	0.032	0.10	659

The GHGs emissions are expected to be higher from the drill ship MODU than from the semi- submersible MODU. The updated GHG calculations are provided in the revised EIS Section 14 (Appendix A; Sections 14.9 and 14.10).

Table IR-11.2 is a comparison of greenhouse gas (GHG) emissions for the semi-submersible MODU option based on average fuel usage and maximum fuel usage considering all eight engines operating at 100% load.

Table IR-11.2 Comparison of GHG Emissions

GHG Source	MODU Drilling Unit
Fuel usage – average (original EIS Section 14)	56 m^3/day
Revised fuel usage – 100% load (revised Section 14 in Appendix A of this EIS Addendum)	190 m^3/day
Total GHG emissions for MODU – average fuel usage (original EIS Section 14)	137 kt-CO_2e
Revised Total GHG Emissions for MODU – 100% load (revised Section 14 in Appendix A of this EIS Addendum)	487 kt-CO_2e

References:
No additional references.

2.4 Fish and Fish Habitat/Marine Mammals and Turtles

2.4.1 Information Requirement: IR-12 (Part One Response – September 2018)

External Reviewer(s): QFN-01-Nx Elsipogtog-11-Nx, -01-Nx; DFO-15 (Annex 1), DFO-38 (Annex 3); MTI-03-Nx, -04-Nx, -23-Nx; WNNB-CRI-09-Nx; Nutash-18-Nx. -19-Nx, -38-Nx; MFN-01-Nx; MFN-06-Nx; MFN-07-Nx; KMKNO-50-Nx

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat

Reference to EIS Guidelines: Part 2, Section 6.3.1 Fish and Fish Habitat

Reference to EIS: Section 8.4.4 Atlantic Salmon

Context and Rationale: Section 8.4.4.2 of the EIS states that Atlantic salmon have a preferred sea surface temperature range of 4°C to 8°C, and that mean sea surface temperature values greater than 3°C occur between July and November and the preferred range (4°C-8°C) can occur between July and October in the Project Area.

The KMKNO has requested consideration of additional published research regarding the timing of Atlantic salmon presence in the Project Area. Reddin (1985) indicated that "favourable conditions (sea surface temperature of 4°C to 8°C) persist in January to April, implying that the eastern and southern Grand Bank region may represent not only the route by which maturing salmon migrate from the Labrador Sea to their home rivers in eastern Canada and northeastern United States but also a major feeding and overwintering area." The EIS does not provide information regarding the return migration of adult Atlantic salmon to feeding areas as post-spawning adults (kelts). In addition, Lacroix (2013) describes habitat utilization by Atlantic salmon kelts in May and June off Newfoundland and the Grand Banks, and July and August around the Project Area.

The KMKNO indicated that immature post-smolts that will return to natal rivers as mature one sea winter salmon (referred to as grilse) will stay local to the Project Area and not migrate to the Labrador Sea; use of the Project Area by post-smolts to maturing grilse is therefore probable between June and August to the spring of the following year (June to May). The KMKNO has further indicated that mature adult salmon would be least likely to be present in the Project Area between October and November, when adult salmon are spawning in their natal streams.

The MTI has expressed concern that the data provided within the EIS to support Atlantic salmon distribution is from dated sources, specifically that the data does not fully encapsulate impacts that have occurred over time, particularly with population declines and shifting range distributions due to climate change.

The DFO has suggested some recent papers discussing the origin of salmon at the Faroe Islands, where there seem to be more North American fish present than previously thought (Gilbey et al. 2017), and the origin of salmon at west Greenland, Labrador coast and south coast of Newfoundland (Bradbury et al. 2014, 2015).

Regarding the Inner Bay of Fundy Population of Atlantic salmon, the EIS notes that "interaction with the Project Area does not occur." While the Inner Bay of Fundy population would not be expected to occur within the Project Area, DFO has stated that it is not correct to say with certainty that they will "not occur."

Comments from the MTI state that Atlantic salmon are known to exhibit avoidance behaviours to light exposure, infrasound, and surface disturbance. In addition, light and sound stimuli can influence swimming depth and speed. MTI stated that researchers have recommended avoiding abrupt changes to visual environment/light exposure, and that salmonids swim with elevated activity (a flight response) after transitions from light-to-dark or dark-to-light environments. MTI further noted that salmon are sensitive to acoustic particle motion at frequencies below 200 Hz. Infrasound disturbance has short term effects on fish behaviours and typically return to pre-stimulus states. This may cause flight behaviour to lessen over time to all stimuli, so repeated/extensive exposure can lead to habituation (Bui et al, 2013). The EIS provides little analyses on the behavioural response effects to migrating salmon due to light and sound effects of the Project. WNNB expressed concerns related to changes in migratory routes and feeding grounds which it stated may occur.

The KMKNO has suggested that drilling activities be avoided when Atlantic salmon are in the area (i.e. between the months of January to August). The KMKNO has further advised caution during all drilling activities to avoid effects on maturing post-smolts, which may be present year-round owing to remaining in the Project Area for their first winter at sea.

Specific Question or Information Requirement: Update the analysis of effects on Atlantic salmon, taking into consideration:

- timing of their presence in the Project Area as well as probability based on the information provided in Lacroix (2013) and Reddin (1985);
- the certainty regarding the presence of Atlantic salmon from the Inner Bay of Fundy population in the Project Area;
- the impacts that climate change may have had on the distribution of Atlantic salmon, and whether the Project could potentially contribute to or exacerbate an already declining population of salmon in the region;
- published research on biological and behavioural responses of Atlantic salmon to light and noise, as available; and
- recent papers on Atlantic salmon including those suggested by DFO.

Update the proposed mitigation and follow-up, as well as effects predictions, accordingly.

Based on the update to the assessment of potential for effects on Atlantic salmon, provide additional mitigation measures to avoid or minimize potential effects on adults and mature post-smolts that may overwinter and feed in the area.

Response:

Part 1: Update the analysis of effects on Atlantic salmon, taking into consideration timing of their presence in the Project Area as well as probability based on the information provided in Lacroix (2013) and Reddin (1985).

The additional literature and information adds to the data on marine movements and habitat utilization, particularly by kelts, but does not alter the utilization and movement patterns described in Section 6.1.8.6 of the Environmental Impact Statement (EIS). The Project is not likely to result in significant adverse environmental effects on marine fish and fish habitat, including Atlantic salmon. The implementation of mitigation measures, combined with the short-term nature of activities, a deep-water dynamic environment that rapidly disperses marine discharges, and avoidance behaviours of salmon, results in adverse effects that are negligible to low-magnitude, short-term, localized and reversible.

The information provided in Reddin (1985) was incorporated into the existing description of known migration and habitat use near and within the Project Area. Reddin (1985) suggests that "favourable conditions (4°C – 8°C) persist for salmon in January and April, implying that the eastern and southern Grand Bank region may represent not only the route by which maturing salmon migrate from the Labrador Sea to their home rivers in eastern Canada and northeastern United States, but also a major feeding and overwintering area". However, there is no data within the paper to support this hypothesis. The Grand Bank area was sampled in May of 1979 and 1980 only, with no winter surveys completed. This research confirmed that salmon appear to congregate near the southern Grand Bank, which is south of the Project Area (refer to Figure 6-38 in the EIS), prior to spring migration and that sea-surface temperatures (SST) may modify the exact location each year. Subsequent research after Reddin (1985) indicate that no overwintering has been confirmed by sampling including:

- Reddin and Shearer (1987) "Seasonal oceanographic conditions suggest that Atlantic salmon do not overwinter in the Grand Bank area since the areas covered by warm water is small and variable".
- Reddin and Friedland (1993) "We hypothesize that factors controlling survival for the North American stock complex of Atlantic salmon are concentrated during the winter months in the habitat formed at the mouth of the Labrador Sea and east of Greenland… Until direct observation on the habits of post-smolts during winter can be made, we can only speculate that mortality is controlled by the interaction of growth, size, and predation."
- Reddin (2006) "Few sets have been made for salmon during the winter months and these were all to the west of the Grand Bank of Newfoundland in 1985. The zero to low catch rates in the area of the Grand Bank suggest that salmon were located elsewhere at this time. These results suggest, since salmon were found in the Labrador Sea in the fall and then in the following spring, that adult salmon of North American origin probably overwinter there."
- Sheehan et al. (2012) "Non-maturing one-sea-winter (1SW) salmon are assumed to have overwintered in the Labrador Sea".

The Lacroix (2013) paper provides information related to the movement of kelt salmon from the Bay of Fundy (BoF; both inner (iBoF) and outer (oBoF) populations) using satellite pop-up tags. Kelt are adult salmon that have returned to spawn in their natal river and have survived to re-enter the marine environment to recondition and return to spawn again, either the next immediate fall (consecutive spawning) or the following year (alternate spawning). Some of the highest return rates for kelts have been recorded for salmon populations within the inner Bay of Fundy (iBoF) (Jessop 1986; Ritter 1989; Cunjak et al. 1998).

The previous review included movements; however, Lacroix (2013) provides valuable information, particularly related to salmon stocks from the BoF. The research included tagging kelts on their return to the marine environment. Kelts from the iBoF and oBoF were tagged and tracked. Individual tracks documented swim direction, speed, water temperature, and depth of activity. Light/dark was also recorded so that estimates of geolocation could be generated. Home ranges were also generated for the iBoF and oBoF salmon.

The kelts from the oBoF and iBoF groups with tracks >60 days at sea generally provided excellent examples of the differences in migration behaviour of inner and outer BoF salmon. IBoF salmon remained mostly in the Bay of Fundy, northern Gulf of Maine, and around the southern tip of Nova Scotia, regardless of season of migration (Lacroix 2013).

The 50% and 75% utilization distributions (UD) within modelled home ranges indicated where the majority of kelt activity was concentrated. The oBoF kelt 50% UD extended through the outer BoF and northern Gulf

of Maine, around the southern tip of Nova Scotia on the western Scotian Shelf and to some extent onto the eastern Scotian Shelf. The 75% UD extended along the length of the Scotian Shelf to the south coast of Newfoundland. An additional 75% UD was located on the southern edge of the Grand Bank (refer to Figure 13 in Lacroix 2013). For iBoF kelt, the 50% and 75% UDs were limited to the Bay of Fundy, the northern Gulf of Maine extending down the coast of Maine, along the southwest shore of Nova Scotia, and onto the western Scotian Shelf (refer to Figure 13 in Lacroix 2013).

Lacroix (2013) indicated that one of the tagged kelt from the oBoF migrated northward to Labrador via the Grand Bank and a second remained on the eastern edge of the Grand Bank until July prior to the tag detaching. This area on the eastern edge of the Grand Bank is similar in location to the area of congregating salmon in the spring as they return to their home rivers. These data corroborate the fact that this area may be a feeding area prior to return migrations. No tags were shown migrating through the Project Area and the 99% UD for oBoF also does not include the Project Area (refer to Figure 13 in Lacroix 2013).

O'Neil et al. (2000) is a proceeding record of an International Workshop completed in June 2000 on research strategies into the causes of declining salmon returns to North American rivers. The workshop re-affirmed that higher mortality is occurring after salmon leave their natal rivers and that higher mortality appears to be common to all North American Atlantic salmon spawning populations. There was a total of 13 proposals presented at the workshop for possible research related to declines in salmon returns. Of these, four marine proposals were presented for consideration; Salmon distribution (models), Salmon distribution (coastal field studies), Salmon distribution (marine field studies), and marine mammal predation. Each was presented and discussed and appraised by experts and ultimately ranked with all other proposed research. While the proposal summaries are provided along with discussion points related to each, it is not indicated within the report whether any research was completed. Additionally, no follow up report was located during a search of public and academic (University of New Brunswick (UNB)) databases; therefore, no additional information was provided for the research in question or with respect to possible migration or habitat use of salmon within or near the Project Area. Therefore, no revisions to the existing baseline summary or effects assessment are required.

The evaluation of possible causes of the decline in pre-fishery abundance of North American Atlantic salmon was completed in Cairns (2001). The evaluation described a total of over 60 hypotheses for the decline in pre-fishery abundance estimates of Atlantic salmon of North American origin. Of the 12 top-ranked hypotheses, five were related to predation, five to life history, one was related to fisheries (natural marine mortality higher than presumed), and one to the physical/biological environment. Three of the four highest hypotheses in overall rankings were in the marine phase. The highest marine rank, and the highest overall rank was related to the hypothesis that post-fishery marine mortality is higher than what is presumed by fisheries models. The highest ranking marine factors that could directly cause mortality were bird and mammal predation (ranked third overall) and changes in migration routes due to altered oceanographic conditions (ranked fourth overall).

The hypothesis related to changes in migration routes due to altered oceanographic conditions states that major changes in the oceanographic conditions of the North Atlantic have occurred since the 1980s and these changes may have altered the temporal and spatial distribution of preferred habitat for Atlantic salmon (Cairns 2001). Tagging of salmon was extensive in the 1970s and 1980s and tag returns showed very little transatlantic migration. However, as tagging activities began to slow, greater numbers of recaptured salmon were being reported from the British Isles (e.g., Faeroes), particularly during the 1980s and early 1990s (Cairns 2001). Little research is available on the routes used to access suitable marine habitat particularly since the close of the commercial salmon fishery and reduction in tagging experiments

(Cairns 2001). No additional information was provided with respect to known migration or habitat use of salmon at the time of the report (2001) nor were any possible routes, or changes, hypothesized, therefore, no revisions to the existing baseline summary or Effects assessment are required.

The information provided adds to the data on marine movements and habitat utilization, particularly by kelts, but does not alter the utilization and movement patterns previously described by the literature summarized within Section 6.1.8.6 of the EIS. As stated and outlined in Sections 6.1.8.6 and 12.3.3.2 of the EIS, migration routes for Atlantic salmon can be variable based on environmental conditions such as Sea Surface Temperature (SST) which can vary considerably within the marine environment. In terms of habitat preferences, it has been shown that avoidance of lower water temperatures, particularly below 3°C, can play a predictive role in habitat use near the Grand Bank and Flemish Pass. Statistical summaries of sea temperature were derived from the Ocean Data Inventory (ODI) of the Bedford Institute of Oceanography (see Table 5.12 in Chapter 5 of the EIS) for a rectangular area surrounding the Project Area, querying the period 1900 to 2016 for depths down to 1,000 m. Mean SSTs range from 1.8°C in February to 11.9°C in August. Minimum temperatures at the surface range from -1.5°C in February to 9.5°C in August and September. Maximum sea surface temperatures range from 4.6°C in March to 15.7°C in August. This seasonal temperature cycle is observed down to 20 m, where temperatures are higher in the summer than in winter. As shown, mean SST values greater than 3°C occur between May and January and the preferred range for salmon (4°C-8°C) can occur between June and December. Minimum SSTs for every month July to September are below 3°C. Given the variability of SST and low frequency of preferable conditions within the Project Area, predicted interactions will be limited and overall risk is considered very low to this species.

The conclusion within the EIS, based on existing data, remains valid: that spring migration of adults within and near the Project Area is possible; however, the likelihood of interaction remains low, given measured SSTs collected between 1900 to 2016, from water depths within 0-20m of the water column. As a result, the Project is not likely to result in significant adverse environmental effects on marine fish and fish habitat, including Atlantic salmon.

Part 2: Update the analysis of effects on Atlantic salmon, taking into consideration the certainty regarding the presence of Atlantic salmon from the Inner Bay of Fundy population in the Project Area.

As described above in Lacroix (2013), recent satellite tags confirm that the general home range of iBoF salmon (kelts) extends to the Gulf of Maine and the southern shores of Nova Scotia. However, given the available data, certainty regarding marine habitat use and migration pathways cannot be guaranteed. Data on genetic differentiation of stocks contained within both the Labrador coastal fishery (Bradbury et al. 2015) as well as the Saint Pierre and Miquelon fishery off southern Newfoundland (Bradbury et al. 2016) identified a potential iBoF genetic signature in these areas. While the proportion was very low relative to other identified stocks, it does suggest that iBoF salmon may be amongst those adults returning from both staging areas. Both the genetic research and the telemetry studies show that iBoF salmon are primarily limited to the BoF and southern shores of Nova Scotia. However, based on the above information and application of the precautionary principle, the potential for interaction with the Project Area was reconsidered and increased from "does not occur" to "negligible" to account for the uncertainty.

The conclusion in the EIS based on existing data remains valid; the Project is not likely to result in significant adverse environmental effects on marine fish and fish habitat, including Atlantic salmon.

Part 3: Update the analysis of effects on Atlantic salmon, taking into consideration impacts that climate change may have had on the distribution of Atlantic salmon, and whether the Project could potentially contribute to or exacerbate an already declining population of salmon in the region.

Many facets of Atlantic salmon life history are influenced, if not controlled, by events and conditions during their marine phase (Drinkwater and Pettipas 1996). Ocean climate impacts on survivorship and growth of Atlantic salmon are complex, but still poorly understood (Todd et al. 2008). Winter temperatures in the Labrador Sea appear to play an important role in determining both recruitment survival and growth of several salmon stocks (Reddin and Shearer 1987; Todd et al. 2008). The distribution of winter (January-March) habitat defined by the area within 4°C-8°C of the Labrador Sea appear to be critical for North American salmon stocks with higher returns in those years when there was more suitable habitat (Drinkwater and Pettipas 1996). In a similar study in the North Sea, Friedland et al. (2000) showed a link between ocean climate conditions, post-smolt growth, and post-smolt survival for salmon stocks. They investigated the correlation between SST and post-smolt growth/survival from two long-term tagging studies of wild Atlantic salmon stocks from Norway and Scotland. The authors concluded that the ocean climate variation related to survival of salmon in the North Sea occurs in spring when the post-smolts first enter the marine environment and occurs in the area of the North Sea and Norwegian coast.

The eastern and western North Atlantic are influenced differently by the subpolar and subtropical gyres, and consequently show differing patterns of decadal variability, but since the early 1970s SST on both sides of the North Atlantic have generally increased (Todd et al. 2008). Large-scale, climate-driven biogeographic shifts in the epipelagic ecosystem are likely to have exerted substantial bottom-up impacts on generalist predators high in the food web including Atlantic salmon (Todd et al. 2008). Notwithstanding the biological complexities, Todd et al. (2008) and Friedland et al. 2005) suggest the general pattern of stock decline throughout the North Atlantic region over the past three decades has likely been a response at least in part, to global climate change (Todd et al. 2008; Friedland et al. 2005).

SST in the eastern North Atlantic has risen at a rate between 0.5°-1.5°C per decade since the 1990s (Todd et al. 2008). Given that Atlantic salmon spend most of their time in surface waters (but undertake brief feeding excursions to colder subsurface depths), and that the preferred oceanic habitat of post smolts in the subpolar gyre lies only within a narrow temperature range, such rates of ocean surface warming are very likely to have marked and possibly detrimental consequences for growth and/or survivorship of salmon at sea (Todd et al. 2008).

As presented in Section 5.7.2.1 of the EIS, Figure 5-42 shows changes in mean monthly water temperature from 1976-1995 to 1996-2015 at depths of approximately five metres, based on European Centre for Medium-Range Weather Forecasts (ECMWF) reanalysis data. The Project Area has experienced warming in each month, although statistically significant warming is most prevalent from late summer to early winter. Warming was also found to be widespread at depths of approximately 45 m (not shown in Figure 5-42 of the EIS).

With respect to Atlantic salmon, an increase in near-surface water temperature may alter general feeding locations such that they follow areas of optimally favourable water or it may alter the condition of fish that are feeding in less optimal locations. Todd et al. (2008) found that the condition of returning European Atlantic salmon decreased 11-14% over a decade. Salmon with the lowest condition (approximately 30% under-weight) were found to be returning to spawn with lipid stores reduced by as much as 80%. Stored lipids are essential for egg development and the ovaries alone comprise approximately 30% of the female's total energy reserves at spawning and represent about half the energy expended in maturation, upstream

migration and reproduction combined (Todd et al. 2008). A direct physiological effect of ocean warming on salmon metabolism is possible. However, other evidence suggests it is more likely that the negative correlations are the result of reduced prey availability from ocean warming (Todd et al. 2008).

The limited interaction between salmon migrating within and near the Project Area and post-smolt and adults feeding north in the Labrador Sea and kelts along the southern edge of the Grand Bank will most likely remain low given the predicted increases in SSTs (i.e., lower suitability) near the Project Area. As the potential for environmental effects of planned Project activities and overall risk to Atlantic salmon is low, it is predicted that the Project will not contribute, nor exacerbate declines, to salmon populations.

The conclusion in the EIS, based on available data, remains valid: the Project is not likely to result in significant adverse environmental effects on marine fish and fish habitat, including Atlantic salmon.

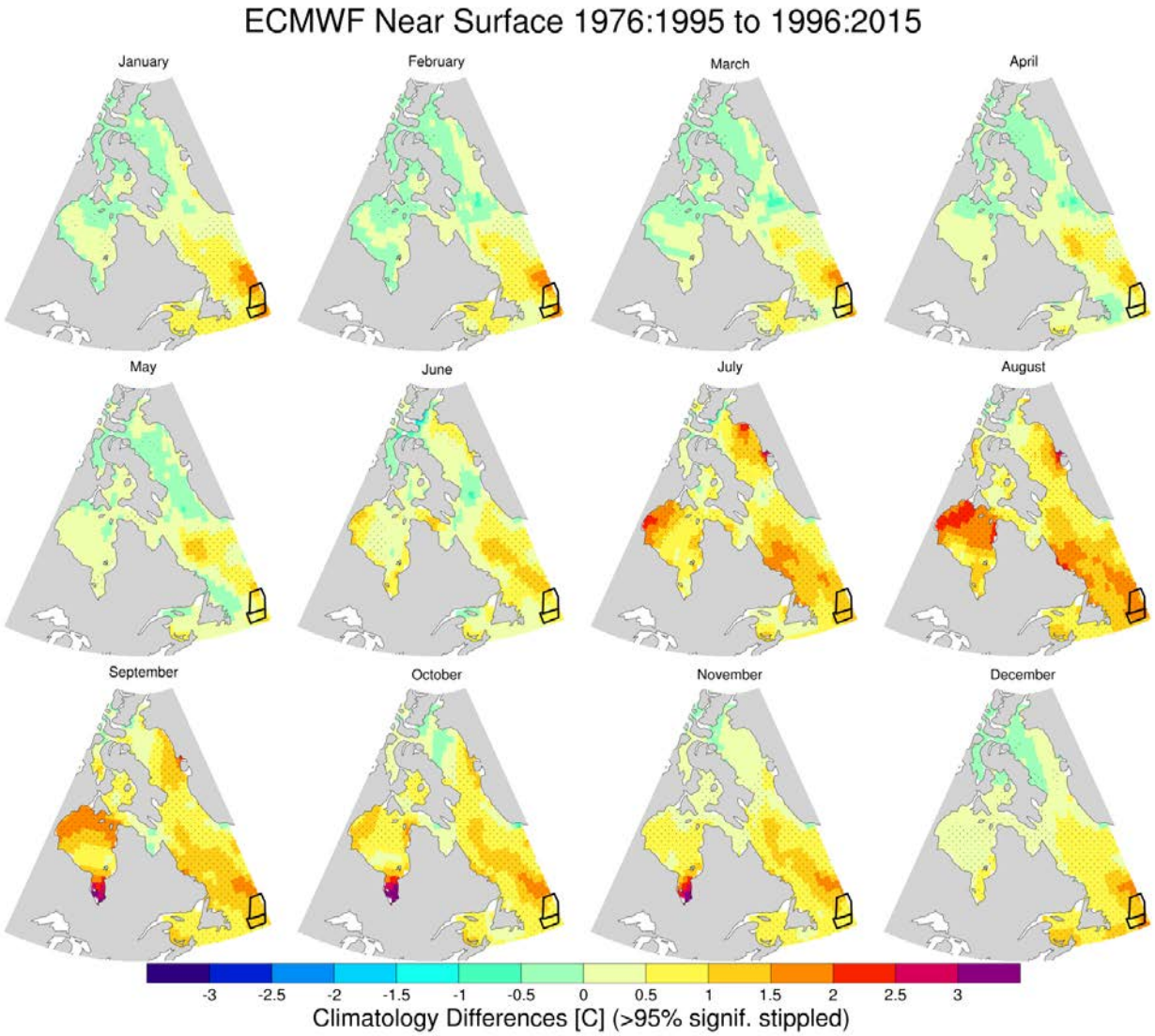


Figure IR-12.1 EIS Figure 5-42 Changes in Mean Monthly Water Temperature (1976-1995 to 1996-2015)

Part 4: Update the analysis of effects on Atlantic salmon, taking into consideration published research on biological and behavioural responses of Atlantic salmon to light and noise, as available.

The potential effects of light and noise pollution has been incorporated into the EIS related to plankton and other potential prey species that salmon would utilize during migration to and within staging areas prior to returning to natal systems to spawn (refer to Section 8.3.3.1). The specific references provided in the Information Requirement (Bui et al. 2013 and Nedwell et al. 2001) were reviewed.

Nedwell et al. (2001) describes a process to validate the use of dBht (Species) to compare different species in terms of perception of loudness of sound. It standardizes the relative loudness of sound and therefore, is not relevant for assessing the potential effects of sound on a single species such as salmon. The dBht (Species) values correspond to the loudness of sound perceived by various species and provides a way to directly compare effects among different species by standardizing the sound based on species hearing ability. No additional information was provided with respect to the effects of sound on salmon (although salmon were used in lab experiments within the study). Therefore, no revisions to the existing baseline summary or assessment are required.

Bui et al. (2013) provides information specific to light and sound simulations related to avoidance behaviours of Atlantic salmon in sea-cage experiments (aquaculture). This study, and others (McConnell et al. 2010; Stewart et al. 2013; and Bui et al. 2014) identify that artificial light can change the behaviour of aquatic organisms, although the direction of response can be species and life-stage specific. For example, Davies et al. (2014) notes that some species are attracted to artificially lit areas where they may experience increased predation, while others avoid artificially lit areas, and so are displaced from habitats that would otherwise be suitably dark in the absence of artificial light. Bui et al. (2014) concluded that in all light intensities (submerged blue LED source), sound (infrasound at 12.5 Hz), and surface disturbance tests, Atlantic salmon returned to their original swimming depth and speed within 20 minutes. They concluded that very intense light (immediately turned on in the cage) appeared to cause temporary blindness.

Offshore activities do not emit intense light emissions under water and therefore direct injury to the eyes or physiology of salmon (or any fish) would be highly unlikely. Light from the drilling installation and/or vessels may shine on the near surface of the water but would be quickly attenuated by surface/wave refraction and absorption. Given estimated ranges of light penetration into seawater, conservatively at a 50 m radius from source (Davies et al. 2014), effects on migrating Atlantic salmon, if present, would be considered negligible. It is anticipated that currents and life-history (spawning migration to natal rivers) would not be influenced by light from infrastructure.

Bui et al. (2013) used infrasound frequencies of 12.5 Hz (below the lower limit of human hearing) to study group behavioural responses of Atlantic salmon. Salmonids do not have special adaptations for hearing; however, Atlantic salmon are sensitive to acoustic particle motion, particularly at frequencies below 200 Hz (Bui et al. 2013) and avoid infrasound frequencies in freshwater environments (5-10 Hz). In controlled experiments, individual fish responded more strongly to sounds that were lower in frequency, had a more sudden onset, were loud, had similarities to sounds made by predators, and had a larger contribution from particle motion (Normandeau 2012). Estimated frequencies from drilling installations (i.e., 20-1,000 Hz for drill ships and 10-4,000 Hz for semi-submersibles) are all capable of producing lower frequency sounds (Peng et al. 2015). Lower frequencies of these drilling installations are similar to other vessels and activities that would also exist in the marine environment as well as the nearshore such as supertankers/container ships (7-70 Hz), medium-sized ships such as ferries (approximately 50 Hz), boats <30m in length (<300 Hz), and smaller ships such as support/supply vessels (20-1,000 Hz) (Peng et al. 2015).

Given the limited behavioural response of infrasounds generated within an enclosed cage, and the recommendation that these stimuli could be used in both freshwater and ocean environments to deter fish from potentially dangerous infrastructures, effects on migrating Atlantic salmon would be considered negligible. It is anticipated that currents and life-history (spawning migration to natal rivers) would not be influenced by noise from infrastructure.

The effects of the Project on salmon has been fully considered in the effects on marine fish and fish habitat. The conclusion in the EIS, based on available data, remains valid: with the application of mitigation measures described in Section 8.3.3.5 of the EIS related to noise and light emissions to marine fish and fish habitat, the environmental effects of routine Project activities on Atlantic salmon are predicted to be not significant.

Part 5: Update the analysis of effects on Atlantic salmon, taking into consideration recent papers on Atlantic salmon including those suggested by DFO.

Consideration of the recent papers on Atlantic salmon suggested by Fisheries and Oceans Canada (DFO) have been incorporated in the above responses. Updates to the effects assessment, where applicable, have been addressed in the above responses.

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Bradbury, I.R., L.C. Hamilton, S. Rafferty, D. Meerburg, R. Poole, J.B. Dempson, M.J. Robertson, D.G. Reddin, V. Bourret. M. Dionne, G. Chaput, T.F. Sheehan, T.L. King, J.R. Candy, and L. Bernatchez. 2015. Genetic evidence of local exploitation of Atlantic salmon in a coastal subsistence fishery in Northwest Atlantic. Can. J. Fish. Aquat. Sci. 72:83-95. Dx.doi.org/10.1139/cjfas-2014-0058.

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Part 5

No additional references.

2.4.2 Information Requirement: IR-13 (Revised Response – February 2019)

External Reviewer(s): Elsipogtog-04, 10, 11, 12, 14- Nx; WNNB-CRI-01-Nx, CRI-03-Nx, CRI-05-Nx, -CRI-06-Nx, -CRI-08-Nx, -CRI-09-Nx; WNNB-Letter-2-Nx; Nutash-18-Nx, -50-Nx; MFN-02-Nx; MFN-03-Nx; MFN-04-Nx; MFN-08-Nx; MFN-09-Nx, KMKNO-50-Nx, MTI-04-Nx

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat

Reference to EIS Guidelines: Part 2, Section 6.3.1 Fish and Fish Habitat

Reference to EIS: Section 8.4.4 Atlantic Salmon

Context and Rationale: Several Indigenous groups have provided information on Atlantic salmon for consideration in the effects analysis. These submissions have been provided in full to the proponent and should be reviewed to ensure consideration of all comments/submissions related to Atlantic salmon. A short description of select information submitted by various Indigenous groups is provided below.

As noted in IR-12, the KMKNO provided a stand-alone submission containing information on Atlantic salmon. The submission includes several additional references that should be considered in describing baseline conditions for Atlantic salmon and in the analysis of potential effects from the Project. Along with the references listed in IR-12, additional references provided by the KMKNO include:

- Crossin, G., Hatcher, B. G., Denny, S., Whoriskey, K., Orr, M. Penney, A., and Whoriskey, F. G. (2016). Condition-dependent migratory behaviour of endangered Atlantic salmon smolts moving through an inland sea, Conservation Physiology, Volume 4, Issue 1, 1 January 2016, cow018, https://doi.org/10.1093/conphys/cow018.
- Reddin, D. G. (1986). Ocean Life of Atlantic salmon (Salmo salar L.) in the Northwest Atlantic. In: Atlantic Salmon: Planning for the Future. [Ed] D. Mills and D. Piggins. Portland: Timber Press, pp483-507.

The Innu First Nation of Nutashkuan has advised that anything that risks adversely affecting the productivity of the salmon's diet, from small crustaceans up to capelin as prey, would likely adversely affect the salmon, and that leaks from drilling wells in particular need to be considered. Likewise, the WNNB raised concerns about the potential adverse effect on quality and quantity of Atlantic salmon as a result of potential changes in the food-web.

The WNNB and Woodstock First Nation indicated that a key finding of their technical review is that Atlantic salmon spend more time in the Project Area than indicated in the EIS, and it advised that the area is likely an important feeding ground for both one sea and multi-sea winter Atlantic salmon from the Outer Bay of Fundy Designatable Unit, not just a migration route. Research currently under peer review for publication was included in the WNNB and Woodstock First Nation submission for the proponent's consideration.

The WNNB, Woodstock First Nation and Elsipogtog First Nation indicated that while the EIS is correct in stating that the Outer Bay of Fundy population has no status under the federal SARA (Section 12.3.3.2), the proponent should note that the population is under consideration for listing under SARA. The WNNB and Woodstock First Nation indicated that from a biological perspective, this population should be considered endangered for the purposes of effects analysis.

The Agency notes that new data from salmon tagging studies, provided by the submission, could be the basis for an additional figure to overlay those data with the Project Area.

The EIS states that "there have also been large declines in marine survival (for Atlantic salmon), but the mechanism for mortality is poorly understood" (Section 6.1.8.6). The WNNB and Woodstock First Nation indicated agreement that Atlantic salmon have issues with marine survival that are not well understood, and that this uncertainty makes it important to further consider the potential impacts of offshore development. Several Indigenous communities, including Miawpukek First Nation, Innu First Nation of Nutashkuan, Elsipogtog First Nation, and NunatuKavut Community Council, expressed similar concerns related to uncertainty around the decline of Atlantic salmon populations in their traditional territories and provided supporting information.

Concerns about the potential adverse effects of noise on Atlantic salmon behavior and migration patterns were described in IR-12, based on comments from MTI. Similar concerns have also been expressed by Miawupkek First Nation. Miawpukek First Nation's submission cited additional references for consideration by the proponent (e.g. Cairns, 2001, Friedland et al, 2000, Nedwell et al, 2007, O'Neil et al, 2000).

Most Indigenous groups expressed concern about the effects of accidental spills on marine resources, including Atlantic salmon. Several also cited concerns about cumulative effects on declining salmon populations.

Targeted baseline monitoring of salmon movement through the Project Area has not been conducted in support of the EIS, nor is this proposed for follow-up. Miawpukek First Nation and Elsipogtog First Nation have advised that additional baseline data on the migration and behaviour of Atlantic salmon while at sea would contribute to the assessment of the effects of the Project. They indicated that rather than initiating a new research project, providing funding to support on-going research projects or programs would allow the research protocol for any study to be designed by established organizations and integrated with existing research. Miawpukek First Nation indicated that organizations involved in the tracking of marine fishes include Miawpukek First Nation, the Atlantic Salmon Federation, the Ocean Tracking Network, and DFO. These organizations are already engaged in projects aimed at understanding the movements of Atlantic salmon while at sea.

Specific Question or Information Requirement: Further to IR-12, provide a stand-alone assessment of the effects of the Project on Atlantic salmon using information from the EIS as well as additional references and other information from Indigenous communities, and information from DFO, as applicable.

In the stand-alone assessment of the effects of the Project on Atlantic salmon:

- Consider information about Atlantic salmon provided in submissions by Indigenous communities (including peer-reviewed references) and subsequent dialogue at April 2018 consultation meetings in St. John's, Moncton, and Quebec City.
- Provide updated figures and tables, as applicable, to reflect the most recent peer-reviewed data, or provide a rationale for excluding information from newer, peer-reviewed references.
- Include a discussion of the effects of accidental events and cumulative effects on Atlantic salmon.
- Recognizing data gaps regarding the presence of Atlantic salmon in the Project Area, migration routes, and at-sea mortality, apply the precautionary approach in the updated effects analysis and in the discussion of proposed mitigation.

- Taking into consideration any uncertainties regarding potential effects, discuss the need for follow-up related to project-specific or cumulative effects on Atlantic salmon, including participation in future regional initiatives and potential for collaboration with Indigenous communities.

Response:

Part 6: Further to IR-12, provide a stand-alone assessment of the effects of the Project on Atlantic salmon using information from the EIS as well as additional references and other information from Indigenous communities, and information from DFO, as applicable.

Refer to the Information Requirement (IR)-12 Part 1 response.

Part 7: Consider information about Atlantic salmon provided in submissions by Indigenous communities (including peer-reviewed references) and subsequent dialogue at April 2018 consultation meetings in St. John's, Moncton, and Quebec City.

The references referred to by Indigenous communities (including peer-reviewed references) and any relevant consultation information received have been incorporated into the responses for IR-12 Parts 1 to 4.

Part 8: Provide updated figures and tables, as applicable, to reflect the most recent peer-reviewed data, or provide a rationale for excluding information from newer, peer-reviewed references. Include a discussion of the effects of accidental events and cumulative effects on Atlantic salmon.

Similar to the IR-13 Part 7 above, the additional information provided and reviewed was included in the IR responses above (IR-12 and IR-13). It does not alter the initial assessment and therefore updates of the figures and tables were not required. The information provided adds to the data on marine movements and habitat utilization, particularly by kelts, but does not alter the utilization and movement patterns previously described by the literature summarized within Sections 6.1.8.6 and 12.3.3.2 of the Environmental Impact Statement (EIS). As stated and outlined in the EIS (Section 8.4.4) and the above responses to earlier IRs, migration routes for Atlantic salmon can be variable based on environmental conditions such as sea surface temperature (SST) which can vary considerably within the marine environment and therefore, interactions will be limited and overall risk is considered very low to this species. The conclusion within the EIS based on existing data remains valid; that spring migration of adults within and near the Project Area is possible. However, the likelihood of interaction remains low, given measured SSTs collected between 1900 to 2016, from water depths within 0-20m of the water column. As a result, the Project is not likely to result in significant adverse environmental effects on marine fish and fish habitat, including Atlantic salmon.

The effects of an accidental event on Atlantic salmon was assessed and described in Section 16.6.6.1 of the EIS. CNOOC Petroleum North America ULC (CNOOC) also repeated its oil spill modeling based on a longer release duration (120 days versus the previous 30 days) and extended the model duration from 60 days to 160 days. Following completion of the revised oil spill modelling, CNOOC updated the Accidental Events section (16) of the EIS to include this additional modelling information which is appended to this submission. This additional modelling information has been incorporated into this response and summary. The existing assessment was based on the detailed results of spill modelling as outlined in Section 16 of the EIS and the revised Section 16 (appended to this submission), which included unmitigated worst-case scenarios, the constituents and nature of a potential spill, and the possible responses of Atlantic salmon. As stated in Section 12.3.3.2 of the EIS, post-smolt and adult salmon are concentrated throughout the year in the Labrador Sea, which is outside the Project Area, where they feed and overwinter. In the spring, both grilse

and multi-sea-winter (MSW) adults appear to congregate in two general locations, both of which are outside the Project Area; near the eastern slope of the Grand Bank of Newfoundland and approximately 480 km east of the Strait of Belle Isle (Reddin and Friedland 1993; Reddin 2006) prior to their spawning migrations back to their natal rivers. Also noted earlier, smolt ages indicate that salmon congregating off the east Grand Bank area are likely from more southern populations from South Newfoundland, a portion of the Gulf of St. Lawrence, as well as Eastern – Southern Nova Scotia and Outer Bay of Fundy. While post-smolt do not likely overwinter in the Flemish Pass area (Reddin and Friedland 1993; Reddin 2006), migration as adults to the east Grand Bank area must occur. Although the exact migration route is not known, it may include areas within and near the Project Area, particularly during time periods when SST are favourable (i.e. over 4°C).

The effects of oil associated with an accidental event on marine fish, including salmon, have principally been described using laboratory studies with farm raised fish or caged fish that are unable to avoid oil exposure (e.g., Barnett and Toews 1977; Thomas and Rice 1987; Fraser 1992; Pineiro et al 1996; Zhou et al 1997; Stagg et al 1998; Meador et al 2006; Stieglitz et al 2016). Many of these studies showed effects on feeding, food conversion, or changes in enzyme levels based on exposure; however, returns to baseline were generally noted in 2-8 weeks (Fraser 1992; Stagg et al. 1998). It is noteworthy that many of the concentrations used in lab studies were very high compared to the results of subsea release modelling described in the revised Section 16 (see Appendix C of this Addendum). For example, Stagg et al (1998) investigated the effects of the Braer oil spill on the Shetland Isles, Scotland. They characterized reference sites in the north of Shetland as having oil in water concentrations between 2 and 5 micrograms per litre (µg/L) and regarded these as being typical background values for the local inshore environment. No effects on farmed salmon enzyme and protein levels were detected at these concentrations. Barnett and Toews (1977) observed no mortality in post-smolt Atlantic salmon during 96-hour acute lethal bioassays with concentrations up to 3,200 µg/L.

Few studies have been conducted on the avoidance behaviour of returning adult salmon to hydrocarbons in water under natural conditions. Weber et al (1981) conducted a behavioural study on adult Pacific salmon (*Oncorhynchus* sp.) where hydrocarbons that closely approximated the water-soluble fraction of Prudhoe Bay crude oil were added to in one of two fishways as salmon were migrating upriver. They found that migrating salmon substantially avoided (i.e., when 50 percent of fish which were expected to ascend a fishway avoided it) hydrocarbons in the water at concentrations of 3,200 µg/L. Concentrations used in the study ranged from 300 to 6,100 µg/L.

The degree of fish exposure to a spill, and therefore the type and level of any effects, would depend on the type and size of spill, time of year, weather, and the number, location and species of animals within the affected area. Appendix G of the revised Section 16 described and modelled multiple spill scenarios including; smaller batch spills of hydrocarbons such as diesel fuel, and larger subsea releases (30 and 120 day releases) of hydrocarbon product. In each spill scenario for the project, the "worst case" was modelled. For example, during a subsea release event, no mitigations were applied prior to capping and therefore all oil released is modelled to enter the water column and migrate unimpeded. See the revised Section 16.1 (Appendix C of this Addendum) for details regarding actual spill prevention mitigations as well as those in response to a potential spill event. In addition to spill prevention and response, the likelihood of an actual spill is extremely low.

In a small spill event, such as a batch spill, model results for a 100L event predicted that total hydrocarbon concentrations (THC) do not exceed 1 µg/L. For the larger batch spill volume (1,000L), low in-water concentrations (2 µg/L) were predicted to extend within about 5km of the spill site. These concentrations are well below any shown to have behavioural or toxic effects on salmon and are within concentrations considered typical background values for the local inshore environment near the Shetland Islands, Scotland (Stagg et al. 1988).

A large subsea release would be considered an extremely rare event; however, large subsea releases were modelled to determine the fate of any hydrocarbons. Models were simulated as 30-day and 120-day unmitigated release scenarios at the EL 1144 and EL 1150 example wells to represent the high end of the range of potential response time that is expected to be required to contain a release using a capping stack and/or other equipment. The 30-day release scenarios included a subsea release at the EL 1144 example well site at a rate of 184,000bpd, totaling 5,520,000 bbl and a subsea release at the EL 1150 example well site at a rate of 44,291bpd, totaling 1,329,000 bbl. The 120-day release scenarios included similar release rates for a longer duration with total releases at the EL 1144 and EL 1150 example well sites estimated at 22,080,000bbl and 5,315,000bbl, respectively. No other mitigations were applied to the scenarios and as such represent a "worst case". Mapping of THC at any depth in the water column (i.e., the highest concentration at any depth as the oil is released at depth and travels to the surface) was provided in the revised Section 16 (see Appendix C of this Addendum). As shown in Figure 16.26 and 16.27 in the revised Section 16.4.4.2, the maximum THC modelled for the EL 1150 example well site is 1,500-5,000 µg/L and the maximum range modelled for the EL 1144 example well site is 5,000-15,000 µg/L. These larger ranges are estimated to occur very near the release sites (i.e., deeper water). Most of the THC values modelled are <1,500 µg/L. The higher concentrations near the deep release sites would be higher than those shown to have behavioural or toxic effects on salmon (3,200 µg/L) and would therefore likely elicit a response (Weber et al. 1981; Barnett and Toews 1977); however, most modelled concentrations would be well below 3,200 µg/L, particularly nearer the surface and farther from the release location.

As described in Section 16.6.2.3 (see Appendix C of this Addendum), potential effects of a batch diesel spill (i.e.100 and 1,000 L) on marine fish and fish habitat are predicted to be adverse, negligible to medium in magnitude, short- to medium-term in duration, to occur within the Project Area, and reversible. This was determined with a moderate level of confidence. The potential effects of a subsea release in the Project Area on marine fish and fish habitat are predicted to be adverse, medium in magnitude, medium to long-term in duration, occur within the Regional Study Area (RSA), and reversible. This was determined with a moderate level of confidence. Both batch spills and subsea release are capable of medium magnitude adverse effects in that both could cause a detectable change that is beyond the range of natural variability for the fish and habitat affected, but with no associated adverse effect on the viability of the affected population. Although there is the potential for effects on fish and their habitats in the RSA, these are, with appropriate mitigations, not likely to result in an overall, detectable decline in overall fish abundance or change in the spatial and temporal distribution of fish populations in the overall RSA and the predicted residual environmental effects are considered not significant.

In reference to potential cumulative effects (Chapter 15 in the EIS), the Project activities will operate for a short period of time in any one location, resulting in a short-term disturbance within a relatively limited zone of influence. This will reduce the potential for individuals and populations to be affected through multiple interactions with this Project and other activities in the marine environment, and for species to be affected simultaneously and repeatedly by multiple projects and activities. This, along with the other planned Project-related mitigation measures that will be implemented and the low potential for salmon to occupy the Project Area, will reduce the potential for and degree of associated cumulative effects.

The conclusion within the EIS based on existing data remains valid; the Project will not result in significant adverse cumulative environmental effects on marine fish and fish habitat, including Atlantic salmon in combination with other projects and activities that have been or will be carried out.

Part 9: Recognizing data gaps regarding the presence of Atlantic salmon in the Project Area, migration routes, and at-sea mortality, apply the precautionary approach in the updated effects analysis and in the discussion of proposed mitigation.

As stated in Sections 6.1.8.6 and 12.3.3.2 of the EIS and IR-12 Part 1 above, post-smolt and adult salmon are concentrated throughout the year in the Labrador Sea and the Greenland Sea, which is outside the Project Area, where they feed and overwinter. In the spring, both grilse and MSW adults appear to congregate in two general locations, both of which are outside the Project Area; near the eastern slope of the Grand Bank of Newfoundland and approximately 480 km east of the Strait of Belle Isle (Reddin and Friedland 1993; Reddin 2006) prior to their spawning migrations back to their natal rivers. Also noted earlier, smolt ages indicate that salmon congregating off the east Grand Bank area are likely from more southern populations from South Newfoundland, a portion of the Gulf of St. Lawrence, as well as Eastern – Southern Nova Scotia and Outer Bay of Fundy. While post-smolt do not likely overwinter in the Flemish Pass area (Reddin and Friedland 1993; Reddin 2006), migration as adults to the east Grand Bank area must occur. Although the exact migration route is not known, using the precautionary approach it has been conservatively assumed that the route may include areas within and near the Project Area, particularly during time periods when SST are favourable (i.e. over 4°C). Please refer to IR-12 Part 1 above and Sections 6.1.8.6 and 12.3.3.2 for additional details regarding salmon migration and habitat use.

The information provided in IR-12 Part 1 adds to the data on marine movements and habitat utilization, particularly by kelts, but does not alter the utilization and movement patterns previously described by the literature summarized within the EIS. Migration routes for Atlantic salmon can be variable based on environmental conditions such as SSTs and therefore, interactions will be limited and overall risk is considered very low to this species. The conclusion within the EIS based on available data remains valid; spring migration of adults within and near the Project Area is possible; however, the likelihood of interaction remains low, given measured SSTs collected between 1900 to 2016, from water depths within 0-20m of the water column. As a result, the Project is not likely to result in significant adverse environmental effects on marine fish and fish habitat, including Atlantic salmon.

Part 10: Taking into consideration any uncertainties regarding potential effects, discuss the need for follow-up related to project-specific or cumulative effects on Atlantic salmon, including participation in future regional initiatives and potential for collaboration with Indigenous communities.

The additional information identified in IR-12 and IR-13 was considered and the potential for Project interactions and effects outlined in the EIS remain valid; the Project is not likely to result in significant adverse environmental effects on marine fish and fish habitat, including Atlantic salmon. However, CNOOC acknowledge that although the Project is extremely unlikely to affect Atlantic salmon, there are some data gaps regarding migratory routes. The understanding of salmon migration continues to evolve, and additional data on migratory routes of salmon may supplement the broad research ongoing by DFO, Indigenous Groups, Atlantic Salmon Federation, etc. CNOOC, in collaboration with industry and other research partners (potentially including Indigenous Groups), may consider supporting research on migratory routes within the offshore Project Area(s). This support could also occur within the context of regional initiatives.

References:

Part 6

No additional references.

Part 7

No additional references.

Part 8

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Part 9

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Part 10

No additional references.

2.4.3 Information Requirement: IR-14 (Part One Response – September 2018)

External Reviewer(s): QFN-01-Nx; KMKNO-17-Nx

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat

Reference to EIS Guidelines: Part 2, Section 6.3.1 Fish and Fish Habitat

Reference to EIS: Section 8.4.5 American Eel

Context and Rationale: Section 8.4.5 of the EIS indicates that migration routes for American eel are possible through the Project Area but it is considered to be of low likelihood. The EIS further states that interactions may be limited and overall risk is considered low to this species, and that Project-related disturbances are also localized and short-term with mitigation measures implemented to reduce potential effects.

The Qalipu First Nation stated that potential changes in habitat and food availability and quality may interrupt migration patterns of American eel through the project site.

The referenced American eel migration routes studies were conducted within a corridor that stretched from Lake Ontario to the Cabot Strait and Sargasso Sea. The KMKNO advised that no study has been undertaken off the eastern coast of Newfoundland.

Specific Question or Information Requirement: Taking into account comments from the KMKNO and Qalipu First Nation provide additional information on the American Eel, including the following:

- a justification to support the assertion that it is unlikely that American Eel pass through the Project Area; and
- identification of any mitigation measures required to address concerns with American Eel or a rationale as to why the current assessment and mitigation remain valid.

Response: Spawning migrations for adult American eels in Canada occur in the fall and follow the continental shelf before travelling across open ocean to the Sargasso Sea (COSEWIC 2012; Béguer-Pon et al. 2015). In tracking studies in Atlantic Canada, adult eels were observed to migrate in two phases. Eels first travel in shallow waters along the continental shelf and edge. Telemetry data indicates that adult eels undergo some exploratory behavior on their way to the Sargasso Sea, which is assumed to be for detection of cues or other migrants (Béguer-Pon et al. 2015). In the second phase of migration, the eels travel in deep waters directly south towards the Sargasso Sea, which includes crossing the Gulf Stream (Béguer-Pon et al. 2015). After spawning from February to April, the larvae in the Sargasso Sea drift north with the Gulf Stream, with some directional swimming (Rypina et al. 2014; Westerberg et al. 2017). Variations in strength of the Gulf Stream and other ocean circulation patterns may influence success rates of larvae reaching coastal waters (Rypina et al. 2016; Westerberg et al. 2017).

Preliminary studies indicate that juvenile and adult American eel showed strong avoidance to lights but were attracted to underwater noise (Hadderingh et al 1992; Patrick et al 1982, 2001). Young American eel larvae in marine environments have avoidance capabilities as demonstrated by net avoidance in the Sargasso Sea (Castonguay and McCleave 1987).

The main threats to this species are largely in freshwater systems including habitat degradation and fragmentation, food web changes, fisheries and chemical and biological contamination (COSEWIC 2012; Chaput et al 2014). However, changes and variations in oceanographic processes are considered the main threat to ocean survival of larvae (Knights 2003; COSEWIC 2012; Chaput et al. 2014). Although seismic activities are suggested to result in localized stress and mortality of larval stages, Chaput et al. (2014) indicated that there is no indication that the larval densities at sea that may encounter seismic activities would result in effects on the population.

As American eel use the continental shelves for migration, it is possible that adult American eels may travel through the shallow water depths of the Project Area. Mitigation strategies to avoid or reduce potential adverse effects of Project activities on American eel would be similar to mitigation strategies for other secure and at-risk marine fish species. With the application of the following mitigation measures, which are listed in Section 8.3.2 of the Environmental Impact Statement (EIS) and apply to marine fish and fish habitat, the environment effects of planned Project activities on American eel are predicted to be not significant.

- Existing and common vessel travel routes will be used wherever practical, vessels will seek to maintain a steady course and vessel speed, and any low-level aircraft operations will also be avoided or minimized (except for approach and landing activities).
- CNOOC Petroleum North America ULC (CNOOC) will minimize environmental discharges and emissions from planned operations and activities, and comply with relevant regulations and standards. Relevant operational discharges will be treated prior to release in compliance with the Offshore Waste Treatment Guidelines (OWTG; NEB 2010) and other applicable regulations and guidelines, and oil-water separators will be used to treat contained oil contaminated fluids, with collected oil above discharge limits properly stored and disposed of.
- Where technically feasible, lower toxicity drilling fluids will preferentially be used. Selection and screening of chemicals will be undertaken pursuant to the Offshore Chemical Selection Guidelines for Drilling and Production Activities on Frontier Lands (NEB et al 2009).
- During any associated well testing, any produced hydrocarbons and small amounts of produced water will be flared using high-efficiency burners. If there is a significant amount of produced water encountered, it will be treated in accordance with the relevant regulatory requirements prior to ocean discharge.
- Appropriate measures for the handling, storage, transportation and on-shore disposal of solid and hazardous wastes will be employed throughout the Project. Maceration of sewage and kitchen waste will be conducted in accordance with the OWTG (NEB 2010) and International Convention for the Prevention of Pollution from Ships (MARPOL; IMO 2017).
- During drilling activities that occur after the riser has been installed, synthetic based mud (SBM) associated drill cuttings will be returned to the mobile offshore drilling unit (MODU) and treated in accordance with the OWTG (NEB 2010) before being discharged to the marine environment. SBM drill cuttings are typically discharged below the sea surface in order to maximize their dispersion and thus, to help avoid or reduce any associated surface sheen and their accumulation on the seabed.
- If removal of the wellhead is required as part of well abandonment procedures, it will be completed via mechanical separation (i.e., cutting, as opposed to the use of explosives).

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2.4.4 Information Requirement: IR-15 (Part One Response – September 2018)

External Reviewer(s): MTI-01-Nx

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat

Reference to EIS Guidelines: Part 2, Section 6.3.1 Fish and Fish Habitat

Reference to EIS: Section 8.3 Environmental Effects Assessment and Mitigation

Context and Rationale: Section 6.1.7.5 of the EIS states that Swordfish may migrate through the southern portion of the RSA during the summer.

While MTI expects that swordfish are in low abundance in the Project Area, given the importance of the species, MTI raised concerns with the fact that a full assessment of environmental effects on Swordfish have not been provided within the effects assessment.

Comments from MTI state that Swordfish are known to only tolerate small environmental changes. Offshore activities have greater detrimental effects on populations when compared to other species (de Sylva et al, 2000)[2].

Specific Question or Information Requirement: Provide an assessment of the potential effects to Swordfish, including any existing published research on biological and behavioural responses of Swordfish to noise, spills and light. Update the proposed mitigation and follow-up, as well as effects predictions, accordingly.

Response: The potential effects on swordfish has been fully considered in the environmental effects assessment as detailed in Section 8.3, 8.4 and 12.3 in the Environmental Impact Statement (EIS). The following provides additional details on this species as requested.

Swordfish (*Xiphias gladius*) are large, highly migratory, pelagic species that occupy Canadian waters for foraging from June to October (DFO 2015) and returns to southern spawning areas from December to June (Govoni et al. 2003; Arocha 2007; Neilson et al. 2009, 2014). The Gulf of Mexico and eastern continental shelf of the United States are suggested to be nursery areas for the pelagic larvae (Govoni et al. 2003; Arocha 2017). In Canadian waters, swordfish primarily feed on squid, Atlantic mackerel, Atlantic herring, and other fishes (Scott and Tibbo 1968; Stillwell and Kohler 1985).

The distribution assessment of swordfish in Canadian waters is primarily based on information from fisheries (longline and harpoon) observations and tracking with pop-up satellite tags (Neilson et al. 2009, 2014; Andrushchenko et al. 2014). Swordfish populations across the North Atlantic are separate with little evidence of movement between the western and eastern North Atlantic (Neilson et al. 2014). There are also separate northern and southern Atlantic stocks with an approximate boundary around 5^0N latitude. Swordfish associate with thermal fronts indicating they follow the warm Gulf Stream in Canadian waters similar to other large pelagic fishes (Podestá et al. 1993; Sedberry and Loefer 2001). Tagging studies indicate the distribution of immature swordfish (<179 cm) is primarily along the eastern United States from Massachusetts to Florida. Mature swordfish (>179 cm) generally occupied higher latitudes including the eastern Coast of the United States, Atlantic Canada, the Grand Banks, and the Flemish Cap with presence during spawning season in the Gulf of Mexico, Sargasso Sea, and Caribbean Sea (Govoni et al. 2003; Neilson

et al. 2013, 2014, Luckhurst and Arocha 2016). The Canadian longline fishery for swordfish generally matches the species distribution from the Georges Bank to the Flemish Cap, however effort is primarily along the Georges Bank, Scotian Shelf and southern Grand Banks (DFO 2011; Lauretta et al. 2014; Andrushchenko et al. 2014; Andrushchenko and Hanke 2015). Swordfish also undergo diel vertical migrations where they occupy surface waters (less than 100 m) during the day and deeper waters (greater than 400 m) at night (Lerner et al. 2013). Occasionally, swordfish bask in surface waters during the day; a behavior more common in colder waters (Dewar et al. 2011; Neilson et al. 2013).

Swordfish are highly visual predators, even in dim light, with specialized mechanisms for warming the brain and eyes that allows for detection of rapidly moving prey (Fritsches et al. 2005; Hazin et al. 2005; Southwood et al. 2008; Ishibashi et al. 2009). Swordfish fisheries are conducted at night with light attractants (light sticks) attached on the longline (Bigelow et al. 1999; Hazin et al. 2005; Orbesen et al. 2017). However, it is unclear whether the light attract prey that attracts swordfish or if the light attracts the swordfish themselves (Hazin et al. 2005). Catch rates of swordfish have been examined in relation to lunar illumination with inconsistent results geographically. Catch rates using the pelagic longline were highest with low lunar illumination in Gulf of Mexico and Reunion Island fisheries and highest with the full moon in the central Atlantic, Portuguese, Hawaii, and eastern Mediterranean Sea fisheries (Orbesen et al. 2017). Low catch rates of swordfish during a gillnet fishery during high lunar illumination was suggested to result from greater net visibility during the full moon (Orbesen et al. 2017). Olfactory or chemosensory cues also play a role in predation as Mejuto et al. (2005) observed presence of prey odors contributed to the strike / no strike decision in swordfish. In comparisons of various bait types, swordfish were more likely to strike baits with prey odors including plastic imitation mackerel stuffed with fish compared to plastic imitation bait with no fish (Mejuto et al. 2005; Southwood et al. 2008). There are few studies on the hearing capabilities for swordfish and as such auditory abilities are inferred from other large pelagic fishes including tunas and sharks (Southwood et al. 2008). Tunas are considered hearing generalists as they lack specialized mechanisms for enhancing hearing and are capable of detecting low frequency sounds (less than 1000 Hz). Yellowfin tuna have been shown to respond to sound cues in the frequency range of 200-700 Hz with higher sensitivity to sounds between 200-400 Hz (Southwood et al. 2008). Sharks are considered low frequency specialists and are attracted to low frequency sounds in the range of 25-1,000 Hz (Southwood et al. 2008). Irregular pulsed sounds may attract shark species as it is similar to what would be generated by struggling prey (Southwood et al. 2008). High intensity sound results in rapid avoidance behavior in sharks, however they may become habituated to these types of noises (Southwood et al. 2008).

There are a variety of potential effects of petroleum extraction activities on swordfish (de Sylva et al. 2000). The combination of drilling installation colonization opportunities and artificial light emissions from the operating decks and navigation may create a "reef effect" in which fish may aggregate underneath in response to increased foraging and shelter opportunities even in areas of underwater noise around anthropogenic activities in the marine environment (see EIS for review, Keenan et al. 2007). Swordfish and other pelagic fishes have been shown to be attracted to marine structures termed fish aggregation devices (FAD), including oil platforms, fish farms, and offshore wind turbines (Franks 2000; Fayram and de Risi 2007; Arechavala-Lopez et al. 2013). Swordfish may be attracted to these areas based on increased foraging opportunities and better lighting for predation (Franks 2000; Hazin et al. 2005 Orbesen et al. 2017). As swordfish are highly visual predators and any discharges such as drill cuttings releases may reduce visibility in the water could have effects on this species' ability to capture fish. Attraction to an offshore infrastructure may also expose individual swordfish to the emissions (noise, light) and discharges associated with drilling activities, however, swordfish is a highly mobile species that is likely able to avoid any anthropogenic effects associated with a drilling installation and associated vessels. Based on hearing capabilities of other pelagic fishes, swordfish may be attracted to low frequency noises that are typical of offshore operations, however

any high intensity noises will likely cause movement away from the area. This species' seasonal distribution in Canadian waters, combined with their non-schooling behavior also reduces any potential population effects (Arocha 2017) from the Projects. Spawning habitats for swordfish are also distant from the Project Area, reducing potential interactions with important habitats and critical life stages that have less capability of avoidance. With the application of mitigation measures outlined in the response to Information Requirement (IR) IR-14, which are included in Section 8.3.2 of the EIS and apply to marine fish and fish habitat, the environmental effects of planned and routine Project activities on swordfish are predicted to be not significant.

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2.4.5 Information Requirement: IR-16 (Part One Response – September 2018)

External Reviewer(s): Unknown

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat

Reference to EIS Guidelines: Part 2, Section 6.3.1 Fish and Fish Habitat

Reference to EIS: Section 8.3.4.2 Residual Environmental Effects Assessment

Context and Rationale: Section 8.3.4.2 of the EIS states that "the likely distance between individual wells that will be drilled as part of this Project means that there is also little or no potential for these environmental releases [drilling muds and cuttings] from individual wells to interact or accumulate in the LSA."

Specific Question or Information Requirement: Indicate the "likely distance" between individual wells assumed in making the determination that there is no potential for overlap. Clarify, what is the closest distance that wells could occur to each other, including exploration and associated delineation wells. Update effects predictions, proposed mitigation, and follow-up, if applicable.

Response: The distance between exploration wells is dependent on the data obtained from the wells and geophysical surveys. Distances between delineation/appraisal wells, exploration wells and each other depend on the perceived extent of the prospect, the sub-surface faulting and compartmentalization, the determination of an oil-water contact, and a desire to determine pressure communication/variances between sub-surface areas. All of the wells are drilled with the consideration of determining economic viability. Learnings from each well drilled will influence the location of the subsequent well. In this respect, delineation/appraisal wells are typically drilled multiple kilometers apart based on the data collected from the exploration well and prospect size to enable determination of the reservoir parameters and size. The reader is also referred to the response to IR-05 for additional information.

The potential effects predictions and proposed mitigation measures identified in the Environmental Impact Statement (EIS) remain valid.

The response to IR-19 may provide additional information.

References:
No additional references.

2.4.6 Information Requirement: IR-17 (Revised Response – February 2019)

External Reviewer(s): C-NLOPB-11-Nx

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat, 5(1)(a)(ii) Aquatic Species, 5(1)(a)(iii) Migratory Birds

Reference to EIS Guidelines: Part 2 - Content of the EIS- 6.6.1 Effects of potential accidents or malfunctions

Reference to EIS: Appendix D – Drill Cuttings Modelling, Section 3.2.2 Cuttings Particle Characterization

Context and Rationale: Table 3-3 of Appendix D includes information related to the samples used in the SBM cuttings modelling, indicating that the cuttings were representative of two wells, Tuckamore and Baccalieu. The C-NLOPB advised that while Tuckamore can be considered as an acceptable sample to use given that it was drilled in 2003, Bacccalieu was drilled in 1985 and that there is more recent information of cutting particle size that could have been used. A well drilled in 1985 has little relevance compared to more recently drilled wells given the changes in drilling fluids, techniques and treatments since that time.

Specific Question or Information Requirement: Provide a rationale to support the decision to complete the modelling using information from a well drilled in 1985 when more recent well data exist.

Response: Baccalieu I-78 was chosen based on several criteria including: distance from EL 1144 and EL 1150, thickness and similarity of the Cretaceous interval to the equivalent package in EL 1144 and EL 1150, the use of synthetic based mud (SBM) drilling fluids, and the availability of particle size information. Cuttings size was predicted from the sieve analysis of SBM drill cuttings provided in the final well report of Baccalieu I-78. This information is not typically provided in final well reports, and was not included in the well report for Tuckamore B-27.

Additional Question or Information Requirement: The Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) has advised that Nexen Energy ULC seek cuttings particle size distribution data from a recently drilled well to demonstrate that the 1985 distribution data used in the cuttings dispersion model is comparable to that from a well drilled in accordance with current drilling and waste disposal standards.

Response (February - 2019): The following is a discussion of the drilling conditions and standards used on the 1985 Baccalieu well (e.g. drilling fluids, drilling methods and cuttings treatment) versus more current conditions and standards and how any differences might affect the resulting dispersion model results (i.e. through differences in resulting cuttings particle distribution).

Baccalieu I-78 was a well that was drilled in 1985 by Esso Parex (Imperial Oil). Baccalieu I-78 was drilled with roller cone bits exclusively, which employs a crushing and gouging mechanism to drill the rock. By nature of this bit's cutting structure, cuttings are generally smaller. Comparatively speaking, more recent wells drilled in the region have utilized roller cone bits only to drill hole sections greater than 17.5" in diameter. Hole sections 17.5" or smaller have employed the use of Polycrystalline Diamond Compact (PDC) fixed cutter bits. The PDC bit employs a penetrate and shear mechanism for drilling the rock. This style of bit generally produces longer cuttings. The rock failure mechanism employed will influence the shape and size of the cuttings coming off the bit face. Other aspects of the bit will also have an effect on the resulting cutting size and shape. The bit's ability to wash cuttings away from the cutting face directly impacts the bit's ability to penetrate more rock and effectively clean the hole. An inability to efficiently remove the cuttings

from the bit face means that the old cuttings will get re-cut as they are churned around the cutting structures longer and become smaller. There have been continued advancements in bit technology over the years and a key area of focus, particularly on PDC bits, has been around the cuttings removal from the bit face. In summary, roller cone bits would have produced smaller cuttings at the bit face, while PDC bits would produce larger cuttings at the bit face.

Baccalieu I-78 was the first well drilled offshore Newfoundland to trial the use of a low toxicity mineral oil-based invert emulsion drilling fluid; a type of synthetic base mud (SBM). It was introduced to eliminate hole instability issues encountered on other wells where hydratable shales were present. Since Baccalieu I-78 was drilled, advancements have been made in SBM's with regards to their performance, safety, and environmental attributes. For example, there is an improvement in the encapsulation of cuttings using modern SBMs. This prevents the cuttings from reacting, disintegrating, and adhering to each other as they are transported up the wellbore to surface. While advancements have been made since 1985 and the adoption of SBMs in Flemish Pass wells is widespread, it is similar geology that will be drilled. So, it is not expected that the advancements achieved in SBM's will greatly alter the cutting size between Flemish Pass wells.

On the MODU, advancements have been made as to how cuttings are processed. In 1985, on Baccalieu I-78, the primary solids control and waste management equipment were shale shakers and mud cleaners. These pieces of equipment separated cuttings from the mud before the mud was circulated back into the system. The current equipment on MODUs is more efficient at solids control and it includes additional "waste management equipment" such as centrifuges and cuttings dryers. Wet cuttings will pass from the shale shakers to the waste management equipment, like cuttings dryers, which pulverize the cuttings by putting them through a high g-force process that dries them into a finer product. The incorporation of this additional waste management equipment on more recent wells has resulted in the particle size distribution (PSD) having a higher percentage of fine or very fine particles.

To summarize the changes in technology between 1985 and current, the identified bit designs would produce different particle sizes at the bit face but once the drill cuttings are circulated to the surface and run through the various solids control and waste treatment processes on the MODU, the particle sizes being deposited in the ocean from either bit design should be similar but the PSD may vary.

The differing PSD between different wells may cause differing dispersion footprints. So, the next step is to identify more recent drill cuttings and run that different data through the existing SBM dispersion models used by CNOOC Petroleum North America ULC (CNOOC) in its EIS to validate the model results. The CNOOC consultants identified a more recent cuttings PSD (PSD #2) and reran the CNOOC EIS cuttings dispersion model, for the June month for both the EL 1144 Deepwater Example Well and the EL 1150 Shallow Water Example Well locations. The new model results are compared with the previously submitted predictions from model runs using the original CNOOC EIS PSD (PSD #1). The two PSDs are as follows:

- (PSD#1) The PSD used for the CNOOC EIS models was as follows: WBM cuttings: PSD estimated from Petro-Canada et al Tuckamore B-27; SBM cuttings: PSD estimated from drill cuttings samples from Esso Parax et al Baccalieu I-78, as reported in the CNOOC EIS modelling report (Section 3.2.2 of the Appendix D).

- (PSD# 2) The second PSD selected is based on a more recent SBM drill cutting sample program from the 2015 drilling of the intermediate and main hole sections of Husky's SWRX (South White Rose Extension) J-05-3 well (2015 unpublished modelling report prepared by Amec Foster Wheeler for Husky Energy; 'Approval to quote SWRX J05-3 cuttings PSD', pers. comm. David Pinsent, Husky Energy, January 2019). The WBM cuttings (conductor and surface sections) PSD is derived from the Hibernia K-18 PSD (1993).

Comparisons of the percent material, and assumed cuttings particle diameters and associated particle velocities for (PSD# 1) and (PSD# 2) are given below, with particle size classes of larger (class 6) (e.g., fine pebbles or cobble-pebbles) to smaller (class 1) (e.g., medium silt or medium silt-clay).

Table IR-17.1 Two Drill Cuttings PSD

Percent Material

Size Class	WBM conductor and surface (PSD# 1)	WBM conductor and surface (PSD# 2)	SBM intermediate (PSD# 1)	SBM intermediate (PSD# 2)	SBM production, sidetrack / main (PSD# 1)	SBM production, sidetrack / main (PSD# 2)
6	0	5	52.0	3.0	8.0	0.1
5	10	5	28.0	10.3	30.0	0.2
4	20	2	13.0	30.8	38.0	2.0
3	25	1	4.0	3.2	20.0	28.8
2	20	2	1.0	2.3	2.0	15.6
1	25	85	2.0	50.4	2.0	53.3

Size Class	Particle Diameter (mm) (PSD# 1)	Particle Diameter (mm) (PSD# 2)	Fall Velocity (m/s) (PSD# 1)	Fall Velocity (m/s) (PSD# 2)
6	4.76	9.52	0.29	0.409
5	2.36	4.76	0.204	0.29
4	1.18	0.545	0.144	0.098
3	0.3	0.149	0.073	0.051
2	0.074	0.074	0.001	0.0012
1	0.01	0.01	0.001	0.0012

There are slight differences in the particle size classes between the two PSDs. The (PSD# 2) data set has more smaller sized particles.

Comparison model runs for June scenarios at the EL 1144 and EL 1150 example well sites were completed, with selected results shown in Figures IR-17.1 to IR-17.8 below. Two views of total cuttings footprints are presented for each modelled scenario: a Project Area view and a 1.5 km scale view showing predicted no effect thresholds (PNET) limits. Figures IR-17.1, IR-17.3, IR-17.5 and IR-17.7 are as presented in the original EIS modelling report (Figures 4-6, 4-10, 4-26 and 4-30 respectively in Section 4 of the EIS).

From these comparison model runs, there is general agreement in the dispersion footprints (where and how thick) and no indication of any significant differences in model predictions with the differing PSDs. In following, we believe the original model predictions provided in the CNOOC EIS are reasonable dispersion estimates.

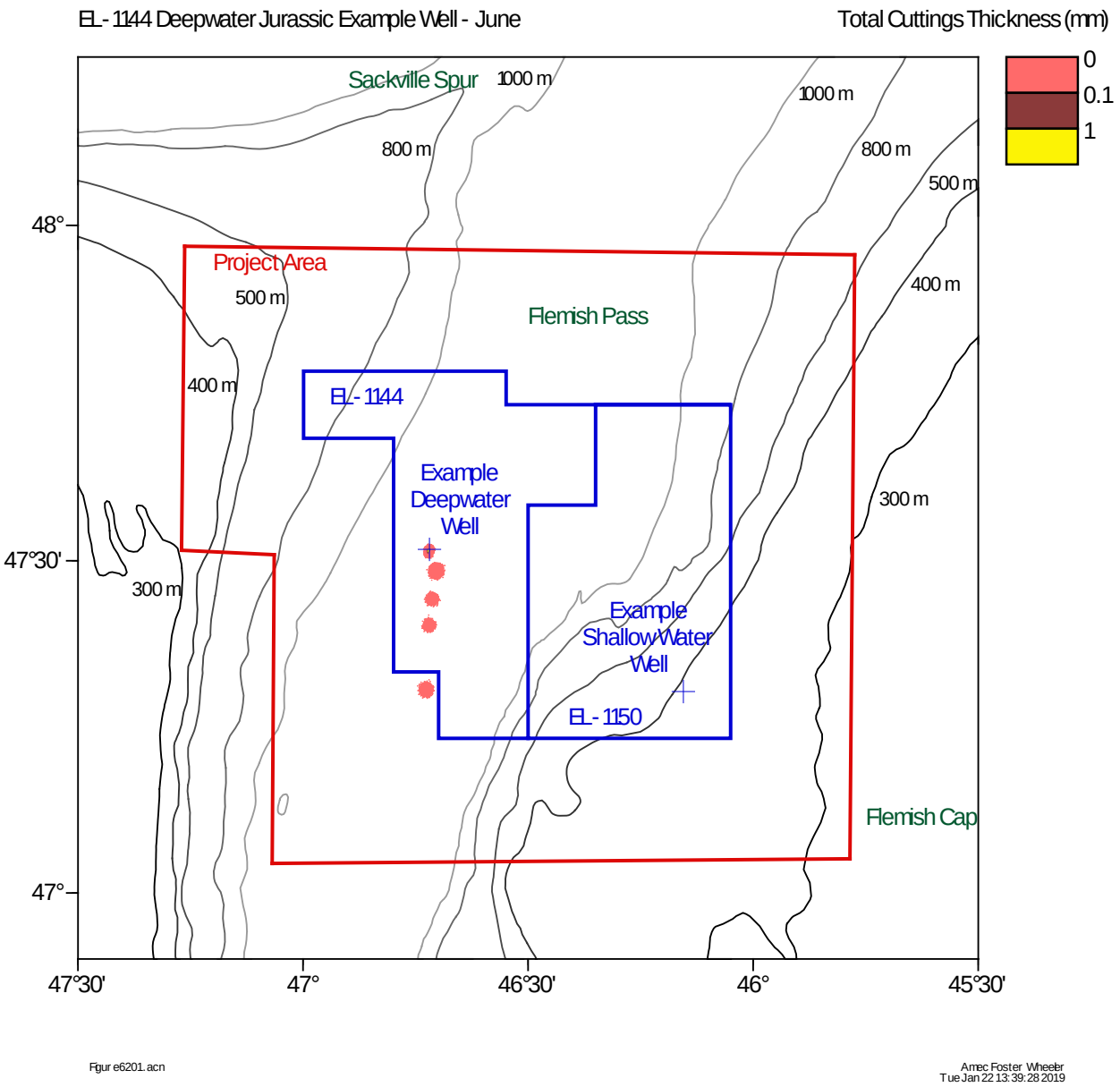


Figure IR-17.1 Total Drill Cuttings Deposition, EL 1144 Deepwater Example Well, June, Project Area (PSD# 1) (Original Figure 4.6 of the EIS)

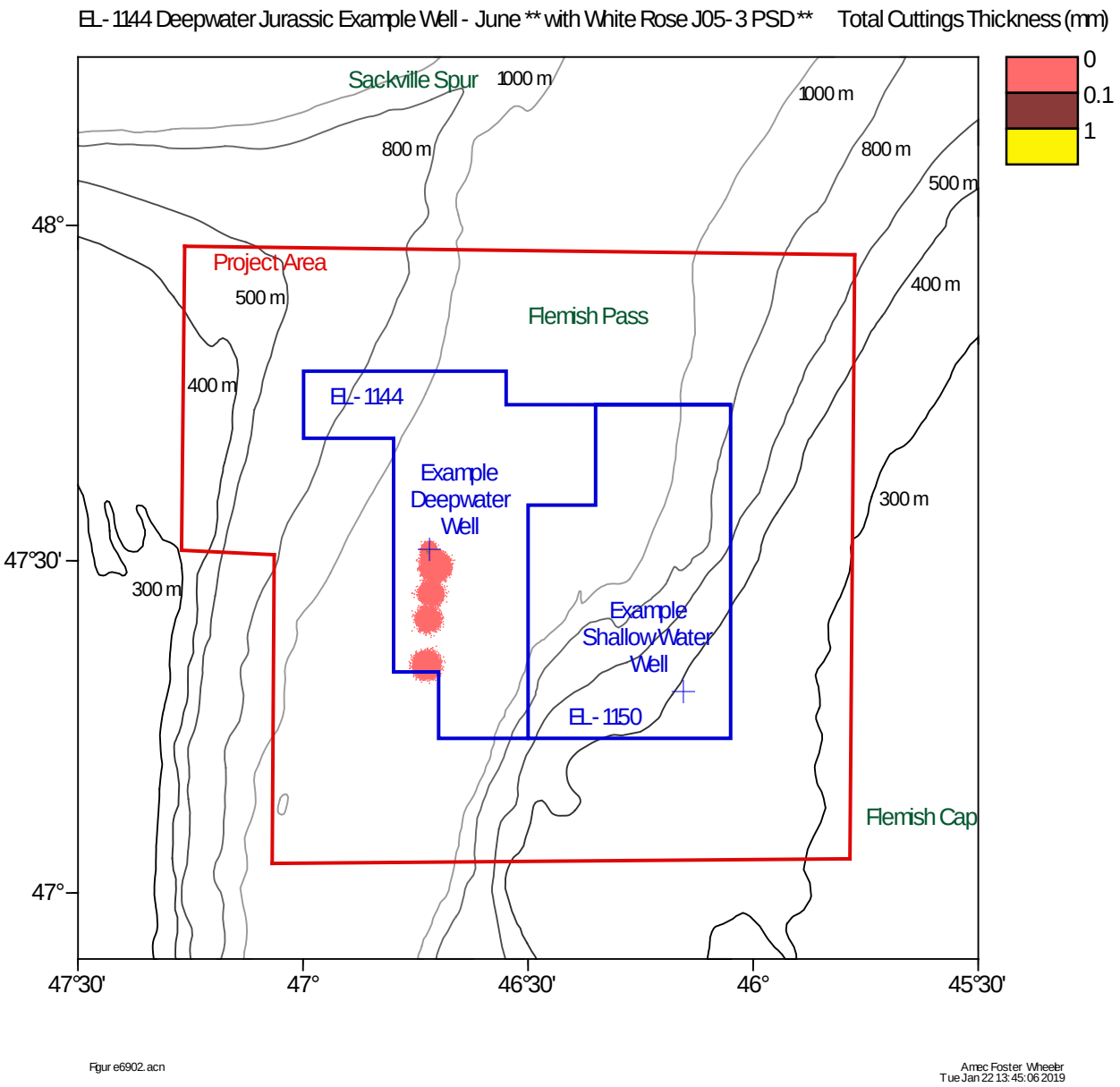


Figure IR-17.2 Total Drill Cuttings Deposition, EL 1144 Deepwater Example Well, June, Project Area ((PSD# 2) w/ White Rose J05-3 PSD)

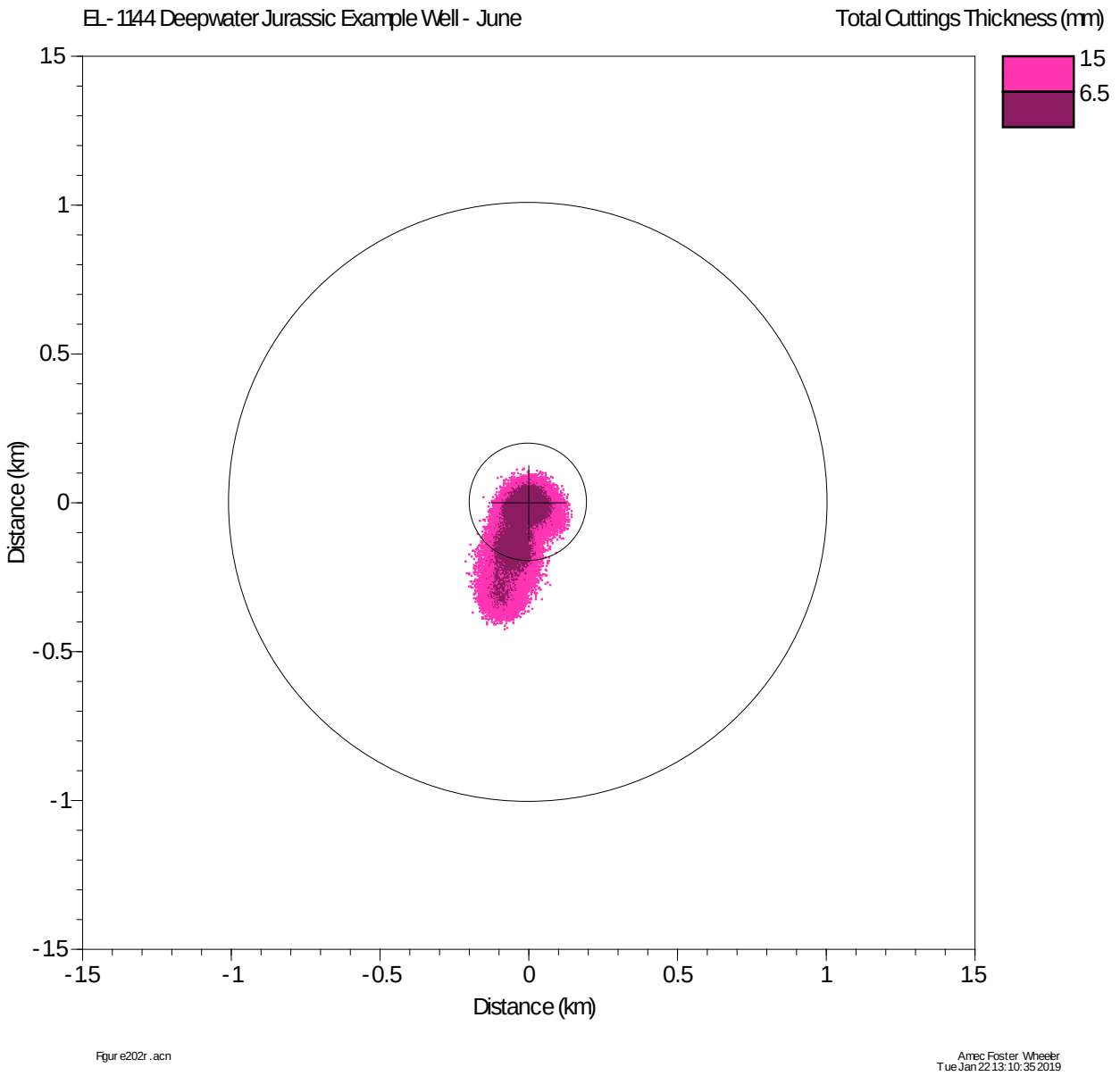


Figure IR-17.3 Total Drill Cuttings Deposition, EL 1144 Deepwater Example Well, June, PNET Limits View (PSD# 1) (Original Figure 4.10 of the EIS)

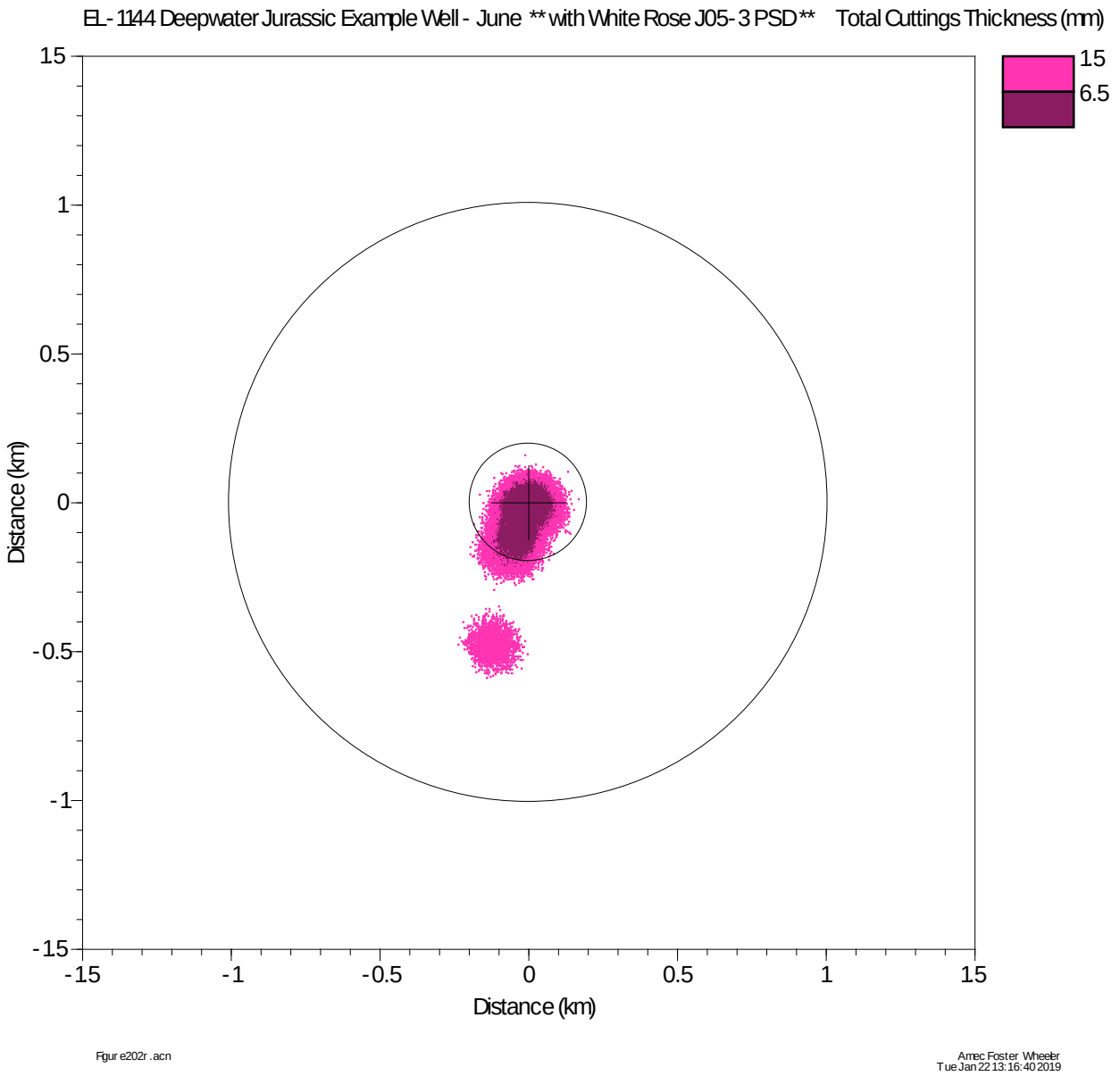


Figure IR-17.4 Total Drill Cuttings Deposition, EL 1144 Deepwater Example Well, June, PNET Limits View ((PSD# 2) w/ White Rose J05-3 PSD)

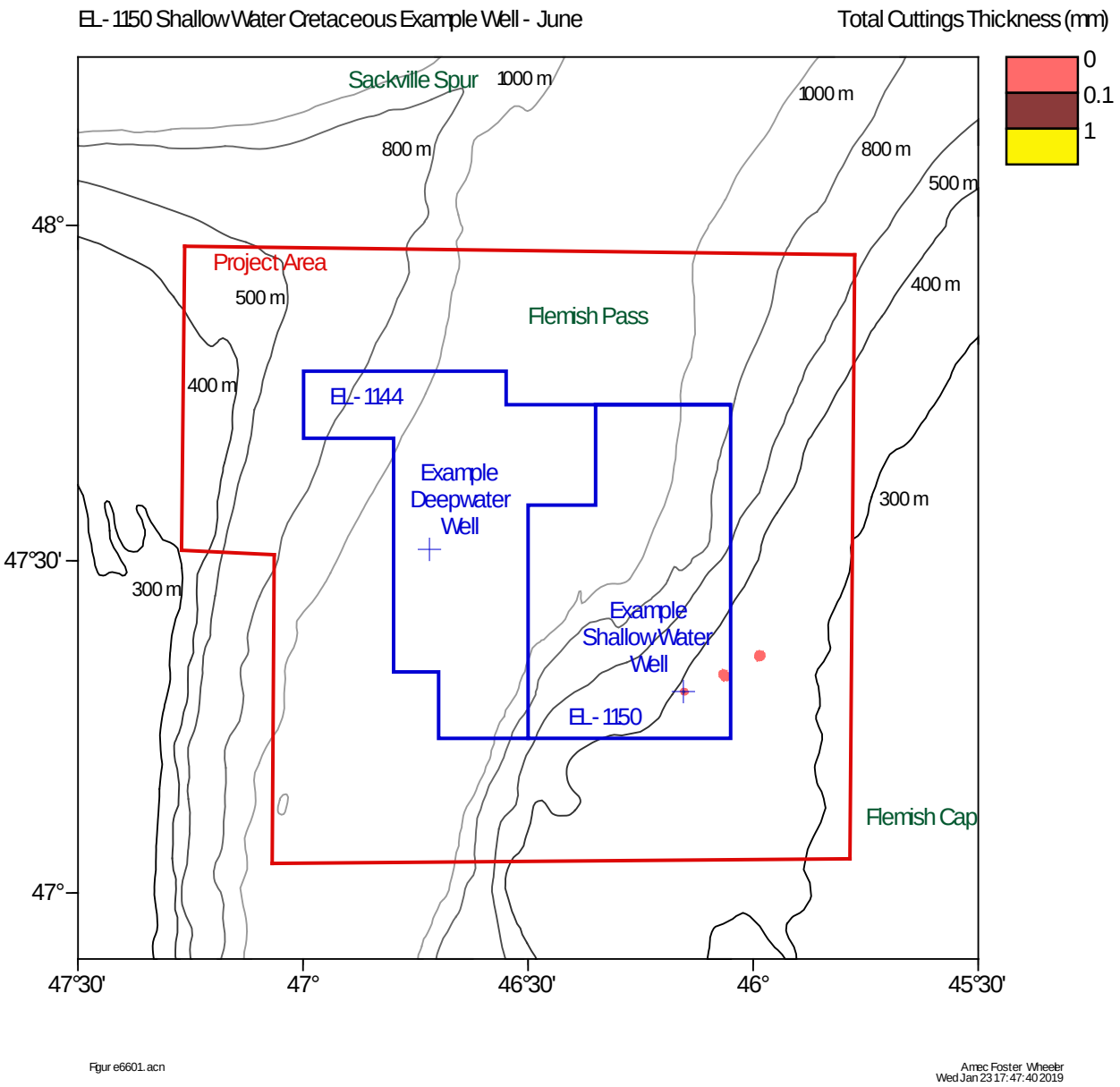


Figure IR-17.5 Total Drill Cuttings Deposition, EL 1150 Shallow Water Example Well, June, Project Area (PSD# 1) ((Original Figure 4.26 of the EIS)

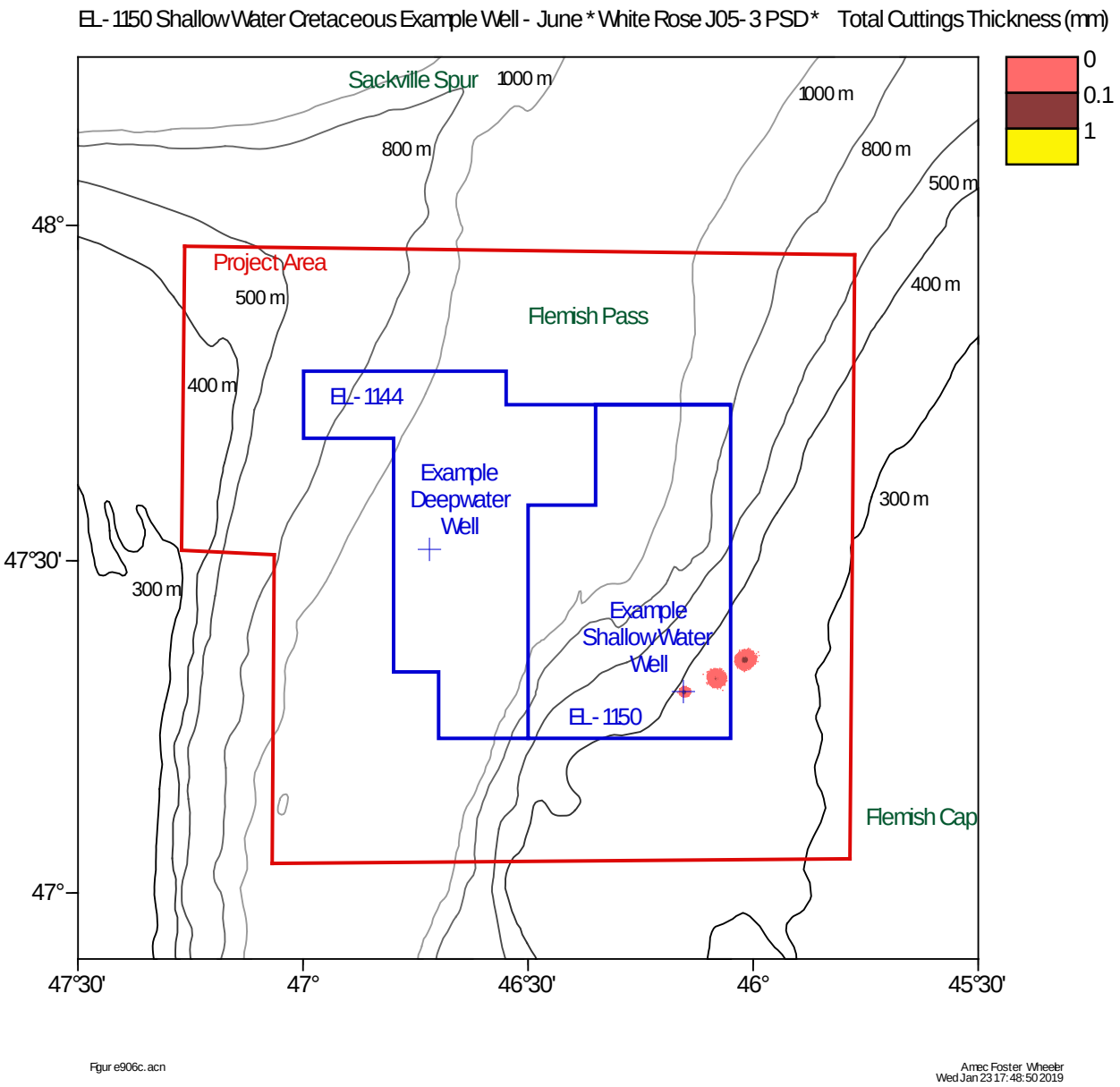


Figure IR-17.6 Total Drill Cuttings Deposition, EL 1150 Shallow Water Example Well, June, Project Area ((PSD# 2) w/ White Rose J05-3 PSD)

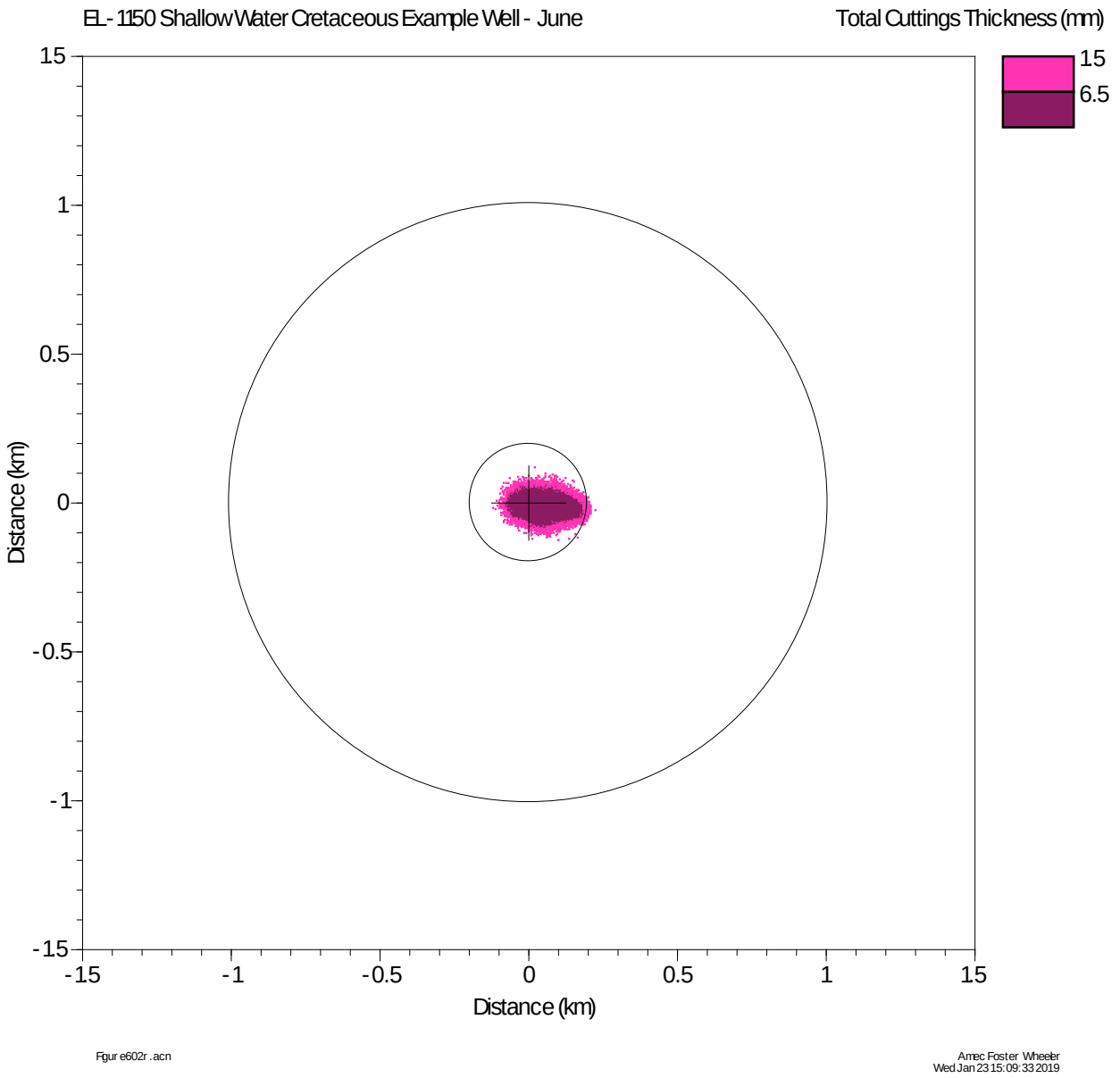


Figure IR-17.7 Total Drill Cuttings Deposition, EL 1150 Shallow Water Example Well, June, PNET Limits View (PSD# 1) (Original Figure 4.30 of the EIS)

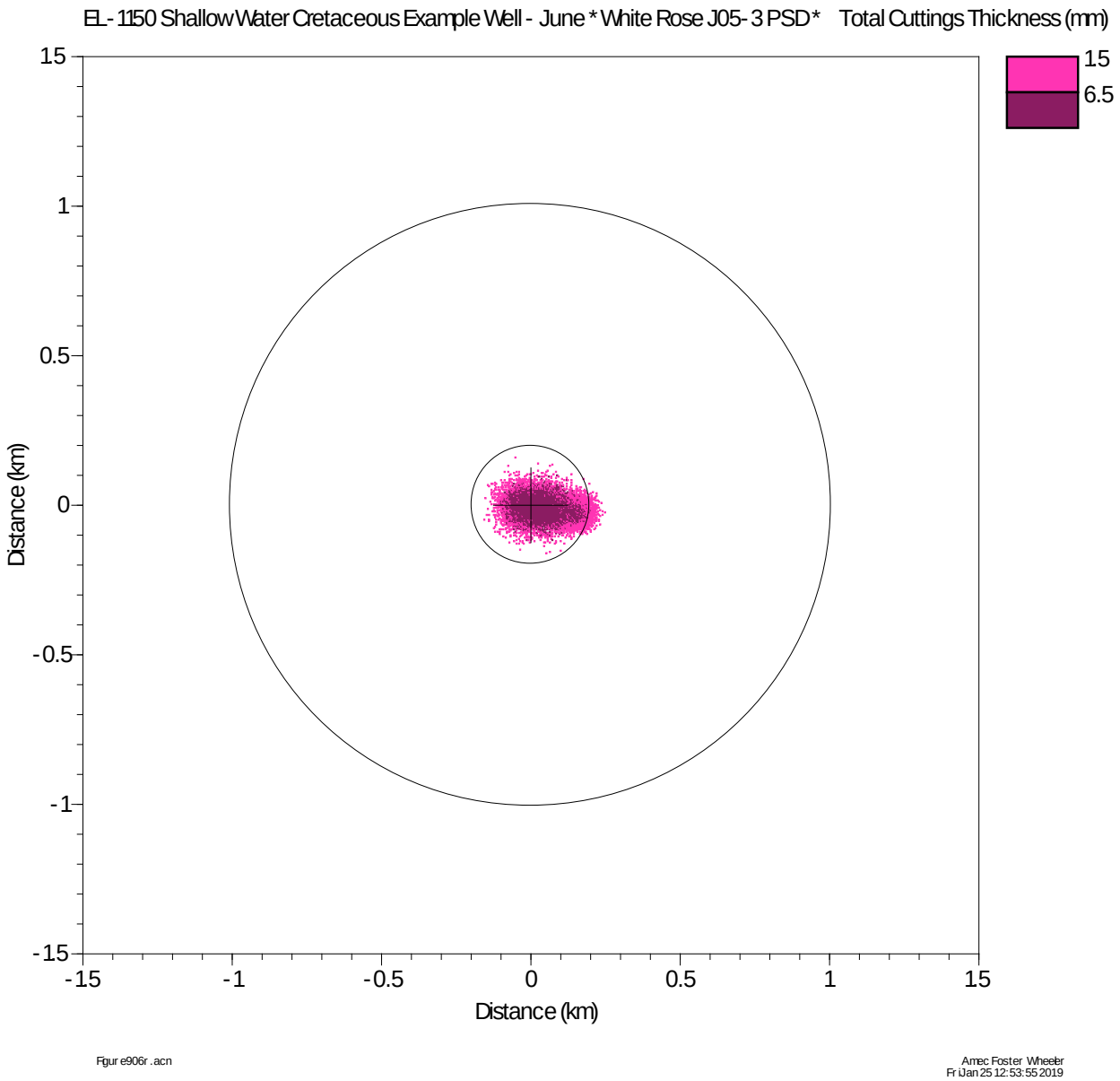


Figure IR-17.8 Total Drill Cuttings Deposition, EL 1150 Shallow Water Example Well, June, PNET Limits View ((PSD# 2) w/ White Rose J05-3 PSD)

References:

No additional reference.

2.4.7 Information Requirement: IR-18 (Part One Response – September 2018)

External Reviewer(s): DFO-34 NX, MFN-10-Nx

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat, 5(1)(a)(ii) Aquatic Species

Reference to EIS Guidelines: Section 6.1.3, Fish and Fish Habitat, and 6.4 Mitigation Measures

Reference to EIS: Section 8.3.2 Summary of Key Mitigation; Section 8.3.3.2 Residual Environmental Effects Assessment; Section 18.2 Summary of Mitigation

Context and Rationale: There is inconsistent information in the EIS on the circumstances under which a seabed investigation would be conducted. Sections 8.3.2 and 18.2 of the EIS indicate that a seabed investigation would be carried out at all wells drilled as part of the Project, while Section 8.3.3.2 indicates that seabed investigation would occur where coral gardens or sponge grounds are known or likely to be present.

The DFO has indicated that no encounters with living Lophelia have been documented in the Flemish Pass region; however, data are biased by substrate with hard bottom representation limited to sporadic ROV surveys. It is possible that living colonies exist based on sub-fossilized pieces of Lophelia documented on the northeast Flemish Cap (NEREDIA Survey 2009-2010). In addition, living colonies have been recorded in adjacent regions such as the Stone Fence (Nova Scotia, Canada) and southern tip of Greenland. Examples of coral gardens in the Flemish Pass include Sea Pen fields, Acanella meadows, Geodia sponge grounds, and bamboo and sponge thickets. For the latter, the composition of the community may change with depth.

Section 8.3.2 of the EIS provides some information on how the seabed investigation surveys would be conducted (i.e. with a drop-camera / video system). Information such as the distance from the wellsite to be surveyed, and timing prior to drilling are not provided.

The DFO has advised that that prior to any activity, the operator will be expected to develop a pre-drill survey plan for review and acceptance by the C-NLOPB and DFO, and that seabed surveys of the area surrounding the proposed well location and anchor moorings, if applicable, will be conducted using side-scan sonar and multibeam echosounder, and will include identification and mapping of deep-sea corals, sponges, and sea pens. Following analysis and interpretation of survey data, potential sensitive benthic organisms/habitat will be visually identified using high-definition images obtained by ROV/drop camera. If identified, a risk assessment approach (considering factors such as size, abundance, degree of exposure, and condition) should be incorporated to determine potential mitigation measures. The pre-drill coral survey and risk assessment report, with proposed mitigations, should be submitted to the C-NLOPB and DFO for review and acceptance prior to commencement of drilling. In the event that any sensitive benthic organisms/habitat are identified, there is the expectation that appropriate mitigation measures will be incorporated.

Specific Question or Information Requirement: Clarify the commitments related to when and where seabed investigations would be undertaken (i.e. would these be undertaken at all well sites and/or anchors/moorings, or just where sensitive species are known or likely to be present?). If seabed investigations are not proposed at all wellsites and anchors/moorings, explain how those areas where sensitive species may occur would be identified.

Provide further information on the seabed investigation methodology that would be followed, including:

- the distance from each wellsite and/or mooring to be surveyed and how the results of the drill cuttings dispersion modelling and water depth would be applied to determine the distance to be surveyed;
- who would review the seabed investigation results;
- who the seabed survey results, including footage, would be communicated to and in what manner; and
- timing of the seabed investigation prior to drilling.

In addition, clarify whether the surveys would seek to identify only coral colonies, as defined in Section 8.3.2 of the EIS, coral gardens, as defined in section 8.3.3.2, or whether they would also seek to identify other sensitive benthic organisms or habitats. Specify whether the seabed investigation could be modified to also include species at risk.

Explain whether a seabed investigation would be conducted if a drill ship is used to account for dynamic positioning requiring the placement of an array of transponder beacons directly on the seabed.

Response: The Environmental Impact Statement (EIS) (Section 2.5.2.1, Section 6.1.2, and Section 8.3.2) indicates CNOOC Petroleum North America ULC (CNOOC) has committed to undertaking a seabed investigation for each proposed wellsite prior to the start of drilling to identify sensitive benthic organisms (such as corals and sponges) or habitats in the vicinity of the proposed wellsite. The details of the seabed investigation will be outlined in a wellsite specific Seabed Investigation Plan which will be provided to the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) and Fisheries and Oceans Canada (DFO) for their review and acceptance prior to commencing the seabed investigation. Upon completion of each seabed investigation, CNOOC will prepare a summary report (outlining the findings and proposed mitigative actions) that will be provided to the C-NLOPB and DFO for their review and acceptance prior to commencing drilling. The Summary Report will outline the following:

- Results of survey(s);
- Predicted areas of sedimentation by drill cuttings deposition;
- Predicted areas of sedimentation by bottom contact of subsea equipment;
- Physical disturbance predicted by bottom contact of subsea equipment;
- Need and type of mitigation measures based on study conclusions; and
- Potential requirements for monitoring.

Sections 8.3.2 and 18.2 of the EIS indicate that the seabed investigation will utilize a drop camera / video system to investigate the potential presence of sensitive benthic organisms or habitats in the immediate area of the wellsite, including the wellhead location and any anchor / transponder locations. This includes all of the proposed well sites within EL 1144 and EL 1150, inclusive of those well sites within areas where corals or sponges are known to be present. This seabed investigation for sensitive benthic organisms or habitat is conducted in advance of drilling operations and can be conducted from the mobile offshore drilling unit (MODU) or from another support vessel.

The seabed investigation would survey an area a minimum of 250m radius from the wellhead location in an 8-spoked search pattern covering the eight main directions on the compass (N, NE, E, SE, S, SW, W, NW). A Marine Scientist onboard the MODU or support vessel will assess the presence of sensitive benthic organisms or habitats in real time and this will be followed up by CNOOC 's Environmental Advisor. The results would be communicated to the C-NLOPB and DFO via a formal report.

The seabed investigation will focus on coral colonies / gardens as well as sponges. The investigation will not focus on species at risk (SAR). However, if they are observed, the Marine Scientist can record the observation.

If a dynamically positioned (DP) MODU is utilized, the transponder array footprint would be included in the survey area. If a moored MODU is utilized, the survey area would include the area around the planned anchor positions.

References:
No additional references.

2.4.8 Information Requirement: IR-19 (Part One Response – September 2018)

External Reviewer(s): CNLOPB-4Nx, DFO 17 NX, KMKNO-12-Nx; -13-Nx, DFO-04 Nx

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat

Reference to EIS Guidelines: Part 2, Section 6.3.1 Fish and Fish Habitat, and Section 6.4 Mitigation

Reference to EIS: Section 8.3.4.2 Residual Environmental Effects Assessment; Section 8.3.2 Summary of Key Mitigation

Context and Rationale: Drill cuttings dispersion modelling results for both a deep water well (1,137 metres) and shallow water well (378 metres) were provided in the EIS. Tables 8.3 and 8.4 of Section 8.3.4.2 of the EIS provide predicted mean and maximum cuttings pile thicknesses for both water-based muds and SBMs at distance intervals from the wellsite one to two kilometres away. These tables depict exceedances for the 1.5 mm and the 6.5 mm thresholds for up to 200 metres away from the wellsite for water-based muds and up to 1 kilometre away for SBMs.

Section 8.3.4.1 of the EIS states that corals and sponges are particularly sensitive to sedimentation and burial in the marine environment. Section 8.3.4.2 of the EIS states the slopes of the Newfoundland Shelf, Flemish Pass and Flemish Cap are more likely to have higher densities of coral and sponge species as compared to other parts of the Project Area/ LSA and the Eastern Newfoundland Offshore Area in general, and that prior to the start of drilling activity at a wellsite, a seabed investigation will be undertaken to investigate the potential presence of aggregations of sensitive benthic organisms or habitats in the immediate area (such as coral gardens and sponge grounds). Should such organisms be observed within or in proximity to a planned wellsite location, Nexen states it will move the wellsite where possible to avoid or reduce the potential for direct interaction with them or other possible effects such as sedimentation or burial from drill cuttings disposal.

Section 8.3.2 of the EIS states that if the seabed investigation observes coral colonies within or in proximity to a planned wellsite location and/or moorings, a 100 metre setback from these organisms will be applied, if feasible.

The C-NLOPB has advised that setting back anchors 100 metres from corals may not be sufficient as the cables or chains also need to be considered. If corals are in the area where an anchor is to be set, would the anchor be offset so that the anchor and its cable or chain would not come in contact with the corals?

The DFO also advised that alternatives to setback of operations (e.g. re-direction of cuttings) could also be considered.

The EIS defines a coral colony as:

- Lophelia pertusa reef complex; or
- Five or more large corals (larger than 30 centimetres in height or width) within a 100 square metre area.

Section 8.3.2 of the EIS states that if moving the wellsite is not feasible, the C-NLOPB will be consulted to determine an appropriate course of action.

The EIS does not describe mitigation measures related to sensitive benthic organisms or habitats, or corals, identified in the seabed investigation, other than those meeting the "coral colony" definition. The EIS does not identify mitigation measures or monitoring in the event that a wellsite cannot be moved.

In addition, the KMKNO indicated that Section 2.5.2.1 of the EIS states "In preparation for MODU arrival at the well location, positioning transponders may be placed on the seabed and met ocean equipment (wave rider and current metres) may be deployed." Further, Section 8.3.3.2 states "In cases where dynamic positioning is used to position and stabilize the MODU and/or support vessels, the interactions with the benthic environment would be limited as mooring would not be required. Therefore, potential interactions with benthic habitats would be limited to the area of the well site itself".

The KMKNO expressed concern that given dynamic positioning transponder beacons are placed directly on the seabed, seabed surveys should also be conducted so that they can be guided into place via ROV to avoid any sensitive locations. If this is not feasible, locations should be verified through ROV video survey and beacons repositioned to avoid coral, sponges and sensitive habitats.

Specific Question or Information Requirement: Discuss if and how completed drill cuttings dispersion modelling for water- and synthetic-based muds would inform mitigation measures, including:

- A description of if and how dispersion modelling results would inform the calculation of appropriate setback distances of wellsites and anchors/moorings from sensitive environmental features, including whether the 1.5mm or 6.5 mm threshold would be used and in what circumstances. If a standard setback of 100 metres would be used, provide a rationale, taking into consideration modelling results.
- Additional information on how/if two different thresholds may be used to determine required setback distances. For example, could the selection of a threshold be dependent on the sensitivity of the species identified during the seabed investigation? If a species could not be identified definitively, would a precautionary approach be taken?

Consider the potential effects of anchors and moorings on benthos, including corals and sponges and identify if there would be mitigation measures to address effects of anchoring systems and moorings, including associated cables and chains. Include a discussion of whether the anchor system placement would be verified and whether anchors would be repositioned via ROV in instances where they have settled on sensitive habitat.

Provide further information on mitigation measures, including:

- what criteria would determine that moving a wellsite is not feasible; and
- what mitigation would be used when a 100 metre setback from the wellsite is not feasible.

Consider if there are alternatives to setback of operations for mitigation measures (e.g. redirection of cuttings) and describe applicability to the Project.

Update proposed mitigation and follow-up and associated effects predictions, as applicable.

Response: Drill cut dispersion modelling was completed for two scenarios, presented in Appendix D of the Environmental Impact Statement (EIS), and summarized in Section 8.3.4.2 of the EIS. The two scenarios include a deepwater Jurassic example well and a shallow water Cretaceous example well that were modelled

over four different seasons (March, June, September, and December). Water-based mud (WBM) cuttings released at the wellhead are predicted to settle within 500 m and over 90% settle within 100 m at the deepwater example well. Over 99 percent of the WBM cuttings released at the wellhead are predicted to settle within 200 m at the shallow water example well. Average thickness of WBM-cuttings deposition areas are approximately 1 mm beyond the 200 m radius. Synthetic-based mud (SBM) cuttings released from the MODU at the sea surface generally settle within 2 km, with over 90 percent settling within 500 m at the deepwater example well. The SBM cuttings released from the MODU at the sea surface settle generally within 1 km, with over 94 percent settling within 500 m at the shallow water example well. Beyond 500 m, average thickness of SBM-cuttings deposition areas are <1 mm. Average burial depths of 6.5 mm are the predicted no effect threshold (PNET) for non-toxic sedimentation based on benthic invertebrate species tolerances to burial, oxygen depletion and change in sediment grain size (Kjeilen-Eilertsen et al 2004; Smit et al 2006, 2008). However, as some species may be more susceptible to shallower burial depths, an average PNET burial depth of 1.5 mm is suggested to be a more conservative approach to assessing drilling discharges (Kjeilen-Eilertsen et al 2004; Smit et al 2006, 2008). This level coincides with assessments on more sensitive coral species where injury observed with sedimentation of less than 6.3 mm (Larsson and Purser 2011). Further details on the drill cuttings modelling and potential effects are described in Section 8.3.4.2 of the EIS.

The potential effects of placement of anchors is described in the assessment of the presence and operation of the MODU on marine fish and fish habitat (Section 8.3.3). In general, placement of anchors may injure or disturb sensitive habitat forming species such as corals and sponges but may provide additional hard substrate for colonization by sessile species. The overall effects on the environment are considered limited due to the small footprint of the anchors.

The EIS (Section 2.5.2.1, Section 6.1.2, and Section 8.3.2) indicates CNOOC Petroleum North America ULC (CNOOC) has committed to undertaking a seabed investigation for each proposed wellsite prior to the start of drilling to identify sensitive benthic organisms (such as corals and sponges) or habitats in the immediate vicinity of the proposed wellsite as well as 50m around each planned anchor, transponder, or subsea equipment location. The details of the seabed investigation will be outlined in a wellsite specific Seabed Investigation Plan, which will be provided to the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) and Fisheries and Oceans Canada (DFO) for their review and acceptance prior to commencing the seabed investigation. The Seabed Investigation Plan will include details on the following:

- Coral and sponge species specific to offshore Newfoundland and Labrador area, and information on species that may be present in the planned wellsite location, if known;
- Proposed survey methods for hard coral, soft coral and sponges;
- Proposed survey area(s); and
- Mapping requirements.

The seabed investigation will help CNOOC to better understand the areas that could be affected by deposition or equipment placement by taking the following factors into consideration:

- Drill cuttings modelling predictions;
- Areas where bottom contact are planned to occur; and
- Coral or sponge species and habitats identified by surveys.

CNOOC acknowledges that the drill cuttings model is a prediction tool and will be considered when developing the extent of the pre-drill seabed investigation surveys. The dispersion modelling informs the placement of wellsites such that the physical presence and placement and eventual cuttings discharges would try to avoid sensitive coral and sponge habitats wherever possible. Upon completion of each seabed investigation, CNOOC will prepare a summary report (outlining the findings and proposed mitigative actions) that will be provided to the C-NLOPB and DFO for their review and acceptance prior to commencing drilling. The Summary Report will outline the following:

- Results of surveys;
- Predicted areas of sedimentation by drill cuttings deposition;
- Predicted areas of sedimentation by bottom contact of subsea equipment;
- Physical disturbance predicted by bottom contact of subsea equipment;
- Need and type of mitigation measures based on study conclusions; and
- Potential requirements for monitoring.

A number of factors will be considered in determining if and what mitigative measures may be required, which include but are not limited to:

- Area(s) of reef-building coral;
- Percentage of living reef-building coral;
- Number of living soft corals per a defined area;
- Condition (health) of hard and soft corals;
- Percentage of sponge coverage;
- Predicted degree of sedimentation; and
- Predicted degree of bottom contact.

In most circumstances, the standard mitigation measure to avoid or minimize potential effects on sensitive benthic habitat will be relocating the planned wellsite or other subsea location such as an anchor location away from the identified feature(s) to meet the minimum setback identified in the C-NLOPB guidance. There are a number of factors that determine if or how much a planned wellsite can be relocated including, but not limited to, sub-surface factors, bathymetry and identified geohazards, and proximity to identified corals or sponges surrounding the planned wellsite. If the setback guideline cannot be achieved due to one or more of the factors, CNOOC will identify the factors constraining the relocation and outline the potential options in the Seabed Investigation Summary Report and discuss these options with the C-NLOPB and DFO prior to the start of drilling.

The placement locations of anchors, transponders, or other subsea equipment will be based on the agreed upon approach outlined in the Seabed Investigation Summary Report.

Dispersion modelling has no implication in the siting of anchors or moorings or other subsea equipment such as anchors or transponders as there is no discharge of cuttings.

This planned Project activity is predicted to have adverse but low magnitude effects, which will be primarily localized but occurring within the local study area (LSA) overall, medium to long-term duration and continuous in nature during drilling, all of which will be reversible with eventual recovery and recolonization of the area. These predictions are made with a high level of certainty. There is no change from what has already been assessed in the EIS.

References:

Kjeilen-Eilertsen, G., Trannum, H., Jak, R., Smit, M., Neff, J. and G. Durell (2004). Literature report on burial: derivation of PNEC as component in the MEMW model tool. Report AM 2004, 24.

Larsson, A.I. and A. Purser (2011). Sedimentation of the cold-water coral Lophelia pertusa: Cleaning effiency from natural sediments and drill cuttings. Marine Pollution Bulletin, 62(2011): 1159-1168.

Smit, M.G.D., Tamis, J.E., Jak, R.G, Karman, C.C., Kjeilen-Eilertsen, H., Trannum, H. and J. Neff (2006). Threshold levels and risk functions for non-toxic sediment stressors: burial, grain size changes and hypoxia. Summary. ERMS Report no. 9.

Smit, M.G.D., Holthaus, K.I.E., Trannum, H.C., Neff, J.M., Kjeilen-Eilertsen, G., Jak, R.G., Singsaas, I., Huiihbregts, M.A.J. and A.J. Hendriks (2008). Species sensitivity distributions for suspended clays, sediment burial and grain size change in the marine environment. Environmental Toxicology and Chemistry, 27(4): 1006-1012.

2.4.9 Information Requirement: IR-20 (Part One Response – September 2018)

External Reviewer(s): DFO 5- NX, KMKNO-14-Nx, -15-Nx; Nutash-50-Nx

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat

Reference to EIS Guidelines: Section 6.1.3, Fish and Fish Habitat, and 8.1 Follow-up

Reference to EIS: Section 8.6 Environmental Monitoring and Follow-up; Section 18.4.1 Follow-up

Context and Rationale: Section 8.6 and Section 18.14.1 of the EIS proposes that a follow-up program in consideration of sensitive benthic habitat would be conducted under specific circumstances (i.e. when a well site is located within an identified Fisheries Closure Area, or in an area where the results of the pre-drill seabed investigation and subsequent review by DFO and C-NLOPB indicate monitoring is required. (Section 18.4.1)).

The KMKNO states that follow up studies should be completed, including a monitoring program via seabed video and/or benthic sampling to determine infaunal recolonization rates following drilling.

Specific Question or Information Requirement: Provide clarification as to whether a follow-up program, should a wellsite be adjacent to or near a Fisheries Closure Area, such that drill cuttings deposition may occur within the Fisheries Closure Area at levels above the biological effects threshold, would be undertaken.

Further discuss the need for follow-up depending on species types and assemblages as well as based on the mitigation implemented.

Discuss the need for and feasibility of a seabed monitoring program to determine infaunal recolonization rates following drilling.

Response: In the event that drill cuttings could be deposited within a Fisheries Closure Area, CNOOC Petroleum North America ULC (CNOOC) will consult with the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) and Fisheries and Oceans Canada (DFO) on the requirements for a post drilling benthic follow-up program.

The need for and feasibility of a follow-up or monitoring program for drill cuttings deposits will be determined based on the results of the pre-drill seabed investigation survey and in consultation with DFO and C-NLOPB.

References:
No additional references.

2.4.10 Information Requirement: IR-21 (Revised Response – February 2019)

External Reviewer(s): KMKNO-16-Nx;

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat

Reference to EIS Guidelines: Part 2, Section 6.3.1 Fish and Fish Habitat

Reference to EIS: Section 8.3 Environmental Effects Assessment and Mitigation

Context and Rationale: The EIS Guidelines require that the assessment considers effects on primary and secondary productivity of water bodies and how Project-related effects may affect fish food sources.

The EIS provided limited information as to how the Project may affect food sources. While there is some reference to phytoplankton (primary production), the assessment is insufficient regarding potential effects to zooplankton (secondary production), and how this may affect fish.

Section 8.0 of the EIS presents some references specific to capelin, but the analysis of effects is general to fish and fish habitat. Detailed analysis on important indicator species/species groups, such as forage fish, is not provided.

Specific Question or Information Requirement: Discuss how the Project could affect the distribution, abundance or quality of zooplankton, including during regular operations and as a result of accidents and malfunctions. Discuss how such changes could affect marine mammals and sea turtles, and birds that rely on this food source, with specific consideration of potential effects on species at risk.

Provide a focused analysis specific to the effects of the Project on forage fish species, such as capelin and herring, with particular consideration of effects of waste discharge, vertical seismic surveys, and accidental events. Update the proposed mitigation and follow-up, as well as effects predictions, accordingly.

Response: An overview of the distribution and composition of plankton including zooplankton, and forage fish is detailed in Section 6.1.4 of the Environmental Impact Statement (EIS). The effects of the planned and routine Project operations and potential accidents and malfunctions on zooplankton and forage fish are detailed in Chapter 8 of the EIS (Marine Fish and Fish Habitat Effects Assessment) and the revised Section 16: Accidental Events (Revised) (provided in Appendix C of this Addendum). The following provides a focused background and assessment on zooplankton and forage fish using details from the EIS and additional supplemental information for both planned and routine Project activities and accidental events, as well as potential effects on birds, marine mammals and sea turtles.

Project activities that are predicted to potentially interact with zooplankton and forage fish communities would include the presence and operation of the mobile offshore drilling unit (MODU), drilling and associated marine discharges, formation flow testing with flaring, vertical seismic profiling (VSP) surveys, and accidental events (spills). As zooplankton encompasses a variety of species the effects of the Project may vary depending on the responses of each taxonomic group.

Presence and Operation of Drilling Installations

Potential discharges to the marine environment associated with the Project may include drill mud and cuttings (see next section below), cement, liquid wastes (e.g., produced water, bilge and deck drainage, ballast water, grey and black water, cooling water, fire control water and Blowout Preventer (BOP) fluids),

and food waste; all of which will be discharged in accordance with the Offshore Waste Treatment Guidelines (OWTG; NEB et al 2010). In general, zooplankton do not have high avoidance capability to discharges in water as their horizontal movements are controlled by oceanographic conditions. Certain taxa of coastal and estuarine copepods may be an exception to this as they have shown an avoidance behavior to hydrocarbon-contaminated water (Seuront 2010). As described below, nauplii stages of copepods have shown sensitivity to hydrocarbons (Utne 2017). Hydrocarbon exposure to early life history stages of herring and capelin may also affect growth, development and survival (Paine et al. 1992; Frantzen et al. 2012; Ingvarsdóttir et al. 2012). Discharged sewage and food wastes may enhance primary and secondary production (Peterson et al. 1996; Wilewska-Bien et al. 2016).

In summary, the predicted environmental effects of presence and operation of the MODU in relation to zooplankton and forage fish species from environmental discharges may result in potential changes to habitat availability and quality, fish mortality/injury risk and fish health, and fish presence and abundance. These effects are predicted to be adverse, low in magnitude, localized and within the Project Area, short to medium term duration, occurring regularly and reversible. These predictions were determined with a high level of confidence.

Drilling and Associated Marine Discharges

The primary interactions from the discharge of drill cuttings in relation to zooplankton and forage fish species includes discharge of drill cuttings, chemical toxicity, and bioaccumulation. The treatment and discharge of drill cuttings will be in accordance with the OWTG (NEB et al 2010). Drilling muds will also be selected in accordance with the Offshore Chemical Selection Guidelines for Drilling and Production Activities on Frontier Lands (NEB et al 2009).

Overall, water-based muds (WBMs) have varied effects on marine organisms, but due to the non-toxic nature of the drilling mud components (Neff 2010), they are not likely to result in toxicity (Holdway 2002; Trannum et al. 2010, 2011; Bakke et al. 2013; Purser 2015). Exposure to WBMs at low concentrations has, for example, not shown toxicity to sea scallops, polychaetes, amphipods, shrimp, and various finfish species (Cranford et al. 1999, Neff 2010). The acute toxicity potential was tested in relatively high concentrations of barite (200-1000 mg/L) and was found to be non-toxic to capelin, snow crab larvae or planktonic jellyfish after 24 hours of continuous exposure (Payne et al. 2006). Conversely, the dissolved constituents in WBMs have been shown to have low acute toxicity in the copepod *C. finmarchicus*. The copepod was observed to rapidly uptake drilling mud particles but slowly excrete particles, resulting in increased sinking of copepods (Farkas et al. 2017).

The relatively high dispersion of drill mud and cuttings particles also indicates that there should not likely be substantial interaction with pelagic species. Discharge of drill cuttings particles may form aggregates with phytoplankton resulting in rapid settling of plankton to the seafloor (Pabortsava et al. 2011). This could have potential effects on zooplankton and forage fish species with reduced food availability. Herring larvae that consumed suspended sediment have also been shown to have reduced feeding rates (Smit et al. 2006). Increases in turbidity from suspended sediments may also reduce foraging effectiveness in fish species (Smit et al. 2006). However, due to the high dispersion of particles, it is unlikely that there will be effects that may adversely affect plankton and forage fish populations.

In summary, the predicted environmental effects of drilling and associated marine discharges on zooplankton and forage fish species are related to change in food availability and quality. Due to the high dispersion of particles, and transient and temporary nature of Project activities, these effects are predicted to be adverse, low in magnitude, localized and within the Project Area, medium to long term in duration, occurring regularly and reversible. These predictions were determined with a high level of confidence.

Vertical Seismic Profiling

The Project may include conducting VSP surveys as required throughout the Project life. VSP surveys are described in Section 2.5.2.3 of the EIS, with additional information provided in the response to IR-05. Potential effects on zooplankton and forage fish species are limited for VSP surveys due to the localized and temporary nature of the activity and are addressed in Section 8.3.5 of the EIS.

Summary

In summary, there is potential for adverse interactions between zooplankton and forage fish species, and during planned and routine Project activities. However, mitigation strategies to avoid or reduce the magnitude of potential adverse effects would be similar to mitigation strategies for marine fish and fish habitat. With the application of the mitigation measures included in Section 8.3.2 of the EIS that apply to marine fish and fish habitat, the environmental effects of planned and routine Project activities on zooplankton and forage fish species are predicted not to be significant.

Accidental Events (spills)

The response of zooplankton to oil spills is diverse and largely dependent on exposure, as detailed in the revised Section 16.6.2 (Appendix C of this Addendum). Certain taxa of coastal and estuarine copepods may be an exception to this as they have shown an avoidance behavior to hydrocarbon-contaminated water (Seuront 2010). Laboratory exposure studies have shown lethal and sublethal effects of oil on zooplankton (Seuront 2010; Almeda et al. 2012; AOSRT-JIP 2014) with few documented mass mortality events related to oil slick episodes (Seuront 2010). Sublethal effects range from physiology, feeding fecundity to behavioral responses related to predator avoidance (Almeda et al. 2012). Laboratory exposure studies comparing arctic and temperate-boreal copepod species have found that Arctic species are less sensitive to oil exposure (Hansen et al. 2011; Gardiner et al. 2013) but this may be related to a delayed response time for the Arctic species (Hansen et al. 2011). Exposure experiments with *Calanus finmarchicus* and *C. hyperboreus* to water soluble fractions of hydrocarbons did not affect hatching success. However, nauplii of *C. hypderboreus* showed sensitivity to temperature treatments when exposed to polycyclic aromatic hydrocarbons (PAHs) (Utne 2017).

While many forage fish species are motile and capable of avoidance responses, their early life stages likely have low avoidance abilities similar to other plankton. Herring larvae exposed to dispersed polycyclic aromatic hydrocarbons (PAHs; 0.129-6.012 µg/L total PAHs) resulted in deformities and impaired growth compared to control groups (Ingvarsdóttir et al. 2012). Early life stages of capelin have also shown sensitivities to hydrocarbons, with lethal effects on larvae at exposures of 1.3-7.1 mg/L total PAHs (Paine et al. 1992) and decreased egg mortality rates and hatching success at 40 µg/L crude oil (Frantzen et al. 2012).

In the event of an offshore hydrocarbon release, some degree of residual adverse effects to marine fish and fish habitat in the area at the time of the event are expected. However, the primary focus of CNOOC Petroleum North America ULC (CNOOC) is on spill prevention, followed by ensuring that there are efficient response measures to avoid or reduce the potential effects of the spill. The degree of exposure and thus the type and level of any such effects would depend on the type and size of spill, time of year, and the number, location and species of animals within the affected area. As described in the revised Section 16.4.4.3

(Appendix C of this Addendum), potential effects of a batch spill (100 and 1,000 L) on marine fish and fish habitat are predicted to be adverse, low to medium in magnitude, short- to medium-term in duration, to occur within the Project Area, reversible and was determined with a moderate level of confidence. The potential effects of a subsea release at the example well sites on marine fish and fish habitat are predicted to be adverse, medium to high in magnitude, medium to long-term in duration, occur within the Regional Study Area (RSA) or beyond, and reversible. This was determined with a moderate level of confidence. Although there is the potential for effects on fish and their habitats in the RSA, these are, with appropriate response measures, not likely to result in an overall, detectable decline in overall fish abundance or change in the spatial and temporal distribution of fish populations in the RSA and the predicted residual environmental effects are considered not significant.

The revised Section 16.6.3 (Appendix C of this Addendum) describes the potential effects of accidental releases on birds. Residual adverse effects to marine and migratory birds present in the area, including Species at Risk (SAR), are expected and could potentially be significant depending on the specific occurrence, and nature and degree of the event. However, such events are unlikely to occur, as spill prevention strategies will be incorporated into the Project as part of contingency planning, thus ensuring the likelihood and potential severity of such events, and their potential effects on the VC, is minimized.

As described in the revised Section 16.6.4 (Appendix C of this Addendum), potential effects of a batch spill on marine mammals and sea turtles are predicted to be adverse, negligible to medium in magnitude, short- to medium-term in duration, to occur within the RSA, and reversible. These predictions were determined with a moderate level of confidence. The potential effects of a subsea release at the Project Area release site on marine mammals and sea turtles are predicted to be adverse, low to high in magnitude, medium to long-term in duration, occur within the Regional Study Area (RSA) or beyond, and reversible. These predictions were determined with a moderate level of confidence. In the unlikely event of a hydrocarbon release, residual adverse effects on marine mammals and sea turtles present in the area, including SAR, are expected; however, these are not anticipated to result in a long-term detectable change in abundance or distribution of populations within the RSA.

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2.4.11 Information Requirement: IR-22 (Part One Response – September 2018)

External Reviewer(s): DFO -35,-36,-37,-38, -39 Nx, DFO 3, 30-31 Ax NX

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat, 5(1)(a)(ii) Aquatic Species

Reference to EIS Guidelines: Part 1, Section 3.1 Project Components

Reference to EIS: Appendix D – Section 3.2.2 Cuttings Particle Characterization, 3.2.3 Ocean Currents

Context and Rationale: The DFO identified several issues with the cutting dispersion model inputs and design. Given that the results of modelling would be used in determining pre-drill coral survey areas, the resolution of modelling results is an important consideration.

Model Inputs:
The DFO indicated that the drift study uses CECOM and Webtide for the wind driven parts of ocean current (CECOM) and Webtide for the tides. The Flemish Pass has more flow components than just tidal and wind driven flow due to large scale oceanic and atmospheric changes over time. The momentum equation in CECOM is governed by wind driven flow as well as mean flow given by climatology. There are much better current descriptions now available for the area then CECOM that include assimilation of sea level, SST and in-situ Argo data to provide the best possible representation of ocean circulation throughout the water column, including:

- the GOC CONCEPTS systems: see transect Hovmöller plot for Flemish Pass at surface and bottom (Appendix A below, Figures 2 and 3);
- HYCOM (US Navy/NOAA);
- FOAM (UK Metoffice); and
- Altimetry derived currents (provide depth averaged 2D currents since 1992 in the area, (i.e. AVISO data base)).

As seen from the GOC CONCEPTS RIOPS prediction system as well as Atlantic Zone Monitoring Program (AZMP) Acoustic Doppler Current Profile (ADCP) transects in the area, there is strong variability of current in the Flemish Pass (see Appendix A below, Figures 2 and 3) and currents as observed by ADCP may be higher than mean spring currents (see tel886 Flemish Cap line (Appendix A below, Figure 4).

The DFO has indicated an inconsistency in Appendix G, Section 3.2.2 of the EIS: equations 4 and 5 are dimensionally inconsistent (unless constants have units that are not specified).

Section 3.2.3 of Appendix G of the EIS states, "In the model algorithm, as each calendar day of drilling and possible discharge is followed, the corresponding day of current data is input from the representative year time series file and is used to advect the particles." DFO has indicated that the meaning of this statement is unclear. There cannot be a "corresponding day" as seasonal averages are used as forcing.

Model design and Limitations:
DFO noted that no stochastic analysis was performed for drill cuttings dispersion modelling (only four simulations argued to be representative of each season), which is a limitation of the modelling. Additionally, it noted that high resolution reanalysis (e.g. Mercator GLORYS or HYCOM that was used for oil spill scenarios) should have been used to force the model over several months/years. Using such products would avoid uncertainty related to the use of incomplete or non-homogeneous forcing from site to site.

Currents for input to the drill cuttings model were derived from seasonal average currents at near-surface, mid-depth and near-bottom depths through the water column, which DFO stated is not sufficient. Bourgault et al. (2014) showed that seasonal average currents may not be appropriate to model dispersion as they remove all energetic high frequency motions (eddies, tides, storms, etc.). The EIS states that such energetic motions are important in this region (see Appendix G of the EIS), and this is confirmed with drifter observations.

The EIS states, "The assumption flat bathymetry is borne out as a reasonable approximation given the distances and directions that the cuttings drift." DFO indicated that this approximation is based on other questionable approximations: the use of constant, uniform, and seasonal currents, as well as neglecting benthic boundary layer processes. The bathymetry approximation may not hold if more realistic currents are used.

The EIS states, "A 'base case' of 0.001 m/s values for the two smallest particle types as reported in Table 3-4, were deemed the most reasonable and selected for the model runs. These values, somewhat smaller than a faster 0.005 m/s settling, provide a somewhat more conservative estimate in terms of how far horizontally the cuttings may disperse." DFO has indicated that this is not necessarily conservative since the slowing down of settling velocities due to benthic boundary layer stress have not been taken into account. The effect of benthic boundary layer stress is even mentioned in the report: "slowing to 0.0001 m/s (for floc breakup when the bottom stress exceeds a threshold)." By neglecting this parametrization, the model neglects re-settling/re-suspension mechanisms that would create a plume/cloud near the bottom that may be critical for benthic biology (e.g. Cranford and Gordon, 1992).

The EIS states, "It is assumed that the currents are representative of the two locations and are uniform over the deposition grids (domain) modelled." DFO stated that if uniform currents are used, then the model is not a real 3D model as stated in the introduction. Moreover, Figures 3-1 to 3-8 show that velocities are not uniform over the domain. This simplification/ shortcut is not acceptable, especially as the selected location for the currents are from the lowest advection velocities. These figures suggest that as the particles move away from the release site, they should be entrained by stronger velocities.

The DFO has indicated that in Section 3.2.5 of Appendix D of the EIS there are problems with the turbulent diffusion term (Rx,Ry,Rz in [-1,1]):

a) x', y', z' are not defined;
b) it is not clear why vertical (Rz) and horizontal (Rx,Ry) "diffusivity" coefficients are the same order of magnitude, and whether there is scientific justification for this;
c) this scheme appears to be totally dependent on the model horizontal and vertical grid resolution (which has the advantage of reducing the problem raised in b); and
d) the scientific rationale for imposing the range [-1,1] is not clear. If interpreted correctly, the equation means that the particle can move at most by one grid cell per time step.

The DFO noted that advective-diffusive equations are a very standard and simple modelling procedure and would produce higher resolution results.

Specific Question or Information Requirement: Provide a rationale for the model inputs used to predict dispersion of disposed drill cuttings, and discuss the potential limitations of the model, including:

- Clarifying the apparent inconsistency in equations used to estimate particle fall velocities (Equations 4 and 5, Section 3.3.2 of Appendix G of the EIS), and provide the correct citation(s) for the relationships (Sleath 2014/1984/1939).
- Clarifying the statement in Section 3.2.3 of Appendix G of the EIS regarding the corresponding day of current data.

Discuss model design and limitations (e.g. the use of low resolution data, model geometry) including the following:

- Incorporate stochastic analysis in drill cutting dispersion scenarios, or provide a rationale for use of four simulations.
- Explain whether the dispersion model has considered processes at the benthic boundary layer (e.g. the presence of a mud plume/cloud near the bottom, and how this affects drill cutting dispersion predictions). If this is not addressed by the model, discuss the implications for model results.
- Provide a justification for the assumption that currents are uniform over the deposition grids modelled.
- Provide a rationale for the model selected and for the use of the turbulent diffusion term, and discuss the limitations of modelling without the use of advective-diffusive equations.

Given the potential limitations of the model approach, indicate how a conservative approach to interpreting results would be taken when identifying areas for pre-drill coral surveys.

Response:
Part 1 - Provide a rationale for the model inputs used to predict dispersion of disposed drill cuttings, and discuss the potential limitations of the model:

a) **Clarifying the apparent inconsistency in equations used to estimate particle fall velocities (Equations 4 and 5, Section 3.3.2 of Appendix G of the EIS), and provide the correct citation(s) for the relationships (Sleath 2014/1984/1939).**
b) **Clarifying the statement in Section 3.2.3 of Appendix G of the EIS regarding the corresponding day of current data.**

The drill cuttings model used in Appendix D of the Environmental Impact Statement (EIS) is the AMEC Advection Dispersion Model (ADM) developed based on corporate experience and modelling algorithms including those from the Terra Nova (Hodgins and Hodgins 1998) and White Rose (Hodgins and Hodgins 2000) cuttings fate modelling studies. The ADM has been used as part of the Hebron 2010 CSR modelling study (AMEC 2010) and Hebron Project Environmental Assessment Amendment (Amec Foster Wheeler 2017), and White Rose Extension Project (now West White Rose Project) (AMEC 2012, Amec Foster Wheeler 2016). Additional discussion on model inputs, design and limitations, and outputs in response to the questions raised above are presented below in Part 2 of this response.

Part 1a - There is a typo in Equation (5) as shown in the EIS: it should be $92 \times 10^4 D^2, D \leq 0.0001\, m$ (not 12 x). This results in a fall velocity estimate of 0.005 m/s (not 0.001 m/s) for the VF Sand class (other particle classes are not affected). The 0.001 m/s value was used in the simulations; however, it is noted that while VF Sand is estimated to make up 20% of the water based mud (WBM) cuttings it is just 1 or 2% of the

synthetic based mud (SBM) cuttings released at the sea surface (Table 3.3). Confirmed with a rerun of March at the EL 1150 Shallow Water Cretaceous Example Well, the resulting differences are a very small increase in cuttings thickness at the wellhead and corresponding very small decrease within about 100 m – essentially this VF Sand material is simply settling more rapidly. The correct citation is: Sleath, J.F.A., 1984. Sea Bed Mechanics. Published by John Wiley & Sons.

Part 1b - Appendix D (incorrectly noted above as Appendix G), Section 3.2.3"...In the model algorithm, as each calendar day of drilling and possible discharge is followed, the corresponding day of current data is input from the representative year time series file and is used to advect the particles. It is assumed that the currents are representative of the two locations and are uniform over the deposition grids (domain) modelled..."

The discharge schedule determines over which days the cuttings are released to the sea. The hourly currents from the corresponding calendar days are used as the discharge/drilling proceeds and used in the particle advection calculations, (e.g., if releases are taking place on July 1st then the input currents from July 1st in the current file are used). Due to the inclusion of tidal and seasonal components, the currents will vary on a daily basis.

Part 2 - Discuss model design and limitations (e.g. the use of low resolution data, model geometry) including the following:

a. **Incorporate stochastic analysis in drill cutting dispersion scenarios, or provide a rationale for use of four simulations.**
b. **Explain whether the dispersion model has considered processes at the benthic boundary layer (e.g. the presence of a mud plume/cloud near the bottom, and how this affects drill cutting dispersion predictions). If this is not addressed by the model, discuss the implications for model results.**
c. **Provide a justification for the assumption that currents are uniform over the deposition grids modelled.**
d. **Provide a rationale for the model selected and for the use of the turbulent diffusion term, and discuss the limitations of modelling without the use of advective-diffusive equations.**

Part 2a - While stochastic analysis may help gain some statistical significance in the interpretation of output predictions, the four deterministic scenarios (at each location) completed do consider seasonal ocean current conditions which should provide a reasonable prediction of the possible direction and extent of the cuttings footprints which is the primary objective for the modelling. A comparison of an EL 1144 Deepwater Jurassic Example Well, June deterministic run commencing 1 June (Figure IR-22.1, left panel) with a stochastic simulation that considers 46 ensembles run every second day from 1 May to 30 July (i.e., 'covering' June) (Figure IR-22.1 right panel), is shown below. These are the total cuttings footprints. The stochastic run (Figure IR-22.1 right panel) footprint shows the median thickness. Both predictions show similar footprint extent and thickness.

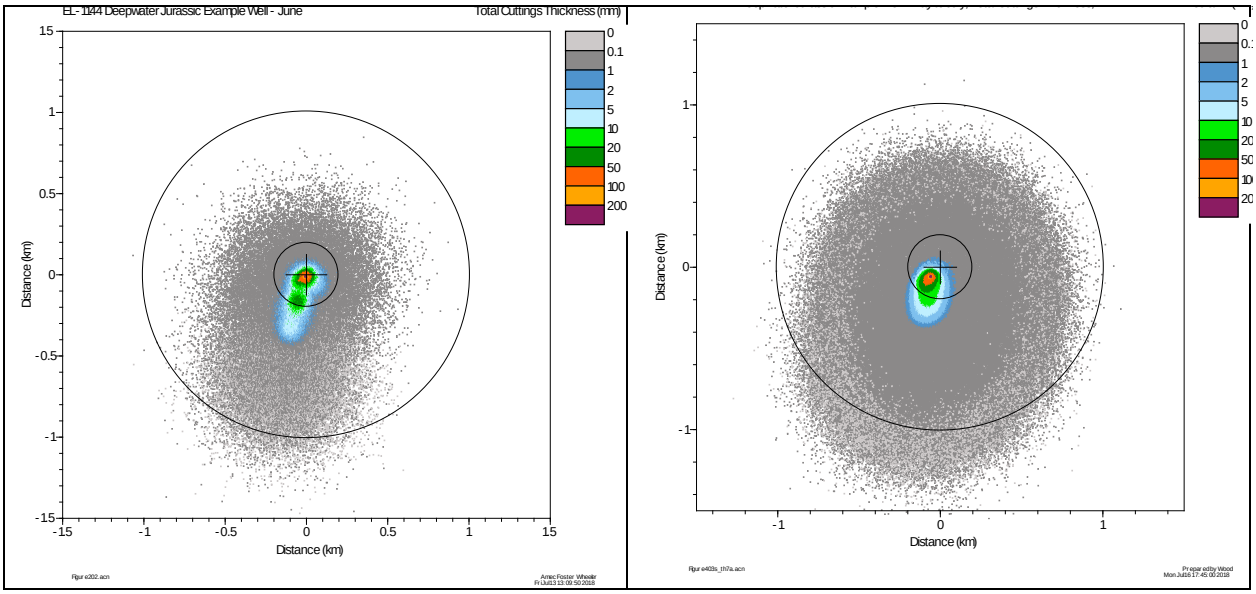


Figure IR-22.1 Total Drill Cuttings Deposition, EL-1144 Deepwater Jurassic Example Well. Left) June, one Simulation (1 Jun); Right) "June", 46 Simulations (1 May-30Jul, every 2 days)

Part 2b - The dispersion model does not consider processes at the benthic boundary layer. This could include resuspension of cuttings with the potential for sediment mobilization based on current speed, e.g., clays and fines, potentially mobilizing at lower current speeds, sands requiring higher speeds to move. Breakup of flocculates might be expected to reduce near-bottom concentrations, i.e., particles resuspend and are advected away by the ambient currents. Bioturbation is another process and difficult to quantify the intensity and rate of reworking that might take place at any of the locations. These post-depositional processes are difficult to model and data are scarce. The implications of not modelling these processes can result in over-prediction of benthic impacts (IOGP 2016) and so using the predicted no effect threshold (PNET) values as a guide to areas potentially affected is likely conservative. Conservative in the sense that subsequent resuspension and further transport would likely make the thicknesses smaller.

Part 2c - The Figures in Appendix D of the EIS, Section 3.2.3 present plan view visualizations of the WebDrogue modelled currents for the region for fall, when bottom currents are largest. These show the currents with fairly uniform speed and generally consistent directions over the 64 km (approximately 0.85° longitude at 47.5°N, approximately 0.6° latitude) grid modelled.

It's relevant to note that over the scale of 4 km used to capture the WBM cuttings released at the seabed, the currents at each of the locations (in EL-1144, EL-1150) can be safely assumed to be generally uniform. Further, as reported (e.g., Appendix D, Section 4.4) all of this material is predicted to settle within 500 m at the EL-1144 (modelled) location and within about 260 m at the EL-1150 location.

Although the depths for materials to settle are much greater for the near-surface MODU release of the SBM cuttings, it is noted here as well that at the EL 1144 location, these settle generally within 2 km, with over 90 percent settling within 500 m, with a remaining 3.5 percent of the total SBM cuttings from one well drift farther away at distances on the order of 25 to 54 km and settling with thicknesses less than 0.1 mm. At the EL 1150 location the SBM cuttings settle generally within 1 km, with over 94 percent settling within 500 m. Only 3.6 percent of the total SBM cuttings from one well drift farther away and settle with thicknesses less than 0.1 mm. The small amounts of fine sand and silt-sized SBM cuttings are predicted to drift to the northeast as distance up to about 12 to 18 km. A key factor here is that for the assumed drilling program

cuttings compositions (Table 3-3) just 2 percent of the SBM cuttings materials are silt sized with slowest fall velocities, i.e., there is little of the material that would be subject to long settling times and therefore susceptible to variation in the currents as well as becoming very widely dispersed.

In this way, the resolution of the ocean current inputs and model geometry applied are reasonable.

Part 2d - The ADM drill cuttings dispersion model employed is an advective-diffusion model[1]: the dispersion of cuttings released from a single point is governed by advection and turbulent diffusion in the horizontal and vertical planes. The governing transport-diffusion equation is solved using a particle tracing technique. A set of discrete particles is released over time, and each particle has an associated mass. Each particle is defined by its position (x,y,z) with location at time t=n+1 given by equations 6-8 (Appendix D, Section 3.2.5). This type of model has been used, and accepted, in other EIS efforts for offshore activities including those noted in Part 1 above.

The turbulent part of the flow field arises from subgrid scale motions that are not resolved in the tidal+non-tidal current data and lead to a random diffusion of particles within the grid. These random motions in the x and y (horizontal) directions, x′ and y′, are estimated from solution of the diffusion equation as $x',y'=((6Ah\Delta tp)^{1/2})R$, with Ah a turbulent eddy diffusivity coefficient set=0.1 m^2/s, and R a uniformly distributed random number in the range [-1,1], i.e., a particle will have a random displacement in the range (-x′, …, x′) each time step Δt. The model integration time step Δt depends on settling velocity. Values for x′ for fine pebble to medium silt sized particles range from 4 m to 47 m. For example, at any time for a coarse particle, the x′R term might range from say -4 m to 4 m. Grid cell sizes simply determine where particles are within the grid, and, for example, in which grid cell they are placed when they reach the seabed, but have no effect on the diffusion. There is similar treatment for y′R. The z′ component is a uniformly distributed random displacement in the vertical, in the range $\pm 0.05*w*\Delta t$, for fall velocity w, i.e., an uncertainty of ±5% in the distance fallen each time step.

Part 3 - Given the potential limitations of the model approach, indicate how a conservative approach to interpreting results would be taken when identifying areas for pre-drill coral surveys.

CNOOC Petroleum North America ULC (CNOOC) recognizes that drill cuttings models have limitations, and assume a number of parameters (i.e., well location, drilling duration, cuttings discharge schedule, etc.). CNOOC acknowledges that the drill cuttings model is a prediction tool and any predictions from the tool will be considered when developing the extent of pre-drill seabed investigation surveys.

References:

AMEC, 2010. Drill Cuttings Deposition, Produced Water, and Storage Displacement Water Dispersion Modelling for the Hebron Project. Prepared for Stantec Consulting Ltd., St. John's, Prepared by AMEC Earth & Environmental, St. John's, September 2010.

AMEC, 2012. Drill Cuttings and WBM Operational Release Modelling, Environmental Impact Assessment, White Rose Extension Project. Prepared for Husky Energy, St. John's, NL. Prepared by AMEC Environment & Infrastructure, St. John's, NL, June 2012.

1 As noted in IOGP (2016), "…most of the currently used numerical models utilize a particle-based (Lagrangian element or 'cloud') scheme to track the dispersion and transport of individual particle 'classes' through the water column with each class having an associated density, mass, and settling velocity."

Amec Foster Wheeler, 2016. White Rose Extension Project, Drill Cuttings Modelling Update. Prepared for Husky Energy, St. John's, NL. Prepared by Amec Foster Wheeler, St. John's, NL, May 2016.

Amec Foster Wheeler, 2017. Hebron Project. Environmental Assessment Amendment. Prepared for Hebron Project, ExxonMobil Canada Properties, St. John's NL. Prepared by Amec Foster Wheeler, St. John's, NL, June 2017.

Hodgins, D.O. and S.L.M. Hodgins, 1998. Distribution of Well Cuttings and Produced Water for the Terra Nova Development. Report prepared for Terra Nova Alliance. Prepared by Seaconsult Marine Research Ltd., Vancouver, B.C., 1998.

Hodgins, D.O. and S.L.M. Hodgins. 2000. Modelled Predictions of Well Cuttings Deposition and Produced Water Dispersion for the Proposed White Rose Development. Report prepared for Husky Oil Operations Limited c/o Jacques Whitford Environmental Limited. Prepared by Seaconsult Marine Research Ltd., Vancouver, B.C., June 2000.

IOGP (International Association of Oil and Gas Producers). 2016. Environmental fates and effects of ocean discharge of drill cuttings and associated drilling fluids from offshore oil and gas operations. Report 543.

2.4.12 Information Requirement: IR-23 (Part One Response – September 2018)

External Reviewer(s): Elsipogtog-03-Nx, -13-Nx; MTI-06-Nx

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat, 5(1)(a)(ii) Aquatic Species

Reference to EIS Guidelines: Section 8 Follow-up and Monitoring Programs

Reference to EIS: Section 8.6 Environmental Monitoring and Follow-up

Context and Rationale: The proponent has not proposed to undertake any follow-up monitoring regarding marine fish, since no significant effects are predicted. However, Elispogtog First Nation is concerned that if no monitoring is conducted, the predictions of effects cannot be tested or verified.

Similar to this, MTI raised concern with the lack of commitment to continually assess fish presence during operations, despite the EIS acknowledging the fluctuating nature of fish presence in the Project Area.

Specific Question or Information Requirement: Provide additional rationale on the need for follow-up to verify effects related to fish and fish habitat.

Comment on the need for and of feasibility of monitoring to provide insight into fish species and abundance in the Project Area.

Response: As described throughout Chapter 8 and summarized in Section 8.5.1 of the Environmental Impact Statement (EIS), the overall nature, localized extent and duration of the various components and activities associated with this Project, along with the offshore and dynamic marine environment involved and the implementation of standard and effective mitigations, will mean that any potential adverse effects on fish and fish habitat will be of low magnitude, localized extent, temporary, and largely reversible in nature (Table 8.7). Moreover, the lack of interactions with critical habitat and areas of known and high abundance outside the local study area (LSA) also indicate that potential significant adverse effects to species at risk are considered unlikely.

The presence and operation of the mobile offshore drilling unit (MODU) will result in the introduction of a number of disturbances into the marine environment, however, given their short-term and localized nature, these changes are not expected to have overall (population level) adverse effects on fish in the LSA or beyond. Drilling itself and any anchoring will result in direct interaction with the seabed, and could in turn adversely affect sensitive benthic biota or habitats in the immediate area (footprint). Potential effects on coral and sponge aggregations should be avoided through the completion of pre-drill seabed investigation surveys using remotely operated vehicles (ROVs) or other equipment, with appropriate mitigation (set-backs) applied as required and relevant. All associated discharges from the MODU will be managed in accordance with applicable regulations and guidelines.

Underwater noise resulting from the use of seismic sound sources during vertical seismic profiling (VSP) activities may result in temporary displacement of some fish species, but is not anticipated to result in injury or mortality of fish and invertebrates. These seismic sound emissions are short term, mainly directed downwards into the well, with limited horizontal range, and VSP surveys typically use sound levels that are lower than the larger seismic (geophysical) surveys that occur throughout the region. Mobile fish and invertebrate species are expected to temporarily avoid areas of VSP operations, minimizing the potential for adverse interactions. The application of standard mitigations such as an initial "ramp up" phase to promote initial fish and invertebrate avoidance will further limit any potential effects.

Eventual well abandonment or suspension and the associated removal of the wellhead using mechanical means (if required) will result in short term, low magnitude emissions of noise and light. Individual fish that are sensitive to lighting and noise emissions may temporarily avoid the area during these activities, with no anticipated population level effects or other adverse environmental implications occurring as a result of these activities.

This short-term nature, reversibility of effects, and EIS predictions of no significant adverse effects, are the reasons that follow-up monitoring for fish and fish habitat will not be completed.

References:
No additional references.

2.4.13 Information Requirement: IR-24 (Part One Response – September 2018)

External Reviewer(s): DFO-46-Nx, MFN-05-Nx

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat

Reference to EIS Guidelines: Part 2, Section 6.3.1 Fish and Fish Habitat

Reference to EIS: Section 8.3.3.2 Residual Environmental Effects Assessment

Context and Rationale: The EIS Guidelines require an analysis of the effects of underwater noise and vibration emissions on fish health and behaviour.

Section 8.3.3.2 of the EIS refers the reader to Appendix E for additional information on anticipated underwater noise emissions. However, in assessing potential noise effects on fish and fish habitat, Section 8.3.3.1 of the EIS refers to "typical sound levels" rather than referencing the source levels and predictions included in Appendix E. It is not clear why specific sound emissions predictions are not used to support the assessment of effects on fish.

The EIS states that "(t)ypical sound levels from offshore drilling activities are generally below estimated received sound exposure guidelines for injury to fish, those that have been established for recoverable injuries (170 dB re 1µPa for 48 hr SEL) and temporary hearing threshold shift (158 dB re 1µPa for 12 hr SEL) (Popper et al. 2014)." However, typical source levels of drilling activities are reported to be greater than 187 dB re 1 µPa based on information presented in Appendix E; this is above the thresholds indicated for effects on fish. It is unclear to what distance the levels would be expected to be above thresholds.

Specific Question or Information Requirement: Update the assessment of effects of noise on fish, using sound levels from Appendix E that are intended to be representative of project conditions. As part of this assessment, include:

- a discussion of how the at-source sound levels predicted in Appendix E compare to the selected noise thresholds for injury and behavioural effects in fish; and
- estimates of the distance from source at which sound levels would be expected to be above thresholds for fish injury and behavioural effects.

Update the effects analysis, proposed mitigation and follow-up, as well as effects predictions accordingly.

Response: Popper et al. (2014) published recommended sound exposure guidelines for fishes exposed to various types of impulsive sound sources (i.e., explosions, pile driving, seismic airguns, naval sonar) as well as a limited number of metrics for certain types of fish exposed to continuous sound sources (e.g., shipping, drilling). Guidelines for continuous sounds were based on a minimal number of studies, the recognition that fish will respond to sound, and their hearing sensitivity. Numeric values for continuous sound sources were only developed for recoverable injury (170 dB root-mean-square [rms] for 48 hours [h]) and temporary threshold shifts (i.e., TTS; a temporary reduction in hearing ability) (158 dB rms for 12 h) for fish species that have swim bladders involved in hearing (e.g., Atlantic cod, herring). Quantitative metrics or guidelines for assessing behavioural effects of sound on fish do not exist, and the aforementioned metrics do not apply to fish species with no swim bladder (e.g., flatfish) or those with swim bladders that are not involved in hearing (e.g., Atlantic salmon).

Source levels presented in Appendix E of the Environmental Impact Statement (EIS) were based on previously modelled source levels for a drill ship, a semi-submersible drilling platform, and a support vessel (i.e., 197, 197, and 189 dB re 1 µPa @ 1 m, respectively; Zykov 2016). However, it is important to note that both the duration of exposure and the distance from the sound source must be considered prior to comparing the numeric values of a sound source and the threshold guidelines. Root-mean-square sound pressure refers to the average of the square of the sound signal pressure over a given duration, and for Popper et al.'s (2014) continuous sound level guidelines to apply, an animal would have to be within the range of these levels for the guideline stated durations. Therefore, in fishes with swim bladders involved in hearing, TTS may be expected to occur following 12 continuous hours of exposure to sound pressure levels of 158 dB (rms), and recoverable injuries may occur following 48 hours of continuous exposure to sound levels of 170 dB (rms) (Popper et al. 2014). The source levels for the drilling activities (i.e., 189-197 dB re 1 µPa) is a representation of the far-field sound pressure levels at the source, and sound levels would dissipate (decrease) rapidly with increasing distance from the source. Based on Section 4.2.1 of the Underwater Sound Propagation Assessment (Appendix E of the EIS), a SPL of 158 dB re 1 µPa is expected to occur between 150 and 330 m from the centre of the drilling platform, and a SPL of 170 dB re 1 µPa is expected to occur between 90 and 150 m from the centre of the drilling platform.

Given the transient nature of fish and demonstrated avoidance behaviours of fish to sound (Section 8.3.3.1 Underwater Noise and Vibrations, and Section 8.3.5 Vertical Seismic Profiling (VSP) Surveys) it is unlikely that fish would remain in the immediate area long enough (i.e., 12-48 hrs) to be continuously exposed to these levels. Many of the studies that demonstrate hearing impairments to sound are based on caged studies where fish and invertebrates are unable to avoid and escape the underwater noises (Popper and Hastings 2009; Popper et al. 2014); this is not the case for species in the natural environment who are free to move at will. Popper et al. (2014) also notes that "there is no direct evidence of mortality or potential mortal injury to fish… from ship noise". Thus, even in the unexpected event that an individual elected to remain within the potential extended-duration exposure area, the result would still be temporary in nature (i.e., both TTS and recoverable injuries are by definition short-term and reversible outcomes). Therefore, the effects assessment in Section 8.3 of the Environmental Impact Statement (EIS) remains unchanged, with the environmental effects of the presence and operation of the drilling installation predicted to be adverse, low in magnitude, localized to within the Project Area, short to medium term in duration, occurring regularly, but reversible, with these predictions being made with a high level of confidence.

References:

Popper, A. N., and M. C. Hastings. 2009. The effects of human-generated sound on fish. Integrative Zoology, 4: 43-52.

Popper, A. N., Hawkins, A. D., Fay, R. R., Mann, D., Bartol, S., Carlson, T., Coombs, S., Ellison, W. T., Gentry, R., Halvorsen, M. B., Løkkeberg, S., Rogers, P., Southall, B. L., Zeddies, D. 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," ASA S3/SC1.4 TR-2014. Springer and ASA Press, Cham, Switzerland (2014).

Zykov, M.M. 2016. Modelling Underwater Sound Associated with Scotian Basin Exploration Drilling Project: Acoustic Modelling Report. Document Number JASCO Document 01112, Version 2.0. Technical report by JASCO Applied Sciences for Stantec Consulting Ltd.

2.4.14 Information Requirement: IR-25 (Part One Response – September 2018)

External Reviewer(s): KMKNO-25-Nx; MMS-05-Nx

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat, 5(1)(a)(ii) Aquatic Species

Reference to EIS Guidelines: Part 2, Section 6.4 Mitigation Measures

Reference to EIS: Section 10.3.2 Summary of Key Mitigation and Section 10.6 Environmental Monitoring and Follow-up

Context and Rationale: The EIS does not propose passive acoustic monitoring for detecting marine mammals in the vicinity of the Project during vertical seismic profiling. Visual monitoring only has been proposed. Deep-diving odontocete species spend most of their time underwater, and may be quite difficult to detect when at the surface. The concurrent use of visual and passive acoustic monitoring can increase the likelihood of detecting deep-diving cetaceans. In addition, to increase the probability to accommodate deeper, longer diving behaviour, a pre-ramp up watch period of 60 minutes in deep water areas where beaked and other deep diving whales may be present should be considered.

The KMKNO expressed concern with the lack of passive acoustic monitoring, in particular during periods of low visibility when marine mammal observers cannot effectively observe the entire exclusion zone (i.e. fog, nighttime).

Specific Question or Information Requirement: Consider passive acoustic monitoring for detecting deep-diving cetaceans in the vicinity of the Project during vertical seismic profiling and the length of the ramp-up observation period. Describe whether passive acoustic monitoring and a longer pre-ramp-up watch would be included in the mitigation measures for the Project. If the proponent does not believe additional mitigation is required, provide associated rationale.

Response: CNOOC Petroleum North America ULC (CNOOC) contracted JASCO Applied Sciences (Canada) Ltd. (JASCO) to complete an Underwater Sound Propagation Assessment (Appendix E of the Environmental Impact Statement) (EIS) to better understand underwater noise associated with exploratory drilling activities. JASCO studied the typical "worst case" underwater noise from exploration activities including noise produced by thrusters on mobile offshore drilling units (MODUs) and support vessels, and noise from large seismic sound source arrays.

As discussed in the EIS (Section 2.5.2.3), vertical seismic profiling (VSP) surveys are of short duration (the actual sound source activation is generally limited to a few hours per instance) and make use of smaller sound source arrays than typical 3D seismic geophysical surveys. As a result, the distances to marine mammal impact thresholds, either behavioral causing or injury causing, will be smaller (i.e., closer to the wellsite) than those modeled in the JASCO study.

As recommended in the Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment (SOCP) (DFO 2007), at all times that a pre-determined zone is visible, a trained Marine Mammal Observer (MMO) will continuously observe the pre-determined zone from 30 minutes prior to the start-up of the sound source array to the shutdown of the sound source array. In deep water areas (>500 metres) that could potentially support deep-diving odontocete species, and based on the professional judgement of the MMO, this observation period could be extended past 30 minutes if required for observation. CNOOC has committed to complying with the SOCP which defines the minimum mitigation

measures to undertake when planning and conducting a marine geophysical survey in order to reduce potential effects on ocean life. The SOCP also includes the "soft start" ramp up procedure starting with the smallest sound source and ramping up the remaining sound array(s) for a minimum period of time following the MMO observation period noted above. With the expectation that if marine life is capable, it will move away from an unexpected or unwanted underwater sound source (See Section 8.3.5.1 of the EIS), the probability that an undetected marine mammal may be nearby and within the impact threshold zone when the VSP is fully operational is predicted to be very low.

As noted, VSP surveys are of short duration and CNOOC will make every effort to not start a VSP survey during periods of limited visibility. CNOOC is not currently planning to make use of other monitoring measures such as passive acoustic monitoring (PAM) and no additional mitigation measures related to VSP surveys are proposed. If regulators determine that additional monitoring measures are required for VSP surveys, CNOOC will develop a monitoring plan outlining the additional measures for regulatory review prior to undertaking a VSP survey.

The response to Information Requirement (IR)-29 may provide additional information.

References:

DFO (Fisheries and Oceans Canada). 2007. Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment. Available online: http://waves-vagues.dfo-mpo.gc.ca/Library/363838.pdf. Accessed June 2018.

2.4.15 Information Requirement: IR-26 (Part One Response – September 2018)

External Reviewer(s): MMS-09-Nx; Nutash-15-Nx; MTI-09-Nx

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat, 5(1)(a)(ii) Aquatic Species

Reference to EIS Guidelines: Part 2, Section 8 Follow-Up and Monitoring Programs

Reference to EIS: Section 10.6 Environmental Monitoring and Follow-up

Context and Rationale: Sections 8, 9, and 10 of the EIS state that noise from the Project may affect marine species; however, there is no discussion in the EIS on follow-up programs to determine the accuracy of effects predictions with respect to noise and effectiveness of proposed mitigation measures.

Specific Question or Information Requirement: State whether the proponent intends to verify noise predictions and/or the effectiveness of mitigation measures through a follow-up program. If follow-up is not proposed, provide a rationale, including consideration of the potential for underwater noise to have adverse effects on marine species, including marine mammals and sea turtles, and certainty/uncertainty related to effects predictions.

Response: CNOOC Petroleum North America ULC (CNOOC) is not planning to verify the noise predictions from the Environmental Impact Statement (EIS). As part of a recent EIS for offshore eastern Newfoundland, Maxner et al (2017) presented a quantitative analysis of underwater acoustic data from within the Flemish Pass collected in 2014 and 2015 in order to characterize the baseline soundscape as well as the soundscape during Equinor's 2014-2016 active exploration drilling programs. The authors also reported on the presence of vocalizing marine mammals during the monitoring period. A modelling study undertaken for the Scotian Basin Exploration Drilling Project (Zykov 2016) explored the distance from the MODU within which underwater noise was predicted to exceed the threshold for auditory injury (<420 m from the MODU) and for behavioural disturbance (50 - 150 km from the MODU), while a study of acoustic propagation in the offshore waters of eastern Newfoundland (Quijano 2017) found that the area was likely to have even shorted propagation distances and that the average sound pressure levels were below the behavioural disturbance threshold at just 35 km from the Hibernia platform, a considerably shorter distance than that predicted by Zykov (2016). In consideration of the results of these studies, the uncertainty level associated with predicted sound levels during operation of the exploratory drilling program, as well as its predicted effects on marine mammals and sea turtles, is considered low. Additionally, the implementation of planned mitigation measures throughout the life of the Project reduces the potential for adverse environmental effects; as stated in Section 10.5.2, and the effectiveness of mitigation is considered to be moderate to high.

References:

Maxner, E., B. Martin, and K. Kowarski. 2017. Marine Mammals and Ambient Sound Sources in the Flemish Pass: Analysis from 2014 and 2015 Acoustic Recordings. Document 01456, Version 1.0. Technical report by JASCO Applied Sciences for Statoil Canada Ltd.

Quijano, J., M.-N. Matthews, and B. Martin. 2017. Eastern Newfoundland Drilling Noise Assessment: Qualitative Assessment of Radiated Sound Levels and Acoustic Propagation Conditions. Document 01366, Version 2.1. Technical report by JASCO Applied Sciences for Stantec Consulting Ltd

Zykov, M.M. 2016. Modelling Underwater Sound Associated with Scotian Basin Exploration Drilling Project: Acoustic Modelling Report. JASCO Document 01112, Version 2.0. Technical report by JASCO Applied Sciences for Stantec Consulting Ltd.

2.4.16 Information Requirement: IR-27 (Part One Response – September 2018)

External Reviewer(s): MMS-04-Nx; KMKNO-03-Nx, -22-Nx, -23-Nx; -37-Nx; MTI-10-Nx, -11-Nx; NunatuKavut-15-Nx, -13-Nx; Nutash-50-Nx; MTI-09-Nx

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat, 5(1)(a)(ii) Aquatic Species

Reference to EIS Guidelines: Part 2, Section 6.4 Mitigation Measures

Reference to EIS: Section 10.3.2 Summary of Key Mitigation

Context and Rationale: The Agency received comments from Indigenous groups about mitigation of effects on marine mammals.

The KMKNO indicated that Section 10.3.8.1 of the EIS states "[r]educing vessel speed has been shown to reduce the number of marine mammal deaths and severe injuries due to vessel strikes (Vanderlaan and Taggart 2007; Vanderlaan et al 2008, 2009; vander Hoop et al 2012). Lethal strikes are infrequent at vessel speeds less than 25.9 km/h (14 knots) and rare at speeds less than 18.5 km/h (10 knots) (Laist et al 2001)." The KMKNO has commented that vessels should be required to reduce speeds (10-knot limit) when not in existing shipping lanes and/or whenever a marine mammal or sea turtle is observed or reported in the vicinity. This is particularly important given the recent deaths of North Atlantic right whales attributable to blunt force trauma. It is possible that North Atlantic right whales would occur in the Project Area.

MMS raised concern with the simultaneous presence of ships and marine mammals resulting in risks of collision which may cause injuries and occasionally be fatal for the animal. The potential Project vessel traffic route is illustrated on Figure 2.5 as a direct line between the drilling installation and the supply base. The KMKNO has recommended that to minimize the risk of collision with marine mammals and sea turtles and to minimize the potential for interference with commercial fisheries, Project vessel traffic routes link up with existing shipping lanes at the earliest practicable opportunity, even where this may result in moderately decreased efficiency. In addition, The KMKNO noted that in some sections of the EIS it is stated the existing and common vessel traffic routes will be used "wherever practical" (section 10.3.1), and other sections state that these will be used "wherever possible" (section 10.3.8.2). Further to this, MTI noted that the EIS indicates that routes may vary at times based on particular location of active MODU(s), onshore facilities being used, environmental and logistical conditions; but does not include information on these possible variations.

To reduce the adverse effects of drilling activities on marine mammals, MTI has suggested that additional mitigation measures should be considered. It suggested that drilling be restricted, or at an minimum closely monitored and regulated with marine mammal discovery contingency plans and work stoppage triggers in place during the period in which North Atlantic right whales are more likely to be present in the Project Area (early May and mid-October), as well as that if observations of individual North Atlantic right whales are made within close proximity during drilling activities. In addition, consideration should be given to implementing all applicable precautionary measures outlined in the Government of Canada's 2018 plan for protecting North Atlantic Right Whales. The NunatuKavut Community Council suggested that if it is determined that the Project or any related activities have an effect on migration routes, activities should be suspended during migration.

Specific Question or Information Requirement: Define speed limits that supply vessels operating outside of shipping lanes would adhere to and consider the associated potential for effects on marine mammals.

Describe existing shipping lanes, clarify in what circumstances they would be used, and discuss where project vessel traffic routes would link up with existing shipping lanes. Describe whether the use of existing shipping lanes could reduce the potential for effects on marine mammals.

Taking into consideration MMS's and MTI's comments, advise whether additional mitigation or follow-up measures are under consideration and would be implemented given the potential effects of the Project on marine mammals.

Response: CNOOC Petroleum North America ULC (CNOOC) recognizes that certain offshore areas in Canada (e.g. the Gulf of St. Lawrence) have defined speed limits and shipping lanes (Transport Canada 2018). However, the offshore Newfoundland area does not currently have prescribed speed limits or shipping lanes.

Vessel speed and direction is generally set based on environmental conditions (e.g. wind, waves, etc.), planned distance to travel and end destination, awareness of other shipping traffic, and will follow operational best practices for the area. As standard practice offshore Newfoundland, vessel transits are typically completed at speeds of between 10-12 knots. Occasionally the vessels will transit at best possible speed which will generally be 13-14 knots. As stated in the EIS (Section 10.3.8), the risk of lethal vessel strikes decreases with vessel speed, and such occurrences are infrequent at speeds of less than 14 knots (Laist et al 2001).

As will be outlined in the CNOOC Environmental Protection Plan (EPP) to be reviewed by the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB), observations for marine mammals and sea turtles are conducted during offshore activities and if marine mammals and/or sea turtles are observed in close proximity to the activities, the speed or direction of the relevant vessel can be adjusted or the planned activity delayed (i.e., vertical seismic profile (VSP) surveys) to avoid or reduce potential effects. The Project is proposing to have an Environmental Observer onboard the mobile offshore drilling unit (MODU) to undertake observations for marine mammals and sea turtles during key activities such as during VSP surveys that utilize seismic sound source arrays.

The response to Information Requirement (IR)-31 may provide additional information.

References:

Laist, D.W., Knowlton, A.R., Mead, J.G., Collet, A.S., and M. Podesta (2001). Collisions between ships and whales. Mar. Mammal Sci., 17(1): 35-75.

Transport Canada. 2018. Protecting North Atlantic Right Whale from Ship Strikes in the Gulf of St. Lawrence. Available online: https://www.tc.gc.ca/en/services/marine/navigation-marine-conditions/protecting-north-atlantic-right-whales-ship-strikes-gulf-st-lawrence.html. Accessed June 2018.

2.4.17 Information Requirement: IR-28 (Part One Response – September 2018)

External Reviewer(s): Unknown

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat, 5(1)(a)(ii) Aquatic Species

Reference to EIS Guidelines: Part 2, Section 8 Follow-up and Monitoring Programs

Reference to EIS: Section 10.6 Environmental Monitoring and Follow-up

Context and Rationale: Section 10 of the EIS states that vessel traffic for supply and servicing of the MODU is estimated at two to three return transits per week for a single MODU (and for two MODUs this will increase proportionally) and that any vessel strikes involving marine mammals or sea turtles will be reported to DFO within 24 hours.

Specific Question or Information Requirement: Explain what procedures are in place for notifications of DFO in case of a vessel collision with a marine mammal or sea turtle. Explain what types of responses could be expected if any, and who would undertake them should a vessel strike occur. As part of a follow-up program, explain how this information would be used to verify effects predictions or test mitigation effectiveness.

Response:

Explain what procedures are in place for notifications of DFO in case of a vessel collision with a marine mammal or sea turtle.

The reporting of any collisions with marine mammals (incident) is under the jurisdiction of Fisheries and Oceans Canada (DFO). The Master of the vessel involved in the collision is responsible to ensure the incident is reported. DFO require that the "Marine Mammal Interaction Form" be completed immediately after an incident and submitted to DFO by email. If the incident involves a live mammal DFO requires a call be placed immediately to the regional response network. The Master of the vessel involved in the collision will also report the incident to CNOOC Petroleum North America ULC (CNOOC) who will subsequently notify the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) in accordance with the Incident Reporting and Investigation Guideline (C-NLOPB, August 2017).

In situations where a vessel in the field or in transit sights a marine mammal in distress (i.e., entangled in netting) an immediate call will be placed to the regional response network, Whale Release and Strandings, at 1-888-895-3003 and, if possible, photographs will be taken as and provided to the response network.

Where a vessel in the field or in transit sight a North Atlantic Right Whale, the Master of the vessel is encouraged to report the sighting using the "Marine Mammal Interaction Form", including the provision of a photo of the mammal if possible.

Explain what types of responses could be expected if any, and who would undertake them should a vessel strike occur.

DFO specifically states that the mammal must not be touched or moved to avoid causing additional harm to the mammal as well prevent any risk to personnel. Any actions to be taken would be under the direction of DFO and/or the regional response network (Whale Release and Strandings) at the time of the incident.

As part of a follow-up program, explain how this information would be used to verify effects predictions or test mitigation effectiveness.

The information supplied is used by DFO to estimate levels of incidental mortalities and injuries to marine mammals. This information allows DFO to better assess the types of threats that may be affecting Canada's marine mammals and develop mitigation strategies and will inform future environmental assessments for similar projects.

References:

Fisheries and Oceans Canada, "Report a marine mammal or sea turtle incident or sighting" http://www.dfo-mpo.gc.ca/species-especes/mammals-mammiferes/report-rapport/page01-eng.html

Incident Reporting and Investigation Guideline, Canada-Newfoundland and Labrador Offshore Petroleum Board, August 2017.

2.4.18 Information Requirement: IR-29 (Part One Response – September 2018)

External Reviewer(s): KMKNO-23-Nx, - 24-Nx, -26-Nx; MMS-05-Nx; MTI-09-Nx

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat, 5(1)(a)(ii) Aquatic Species

Reference to EIS Guidelines: Part 2, Section 6.4 Mitigation Measures

Reference to EIS: Section 10.3.2 Summary of Key Mitigation; Table 10.5 Environmental Effects Assessment Summary: Marine Mammals and Sea Turtles; Section 10.6 Environmental Monitoring and Follow-up

Context and Rationale: Section 10.3.2 of the EIS states that mitigation measures applied during the Project's vertical seismic profiling surveys will conform with those in the Statement of Canadian Practice with Respect to the Mitigation of Seismic Sound in the Marine Environment (Statement), while Table 10.5 states that Nexen will operate in compliance with relevant aspects of the Statement. It is unclear whether all mitigation measures in the Statement will be applied to the Project.

Section 10.6 of the EIS states that visual monitoring for the presence of marine mammals and sea turtles within a pre-determined exclusion zone will take place during vertical seismic profiling operations where a seismic sound source array is used. The size of the monitored exclusion zone is not clear.

Section 10.3.2 and Table 10.5 of the EIS states that there will be marine mammal observers during vertical seismic profiling surveys that will enable sound source array shutdown or delay actions to be implemented if marine mammal or sea turtle species listed on Schedule 1 of the SARA are detected within the monitored exclusion zone.

It is unclear whether shutdown would occur if any marine mammal or sea turtle is sighted or only if endangered or threatened species are sighted.

The KMKNO has asked about the feasibility of extending the safety zone during vertical seismic profiling (e.g. to a radius of 1 kilometre from the installation). In addition, the KMKNO asked if vessel personnel should be provided with training to identify marine mammals and sea turtles to serve as look outs during travel time, to minimize potential impacts.

Specific Question or Information Requirement: Clarify what aspects of the Statement are considered "relevant" and whether all mitigation measures in the Statement will be applied to the Project. Including:

- whether shut-down of the array would occur if any species of marine mammals or sea turtles enter the safety zone. Should shut down only occur on sighting of listed species, provide an explanation of how these species would be identified, and
- what the size of a safety zone within which a qualified marine mammal observer will monitor for the presence of marine mammals and sea turtles would be.

Provide explanation/justification for any mitigation measures included in the Statement that would not be applied to the Project.

Discuss the need for and feasibility of extending the safety zone during vertical seismic profiling. Clearly identify any modified or additional mitigation measures which would be applied.

Confirm if there would be observations for marine mammals and sea turtles when transiting to and from the Project Area. If so, provide information on the actions to be taken in the event a marine mammal or sea turtle is spotted.

Response: CNOOC Petroleum North America ULC (CNOOC) has committed to complying with the Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment (SOCP) (DFO 2007) which defines the minimum mitigation measures to undertake when planning and conducting a marine geophysical survey to reduce potential effects on ocean life. As recommended in the SOCP, a trained Marine Mammal Observer (MMO) will continuously observe a pre-determined zone for 30 minutes prior to the start-up of the vertical seismic profile (VSP) sound source array. If any marine mammal or sea turtle is observed within the pre-determined zone during this 30 minute monitoring period, the sound source array will not start. Once the pre-determined zone is determined to be cleared of the observed marine mammal or sea turtle, the 30 minute monitoring period will start again. If any marine mammal or sea turtle (not just listed species) is observed within the pre-determined zone while the sound source is in operation, the sound source array will be shut down.

The pre-determined zone is typically defined as a 500 metres radius surrounding the mobile offshore drilling unit (MODU). Extending the pre-determined zone well beyond 500 metres can cause challenges in reliably scanning the area for marine mammals and sea turtles particularly during adverse weather. As noted in the response to Information Requirement (IR)-25, VSP surveys are of short duration (the actual sound source activation is generally limited to a few hours per instance) and CNOOC will make every effort to not start a VSP survey during periods of limited visibility.

The responses to IR-25 and IR-31 provide additional relevant information.

References:

DFO (Fisheries and Oceans Canada). 2007. Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment. Available online: http://waves-vagues.dfo-mpo.gc.ca/Library/363838.pdf. Accessed June 2018.

2.4.19 Information Requirement: IR-30 (Part One Response – September 2018)

External Reviewer(s): Unknown

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat, 5(1)(a)(ii) Aquatic Species

Reference to EIS Guidelines: Part 2, Section 6.3.3. Marine Mammals and 6.3.4 Marine Turtles

Reference to EIS: Appendix E Underwater Noise Propagation Assessment; Section 2.7 Project Schedule

Context and Rationale: Appendix E of the EIS states that for sound modelling, "May was selected… since this profile is the least downward refracting during the months that are traditionally most operationally active (May to October). Thus, using the sound speed profile for May will result in conservative but realistic distances to the assessed sound thresholds compared to the yearly averaged." The EIS also states that distances to behavioural thresholds may be slightly longer for activities during January-May, but that during this time activities are unlikely due to heavy weather in the region. Section 2.7 of the EIS states that within its temporal scope, each of the planned exploration activities that comprise this project may occur in any year of the proposed exploration project, and at any time of the year.

Based on Nexen's sound modelling results, behavioural acoustic threshold levels in marine mammals could be reached as far as 56.8 km from the MODU. It is not clear in the EIS whether the distance to behavioural thresholds could extend further in the months that weren't modelled for (January-April) and whether there is the possibility of exploration activity occurring during that time.

Specific Question or Information Requirement: Confirm whether project activities could occur year-round. If so, taking into account that sound is expected to propagate longer distances from January-May, explain whether the distance to marine mammal and sea turtle behavioral sound threshold limits for the months that weren't modelled for (January-April) could extend further than the 56.8 km modelled in the EIS for May.

Response: According to Section 2.7 of the Environmental Impact Statement (EIS), each of the planned exploration activities that comprise the Project may occur at any time of the year throughout the duration of the proposed exploration program. Therefore, although activity may occur during the period from May to October as stated in Appendix E of the EIS, there is potential for Project-related activities to occur outside this period, including from January to May when sound is expected to propagate over slightly greater distances. Exceedances to behavioural thresholds may be seen at slightly greater distances from the source, but because distance to injury criteria are much shorter, these distances would not vary significantly throughout the year (Appendix E of the EIS).

Based on previous work by Quijano et al. (2017) in eastern Newfoundland, differences in the summer and winter sound profiles were minor compared with those seen in the Scotian Basin; therefore, distances to thresholds are presumed to be relatively similar in summer and winter in eastern Newfoundland. Further, the sound speed profile for May is similar to those from January to April in that they are less downward refracting than the profiles from June to December (Appendix E of the EIS). Based on this, the differences in the modeled distances at which the behavioural threshold could be exceeded are anticipated to be very minor.

References:

Quijano, J., M.-N. Matthews, and B. Martin. 2017. Eastern Newfoundland Drilling Noise Assessment: Qualitative Assessment of Radiated Sound Levels and Acoustic Propagation Conditions. Document 01366, Version 2.1. Technical report by JASCO Applied Sciences for Stantec Consulting Ltd.

2.4.20 Information Requirement: IR-31 (Part One Response – September 2018)

External Reviewer(s): Unknown

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat, 5(1)(a)(ii) Aquatic Species

Reference to EIS Guidelines: Part 2, Section 8 Follow-up and Monitoring Programs

Reference to EIS: Section 9.6 Environmental Monitoring and Follow-up, Marine Migratory Birds

Context and Rationale: Section 9.6 of the EIS states that a trained Environmental Observer will be onboard the MODU to record marine bird and marine mammal sightings during Project operations.

Specific Question or Information Requirement: Describe any protocols that will be utilized while undertaking the marine mammal observation during Project operations, including reporting the results of the monitoring program.

Response: Sections 10.6 and 18.4.2.1 of the Environmental Impact Statement (EIS) indicate that CNOOC Petroleum North America ULC (CNOOC) will develop and implement a marine mammal and sea turtle monitoring program for vertical seismic profiling (VSP) activity when a seismic sound source is utilized. Prior to implementing the program, CNOOC will outline the requirements in its Environmental Protection Plan (EPP) or Environmental Compliance Monitoring Plan (ECMP), which must be submitted to the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) as part of an Operations Authorization (OA). The program outlined in the EPP or ECMP will take into consideration the latest available information from Fisheries and Oceans Canada (DFO). A trained Marine Mammal Observer (MMO) will be on board the mobile offshore drilling unit (MODU) during VSP operations, when a seismic sound source array is used, and will visually monitor for the presence of marine mammals and sea turtles within a pre-determined zone.

CNOOC has committed to complying with the Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment (SOCP) (DFO 2007) which defines the minimum mitigation measures to undertake when planning and conducting a marine geophysical survey to reduce potential effects on ocean life. As recommended in the SOCP, an MMO will continuously observe a pre-determined zone for 30 minutes prior to the start-up of the sound source array. If marine mammals or sea turtles are observed within the pre-determined zone during the 30-minute monitoring period, the sound source array will not start. If a marine mammal or sea turtle is observed within the pre-determined zone while the sound source is in operation, the sound source array will be shutdown and the 30 minute monitoring period will start again.

CNOOC will submit observation reports annually to the C-NLOPB and DFO.

Any vessel strikes of marine mammals or sea turtles will be reported to DFO as per the regulatory requirements.

The responses to Information Requirement (IR)-25 and IR-29 provide additional relevant information.

References:

DFO (Fisheries and Oceans Canada). 2007. Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment. Available online: http://waves-vagues.dfo-mpo.gc.ca/Library/363838.pdf. Accessed June 2018.

2.4.21 Information Requirement: IR-32 (Part One Response – September 2018)

External Reviewer(s): C-NLOPB- 3 (Nexen)

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat, 5(1)(a)(ii) Aquatic Species

Reference to EIS Guidelines: Part 2, Section 6.3.1 Fish and Fish Habitat, and 6.6.3 Marine Mammals

Reference to EIS: Appendix E Underwater Sound Propagation Assessment (JASCO 2017

Context and Rationale: The EIS Guidelines require a description, assessment, and determination of the significance of potential effects from underwater noise on fish and marine mammals (Part 2, Section 6.3.1 and Section 6.6.3).

It is noted that the Nexen model (Appendix E of the EIS, Underwater Sound Propagation Assessment) was conducted in relation to operation of a single drilling unit, while two drilling units may be operating simultaneously for the Project. The effects of noise from two drilling units operating simultaneously is not addressed in Appendix E, nor carried through the effects assessment.

Specific Question or Information Requirement: Assess the effects of noise from operating multiple drilling units simultaneously, as proposed for the Project.

Update the effects assessment, as applicable.

Response: CNOOC Petroleum North America ULC (CNOOC) will not have multiple mobile offshore drilling units (MODUs) operating simultaneously as part of this project.

The response to Information Requirement (IR)-01 provides additional information.

References:
No additional references.

2.4.22 Information Requirement: IR-33 (Part One Response – September 2018)

External Reviewer(s): MMS-05-Nx; MTI-09-Nx

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat, 5(1)(a)(ii) Aquatic Species

Reference to EIS Guidelines: Part 2, Section 6.1.6 Marine Mammals

Reference to EIS: Section 10.5.1 Residual Environmental Effects Summary

Context and Rationale: Vertical seismic profiling activities may adversely affect marine mammals. The EIS states in Table 10.5 that measures to mitigate the effects of vertical seismic profiling include keeping seismic sound levels at the minimum level possible based on the associated technical requirements for the survey. Typical energy levels are provided in Appendix E (Underwater Sound Propagation Assessment).

Specific Question or Information Requirement: Describe how seismic sound levels will be kept at the minimum level possible. Within the description, include the following information:

- what would be considered a minimum level;
- above what frequency is energy considered unnecessary for the purpose of the survey;
- how much reduction can be achieved; and
- to what extent would these changes reduce potential effects on marine mammals?

Response:

What would be considered a minimum level?

A minimum level would be defined as the minimum sound level at which optimal data could be collected. This sound level would be based on the individual well in question, the geological target being investigated, further discussion with the selected vertical seismic profiling (VSP) contractor and the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB), and the particular objectives and data requirements associated with the survey. If a VSP survey is being considered as part of a planned well, the proposed program would be included in the Application to Drill a Well (ADW) submitted to the C-NLOPB. However, the decision to undertake the individual VSP survey would not take place until drilling is already underway.

Section 10.3.5.2 of the Environmental Impact Statement (EIS) indicates that VSP source array volumes will likely range from 450-2400 cubic inches (in^3) in volume with typical operating pressures of 2000 psi, and are expected to produce peak to peak pressures of approximately 20-60 bar-m in the vertical direction (directly under the VSP).

What frequency is energy considered unnecessary?

VSP surveys typically use sound levels that are lower than the larger geophysical surveys that occur throughout the region. Typically, to ensure quality imaging beneath the seafloor, the larger geophysical surveys will predominantly use low frequencies (less than 200 Hz) for seismic imaging. As noted in the response to Information Requirement (IR)-25, VSP surveys are of short duration (the actual sound source activation is generally limited to a few hours per instance).

How much reduction can be achieved?
Section 10.5.1 (Table 10.5) of the EIS indicates the following mitigation procedures will be applied during the Project's VSP surveys:

- At the commencement of the VSP survey activity, a gradual ramp-up procedure of the seismic source array over a minimum time period will be implemented in order to allow any mobile marine animals to move away from the area if they are disturbed by it.
- A trained Marine Mammal Observer (MMO) will monitor and report on marine mammal and sea turtle sightings for a minimum of 30 minutes prior to, and during the course of, any VSP surveys that involve the use of a seismic sound source.
- This will enable sound source array shutdown or delay actions to be implemented if marine mammal or sea turtle species, including (but not limited to) those listed on Schedule 1 of the *Species at Risk Act* (SARA), are detected within the pre-determined monitored zone.

No additional sound source reduction is planned beyond keeping the seismic sound level at the minimum level possible for successful completion of the program.

Would these changes reduce potential effects?
There are no substantive changes proposed to the sound and frequency parameters described in the EIS. Based on the mitigation described above and in the EIS, there will be no changes to the effects assessment included in the EIS.

References:
No additional references.

2.5 Migratory Birds

2.5.1 Information Requirement: IR-34 (Revised Response – February 2019)

External Reviewer(s): ECCC-08-NX; MTI-13-Nx

Project Effects Link to CEAA 2012: 5(1)(a)(iii) Migratory Birds

Reference to EIS Guidelines: Part 2, Section 6.3.5 Migratory Birds and 6.6.3 Cumulative Effects Assessment

Reference to EIS: Part 2, Section 6.3.5 Migratory Birds and 6.6.3 Cumulative Effects Assessment

Context and Rationale: Table 15.6 (Cumulative Effects) states that the interactions between the oil platform and migratory birds are anticipated to be confined to within five kilometers of the source of lighting, based on Poot et al. 2008. However, Poot et al. 2008 state that their study design could not rule out that birds were attracted to fully lit oil platforms at much greater distances. ECCC has advised that the EIS overstates the result of the cited paper, which states: "The impression that we derived from our observations on oil platforms leading up to this study was that birds could be attracted from up to 5 km distance with full lighting (30 kW)… We cannot rule out the possibility that the birds that passed by in this study were already attracted to the experimental lamps from a much greater distance".

Section 9.3.3.2 of the EIS states that "(o)verall, the presence and operation of the MODU(s) in the Project Area is anticipated to be a negligible addition to the total amount of lighting in the overall offshore area…". ECCC has advised that drilling operations emit considerable amounts of light and would be detectable to the birds in the area, especially the Leach's storm-petrels, regardless of the other light sources in the area. Each additional platform would emit lights that would attract birds and should therefore not be considered "a negligible addition".

The EIS recognizes the potential effect of lighting on migratory birds, and Section 2.10.5 indicates that the use of artificial lighting will be minimized to the greatest extent possible and that "[t]his may include minimizing the amount, duration and frequency of pilot warning and obstruction avoidance lighting; shielding lights downward so that the light is directed toward the deck; and using strobe lights instead of solid-burning or slow pulsing warning lights at night where possible." However, specific mitigation measures related to lighting and bird attraction were not confirmed.

Specific Question or Information Requirement: Provide evidence to support the statement that bird attraction is limited to five kilometers given that the Poot et al. 2008 study could not eliminate the possibility that birds are attracted at greater distances. If birds could be attracted beyond 5 km, discuss implications for the assessment of associated effects.

Confirm whether the measures described in section 2.10.5 of the EIS will be used to mitigate effects of lighting from the Project on migratory birds and/or under which conditions they would be implemented. Consider potential need for additional follow-up related to effects on migratory birds.

Update proposed mitigation, follow-up and significance predictions accordingly.

Response:

Evidence to support bird attraction is limited to five kilometers.

Section 9.3.4 of the Environmental Impact Statement (EIS) indicates that the potential for attraction of birds to the mobile offshore drilling unit (MODU) due to lighting is the primary interaction between the Project and marine and migratory birds. Information is limited regarding the distance from which birds may be attracted to lighted structures in the offshore environment, and the zone of influence is expected to vary with factors such as weather, intensity and position (height) of the light source, and ambient light conditions (Montevecchi 2006). Available studies on attraction of birds to offshore lighting from oil and gas production facilities have demonstrated attraction distances of less than 2 kilometres (km) (Day et al 2015) to as much as 5 km (Poot et al 2008), although attraction from distances of much greater than 5 km could not be ruled out in the Poot study. Attraction of marine and migratory birds from greater distances than the 5 km zone of influence assumed in the EIS would result in a greater number of birds potentially affected by artificial lighting associated with the Project. To date, we are unaware of any studies demonstrating attraction from such large distances. CNOOC Petroleum North America ULC (CNOOC) indicates that MODUs typically have fewer light sources than stationary production facilities such as those considered in the Poot study. The potential for associated attraction effects from a MODU is predicted to be smaller in magnitude and there are no implications for the assessment of associated effects in the EIS.

Confirm measures to mitigate effects of lighting.

Section 2.10.5 of the EIS states that due to operational and regulatory requirements related to offshore lighting, light types and levels will be selected and implemented to ensure that the safety of the Project personnel and equipment and other ocean uses, as well as the operational requirements of the Project, are not compromised. The use of artificial lighting will be minimized to the greatest extent possible. CNOOC is expecting to contract its MODU and other support vessels and aircraft from suppliers that have operated in the region. The contractors and their equipment will be selected based on safety considerations and technical capabilities. Safety will be the primary consideration in determining the nature and amount of lighting utilized. Lighting is task specific by design, and where safe and technically feasible some amount of reduced lighting may be considered.

Consider potential need for additional follow-up.

Follow-up related to the effects of attraction due to lighting will be implemented as presented in the response to Information Requirement (IR)-38; the relevant portion of which is repeated below.

CNOOC is committed to having an Environmental Observer trained by Environment and Climate Change Canada (ECCC) *on board the MODU to record marine bird sightings during Project operations. These observations will be undertaken in accordance with* ECCC Canadian Wildlife Services (CWS) *monitoring protocol from stationary platforms (Gjerdrum et al 2012). In addition to the seabird monitoring program, a comprehensive program will be developed for systematic searches of the MODU. Searches will be undertaken at regular (daily) intervals, and searchers will carefully document search effort including the time of day, duration, and area searched, as well as presence and absence of stranded birds. In the event that birds are encountered during these searches, accepted protocols for the collection / handling of bird mortalities and release of birds that become stranded will be implemented. If a Species at Risk (SAR) is found alive (stranded) or dead on the MODU, a report will be sent to ECCC-CWS. Finally, a seabird observations report will be submitted to the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) within 90 days of well suspension and/or decommissioning, and an annual report summarizing search effort (including observations of stranded birds and/or seabird handling) will be submitted to ECCC in accordance with the Seabird Handling permit requirements.*

In summary, a program will be developed for standardized searches of the MODU to be undertaken at regular intervals. This program will document search effort including the time of day, duration, and areas searched, and will include negative as well as positive findings (i.e. the presence and absence of stranded and/or deceased birds). Accepted protocols for the collection and handling of live and deceased birds, and release of birds that become stranded, will be implemented as required under the Seabird Handling Permit from ECCC-CWS.

Update proposed mitigation, follow-up and significance predictions accordingly.
In consideration of the above information related to the proposed environmental monitoring and follow-up, the significance predictions presented in Section 9.5 of the EIS remain valid.

References:

Day, R.H., J.R. Rose, A.K. Prichard and B. Streever. 2015. Effects of Gas Flaring on the Behavior of Night-Migrating Birds at an Artificial Oil-Production Island, Arctic Alaska. Arctic, 68(3), 367-379.

Gjerdrum, C., D.A. Fifield, and S.I. Wilhelm. (2012). Eastern Canada Seabirds at Sea (ECSAS) standardized protocol for pelagic seabird surveys from moving and stationary platforms. Canadian Wildlife Service Technical Report Series No. 515. Atlantic Region. vi + 37 pp.

Montevecchi, W.A. (2006). Influences of artificial light on marine birds. In: Rich, C., and Longcore, T., eds. Ecological consequences of artificial night lighting. Washington, D.C.: Island Press. 94 – 113.

Poot, H., Ens, B.J., de Vries, H., Donners, M.A.H., Wernand, M.R., and Marquenie, J.M. 2008. Green light for nocturnally migrating birds. Ecology and Society 13: 47.

2.5.2 Information Requirement: IR-35 (Part One Response – September 2018)

External Reviewer(s): ECCC-13-NX

Project Effects Link to CEAA 2012: 5(1)(a)(iii) Migratory Birds

Reference to EIS Guidelines: Part 2, Section 6.3.5 Migratory Birds and 6.6.3 Cumulative Effects Assessment

Reference to EIS: Chapter 15, Cumulative Environmental Effects

Context and Rationale: Section 15.3.4 of the EIS states "the current petroleum production projects (Hibernia, Terra Nova, White Rose and Hebron) are located at considerable distance from the Project Area / LSA, and with the possible exception of associated vessel transits, any environmental disturbances that are relevant to this VC resulting from Project activities (including light emissions that may attract and/or disorient night-flying birds) in this area will not likely overlap with those of the current production projects."

ECCC has advised that a new light source in darker parts of the Project Area where there is currently no offshore production may have a comparatively larger direct effect compared to the incremental effect of a new light source in the more active north western portion of the Project Area.

Specific Question or Information Requirement: Update the assessment of effects of light on migratory birds taking into consideration differences in existing/proposed background lighting within ELs (i.e. differences between a new light source in the more active northwestern portion of the Project Area and a new light source in the portion of the Project Area which is currently a darker environment).

Response: As discussed in Section 9.3.3 of the Environmental Impact Statement (EIS), the potential for attraction of birds to the mobile offshore drilling unit (MODU) due to lighting is the primary source of interaction between the Project and marine and migratory birds. In particular, because parts of the Project Area are currently subject to lower levels of anthropogenic activity (e.g., fishing and current petroleum production facilities), light pollution is low; therefore, the lighting associated with the Project may have a comparatively larger direct effect on marine and migratory birds in the region relative to the western section, which is subject to more human activity (fishing), as illustrated in Figure 15.1 of the EIS. Even in the more active portion of the Project Area, where current sources of artificial lighting are more numerous, the addition of lighting associated with the Project will result in a cumulative increase in potential for attraction and disorientation of marine and migratory birds, as discussed in Section 15.3.

As discussed in the response to Information Requirement (IR)-38, a program will be developed for standardized searches of the MODU to be undertaken at regular intervals; this program will document search effort (including the time of day, duration, and areas searched) as well as presence and absence of stranded and/or deceased birds. Information from these searches can be used to inform the assessment and comparison of effects on migratory birds in areas with lower levels of anthropogenic activity with those in the northwest portion of the Project Area.

References:
No additional references.

2.5.3 Information Requirement: IR-36 (Part One Response – September 2018)

External Reviewer(s): ECCC-06-NX, ECCC-10-NX, KMKNO-18-Nx

Project Effects Link to CEAA 2012: 5(1)(a)(iii) Migratory Birds

Reference to EIS Guidelines: Section 6.3.5 Predicted Effects on Valued Components - Migratory Birds

Reference to EIS: Section 9.3.2 Summary of Key Mitigation and Section 9.3.6.1 Overview of Potential Effects and Existing Knowledge

Context and Rationale: Section 9.3.6.1 of the EIS provides information on the few studies to-date that have seen little or no bird mortality at flares but ECCC states the discussion fails to mention how episodic in nature such mortality can be. The studies that have tried to examine mortality at flares may not have documented much mortality because the events are infrequent. The Canaport liquid natural gas facility in 2013 had a flare mortality event where 7 500 birds were estimated to be killed in one flaring event, illustrating episodic mass mortality at flares.

The discussion of potential measures to mitigate effects of flaring is limited. Section 9.3.2 of the EIS states that flaring will be kept to the minimum necessary to characterize the hydrocarbon accumulation and as necessary for the safety of the operation. Flare shields will be considered if technically and safely feasible. Information on the specific circumstances under which flare shields would be feasible are not provided. In addition, ECCC identified the following mitigation measures that require consideration:

- notification to the C-NLOPB at least 30 days in advance of flaring to determine whether the flaring would occur during a period of migratory bird vulnerability along with a description of how the proponent plans to prevent harm to migratory birds; and
- the minimization of flaring during night time and during periods of bird vulnerability.

The KMKNO stated that in order to minimize the chance of episodic mass mortality, flaring during periods when birds are more vulnerable (fog, at night, etc.) should be avoided and that additional mitigation measures such as water curtains should be used.

Specific Question or Information Requirement: Discuss the potential effects for large-scale, episodic mortality in flaring events. The discussion should include consideration of mass mortality events which may occur, albeit infrequently, making them difficult to measure.

Describe potential measures that could mitigate the effects of flaring on migratory birds, and applicability to the Project, including:

- use of water curtains and flare shields, and the factors that would be considered in determining technical and economic feasibility;
- timing of flaring to avoid periods of migratory bird vulnerability; and
- minimizing night-time flaring.

Update proposed mitigation accordingly.

Response: Avian mass mortality incidents related to flaring appear to be very rare, but currently, the available body of research is limited. One of the most well-documented cases occurred at the Canaport liquid natural gas facility in Saint John, New Brunswick (NB), where approximately 7,500 birds were killed in a single night in September 2013. Other accounts of mass mortality events (defined here as >100 birds in a night) associated with oil and gas activities have been reported; a literature review revealed fewer than five documented occurrences (Bjorge 1987; CWHC 2009), and because these events are so rare, no comprehensive analysis has yet been published. One mass mortality incident in which reportedly "hundreds to thousands" of passerines were killed in a single night by flares was reported at an offshore facility in the North Sea (Sage 1979); however, subsequent research by Bourne (1979) and Hope Jones (1980) indicated a much lower mortality rate of approximately a few hundred birds per year per platform in the North Sea.

To-date, no mass mortality events have been reported at offshore oil and gas operations in offshore Newfoundland; nonetheless, it is recognized that accurate assessment of mortality at offshore facilities is difficult because these tend to occur during times of poor visibility (e.g., at night, or in foggy conditions). While the rarity of such events makes determination of trends difficult, based on the limited evidence available, mortality incidents tend to occur more frequently during migration season (April-May and September-October). Incidents tend to be associated with certain atmospheric conditions; in particular, fog or mist coupled with low cloud cover may force birds to fly lower than usual. Flares appear to provide misleading navigational cues to migrating birds, causing them to become disoriented and circle or fly into the light source, particularly in the absence of other visual cues such as the moon and stars (Montevecchi 2006).

Mitigation for potential effects from flaring on marine and migratory birds include potential reduction of flare frequency/duration if technically and safely feasible. Flaring will be kept to the minimum amount necessary to characterize the hydrocarbon accumulation and as necessary for the safety of the operation. High efficiency burners will be used and flare shields will be considered if technically and safely feasible. In addition, water curtains will be deployed during flaring operations to protect the drilling installation from the generated heat, and while CNOOC Petroleum North America ULC (CNOOC) is not currently aware of any literature that suggests that water curtains are effective in preventing attraction of birds, they may reduce the risk of injury or death from direct exposure to the flare.

The response to Information Requirement (IR)-08 provides additional information and discusses the use of alternate technologies that may reduce the requirement for well flow testing with flaring.

A rigorous monitoring program, as outlined in the response to IR-38, will be undertaken to maintain records of bird mortality and strandings on the MODU, including near flares, and this will enable identification of potential issues related to flares and other lighted structures. If it is determined that mass strandings and/or mortalities are occurring, then further mitigative strategies may be required and these will be developed in consultation with the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB).

References:

Bjorge, R. R. (1987). Birds kill at an oil industry flare stack in northwest Alberta. The Canadian Field-Naturalist 101: 346-350.

Bourne, W.R.P. (1979). Birds and gas flares. Marine Pollution Bulletin 10(5):124 – 125.

CWHC (Canadian Wildlife Health Cooperative). (2009). Canadian Cooperative Wildlife Health Centre: annual report 2008-2009. Available at: http://www.cwhc-rcsf.ca/docs/annual_reports/2008_2009_CCWHC_Annual_Report_EN.pdf.

Hope Jones, P. (1980). The effect on birds of a North Sea gas flare. British Birds 73(12):547 – 555.

Montevecchi, W.A. (2006). Influences of artificial light on marine birds. In: Rich, C., and Longcore, T., eds. Ecological consequences of artificial night lighting. Washington, D.C.: Island Press. 94 – 113.

Sage, B. (1979). Flare up over North Sea birds. New Scientist 81: 464-466.

2.5.4 Information Requirement: IR-37 (Part One Response – September 2018)

External Reviewer(s): Unknown

Project Effects Link to CEAA 2012: 5(1)(a)(iii) Migratory Birds

Reference to EIS Guidelines: Part 2, Section 6.3.5 Migratory Birds

Reference to EIS: Section 9.3.3. Presence and Operation of MODUs

Context and Rationale: Section 9.3.3 provides results of bird searches on board offshore platforms and vessels in the offshore area, over non-continuous timelines between 1998 and 2006. However, more contextual information and information on the data is required to determine its applicability to the current project's effects assessment.

Specific Question or Information Requirement: With regard to the information referenced in Section 9.3.3 of the EIS and reported by Husky Energy (2000):

- Is there any additional information available from the Terra Nova vessel that may be relevant?
- The EIS states that Husky Energy reported 52 Leach's storm-petrels were recovered over a three week period. Were there other species recovered during that time or was the survey focused only on reporting numbers of Leach's storm-petrel? In relation to operations, was the three week period representative (i.e. how long was the vessel actively drilling? Was the majority of drilling in the summer, or did it span spring and fall?)?

Provide additional information and context on the Baillie et al. 2005 reference, which is quoted in the EIS to have reported 469 stranded birds (mostly Leach's storm-petrels) at offshore installations and vessels off Newfoundland between 1998 and 2002. Additional information should include other species found, time of year covered during the period during which information was collected, and if there were any noted differences in numbers or species composition of birds collected on platforms versus support vessels. Further, provide support for the use of this reference, as the fate of more than half of the birds was not recorded.

With respect to information on bird strandings referred to in the EIS from Ellis et al., 2013 and Environment Canada, 2015, confirm if these results were specific to vessels used by the offshore oil and gas industry or were results from monitoring of various vessel types (offshore oil and gas, fishing, research, military vessels, etc.).

Based on the additional information, update the effects analysis, conclusions and proposed mitigation and follow-up, as applicable.

Response: Bird searches conducted at the Terra Nova site on platforms and vessels (Husky 2000) were conducted on a consistent schedule when offshore activities were occurring; if offshore activities were not occurring, then searches were not applicable. Therefore, the period where surveys were conducted was representative in relation to operations. The surveys conducted by Husky Energy were not restricted to Leach's Storm-petrels; however, no other species were found during the surveys (Husky Energy 2000). The Husky report did not provide any further information on the Terra Nova monitoring that would be relevant to this assessment.

Baillie et al (2005) reported 469 stranded birds (mostly Leach's Storm-petrels) at offshore installations and vessels off Newfoundland between 1998 and 2002, of which 16 (3%) were reported to have died and 344 (74%) were released; the fate of the remaining birds was not reported. The strandings were most common in September and October, and 97% of the birds were Leach's Storm-petrels, which was also the most commonly seen species during seabird surveys conducted from the vessel; other species that were found included Atlantic Puffin, Common Murre, Ruddy Turnstone and Glaucous Gull.

In both Ellis et al. 2013 and Environment Canada 2015, Leach's Storm-petrels were the most commonly found species stranded on vessels. These reports were not specific to oil and gas, and included vessels of various types, including fishing and research vessels as well as oil and gas-related vessels.

In consideration of this additional information, the analysis of effects, proposed mitigation and follow-up, and significance predictions in the EIS remain valid and do not need to be updated.

References:

Baillie, S.M., Robertson, G.J., Wiese, F.K. and Williams, U.P. 2005. Seabird Data Collected by the Grand Banks Offshore Hydrocarbon Industry 1999-2002: Results, Limitations and Suggestions for Improvement. Canadian Wildlife Service Technical Report Series No. 434. Atlantic Region, Mount Pearl, Newfoundland and Labrador, Canada.

Ellis, J.I., Wilhelm, S.I., Hedd, A., Fraser, G.S., Robertson, G.J., Rail, J.F., Fowler, M., Morgan, K.H. 2013. Mortality of migratory birds from marine commercial fisheries and offshore oil and gas production in Canada. Avian Conservation Ecology 8.

Environment Canada. 2015. Best practices for stranded birds encountered offshore Atlantic Canada. Draft 2 – April 17, 2015. Available online: http://www.cnlopb.ca/pdfs/mg3/strandbird.pdf.

Husky Energy. 2000. White Rose Development Environmental Comprehensive Study. Part I. Husky Oil, St. John's, NL, p. 639.

2.5.5 Information Requirement: IR-38 (Part One Response – September 2018)

External Reviewer(s): ECCC-07-NX, ECCC-12-NX, KMKNO-19-Nx; MTI-15-Nx, -16-Nx

Project Effects Link to CEAA 2012: 5(1)(a)(iii) Migratory Birds

Reference to EIS Guidelines: Section 6.3.5 Predicted Effects on Valued Components - Migratory Birds; Section 8 Follow-up and Monitoring Programs.

Reference to EIS: Section 9.6 Environmental Monitoring and Follow-up

Context and Rationale: ECCC has advised that until an adequate estimate of strandings and mortality at offshore infrastructure is obtained, there is uncertainty as to the level of effect.

ECCC has also advised that while the proponent has committed to using the Canadian Wildlife Service's Guidance for handling and documenting stranded birds, the document does not outline methods for conducting the searches.

The EIS refers to protocols for handling stranded birds, but handling protocols are distinct from systematic searching protocols. Searching protocols which document searching effort should be developed by the proponent. ECCC has advised that systematic deck searches for stranded birds conducted by trained observers should be undertaken instead of opportunistic searches. These systematic searches should occur at least daily, and have search effort documented and observations recorded (including notes of effort when no birds are found). ECCC should be consulted in the development of systematic monitoring protocols.

The EIS states that a trained Environmental Observer will be on board. It is not clear who would deliver training for the Environmental Observer or what this training would comprise. ECCC has advised that it should conduct training for seabird observations.

MTI has recommended additional monitoring and mitigation measures be considered for birds. For example, data on the number of bird strandings and deaths could be used as an adaptive management tool to determine the effectiveness of or need for additional mitigation.

Specific Question or Information Requirement: Consider whether the "certainty" of effects predictions related to migratory birds requires revision, taking into account advice from ECCC. Explain the associated rationale and update the effects predictions accordingly.

Taking into consideration the certainty/uncertainty of predictions identified by ECCC, discuss requirements for a follow-up program in relation to the potential effects of the Project. Confirm whether the proponent intends to:

- implement a comprehensive, scientifically rigorous and systematic protocol to search for and document stranded birds on the drilling unit and the platform supply vessels for the duration of the drilling program; and
- have its Environmental Observers engaged in seabird observations trained by ECCC.

Discuss the need for and feasibility of using bird stranding and mortality data as an adaptive management tool.

Response: Effects ratings related to strandings and mortalities, and the associated level of certainty, are presented in Sections 9.3 to 9.5 and summarized in Table 9.4 of the Environmental Impact Statement (EIS). With the implementation of appropriate mitigation measures as outlined in Section 9.3.2 of the EIS, the Project is considered unlikely to result in significant adverse environmental effects on marine and migratory birds, where significant effects are defined as those which have ecological or population-level effects. This conclusion has been determined with a moderate to high level of certainty. This level of certainty takes into consideration the short-term nature of disturbance in any one exploration drilling site, as well as our current understanding of the effects of similar projects on the valued component (VC).

Nonetheless, it is understood that certain project components (i.e. attraction and disorientation due to flaring and project lighting, and drilling and associated marine discharges) only have a moderate degree of certainty in terms of the magnitude of effect on marine and migratory birds (Table 9.4), partly because the associated mortality rates are poorly understood. Adaptive management includes gathering knowledge about environmental interactions through monitoring, e.g. of avian mortality and strandings around offshore facilities; this information can then be used to test assumptions and further refine future predictions. To increase the level of certainty of the effects prediction for these activities on marine and migratory birds, CNOOC Petroleum North America ULC (CNOOC) is committed to efforts to obtain information on rates of strandings and mortalities through a standardized survey program for stranded birds on the mobile offshore drilling unit (MODU).

In support of these efforts, CNOOC is committed to having an Environmental Observer trained by Environment and Climate Change Canada (ECCC) on board the MODU to record marine bird sightings during Project operations. These observations will be undertaken in accordance with ECCC-Canadian Wildlife Service's (CWS's) monitoring protocol from stationary platforms (Gjerdrum et al 2012).

In addition to the seabird monitoring program, a comprehensive and scientifically rigorous program will be developed for systematic searches of the MODU to look for stranded birds. Searches will be conducted by individuals who have been trained in ECCC seabird handling protocols, and CNOOC will obtain a Seabird Handling Permit (SHP) from ECCC-CWS prior to implementing this program. Searches will be undertaken at regular (daily) intervals, and searchers will carefully document search effort including the time of day, search duration, and area searched, as well as presence and absence of stranded birds. In the event that stranded birds are encountered during these searches, accepted protocols for the collection / handling of bird mortalities and release of birds that become stranded will be implemented. If a Species at Risk is found alive (stranded) or dead on the MODU, a report will be sent to ECCC-CWS. Finally, a seabird observations report will be submitted to the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) within 90 days of well suspension and/or decommissioning, and an annual report summarizing search effort (including observations of stranded birds and/or seabird handling) and findings will be submitted to ECCC.

In consideration of the above information, the proposed environmental monitoring and follow-up as discussed in Section 9.6 of the EIS (including regular searches of the MODU for stranded birds) and the certainty of effects predictions outlined in Section 9.5 of the EIS are considered appropriate to the Project and do not need to be revised.

References:

Gjerdrum, C., D.A. Fifield, and S.I. Wilhelm. (2012). Eastern Canada Seabirds at Sea (ECSAS) standardized protocol for pelagic seabird surveys from moving and stationary platforms. Canadian Wildlife Service Technical Report Series No. 515. Atlantic Region. vi + 37 pp.

2.5.6 Information Requirement: IR-39 (Part One Response – September 2018)

External Reviewer(s): MTI-12-Nx, -15-Nx

Project Effects Link to CEAA 2012: 5(1)(a)(iii) Migratory Birds

Reference to EIS Guidelines: Part 2, Section 6.3.5 Migratory Birds

Reference to EIS: Section 9.6 Environmental Monitoring and Follow-Up

Context and Rationale: MTI has recommended that onsite observers and/or automated sensors on platforms be utilized to reduce uncertainty related to seabird attraction to platforms, mortality events, and chronic spills and discharges. They reference a paper, which makes further suggestions for monitoring (Fraser and Racine, 2016; https://nlenvironmentnetwork.files.wordpress.com/2016/05/fraser_racine_spills_seabirds-2016.pdf)."

Specific Question or Information Requirement: Taking into consideration MTI's recommendations, review and provide a rationale related to the potential need for implementation of additional measures to monitor potential effects of the Project on migratory birds and associated economic/technical feasibility of these measures.

Response: CNOOC Petroleum North America ULC (CNOOC) recognizes the need for detailed observations and accurate reporting of seabird presence and behaviour as it relates to mobile offshore drilling unit (MODU) attraction, discharges and small hydrocarbon releases (i.e. chronic spills), and mortality events. Further, CNOOC understands the value of consistent and complete incident reporting and communications with the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB), as discussed in Fraser and Racine (2016).

An Environmental Observer (EO) responsible for wildlife observation and reporting (including seabirds as well as marine mammals and sea turtles) will be present on the MODU, fulfilling Mi'gmawe'l Tplu'taqnn Incorporated (MTI's) recommendation to have an observer on board. As detailed in the response to IR-38, marine bird observations will be undertaken in accordance with Environment and Climate Change Canada-Canadian Wildlife Service's (ECCC-CWS's) monitoring protocol from stationary platforms (Gjerdrum et al 2012). Additional surveillance and monitoring of small spills and the associated reporting efforts, as recommended by Fraser and Racine (2016), can be undertaken by this observer on an as-needed basis. If there is a future regulatory requirement to incorporate technology such as radar and thermal imaging into monitoring in addition to trained seabird observers, CNOOC will comply with it.

As well, CNOOC will obtain a Seabird Handling Permit from ECCC-CWS; and in accordance with this permit, the following reporting conditions will be met:

- All observed stranded and deceased birds will be reported, including details on whether they were oiled or un-oiled.
- ECCC-CWS will be contacted immediately in the event of an injured or oiled live bird (other than storm-petrels), and the bird will be transported to the Suncor Environment Centre in St. John's.
- ECCC-CWS will be contacted immediately in the event of any oiled deceased bird, and arrangements will be made for CNOOC to transport the bird.
- Any storm-petrel that is found dead (regardless of oiling) will be collected and transported to ECCC-CWS.

The response to Information Requirement (IR)-38 may provide additional information.

References:

Fraser, G.S. and V. Racine. 2016. An evaluation of oil spill responses for offshore oil production projects in Newfoundland and Labrador, Canada: Implications for seabird conservation. Mar. Poll. Bull., 107: 36-45.

Gjerdrum, C., D.A. Fifield, and S.I. Wilhelm. (2012). Eastern Canada Seabirds at Sea (ECSAS) standardized protocol for pelagic seabird surveys from moving and stationary platforms. Canadian Wildlife Service Technical Report Series No. 515. Atlantic Region. vi + 37 pp.

2.5.7 Information Requirement: IR-40 (Part One Response – September 2018)

External Reviewer(s): ECCC-09-NX

Project Effects Link to CEAA 2012: 5(1)(a)(iii) Migratory Birds

Reference to EIS Guidelines: Section 6.3.5 Predicted Effects on Valued Components - Migratory Birds

Reference to EIS: Section 9.3.3.2 Residual Environmental Effects of the Project

Context and Rationale: The EIS states that "… (t)he MODU will be situated over 400 kilometers offshore, which is far from coastal breeding sites and IBAs, and well beyond the foraging range of almost all species that nest in Newfoundland."(p. 698). The EIS also states that "(a)lthough the MODU will be situated outside the foraging range of most species, the Leach's Storm-petrel is known to make foraging trips of thousands of kilometres during the breeding season (Pollet et al 2014). The MODU will take up to 160 days to drill… and so disturbance will be short- to medium-term and transient in nature"(p.699).

ECCC has advised that Leach's storm-petrels breeding on both Gull Island and Baccalieu Island forage in the proposed Project Area during the breeding season. Therefore, there is potential for effects on breeding birds. Depending on the timing of the disturbance, the potential effects of light attraction caused by the Project has the potential to effect significant numbers of Leach's storm-petrels. For example, if activities take place during the autumn when young birds have left the colonies, numbers could be especially high.

The EIS concludes that the effects of the Project on most breeding birds would be low. ECCC has advised that insufficient information has been provided to provide confidence in that conclusion. ECCC has indicated that while the effects on most breeding bird species would be low, the number of individual birds potentially affected may be high. Most breeding birds in eastern Newfoundland are in fact Leach's storm-petrels, with Baccalieu Island alone hosting four million breeding individuals.

A submission from the public on another offshore exploratory drilling project in the area stated that there is concern associated with the disappearance of 2.7 million Leach's storm-petrels and the role of light attraction, platform collision and oiling since offshore production came on line (Wiese et al., 2001). This decline represents 25 to 40 percent of the mature species population (Birdlife International, 2017).

Specific Question or Information Requirement: Taking into account the information provided about the Leach's Storm-petrel, including the status of the species, provide further information and analysis on the potential effects of the Project on this species, to support the prediction that negative effects on the population would be of low magnitude, and reversible. Update the analysis, potential mitigation and follow-up, as well as significance predictions, as applicable.

Response: It is recognized that populations of Leach's Storm-petrel have declined substantially in the past two decades, which has resulted in a recent International Union for Conservation of Nature (IUCN) designation of "Vulnerable". The decline is believed to be attributable to a number of factors including predation, ingestion of marine contaminants (e.g., mercury), collisions and strandings due to attraction to lighted structures, and contact with hydrocarbons (BirdLife International 2017). Foraging ranges during the breeding season for four of seven major colonies in the western Atlantic overlap with offshore oil and gas operations, and numbers have declined at three of these colonies in recent decades (Pollet et al 2014).

Section 9.3.3 of the Environmental Impact Statement (EIS) recognizes that the Leach's Storm-petrel is attracted to anthropogenic light sources, and it is further recognized that the species is vulnerable to effects of light attraction due to the Project, including during the breeding season due to their long foraging trips (see Section 9.3.3.2). However, the short-term nature (in any one location) of the Project, relative to a long-term stationary offshore production facility, means that the Project effects will consequently be short-term and transient in nature. Further, as noted in the response to Information Requirement (IR)-27, Mobile Offshore Drilling Units (MODUs) typically have fewer light sources than a production facility, and therefore, the potential attraction is predicted to be lower in magnitude. As stated in Table 9.4, project-related effects due to lighting and flaring may result in some mortality and injury of individuals, particularly Leach's Storm-petrels. However, due to the comparatively low magnitude of light sources associated with the Project, and their short-term nature at any one location, these are unlikely to have overall effects on populations.

References:

BirdLife International. 2017. *Hydrobates leucorhous* (amended version of assessment). The IUCN Red List of Threatened Species 2017: e.T22698511A119292983. Available online: http://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T22698511A119292983.en. Accessed July 2018.

Pollet, I.L., Hedd, A., Taylor, P.D., Montevecchi, W.A. and Shutler, D., 2014. Migratory movements and wintering areas of Leach's Storm-Petrels tracked using geolocators. Journal of Field Ornithology., 85(3), pp.321-328.

2.5.8 Information Requirement: IR-41 (Part One Response – September 2018)

External Reviewer(s): Unknown

Project Effects Link to CEAA 2012: 5(1)(a)(iii) Migratory Birds

Reference to EIS Guidelines: Section 6.1.5 Species at Risk

Reference to EIS: Section 6.2.6 Species at Risk and Otherwise of Special Conservation Concern

Context and Rationale: The current EIS does not consider avian species listed on the IUCN Red List of Threatened Species. Species such as the Bermuda Petrel (*Pterodroma cahow*), and White-tailed Tropicbird (*Phaethon lepturus*) have been noted in the area of similar projects offshore Newfoundland.

The Bermudan White-tailed Tropicbird has been noted as one of the most endangered species of seabirds with a population of 146 mature individuals (BirdLife International, 2016).

Specific Question or Information Requirement: Include a list of bird species classified on the IUCN Red List of Threatened Species, which may be found in the Project Area along with their status. Assess potential effects of the Project on these species, and update potential mitigation and follow-up, as well as effects predictions, as applicable.

Response: The assessment of potential Project effects on marine and migratory bird species at risk focusses on those species designated under Canada's *Species at Risk Act* (Government of Canada 2002) and the provincial *Endangered Species Act* (Government of Newfoundland and Labrador 2001) that are likely to frequent the waters off eastern Newfoundland. Nevertheless, it is recognized that species of global conservation concern, other than those listed under federal or provincial legislation may be present in the Project Area. This potentially includes the Bermuda Petrel, as noted in the context of the Information Requirement (IR). The Bermuda Petrel has a population of 142 mature adults; it is listed as "Endangered" by International Union for Conservation of Nature (IUCN) (BirdLife International 2016). The species nests exclusively in Bermuda but in the non-breeding season, individuals are thought to move northward following the warm waters on the western edges of the Gulf Stream; thus they may potentially occur within the Project Area, although CNOOC Petroleum North America ULC (CNOOC) is unaware of any records of this species within the regional study area. According to the IUCN, the primary threats to the Bermuda Petrel are habitat loss due to competition for nesting habitat from the White-tailed Tropicbird and other natural factors such as sea level rise and storm activity, as well as exploitation, predation and light pollution near their Bermudan breeding grounds which affects their nocturnal courtship.

The Bermudan population of the White-tailed Tropicbird is the largest in the Atlantic, with approximately 3,500 breeding pairs. The most recent IUCN assessment considers the White-tailed Tropicbird a species of "Least Concern" (BirdLife International 2017); a designation of "Least Concern" indicates the species is considered widespread and abundant (IUCN 2017). White-tailed Tropicbirds are typically found over pelagic waters and the coast in the tropics and subtropics (BirdLife International 2017) although they have been reported in the Project Area in the fall and winter months (Mejías et al 2017).

Four marine-associated bird species classified on the IUCN Red List of Threatened Species as "Vulnerable" are known to occur in the Study Area: Long-tailed Duck, Black-legged Kittiwake, Atlantic Puffin, and Leach's Storm-petrel. Each of these species are discussed in Section 6.2 of the Environmental Impact Statement (EIS).

Mitigation measures outlined in Section 9.3.2 that will be implemented to help avoid or reduce potential environmental effects of the Project will benefit all marine and migratory bird species in the Project Area, including the IUCN-listed species described here.

References:

BirdLife International. 2016. *Pterodroma cahow*. The IUCN Red List of Threatened Species 2016: e.T22698088A93660004. Available online: http://dx.doi.org/10.2305/IUCN.UK.2016 3.RLTS.T22698088A93660004.en. Accessed July 2018.

BirdLife International. 2017. *Phaethon lepturus* (amended version of 2016 assessment). The IUCN Red List of Threatened Species 2017: e.T22696645A111235714. Available online: http://dx.doi.org/10.2305/IUCN.UK.2017-1.RLTS.T22696645A111235714.en. Accessed July 2018.

Government of Canada. 2002. *Species at Risk Act*. S.C. 2002, c.29. Published by the Minister of Justice. Current to April 24, 2018. Last Amended February 2, 2018. Available online: http://laws-lois.justice.gc.ca/PDF/S-15.3.pdf.

Government of Newfoundland and Labrador. 2001. *Endangered Species Act*. Assented to December 13, 2001. Published by Queens Printer. Amended: 2004 cL-3.1 s27; 2004 c36 s11. Available online: http://www.assembly.nl.ca/Legislation/sr/statutes/e10-1.htm.

IUCN. 2017. The IUCN Red List of Threatened Species 2001 Categories and Criteria (version 3.1). Available online: http://www.iucnredlist.org/static/categories_criteria_3_1. Accessed July 2018.

Mejías, M.A., Y.F. Wiersma, D.B. Wingate and J.L. Madeiros. 2017. Distribution and at-sea behavior of Bermudan White-tailed Tropicbirds (*Phaethon lepturus catesbyi*) during the non- breeding season. Journal of Field Ornithology. 88(3):184–197.

2.5.9 Information Requirement: IR-42 (Part One Response – September 2018)

External Reviewer(s): ECCC-01 Conformity

Project Effects Link to CEAA 2012: 5(1)(a)(iii) Migratory Birds

Reference to EIS Guidelines: Section 6.3.5 Predicted Effects on Valued Components - Migratory Birds

Reference to EIS: Section 9.2 Potential Environmental Changes, Effects and Associated Parameters, Table 9.2

Context and Rationale: ECCC has advised that Table 9.2, the matrix of potential interactions, should be updated. Some migratory birds are attracted to oil slicks, and oil has the potential to change habitat quality. Flaring affects behavioural patterns in migratory birds. Seismic surveys (as part of the geophysical surveys) may change food availability, due to prey being impacted by seismic activity.

Section 6.3.5 of the EIS Guidelines require examination of the change in marine habitat quality from drill muds and cuttings and sedimentation, and indirect effects caused by increased disturbance (e.g. noise, light, presence of workers), relative abundance movements and changes in migratory bird habitat.

ECCC has advised that a change in avifauna presence and abundance and change in habitat availability could result from drilling and associated marine discharges. Likewise, ECCC advised that vertical seismic profiling could result in change in habitat availability and quality.

Specific Question or Information Requirement: Update the effects analysis taking into account the following interactions or provide additional rationale to explain why they were excluded from consideration:

- Drilling and associated discharges: Avifauna presence and abundance; and
- Drilling and associated discharges: Habitat availability and quality.

If no changes are proposed, provide a rationale for no change in habitat availability as a result of drilling and associated marine discharges or vertical seismic profiling, or no change in avifauna presence and abundance as a result of drilling and associated marine discharges.

Update the analysis of effects, proposed mitigation and follow-up, and significance predictions, as applicable.

Response: The following provides clarification for the potential interactions between marine and migratory birds and the planned and routine Project activities noted in the Information Requirement (IR):

- Drilling and associated discharges - Avifauna presence and abundance: Oil slicks, which are defined as hydrocarbon concentrations at the water's surface greater than 3 micrometres (µm) thickness, are the primary discharge that has potential to adversely affect marine and migratory birds. Oil slicks are not anticipated from planned and routine Project activities, as described in Section 9.3.4 of the Environmental Impact Statement (EIS); therefore, effects on avifauna presence and abundance resulting from planned and routine drilling and associated discharges are not anticipated.

- Drilling and associated discharges - Habitat availability and quality: Hydrocarbon sheens that may occur from planned and routine discharges (i.e., hydrocarbon concentrations of 0.01 to 1 µm thickness) may have an effect on habitat quality, albeit localized and in the very short term, dispersing within 24 hours. This is presented in Section 9.3.4 of the EIS.

Based on the above clarifications, the analysis of effects, proposed mitigation and follow-up, and significance predictions in the EIS remain valid and do not need to be updated.

References:
No additional references.

2.5.10 Information Requirement: IR-43 (Revised Response – February 2019)

External Reviewer(s): Unknown

Project Effects Link to CEAA 2012: 5(1)(a)(iii) Migratory Birds

Reference to EIS Guidelines: Section 6.3.5 Predicted Effects on Valued Components - Migratory Birds

Reference to EIS: Section 16.6.3.2 Environmental Effects Assessment

Context and Rationale: The EIS states that "[b]ased on vulnerability indices (French-McCay 2009), the mortality risk would range from 35-99 percent for birds that come in contact with slick in the 0.01-0.1 mm thickness range. Murres and dovekies, which spend most of their time sitting on the water's surface, are most vulnerable (estimated 95 percent mortality), while species that dive or feed at the water's surface for their prey but otherwise spend little time on the water, including Leach's storm-petrels, great shearwaters, and great skuas, are predicted to have a lower mortality rate of 35 percent. Black-legged kittiwakes and northern gannets, which do often sit on the water but spend more time in the air than alcids (murres and dovekies), would be expected to have an intermediate mortality rate." It is not clear based on the information provided in the EIS how the vulnerability of various bird species was estimated based on French-McCay 2009 vulnerability indices.

Specific Question or Information Requirement: Provide the vulnerability indices relied upon for the above information and use these indices to provide further rationale that seabirds spending more time in the air are less likely to suffer from water contaminants and oil spills. In light of diving birds being susceptible to surface oil, explain how mortality rates were assumed from the literature. Describe any measures that would be put into place to prevent bird mortality from water contaminants and oil spills.

Response: French-McCay (2009) states that a species' behaviour affects its likelihood of being oiled. Species that spend more time on water, including those exhibiting diving behaviour, having extended flightless periods (e.g., moulting), and/or roosting on the water, tend to have a greater risk of becoming oiled if a slick is present, and oiled birds are generally assumed to have a very low survival rate of approximately 0 to 5%. French-McCay (2009) calculated vulnerability scores (i.e., the combined probabilities of a) encountering oil and b) mortality once oiled) which are the mortality rate of a bird in the area of an oil slick. These scores were calculated by French-McCay (2009) for various wildlife groups, which were then applied to species in the Environmental Impact Statement (EIS) (see Section 16.6.3.1 in Appendix C of this Addendum) including surface diving seabirds and waterfowl (99% combined probability of oil encounter and mortality once oiled), nearshore aerial divers (35% combined probability), and aerial seabirds (5% combined probability).

Among the mitigation measures outlined in Section 16.1 (see Appendix C in this Addendum), spill prevention measures and spill response plans will be in place throughout the life of the Project to reduce the risk of a spill occurring and limiting the duration and extent of a spill.

Following completion of the additional oil spill modelling for a longer duration unmitigated oil release, this IR was reviewed in the context of this additional work. No updates were required.

References:

French-McCay, D. 2009. State-of-the-Art and Research Needs for Oil Spill Impact Assessment Modeling. In: Proceedings of the 32nd AMOP Technical Seminar on Environmental Contamination and Response, Emergencies Science Division, Environment Canada, Ottawa, ON, pp. 601-653.

2.6 Species at Risk

2.6.1 Information Requirement: IR-44 (Revised Response – February 2019)

External Reviewer(s): DFO 10-NX

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat, 5(1)(a)(ii) Aquatic Species

Reference to EIS Guidelines: Part 2, Section 6.1.5 Species at Risk

Reference to EIS: Section 6.3.5 Species at Risk and Otherwise of Special Conservation Concern

Context and Rationale: The Agency is the responsible authority for the EA of the Project and therefore must identify the adverse effects of the Project on listed wildlife species and their critical habitat under the SAR) and, if the Project is carried out, must ensure that specific measures are taken to avoid or lessen those effects and to monitor them. The measures must be consistent with any applicable recovery strategy and action plans. Furthermore, in recognition of the potential risks to the COSEWIC species, the Agency requires an assessment of effects on these species as well as an accounting of measures that could be taken to avoid or lessen effects and to monitor them. The EIS Guidelines require direct and indirect effects on the survival or recovery of federally listed species to be described (Section 6.3.6).

The EIS does not explain how the mitigation measures for general VCs are consistent with applicable recovery strategies and action plans. In some cases, actions plans have not been referenced (e.g. Bottlenose whale), while in other cases, references to management plans are outdated (e.g. Fin whale, Sowerby's beaked whale).

Specific Question or Information Requirement: Update information related to species at risk for those species that are predicted to interact with the Project, including:

- a listing of species for which there are recovery strategies or action plans; and
- a description of key threats to species at risk as included in applicable recovery strategies and action plans as relevant to the Project, as well as the potential contribution of project activities to these threats.

Update the effects assessment, potential mitigation and follow-up, as appropriate, including a description of how mitigation measures for VCs are consistent with applicable recovery strategies and action plans.

Resulting analysis should take into consideration clarifications and corrections described in Appendix B.

Response: A listing of species that may interact with the Project for which recovery strategies or action plans have been developed is provided in Table IR-44.1 below. Key threats outlined in the recovery strategies and action plans, as well as the potential for Project-related contributions, are discussed.

Action plans and/or recovery strategies are available for six marine and/or migratory bird species with potential to interact with the Project: Ivory Gull (Environment Canada 2014), Piping Plover (*melodus* subspecies) (Environment Canada 2012), Red Knot (*rufa* subspecies) (Environment and Climate Change Canada 2017), Roseate Tern (Environment Canada 2010, 2015), Common Nighthawk (Environment Canada 2016a), and Olive-sided Flycatcher (Environment Canada 2016b). Major threats to these birds as identified in the action plans and recovery strategies that may be associated with Project activities include chronic oil

pollution from oil and gas exploration and production, habitat loss and degradation (i.e., from oil or contaminant spills), and collision with anthropogenic structures (Table IR-44.1). The potential for each of these interactions has been considered in the effects assessment in Section 9.3 of the Environmental Impact Statement (EIS) and the revised Section 16.6.3 (Appendix C of this Addendum). While there may be some increased potential for adverse interactions due to the Project, with the implementation of mitigation measures outlined in Section 9.3.2, the residual effects on marine and migratory birds (including species at risk) is predicted not to be significant, as described in Section 9.5.2 of the EIS and the revised 16.6.3 (Appendix C of this Addendum).

Action plans and/or recovery strategies are available for four marine mammal species at risk and one sea turtle species at risk that may interact with the Project: beluga whale (St. Lawrence Estuary population) (DFO 2012), blue whale (Atlantic population) (Beauchamp 2009), North Atlantic right whale (DFO 2014,2016b), northern bottlenose whale (Scotian Shelf population) (DFO 2016c, 2017a), and leatherback sea turtle (Atlantic population) (Atlantic Leatherback Turtle Recovery Team [ALTRT] 2006). Major threats to these species as identified in action plans and recovery strategies that may be associated with Project activities include: contaminants, anthropogenic disturbances (physical presence and noise), degradation of habitat, vessel strikes, and toxic spills (Table IR-44.1). The potential for each of these interactions with marine mammals and sea turtles has been considered in the effects assessment (Section 10.3 of the EIS and the revised Section 16.6.4 (Appendix C of this Addendum)). While the Project has the potential to result in interactions with marine mammals and sea turtles, including species at risk, with the application of mitigation measures outlined in Section 10.3.2 of the EIS and adherence to published and/or industry standards and best management practices (e.g., OWTG (NEB et al 2010), and *Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment* [SOCP; DFO 2007]), overall potential adverse effects to marine mammal and sea turtle species at risk are predicted not to be significant, as detailed in Section 10.5.2 of the EIS and the revised Section 16.6.4 (Appendix C of this Addendum).

Table IR-44.1 Action Plans / Recovery Strategies: Marine SAR with Potential to Interact With the Project

Species	Action Plan (AP) / Recovery Strategy (RS)	Major Threats Identified in AP / RS	Project Activities with Potential to Contribute to Threats
Ivory Gull	RS (Environment Canada 2014)	• Illegal Shooting • Predation on Nests • Industrial Activities (e.g., mining) • Contaminants • Human Disturbance (monitoring) • Climate Change • Oil and Gas Exploration and Production (chronic oil pollution)	• Accidental oil spills • Drill mud discharges (accidental and routine) • Liquid discharges (bilge/deck drainage, ballast, cooling water, fire control water)
Piping Plover (*melodus* ssp.)	RS (Environment Canada 2012)	• Predation • Disturbance or Harm from Human Activities • Habitat Loss or Degradation (human disturbance, coastal development, natural processes) • Oil or contaminant spills	• Accidental oil spills

Red Knot (*rufa* ssp.)	RS (Environment and Climate Change Canada 2017)	• Residential & commercial development (housing and urban areas; commercial/ industrial areas; tourism and recreation areas) • Agriculture and aquaculture • Energy production and mining (mining and quarrying; renewable energy) • Biological resource use (hunting; fishing and harvesting aquatic resources) • Human intrusions and disturbance (recreational activities) • Natural system modifications • Invasive non-native and problematic native species • Pollution (household sewage and wastewater; industrial and military effluents; agriculture and forestry effluents; garbage and solid waste) • Climate change	• Accidental oil spills
Roseate Tern	AP (Environment Canada 2015), RS (Environment Canada 2010)	• Predation • Post-fledging mortality • Shortage of males • Habitat Loss and Degradation • Human Disturbance	• Accidental oil spills
Common Nighthawk	RS (Environment Canada 2016a)	• Reduced availability of insect prey • Fire suppression • Loss of breeding habitat (habitat succession; change in roof construction and materials; residential and commercial development; agriculture; logging and wood harvesting) • Loss of non-breeding habitat • Temperature extremes and storms • Habitat shifting and alteration • Collisions with vehicles, planes and human structures • Pesticides • Mercury • Acid precipitation • Problematic native and invasive non-native species	• Accidental oil spills
Olive-sided Flycatcher	RS (Environment Canada 2016b)	• Reduced availability of insect prey • Fire suppression	• Accidental oil spills

		• Non-breeding habitat loss (deforestation and land conversion) • Breeding habitat loss (forest harvesting and silviculture; residential and commercial development) • Energy and mining (onshore exploration and extraction) • Temperature extremes and storms • Habitat shifting and alteration • Collisions with anthropogenic structures and vehicles • Pesticides • Mercury • Acid precipitation • Problematic native and invasive non-native species	
Beluga whale (St. Lawrence Estuary population)	RS (DFO 2012)	• Hunting and harassment (historical) • Contaminants • Anthropogenic disturbances (marine traffic and marine life observation activities; anthropogenic noise) • Reduction in the abundance, quality, and availability of prey (reduced fish abundance; competition with other predators; competition with commercial fisheries) • Other degradation of habitat (inshore and offshore development; introduction of exotic species) • Ship strikes • Entanglement in fishing gear • Scientific research activities • Toxic spills • Harmful algal blooms • Epizootic disease	• Underwater noise from geophysical surveys and marine traffic • Accidental oil spills • Drill mud discharges (accidental and routine) • Grey water (sanitary sewer) and food waste • Liquid discharges (bilge/deck drainage, ballast, cooling water, fire control water) • Potential change in the abundance, quality, and availability of prey • Ship strikes
Blue Whale (Atlantic population)	RS (Beauchamp 2009)	• Whaling (historical) • Natural mortality (ice entrapment; predation) • Anthropogenic noise (acoustic environment degradation and changes in blue whale behaviour; physical harm) • Food availability • Contaminants • Collisions with vessels	• Underwater noise from geophysical surveys and marine traffic • Accidental oil spills • Drill mud discharges (accidental and routine)

		• Whale watching • Accidental entanglements in fishing hear • Epizootics and toxic algal blooms • Toxic spills	• Grey water (sanitary sewer) and food waste • Liquid discharges (bilge/deck drainage, ballast, cooling water, fire control water) • Potential change in the abundance, quality, and availability of prey • Ship strikes
North Atlantic Right Whale	RS (DFO 2014), AP (Proposed) (DFO 2016)	• Whaling (historical) • Vessel strikes • Entanglement in fishing gear • Disturbance and habitat reduction or degradation (contaminants; acoustic disturbances; vessel presence; changes in food supply)	• Ship strikes • Accidental oil spills • Grey water (sanitary sewer) and food waste • Liquid discharges (bilge/deck drainage, ballast, cooling water, fire control water) • Potential change in the abundance, quality, and availability of prey
Northern bottlenose whale (Scotian Shelf population)	RS (DFO 2016c), AP (DFO 2017a)	• Impacts of historical whaling • Entanglement in fishing gear • Oil and gas activities • Acoustic disturbance • Contaminants • Changes to food supply • Vessel strikes	• Ship strikes • Accidental oil spills • Acoustic disturbances (vessel noise, VSP surveys) • Grey water and food waste • Liquid discharges (bilge/deck drainage, ballast, cooling water, fire control water) • Potential change in the abundance, quality, and availability of prey
Leatherback Turtle (Atlantic population)	RS (ALTRT 2006)	• Threats in the marine environment (entanglement in fishing gear; collisions; marine pollution; acoustic disturbances) • Threats to the nesting environment (poaching; coastal construction; artificial light; climate change; other potential threats)	• Ship strikes • Acoustic disturbances (vessel noise, VSP surveys) • Accidental oil spills • Grey water and food waste

			• Liquid discharges (bilge/deck drainage, ballast, cooling water, fire control water)

The clarifications and corrections provided in Appendix B to the Information Requirements were reviewed and considered. Based on this review, no changes to the significance conclusions for marine fish and fish habitat (Section 8.5.2 of the EIS and the revised Section 16.6.2 (Appendix C of this Addendum)), marine and migratory birds (Section 9.5.2 of the EIS and the revised Section 16.6.3 (Appendix C of this Addendum)) and marine mammals and sea turtles (Section 10.5.2 of the EIS and the Revised Section 16.6.4 (Appendix C of this Addendum)) were considered necessary. However, significance conclusions for these VCs were reviewed based on the results of additional oil spill modelling (RPS 2019), and have been updated accordingly in Section 16 of this Addendum (Appendix C Accidental Events Effects Assessment (REVISED)).

References:

DFO (Fisheries and Oceans Canada). 2007. Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment. Available online: http://waves-vagues.dfo-mpo.gc.ca/Library/363838.pdf. Accessed June 2018.

NEB, Canada-Nova Scotia Offshore Petroleum Board and Canada-Newfoundland and Labrador Offshore Petroleum Board. 2010. Offshore Waste Treatment Guidelines. Available online: http://www.cnlopb.ca/pdfs/guidelines/owtg1012e.pdf?lbisphpreq=1. Accessed April 2018.

2.6.2 Information Requirement: IR-45 (Revised Response – February 2019)

External Reviewer(s): DFO 20-NX, DFO 21-NX, DFO 23-NX, DFO 24-NX, DFO 26-NX, 29 NX, DFO 30-NX, DFO 31-NX

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat, 5(1)(a)(ii) Aquatic Species

Reference to EIS Guidelines: Part 2, Section 6.1.5 Species at Risk

Reference to EIS: Section 6.3.5 Species at Risk and Otherwise of Special Conservation Concern

Context and Rationale: The EIS Guidelines require descriptions of federal species at risk and their habitat at the project site and within areas that could be affected by routine project operations or accidents and malfunctions.

While the EIS provides a description of most species at risk and considers potential effects of the Project on these within other more general VCs, in some cases the analysis pertaining to specific species is limited. For example, while Table 10.4 identifies a high or moderate potential for interaction between the Project and Fin, Killer and Northern bottlenose whales and the Harbour porpoise, no further effects analysis specific to these species is completed.

DFO has advised that certain species designated by COSEWIC have not been included in the assessment (e.g. Lumpfish [Threatened], White hake [Atlantic and Northern Gulf of St. Lawrence population; Threatened]. In addition, the EIS includes errors in risk categories for species at risk as well as inconsistencies in its descriptions between sections (Appendix B).

DFO has advised that the EIS provides very short descriptions of marine mammal and sea turtle species at risk and generally does not provide references when detailing the potential presence of these species.

Additionally, DFO has advised that the statement in Section 6.1.8 of the EIS regarding fish species at risk that "of the 30 listed species in the North Atlantic, 13 species have a higher potential to have ranges that overlap with the Project Area and/or the RSA" is not justified, nor consistent with the 16 species that are later described in the text. All species listed on Schedule 1 of SARA and designated by COSEWIC with the potential to overlap with the project should be described.

The EIS identifies three species at risk which have not been included in Table 8.6: Cusk, American plaice and Spiny dogfish.

Table 8.6 indicates marine fish species at risk likely to be encountered within the Project Area and summarizes potential interactions. All species are indicated as having a "limited potential for interaction" with the Project due to mobility of species, project mitigation, and absence of critical habitat. Species abundance and seasonal presence in the Project Area do not appear to have been considered in assigning potential for interaction.

Specific Question or Information Requirement: Provide additional information about marine species at risk, including:

- an analysis of potential effects of the Project on the Fin, Killer and Northern bottlenose whales and Harbour porpoise with consideration of the high or moderate likelihood of interaction between these species and the Project;

- Lumpfish, Smooth Skate (Laurentian-Scotian population), Bowhead Whale (Eastern Canada – West Greenland population), and White hake (Atlantic and Northern Gulf of St. Lawrence population) and their habitat within areas that could be affected by the Project, update the effects assessment, potential mitigation and follow-up, as appropriate;
- descriptions of marine mammal and sea turtle species at risk, including information on seasonal movement patterns and migration corridors and references to support the potential presence of these species;
- the number of fish species with the potential to overlap with the Project Area and/or RSA, descriptions of each of those species and references to support presence of those species that have a potential to have ranges that overlap with the Project Area or RSA;
- information on Cusk, American plaice and Spiny dogfish with applicable analysis of potential environmental interactions and effects to these marine fish species of concern; and
- additional rationale for the summary of potential interactions for marine fish species at risk identified in Table 8.6, considering how abundance, timing of presence (e.g. infrequent occurrence versus year-round presence) and life-cycle (i.e. spawning/presence of eggs/larvae/rearing) may be indicative of varying potential for interaction with the Project.

Update effects assessment, as appropriate.

Resulting analysis should take into consideration clarifications and corrections described in Appendix B.

Response: Relative to the 'Specific Question or Information Requirement' bullets above, it was determined that re-ordering the response to the first three (3) bullets provided a more logical flow of information. In following, the 3rd bullet is addressed first providing more information on marine mammal and sea turtle distribution and movements / potential presence. Following this content, the 1st bullet is addressed providing analysis of Project effects for each of the four (4) mammal species noted with 'moderate' to 'high' potential for interactions (fin whale, killer whale, northern bottlenose whale, harbour porpoise). After the marine mammal and sea turtle information, the marine fish and fish habitat information is presented for bullets 2, 4-6.

Specific Question or Information Requirement: Provide additional information about marine species at risk, including:

- **descriptions of marine mammal and sea turtle species at risk, including information on seasonal movement patterns and migration corridors and references to support the potential presence of these species.**

Life history information for marine mammal and sea turtle species at risk (SAR) observed in the Regional Study Area (RSA), including information on seasonal movements and migration, has been adapted from the Eastern Newfoundland Strategic Environmental Assessment (SEA), and updated with recent Committee on the Status of Endangered Wildlife in Canada (COSEWIC) reports where applicable. This information is provided below for the following SAR:

- North Atlantic Right Whale
- Blue Whale (Atlantic Population)
- Fin Whale (Atlantic Population)
- Bowhead Whale (Eastern Canada – West Greenland population)
- Northern Bottlenose Whale (Davis Strait-population/ Scotian Shelf population)
- Sowerby's Beaked Whale

- Killer Whale (Northwest Atlantic / Eastern Arctic population)
- Harbour Porpoise (Western North Atlantic population)
- Beluga Whale (St. Lawrence Estuary population/ Arctic populations)
- Atlantic Walrus
- Leatherback (Atlantic population)
- Loggerhead Sea Turtle

North Atlantic Right Whale:

North Atlantic Right Whales are known to aggregate in five seasonal habitat areas along the east coast of North America, all of which are south of Newfoundland (Table IR-45.1; (COSEWIC 2013a)). In Canada, they can be found in the Bay of Fundy (BoF) from June to November, with peak abundance in August to early October, and in the Roseway Basin south of Nova Scotia from July to November. Right whales are rarely sighted in the RSA, have not been reported in the Local Study Area (LSA) (Figure 6.3 1 in the Environmental Impact Statement (EIS)), and none were observed during aerial surveys conducted in 2007 in the areas off eastern and southern Newfoundland (Brown et al. 2009, Lawson and Gosselin 2009). Occurrences are therefore likely to be rare in the LSA.

Table IR-45.1 Overview of the North Atlantic Right Whale

North Atlantic Right Whale	Summary	Reference(s)
Description	• Adult North Atlantic right whales average 13-16 m in length and 40,000 to 70,000 kg in weight. • Concentrated in the western North Atlantic but may occur further east to Europe. • Considered to be the most endangered large whale in the world, with approximately 468 individuals remaining (2010). • Endangered (*Species at Risk Act* (*SARA)* Schedule 1).	(Kraus et al. 2001, COSEWIC 2013a)
Habitats and Movements	• Generally found in waters with surface temperatures ranging from 8-15°C, in areas that are 100-200 m deep. • Shifts in the distribution and abundance of their primary prey items can dramatically affect right whale distribution within their range. • Occurrence within the LSA is expected to be extremely rare, so project interactions are not likely.	(Kenney 2001, COSEWIC 2013a)
Reproduction	• Mean age at first reproduction is 10 years for females and is likely similar for males. • Gestation period is unknown; may be >12 months. • Interval between births typically 3 - 5 years (mean: 3.7).	(COSEWIC 2013a)
Foraging Strategy and Food Sources	• Plankton feeders. The primary prey item of the North Atlantic Right whale is the copepod *Calanus finmarchicus*, which they capture by filtering seawater through the baleen plates in their mouths.	(Kenney 2001)

Blue Whale (Atlantic population):

The North Atlantic population of blue whales was severely depleted by whaling, and sightings of this species within its range are uncommon (Table IR-45.2). Sightings occur predominantly along the Quebec North Shore between Saguenay River and the Strait of Belle Isle, and along the southwest and eastern coasts of Newfoundland during winter and early spring (Sears et al. 1990, Lesage et al. 2007). Individuals sighted in the Gulf of St. Lawrence have been subsequently sighted as far away as Greenland, indicating they are highly mobile both within and between seasons (DFO 2016). Migration routes of blue whales are poorly known, with new studies now using radio tracking to follow individuals. Small numbers of blue whales (four sightings totaling six individuals) were observed during aerial surveys off the south and east Newfoundland coasts in the summer of 2007 (Lawson and Gosselin 2009).

Table IR-45.2 Overview of the Blue Whale

Blue Whale	Summary	Reference(s)
Description	• The largest animal ever known to live, an adult blue whale can reach up to 30 m in length. • All populations have been exploited commercially. It is estimated the western North Atlantic stock to be on the order of a few hundred individuals. • Widely distributed throughout the world's oceans and occurs in coastal, shelf and oceanic waters. • Atlantic Population: Endangered (*SARA* Schedule 1).	(COSEWIC 2002)
Habitats and Movements	• Usually occur alone or in small groups. • Distribution during feeding seasons is largely dependent on the areas of high concentrations of their primary food item. • Critical habitat in the estuary and Gulf of St. Lawrence is currently being identified for the species. • In the western North Atlantic, blue whales occur in the Gulf of St. Lawrence and east of Nova Scotia in spring, summer and fall and off southern Newfoundland in winter to early spring. • Potentially present in small numbers in the RSA in the winter and early spring, so project interactions are possible.	(Leatherwood and Reeves 1983, Sears et al. 1990, Lesage et al. 2007, Waring et al. 2002, DFO 2016)
Reproduction	• Mate and calve from late fall to mid-winter in Northern hemisphere. • Age at sexual maturity: 5 - 15 years for both sexes. • Gestation period 10 - 11 months. • Interval between births is 2 - 3 years.	(COSEWIC 2002)
Foraging Strategy and Food Sources	• The primary prey item of the blue whale is euphausiids.	(Yochem and Leatherwood 1985)

Fin Whale (Atlantic population):

The fin whale is common in the Grand Banks throughout the year, particularly during the summer months, and its distribution is associated with the presence of abundant food supply (e.g. capelin) (Table IR-45.3). Based on surveys conducted off southern and eastern Newfoundland in 2007, the abundance of fin whales in the area is estimated at 890 individuals (95 percent confidence range of between 551 and 1,435 individuals). These estimates are considered by the authors to be preliminary and likely negatively biased, as they have not been corrected for perception biases (Lawson and Gosselin 2009).

Table IR-45.3 Overview of the Fin Whale

Fin Whale	Summary	Reference(s)
Description	• Adult fin whales average 18-20 m in length. • Lower jaw is white on the right side while the left side is gray or black. • One of the fastest whales on earth and nicknamed "the greyhound of the sea", the fin whale can sustain speeds of up to 37km/h and burst speeds of over 40km/h. • Atlantic population: Special Concern by *SARA* (Schedule 1) and COSEWIC.	(COSEWIC 2005)
Habitats and Movements	• Widely distributed in all the world's oceans but typically occur in temperate and polar regions. • Appear to have complex seasonal movements and are likely seasonal migrants. • Mate and calve in temperate waters during winter but migrate to northern latitudes during the summer to feed. • Occur in coastal and shelf waters, as well as in oceanic waters. • Observed alone or in pairs but groups of up to 20 individuals are often seen on feeding grounds. • Regularly observed in the LSA year-round, so interactions are predicted.	(Gambell 1985, COSEWIC 2005)
Reproduction	• Average age of sexual maturity: 6-7 years for males 7-8 years for females. • Conception and calving typically in winter. • Average 2.7 years between births.	(COSEWIC 2005)
Foraging Strategy and Food Sources	• The primary prey of the fin whale is small schooling fishes such as capelin, as well as krill.	(Kenney 2001)

Bowhead Whale (Eastern Canada – West Greenland population):

Bowhead whales live primarily in Canada's arctic, though rare sightings have happened in Newfoundland (Table IR-45.4). The Eastern Canada-West Greenland population is roughly estimated to be 10,000 individuals, with considerable variation between estimates (COSEWIC 2009a). Historically whaling was their greatest threat, though the killer whale may pose the greatest threat today. Other threats include anthropogenic noise, entanglement, vessel strikes, and pollution. This species is currently under consideration by SARA for further protection.

Table IR-45.4 Overview of the Bowhead Whale

Bowhead Whale	Summary	Reference(s)
Description	• Adult bowhead whales average 14-18 m in length. • Adults are black in colour with white areas near chin and tail. • Barrel shaped body with large head capable of breaking through ice, with very thick blubber layer (maximum 50cm). • Eastern Canada-West Greenland population: Special Concern by COSEWIC (*SARA*: no status).	(COSEWIC 2009a)
Habitats and Movements	• Circumpolar distribution in the northern hemisphere. • Eastern Canada-West Greenland population covers 1 million square kilometers. • Summer in western Baffin Bay, high arctic, northwestern Hudson Bay, and off west Greenland. • Winter migration takes 2-3 months, and they occupy areas with unconsolidated pack ice such as Hudson Strait, southern Baffin Bay, and off west Greenland. • No typical activity or migration enters the LSA, so interactions are not predicted.	(COSEWIC 2009a)
Reproduction	• Average age of sexual maturity: 25. • Conception is typically late winter or early spring, with most births happening between April and June. • Average 3-4 years between births, with gestation lasting 12-16 months.	(COSEWIC 2009a)
Foraging Strategy and Food Sources	• The primary prey of the bowhead is crustacean zooplankton, including euphausiids, copepods, mysids, and gammarid amphipods.	(COSEWIC 2009a)

Northern Bottlenose Whale (Davis Strait population/ Scotian Shelf population):

Northern bottlenose whales are known to occur in the Grand Banks and were sighted in the waters off eastern and southern Newfoundland during aerial surveys conducted in 2007 (Lawson and Gosselin 2009; Table IR-45.5). Any individuals of this species that are found in the RSA may be of either the Labrador (Davis Strait) population or the endangered Scotian Shelf population, although the latter is considered to be less wide-ranging (COSEWIC 2011).

Table IR-45.5 Overview of the Northern Bottlenose Whale

Northern Bottlenose Whale	Summary	Reference(s)
Description	• Adult Northern bottlenose whales grow to approximately 10 m in length. • Pronounced beak that is white on males and grey on females. • Davis Strait-Baffin Bay-Labrador Sea population listed by COSEWIC as a species of Special Concern, while localized Scotian Shelf population considered endangered by *SARA* (Schedule 1) and COSEWIC. • Scotian Shelf population is believed to be non-migratory, while the Labrador population migrates north to south seasonally.	(COSEWIC 2011)
Habitats and Movements	• Live in deep water areas of the North Atlantic and are rarely found in waters less than 800 m deep. • Capable of remaining submerged for over an hour. • Can be found in groups ranging in size from one to 20 individuals. • Two areas of abundance in the western North Atlantic: Davis Strait off northern Labrador and "the Gully" on the Scotian Shelf. • Occasionally observed in the LSA in the spring and summer, so project interactions are possible.	(Gowans 2002)
Reproduction	• Mate and give birth in April in the Labrador population. • Females reach reproductive age at 8 - 13 years, males somewhat earlier. • Single offspring produced every two years.	(COSEWIC 2011)
Foraging Strategy and Food Sources	• The primary prey item of the Northern bottlenose whale is deep water squid.	(Gowans 2002)

Sowerby's Beaked Whale:

During aerial surveys conducted in summer of 2007, Sowerby's beaked whales were not observed in the areas off eastern and southern Newfoundland (Lawson and Gosselin 2009); Table IR-45.6). The RSA is, however, within the species' known range (COSEWIC 2007). Moreover, Sowerby's beaked whales are known to prefer deep waters (> 1,000 m) which is present in the LSA, and so it is considered to possibly occur in this area (LGL Limited 2003). All confirmed sightings and strandings of this species off Newfoundland have been in the summer months, although this may be due to the relatively poor sighting conditions and lack of search effort in other times of the year (COSEWIC 2007).

Table IR-45.6 Overview of Sowerby's Beaked Whale

Sowerby's Beaked Whale	Summary	Reference(s)
Description	• Up to 5.5 m long and dark grey in colour. • Small head with a long, narrow beak, and a small triangular dorsal fin and relatively long dorsal fins. Tail flukes lack center notch. • Species of special concern according to COSEWIC and *SARA* (Schedule 1).	(COSEWIC 2007)
Habitats and Movements	• Most northerly of the beaked whales; has been found on the eastern and western side of the North Atlantic. • No data on seasonal movements of the species. • Social structure poorly known, but most sightings and strandings have been of small groups of fewer than ten individuals. • Seldom observed in the LSA, but it is within the species' known distribution, so project interactions are possible.	(COSEWIC 2007)
Reproduction	• Poorly known. Females apparently sexually mature when they attain a length of between 4.6 and 4.8 m, while males are apparently sexually mature at 5.0 m.	(COSEWIC 2007)
Foraging Strategy and Food Sources	• Based on stomach contents and isotope analysis, diet appears to consist primarily of mid- to deep-water fishes and squid.	(COSEWIC 2007)

Killer Whale (Northwest Atlantic / Eastern Arctic population):

Killer whales occur year-round in small numbers within the RSA, but due to their preference for warmer waters, are more likely to be present in the spring and summer (Lien et al. 1988; Table IR-45.7). They have been sighted in the marine areas off Eastern Newfoundland in small numbers (Wiese and Montevecchi 1999, Lawson and Gosselin 2009). Based on the available information, this species is likely to be present but uncommon in the RSA.

Table IR-45.7 Overview of the Killer Whale

Killer Whale	Summary	Reference(s)
Description	• Killer whales, also known as orcas, are large members of the dolphin family. They are black with distinct white patches on the chest, sides and above the eye. • Adult male killer whales can reach a length of 6-8 m while females can reach a length of 5-7 m. • Have tall dorsal fins that can reach a height of 2 m. • Northwest Atlantic / Eastern Arctic population assessed as Special Concern by COSEWIC.	(COSEWIC 2009b)
Habitats and Movements	• Cosmopolitan and globally abundant; have been observed in all oceans of the world. • Prefer warm waters but have been reported in cold waters as well. Not known to be reliably migratory. • The greatest abundance of killer whales is found within 800 km of major continents. • Often travel in close-knit matrilineal groups of a few to tens of individuals. • Regularly observed in small numbers in the LSA so project interactions are possible, particularly in the spring and summer months.	(Ford 2002, COSEWIC 2009b)
Reproduction	• Males reach sexual maturity at about 13 years, females at 14 - 15 years. • Calving peaks from fall to spring. • Average period between calving is approximately 5 years.	(COSEWIC 2009b)
Foraging Strategy and Food Sources	• Prey on a diverse variety of items including marine mammals, fish and squid.	(COSEWIC 2009b)

Harbour Porpoise (Western North Atlantic population):

Off Eastern Newfoundland, harbour porpoises are most likely to be found in the shallower waters of inshore areas in the summer months (Table IR-45.8). Bycatch data show that porpoises occur around the entire island of Newfoundland, especially along the south coast, west coast and in Notre Dame Bay. However, in the 1980s, bycatches were particularly common in St. Mary's Bay and elsewhere in southeastern Newfoundland during the early summer (COSEWIC 2006). Harbour porpoise bycatch has also been reported across the entire Grand Banks (COSEWIC 2006). A harbour porpoise was seen within the LSA (Figure 6.3 2 in the EIS), which is unusual since they need to feed frequently and typically do not leave the continental shelf. Populations exist in the Bay of Fundy (BoF), Gulf of St. Lawrence, Newfoundland, and Greenland, and genetics indicate that there is movement between populations (COSEWIC 2006). To reach Greenland or vice versa, harbour porpoises must be able to cross bodies of deep water within the food requirements of their metabolism. Though no migration pattern has been studied to date, porpoises offshore may be travelling further north or simply following a food source. Based on surveys conducted off southern and eastern Newfoundland in 2007, the abundance of harbour porpoises in the area is estimated at 1,195 individuals (95 percent confidence range of between 639 and 2,235 individuals), although these estimates are considered by the authors to be preliminary (Lawson and Gosselin 2009).

Table IR-45.8 Overview of the Harbour Porpoise

Harbour Porpoise	Summary	Reference(s)
Description	• The harbour porpoise is a small compared to other cetaceans, growing to a length of 1.2 to 1.4 m. • Most commonly observed near the coast and will enter small bays and estuaries. • Harbour porpoises in the Western North Atlantic Population have been divided into four different subpopulations: the BoF/Gulf of Maine, the Gulf of St. Lawrence, the Newfoundland, and the west Greenland populations. The boundaries between these sub-populations are not well defined as there is some genetic overlap.	(Wang et al. 1996, COSEWIC 2006)
Habitats and Movements	• Found in shelf waters throughout the northern hemisphere, usually in waters colder than 17°C. • Usually seen in small groups of one to three animals often including at least one calf. Occasionally they form larger groups. • Present in northern coastal waters during the summer months. • Observed in the LSA, so project interactions are possible.	(COSEWIC 2006)
Reproduction	• Most mature females become pregnant each year. Gestational period is 10 - 11 months. • Mean age at sexual maturation is 3.5 years.	(COSEWIC 2006)
Foraging Strategy and Food Sources	• Feed on small schooling fishes such as capelin, and Atlantic herring. • Need to feed frequently as they have limited energy reserves, and typically follow prey species closely.	(COSEWIC 2006)

Beluga Whale (St. Lawrence Estuary population/ Arctic populations):

The St. Lawrence Estuary population of Beluga whales occur in the mouth of the St. Lawrence river in the summer and extend into the Gulf of St. Lawrence in the winter, though rarely further than Sept-Iles, QC (Table IR-45.9). This population is distinct from the other six populations that occur in the arctic, with no genetic mixing. Current population size is estimated around 1000 individuals, with recent decreases in neonate survival and fewer young individuals suggesting the status of this population is worsening.

Table IR-45.9 Overview of the Beluga Whale

Beluga Whale	Summary	Reference(s)
Description	• The Beluga is a medium-sized whale (3-5.5m). • This population occurs mainly in the St. Lawrence River estuary, with main summer concentration centered around the Saguenay River mouth. Little is known about winter distribution but there appears to be a slight increase in the use of downstream areas. • Arctic Belugas have shown genetic mixing, but the St. Lawrence Estuary population is reproductively and geographically isolated from other populations.	(COSEWIC 2015)
Habitats and Movements	• St. Lawrence Estuary Belugas occur in the Estuary during the summer and shift eastward into the north-western Gulf of St. Lawrence during the fall and winter. Their winter distribution does not overlap that of any of the Arctic populations. • Critical habitat has been identified in the St. Lawrence Estuary and lower reaches of the Saguenay River. • No typical activity or migration enters the LSA, so interactions are not predicted.	(COSEWIC 2015, DFO 2016)
Reproduction	• Belugas live roughly 30-60 years and attain maturity at 6-7 years. • Females give birth to one calf every 3 years on average. • A decline in immature individuals since the late 1990s has been noted.	(COSEWIC 2015)
Foraging Strategy and Food Sources	• Beluga diet is dominated by fish species, including capelin, herring, sand lance, and cod.	(COSEWIC 2015)

Atlantic Walrus:

Walrus live in arctic waters where ice flows are common in shallow waters (Table IR-45.10). They are present in northern Hudson Bay, around Baffin Island, and as far west as Greenland (COSEWIC 2017).They were once common throughout the Atlantic provinces but were extirpated primarily by hunting. They are vulnerable to anthropogenic disturbance, fleeing from the sound of airplanes and boats and occasionally trampling other individuals. Solitary males range as far south as northern Labrador in most years, though in recent years some have been seen along the east and south coast of Newfoundland including an individual within Witless Bay (COSEWIC 2017).

Table IR-45.10 Overview of the Atlantic Walrus

Atlantic Walrus	Summary	Reference(s)
Description	• Walrus are large pinnipeds, with adults approximately 2.6 – 3.1 m long. • Both males and females have long tusks, though they are larger in males. • Walrus are found in Arctic waters from the polar ice-sheet in the Arctic Ocean to the Bering Sea, James Bay and the Labrador coast. • No information is available to determine if walruses migrate or form sedentary groups.	(COSEWIC 2008, 2017)
Habitats and Movements	• Require shallow open areas with substrate supporting a productive bivalve community, and suitable ice or land nearby upon which to haulout. • Live on ice near open water in the winter (e.g. polynyas) and when ice is rare during the summer they migrate to coasts and beaches. • Once common in the Atlantic provinces, but now restricted to Arctic to sub-Arctic regions. • No typical activity or migration enters the LSA, so interactions are not predicted.	(COSEWIC 2017)
Reproduction	• Walrus reach sexual maturity at 6 or 7 years. • They move into land to give birth, and females produce one young every three years.	(COSEWIC 2017)
Foraging Strategy and Food Sources	• Primarily molluscs, which they dig up from the ocean floor.	(COSEWIC 2017)

Leatherback (Atlantic population):

Leatherbacks are seen with some frequency in the RSA mainly from April to December (COSEWIC 2013b); Table IR-45.11). While they do not nest in Canada, they migrate to Atlantic Canada to feed on gelatinous zooplankton, mainly jellyfish. They are seen in both coastal and offshore waters, but most sightings are from the continental shelf with a mean depth of 113 m and temperature of 16.6 °C (COSEWIC 2013b). The Ocean Biogeographic Information system (OBIS) does not appear to have good coverage within the Canadian Exclusive Economic zone (EEZ) and so most sightings are far offshore (Figure 6.3 5 in the EIS). Population trends in the Atlantic are difficult to determine, though new nesting areas have been identified in Colombia and Trinidad (COSEWIC 2013b). Their main threat in Atlantic Canada is entanglement in fishing gear, though other threats include vessel strikes, marine pollution, and acoustic disturbance.

Table IR-45.11 Overview of the Leatherback

Leatherback	Summary	Reference(s)
Description	• The Leatherback is the largest living turtle, measuring up to 2.19 m in length. • Has a characteristic leathery shell, compared to the bony shells of all other sea turtles. • Estimates of population in the Atlantic is several thousand individuals. • Leatherback (Atlantic population) is listed as endangered under Schedule 1 of *SARA*.	(Ernst et al. 1994, COSEWIC 2013b)
Habitats and Movements	• Leatherbacks range throughout the Atlantic, Pacific and Indian oceans. In Atlantic Canadian waters, present from April to December and most numerous from July to September. They are predominantly pelagic, typically inhabiting coastal shelf waters to a depth of <200 m. • Observed in the LSA in the spring to fall, so project interactions are possible.	(Ernst et al. 1994, COSEWIC 2013b)
Reproduction	• Leatherbacks nest on open beaches in the tropics; females lay an average of 6 clutches per season. • Median age of maturity is 16 years, though estimates vary from 3-30 years. • Sex determination of marine turtle hatchlings is temperature dependent.	(Jones et al. 2011, COSEWIC 2013b)
Foraging Strategy and Food Sources	• The preferred prey for Leatherbacks is jellyfish and other gelatinous organisms.	(Ernst et al. 1994, COSEWIC 2013b)

Loggerhead Sea Turtle:

In Atlantic Canada, the Loggerhead is most abundantly seen in spring to fall, and generally associated with the Gulf Stream (Table IR-45.12). One time thought to be an accidental arrival in Canadian waters, incidental catch from Canadian fisheries from 1999-2006 numbered 9,592 individuals showing a significant presence in Atlantic Canada (COSEWIC 2010). They do not nest in Canada, though they are seen in both coastal and offshore waters, typically in summer months when water temperatures exceed 22°C. The largest threat in Canada is fishing bycatch (longline especially).

Table IR-45.12 Overview of the Loggerhead Sea Turtle

Loggerhead	Summary	Reference(s)
Description	• The Loggerhead is the largest hard-shelled turtle in the world, typically reaching 0.85-1.0 m in length. • The Loggerhead is considered endangered by COSEWIC.	(Ernst et al. 1994, COSEWIC 2010)
Habitats and Movements	• Loggerhead is the most abundant sea turtle in North American waters. Wander widely in their range from coastal areas to more than 200 km from shore. In Eastern Canada, seldom found in nearshore waters. • Observed in the LSA in the spring to fall, so project interactions are possible.	(Ernst et al. 1994, COSEWIC 2010)
Reproduction	• Loggerheads nest in the southern United States and in tropical areas; they lay 4 clutches per season and will go 2 - 3 years between breeding seasons. • Age of maturity is estimated between 16-34 years. • Sex determination of marine turtle hatchlings is temperature dependent.	(COSEWIC 2010)
Foraging Strategy and Food Sources	• Loggerheads consume crustaceans, mollusks, squid, and jellyfish.	(COSEWIC 2010)

SAR Critical Habitat Discussion:

No critical habitat for the SARs listed above has been identified within the RSA. Critical habitat has been identified in the federal recovery strategies for the Beluga (St. Lawrence Estuary population), Northern Bottlenose whale (Scotian Shelf population) and the North Atlantic right whale. Critical habitat for the Beluga (St. Lawrence Estuary population) is restricted to the St. Lawrence estuary (DFO 2012b). Critical habitat for the Northern Bottlenose whale (Scotian Shelf population) is in three deep underwater canyons off the southern coast of Nova Scotia, along the Scotian Shelf (DFO 2010). Researchers have recently discovered at least 50 northern bottlenose whales in the Sackville Spur area; this significant find (in size, numbering 30 percent or more of the entire Scotian Shelf population) is thought to potentially represent a previously undiscovered population of the species (CBC 2016). The North Atlantic right whale's critical habitat is in the Grand Manan Basin within the Bay of Fundy, and off southern Nova Scotia at Roseway Basin (DFO 2016).

Recovery strategies identifying critical habitat are not currently available for the other SAR reported in the RSA and described above. A study intended to aid in the identification and delineation of critical habitat for the blue whale is underway; recent studies have identified important feeding grounds in the St. Lawrence estuary and Gulf of St. Lawrence, and these will be used to inform the identification of critical habitat areas (Beauchamp et al. 2009, DFO 2016). Additionally, three high-use feeding areas in Canadian waters (none within the RSA) used by leatherback sea turtles are being studied for inclusion in a forthcoming amendment to the species' recovery strategy: 1) waters east and southeast of Georges Bank, including the Northeast Channel near the southwestern boundary of the Canadian EEZ; 2) the southeastern Gulf of St. Lawrence and waters off eastern Cape Breton Island, including Sydney Bight, the Cabot Strait, portions of the Magdalen Shallows and adjacent portions of the Laurentian Channel; and 3) waters south and east of the Burin Peninsula, Newfoundland, including parts of Placentia Bay (DFO 2012a; 2013).

Specific Question or Information Requirement: Provide additional information about marine species at risk, including:

- **an analysis of potential effects of the Project on the Fin, Killer and Northern bottlenose whales and Harbour porpoise with consideration of the high or moderate likelihood of interaction between these species and the Project.**

As stated in Section 6.3.5 of the EIS, four of the marine mammal species described above were identified as having a moderate or high potential for interaction with the Project: the fin whale is frequently observed in the RSA year-round, including the LSA and thus has high potential to interact with the Project, while the killer whale, Northern bottlenose whale and harbour porpoise are less frequently but regularly observed in the RSA (including the LSA) during the spring and summer months and are considered to have a moderate potential for interaction with the Project because of their lower abundance and seasonal presence in the RSA. Further discussion of the potential effects of the Project on each of these species is provided below.

Fin Whale, Atlantic Population (Species at Risk Act (SARA) Schedule 1 and Committee on the Status of Endangered Wildlife in Canada (COSEWIC): Special Concern): Fin whales are relatively common in the LSA, particularly in summer; the abundance estimate in southern and eastern Newfoundland is 890 individuals (95 percent confidence limits: 551 - 1,435) based on 2007 Trans North Atlantic Sightings Survey (TNASS), although this estimate is considered by the authors to be preliminary, as it has not been corrected for perception biases (Lawson and Gosselin 2009). Concentrations of fin whales are known to occur in the nearshore and offshore waters of Newfoundland and Labrador in the summer months, as well as on the Scotian Shelf (COSEWIC 2005). In previous acoustic monitoring conducted for a recent project in the Flemish Pass (west of EL 1144), fin whales were determined to be a dominant noise source in the RSA throughout the fall, winter, and spring (Quijano et al 2017; Maxner et al 2017).

The potential Project interactions with the fin whale are similar to those for all marine mammals, which are discussed in detail in Section 10.3 of the EIS, namely:

- Change in mortality / injury levels and health due to underwater noise from the mobile offshore drilling unit (MODU) and vertical seismic profile (VSP) surveys, and to vessel strikes.
- Change in habitat availability, quality and use due to underwater noise from the MODU and VSP surveys, and to disturbance from vessels.
- Change in food availability / quality due to underwater noise from the MODU and VSP surveys, and to disturbance from vessels and introduction of discharges (particularly organic waste) from vessels and the MODU.

The species' Status Report (COSEWIC 2005) and Management Plan (DFO 2017a) identify anthropogenic threats that are of particular concern for the fin whale; with respect to the Project, these include potential for vessel strikes and the introduction of underwater noise.

Like other mysticetes (baleen whales), fin whales are known to be more vulnerable to vessel strikes than other marine mammals (Laist et al. 2001, Jensen and Silber 2003). Vanderlaan and Taggart (2007) note that the species with the highest risk of mortality due to vessel strikes include North Atlantic right whales, fin whales, humpback whales and grey whales. As stated in Section 10.3.8 of the EIS, however, vessel traffic for supply and servicing of the MODU is estimated at two to three return transits per week for a single MODU, representing a negligible contribution to the overall vessel traffic off Eastern Newfoundland. Project-related supply vessel traffic will utilize established routes wherever possible, and will seek to maintain a steady course, safe vessel speed and avoid concentrations of identified marine mammals and sea turtles whenever possible to further reduce the risk of a vessel strike.

Fin whales may experience behavioural disturbance or masking of communication during activities that produce underwater noise, such as MODU operation, VSP surveys, drilling activity, and vessel traffic. Maxner et al (2017) reported that a lower than expected number of detections of fin whale songs during the study period may have been due to masking by seismic noise and other low-frequency sound sources.

While fin whales are present in the RSA and LSA, in consideration of the mitigation measures that will be applied (Section 10.3.2) as well as adherence to industry standards and guidelines such as the Offshore Waste Treatment Guidelines (OWTG; NEB et al 2010) and Statement of Canadian Practice with Respect to the Mitigation of Seismic Sound in the Marine Environment (SOCP; DFO 2007), the information on potential effects to fin whales presented in Table 10.5 of the EIS remains valid. As stated in the revised Sections 16.6.3 and 16.6.4 (Appendix C of this Addendum), the likelihood of an uncontrolled well event is extremely low, and in consideration of the response measures that will be implemented, adverse effects on fin whales are unlikely.

Depending on the Project activity, adverse effects are expected to be negligible to medium in magnitude, and the geographic extent will be localized (i.e. in the immediate vicinity of activity) to within the LSA, at a regular or sporadic frequency, and will be short- to medium-term in duration and reversible. Further, the Project and associated effects will occur within an already disturbed context (i.e., existing human activity) with additional future activities expected within and near the Project Area, LSA, and RSA. Thus, in consideration of the nature and characteristics of the Project and the existing environment within the LSA and RSA, and with the implementation of planned mitigation measures, the Project is not likely to result in significant adverse effects on the Atlantic population of fin whales.

Killer Whale, Northwest Atlantic / Eastern Arctic Population (COSEWIC: Special Concern): Killer whales are present in small numbers in the RSA, predominantly in the spring and summer months (Lein et al 1988; Lawson and Gosselin 2009). The population size is estimated at less than 1000 individuals (COSEWIC 2008). Sightings off Newfoundland and Labrador have been more frequent over the last decade (Lawson and Stevens 2014). They inhabit a wide range of nearshore and pelagic habitats worldwide and tolerate broad temperature, salinity and turbidity levels; basic requirements include sufficient quantity and quality of prey, an acoustic environment that does not inhibit communication / foraging or result in hearing loss, and safe passage conditions that allow for seasonal movements, resting and foraging (COSEWIC 2008). In the Northwestern Atlantic, prey includes a variety of marine mammals (e.g., harp seals, dolphins, common minke whales, belugas and humpbacks), seabirds (e.g. Razorbills), and fish such as bluefin tuna and herring (Lien et al. 1988).

The potential Project interactions with the killer whale are similar to those for all marine mammals, which are discussed in detail in Section 10.3 of the EIS, namely:

- Change in mortality / injury levels and health due to underwater noise from the MODU and VSP surveys, and to vessel strikes.
- Change in habitat availability, quality and use due to underwater noise from the MODU and VSP surveys, and to disturbance from vessels.
- Change in food availability / quality due to underwater noise from the MODU and VSP surveys, and to disturbance from vessels and introduction of discharges (particularly organic waste) from vessels and the MODU.

The species' Status Report (COSEWIC 2008) identifies anthropogenic threats that are of particular concern for the killer whale; with respect to the Project, these include physical and acoustic disturbance, oil spills and ship strikes. As stated in Section 10.3.8, vessel traffic for supply and servicing of the MODU is estimated at two to three return transits per week, representing a negligible contribution to the overall vessel traffic off Eastern Newfoundland. Project-related supply vessel traffic will utilize established routes wherever possible, and will seek to maintain a steady course, safe vessel speed and avoid concentrations of identified marine mammals and sea turtles whenever possible to further reduce the risk of a vessel strike.

Killer whales may experience behavioural disturbance or masking of communication during activities that produce underwater noise, such as MODU operation, VSP surveys, drilling activity, and vessel traffic. Systematic surveys of cetaceans during seismic surveys in United Kingdom (UK) waters suggested a degree of avoidance behaviour by killer whales (Stone and Tasker 2006), while unusual behaviour of killer whales in response to intense mid-frequency military sonar was observed by Balcomb (2007).

Killer whales show little or no tendency to avoid oil spills (COSEWIC 2008). During the Exxon Valdez spill in 1989, individuals were seen swimming in oil slicks immediately following the spill; this group experienced significant mortality in the following months, likely due to inhalation of petroleum vapour (Matkin et al 2008). However, as stated in the revised Sections 16.6.3 and 16.6.4 (Appendix C of this Addendum), the likelihood of an uncontrolled well event is extremely low, and in consideration of the response measures that will be implemented, adverse effects on killer whales are unlikely.

Killer whales have potential to occur in the RSA and LSA; however, in consideration of the mitigation measures that will be applied as well as adherence to industry standards and guidelines such as the OWTG (NEB et al 2010), SOCP (DFO 2007), and relevant C-NLOPB guidelines for environmental protection such as Offshore Chemical Selection Guidelines for Drilling and Production Activities on Frontier Lands (OCSG) and Environmental Protection Plan Guidelines, the information on potential effects to killer whales presented in Table 10.5 of the EIS remains valid. Depending on the Project activity, adverse effects are expected to be negligible to medium in magnitude, and the geographic extent will be localized (i.e. in the immediate vicinity of activity) to within the LSA, at a regular or sporadic frequency, and will be short- to medium-term in duration and reversible. Further, the Project and associated effects will occur within an already disturbed context (i.e., existing human activity) with additional future offshore development and activities expected within and near the Project Area, LSA, and RSA. Thus, in consideration of the nature and characteristics of the Project and the existing environment within the LSA and RSA, and with the implementation of planned mitigation measures, the Project is not likely to result in significant adverse effects on the Atlantic population of killer whales.

Northern Bottlenose Whale, Davis Strait population and Scotian Shelf population (SARA Schedule 1 and COSEWIC: Endangered (Scotian Shelf pop); COSEWIC: Special Concern (Davis Strait pop)): The Scotian Shelf population, though apparently stable, is estimated at only 163 individuals; numbers and population trends for the Davis Strait population are unknown (COSEWIC 2011; DFO 2016). Critical habitat for the Scotian Shelf population has been identified in the Gully Marine Protected Area, and a Critical Habitat Order protecting this area was published in the Canada Gazette Part II, Vol. 152 (SOR/2018-157, dated July 6, 2018).

Small numbers of Northern bottlenose whales have been observed in the RSA (Lawson and Gosselin 2009), though it is not clear to which population these individuals belong. As well, in previous acoustic monitoring conducted for a recent project in offshore Newfoundland, Northern bottlenose whales were detected acoustically in the Flemish Pass to the west of EL 1144 (Quijano et al 2017; Maxner et al 2017). Further, recent sightings of between 50 and 200 Northern bottlenose whales were reported in the Sackville Spur area of the Flemish Cap by a survey team from Dalhousie University in 2015 and 2016 (Gillis 2016). Based on these observations, Northern bottlenose whales are at least occasional visitors to the Project Area and RSA and have potential to interact with Project activities.

The potential Project interactions with the Northern bottlenose whale are similar to those for all marine mammals, which are discussed in detail in Section 10.3 of the EIS:

- Change in mortality / injury levels and health due to underwater noise from the MODU and VSP surveys, and to vessel strikes.
- Change in habitat availability, quality and use due to underwater noise from the MODU and VSP surveys, and to disturbance from vessels.
- Change in food availability / quality due to underwater noise from the MODU and VSP surveys, and to disturbance from vessels and introduction of discharges (particularly organic waste) from vessels and the MODU.

The species' Recovery Strategy (DFO 2016) and Management Plan (DFO 2017b) identify anthropogenic threats that are of particular concern for the Northern bottlenose whale; with respect to the Project, these include underwater noise and potential exposure to contaminants. The nature of these effects is discussed in detail in Section 10.3 of the EIS and the revised Section 16.6.4 (Appendix C of this Addendum), and the assessments presented therein are applicable to Northern bottlenose whales.

Northern bottlenose whales, like other beaked whales, are in the mid-frequency cetacean hearing group and are thought to be particularly sensitive to underwater noise. Northern bottlenose whales in the Gully Marine Protected Area showed no displacement due to received sound levels of 145 dBrms re 1 µPa generated by a seismic survey taking place more than 20 km away (Lee et al 2005). Beaked whales generally avoid approaching vessels, sometimes diving for extended periods (Kasuya 1986; Würsig et al 1998), and it is expected that they would demonstrate avoidance behaviours in response to VSP and activity.

With the implementation of standard mitigation measures and best management practices for addressing contaminants, including adherence to the OWTG (NEB et al 2010) and MARPOL (IMO 2017), planned and routine discharges including drilling muds, drilling fluid, and cuttings associated with drilling activities are not expected to result in a measurable change in health for Northern bottlenose whale. Toxic spills would be of concern in the event of an accident or malfunction, but as stated in the revised Sections 16.6.3 and 16.6.4 (Appendix C of this Addendum), the likelihood of an uncontrolled well event is extremely low, and in consideration of the response measures that will be implemented, adverse effects on Northern bottlenose whales are unlikely.

Northern bottlenose whales have potential to occur in the RSA and Project Area where they are most often observed in the spring and summer months; however, in consideration of the mitigation measures that will be applied as well as adherence to industry standards and guidelines such as the OWTG (NEB et al 2010), SOCP (DFO 2007), and C-NLOPB guidelines, the information on potential effects to Northern bottlenose whales presented in Table 10.5 of the EIS remains valid. Depending on the Project activity, adverse effects are expected to be negligible to medium in magnitude, and the geographic extent will be localized (i.e. in the immediate vicinity of activity) to within the LSA, at a regular or sporadic frequency, and will be short- to medium-term in duration and reversible. The Project and associated effects will occur within an already disturbed context (i.e., existing human activity) with additional future offshore development and activities expected within and near the Project Area, LSA, and RSA. In consideration of the nature and characteristics of the Project and the existing environment within the LSA and RSA, and with the implementation of planned mitigation measures, the Project is not likely to result in significant adverse effects on the Northern bottlenose whale (Davis Strait and Scotian Shelf populations).

Harbour Porpoise, Northwest Atlantic Population (COSEWIC: Special Concern): Harbour porpoises are considered abundant in coastal waters of eastern Canada (COSEWIC 2006) and are occasionally found offshore; abundance estimate in southern and eastern Newfoundland is 1,195 individuals (95 percent confidence limits: 639 - 1,195) based on 2007 TNASS surveys. This estimate is considered by the authors to be preliminary, as it has not been corrected for perception biases (Lawson and Gosselin 2009).

The primary potential environmental interactions with the Project for the harbour porpoise are similar to those for all marine mammals, which are discussed in detail in Section 10.3 of the EIS:

- Change in mortality / injury levels and health due to underwater noise from the MODU and VSP surveys, and to vessel strikes.
- Change in habitat availability, quality and use due to underwater noise from the MODU and VSP surveys, and to disturbance from vessels.
- Change in food availability / quality due to underwater noise from the MODU and VSP surveys, and to disturbance from vessels and introduction of discharges (particularly organic waste) from vessels and the MODU.

The primary threat to harbour porpoises, according to the species' Status Report (COSEWIC 2006), is the susceptibility of harbour porpoises to bycatch in fishing gear. Other potential Project-related threats to the species include the introduction of underwater noise (COSEWIC 2006) and an unplanned release of hydrocarbons in the event of an accident or malfunction as discussed in the revised Section 16.6.4 (Appendix C of this Addendum). The status report notes that acoustic harassment or displacement could occur during seismic exploration, particularly if such activities occur relatively close to shore, in preferred feeding areas, or within migration corridors (COSEWIC 2006). Potential effects associated with the introduction of anthropogenic noise in the marine environment discussed in detail in Section 10.3.3 of the EIS are relevant to the harbour porpoise.

Harbour porpoise may experience behavioural disturbance or communication masking during activities that produce underwater noise, such as VSP and other geophysical surveys. Along with beaked whales, harbour porpoises are considered one of the most sensitive species to underwater noise (including seismic sound), demonstrating behavioural responses to air source arrays at levels <145 decibels (dB) re 1 µPa (root mean squared [rms]) (Bain and Williams 2006). Short-term avoidance responses and decrease in density have been observed at 10 km from commercial 2D seismic surveys in the North Sea (peak-to-peak source sound pressure levels of 242 to 253 dB re 1 µPa at 1 m), although individuals returned to the area within a few hours of the cessation of activity (Thompson et al. 2013). Pirotta et al (2014) used passive acoustic loggers

to monitor vocalizations in harbour porpoises in an area where there had been no evidence of broad scale displacement of animals from seismic activity. The authors determined that such vocalizations declined by 15 percent in the seismic area and that the further animals were away from activity, the greater the likelihood of vocalizations. This paper also documents evidence of sub-lethal effects of seismic sound source arrays on harbour porpoises and suggests that exposure to seismic activity could influence energy budgets through reduced foraging performance.

Harbour porpoises have potential to occur in the RSA and Project Area. However, in consideration of the mitigation measures that will be applied as well as adherence to industry standards and guidelines such as the OWTG (NEB et al 2010), SOCP (DFO 2007), and C-NLOPB guidelines, the information on potential effects to harbour porpoises presented in Table 10.5 of the EIS remains valid. Depending on the Project activity, adverse effects are expected to be negligible to medium in magnitude, and the geographic extent will be localized (i.e. in the immediate vicinity of activity) to within the LSA, at a regular or sporadic frequency, and will be short- to medium-term in duration and reversible. The Project and associated effects will occur within an already disturbed context (i.e., existing human activity) with additional future offshore development and activities expected within and near the Project Area, LSA, and RSA. In consideration of the nature and characteristics of the Project and the existing environment within the LSA and RSA, and with the implementation of planned mitigation measures, the Project is not likely to result in significant adverse effects on the harbour porpoise (Northwest Atlantic populations).

Specific Question or Information Requirement: Provide additional information about marine species at risk, including:

- **Lumpfish, Smooth Skate (Laurentian-Scotian population), Bowhead Whale (Eastern Canada – West Greenland population), and White hake (Atlantic and Northern Gulf of St. Lawrence population) and their habitat within areas that could be affected by the Project, update the effects assessment, potential mitigation and follow-up, as appropriate.**

Additional biological and ecological information is presented below for lumpfish, smooth skate, bowhead whale and white hake. The additional information provides further context on the potential effects of Project activities on SAR. As with secure species, SAR may interact with Project activities based on occupation of various habitats at different life history stages and the same planned mitigation measures will be used to avoid or reduce such adverse interactions.

Common Lumpfish (COSEWIC: Threatened): Common lumpfish were assessed in November 2017 as "threatened" and no status or recovery documents have been finalized for this species. Common lumpfish (*Cyclopterus lumpus*) are widely distributed in temperate waters from shallow coastal waters of less than 20 m to depths greater than 300 m (Simpson et al 2016). In Newfoundland and Labrador waters, lumpfish are distributed from inshore bays to the Newfoundland and Labrador Shelf. Across various survey types, lumpfish densities are ≤1 individuals per tow inside the Project Area with areas of highest densities (up to 100-2,010 individuals per tow) south of Newfoundland (Simpson et al 2016). This semi-pelagic species primarily occupies pelagic areas, but adults become demersal during spawning in shallow coastal waters (Simpson et al 2016). Canadian Research Vessel (RV) surveys indicate that this species prefers waters ≤4^{0}C (Simpson et al 2016).

This species undergoes inshore spawning migrations in spring with spawning occurring from May-June in the subtidal zone (Simpson et al 2016). Tagging studies indicate that this species returns to the same spawning areas each year and adults may make migrations of hundreds of kilometres (Simpson et al 2016). Common lumpfish are batch spawners where the eggs deposited in a nest are fertilized externally. The eggs

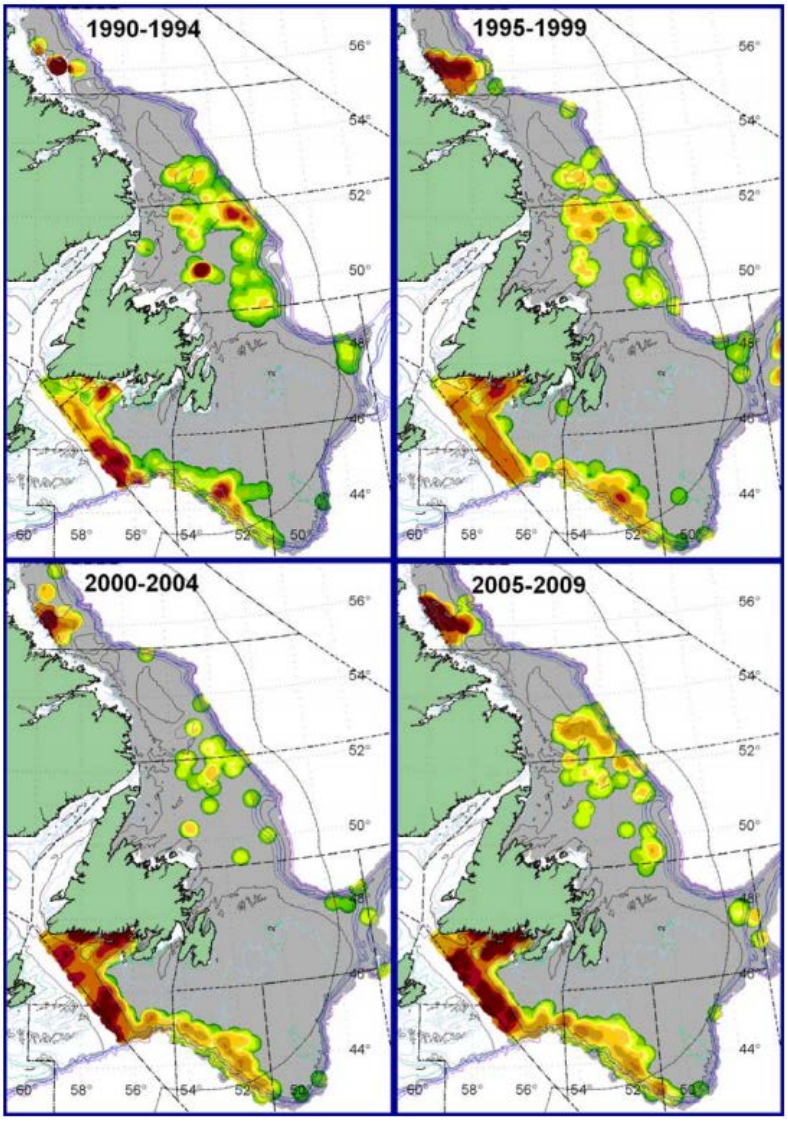
are secured to hard substrate and guarded by the male. After hatching, larval lumpfish attach themselves to hard substrates, macroalgae and eel grass. Eelgrass beds may be important nursery habitat for lumpfish as with other fish species (Simpson et al. 2016; DFO 2017; Gauthier et al. 2017). For the first year, juveniles also live in the upper 1 m of the water column and are often attached to floating macroalgae. Juvenile stages in surface waters primarily consume zooplankton (Simpson et al 2016).

Primary potential threats to this species include changes in oceanographic processes, spawning habitat destruction, seal predation, coastal pollution, seismic activities, fishing, and bycatch mortalities (Simpson et al 2016; DFO 2017d). However, there has not been any direct link between suggested potential threats and observed declines in abundance (Simpson et al 2016; DFO 2017). Currently, no critical habitat or recovery plan has been established for this species, however coastal spawning habitats are considered important for lumpfish recovery and survival (Simpson et al 2016; DFO 2017; Gauthier et al. 2017).

The potential for common lumpfish occurrence in the Project Area is low and in the RSA is high with the potential for all life stages (egg, larvae, juveniles, and adults) to interact with Project activities. Primary aggregations and spawning habitats for this species are known to occur outside the LSA in coastal waters around southern Newfoundland. With the application of mitigation measures and adherence to published and/or industry standards and best management practices (e.g., OWTG (NEB et al 2010), SOCP (DFO 2007), and C-NLOPB guidelines), potential effects to lumpfish are expected to be adverse, negligible to low magnitude, occur localized or within the Project Area as sporadic to long term events (depending on the Project Activity and life history stage), and are reversible. These effects will occur within an already disturbed context (i.e., existing human development and industrial activity) with additional future offshore development and activities expected within and near the Project Area, LSA, and RSA. Based on the nature and characteristics of the Project and the existing environment for marine fish and fish habitat within the LSA and RSA, and with the implementation of planned mitigation measures, the Project is not likely to result in significant adverse effects on common lumpfish.

Smooth Skate, Laurentian-Scotian population (COSEWIC: Special Concern): Smooth skate (*Malacoraja senta*) are listed as "special concern" under COSEWIC (2012) and are distributed from the mid-Labrador coast to Georges Bank. They have a disjunct distribution, and four designatable units (DUs) are proposed in Canadian waters: Hopedale Channel, Funk Island Deep, Nose of the Grand Bank, and Laurentian-Scotian. Two of the DUs, Hopedale Channel and Funk Island Deep, fall exclusively in Canadian waters, whereas 77% of the Nose of the Grand Bank DU occurs in international waters. The Laurentian-Scotian DU extends slightly (<0.5%) into international waters on the southeastern Grand Banks and the southwestern edge is contiguous with Georges Bank concentration in USA waters (COSEWIC 2012). The Laurentian-Scotian DU historically accounts for 90% of the species' estimated abundance in Canada and 70% of the Canadian range.

These fish are found over a relatively narrow range of temperatures; the coldest/warmest records are -1.3 / 15.7°C although only 0.9% of occurrences were associated with bottom temperatures <0°C and 7% with <2°C. The densest concentrations and 90% of survey occurrences were found between 2.7 and 10°C. Fish tend to be found in shallower waters at the southern end of the distribution, with the density peaking at 325 m in the Gulf of Maine (GoM) and 525 m at the Hopedale Channel DU. The densest concentrations occur in the troughs surrounding the banks where the temperature is warmer (COSEWIC 2012) (Figure 45.1).



Distribution of Smooth Skate in the waters off Newfoundland and Labrador for combined spring and fall surveys by five-year intervals. Grey areas denote areas sampled but with no catches, green low catches grading to red, high catches
From COSEWIC 2012

Figure IR-45.1 Distribution of Smooth Skate in the waters off Newfoundland and Labrador

Development of young into a fully formed juvenile of about 7-10 cm total length occurs within an egg capsule after it is laid on the bottom. The length of time between extrusion and hatching is unknown but generally this takes about 1-2 years. Smooth skate egg production has been reported to up to 100 capsules annually. Reproduction appears to be widespread throughout the range, with egg cases having been found on the bottom at various times of the year within the various DUs (COSEWIC 2012).

Mark-recapture studies of skates (primarily other species) suggest limited dispersal. The complete absence of smooth skate between the DUs in 60 years of intense sampling suggests isolation among concentrations. Skates produce large eggs (purses) deposited on the bottom, therefore there is little chance for wide dispersion of early stages. Large females showing signs of having spawned have been observed within each of the DUs, and all DUs contain a broad spectrum of sizes, including juveniles and adults. These characteristics combined suggest discreet breeding units (COSEWIC 2012).

The potential for smooth skate occurrence in the Project Area and RSA is low based on known distributions (Figure 1) and there is limited potential for life stages (egg, larvae, juveniles, and adults) to interact with Project activities. The known areas of high aggregation are well outside the Project Area, and with the implementation of planned mitigation measures, the Project is not likely to result in significant adverse effects on smooth skate.

Bowhead Whale, Eastern Canada-West Greenland population (COSEWIC: Special Concern): Bowhead whales live primarily in arctic waters with a circumpolar distribution, but very rare sightings have been reported in Newfoundland. The Eastern Canada-West Greenland population is roughly estimated to be 10,000 individuals, with considerable variation between estimates (COSEWIC 2009a). Historically, whaling was their greatest threat, though the killer whale may pose the greatest threat today. Other threats include anthropogenic noise, entanglement, vessel strikes, and pollution. This species is considered to be of Special Concern by COSEWIC and is currently under consideration by SARA for further protection.

The distribution of the Eastern Canada-West Greenland population covers 1 million square kilometers, with individuals summering in western Baffin Bay, high arctic regions, northwestern Hudson Bay, and off west Greenland. Winter migration takes 2-3 months, where they occupy areas with unconsolidated pack ice in the Hudson Strait, southern Baffin Bay, and off west Greenland. As the species does not typically reside in or migrate through the Project Area, interactions with the Project are not predicted. The mitigation measures outlined in Section 10.3.2 of the EIS will be implemented to avoid or reduce potential environmental effects of the Project on all marine mammals and sea turtle species, including the bowhead whale. In consideration of the bowhead whale's primarily Arctic distribution, interactions with routine Project activities are considered highly unlikely.

White Hake, Atlantic and Northern Gulf of St. Lawrence population (COSEWIC: Threatened): White hake (*Urophycis tenuis*) are listed as "threatened" under COSEWIC (2013; DFO 2016d) and are mainly distributed in the Gulf of St. Lawrence, Scotian Shelf, and southern Newfoundland. Two population DUs have been established; the southern Gulf of St. Lawrence (DU1) and the Atlantic and northern Gulf of St. Lawrence (DU2) (COSEWIC 2013). Prior to mid-1990 and over the past three generations, there has been a decline in adult white hake abundance by 70% (COSEWIC 2013).

White hake are associated with fine mud substrates at depths between 50-360 m. Canadian RV surveys indicate that white hake are associated with the shallow slope (250-600 m) depth zone with highest abundances in the Project Area ranging from 5-8 individuals per tow. Along the southern Grand Banks, highest catch rates are >98 individuals per tow. White hake are not a key fish species in species assemblages on the Flemish Cap (Nogueira et al 2017) and areas of high aggregation and abundance exist outside the Project Area.

This species does not undergo vertical migrations and abundance at depths is linked to fish size as larger adult fish are associated with deeper waters (COSEWIC 2013). Spawning seasons are variable depending on population location with spawning occurring between June to September in the southern Gulf of St.

Lawrence. In offshore areas, spawning is estimated to occur in the spring and in the summer on the Scotian Shelf (COSEWIC 2013). Eggs, larvae and pelagic juveniles may remain planktonic for two to three months depending on environmental conditions and distance to suitable settling areas (COSEWIC 2013). Juvenile and adult hake primarily feed on crustaceans and fish and are prey species for other fish, seabirds, and seals (COSEWIC 2013).

Fishing mortality through directed fishery and by-catch, remains the greatest threat to white hake populations with habitats considered not likely to be a limiting factor to this species survival and recovery (COSEWIC 2013; DFO 2016a, b). Natural mortality from seal predation has also been suggested as a threat for the Gulf of St. Lawrence DU. No critical habitat has been established for this species, however white hake have been observed to aggregate for foraging opportunities in the spring in the Laurentian Channel and Southwest Shelf Edge and Slope Ecologically and Biologically Significant Areas (EBSAs) (Templeman 2007; COSEWIC 2013; DFO 2016a).

The potential for white hake occurrence in the RSA ranges from low to high with the potential for all life stages (egg, larvae, juveniles, and adults) to interact with Project activities. As the known areas of high aggregation and importance (Laurentian Channel and Southwest Shelf Edge and Slope EBSAs) are outside the Project Area, and with the application of mitigation measures and adherence to published and/or industry standards and best management practices (e.g., OWTG (NEB et al 2010), SOCP (DFO 2007), and C-NLOPB guidelines), potential effects to white hake are expected to be adverse, negligible to low magnitude, occur localized or within the Project Area as sporadic to long-term events (depending on the Project Activity and life history stage) and reversible. These effects will occur within an already disturbed context (i.e., existing human development and industrial activity) with additional future offshore activities expected within and near the Project Area, LSA, and RSA. Based on the nature and characteristics of the Project and the existing environment for marine fish and fish habitat within the LSA and RSA, and with the implementation of planned mitigation measures, the Project is not likely to result in significant adverse effects on white hake.

Specific Question or Information Requirement: Provide additional information about marine species at risk, including:

- **the number of fish species with the potential to overlap with the Project Area and/or RSA, descriptions of each of those species and references to support presence of those species that have a potential to have ranges that overlap with the Project Area or RSA.**

Clarification is required regarding the potential species at risk (SAR) that may interact with the RSA and the Project. There are 31 species across various SAR designations in the North Atlantic including the NL ESA, COSEWIC, SARA, and IUCN. There are 23 Canadian listed species (NL ESA, COSEWIC, SARA) in the western North Atlantic that have potential to overlap with the RSA as presented in Table IR-45.13 (updated from Table 6.17 of the EIS). Two species, blue shark and barndoor skate, have been listed as "Not at risk" and are not included in the tally for Canadian listed species.

Further species information was presented in the EIS and this IR based on the SAR designation, indigenous importance, or range overlap with the Project Area or combination of these reasons. There are currently four SARA (Schedule 1) listed and one NL ESA listed species that may occur within the RSA, including three species of wolffish, white shark, and American eel. Due to this level of designation, further species descriptions were provided in the EIS (Section 6.1.8). Striped, northern and spotted wolfish also have ranges that overlap with the Project Area. American eel and Atlantic salmon were further described as they are species of interest for indigenous groups as described in Chapter 7 of the EIS. Eleven other species have

ranges that potentially overlap with the Project Area including Atlantic cod, white hake, thorny skate, grenadier species, redfish species, shark species, and Atlantic bluefin tuna based on COSEWIC Assessment and Status reports.

In summary, there are 31 internationally designated SAR that may interact with the RSA including the 23 Canadian designated SAR. There were 17 species that were further described in the EIS based on the SAR designation, indigenous importance, or range overlap with the Project Area.

Table IR-45.13 Fish Species at Risk or Otherwise of Special Conservation Concern

Family	Species		Status / Designation[1]			
	Common Name	Scientific Name	*NL ESA*	*SARA* Status (Schedule 1)	COSEWIC Designation	IUCN
Anarhichadidae	Striped (Atlantic) wolffish	*Anarhichas lupus*		SC	SC	
Anarhichadidae	Northern (Broadhead) wolffish	*Anarhichas denticulatus*		T	T	
Anarhichadidae	Spotted wolffish	*Anarhichas minor*		T	T	
Anguillidae	American eel	*Anguilla rostrata*	V		T	E
Carcharhinidae	Blue shark	*Prionace glauca*			NR	NT
Cetorhinidae	Basking shark	*Cetorhinus maximus*			SC	V
Cyclopteridae	Common lumpfish	*Cyclopterus lumpus*			T	
Gadidae	Atlantic cod (Newfoundland and Labrador Population)	*Gadus morhua*			E	V
Gadidae	Cusk	*Brosme brosme*			E	
Gadidae	Haddock	*Melanogrammus aeglefinus*				V
Lamnidae	Porbeagle	*Lamna nasus*			E	V
Lamnidae	Shortfin mako	*Isurus oxyrinchus*			T	V
Lamnidae	White shark	*Carcharodon carcharias*		E	E	V
Macrouridae	Roughhead grenadier	*Macrourus berglax*			SC	
Macrouridae	Roundnose grenadier	*Coryphaenoides rupestris*			E	CE

Family	Species		Status / Designation[1]			
	Common Name	Scientific Name	*NL ESA*	*SARA* Status (Schedule 1)	COSEWIC Designation	IUCN
Phycidae	White hake (Atlantic and Northern Gulf of St. Lawrence Population)	*Urophycis tenuis*			T	
Pleuronectidae	American plaice (Newfoundland and Labrador Population)	*Hippoglossoides platessoides*			T	
Pleuronectidae	Atlantic halibut	*Hippoglossus hippoglossus*				E
Rajidae	Barndoor skate	*Dipturus laevis*			NR	E
Rajidae	Little skate	*Leucoraja erinacea*				NT
Rajidae	Smooth skate (Funk Island Deep Population)	*Malacoraja senta*			E	E
Rajidae	Spinytail skate	*Bathyraja spinicauda*				NT
Rajidae	Thorny skate	*Amblyraja radiata*			SC	V
Rajidae	Winter skate (Eastern Scotian Shelf – Newfoundland)	*Leucoraja ocellata*			E	E
Salmonidae	Atlantic salmon (South Newfoundland Population (T); Quebec Eastern North Shore (SC), Quebec Western North Shore (SC), Anicosti Island (E), Inner St. Lawrence (SC), Gaspe-Southern Gulf of St. Lawrence (SC), Eastern Cape Breton (E), Nova Scotia Southern Upland (E); Outer Bay of Fundy Population (E))	*Salmo salar*			T; E; SC	LC
Scombridae	Albacore tuna	*Thunnus alalunga*				NT
Scombridae	Atlantic Bluefin tuna	*Thunnus thynnus*			E	E
Scombridae	Bigeye tuna	*Thunnus obesus*				V
Scorpaenidae	Acadian redfish (Atlantic Population)	*Sebastes fasciatus*			T	E
Scorpaenidae	Deepwater redfish (Northern Population)	*Sebastes mentella*			T	LC

Family	Species		Status / Designation[1]			
	Common Name	Scientific Name	*NL ESA*	*SARA* Status (Schedule 1)	COSEWIC Designation	IUCN
Squalidae	Spiny Dogfish	*Squalus acanthias*			SC	V
		Total Species	1	4	23[2]	23

[1] Not at Risk (NR), Least Concern (LC), Vulnerable (V), Near Threatened (NT), Special Concern (SC), Threatened (T), Endangered (E), Critically Endangered (CE)
[2] Total does not include two species designated as Not at Risk.

Specific Question or Information Requirement: Provide additional information about marine species at risk, including:

- **information on Cusk, American plaice and Spiny dogfish with applicable analysis of potential environmental interactions and effects to these marine fish species of concern.**

Additional biological and ecological information is presented below for cusk, American plaice and spiny dogfish. The additional information provides further context on the potential effects of Project activities on SAR. As with secure species, SAR may interact with Project activities based on occupation of various habitats at different life history stages and the same planned mitigation measures will be used to avoid or reduce such adverse interactions.

Cusk (COSEWIC: Threatened): Cusk (*Brosme brosme*) are listed as "threatened" under COSEWIC (2003) and are mainly distributed in subarctic and boreal shelf waters of the north Atlantic. The cusk's centre of abundance in the western Atlantic is between 41-44°N latitude (Gulf of Maine and southern Scotian Shelf). It also occurs rarely in the deep waters along the edge of the continental shelf off Newfoundland and Labrador. Data provided for the Newfoundland region; only 39 specimens were caught at the >15,000 stations sampled from 1978-2001, illustrates that cusk are rare north of the Laurentian Channel (COSEWIC 2003).

Cusk are common on hard, rough, and rocky substrates in the relatively warm water of intermediate depths on the Scotian Shelf and Gulf of Maine. Cusk are found at temperatures from 2-12°C on the Scotian Shelf but 6-10°C is the preferred range. Spawning takes place from April to July with peak spawning in late June on the Scotian Shelf (COSEWIC 2003).

Given the scarcity that cusk are found in the RSA and with the implementation of planned mitigation measures, the Project is not likely to result in significant adverse effects on cusk (COSEWIC 2003).

American Plaice, Newfoundland and Labrador population (COSEWIC – Threatened): American plaice (*Hippoglossoides platessoides*), listed by COSEWIC (2009) as 'threatened' are distributed contiguously from Georges Bank and the BoF in the south, northward over the Scotian Shelf, into the Gulf of St. Lawrence,

surrounding Newfoundland and Labrador and along the eastern coast of Baffin Island, Nunavut. Neighbouring the Canadian populations are populations of American plaice along the west coast of Greenland, on and around the Flemish Cap and in the Gulf of Maine and on Georges Bank (COSEWIC, 2009). They have a year-round presence in the Project Area.

American plaice exist as pelagic eggs and larvae for the first few weeks of life, settled juveniles prefer depths of 100-200 m and small particle sediments that they can use to partially or fully bury themselves. Adult plaice have less stringent habitat requirements. They have been collected from areas with a broad range of salinities and temperatures. Like juveniles, adults prefer areas with sediment suitable for burrowing, but the range of suitable particle sizes probably increases with fish size. American plaice are batch spawners, with the possibility of spawning as many as 10 egg batches. Adults do not appear to undergo large spawning migrations but may move into slightly deeper, warmer waters in winter (COSEWIC 2009).

The potential for American plaice occurrence in the RSA and Project Area is high with the potential for all life stages (egg, larvae, juveniles, and adults) to interact with Project activities. With the application of mitigation measures and adherence to published and/or industry standards and best management practices (e.g., OWTG (NEB et al 2010), SOCP (DFO 2007), and C-NLOPB guidelines), potential effects to American plaice are expected to be adverse, negligible to low magnitude, occur localized or within the Project Area as sporadic to long-term events (depending on the Project Activity and life history stage) and reversible. These effects will occur within an already disturbed context (i.e., existing human development and industrial activity) with additional future offshore activities expected within and near the Project Area, LSA, and RSA. Based on the nature and characteristics of the Project and the existing environment for marine fish and fish habitat within the LSA and RSA, and with the implementation of planned mitigation measures, the Project is not likely to result in significant adverse effects on American plaice.

Spiny Dogfish (COSEWIC – Special Concern): Spiny Dogfish (*Squalus acanthias*), listed by COSEWIC (2010) as 'special concern' occurs world-wide on the continental shelf, from the intertidal to the shelf slope, in temperate and boreal waters. In the northwest Atlantic, abundance is highest between Nova Scotia and Cape Hatteras (North Carolina). It has been observed on the Grand Bank including the Flemish Pass, but their presence is limited.

Spiny dogfish mate during the fall and early winter and have internal fertilization. After a gestation of 18-24 months, an average of six pups are born live in the winter. Growth is slow and varies between males and females, with females maturing later and growing larger than the males. They have a slow growth rate, long gestation periods, and late age to maturity. These characteristics indicate this species may have lesser potential for recovery in response to adverse effects.

The potential for spiny dogfish occurrence in the Project Area is limited as they are a mobile species whose main population occurs outside of the Project Area. The highest potential for interaction with the Project area is during inshore and offshore migrations and will interact with the juvenile and adult life stages.

With the application of mitigation measures and adherence to published and/or industry standards and best management practices (e.g., OWTG (NEB et al 2010), SOCP (DFO 2007), and C-NLOPB guidelines), potential effects to spiny dogfish are expected to be adverse, negligible to low magnitude, occur localized or within the Project Area as sporadic to long-term events (depending on the Project Activity and life history stage) and reversible. These effects will occur within an already disturbed context (i.e., existing human development and industrial activity) with additional future offshore activities expected within and near the Project Area, LSA, and RSA. Based on the nature and characteristics of the Project and the existing

environment for this VC within the LSA and RSA, and with the implementation of planned mitigation measures, the Project is not likely to result in significant adverse effects on spiny dogfish.

Specific Question or Information Requirement: Provide additional information about marine species at risk, including:

- **additional rationale for the summary of potential interactions for marine fish species at risk identified in Table 8.6, considering how abundance, timing of presence (e.g. infrequent occurrence versus year-round presence) and life-cycle (i.e. spawning/presence of eggs/larvae/rearing) may be indicative of varying potential for interaction with the Project.**

Summary of Potential Interactions for Marine Fish Species at Risk:
The potential effects of the Project on SAR are described in Section 8.4 of the EIS. Table 8.6 of the EIS provides an overview of potential environmental interactions and effects and identifies aspects of the SAR's abundance, timing of presence, and life cycle. While high abundance within the Project Area may increase the potential for Project interaction with the species, areas of high abundance outside the Project Area reduces potential regional effects on the population. It is worth noting that critical habitat has now been established for Northern and spotted wolffish (DFO 2018) based on area of occurrence. However, the Project Area remains outside identified critical habitat areas for these species. Species with infrequent presence within the region (i.e., seasonal migrating sharks, tuna) have lower potential to interact with the Project relative to species with year-round presence (i.e., wolffish, grenadier). Larval life stages may be more sensitive to anthropogenic effects relative to mobile adults.

The summary table (Table 8.6 of the EIS) notes limited potential for interaction with the Project based on mobility, mitigation measures, and critical habitat presence. However, the overall abundance, life history, and species presence has been considered in detail in species descriptions in Section 6.1.8 – Species at Risk and Otherwise of Special Conservation Concern and in the overall assessments of environmental effects in Section 8.3 – Environmental Effects Assessment and Mitigation.

As described throughout Chapter 8 of the EIS, the overall nature, localized extent and duration of the various components and activities associated with this Project, along with the offshore and dynamic marine environment involved and the implementation of planned mitigation measures, will mean that any potential adverse effects on Marine fish species at risk will be of low magnitude, localized extent, temporary, and largely reversible in nature. Moreover, the lack of Project interactions with critical habitat and areas of known and high abundance outside the LSA also indicate that adverse Project effects to species at risk are considered unlikely.

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2.7 Special Areas

2.7.1 Information Requirement: IR-46 (Revised Response - February 2019)

External Reviewer(s): QFN-04-Nx, CEAA; NunatuKavut-17-Nx; KMKNO-27-Nx

Project Effects Link to CEAA 2012: Section 5 - All

Reference to EIS Guidelines: Part 2, Section 6.3 Predicted Effects on Valued Components

Reference to EIS: Section 11.3.3 Environmental Effects Assessment; Section 11.4 Environmental Effects Evaluation; Section 11.5 Environmental Monitoring and Follow-up

Context and Rationale: Section 6.3.8.3 of the EIS Guidelines requires consideration of the effects of the Project on special areas, including, but not limited to the use of dispersants, and change to habitat quality (e.g. noise, light, water, sediment quality). The EIS identifies several special areas within the RSA. The EIS indicates that the analysis of effects on special areas is covered in other VC sections; however, it is not clear where and how routine effects of noise, light, or water and sediment quality on special areas have been fully considered.

Qalipu First Nation and the KMKNO expressed concern about the effects of project related activities on special areas, which are adjacent to or overlap with the Project Area, in particular with respect to sponges and corals as they are easily disturbed and slow to recover.

The NunatuKavut Community Council suggests that as a means by which to reduce the effects of operations on special areas, buffer zones around protected areas should be considered.

Specific Question or Information Requirement: Assess the potential environmental effects of routine Project operations (e.g. noise, light, water, sediment) on special areas that are both overlapping with the Project and on those to which potential effects may extend. Focus the assessment on the defining features of the special areas (e.g. components linked to "special" status). Update the effects assessment, potential mitigation, and follow-up, as appropriate.

Response:

Special Areas

Special areas, were identified, mapped, and described in detail in Section 6.4 and assessed for potential Project effects in Section 11 of the Environmental Impact Statement (EIS). Special Areas were also considered in the sections that describe the existing biophysical and socioeconomic environments. Special areas in offshore Newfoundland have been identified based on defining environmental features including sensitive habitats and the presence of species such as marine fish, marine and migratory birds and marine mammals and sea turtles as described in Sections 6.1, 6.2 and 6.3, respectively. The potential effects of the Project on these valued components (VCs) are presented in Sections 8.3, 9.3 and 10.3. In many cases, these Special Areas in marine and coastal environments have also been identified and/or protected based on socioeconomic interests including reducing the effects of bottom-contact fishing to support the long-term sustainability of commercial fisheries. The effects of the Project on Commercial Fisheries are addressed in Section 13.3 of the EIS. The assessment of potential Project effects on all identified Special Areas is presented in section 11 of the EIS. Where the potential effects of the Project on Special Areas are discussed in this Information Requirement (IR) response, these descriptions of potential effects are based on applicable information presented in the relevant sections of the EIS as noted.

Special Areas in the LSA

Most of the Special Areas identified in Section 6.4 are located on land or in coastal and nearshore areas, well outside of the Project Area (See Table 11.3 in the EIS). Special Areas in offshore locations include various Northwest Atlantic Fisheries Organization (NAFO) Fishing Closure Areas (FCAs) that protect sensitive benthic habitats from bottom fishing activities, but with no associated prohibitions of petroleum exploration and development activities within their boundaries. Other identified Special Areas in the offshore include Vulnerable Marine Ecosystem (VME) areas identified by the NAFO for their high ecological or biological activity, portions of which may eventually be designated as FCAs.

Many of the Special Areas overlapping with the LSA in the offshore are NAFO FCAs and VMEs (Table IR-46.1). In nearshore areas of the local study area (LSA) (within the zone of influence of Project-related marine and air traffic), Special Areas include a Canadian Ecologically and Biologically Significant Area (EBSA) identified as important to seabirds, mammals and sea turtles, an Important Bird Area (IBA) and two National Historic Sites. Following submission of the EIS, the United Nations (UN) Convention on Biological Diversity (CBD) EBSAs have been identified. These are discussed and illustrated in the response to Information Requirement (IR)-47 and, as relevant, identified in the table below. Note that the information below differs somewhat from that found in Section 6.4 and Chapter 11 of the EIS due to the addition of Special Areas noted in IR-47 as well as refinement of some Canadian EBSAs. The Slopes of the Flemish Pass and Grand Bank EBSA has been identified for important coral and sponge habitats, high diversity, threatened and listed species commercial fisheries (Table IR-46.1). Note that due to the refinement of the Placentia Bay Grand Bank (PB/GB) Large Ocean Management Area (LOMA) EBSAs in 2017, the Northeast Shelf and Slope EBSA has been reconfigured. This EBSA no longer overlaps with the vessel and aircraft traffic route or the 10 km zone of influence surrounding it (i.e., the LSA) Thus, it was removed from the list of Special Areas overlapping with the LSA (Table IR-46.1).

One NAFO FCA is located within a Project EL and a small portion a UN CBD EBSA overlaps with both the ELs (Table IR-46.2). These include areas identified and/or protected from bottom-contact fishing due to the presence of high concentrations of corals and sponges and sensitive benthic habitats.

The nine Special Areas listed in Table IR-46.1 overlap with the LSA, which includes the Project Area and zone of influence of the vessel and aircraft traffic routes. Five of these Special Areas have been identified for sensitive benthic habitats including high concentrations of corals and sponges as well as vulnerable, threatened or listed fish species. Two have been identified based on the presence of seabirds and/or waterfowl, and one of these areas also provides seasonal feeding habitat for cetaceans, leatherback turtles and seals. Two sites are designated for historic reasons.

Table IR-46.1 Special Areas Overlapping with the LSA

Special Area	Rationale for Identification / Designation
Flemish Pass/Eastern Canyon (2) NAFO FCA	Various high concentration areas for sponges and corals around the slopes of the Flemish Cap have been closed to bottom fishing due to habitat sensitivity. High species diversity compared with non-sponge ground habitat at similar ocean depths. Dominant sponge species include demosponges of the order Astrophorida. Geodiids (mostly *Geodia barretti*), Stelletta normani and Stryphnus ponderosus in deeper water. These large sponges, sometimes grow to more than 25 cm in diameter. The Flemish Cap is also surrounded by a system of sea pens, which are key biophysical components of soft-bottom VME indicator elements in the NAFO regulatory area. Sea pen "fields", provide important structure in low-relief sand and mud habitats where there is little physical habitat complexity. Such fields provide refuge for small planktonic and benthic invertebrates that may be preyed upon by fish. Crinoids and cerianthids and black corals also have been found associated with this sea pen system.
Northwest Flemish Cap (10) NAFO FCA	
Northwest Flemish Cap (11) NAFO FCA	
Southern Flemish Pass to Eastern Canyons VME	Large gorgonians and high density of sponges. Vulnerable fish species: striped wolffish, redfish, spiny tailed skate, northern wolffish, some black dogfish, deep sea cat shark.
Slopes of the Flemish Cap and Grand Bank UNCBD EBSA	Contains most of the aggregations of indicator species for VMEs in the NAFO Regulatory Area. Encompasses NAFO closures to protect corals and sponges and a portion of Greenland halibut fishery grounds in international waters. High diversity, including threatened and listed species.
Eastern Avalon Canadian EBSA	Seabird feeding areas. Cetaceans, leatherback turtles and seals feed in the area from spring to fall.
Cape Spear Lighthouse National Historic Site	Restored historical lighthouse and lighthouse keepers home on most eastern point of North America.
Quidi Vidi Lake IBA	From late fall to early spring, an important daytime resting site for gulls, including significant numbers of herring, great black-backed, Iceland, glaucous and common black-headed gulls. Ring-billed, mew and occasionally lesser black-backed gulls. Waterfowl including American black ducks, mallards and northern pintails are common in winter.
Signal Hill National Historic Site	Historic site of wireless communication and military defence of St. John's Harbour.
Sources: Templeman (2007); WG-EAFM (2008); NAFO (2015, 2018); Parks Canada (2016); DFO (2016); Bird Studies Canada (2018); UNCBD 2017; FAO 2016	

Table IR-46.2 Special Areas Overlapping with Project Exploration Licences

Exploration Licence	Overlapping Special Areas
EL 1144	• Northwest Flemish Cap (11). • Slopes of the Flemish Cap and Grand Bank UN CBD EBSA.
EL 1150	• Slopes of the Flemish Cap and Grand Bank UN CBD EBSA.

Effects Assessment for Special Areas

As discussed in Section 11 of the EIS, Project activities may have direct effects on important ecological or biological features and aspects of Special Areas that overlap with the LSA. The defining features of the Special Areas that specifically overlap with Project ELs are mainly important benthic habitats such as sponge and coral grounds, which are sensitive areas because of their high biological activity and slow recovery rates. Given the various mitigation measures listed throughout the EIS and below, especially CNOOC Petroleum North America ULC (CNOOC's) commitments to complying with all requirements to avoid damage to coral and sponge habitat (e.g., a pre-drilling seabed investigation survey, a 100 m "set-back" to avoid or reduce interaction with corals and sponges, ongoing consultation with the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB), treatment of synthetic based mud (SBM) associated drill cuttings to meet Offshore Waste Treatment Guidelines (OWTG; NEB 2010), the Project is not likely result in significant adverse effects on Special Areas. The NAFO FCAs have been protected because of their importance to productive commercial fisheries and because of the effects of bottom-contact fishing activity. The potential effects of the Project on commercial fisheries were discussed in Section 13.3 of the EIS.

Other Special Areas in the LSA include those that are adjacent to the Project Area and / or will intersect with the LSA. Table IR-46.1 identifies these Special Areas and their important defining features. These again include marine habitats for bird, fish, mammal and turtle species and National Historic Sites. The presence and operation of the mobile offshore drilling unit (MODU), various related activities and Project traffic may result in associated noise, vibrations, lighting, flaring, discharges and emissions that could affect marine fish, birds and mammals in Special Areas, through disturbance and possibly changes to behaviour (Sections 8.3, 9.3 and 10.3 of the EIS). Oil and gas exploration activities such as those being proposed for this Project are not prohibited within Special Areas that overlap with the Project Area. As described below, CNOOC will implement a number of mitigation measures to address the potential effects of disturbances and discharges / emissions. As a result, for the Special Areas that do interact with planned Project activities, potential Project activities are considered to be not significant.

Summary of Key Mitigation

Key mitigations related to biophysical effects, as summarized in Table 18.2 of the EIS, are also listed below.

Drilling and Cuttings Management:

- Prior to the start of drilling activity, a seabed investigation will be undertaken with a drop camera / video system to investigate the potential presence of sensitive benthic organisms (such as corals and sponges) or habitats in the immediate area of the wellsite. Should coral colonies be observed within or in proximity to a planned wellsite location, a 100 m "set-back" will be applied to avoid or reduce the potential for direct interaction, or other potential effects, on sensitive organisms. This mitigation will adhere to the C-NLOPB's standard regulatory guidance, as follows:
  - Drilling activities, including moorings, shall not occur within 100 m of coral colonies without the prior approval of the Chief Conservation Officer. A coral colony is defined as: *Lophelia pertusa* reef complex; or five or more large corals (larger than 30 centimeters in height or width) within a 100 square metre area.

  - If moving the wellsite in this manner is not feasible, CNOOC will consult with the C-NLOPB to determine an appropriate course of action.
- SBM associated drill cuttings will be returned to the MODU and treated in accordance with the OWTG (NEB 2010) before being discharged to the marine environment. SBM drill cuttings are typically discharged below the sea surface to maximize dispersion to help avoid or reduce any associated surface sheen and accumulation on the seabed.

Discharges, Wastes and Emissions Management:

- The Project will be planned and implemented to avoid or minimize environmental discharges and emissions from its associated operations and activities. This will be achieved through compliance with relevant regulations and standards and company procedures regarding materials selection and use, waste management, and discharge prevention and management for any potential liquid, solid or air emissions, including:
  - Chemicals will be selected and screened pursuant to the OCSG (NEB 2009). Where technically feasible, lower toxicity drilling fluids and chemicals will preferentially be used.
  - Operational discharges (such as sewage, deck drainage, bilge / cooling water, wash fluids, produced water, other waste) will be treated prior to release in compliance with the OWTG, MARPOL and other applicable regulations and standards (NEB 2010; MEPC 2005).
  - Oil-water separators will be used to treat contained oil-contaminated fluids, with collected oil properly stored and disposed of.
  - Appropriate measures will be used for handling, storage, transportation and on-shore disposal of solid and hazardous wastes will be implemented throughout the Project.
  - Sewage and kitchen waste will be macerated to comply with MARPOL and the OWTG (NEB 2010; MEPC 2005).
  - Exhaust emissions will be managed in compliance with the *Canadian Environmental Protection Act*, (CEPA) the National Ambient Air Quality Objectives, the NL Air Pollution Control Regulations and relevant regulations under MARPOL.

Artificial Noise, Vibrations, Lighting and Flaring:

- The frequency of aircraft traffic transits associated with the Project will be minimized to the extent possible. Low-level aircraft operations will also be avoided, wherever possible and feasible, or minimized (except for approach and landing activities).
- Existing and common vessel travel routes will be used wherever practical, vessels will seek to maintain a steady course and vessel speed.
- MODU and supply vessel contractors will maintain their equipment per their management system, to ensure all equipment is properly maintained / operating efficiently, thus reducing risk of excess noise.
- For any required VSP surveys using seismic sound arrays, CNOOC will operate in compliance with the Statement of Canadian Practice (SOCP) with respect to the Mitigation of Seismic Sound in the Marine Environment (DFO 2007). Key mitigations that will be applied include:
  - Seismic sound levels will be kept at the minimum level possible based on the associated technical requirements for the survey.
  - At the commencement of the VSP survey, a gradual "ramp-up" procedure of the seismic sound array will be implemented to allow any mobile marine animals to move away from the area if they are disturbed by it.
  - There will be a planned shut-down of the seismic sound arrays or reduction to the smallest, single source element during any required maintenance activities.

- A trained Marine Mammal Observer (MMO) will monitor and report on marine mammal and sea turtle sightings during any VSP surveys:
  - This will enable sound source array shutdown or delay actions to be implemented if marine mammal or sea turtle species listed on Schedule 1 of SARA are detected within the monitored exclusion zone.
- Project-related artificial lighting will be minimized to the greatest extent possible without compromising safety.
- Flaring will be kept to the minimum amount necessary to characterize the hydrocarbon accumulation and as necessary for the safety of the operation. High efficiency burners will be used when flaring is required, and the Project will consider flare shields if technically and safely feasible. In accordance with C-NLOPB's Measures to Protect and Monitor Seabirds in Petroleum-Related Activity in the Canada-Newfoundland and Labrador Offshore Area, CNOOC will notify the C-NLOPB of plans to flare so that the Board may consult with Environment and Climate Change Canada (ECCC) Canadian Wildlife Service (CWS) to determine a safe timeline to proceed to minimize effects on migratory birds.
- CNOOC will operate in accordance with the Measures to Protect and Monitor Seabirds in Petroleum-Related Activity in the Canada-Newfoundland and Labrador Offshore Area.
- Where possible, known and observed bird colonies, other significant aggregations of avifauna, and other identified sensitive areas will be avoided in the planning and conduct of Project-related exploration activities as per requirements of the Seabird Ecological Reserve Regulations, 2015, which prohibit aircraft flying at an altitude of less than 300 m over ecological reserves over specified time periods.
- As birds are attracted to lighting on offshore platforms and marine vessels, routine searches for stranded birds will be conducted on the MODUs and supply vessels, and appropriate programs and protocols for the collection and release of marine and migratory birds will be implemented for any birds that become stranded, including ECCC-CWS's Oiled Birds Protocol and Protocol for Collecting Dead Birds From Platforms, Best Practices for Stranded Birds Encountered Offshore Atlantic Canada (Draft 2). CNOOC will obtain the necessary Seabird Handling Permit (SHP) from ECCC-CWS.
- If removal of the wellhead is required as part of abandonment procedures, it will be completed via mechanical separation (i.e., cutting, as opposed to the use of explosives).

Monitoring and Follow-Up

These monitoring and follow-up activities will not be for Special Areas specifically but will address these areas as they include sensitive habitats and species.

Marine Fish and Fish Habitat

CNOOC will obtain the required authorizations for the Project, and comply with applicable regulations, guidelines, and mitigation measures as identified and committed to in the EIS, the implementation of which will be planned, managed, and monitored in accordance with existing operational procedures and policies. As was discussed in the EIS, a follow-up program will be undertaken in consideration of sensitive benthic habitat in the following circumstances:

- When a planned well site is located within an identified FCA; or
- In an area where the results of the pre-drill seabed investigation and subsequent review by Fisheries and Oceans Canada (DFO) and C-NLOPB indicate that monitoring is required.

The purpose of the program would be to determine the effectiveness of mitigation measures in protecting the sensitive benthic habitat. It may include:

- Post-drilling visual assessment using high-definition images / video.

If exploration wells are planned to be drilled under the circumstances identified above, a follow-up monitoring plan will be developed and submitted for DFO and C-NLOPB for review prior to commencement of drilling.

Marine and Migratory Birds

CNOOC will develop and implement an operational monitoring program for marine birds throughout the course of the Project. A trained Environmental Observer will be onboard the MODU to record marine bird (and marine mammals) sightings during Project operations, which will be undertaken in accordance with the Environment and Climate Change Canada's Canadian Wildlife Service's (ECCC-CWS) pelagic seabird monitoring protocol, and will utilize other available information and sources, including the guide for pelagic seabirds of Atlantic Canada. A report of the seabird monitoring program, together with any recommended changes, will be submitted to the C-NLOPB and ECCC-CWS on a yearly basis in the format recommended by the regulator.

During Project operations offshore, regular searches of vessel decks will be undertaken and accepted protocols for the collection and release of any birds that become stranded will be implemented by qualified and experienced personnel, in accordance with applicable regulatory guidance and requirements and the ECCC-CWS bird handling permit.

No specific follow-up related to the marine and migratory birds VC is considered necessary in relation to the Project.

Marine Mammals and Sea Turtles

CNOOC will develop and implement an operational monitoring program for marine mammals during VSP surveys for the Project:

- A trained MMO will be onboard to record marine mammal and sea turtle sightings during VSP survey operations that use a seismic sound source.
- Visual monitoring for the presence of marine mammals and sea turtles, within a pre-determined 500m zone, will take place during VSP operations where a seismic sound source array is used.
- Observational / shutdown procedures will follow the SOCP for marine mammals and sea turtles (DFO 2007).
- A report of the observational program will be submitted annually to the C-NLOPB and DFO, including documentation of marine mammal and sea turtle sightings.
- Any vessel strikes involving marine mammals or sea turtles will be reported to DFO within 24 hours.

No specific follow-up related to the marine mammals and sea turtles VC is considered necessary in relation to the Project to confirm effects predictions or the effectiveness of the proposed mitigation measures.

In terms of the various Special Areas that overlap with the LSA (both offshore and along the associated support vessel and aircraft traffic route), the overall and defining physical, biological and socioeconomic environments within these areas will not be adversely affected by planned Project activities. A pre-drilling seabed investigation survey will be used to identify coral and sponge habitats so that direct contact can be avoided.

References:

DFO (Fisheries and Oceans Canada). 2007. Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment. Available online: http://waves-vagues.dfo-mpo.gc.ca/Library/363838.pdf. Accessed June 2018.

MEPC (Marine Environment Protection Committee). 2005. Guidelines for the Application of the Revised MARPOL Annex I Requirements to Floating Production, Storage and Offloading Facilities (FPSOs) and Floating Storage Units (FSUs). http://www.imo.org/en/KnowledgeCentre/IndexofIMOResolutions/Marine-Environment-Protection-Committee-%28MEPC%29/Documents/MEPC.139%2853%29.pdf.

NEB (National Energy Board). 2009. Offshore Chemical Selection Guidelines. Available at: https://www.cnsopb.ns.ca/pdfs/chemicalguidelines.pdf.

NEB (National Energy Board). 2010. Offshore Waste Treatment Guidelines. Available at: https://www.cnlopb.ca/wp-content/uploads/guidelines/owtg1012e.pdf.

2.7.2 Information Requirement: IR-47 (Revised Response – February 2019)

External Reviewer(s): DFO 32 Nx, DFO-26 Ax NX, KMKNO-28-Nx

Project Effects Link to CEAA 2012: Section 5 – All

Reference to EIS Guidelines: Part 2, Section 6.3 Predicted Effects on Valued Components

Reference to EIS: Section 11.3.3 Environmental Effects Assessment (All Planned Components and Activities) Table 11.3

Context and Rationale: There are Ecologically and Biologically Significant Areas (EBSA) identified by the Conference of the Parties to the Convention on Biological Diversity located outside Canada's exclusive economic zone in the Northwest Atlantic, which overlap with the RSA and Project Area and which were not identified in the EIS. These areas include: the Seabird Foraging Zone in the Southern Labrador Sea and Labrador Sea Deep Convection Area; and two marine refuges in the Newfoundland-Labrador Shelves Bioregion, specifically the Hopedale Saddle Closure and the Hatton Basin Conservation Area. Relevant documents can be found at:

- http://www.dfo-mpo.gc.ca/oceans/oeabcm-amcepz/refuges/index-eng.html;
- https://chm.cbd.int/database/reco rd?documentID=204102; and
- https://chm.cbd.int/database/record?documentID=204101.

In addition, the Laurentian Channel should be listed as an Area of Interest or a proposed Marine Protected Area, as it has not been designated as a Marine Protected Area under the *Oceans Act*.

Specific Question or Information Requirement: Further to IR-46, provide updated tables and a related figure with listings of all Special Areas that could be affected by the Project. Indicate closest distance to ELs 1144 and 1150 and potential for vessels to transect Special Areas. Where analysis in relation to specific Special Areas has not been included in the EIS (e.g. Seabird Forage Zone in Southern Labrador Sea, the Labrador Sea Deep Convection Area EBSA, Hopedale Saddle Closure, and Hatton Basin Conservation Area), conduct an assessment of potential effects, proposed mitigation and follow-up, as well as effects predictions, for routine activities and accidental events.

Response:

ADDITIONAL AND REVISED SPECIAL AREAS

Section 6.4 of the Environmental Impact Statement (EIS) presents information, tables and figures to describe all identified Special Areas within the extent of the identified study areas. This information shows intersections of, and distances between, the Project ELs / the Project Area and identified Special Areas as well as proximity to all Special Areas within the Regional Study Area (RSA) and the larger Eastern Newfoundland offshore area for regional context. Section 11 of the EIS presents the effects assessment for Special Areas. The following text provides updated or additional information on Special Areas identified or changed since the submission of Section 11 of the EIS.

Marine Refuges

Section 6.4.1.4 of the EIS illustrates and discusses Marine Refuges off eastern Newfoundland. Three Marine Refuges are in the RSA. These include Northeast Newfoundland Slope Closure (formerly known as Tobin's Point), Funk Island Deep Closure and Hawke Channel Closure, none of which intersect with the LSA (i.e.,

Project Area and zone of influence for potential Project effects) as discussed in Section 6.4 and Section 11 of the EIS. The Hopedale Saddle Closure Marine Refuge and Hatton Basin Conservation Area Marine Refuge are off the coast of Labrador outside of the RSA) and thus, were not identified or addressed in the EIS.

UN Convention on Biological Diversity EBSAs

In 1992, Canada ratified the UN Convention on Biological Diversity, which came into effect in December 1993. Identified EBSAs include ocean habitat areas of eastern Newfoundland and Labrador outside of Canada's Exclusive Economic Zone (EEZ) (Figure 2.2 of the EIS). These EBSAs are described based on their defining features in Table 47.1 below. The Project Area and LSA (i.e., zone of influence of the Project) intersect with the Slopes of the Flemish Cap and Grand Bank UNCBD EBSA.

Table IR-47.1 UN Convention on Biological Diversity EBSAs

EBSA	Rationale for Identification/Designation	Area
Labrador Sea Deep Convection Area	The only North-West Atlantic site where winter convection exchanges surface and deep ocean waters. Provides mid-water overwintering refuge for pre-adult *Calanus finmarchicus*, a key species for zooplankton populations of the Labrador Shelf and downstream areas. Annual variability in convection results in significant yearly change through ecosystems of the North-West Atlantic.	Approximately 43,278 km^2. Not a fixed geographic area but delineated annually by physical oceanographic properties
Seabird Foraging Zone in the Southern Labrador Sea	Supports globally significant populations of marine vertebrates, including an estimated 40 million seabirds annually. Important foraging habitat for seabirds, including 20 populations of over-wintering black-legged kittiwakes (*Rissa tridactyla*), thick-billed murres (*Uria lombia*) and breeding Leach's storm-petrels (*Oceanodroma leucorhoa*). Encompasses the pelagic zone of the Orphan Basin, continental shelf, slope and offshore waters inside and outside the Canadian EEZ.	152,841 km^2
Orphan Knoll	Seamounts typically support endemic populations and unique faunal assemblages. This seamount is an island of hard substratum with uniquely complex habitats that rise from the seafloor of the surrounding deep, soft sediments of the Orphan Basin. Although close to the adjacent continental slopes, Orphan Knoll is much deeper and appears to have distinctive fauna. Fragile and long-lived corals and sponges have been observed and a Taylor Cone circulation provides a mechanism for retention of larvae.	12,742 km^2
Slopes of the Flemish Cap and Grand Bank	Contains most of the aggregations of indicator species for VMEs in the NAFO Regulatory Area. Includes NAFO closures to protect corals and sponges and a component of Greenland halibut fishery grounds in international waters. A high diversity of marine taxa, including threatened and listed species, are found within the EBSA.	87,817 km^2
Source: UNCBD (2017)		

Other Special Areas

Since the EIS was submitted, other Special Areas (e.g., Snowcrab Stewardship Exclusion Zones and Lobster Closure Areas), have been identified in the marine environment. In addition, the Canadian EBSAs have been refined. These changes to the existing environment are discussed in the following paragraphs.

Canadian fisheries closures include marine and coastal areas where certain types of fishing activities are restricted or prohibited. Snow crab fishing is prohibited in various Stewardship Exclusion Zones including portions of Bonavista Bay, Trinity Bay, Conception Bay, the Eastern Avalon and St. Mary's Bay as well as Near Shore and Mid Shore crab fishing areas (DFO 2015). Lobster fishing is prohibited in seven areas (totaling 94 km^2) around coastal Newfoundland to protect lobster spawning habitat and increase egg production (DFO 2017). Two Lobster Closures (i.e., Gooseberry Island and Gander Bay) are in the RSA in Eastern Newfoundland.

In 2016-2017, DFO revaluated the PBGB-LOMA EBSAs. Complete and final detailed information on the revised EBSAs have not yet been released publicly (N. Wells pers comm 2018). Based on draft information, five new EBSAs have been delineated, two areas are no longer listed as EBSAs and the total combined EBSA area has been increased by 26 percent. Portions of the EBSAs that previously extended beyond the Canadian EEZ into the NAFO regulatory area are no longer considered to be within EBSA boundaries (DFO 2016). These Special Areas and their defining features are included in the effects assessment as appropriate.

The following effects assessment has been updated to address changes to Special Areas, as identified above (i.e., Marine Refuges, UN Convention on Biological Diversity EBSAs, Snow Crab Stewardship Exclusion Zones, Lobster Closures and revised Canadian EBSAs) and to address the request in IR-47. Also, to provide a more detailed effects assessment than the EIS, all Special Areas in the RSA have been included in this analysis. Sections 11.0 to 11.3.2 of the EIS have not been revised. Sections 11.3.3 to 11.5 of the EIS have been updated with the following information.

SPECIAL AREAS: REVISED ENVIRONMENTAL EFFECTS ASSESSMENT Environmental Effects Assessment (Updated Section 11.3.3 of the EIS)

This section summarizes the residual effects of the Project on Special Areas and presents a determination of significance for the environmental effects assessment for this VC. Some of the key components and activities, and potential interactions, that may be associated with the Project and which would be particularly relevant to the environmental effects analysis for Special Areas, include:

- Presence and operation of MODUs (including lights, noise, air emissions, positioning / mooring, on-site vessels, seabed investigation);
- Drilling and associated marine discharges (including fluids and cuttings);
- Vertical seismic profiling;
- Well testing;
- Well abandonment or suspension; and
- Supply and servicing.

Based on these various components and activities, some of the key potential environmental issues and potential environmental changes that may be associated with the Project are identified below:

- The general presence of Project components (MODUs, vessels, other equipment) and activities in the offshore environment, including the noise, light and other associated disturbances.
- Possible effects on water quality and on the seabed (benthic) environment due to physical disturbance of the substrate (and associated sedimentation), the discharge and deposition of drill cuttings and fluids, and other potential environmental emissions during planned activities.
- Potential changes in the presence, abundance, diversity and health of marine biota in the area due to potential injury or mortality, or possible behavioral effects. This may include temporary avoidance of areas by marine fish, birds, mammals and sea turtles due to underwater noise or other disturbances, which may alter their presence and abundance as well as disturbing movements/migration, feeding or other activities. There may also be possible attraction of marine fish, birds, mammals and sea turtles to MODUs and vessels, with increased potential for injury, mortality, contamination or other interactions (e.g., collisions).

These or other environmental changes and biophysical effects resulting from planned Project components and activities may, in turn, have adverse effects on Special Areas by affecting their real or perceived overall ecological characteristics, integrity, use and value. Project activities may also result in direct interference with, and possible reduced human access to, important and valued marine areas during Project activities in certain locations, with possible decreases in these activities and their success, efficiency, value or enjoyment. A description (and mapping) of each of the marine and coastal areas within and adjacent to the Project Area/LSA and RSA that have been designated as protected or identified as otherwise special or sensitive was provided in Section 6.4 of the EIS. The following sections provide an assessment and evaluation of the potential effects of planned Project activities on these Special Areas. Again, the previously identified mitigation measures are considered integrally within the environmental effects analysis, as relevant.

Table 47.2 below provides a summary of the (minimum) distance between the edge of the Project Area, ELs 1144 and 1150, and LSA, and the various Special Areas in the RSA. As indicated, planned Project activities will occur in an offshore marine area that is more than 400 km from the shoreline of Eastern Newfoundland. These planned Project activities will therefore not occur within, or otherwise interact directly with, any of the existing provincially-defined Special Areas (e.g., Provincial Ecological Reserves, Parks and Protected Areas or Historic Sites). Likewise, the Project will not have a direct interaction with most federally designated areas (e.g., Marine Protected Areas, Fisheries Closures within Canada's EEZ, Preliminary Representative Marine Areas, Migratory Bird Sanctuaries, National Parks and Historic Sites). International designations such as Important Bird Areas will also not be directly affected by the Project.

The Project Area intersects with small portions of three NAFO FCAs and one UNCBD EBSA (Table 47.2). Only one of these NAFO Closure Areas and the UNCBD EBSA intersect with any part of the ELs themselves (Figure 47.1). Various other Special Areas (VMEs, NAFO FCAs, a Marine Refuge, and a Canadian EBSA) are located within the general vicinity of the Project but do not intersect with the LSA, which encompasses the identified general vessel/aircraft traffic route from Eastern Newfoundland to the Project Area. As it surrounds the Project Area, the LSA intersects the four Special Areas in the Project Area as well as a VME, in the offshore. The LSA also intersects with a Canadian EBA, two Snow Crab Stewardship Exclusion Zones, two National Historic Sites, and an IBA.

Table IR-47.2 Summary of Minimum Distances for Special Areas in the RSA (Updated Table 11.3 of the EIS)

Special Areas	Minimum Distance (km)		
	PROJECT AREA	EL 1144 and/or EL 1150	LSA
Canadian EBSAs			
Northeast Slope	33	54	10
Eastern Avalon	358	380	Intersects
Virgin Rocks	237	265	69
Lilly Canyon-Carson Canyon	197	231	187
Southeast Shoal	336	370	298
Southwest Slope	514	549	274
Placentia Bay	493	513	72
Smith Sound	446	469	69
Fogo Shelf	451	477	181
Grey Islands	552	579	273
Notre Dame Channel	431	458	225
Orphan Spur	223	251	180
St. Mary's Bay	468	490	59
Haddock Channel Sponges	533	558	190
Baccalieu Island	354	376	3
Bonavista Bay	456	481	105
Marine Protected Areas and Areas of Interest			
Eastport - Duck Island	484	508	140
Eastport - Round Island MPA	492	515	130
Marine Refuges			
Northeast Newfoundland Slope Closure	40	67	30
Funk Island Deep Closure	428	456	224
Federal Fisheries Closure Areas			
Funk Island Deep Box	428	456	224
Eastport Peninsula Lobster Management Area	470	494	127
Snow Crab Stewardship Exclusion Zones			

Special Areas	Minimum Distance (km)		
	PROJECT AREA	EL 1144 and/or EL 1150	LSA
Crab Fishing Area 5A	404	429	104
Crab Fishing Area 6A	381	403	49
Crab Fishing Area 6B	413	391	3
Crab Fishing Area 6C	360	381	Intersects
Crab Fishing Area 8A	387	410	62
Crab Fishing Area – 8BX	113	140	60
Crab Fishing Area 9A	464	486	57
Crab Fishing Area Near Shore	309	330	Intersects
Lobster Closure Areas			
Eastport Peninsula Lobster Management Area	470	494	126
Gander Bay	552	578	232
Gooseberry Island	483	504	86
Preliminary Representative Marine Areas			
Virgin Rocks	230	256	54
South Grand Bank Area	281	315	268
Northwestern Conception Bay	402	424	30
Migratory Bird Sanctuaries			
Terra Nova	500	524	140
Coastal National Parks			
Terra Nova	484	507	125
Coastal National Historic Sites			
Cape Spear Lighthouse	403	423	Intersects
Signal Hill	407	427	Intersects
Ryan Premises	440	464	114
Castle Hill	507	528	91
Coastal Ecological Reserves			
Baccalieu Island	413	435	54
Witless Bay	418	440	28

Special Areas	Minimum Distance (km)		
	PROJECT AREA	EL 1144 and/or EL 1150	LSA
Mistaken Point	461	484	98
Cape St. Mary's	531	553	130
Funk Island	477	504	237
Provincial Parks			
The Dungeon	438	462	116
Chance Cove	445	468	81
Windmill Bight	486	511	190
Bellevue Beach	487	507	69
Deadman's Bay	497	523	200
Gooseberry Cove	518	540	108
Provincial Historic Sites			
Cape Bonavista Lighthouse	439	463	119
Heart's Content Cable Station	457	478	50
United Nations Convention on Biological Diversity EBSAs			
Slopes of the Flemish Cap and Grand Bank	Intersects	Intersects	Intersects
Orphan Knoll	211	239	201
Seabird Foraging Zone in the Southern Labrador Sea	179	200	169
Vulnerable Marine Ecosystems			
Southern Flemish Pass to Eastern Canyons	6	31	Intersects
Northern Flemish Cap	32	64	22
Sackville Spur	36	57	26
Northeast Shelf and Slope (within Canadian EEZ)	36	57	14
Beothuk Knoll	60	81	50
Flemish Cap East	171	193	161
South East Shoal and Adjacent Shelf Edge/Canyons	329	360	292
Deep Water Coral Area	120	147	110
Division 3O Coral Closure	553	588	318
NAFO Fisheries Closures			

Special Areas	Minimum Distance (km)		
	PROJECT AREA	EL 1144 and/or EL 1150	LSA
Tail of the Bank (1)	327	358	317
Flemish Pass/Eastern Canyon (2)	Intersects	15	Intersects
Beothuk Knoll (3)	117	138	107
Eastern Flemish Cap (4)	137	162	127
Northeast Flemish Cap (5)	120	150	110
Sackville Spur (6)	39	59	29
Northern Flemish Cap (7)	56	89	46
Northern Flemish Cap (8)	79	111	69
Northern Flemish Cap (9)	58	88	48
Northwest Flemish Cap (10)	Intersects	6	Intersects
Northwest Flemish Cap (11)	Intersects	Intersects	Intersects
Northwest Flemish Cap (12)	25	52	15
Beothuk Knoll (13)	77	97	67
Eastern Flemish Cap (14)	130	150	120
3O Coral Closure	551	586	318
Orphan Knoll Seamount	227	248	217
Newfoundland Seamounts	339	359	329
Fogo Seamounts 1	664	698	550
Fogo Seamounts 2	753	785	706
Important Bird Areas			
Quidi Vidi Lake	406	426	Intersects
Cape St. Francis	408	428	13
Baccalieu Island	410	432	49
Witless Bay Islands	414	435	21
Grates Point	416	438	52
Mistaken Point	452	476	96
Funk Island	471	498	230
Cape Freels Coastline and Cabot Island	472	497	163

Special Areas	Minimum Distance (km)		
	PROJECT AREA	EL 1144 and/or EL 1150	LSA
Terra Nova National Park	480	503	119
The Cape Pine and St. Shotts Barren	483	506	109
Placentia Bay	497	518	81
Wadham Islands and adjacent Marine Area	507	533	221
Cape St. Mary's	521	543	120
UNESCO World Heritage Sites			
Mistaken Point	459	483	101

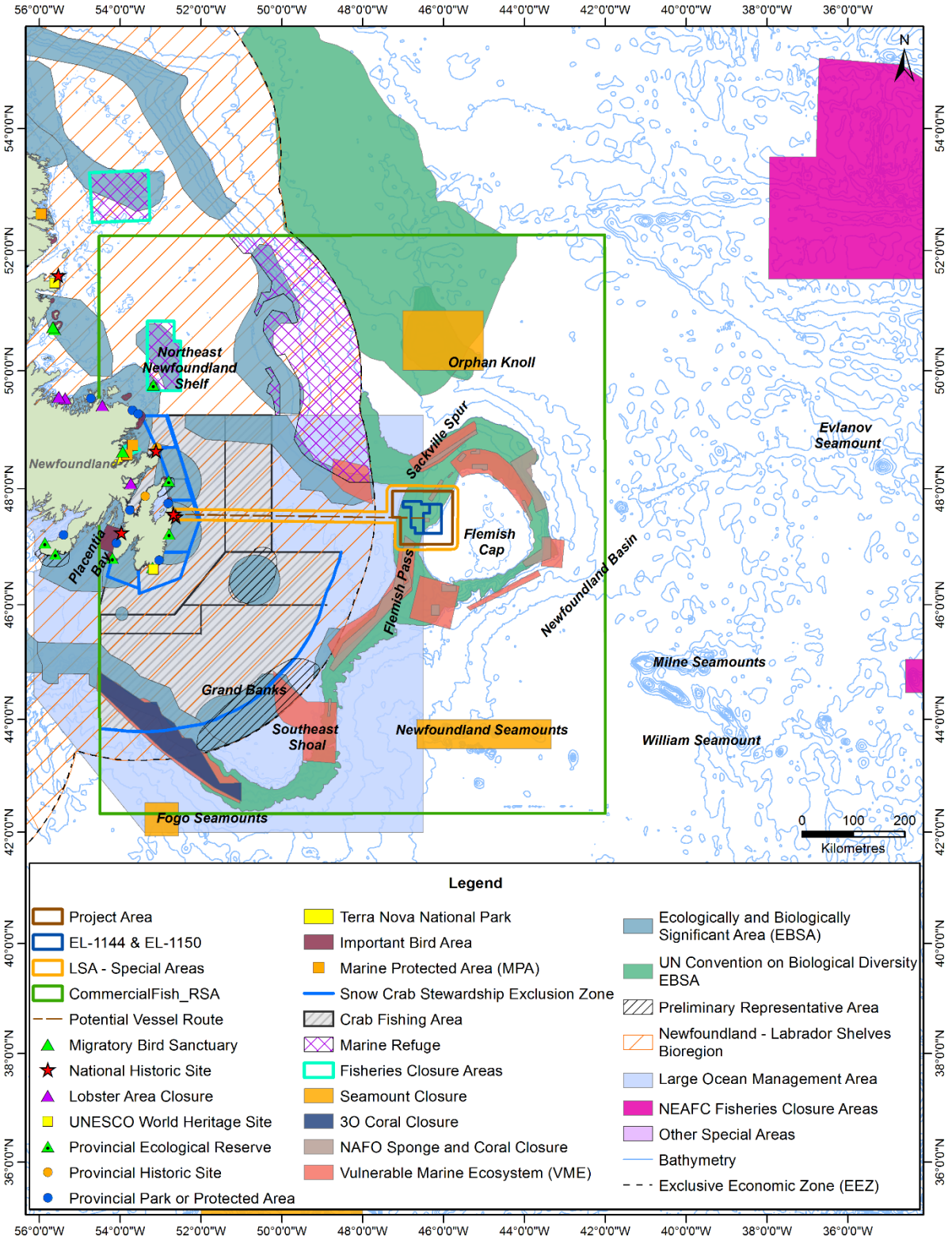


Figure IR-47.1 Overview of Special Areas in the RSA

Presence and Operation of the MODU

As described in Section 2 of the EIS, the Project will include drilling of up to 10 exploration wells in CNOOC-operated licences (ELs 1144 and 1150). The offshore exploration drilling program will involve positioning and operation of a MODU, which may include use of semi-submersibles and/or drill ships.

The presence and operation of a MODU and supporting vessels may result in associated environmental interactions with Special Areas in the marine environment. Drilling operations will involve direct interaction with the seabed itself through any required anchoring. In addition, marine fish and invertebrates may be exposed to underwater noise, lighting and other environmental discharges that may be associated with Project activities.

Two Special Areas intersect with Project ELs (Figure 47.2). These are Northwest Flemish Cap (11) NAFO FCA, which has been identified and protected for coral and sponge habitat (Table 47.3). The Slopes of the Flemish Cap and Grand Bank UNCBD EBSA has also been identified for benthic habitats, including corals and sponges, as well as high biodiversity and a portion of a commercial fishery.

Table IR-47.3 Defining Features Special Areas Intersecting Project ELs

Special Areas	Defining Features
Slopes of the Flemish Cap and Grand Bank UNCBD EBSA	Aggregations of corals and sponges and high diversity of marine taxa including threatened and listed species (i.e., Marine Fish and Fish Habitat) Includes a component of the Greenland halibut fishery grounds in international waters (i.e., Marine Fisheries)
Northwest Flemish Cap (11)	Closed to protect high coral and sponge concentrations (e.g., crinoids, cerianthids and black corals). Includes sea pen fields, which serve as habitat structure in low-relief sand and mud habitats and provide refuge for small planktonic and benthic invertebrates (i.e., Marine Fish and Fish Habitat).

The presence and operation of a MODU will include localized direct physical interaction with the seabed and may result in exposure, injury, and / or mortality of benthic organisms, including corals, sponges and sea-pens. These organisms are vulnerable to physical disturbance due to their low avoidance capabilities (Clark et al. 2016; Cordes et al. 2016). Coral and sponge biogenic habitats, where habitat is created by an organism itself, are fragile and recover slowly (Cordes et al. 2016). See Section 8 Marine Fish and Fish Habitat VC of the EIS for more detailed information on potential Project effects.

In fine mud substrate habitat, such as that common in the Flemish Pass (Murillo et al. 2016), Project activities may temporarily disturb the seabed environment, resuspending sediments. An increase or change in suspension solids may clog feeding structures of filter-feeding organisms, including corals, sponges, and sea pens (Bell et al. 2015; Liefmann et al. 2018; Vad et al. 2018).

While anthropogenic sound associated with offshore oil and gas activities is transmitted through water and may result in disturbances to marine biota, there is no direct evidence of mortality to marine fish and invertebrates resulting from exposure to continuous underwater sound (Popper and Hastings 2009; Popper et al. 2014). Mobile, and sessile species depending on life stages (many sessile species have mobile larval stages), can move away from an area temporarily if they are disturbed by operational noises and this may result in localized area avoidance.

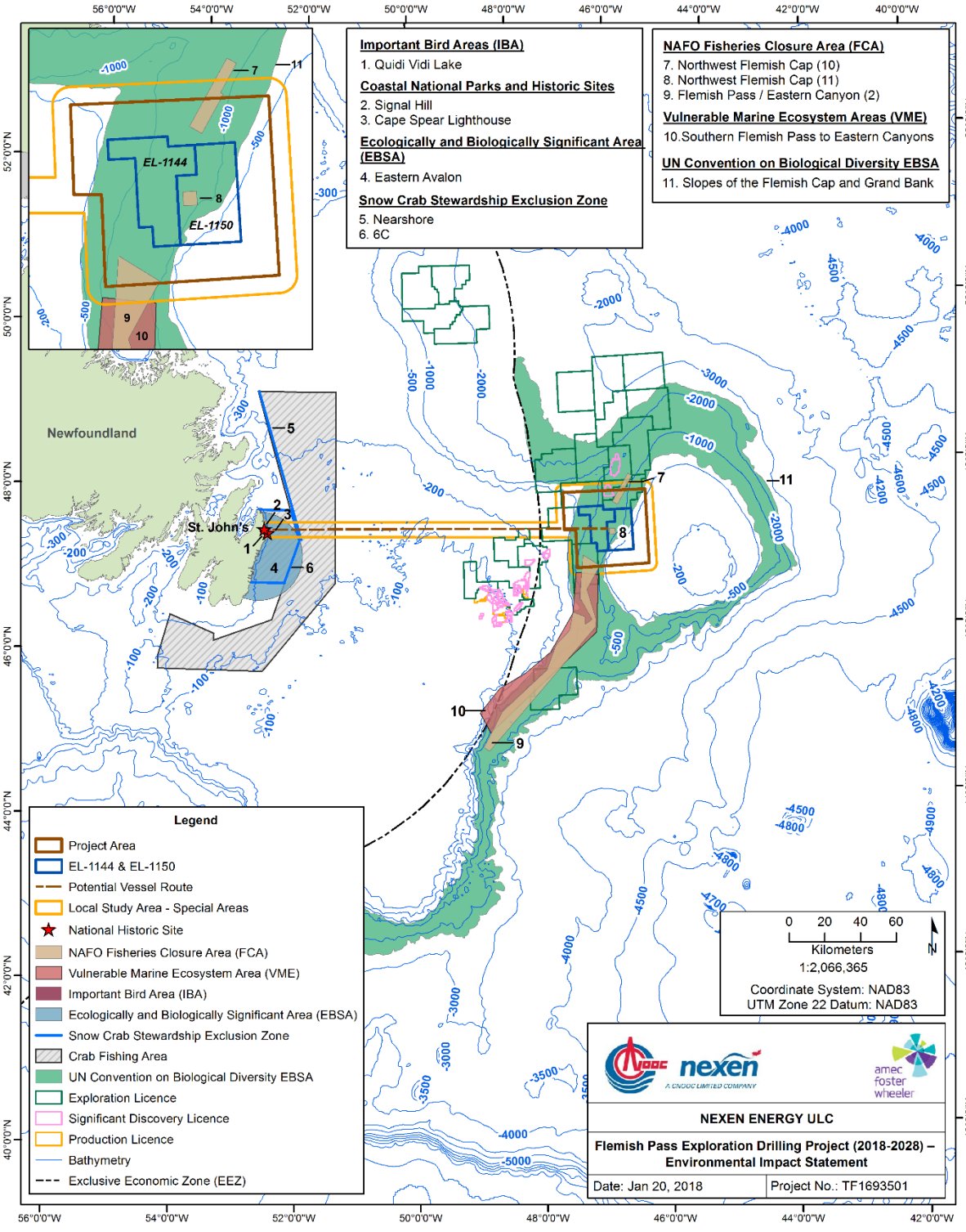


Figure IR-47.2 Special Areas Intersecting the LSA (Updated Figure 11.2 of the EIS)

The Slopes of the Flemish Cap and Grand Bank UNCBD EBSA is also noted as having high biodiversity, which likely includes fish and invertebrate species. Suspended sediments resulting from subsea activities may promote temporary avoidance of the Project Area by mobile fish and invertebrates, particularly visual predators. Project activities will likely result in low intensity sounds that also promote temporary avoidance of the area by mobile fishes with return after cessation of the underwater noise (Bergström et al. 2014, Popper and Hastings 2009). Section 8 of the EIS has determined that with implementation of proposed mitigation measures to avoid or reduce residual Project effects, the Project is unlikely to result in significant adverse effects on Marine Fish and Fish Habitat including benthic habitats.

The MODU operator will manage and dispose of waste products in accordance with applicable regulations and standards and CNOOC will establish a Waste Management Plan for the Project. Proper waste management practices and adherence to associated regulatory requirements will minimize potential effects. The relatively low discharge volumes that are released high in the water column would likely become highly dispersed in the marine environment. Other potential environmental discharges include oily water and other substances. All wastewater will be treated to minimize contaminant or hydrocarbon levels prior to discharge in accordance with the OWTG and other regulatory requirements.

Human use of the Project Area is mainly limited to activities such as commercial fisheries, oil and gas exploration and production, and marine transportation. A portion of the Greenland Halibut fishery in international waters has been identified as being within the Slopes of the Flemish Pass and Grand Bank UNCBD EBSA. However, as this EBSA is so large (i.e., 87,817 km2) and the Greenland Halibut fishery is limited within the Project Area (additional information is included in Section 13.3 of the EIS), limited access to the Project Area is not likely to result in Project-related effects on the Greenland halibut fishery in this special area. Section 13 of the EIS has determined that with the implementation of the proposed mitigation measures to avoid or reduce residual Project effects, the Project is unlikely to result in significant adverse effects on Fisheries and Other Ocean Uses.

Residual Environmental Effects Assessment (Presence and Operation of the MODU)

As described in Section 8 of the EIS, and above, the Project is not expected to result in significant adverse effects upon marine fish or habitat such as that of the Slopes of the Flemish Cap and Grand Bank UNCBD EBSA and Northwest Flemish Cap (11) NAFO FCA. Therefore, it is not likely to adversely affect the ecological features, processes and integrity, nor the human use and societal value, of these Special Areas.

The primary interactions, resulting from the presence and operation of MODUs, that may have adverse effects on these Special Areas are direct interaction with the seabed and resuspension of sediments, which may result in injury or mortality to benthic species. Disturbances from exposure to sound from Project activities may result in temporary avoidance by fish species. Section 8 of the EIS has determined that the number of individuals that may be affected is not anticipated to have overall ecological or population-level effects. The localized extent of the activities, along with the implementation of planned mitigation measures, will mean that any potential residual effects on these Special Areas may be adverse, low in magnitude and localized, short-term, regular and reversible. This prediction is made with a high level of confidence.

Drilling and Associated Marine Discharges

As discussed, the defining features of Special Areas (i.e., the Slopes of the Flemish Pass and Grand Bank UNCBD EBSA and NAFO FCAs) that intersect with the Project Area are mainly the presence of sensitive benthic habitats. Physical interaction with the seabed may result in direct disturbance to the seafloor and benthic habitats. This may also result in exposure, injury, and / or mortality of benthic organisms, including corals, sponges and sea-pens, through burial by deposition of cuttings and the introduction of suspended solids in the water column.

Drilling will include discharge of associated drill cuttings. Corals and sponges are particularly sensitive to deposited drill cuttings and suspended mud particles as well as smothering through burial (Larsson and Purser 2011; Allers et al. 2013; Bell et al. 2015; Purser 2015; Järnegren et al. 2016; Ragnarsson et al. 2017; Liefmann et al. 2018; Vad et al. 2018, Baussant et al., 2018). Suspension-feeding structures of sessile species may become clogged by suspended drill cuttings or sediment (Neff et al. 2000; Smit et al. 2006). Increased larval mortality and change in feeding behaviour of corals has been identified due to exposure to cuttings particles (Raimondi et al. 1997, Neff 2010; Buhl-Mortensen et al. 2015; Järnegren et al. 2016; Ragnarsson et al. 2017), although some corals have higher tolerance to drill fluid deposition (Allers et al. 2013). As described in Section 2.9 of the EIS, all chemicals that will be utilized as part of the Project – including drilling fluids – will be screened and selected in accordance with the OCSG and in accordance with CNOOC's chemical screening and management practices.

WBMs have varied effects on marine species but due to the non-toxic nature of the drilling fluid components (Neff 2010), are not likely to result in chemical toxicity (Holdway 2002; Trannum et al. 2010, 2011; Bakke et al. 2013; Purser 2015). Any released WBM and WBM-associated drill cuttings resulting from the Project have potential for low adverse effects as these materials are associated with low toxicity, have low bioaccumulation and only localized biological effects (Deblois et al. 2014).

Based on laboratory experiments and field evaluations of SBM-associated drill cuttings piles, acute toxicity of SBMs is relatively low (Still et al. 2000; Tsvetnenko et al. 2000; Hamoutene et al. 2004; Paine et al. 2014; Tait et al. 2016). Any potential effects on these Special Areas are likely to be temporary in nature as SBMs biodegrade within a few years (Terrens et al. 1998; Ellis et al. 2012; IOGP 2016). Any released SBM and SBM-associated drill cuttings resulting from the Project will not result in adverse effects from contamination of marine biota or habitats, as these materials have low toxicity and localized biological effects (Bakke et al 2013; Deblois et al 2014). As previously stated, CNOOC will use proven and practicable best available technologies and practices for the treatment of SBM cuttings prior to discharge.

Detailed drill cuttings dispersion modelling was prepared to provide Project-specific information and analysis related to the nature and extent of drilling fluid and associated cuttings deposition. This included modelling at representative sites within each of the two exploration licenses (EL 1144 and EL 1150) to evaluate the potential dispersion and eventual seabed "footprint" of these cuttings in seasonal scenarios (for more information see Section 8.2 or Appendix D of the EIS).

The modelling indicated that deposition of WBM and SBM drill cuttings will be highly localized with most materials predicted to settle within 500 m of a well head. Small quantities (less than four percent) of SBM cuttings are predicted to disperse beyond 1-2 km from the deepwater wellsite with predicted accumulations (less than 0.1 mm) well below Predicted No Effect Threshold (PNET) values. Due to the relatively low quantities, dispersed SBM cuttings are only expected to have low potential for interactions with organisms in the water column and benthic areas beyond 1-2 km from the wellsite.

The initial high settling of particles and relatively low quantities of dispersed cuttings beyond two kilometres also indicates that there should not be any substantial interaction with pelagic species. Project Area depths are beyond the photic zone. Therefore, it is also not expected that there will be any interaction with marine macroflora species. Discharge of drill cuttings particles may form aggregates with phytoplankton resulting in rapid settling of plankton to the seafloor (Pabortsava et al 2011). However, due to the low quantities, it is unlikely that there will be high settling or turbidity effects that may adversely affect any suspended phytoplankton species.

A deep-water drilling site (380 m depth) in the Faroe-Shetland Channel produced similar project footprints with 30,700 m2 covered completely by cuttings and greater than 70,890 m2 partially covered by cuttings (Jones et al 2012). Environmental monitoring of the site showed relatively higher faunal density and richness three and 10 years from the initial disturbance indicating recovery of the site over time (Jones et al 2012). Localized accumulations indicate that potential burial effects are relatively low spatially and presence of surrounding undisturbed areas may further promote recolonization and recovery.

As described in Section 8.3.2 of the EIS, prior to the start of drilling activity at a wellsite, a seabed investigation will be undertaken with an underwater video system to investigate the potential presence of aggregations of sensitive benthic organisms or habitats in the immediate area (such as corals gardens and sponge grounds). Should such organisms be observed within or in proximity to a planned wellsite location, CNOOC will move the wellsite where possible to avoid or reduce the potential for direct interaction with them or other potential effects (such as sedimentation or burial from drill cuttings disposal). In addition, the likely distance between individual wells that will be drilled as part of this Project means that there is also little or no potential for these environmental releases from individual wells to interact or accumulate in the LSA.

Residual Environmental Effects Assessment (Drilling and Associated Marine Discharges)

Exploration drilling activities associated for this Project have the potential to result in injury or mortality of benthic species and habitats. This could be due to direct contact or deposition of drilling cuttings and muds. Both WBMs and SBMs are used at various stages of well drilling. Predrilling coral surveys will be used to identify and avoid sensitive benthic habitats.

WBM drilling fluids and associated cuttings will be discharged directly to the seabed, as permitted under the OWTG. As described in Section 2.9 of the EIS, all chemicals that will be utilized as part of the Project – including drilling fluids – will be screened and selected in accordance with the OCSG and in accordance with CNOOC 's chemical screening and management practices. Any released WBM and WBM-associated drill cuttings resulting from the Project are not anticipated to result in adverse effects from contamination of marine biota or habitats.

SBM-associated drill cuttings are permitted to be discharged at the drill site provided they are appropriately treated prior to discharge in accordance with proven and practicable best available technologies and practices. SBM drill fluids and cuttings will be returned to the MODU for treatment. Once onboard the MODU, drill cuttings will be separated from the drilling fluids. Most fluids will be reconditioned and reused, and any spent SBM fluids will be returned to shore for disposal or recycling/reuse.

In summary, discharged volumes of WBM and SBM drill cuttings will be highly localized to the wellsite with very low quantities dispersing widely. The predicted small footprint limits smothering effects on benthic species to less than 500 m around the wellsite. The remaining low quantities of cuttings dispersed beyond two kilometres are not predicted to have any potential interactions due to the expected low concentration

in the water column and lack of accumulation on the seabed. Released SBM associated drill cuttings will be treated in accordance with the OWTG to minimize any toxic and bioaccumulation effects.

With the application of mitigations outlined throughout this VC, drilling and associated discharges are predicted to have adverse but low magnitude effects, primarily localized, but occurring within the Project Area overall, long-term duration, regular and reversible with eventual recovery and recolonization. These predictions were determined with a high level of confidence.

Vertical Seismic Profiling

VSP acquisition surveys are typically short-term activities of one to two days duration, with seismic source activation often limited to just a few hours. The VSP array and its sound emissions are also typically small and localized, with the majority of sound directed downwards into the well and a lesser degree directed horizontally. The effects of VSP surveys have not been well studied and the available literature mainly describes the effects of larger offshore seismic (geophysical) surveys. Sound emitted during a 3D / 4D seismic survey represents the worst-case scenario with respect to exposure of marine species to underwater sound. Appendix E provides an analysis of the underwater sound that will be generated by the VSP surveys such as those that may be generated as part of this Project. Section 8 of the EIS provides a comprehensive discussion of the potential effects of geophysical surveys on marine fish and invertebrates.

The Special Areas that intersect with the Project ELs are identified for the presence of aggregations of corals and sponges, though one of these areas is also identified for general high biodiversity. The principal aspects of VSP surveys that have potential to cause effects on these Special Areas are those that interact with benthic habitat or result in artificial light and underwater sound. Underwater noise generated by geophysical activities has the potential to affect fish and invertebrate species. Most fishes and invertebrates appear to be more sensitive to low-frequency sound (<1 kHz) (Popper et al. 2014) such as that emitted by seismic air sources, marine vessels and drilling. Some fishes with morphological structures that include either a direct or proximate mechanical link between the swim bladder and the inner ear are also sensitive to higher frequencies (i.e., ultrasound).

Fishes exhibit both subtle and overt behavioural changes in response to seismic air source sound and these effects appear to be quite variable between and within species. Generally, behavioural effects are localized and temporary. For example, Løkkeborg et al. (2012) described a 2009 study of the effect of exposure to seismic sound on commercial fishes, which showed that longline catches of Greenland halibut decreased during seismic operations but increased again after surveying was completed; gillnet catches were higher during surveying and remained elevated after the program.

While certain studies have suggested that some marine invertebrates are affected physically by exposure to air source sound, the degree of the suggested effects is minimal. In addition, the suggested physical effects were observed when constrained marine invertebrates were exposed to air source sound at very close range, resulting in exposures unrepresentative of those that would occur under conditions such as those that would be induced by Project activities.

Operational procedures, such as use of a gradual “ramp-up” or soft-start procedures will be implemented for this Project. This will allow mobile marine fish and invertebrates to move away from the area if they are disturbed by the underwater sound levels. This will help to reduce the potential for fish injury or morality, as well as reduce any startle effects and resulting stress on fish in the nearby area. These procedures, along with the relatively short-term nature of any seismic sound used for the Project, will reduce any potential for fish injury or morality from VSP surveys.

Residual Environmental Effects Assessment (Vertical Seismic Profiling)

Although there may be some short-term behavioural effects by fish in the immediate vicinity of VSP survey activities, it is very unlikely that any fish will be displaced from key habitats or disrupted during key activities over extended areas or periods in a manner that causes adverse and detectable effects to fish populations in the region. Best practices for seismic operations will be used to reduce or avoid any potential effects on marine fish.

With the application of mitigations outlined throughout this VC, potential effects from VSP activities are therefore predicted to be adverse but low in magnitude, localized short term in nature, occurring regularly and reversible. These predictions were determined with a high level of confidence.

Well Testing

During well testing, any hydrocarbons would be separated from produced water on the MODU and subject to analysis. Larger quantities of produced water would be treated prior to disposal to the ocean in compliance with the OWTG. As any such emissions will become rapidly diluted, adverse effects on fish and fish habitat are not anticipated. Small quantities of resulting produced water would be sent for flaring on the MODU and flaring would last for one to three days per analysis period. Artificial light from flaring is not anticipated to affect marine fish and fish habitat. Atmospheric emissions may be released due to well flow testing with overall low effects due to the infrequent and short time periods for flaring and will adhere to relevant legislation and regulations discussed in Section 2 of the EIS.

Residual Environmental Effects Assessment (Well Testing)

Any produced water to be discharged will be treated in accordance with the OWTG prior to discharge and thus, is not anticipated to affect fish and fish habitat. Light and emissions from formation fluid flaring are considered low and unlikely to adversely affect fish and fish habitat.

With the application of mitigations outlined throughout this VC, potential residual effects due to well testing are therefore predicted to be neutral to adverse, negligible, localized in extent, short term in nature, occurring sporadically and reversible. These predictions were determined with a high level of confidence.

Well Abandonment or Suspension

Well abandonment plans have not been finalized, but will adhere to the requirements of the Newfoundland Offshore Petroleum Drilling and Production Regulations SOR/2009-316 as well as CNOOC 's internal governance. Use of explosives is not considered a well abandonment option for environmental and safety reasons.

Upon completion of the exploration drilling program, wellheads will be abandoned or suspended for future re-entry. Abandonment involves installation of cement plugs, and / or mechanical devices and then cutting of the wellhead if required. An ROV or other equipment will be used to monitor and inspect the condition of the wellsite in accordance with applicable regulatory requirements at the time of abandonment. If a wellhead remains in place, the position will be reported to Canadian Hydrographic Services so nautical charts can be updated. Where wells are suspended, this will be done in accordance with C-NLOPB requirements.

As discussed, physical interaction with the seabed may result in disturbances to benthic habitats and organisms. This may also result in injury, and / or mortality of corals, sponges and sea-pens, through introduction of suspended solids in the water column. However, if a wellhead is not removed, the remaining seabed infrastructure in deeper parts of the Project Area may add small quantities of habitat heterogeneity to the barren environment and potentially aid in recolonization of benthic species and overall recovery.

Plug installation and wellhead cutting may result in short term (i.e., hours), of emissions of noise and light that would be no more than for drilling operations. Fish may temporarily avoid or remain in the area during activities depending on species-specific sensitivities to light and sound. Removal of subsea infrastructure, including wellheads, may cause short-term localized suspended particle and sedimentation disturbance effects, to marine fish and fish habitat, similar to other Project activities. Use of ROVs in the water column could potentially elicit temporary behavioural responses from certain fishes and invertebrates. When these Project activities cease, effects on fish and fish habitat would be reduced accordingly.

Residual Environmental Effects Assessment (Well Abandonment or Suspension)

Fishes may temporarily avoid an area during plug installation and wellhead cutting depending on species-specific sensitivities to light and sound emissions. Any remaining wellheads in deeper parts of the Project Area may potentially aid in recolonization of benthic species and overall habitat recovery.

With the application of mitigations outlined throughout this VC, potential effects from well abandonment or suspension are predicted to be adverse, low in magnitude, localized, short term in nature, occurring sporadically, and reversible. These predictions were determined with a high level of confidence.

Supply and Servicing

The Project will involve vessel and aircraft use for Supply and Servicing to, from and within the Project Area year-round throughout Project duration. A stand-by vessel will also attend to the MODU throughout the drilling program. It is expected that offshore supply vessel and aircraft (helicopter) services for the Project will be based in St. John's, NL. Thus, supply and servicing is considered within the LSA, which includes the zone of influence for light and sound around the offshore Project Area and the associated vessel and aircraft traffic route to the onshore supply base.

Servicing the MODU will involve two to three return vessel transits per week by the supply vessels during the Project. It is estimated that there would be one to three helicopter transits per day to the MODU. Marine vessel and helicopter traffic will interact with Special Areas due to associated sound, lighting, and discharges / emissions while in transit within the vessel traffic route, or at a location within the Project Area. Potential environmental effects of vessel and aircraft presence and movements include disturbances to marine fish, marine and migratory birds, marine mammals and sea turtles in Special Areas.

The LSA intersects with various Special Areas, including the Slopes of the Flemish Cap and Grand Bank UNCBD EBSA and the Northwest Flemish Cap (11) NAFO FCA as described above. The defining features of Special Areas that intersect the LSA (i.e., zone of influence) are summarized in Table 47.4. These Special Areas are identified for the presence of benthic habitat, marine fish, marine and migratory birds, marine mammals and sea turtles, and human uses including the fishing industry. More detailed information regarding the potential effects of the Project on overall marine biota is included in Sections 8.2, 9.2, and 10.2 of the EIS.

Table IR-47.4 Defining Features of Special Areas Intersecting the LSA

Special Areas	Defining Features
Snow Crab Stewardship Exclusion Zone in Crab Fishing Area 6C	Refuge areas for snow crab (i.e., Marine Fish and Fish Habitat).
Snow Crab Stewardship Exclusion Zone in Crab Fishing Area Near Shore	
Eastern Avalon Canadian EBSA	Seabird feeding areas (i.e., Marine and Migratory Birds). Cetaceans, leatherback turtles and seals feed in the area from spring to fall (i.e., Marine Mammals and Sea Turtles).
Cape Spear National Historic Site	Restored historical lighthouse and lighthouse keepers home, most eastern point of North America (i.e., Other Ocean Uses).
Signal Hill National Historic Site	Historic site of wireless communication and military defence of St. John's Harbour (i.e., Other Ocean Uses).
Southern Flemish Pass to Eastern Canyons VME	Large gorgonians and high density of sponges. Vulnerable fish species: striped wolffish, redfish, spiny tailed skate, northern wolffish, some black dogfish, deep-sea cat shark (i.e., Marine Fish and Fish Habitat).
Slopes of the Flemish Pass and Grand Bank UNCBD EBSA	Includes NAFO closures to protect corals and sponges (i.e., Marine Fish and Fish Habitat). A component of Greenland halibut fishery grounds in international waters (i.e., Fisheries). A high diversity of marine taxa, including threatened and listed species (Assumed Marine Fish and Fish Habitat).
Flemish Pass / Eastern Canyon (2) NAFO FCA	Closed to protect extensive sponge grounds large gorgonian corals (i.e., Marine Fish and Fish Habitat).
Northwest Flemish Cap (10) NAFO FCA	Closed to protect high coral and sponge concentrations (e.g., crinoids, cerianthids and black corals). Includes sea pen fields, which serve as habitat structure in low-relief sand and mud habitats and provide refuge for small planktonic and benthic invertebrates.
Northwest Flemish Cap (11) NAFO FCA	
Quidi Vidi Lake IBA	Important daytime resting site for gulls including significant numbers of herring, great black-backed, Iceland, glaucous and common black-headed gulls from late fall to early spring; locally rare ring-billed gull, mew gull and lesser black-backed gull occasionally reported; waterfowl including American black ducks, mallards and northern pintails common in the winter (i.e., Marine and Migratory Birds).

Special areas in the RSA that are regularly used by humans for recreation, subsistence, or tourism activities, are in coastal and onshore areas which are more than 400 km away from the Project Area. National Historic Sites are valued for cultural / historical reasons and are used for recreational purposes such as hiking and sight-seeing. Snow Crab Stewardship Exclusion Zones are closed to crab fishing. Users of either of these Special Areas could potentially experience increased sound from marine vessel and aircraft traffic, but any sound would be generally consistent with the overall marine traffic that has occurred throughout the region for many years. Section 13 of the EIS has determined that with the implementation and application of the proposed mitigation measures to avoid or reduce residual effects, the Project is unlikely to result in significant adverse effects on Fisheries and Other Ocean Uses.

As discussed in Section 8.3.8 of the EIS, Supply and Servicing is not anticipated to result in interactions with benthic species and habitats such as those found in the Slopes of the Flemish Pass and Grand Bank UNCBD EBSA, and Southern Flemish Pass to Eastern Canyons VME, Flemish Pass / Eastern Canyon (2) NAFO FCA, Northwest Flemish Cap (10) NAFO FCA, or Northwest Flemish Cap (11) NAFO FCA. The following paragraphs discuss potential effects of Supply and Servicing on marine fish, marine and migratory birds, and marine mammals and sea turtles such as those found in Special Areas in the LSA.

Although the presence of marine vessels may result in some level of attraction, avoidance or other behavioural responses by individual fish and invertebrates due to light and sound emissions (Røstad et al. 2006; De Robertis and Handegard 2013), marine fishes and invertebrates will likely not be disturbed by Project-related vessel activity given its transitory nature and short-term presence at any one location.

Atmospheric emissions would originate from vessel exhausts, although these would be negligible overall. Environmental disturbances and effects due to emissions from vessels will also be transient in nature. Other potential environmental discharges from vessels and equipment relate to the possible release of oily water and other substances through deck drainage, bilge/ballast water, open drains, sanitary waste/grey water, and other hazardous/non-hazardous wastes. All wastewater will be treated to minimize contaminant or hydrocarbon levels prior to discharge in accordance with the OWTG and other regulatory requirements.

All vessels that are used for this Project will meet the operational and environmental capabilities needed for the associated exploration activities, including for implementing relevant environmental mitigations and safety and emergency response procedures. All vessels will be in compliance with applicable legislation and regulations and will be inspected by Transport Canada and approved for operation by the C-NLOPB before beginning any Project-related work. They will have appropriate oil spill / pollution prevention and emergency response plans in place, and each will be MARPOL compliant.

The LSA intersects Special Areas (i.e., Eastern Avalon EBSA and Quidi Vidi Lake IBA), including coastal feeding, resting and wintering areas, that have been identified for various marine and migratory bird populations. Supply and Servicing vessels may interact with marine and migratory birds through lighting, sound, marine discharges and other associated emissions, which may result in disturbances in feeding, breeding or migration areas of marine and migratory birds. Marine and migratory birds are vulnerable to changes in the abundance of prey species (e.g., fish, plankton, cephalopods) on which they may rely for food and the presence of vessels may disturb prey species and disrupt foraging activities. Vessel lighting at night may attract some fish species to the surface, which in turn may attract some gull species for improved foraging opportunities (Davis et al. 2017). Detailed information can be found in Section 9 of the EIS.

Birds are likely to experience some localized and short-term behavioural effects (change in presence and abundance), with some species being displaced from the LSA and others attracted by lighting. The greatest potential for interaction between artificial light emissions and marine and migratory birds is in the attraction of Leach's storm-petrels. Tracking of storm-petrels nesting at seven colonies in Atlantic Canada during incubation shows that adults nesting at Baccalieu Island and Witless Bay colonies forage in the Flemish Pass and adjacent areas, averaging 4 days per foraging trip (Hedd et al 2018). There may be a slight increase in mortality / injury levels due to collisions and disorientation resulting in birds being stranded on vessels although the mortality rate is anticipated to be low as most birds stranded on platforms and vessels are released successfully. Light attraction has also been reported for Atlantic puffins in coastal areas near nesting colonies in both Scotland and Newfoundland (Miles et al. 2010; Wilhelm et al. 2013).

Release of organic wastes by vessels can attract birds, which may increase the potential for interactions including risk of predation, collision and exposure to contaminants. Each of the vessels involved in this Project will manage and dispose of waste in accordance with applicable regulations and standards in compliance with the Project Waste Management Plan. Proper waste management practices and adherence to MARPOL requirements will minimize potential effects. The relatively low discharge volumes would likely become highly dispersed in the marine environment, and any discharges are unlikely to accumulate in any specific area due to the mobile nature of vessels.

Marine vessels are transitory and thus, short-term at any one location. Thus, it is anticipated that bird species, will not be displaced from key habitats or during important activities or be otherwise affected in a manner that causes adverse and detectable effects to overall populations in the region. Changes in habitat and food availability and quantity will also be on a localized scale and for a short-term duration. The activities of supply vessels are generally consistent with overall marine traffic that has occurred throughout the region for many years. Project support vessels will use existing and established routes wherever possible. Vessels will avoid coastal seabird colonies during the nesting season as per the *Seabird Ecological Reserve Regulations, 2015* and CWS guidelines.

Aircraft traffic may affect seabirds through lighting, noise, and other emissions. Helicopters will be used for crew transfers and other purposes, and 1 to 3 return transits per day are anticipated for the MODU. Additional helicopter trips may be required (e.g., transportation of technical personnel, parts or equipment, or removal of a crew member in an emergency situation), but these are anticipated to be infrequent.

Helicopter use is of relevance to the marine and migratory birds VC because this activity and its associated noise can potentially disturb nesting seabirds. Flushing of breeding birds from nests in response to loud noises, such as helicopter overflights, can have immediate negative consequences including predation of eggs and chicks and decreased incubation and brooding (Burger 1981; Brown 1990; Bolduc and Guillemette 2003; Beale 2007; Burger et al 2010). Nestlings may also be vulnerable to exposure, and adults may inadvertently knock eggs and flightless young from the nest, which is of concern for cliff-nesting species such as murres and kittiwakes (Burger 1981; Carney and Sydeman 1999). Disturbance to adult foraging and provisioning activities may impact nestling growth and survival (Davis and Wiseley 1974; Lynch and Speake 1978; Belanger and Bedard 1990; Delaney et al 2002; Goudie 2006).

Noise may deter birds from favourable habitats and may alter migration paths, resulting in greater energy expenditure (Larkin 1996; Beale 2007). Reactions of marine birds to helicopters and other aircraft depends on factors such as the species and previous exposure levels of individuals (i.e., degree of habituation), as well the location, altitude and frequency of flights (Hoang 2013). Research has shown that flushing may occur at distances greater than 350 m for common murres (Rojek et al 2007), although there is inherent variability in behavioural responses between and even within species (Blumstein et al 2005; Hoang 2013).

Aircraft overflights may result in temporary loss of useable habitat and increased energy expenditure of birds due to escape reactions, increased heart rate, and lower food intake due to interruptions (Ellis et al. 1991, Trimper et al. 2003, and Komenda-Zehnder et al. 2003, as cited in Statoil Canada Ltd. 2017).

Project-related flights will use existing and established routes wherever possible. Known and observed bird colonies, large aggregations of avifauna, protected or sensitive areas and times will also be avoided wherever possible. Helicopter operations will avoid coastal seabird colonies during the nesting season as per the Seabird Ecological Reserve Regulations, 2015 (i.e., by not taking off or landing in, and by flying at an altitude greater than 300 m over seabird ecological reserves during sensitive times of year to avoid disturbance. Therefore, adverse interactions with, and effects on, coastal breeding colonies, including areas identified as Special Areas, are unlikely.

Marine mammals and sea turtles may be affected by Supply and Servicing activities. Marine mammal responses to vessels are variable and range from avoidance at long distances to little or no response or approach (Richardson et al. 1995). Seals often show considerable tolerance to vessels, but may also show signs of avoiding vessel traffic. Baleen whales, such as humpbacks, often interrupt their normal behaviour and swim rapidly away from vessels that have strong or rapidly changing noise, especially when a vessel

heads directly towards a whale. Stationary vessels or slow-moving, "non-aggressive" vessels typically elicit very little response from baleen whales. Vessel traffic and associated noise can be a source of chronic stress for marine mammal populations (Rolland et al 2012; Wright et al. 2011; Atkinson et al. 2015). Cetaceans and some seal species have been observed to adjust their movement behaviour around ships (Richardson et al 1995; Lalas and McConnell 2015).

Marine mammals (and likely sea turtles) may exhibit minor, short-term disturbance responses to underwater sounds from vessels. Underwater sound may also result in hearing impairment, injury, masking, behavioural responses in marine mammal and sea turtles. However, continuous sounds produced by vessels (as well as dynamic positioning thrusters) do not typically exceed threshold levels for temporary or permanent changes in hearing ability (Richardson et al. 1995; Nowacek et al. 2007; Southall et al. 2007; NMFS 2016). Section 10 of the EIS provides more information on potential Project effects on Marine Mammals and Sea Turtles.

Ship noise, through masking, can reduce the effective communication distance of a marine mammal if the frequency of the sound source is close to that used by the animal, and if the sound is present for a significant length of time (Richardson et al. 1995; Nowacek et al. 2007; Southall et al. 2007; NMFS 2016). In addition to the frequency and duration of masking sound, the strength, temporal pattern, and location of the introduced sound also play a role in the extent of masking (Branstetter et al. 2013, 2016; Finneran and Branstetter 2013). Cetaceans have been observed to modify their vocal patterns around ships (Clark et al 2009).

Available information indicates that single or occasional aircraft overflights cause no more than brief behavioural responses in baleen whales and seals (summarized in Richardson et al. 1995). Offshore helicopter traffic may also result in changes in habitat quality or use for marine mammals and sea turtles due to both auditory and visual sensory disturbance. Helicopter sound frequencies are mainly below 500 Hz, and transmission of these sounds into the marine environment depends primarily on altitude and sea surface conditions, with noise from helicopters being most intense just below the water surface and directly beneath the aircraft, with sounds attenuating over shorter distances underwater than in the air (Richardson et al 1995). Behavioural responses of cetaceans to aircraft noise can include diving, reduced surfacing periods, and breaching (Patenaude et al 2002; Luksenburg and Parsons 2009), and can depend on their activity at the time of exposure (Würsig et al 1998; Luksenburg and Parsons 2009). Responses of sea turtles to helicopter traffic are expected to be similar to marine mammals, although research indicates that turtles are more reliant on visual cues (Hazel et al 2007).

Project-related marine vessel traffic has the potential to result in mortality or injury of marine mammals due to vessel strikes (Williams and O'Hara 2010). Baleen whales are more susceptible to mortality from vessel strikes than other marine mammal groups (Laist et al 2001; Jensen and Silber 2003). All six baleen whale species found in the northwest Atlantic, including humpbacks, which are common in Eastern Newfoundland, have been struck by ships (Jensen and Silber 2003). North Atlantic right whales, fin whales, humpback whales and grey whales have the highest risk of mortalities (Vanderlaan and Taggart (2007). Vessel strikes have been implicated in mortalities of North Atlantic right whales in the Gulf of St. Lawrence (Science 2017).

As indicated in Section 10 of the EIS, the potential for vessel strikes on marine mammals and sea turtles is unlikely. Vessel strikes can have serious consequences for individuals involved, but avoidance behaviour tends to reduce the risk of collision. For example, beaked whales tend to avoid approaching vessels by diving for extended periods (Kasuya 1986; Würsig et al 1998). Also, potential exists for Project vessels to strike sea turtles resulting in injury or mortality. Propeller and collision injuries from boats and ships are common in sea turtles, at least in U.S. waters (NMFS 2008). Reducing vessel speed has been shown to

decrease the number of marine mammal deaths and severe injuries due to vessel strikes (Vanderlaan and Taggart 2007; Vanderlaan et al 2008, 2009; van der Hoop et al 2012). Lethal strikes are infrequent at vessel speeds less than 25.9 km/h (14 knots) and rare at speeds less than 18.5 km/h (10 knots) (Laist et al 2001).

Residual Environmental Effects Assessment (Supply and Servicing)

As is the case for all marine traffic, the operation of supply vessels and aircraft will introduce potential changes to the environment, including the noise, light and other possible emissions that are typically associated with such activities. Project-related vessel movements will have a short-term presence at any one location and create noise types and levels similar to daily and frequent marine traffic in the area. Given the transitory nature of aircraft movements and the planned avoidance of low level flights wherever possible, no adverse environmental effects on fish and fish habitat in Special Areas are anticipated due to air traffic. With the application of mitigations outlined throughout this VC, potential effects from Supply and Servicing on Special Areas identified for marine fish and fish habitat are predicted to be adverse, but low in magnitude, within the LSA, of short term duration, occurring regularly, and reversible. These predictions were determined with a high level of confidence.

The presence and operation of vessels and aircraft may result in adverse effects on avifauna in Special Areas in the LSA, primarily through attraction or avoidance behaviour associated with lighting and other potential environmental interactions and emissions leading to some increased potential for changes in individual bird mortality / injury or other health effects. However, these will be avoided or reduced through the various mitigation measures identified in Section 9.3 of the EIS and will not result in population-level effects. Project-related support vessel and aircraft activities may result in temporary disturbance to bird colonies. Such traffic will be transitory and short-term at any one location, and the amount of traffic is generally in keeping with the overall marine traffic that has occurred throughout the region for many years. Project-related supply vessel traffic will utilize existing and established routes wherever possible and avoid concentrations of marine and migratory birds whenever possible. Helicopter operations adhere to regulations and best practices such as the *Seabird Ecological Reserve Regulations, 2015* and Measures to Protect and Monitor Seabirds in Petroleum-Related Activity in the Canada-Newfoundland and Labrador Offshore Area. Supply and Servicing is not likely to result in population level effects on marine and migratory birds. With the application of these and other mitigations outlined throughout this VC, potential effects on Special Areas identified for marine and migratory birds are predicted to be adverse, low in magnitude, within the LSA, short-term, regular, and reversible. These predictions were determined with a high level of confidence.

Any interactions between Project-related Supply and Servicing vessels and marine mammals and sea turtles in Special Areas in the LSA are anticipated to be minor due to the localized and transitory nature of these activities, and because it will generally be in keeping with the overall marine traffic that has occurred throughout the region for decades. Project-related supply vessel traffic will use established routes, seek to maintain a steady course and safe speed and avoid concentrations of marine mammals and sea turtles whenever possible to reduce the risk of vessel strikes.

While there is some potential for individuals in close range of the support vessels to be exposed to sound levels that may trigger a behavioural response, vessel-related underwater noise during transit to the Project Area will be temporary and transient at any one location, and therefore, any potential disturbance is expected to be minor and temporary. Underwater sound levels produced by Project-related support vessels and helicopters are not expected to exceed threshold levels for either marine mammals or sea turtles. The potential for exposure of marine mammals or sea turtles to disturbance from helicopter overflights is anticipated to be negligible and infrequent. Marine mammals and sea turtles are not likely to be displaced from any key habitats or during important activities or be otherwise affected in a manner that causes

negative and detectable effects to overall populations in the region. With the application of mitigations outlined throughout this VC, potential effects on Special Areas identified for marine mammals and sea turtles are predicted to be adverse, low in magnitude, within the LSA, short-term, regular, reversible, and are predicted with a high level of confidence.

Organic wastes and other waste materials that may be generated and discharged by offshore vessels can attract marine biota. All vessels involved in this Project will manage and dispose of waste in accordance with applicable regulations and standards and the Project Waste Management Plan. Other potential emissions and discharges will be managed through strict adherence to applicable regulations, standards, and best practices. All Project-related support vessels will also follow applicable environmental and safety regulations and guidelines. The transitory nature of these activities means that any environmental discharges are not likely to accumulate in any single area, and will not have detectable, adverse environmental effects upon marine biota and their habitats or food sources.

In summary, Supply and Servicing is not likely to result in significant adverse environmental effects on Special Areas. With the application of mitigations outlined throughout this VC and in the relevant biological VC sections of the EIS, potential effects on Special Areas identified for marine biota are predicted to be adverse, low in magnitude, within the LSA, short-term, regular, and reversible. These predictions were determined with a high level of confidence.

Environmental Effects Evaluation

This section summarizes the residual effects of the Project on marine fish and fish habitat and presents a determination of significance for the environmental effects assessment for this VC.

Residual Environmental Effects Summary

Table 47.5 provides a summary of potential residual effects of the Project on Special Areas. As described for the biophysical VC sections of the EIS (Sections 8: Marine Fish and Fish Habitat, 9: Marine and Migratory Birds, 10: Marine Mammals and Sea Turtles, 13: Fisheries and Other Ocean Uses), the Project is not expected to result in significant adverse effects upon the physical, biological and socioeconomic features in the LSA. The implementation of the various mitigation measures (including a pre-drilling seabed investigation survey to identify sensitive benthic habitat and species such as corals and sponges and adherence to regulations and best practices related to avoidance of sensitive areas for marine and migratory birds and marine mammals and sea turtles), outlined throughout the EIS will reduce potential direct or indirect effects on the existing environmental characteristics and conditions. Therefore, the Project is not likely to result in significant adverse residual environmental effects on Special Areas.

The planned exploration activities are characterized by small environmental footprints. Moreover, the implementation of the various environmental mitigation measures outlined throughout the EIS, including those designed to avoid or reduce Project-related discharges and/or disturbances and their associated environmental changes, will address any direct or indirect potential environmental effects that may have implications for intersecting or adjacent Special Areas. Additionally, the short duration of the various activities associated with this Project, along with the offshore and dynamic marine environment involved and the implementation of planned mitigation measures, means that any potential adverse effects will be of generally low magnitude, localized extent though some occur in the Project Area or LSA, short to long term, occurring sporadically or regularly and reversible. These effects are predicted with a high level of certainly.

Table IR-47.5 Environmental Effects Assessment Summary: Special Areas (Updated Table 11.4 of the EIS)

ENVIRONMENTAL EFFECTS ASSESSMENT SUMMARY *

Summary of Existing Conditions and Environmental Context

- A number of marine and coastal areas in Newfoundland and Labrador have been designated as protected under provincial, federal and / or other legislation or agreements due to their biological / ecological or socio-cultural characteristics and importance, and other areas have been identified as being special or sensitive through relevant processes and initiatives.
- Special areas identification is often directly related to the existing physical and biological environment, including habitat of marine fish, marine and migratory birds and marine mammals and sea turtles or socio-cultural values such as economy, culture, history or recreation, which are also covered in other sections of the EIS.
- Many Special Areas are located on land or in coastal areas outside of the Project Area and LSA.
- None of the Special Areas (i.e., a UNCBD EBSA and a NAFO FCA) that intersect the Project ELs have prohibitions for offshore oil and gas activities.
- Special areas located in the general vicinity are valued for their biological and ecological characteristics and their importance for activities such as the fishing industry, but none are likely to have an active commercial fishery.
- Special areas in the LSA or zone of influence for Project effects such as light, sound and drill cuttings emissions are identified for sensitive benthic habitat, marine fish, marine and migratory birds, and marine mammals and sea turtles.
- Special areas most regularly used by humans for recreation, subsistence, or tourism activities, are in coastal and onshore areas 400 to 500 km from the Project Area.

Key Mitigation Measures

- Mitigations designed to avoid or reduce effects of activities on marine biota, habitats and marine users will address effects on Special Areas
- MODU and supply vessel / aircraft contractors will maintain equipment, to reduce excess light, noise, emissions and discharges.
- Project activities will avoid or minimize discharges, emissions and waste. This includes compliance with regulations, and company procedures.
- Seabed investigations will be used to investigate presence of sensitive benthic organisms or habitats in the immediate area of the wellsite.
- VSP surveys will conform with the Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment.
- Produced hydrocarbons will be flared using high-efficiency burners. Produced water will be treated in keeping with regulatory requirements.
- CNOOC will operate in accordance with Measures to Protect and Monitor Seabirds in Petroleum-Related Activity in the Canada-Newfoundland and Labrador Offshore Area.
- Vessel and aircraft traffic transits will be minimized, and low-level aircraft operations will also be avoided, or minimized.
- Existing and common vessel travel routes will be used wherever practical, vessels will seek to maintain a steady course and vessel speed.
- If wellhead removal is required during abandonment, wells will be cut by mechanical separation as opposed to the use of explosives.

Project Component or Activity	Potential Environmental Effects	Residual Environmental Effects Summary Descriptors						
		Nature	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Certainty
Presence and Operation of MODUs (including lights, noise, air emissions, positioning / mooring, on-site vessels, seabed investigation)	• Possible change in environmental features and/or processes • Possible change in human use and/or societal value	A	N	L	S	R	R	H

Drilling and Associated Marine Discharges (including fluids and cuttings)	• Possible change in environmental features and/or processes • Possible change in human use and/or societal value	A	L	L	L	R	R	H
Vertical Seismic Profiling	• Possible change in environmental features and/or processes • Possible change in human use and/or societal value	A	L	L	S	R	R	H
Well Testing	• Possible change in environmental features and/or processes	N-A	N	L	S	S	R	H
Well Abandonment or Suspension	• Possible change in environmental features and/or processes	A	L	L	S	S	R	H
Supply and Servicing	• Possible change in environmental features and/or processes • Possible change in human use and/or societal value	A	L	LSA	S	R	R	H

Evaluation of Significance

Not Significant

- Activities such as those planned for this Project are not likely to result in significant adverse environmental effects on Special Areas.
- Oil and gas exploration activities are not prohibited within any of the Special Areas that overlap with the Project Area or LSA.
- For the various Special Areas that overlap with or are in the vicinity of the Project Area (offshore) or LSA (associated vessel and aircraft traffic route), the overall and defining physical, biological and socioeconomic environments within these areas are not likely to be adversely affected by the Project.

* The results of the environmental effects assessment summarized above apply to Project activities related to both EL 1144 and EL 1150, unless otherwise indicated.

KEY

Nature / Direction:

P	Positive
A	Adverse
N	Neutral (or No Effect)

Magnitude:

N	Negligible
L	Low
M	Medium
H	High

Geographic Extent:

L	Localized, In Immediate Vicinity of Activity
PA	Within Project Area
LSA	Within LSA
RSA	Within RSA or Beyond

Frequency:

N	Not likely to occur
O	Occurs once
S	Occurs sporadically
R	Occurs on a regular basis
C	Occurs continuously

Duration:

S	Short term (For duration of the activity / disturbance)
M	Medium term (Beyond duration of the activity / disturbance – weeks or months)
L	Long term (Beyond duration of the activity / disturbance – years)
P	Permanent (Recovery unlikely)

Reversibility:

R	Reversible (Will recover to baseline)
I	Irreversible (Permanent)

Certainty in Predictions:

L	Low level of confidence
M	Moderate level of confidence
H	High level of confidence
N/A	Not Applicable

The offshore support vessel and aircraft activity within the Project Area and to and from Eastern Newfoundland will make a relatively minor contribution to the overall offshore petroleum activity (especially, vessel and aircraft traffic) that has occurred throughout the region for decades and general marine traffic that has existed for hundreds of years. Supporting vessels and aircraft engaged in Project activities will, under normal conditions, be expected to travel directly between an established facility in Eastern Newfoundland and the MODU operating within an EL in the Project Area. Specific travel routes may vary at times based on the location of the active MODU, the shore-based support facility being used, environmental conditions (including weather and ice) and other logistical factors.

The planning and conduct of Project-related support vessel traffic will be undertaken in consideration of these factors, relevant regulatory requirements, and through established cooperative processes that involve discussions and communications between the oil and gas sector, fishing industry and other ocean uses to minimize interactions between these activities and Special Areas.

The various environmental monitoring and follow-up initiatives, outlined in Section 18.4 of the EIS, in relation to relevant components of the biophysical environment will be indirectly applicable to Special Areas. CNOOC will also continue to track any new or revised special area designations or conditions within the RSA over the course of the Project. No additional and specific environmental monitoring or follow-up is considered necessary in relation to this VC.

Determination of Significance

As determined in the biological and socioeconomic VCs, the Project is not anticipated to result in significant residual effects on the defining physical, biological, and socio-economic features of these areas. Many of the offshore activities and associated disturbances will be localized and short-term at a specific location. The implementation of mitigation measures outlined in Sections 9 of the EIS to avoid sensitive corals, sponges, and sea pens will reduce direct or indirect potential effects on Special Areas identified for the presence of sensitive benthic habitats and marine species. Subsea infrastructure and well drilling sites will represent small areas of disturbance to benthic habitats within the extensive areas of marine environment of Special Areas in the offshore. The results of drill cuttings modelling, and a pre-drill seabed investigation will enable identification and avoidance of sensitive habitat areas in determining the location of infrastructure, drilling wells and drill cuttings deposition sites. Discharges, including drill cuttings, will be treated as per regulations and best practices prior to discharge. Thus, the Project is not likely to result in significant adverse residual effects on the defining features of Special Areas that intersect with the Project Area.

Special areas within the LSA have also been identified based on the presence of sensitive benthic habitats and to a lesser extent on marine fish, marine and migratory birds, marine mammals and sea turtles, and human activities. Planned Project activities in the LSA (e.g., Supply and Servicing) will not result in direct contact with the seabed and will therefore not physically disturb benthic animals or their habitats. These activities may cause light and noise that could result in temporary behavioural changes in marine species. Humans may also be subject to noise and light from Project-related traffic, but this activity is not anticipated to result in an increase in the general marine traffic that occurs in the area. Based on present knowledge of Special Areas, and planned mitigations, the predicted residual environmental effects from planned Project activities on Special Areas in the LSA are also likely to be not significant.

In summary, the predicted residual effects on Special Areas resulting from planned Project activities would be neutral to adverse, negligible to low in magnitude, within the Project Area or LSA. The effects would be generally short-term in duration, sporadic to regular, but reversible. These predictions are determined with a high level of confidence and based on the outcomes of effects assessments for the Marine Fish and Fish Habitat, Marine and Migratory Birds and Marine Mammals and Sea Turtles VCs as well as Commercial Fisheries and Other Ocean Uses

VC for this Project. As described and summarized above, the Project is therefore not likely to result in a detectable adverse change in environmental processes or features of Special Areas, or a decrease in its overall or use or societal value.

Environmental Monitoring and Follow-up

The various environmental monitoring initiatives outlined earlier in relation to relevant components of the biophysical environment will also be applicable to Special Areas (see Sections 8.6, 9.6, and 10.6 of the EIS). CNOOC will also continue to track any new or revised special area designations within the RSA over the course of the Project. No additional and specific environmental monitoring or follow-up is considered necessary in relation to this VC.

- CNOOC will obtain the required authorizations for the Project, and comply with applicable regulations, guidelines, and mitigation measures as identified and committed to in the preceding sections, the implementation of which will be planned, managed, and monitored in accordance with existing operational procedures and policies. Based on the information presented in the EIS, and the conclusion of the effects assessment, a follow-up program will be undertaken in consideration of sensitive benthic habitat in the following circumstances:
  - When a planned well site is located within an identified FCA; or
  - In an area where the results of the pre-drill seabed investigation and subsequent review by DFO and C-NLOPB indicate that monitoring is required.

- The purpose of the program would be to determine the effectiveness of mitigation measures in protecting the sensitive benthic habitat. It may include parameters such as:
  - Post-drilling seabed core samples to measure drill cuttings deposition; and/or
  - Post-drilling visual assessment using high-definition images / video.

If exploration wells are planned to be drilled under the circumstances identified above, a follow-up monitoring plan will be developed and submitted for DFO and C-NLOPB for review prior to commencement of drilling.

SPECIAL AREAS: ACCIDENTAL EVENTS

Refer to Section 16.6.6 of this Addendum (Appendix C) for an updated assessment of potential Accidental Events.

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2.7.3 Information Requirement: IR-48 (Part One Response – September 2018)

External Reviewer(s): Unknown

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat; 5(1)(a)(ii) Aquatic Species

Reference to EIS Guidelines: Part 2, Section 6.6.1 Effects of potential accidents or malfunctions

Reference to EIS: Section 16.4.1 Locations and Scenarios, page 946

Context and Rationale: The EIS Guidelines require that the points of origin selected for the spill trajectory models be conservative (e.g. selecting a potential location within the proposed drilling area that is closest to a sensitive feature or that could result in greatest effects).

While the EIS states that "the criteria used included: reservoir type and properties; administrative boundaries (e.g., licence area boundaries); and the physical environment (e.g., potential range of water depths, proximity to more sensitive areas, potential range of ocean currents)", it does not describe how the proximity to sensitive areas was considered in selection of the example drill site locations.

Specific Question or Information Requirement: Provide clarification on how the proximity to sensitive areas was considered in the selection of the points of origin for the spill trajectory modelling.

Response: Many criteria were evaluated when selecting the example well site locations for spill trajectory modelling including, but not limited to, subsurface features, seabed features, water depth, drilling depth, environmental features, and placement within EL 1144 or EL 1150. The two example locations were chosen to represent a range of ocean environments found in EL 1144 and EL 1150 that could represent potential drilling locations. The location of surrounding environmental features, such as proximity to sensitive areas, was considered as part of that evaluation criteria.

References:
No additional references.

2.8 Indigenous Peoples

2.8.1 Information Requirement: IR-49 (Revised Response – February 2019)

External Reviewer(s): QFN-01-Nx; MTI-03-Nx, 05-Nx, 08-Nx, -24-Nx, -29-Nx; WNNB-CR-04-Nx, -CRI-07-Nx, -CRI-09-Nx; MMS-03-Nx; MFN-27-Nx

Project Effects Link to CEAA 2012: 5(1)(c) Aboriginal Peoples

Reference to EIS Guidelines: Section 6.3.7 Indigenous Peoples

Reference to EIS: Section 12 Indigenous Peoples

Context and Rationale: Section 6.3.7 of the EIS Guidelines requires a description and analysis of how changes to the environment caused by the Project would affect current use of resources by Indigenous peoples for traditional purposes.

Section 12.4.1 of the EIS concludes that, with respect to potential for indirect effects of the Project on Indigenous communities and activities, "(t)he environmental effects analysis also indicates there is limited potential for marine associated species that are known to be used by Indigenous groups to occur within the LSA prior to moving to any area of traditional use. The implementation of the mitigation measures outlined throughout this EIS will avoid or reduce direct or indirect potential effects on these resources. The Project will not have an adverse effect on the availability or quality of resources that are currently used for traditional purposes by Indigenous groups, especially in a manner or to a degree that would alter the overall nature, location, or timing of current land and resource use activities for traditional purposes by one or more Indigenous groups, resulting in a detectable and sustained reduction in overall activity levels."

Several Indigenous groups have expressed concern with the approach taken in evaluating effects on current use for traditional purposes, indicating that a precautionary approach is warranted when determining the degree to which there is a connection between Project Area effects and resource availability in Indigenous communities. MTI raised concern related to the data gaps and stated that additional clarification is required to understand project effect on Atlantic salmon and swordfish. It was noted that without additional analysis there remains uncertainty surrounding potential impacts on salmon populations that may be harvested by MTI members.

Agency IRs (IR-12, IR-13, IR-15, and IR-79) have identified the need for additional analysis of routine operations and accidental events on Atlantic salmon, swordfish and Bluefin tuna. Subsequently, indirect effects on resources currently used or valued by Indigenous groups also require additional analysis.

Specific Question or Information Requirement: Utilizing the updated effects analysis required in IR-12, IR-13, IR-15, and IR-79, update the effects assessment, including cumulative effects assessment, for routine project operations and accidental events on the current/future use of Atlantic salmon, swordfish and Bluefin tuna by Indigenous peoples. Include consideration of additional information obtained during consultation meetings in Moncton (April 12, 2018), Quebec City (April 18, 2018), and St. John's (April 20, 2018), as applicable.

For harvest (or potential harvest, in the case of Atlantic salmon that are currently not being harvested due to population status) that occurs outside the Project Area, ensure a fulsome discussion of potential indirect effects on Indigenous communities via changes to resource availability or quality as a result of the Project.

The Agency understands that the proponent is considering, collecting further traditional knowledge from Indigenous communities. Please advise when this information will be available, and how it will be utilized, including how it could be used in the design and implementation of follow-up and monitoring programs and further mitigations.

Response:

Utilizing the updated effects analysis (IR-12, IR-13, IR-15, and IR-79), update the effects assessment, including cumulative effects assessment, for routine project operations and accidental events on the current/future use of Atlantic salmon, swordfish and Bluefin tuna by Indigenous peoples.

This question has been addressed in responses to other Information Requirements (IRs) in the addendum report. For ease of review, the relevant portions of these IRs are repeated below.

IR-12

The Project is not likely to result in significant adverse environmental effects on marine fish and fish habitat, including Atlantic salmon.

As the potential for environmental effects of planned Project activities and overall risk to Atlantic salmon is low, it is predicted that the Project will not contribute, nor exacerbate declines, to salmon populations.

The effects of the Project on salmon has been fully considered in the effects on marine fish and fish habitat. The conclusion in the Environmental Impact Statement (EIS), based on existing data, remains valid: with the application of mitigation measures described in Section 8.3.3.5 of the EIS related to noise and light emissions to marine fish and fish habitat, the environmental effects of routine Project activities on Atlantic salmon are predicted to be not significant.

Based on the information provided in IR13 Part 8, oil concentrations during a batch spill event would not be considered capable of altering the migratory behaviour of salmon. In the event of a subsea release, the potential concentrations that have been shown to cause avoidance behaviour in salmon (3,200 µg/L) would be limited in extent and located very near the release site (i.e., deeper water). Any salmon that may be located in the general area of the Project would be in the process of migrating to their home river to spawn. Therefore, a release during migration may cause a slight alteration of course but with the limited extent of concentrations greater than 3,200 µg/L, it would be considered a minor deviation and with the biological drive to return to spawn, it would not be expected to delay the timing of return to their natal rivers. Detailed information on the effects of Accidental Events on Atlantic salmon is presented in the revised Section 16.6.2 (Appendix C of this Addendum).

IR-13

In reference to potential cumulative effects (Chapter 15 in the EIS), the Project activities will operate for a short period of time in any one location, resulting in a short-term disturbance within a relatively limited zone of influence. This will reduce the potential for individuals and populations to be affected through multiple interactions with this Project and other activities in the marine environment, and for species to be affected simultaneously and repeatedly by multiple projects and activities. This, along with the other planned Project-related mitigation measures that are expected to be implemented and the low potential for salmon to occupy the Project Area, should reduce the potential for and degree of associated cumulative effects.

The conclusion within the EIS based on existing data remains valid; that the Project will not result in significant adverse cumulative environmental effects on marine fish and fish habitat, including Atlantic salmon in combination with other projects and activities that have been or will be carried out.

IR-15

The potential effects on swordfish has been fully considered in the environmental effects assessment as detailed in Chapter 8 and 12 in the EIS.

There are a variety of potential effects from petroleum extraction activities on swordfish (de Sylva et al. 2000). The combination of drilling installation colonization opportunities and artificial light emissions from the operating decks and navigation may create a "reef effect" in which fish may aggregate underneath in response to increased foraging and shelter opportunities even in areas of underwater noise around anthropogenic activities in the marine environment (see EIS for review, Keenan et al. 2007). Swordfish and other pelagic fishes have been shown to be attracted to marine structures termed fish aggregation devices (FAD), including oil platforms, fish farms, and offshore wind turbines (Franks 2000; Fayram and de Risi 2007; Arechavala-Lopez et al. 2013). Swordfish may be attracted to these areas based on increased foraging opportunities and better lighting for predation (Franks 2000; Hazin et al. 2005 Orbesen et al. 2017). As swordfish are highly visual predators and any discharges such as drill cuttings releases may reduce visibility in the water could have effects on this species' ability to capture fish. Attraction to an offshore infrastructure may also expose individual swordfish to the emissions (noise, light) and discharges associated with drilling activities, however, swordfish is a highly mobile species that is likely able to avoid any anthropogenic effects associated with a drilling installation and associated vessels. Based on hearing capabilities of other pelagic fishes, swordfish may be attracted to low frequency noises that are typical of offshore operations, however any high intensity noises will likely cause movement away from the area. This species' seasonal distribution in Canadian waters, combined with their non-schooling behavior also reduces any potential population effects (Arocha 2017) from the Project. Spawning habitats for swordfish are also distant from the Project Area, reducing potential interactions with important habitats and critical life stages that have less capability of avoidance. With the application of mitigation measures outlined in the response to IR-14, which are included in Section 8.3.2 of the EIS and apply to marine fish and fish habitat, the environmental effects of routine Project activities on swordfish are predicted to be not significant.

The RSA is within the geographic area potentially used by swordfish, whose overall distribution and migration patterns include most of the North Atlantic Basin. Given that small numbers of swordfish tend to occur in any area at one time, and the overall ranges and migration patterns of this species, it unlikely that a high number of individuals would be present within an affected area during an accidental event. In addition, the highly mobile nature of this species would likely allow individuals to avoid affected areas. Detailed information on the effects of Accidental Events on swordfish is presented in the revised Section 16.6.2 (Appendix C of this Addendum).

IR-79

Atlantic bluefin tuna are seasonal migrants to Canadian waters where they may form schools, generally of less than 50 individuals. They are fished from July through December in the Scotian Shelf, Gulf of St. Lawrence, Bay of Fundy and Conception Bay, Newfoundland. The occurrence and abundance of bluefin tuna in any one of these locations varies considerably from one year to the next (Committee on the Status of Endangered Wildlife in Canada (COSEWIC), 2011). They consist of at least two discrete populations, one that spawns in the Gulf of Mexico (western population) and one or more that spawn in the Mediterranean Sea (eastern population). The majority of tuna found in Canadian waters are thought to originate in the Gulf of Mexico (COSEWIC, 2011).

Spawning for the western population is known to occur in the Gulf of Mexico; larvae and mature individuals have also been found in the Bahamas / Straits of Florida in suitable water temperatures at the time of spawning. There are no known spawning or rearing habitats for larval and juvenile stages in Canadian waters (COSEWIC, 2011).

While considerable research has been conducted on the effect of oil spills on embryonic and larval bluefin, Hazen et al (2016) states less is known about the impacts on juvenile or adult tuna. Hazen also notes that impacts may be limited as adult tuna are highly mobile and have high capability for avoidance. A literature search revealed no studies on the effects of oil spills on adult Atlantic bluefin tuna other than those individuals that have been exposed in embryonic stages. Detailed information on the effects of Accidental Events on bluefin tuna is presented in the revised Section 16.6.2 (Appendix C of this Addendum).

With the absence of spawning grounds in the Project Area, a large-scale effect on larval or juvenile tuna will not occur. As noted above, adult tuna are highly mobile, have a high capacity for avoidance, have no consistency in the waters they utilize, and migrate in relatively small schools, if at all. With application of mitigation presented in the EIS, it is anticipated that effects to bluefin tuna are predicted to be not significant.

Summary

The IR responses provided above indicate that, with the application of the mitigation measures presented in the EIS, it is anticipated that potential effects, including cumulative effects, for planned and routine project operations and accidental events, to Atlantic salmon, swordfish and bluefin tuna are predicted to be not significant.

Include consideration of additional information obtained during consultation meetings in Moncton (April 12, 2018), Quebec City (April 18, 2018), and St. John's (April 20, 2018), as applicable.

CNOOC Petroleum North America ULC (CNOOC) has compiled a condensed summary of items, potentially relevant to the Project and this IR, which were presented in the minutes available for the above noted meetings. Items presented in the minutes of meetings from more than one location are not repeated.

Moncton

- Potential that Atlantic salmon use the area of these projects for more than just migration (i.e. recently published studies cited in comment submissions, as well as research currently under peer review suggest potential use as feeding area).
- Given the lack of information on presence of salmon and research on effects of offshore exploration on the species, there is uncertainty about impact predictions.
- The contribution of offshore exploration to existing pressures on Atlantic salmon populations.
- Atlantic salmon are not currently being harvested in much of Nova Scotia and New Brunswick due to concern for populations; there is not a lack of interest in harvesting. Indigenous communities want to see populations recover so harvesting can resume. There are connections between current/future use and socioeconomic, health effects of the projects in Indigenous communities.

Quebec City

- More information is required on risk of oil spill going into the Gulf of St. Lawrence.

St John's

- Consider effects at sensitive periods, i.e., when salmon are in the area.
- Effects of dispersants on fish and requested clarification on how the decision is made to use dispersants. Potential effects of the projects on the shrimp fishery, since this fishery is 250 miles offshore and there is potential to overlap with projects. Fishers report observations of seismic surveys effects on shrimp catch (i.e. shrimp seem to avoid the survey area for a few days following seismic activity).
- Clarification about response to various accident scenarios, such as two events occurring at the same time, and how the capping stack is installed on a damaged well.

- Capping stack availability and response times. Clarification on the potential for a capping stack being located in Newfoundland and Labrador, given the level of activity offshore.
- Indigenous knowledge about Atlantic salmon populations has not been factored into management planning and environmental assessments.

For harvest (or potential harvest, in the case of Atlantic salmon that are currently not being harvested due to population status) that occurs outside the Project Area, ensure a fulsome discussion of potential indirect effects on Indigenous communities via changes to resource availability or quality as a result of the Project.

CNOOC has undertaken additional oil spill modelling for longer duration unmitigated subsea releases at the example wellsites in EL 1144 and EL 1150. The results of the effects assessment for marine fish (including the results of additional modelling), and indirectly to Indigenous groups that may harvest species such as salmon in traditional territories, are summarized below.

Summary of Residual Effects of Accidental Events on Marine Fish and Fish Habitat

Given the existing knowledge of marine fish and fish habitat occurrence in the RSA, spill modelling scenarios, and planned mitigation, the predicted residual environmental effects from an accidental event scenario on marine fish and fish habitat (including species at risk) are predicted to be not significant. This evaluation of residual effects incorporates the conservative approach used during spill modelling and the implementation of mitigation measures to prevent and reduce effects from any such spill.

In the unlikely event of an offshore hydrocarbon release, residual adverse effects to marine fish and fish habitat in the area at the time of the accident or malfunction are expected. The type and level of any effects would be dependent on such factors as the degree of exposure, spill type and size, time of year, and species presence and occurrence within the affected area, and oil spill response measures undertaken. Potential residual adverse effects may result in decline or change to food availability and quality with implications for higher trophic levels. Interactions with hydrocarbons would also result in nonlethal effects and mortality of fish and invertebrates depending on species-specific responses and degree of interaction. These potential effects would be similar for both secure and at-risk species.

For the duration of any accidental offshore hydrocarbon release, there would be reductions in availability or access to fish habitat. The eventual break down of hydrocarbon material in the water column and surface may become transported to benthic habitats through sinking and flocculation. This pathway would allow for contamination of deep sea environments and potential hydrocarbon interactions with sensitive coral and sponge species and fish habitat. In the context of a batch spill, the potential residual effects would be greatly reduced due to the limited quantities released and therefore localized nature of the such an event.

In the context of applied mitigations, adverse environmental effects are considered unlikely and are not likely to result in an overall detectable decline in population-level fish abundance or change in the spatial and temporal distribution of fish populations in the RSA. It is also unlikely that the overall abundance, distribution or health of any species at risk and its eventual recovery will be negatively affected. With applied mitigations, these unlikely adverse environmental effects are not predicted to have significant effects on fish and fish habitat. Spill prevention techniques and response measures will be incorporated into the design and operations for all Project activities as part of contingency planning. This planning will further help ensure that effects do not occur, and in the unlikely event of an occurrence, that these events would not have significant adverse effects to fish populations and fish habitats in the RSA.

Summary of Effects of Accidental Events on Indigenous Peoples

Indigenous groups have expressed concerns regarding the potential effects of accidental events on Atlantic salmon that may potentially migrate through the Flemish Pass area. As discussed in Section 8.4.4 of the EIS, post-smolt and adult salmon are concentrated throughout the year in the Labrador Sea where they feed and overwinter. In the spring, both grilse and multi-sea winter adults appear to congregate in two general locations; near the eastern slope of the Grand Banks of Newfoundland and approximately 480 km east of the Strait of Belle Isle (Reddin and Friedland 1993; Reddin 2006) prior to their spawning migrations back to their natal rivers. Smolt ages indicate that salmon congregating off the east Grand Banks area are likely from more southern populations from South Newfoundland, a portion of the Gulf of St. Lawrence, as well as Eastern – Southern Nova Scotia and Outer Bay of Fundy. While post-smolt do not likely overwinter in the Flemish Pass area (Reddin and Friedland 1993; Reddin 2006), migration of adults from north to south to the east Grand Banks area must occur though the specific migration route is unknown. Thus, it may include areas within and near the Project Area, particularly during time periods when sea-surface temperatures are favourable (over 4°C). The following paragraphs provide a summary of the potential residual effects of accidental events on Indigenous Peoples.

An accidental event such as a large diesel spill or a subsea release will be prevented through the application of mitigations measures in Project planning and implementation by the CNOOC and reinforced through the various post-EA regulatory review processes and requirements that will apply to the proposed drilling activities that comprise this Project. The probability of such an accidental event occurring, and therefore resulting in adverse effects on this VC or any other component of the environment, is therefore low. This is further reinforced through the oil spill probability analysis summarized in the revised Section 16.3 (Appendix C of this Addendum), and presented in detail in the associated report included in Appendix F of the EIS.

Large diesel spills from Project related MODUs or vessels are both unlikely to occur, and in the event that one were to occur, the relatively localized and short term nature of any resulting environmental disturbance and associated effects, coupled with the lack of Indigenous communities and activities in this offshore area, would mean that there is little or no potential for residual adverse effects on the various components of this VC. The various response procedures outlined previously will further serve to reduce the extents of any adverse effects.

A subsea release is unlikely to occur, especially with the various prevention measures that are required and committed to in this EIS. In the unlikely event that an accidental event such as a subsea release did occur, the (conservative, without mitigation) oil spill modelling carried out for this EIS predicts a low probability (generally <25% and typically <10%) of oil moving west and reaching the shoreline of Eastern Newfoundland and always less than 10% for Labrador. Thus, surface oil is not likely to come into direct contact with any Indigenous communities or activities in Newfoundland and Labrador or other areas of Atlantic Canada. As described for marine species, any such event is not expected to result in significant adverse residual effects upon marine fish, birds, or mammals, and would thus not have a significant effect on the presence, abundance, distribution or quality such resources in the area, and thus, their availability for resource use activities by Indigenous groups within their traditional harvesting areas. There would be no potential for such direct and / or indirect biophysical effects to translate into any decrease in the overall nature, intensity, distribution, quality or cultural value of these traditional activities by Indigenous peoples.

Any accidental events that may be associated with the Project are therefore not likely to result in significant adverse environmental effects on Indigenous peoples.

When will further TK information be available, and how will it be utilized, including how it could be used in the design and implementation of follow-up and monitoring programs and further mitigations.

This question has been addressed in responses to other IRs in this Addendum. For ease of review, the relevant portions of these IRs are repeated below.

IR-13
CNOOC acknowledges that although the Project is extremely unlikely to affect Atlantic salmon, there are some data gaps regarding migratory routes. The understanding of salmon migration continues to evolve, and additional data on migratory routes of salmon may supplement the broad research ongoing by Fisheries and Oceans Canada (DFO), Indigenous Groups, Atlantic Salmon Federation, etc. CNOOC, in collaboration with research partners (potentially including Indigenous Groups), may consider supporting research on migratory routes within the Project Area. This support could also occur within the context of regional initiatives.

IR-53
Section 3.3.2 of the EIS states that the proposed activities that comprise this Project will be located at a considerable distance from any Indigenous groups and their communities (i.e., over 400 km from land and at least 635 km from any Indigenous community), and from the known traditional territories and activities associated with each of these groups. CNOOC is not aware that any Indigenous groups hold, claim or assert Aboriginal or Treaty rights or otherwise undertake traditional activities within or near the proposed Project Area, pursuant to section 35 of the *Constitution Act, 1982*. Furthermore, given the location of the Project Area over 400 kilometres offshore, it is unlikely that traditional activities took place in or near the area.

When preparing the EIS, CNOOC made reasonable efforts to integrate traditional knowledge related to the Project and its existing environment and potential effects, where such knowledge was known to exist and/or was identified and communicated by the holders of that knowledge. CNOOC's correspondence with each of the identified Indigenous groups, for example, made specific reference to traditional knowledge and invited each group to indicate whether they possessed such knowledge related to the Project Area and its potential effects, and to provide that information for discussion and possible use in the EIS.

In no cases, however, did any of the Indigenous groups identify or provide knowledge for use in the EIS as part of CNOOC's engagement program. Furthermore, following submission of the EIS and during CNOOC's engagement program CNOOC has continuously and repeatedly requested relevant traditional knowledge, information regarding traditional practices and customs, as well as information regarding how CNOOC's proposed exploration drilling program may impact any asserted Aboriginal and/or Treaty rights. Again, to date none of the Indigenous groups have provided relevant traditional knowledge for CNOOC's use.

Despite the fact that no relevant traditional knowledge information has been identified to date, CNOOC has endeavoured to incorporate all other inputs and information provided by Indigenous groups into the EIS. CNOOC has incorporated any pertinent information provided by Indigenous groups through exchange of correspondence, as well as information provided through Indigenous groups' written submissions to the Canadian Environmental Assessment Agency (the Agency) with respect to other similar offshore projects, since the geographic location and nature of their proposed programs are similar. CNOOC remains open to receiving and considering additional traditional knowledge or other inputs and perspectives from Indigenous groups as part of its planned engagement initiatives throughout the course of the Project.

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2.8.2 Information Requirement: IR-50 (Part One Response – September 2018)

External Reviewer(s): KMKNO-35-Nx, -39-Nx

Project Effects Link to CEAA 2012: 5(1)(c) Aboriginal Peoples

Reference to EIS Guidelines: Section 6.3.7 Indigenous Peoples

Reference to EIS: Section 12 Indigenous Peoples

Context and Rationale: As a primary measure to mitigate potential effects on Indigenous Communities and Activities, the EIS proposes to develop an Indigenous Communities Fisheries Communication Plan through which the proponent would communicate an annual update of planned activities, including timing of exploration activities and locations of planned wells.

The EIS states that each Indigenous community would be involved in the development of the Indigenous Communities Fisheries Communication Plan; however, it is unclear whether this plan would allow adaptive management strategies specifically for Indigenous fisheries should issues arise in the future that were not predicted within this EIS.

Specific Question or Information Requirement: Provide additional information on the Indigenous Communities Fisheries Communication Plan, including a discussion of the following:

- whether the Indigenous Communities Fisheries Communication Plan would include measures to ensure that issues and concerns can be raised by Indigenous groups during the life of the Project and how this could occur;
- whether an adaptive approach would be used to allow for a harvester feedback mechanism to report changes in harvesting (e.g. access, quality, quantity) over the life of the Project and how this could occur; and
- the sufficiency of providing annual updates to Indigenous communities about planned activities given potential for changes in operations, and the potential need for more frequent communication over the life of the Project, for example monthly updates throughout Project execution to fishers.

Response: CNOOC Petroleum North America ULC (CNOOC) acknowledges that a number of Indigenous groups continue to express interest regarding the Indigenous Fisheries Communication Plan (the "Plan"). CNOOC will prepare the Plan and will provide Indigenous groups with opportunities to review and provide comments on the Plan before it is finalized which is a similar communication model currently being used by other operators in the region. The content of the Plan may include, among other things, a process and measures to ensure that issues and concerns can be raised by Indigenous groups during the life of the Project. In addition, CNOOC notes that it is possible that unanticipated issues, including changes in harvesting (e.g., access, quality, quantity), could arise many years in the future. CNOOC intends that the Plan will be designed to be responsive throughout the life of the Project and believes it is important that the Plan contain a mechanism that ensures adaptive management measures can be taken if required. With this goal in mind, CNOOC will consider how an adaptive management approach can be incorporated into the Plan. While the specifics of any adaptive management process will be established during the development phase of the Plan, CNOOC notes that adaptive management processes must allow for flexibility in order to identify and implement, if required, new mitigation measures or to modify existing measures during the life of a project should unanticipated events arise. The details of how this may be achieved will be considered during the Plan development phase, but could include a feedback reporting mechanism, other various forms of communication between CNOOC, Indigenous communities and stakeholders, and annual reviews.

Over the life of the Project, engagement opportunities will continue through, among other things, Project updates, safety and public awareness presentations, community events, regulatory processes and ongoing informal meetings with Indigenous groups. This will include updates to Indigenous groups about planned activities given potential for changes in operations. During drilling operations, CNOOC proposes providing Indigenous groups with quarterly updates regarding Project activities. CNOOC is cognizant that a number of projects are being proposed in the Newfoundland offshore area and that some Indigenous groups have raised concerns regarding process fatigue and the volume of information being shared. Therefore, following these initial updates, the frequency and method of engagement will be informed and, if appropriate, modified by feedback from Indigenous groups throughout the life of the Project.

References:

No additional references.

2.8.3 Information Requirement: IR-51 (Text Corrected – February 2019)

External Reviewer(s): SIPE-01-Nx, KMKNO-36-Nx; Nunastiavut-01-Nx

Project Effects Link to CEAA 2012: 5(1)(c) Aboriginal Peoples

Reference to EIS Guidelines: Section 6.3.7 Indigenous Peoples

Reference to EIS: Section 16.6.7.2 Environmental Effects Assessment (Accidental Events)

Context and Rationale: While a blowout event is unlikely to occur, in the event that an accidental event such as a blowout did occur there is potential for adverse effects to Indigenous Peoples on food, social, ceremonial fisheries, moderate livelihood fisheries and communal commercial fisheries.

Recognizing that Nexen will develop a Fishing Gear Damage or Loss Compensation Program, Sipekne'katik First Nation expressed interest in how the Plan would take into account differences between the communal commercial rights holders fishery and the commercial fishery. Sipeken'katik First Nation indicated that these fisheries differ in that:

- stakeholders have the ability to leverage their fishing licence as an asset, whereas rights holder's licences do not allow for this;
- stakeholders have the ability to apply for employment insurance, whereas rights holders' licences do not allow for this; and
- the income from the communal commercial rights holders is an important source of revenue to the community.

Sipekne'Katik First Nation noted that these differences should be recognized in the development and the implementation of the Fishing Gear Damage or Loss Compensation Program.

The KMKNO noted that there is a lack of information in the EIS on how Indigenous groups would be involved in the development of the Fisheries Gear Damage or Loss Compensation Program.

Specific Question or Information Requirement: With respect to the development and implementation of the Fishing Gear Damage or Loss Compensation Program, discuss how differences between the communal commercial rights holders fishery and the commercial fishery stakeholders fishery would be considered.

Provide information on if and how Indigenous groups would be involved in the development of the Fisheries Gear Damage or Loss Compensation Program.

Response:

Gear Damage or Loss Compensation Program (Routine Events). Section 13.3.2.1 (e)(Fisheries) of the Environmental Impact Statement (EIS) describes the CNOOC Petroleum North America ULC (CNOOC) commitment to develop, implement and publicize "*a Fishing Gear Damage or Loss Compensation Program*, in accordance with applicable Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) requirements, to address any unplanned interactions between Project components and commercial fishing equipment"; this Program is also referenced in Section 12.3.3.2 (Swordfish), other sections of Chapter 13 (13.3.8, Table 13.5), and in Chapter 15 (Section 15.7.2 and Table 15.14). This Program is intended to apply primarily to losses resulting from damage to physical fishing assets that might occur – unintentionally – during planned and routine operations, and is not intended to address a major accidental event such as an oil spill that might affect nearshore areas. Given its purpose, this Program would pertain mainly to fishing activities that occur within the offshore Project Area and

near routes that Project-associated vessels take to transit between the Project Area and shore. CNOOC will prepare a draft plan of the Program and will provide Indigenous groups with opportunities to review and provide comments on the planned Program before it is finalized.

The purpose of this Program is in keeping with the C-NLOPB's Geophysical, Geological, Environmental and Geotechnical Program Guidelines (2017) Appendix 2, II. 1.c (Interaction with Other Ocean Users) which state that "Operators should implement a gear and/or vessel damage compensation program, to promptly settle claims for loss and/or damage that may be caused by survey operations. The scope of the compensation program should include replacement costs for lost or damaged gear and any additional financial loss that is demonstrated to be associated with the incident. "

Such losses might result from marine operations (e.g. surveys, other vessel traffic, escaped debris and even a small localized spill) that occur outside any Safety Zone, and would apply to gear, vessels or other fishing equipment lost, damaged, fouled, degraded or otherwise negatively affected in terms of usefulness, efficiency or effectiveness. Similar gear and vessel damage compensation programs that have been implemented in the region (e.g., for seismic surveys) also provide for compensation of any value of catch lost as a result of gear/vessel damage or loss.

Although Section 13.3.2.1 (which is focused on commercial fishing activities) uses the term "commercial fishing equipment", CNOOC does not intend to exclude harvesting equipment used by rights holders, and will include similar provisions for such damage to Indigenous group fishing equipment, commercial or otherwise in the Program. As such, any fishing gear, boats or other related equipment used within Indigenous food, social, ceremonial, moderate livelihood, as well as communal commercial fisheries affected by such occurrences, would be compensable under its terms.

A key consideration in the design of this Program will be expediency ("to promptly settle claims"), recognizing the importance of restoring affected gear quickly so that harvesting (whether by stakeholders or rights holders) can resume quickly to help minimize monetary or opportunity losses.

Operator Compensation Program (Accidental Events). Section 16, (See revised version in Appendix C of this Addendum) assesses the potential effects of Accidental Events, including a subsea release, and spills of hydrocarbons or other substances, references CNOOC's compensation requirements and commitments in such cases. Section 16.6.7.2 states that "CNOOC will develop and implement a compensation program for any economic damages suffered by fish harvesters caused by any unauthorized discharge, emission or escape of petroleum, or the escape of debris. This program will serve as a means of mitigation for any residual economic effects on the fisheries that could not be prevented or fully mitigated by other measures. It will be developed to resolve claims in an efficient and timely manner, in consideration of relevant best practices, precedents and industry guidelines, and in accord with the C-NLOPB's Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activities (2017). Requirements from the C-NLOPB include the ability of an operator to demonstrate the financial resources to meet a liability obligation of CAD $1 billion relating to damages, and to pay a deposit of $100 million for financial responsibility in case an accidental event might occur." Similarly, Section 16.6.3, states that "affected fishers would be compensated under the Operator Compensation Program, which includes provisions for lost and future lost income replacement, following the C-NLOPB Compensation Guidelines Respecting Damages relating to Offshore Petroleum Activities (2017)."

The Compensation Guidelines referenced, which follow *Accord Acts* requirements, are more specifically concerned with losses or damages that are "a consequence of a Spill or authorized discharge, emission or escape of petroleum or as a result of Debris or any action or measure taken in relation to Debris" (Section 1.1). In these Guidelines, as in the *Accord Acts*, compensation may be payable to affected parties for all "actual loss or damage". "Actual Loss or Damage," as defined, specifically includes "income, including future income, and, with respect to any Aboriginal peoples of Canada, loss of hunting, fishing and gathering opportunities" (*Accord Act* 155 (2); Guidelines 1.2). Thus, according to these requirements and CNOOC's stated commitments, the loss to Indigenous groups of opportunities to hunt or fish, as well as loss of income, will be considered in the Program's development. To accomplish this, CNOOC will necessarily consider differences between stakeholders and rights holders.

As with the gear damage and loss compensation Program referenced above, the Operator Compensation Program from such occurrences will recognize the importance of restoring lost gear or vessels promptly so that harvesting can resume to minimize monetary or opportunity losses.

CNOOC will prepare a draft plan of the Operator Compensation Program and will provide Indigenous groups with opportunities to review and provide comments on the planned Program before it is finalized.

Note that Section 16.6.7.2 of the EIS states "As noted above, compensation planning for accidental fishing gear and/or vessel damage occurring as a result of planned operations is described in Section 16.6.7.3." This should be "As noted above, compensation planning for accidental fishing gear and/or vessel damage occurring as a result of planned operations is described in Section 13.3.2.1."

References:
No additional references.

2.8.4 Information Requirement: IR-52 (Revised Response – February 2019)

External Reviewer(s): KMKNO-09-Nx, -33-Nx, -34-Nx; MTI-21-Nx, -22-Nx; NunatuKavut-03-Nx, -06-Nx, -01-Nx; Ekuan-11-Nx, 12-Nx, -14-Nx,-16-Nx, -17-Nx, Nutash-18-Nx. -23-Nx, -40-Nx; MMS-03-Nx

Project Effects Link to CEAA 2012: 5(1)(c) Aboriginal Peoples

Reference to EIS Guidelines: Section 6.3.7 Indigenous Peoples

Reference to EIS: Section 16.6.7.2 Environmental Effects Assessment (Accidental Events)

Context and Rationale: Section 6.3.7 of the EIS Guidelines requires a description and analysis of how changes to the environment caused by the Project will affect current use of resources by Indigenous peoples for traditional purposes, as well as human health and socio-economic conditions (including commercial fishing) of Indigenous communities. Underlying environmental changes to be considered in this analysis include any changes to environmental quality, including perceived disturbance of the environment (e.g. fear of contamination of water or country foods), and assessment of the potential to return affected areas to pre-Project conditions. The EIS Guidelines also require that the proponent provide justification if it is determined that an assessment of potential for contamination of country foods is not required.

Section 16.6.6 of the EIS provides an analysis of potential effects of accidental events on Indigenous communities and activities. The EIS states that in the event of an uncontrolled well event, due to a limited potential for any degree of connection between individual fish, mammals, or birds affected by a spill and individuals harvested by Indigenous communities, there is "little potential for any effects on marine-associated species in general (and individuals in particular) to translate into a detectable effect on the use of such species for traditional purposes by an Indigenous group elsewhere in Eastern Canada. Adverse effects on the health of Indigenous peoples are also not predicted to occur as a result of the Project as a result of these factors, and given the imposition of a temporary harvesting closure around the affected area."

For similar projects in the area, it has been noted that despite the limited potential for connection cited by the proponent, it is perceived that if an accidental event or malfunction occurred, there would be potential effects on species that are present, spawn, or migrate through the surrounding area, potentially impacting upon rights.

Several Indigenous communities have raised concerns about the effects of a major blowout on traditionally harvested species, including the Innu First Nation of Ekuanitshit, which asked for additional effects analysis of potential contamination of species harvested by the Innu First Nation of Ekuanitshit (Atlantic salmon, the common eider, the Canada goose and pinnipeds), either directly via contact with spilled oil, or indirectly via food chain effects.

The MTI, the KMKNO, and the NunatuKavut Community Council expressed concerns regarding the effects analysis of accidents and malfunctions on the health (both physical and psycho-social well-being) and socio-economics of potentially affected Indigenous communities. The Agency notes that there is no discussion in Section 16.6.6 of the EIS of the potential for contamination of traditionally harvested species, either through direct contact with oil (including potential oiling on inshore or near shore environments) or through bioaccumulation in the food chain. Although taint is briefly discussed in the analysis of effects of accidents and malfunctions on commercial fisheries (Section 16.6.7), it is not clearly linked in the discussion of effects on Indigenous communities. Moreover, there is no discussion of the effects of perceived contamination after a spill event, either on communities themselves or on the marketability of commercial catches.

Section 16.6.3.3 of the EIS indicates that a precautionary conclusion was drawn when predicting significant residual adverse effects of accidents and malfunctions on marine and migratory birds. It is unclear what the assumptions of this precautionary approach were and why this approach was taken for birds only. It is also unclear whether this predicted significant adverse effect on birds was carried through the assessment of effects of accidental events on Indigenous communities and activities.

Specific Question or Information Requirement: With consideration of the concerns expressed by Indigenous groups, provide additional analysis about the effects of an uncontrolled well event on Indigenous communities and activities, including:

- an expanded discussion of the potential for contamination of fish, bird and marine mammal species harvested by Indigenous communities, either directly through contact with spilled oil, or indirectly through the food chain;
- potential adverse effects on health of Indigenous peoples from the consumption of contaminated species, or justification for the determination that this assessment is not required; and
- potential adverse effects of perceived contamination of country foods by Indigenous peoples, including effects of lack of access to traditional harvest species, and dietary changes if country foods are avoided and replaced with foods of lower nutritional content.

Provide information on whether Indigenous groups would be engaged in development of the emergency response plan.

Response:

Potential for contamination. The revised Section 16.3 (Appendix C of this Addendum) discusses the very low probability of an uncontrolled well event. If an uncontrolled release occurs, it does not necessarily mean that a release of hydrocarbons will occur. Section 16.1.3 (Appendix C of this Addendum) indicates that the MODU will be equipped with well control equipment (e.g., blowout preventer [BOP]), which will reduce the potential risk of a release of hydrocarbons.

CNOOC Petroleum North America ULC (CNOOC) also repeated its oil spill modeling based on a longer release duration (120 days versus the previous 30 days) and extended the model duration from 60 days to 160 days. Following completion of the revised oil spill modelling, CNOOC updated the Accidental Events section (16) of the EIS (see Appendix C of this Addendum) to include this additional modelling information, which is appended to this submission. This additional modelling information has been incorporated into this response and summary.

The cumulative stochastic footprints for potential surface oil exceeding a thickness of 0.04 µm were between 8,152,000-8,211,000 km2. These footprints depict areas with the highest predicted likelihood of potential oil contamination to the east of the release sites, with a much lower probability (1-10% and 10-25%) for oil to be transported to the west towards Canadian waters. While these areas are quite large, most of the footprint represents a relatively low probability (<10%) of surface oil thickness >0.04 µm.

Seasonal variations were evaluated yielding different predicted surface oil results for summer versus winter scenarios. Larger surface oil footprints associated with >90% probability contours were predicted for summer scenarios indicating more coherency in the release.

The highest predicted potential (77% and 70%) for oil to make contact with any shoreline exceeding 1 g/m2 occurred only in the summer scenarios, associated predominantly with oil reaching the islands of the Azores. The maximum probability of oil reaching the shores of Newfoundland is less than 25% (and typically less than 10%) and for Labrador was always less than 10%.

The minimum predicted time for oil to contact shorelines for the modelled 95th percentile representative deterministic shoreline scenario at EL 1144 was 81 days into the release for the shores of Newfoundland, 111 days for the Azores, and no oil was predicted to reach the shores of Labrador. For EL 1150, oil was only predicted to contact the shores of the Azores, 80 days into the release for the modelled 95th percentile shoreline scenario. In all cases, based upon the minimum time to shore, oil was predicted to be extremely weathered by the time it reached shorelines.

For most representative deterministic scenarios, the amount of evaporation and degradation was relatively consistent between model runs. Approximately 43-51% of the releases were predicted to evaporate and another 34-40% to degrade by the end of the 160-day simulation. Most of the remaining variability in the mass balances was associated with the amount of oil found either on the surface or entrained within the water column. Predicted surface oil was <12%, while entrained oil in the water column ranged between 3% and 7%. The mass of oil contacting shorelines was minimal (<0.09%) with respect to the total release volume for these modelled simulations, where even the 95th percentile shoreline contact case was predicted to have 0.03% and 0.09% of the total volume of released oil reaching shore. Oil on sediments was typically 0.01%, making up the smallest portion of the predicted mass balance.

In the case of an uncontrolled well event, there is potential for marine birds and mammals to be exposed to oil, as discussed in Sections 16.6.3 and 16.6.4, respectively (see Appendix C of this Addendum). Section 16.6.3 indicates that individual birds exposed to oil suffer a mortality rate of close to 100 percent. It is unlikely that oiled birds would be consumed by Indigenous peoples. Ingestion of contaminated prey by marine mammals does have potential to result in accumulation of high concentrations of organic pollutants, especially for top-level predators, although there is evidence that ingested oil leaves the system when the organism returns to uncontaminated waters (Section 16.6.4). Pinnipeds are more susceptible to adverse effects of oil exposure than cetaceans; direct contact with oil may result in some mortality of individuals due to difficulty with locomotion and/or foraging. Sections 16.6.3 and 16.6.4 state that the likelihood of an uncontrolled well event is extremely low, and in consideration of the response measures that will be implemented, adverse effects on marine mammals and birds are unlikely. This is expected to be similar for both secure and at-risk species.

Section 16.6.2 (Appendix C of this Addendum) indicates that in the case of an uncontrolled well event, there is potential for marine fish, including plankton, benthos and finfish, to be exposed to oil. Such a spill would be expected to affect fish health and mortality. Adult demersal and pelagic fish could potentially avoid spill areas, but fish and benthic invertebrates, in juvenile and the early life stages, in the immediate area of the spill would likely suffer from nonlethal and lethal effects (Section 16.6.3; Appendix C of this Addendum). A spill of this magnitude would also have potential mortality, injury and nonlethal effects on plankton that would have further implications on foraging opportunities and overall health of higher trophic levels. In the unlikely event of an offshore hydrocarbon release, residual adverse effects to marine fish and fish habitat in the area and at the time of the accident are expected. The type and level of any effects would be dependent on such factors as the degree of exposure, spill type and size, time of year, and species presence and occurrence within the affected area. Potential adverse residual effects could include local changes to food availability and quality with potential implications for higher trophic levels. Interactions with hydrocarbons may result in sublethal and lethal mortality of fish and invertebrates depending on the species-specific responses and degree of interaction. This is expected to similar for both secure and at-risk species.

Potential adverse effects on perceived contamination of country foods and health. Section 12 of the EIS describes the potential for effects of planned and routine project activities on species harvested by Indigenous communities, based on species ranges and movements of individuals between and through the Project Area and traditional harvesting areas. Specifically, Table 12.7 of the EIS provides a summary evaluation of whether, based on existing and available scientific literature, individuals from these identified species are known or likely to be present within the Local Study Area (LSA) at any time of year before making their way into known areas of

traditional use by one or more Indigenous peoples. Existing and available biological information indicates that a limited number of the species that are known to currently be used by Indigenous groups have any potential to be present in the LSA and thus to be potentially affected by planned Project activities.

Based on the above information, the potential for contaminated marine birds, mammals, or fish to be ingested by Indigenous peoples (either directly through harvest or indirectly through the food chain) is considered very low, based on the extremely low probability of an uncontrolled well event combined with the low likelihood of a transient species intersecting the spilled materials and then travelling to an onshore or near shore location and being harvested and consumed.

Therefore, an assessment of potential adverse effects on the health of Indigenous peoples from potential consumption of contaminated species is not required as there is no credible pathway for an interaction. Any perceived contamination would be addressed by a post-spill sampling and supporting information program to demonstrate (through sampling) that the various harvested foods are not contaminated.

Whether Indigenous groups would be engaged in development of the emergency response plan. Indigenous groups would be consulted in the development of the oil spill response plan that is one part of the Operational Authorization (OA) that would be approved by the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB).

This information requirement is also discussed in Clarification Request (CL)-24, the relevant portion of which is repeated below.

Oil spill response is based on an established set of global industry standards. Many Indigenous groups in Atlantic Canada are already familiar with these global standards and practices through previous engagement and training with other operators in the region. At recent engagement workshops with Indigenous groups, CNOOC Petroleum North America ULC (CNOOC) (and other operators) shared an overview of their approach to oil spill response, in the unlikely case of an emergency event. CNOOC's oil spill response plan specific to this Project are currently being developed. CNOOC commits to sharing the final oil spill response plan with Indigenous groups for discussion and will consider input from those groups.

CNOOC will continue to engage with Indigenous communities throughout the life of the Project and will also explore opportunities to provide education in oil spill response with interested Indigenous groups.

References:
No additional references.

2.8.5 Information Requirement: IR-53 (Part One Response – September 2018)

External Reviewer(s): KMKNO-29-Nx, -30-Nx; MTI-21-Nx

Project Effects Link to CEAA 2012: 5(1)(c) Aboriginal Peoples

Reference to EIS Guidelines: Section 6.1.8 Indigenous Peoples

Reference to EIS: Section 7.4 Existing Human Environment

Context and Rationale: Section 7.4 of the EIS states that for each of the Indigenous groups, limited information is available on the current use of lands and the resources for traditional purposes and the discussion is based on available information on food, social and ceremonial harvesting and commercial communal fishing.

The MTI states that other means of data collection that support a more comprehensive understanding of each community's activities should be employed.

The KMKNO describes primary sources of information as possibly including traditional land use studies, socio-economic studies, heritage surveys or other relevant studies conducted specifically for the project and its EIS. Often these studies and other types of relevant information are obtained directly from Indigenous groups. Secondary sources of information could include previously documented information on the area, not collected specifically for the purposes of the project, or desk-top literature based information.

Furthermore, the Agency understands that the proponent may be considering collecting further traditional knowledge from Indigenous communities that may inform the effects assessment.

Specific Question or Information Requirement: Provide a rationale for only using secondary sources of information, particularly related to land and resources use, fishing activity, health and socio-economic issues.

The Agency understands that the proponent may be in discussions with some Indigenous groups regarding the collection of additional traditional knowledge. Please advise when and if the traditional knowledge being considered for collection would be available, and how it would be integrated into the current assessment as well as potential monitoring and follow-up.

Response: As stated in Section 3.3.2 of the Environmental Impact Statement (EIS), the proposed activities that comprise this Project will be located at a considerable distance from any Indigenous groups and their communities (i.e., over 400 km from land and at least 635 km from any Indigenous community), and from the known traditional territories and activities associated with each of these groups. CNOOC Petroleum North America ULC (CNOOC) is not aware of any Indigenous groups that hold, claim or assert Aboriginal or Treaty rights or otherwise undertake traditional activities within or near the Project Area, pursuant to section 35 of the *Constitution Act, 1982*. Furthermore, given the location of the Project Area is over 400 kilometres offshore, it is unlikely that traditional activities took place in or near the area.

When preparing the EIS, CNOOC made reasonable efforts to integrate traditional knowledge related to the Project and its existing environment and potential effects, where such knowledge was known to exist and/or was identified and communicated by the holders of that knowledge. CNOOC's correspondence with each of the identified Indigenous groups, for example, made specific reference to traditional knowledge and invited each group to indicate whether they possessed such knowledge related to the Project and its potential effects, and to provide that information for discussion and possible use in the EIS.

In no cases, however, did any of the Indigenous groups identify or provide knowledge for use in the EIS as part of CNOOC's engagement program. Furthermore, following submission of the EIS and during CNOOC's engagement program CNOOC has continuously and repeatedly requested relevant traditional knowledge, information regarding traditional practices and customs, as well as information regarding how CNOOC 's proposed exploration drilling program may impact any asserted Aboriginal and/or Treaty rights. Again, to date none of the Indigenous groups have provided relevant traditional knowledge for CNOOC 's use.

Despite the fact that no relevant traditional knowledge information has been identified to date, CNOOC has endeavoured to incorporate all other inputs and information provided by Indigenous groups into the EIS. CNOOC has incorporated any pertinent information provided by Indigenous groups through exchange of correspondence, as well as information provided through Indigenous groups' written submissions to the Canadian Environmental Assessment Agency (the Agency) with respect to other similar offshore projects, since the geographic location and nature of their proposed programs are the same. In addition, as stated in the EIS and to Indigenous groups during CNOOC's engagement program, CNOOC remains open to receiving and considering additional traditional knowledge or other inputs and perspectives from Indigenous groups as part of its planned engagement initiatives throughout the course of the Project.

With respect to the use of secondary sources of information, particularly related to land and resources use, fishing activity, health and socio-economic issues, CNOOC notes that there have been a number of studies related to similar natural resource projects in the region in recent years, and those have been reviewed to provide baseline information regarding Indigenous communities. Given the location of the Project, and the nature of these types of information, CNOOC does not consider that additional Project-specific studies of this nature are warranted or would provide any additional relevant information.

References:

No additional references.

2.8.6 Information Requirement: IR-54 (Part One Response – September 2018)

External Reviewer(s): MTI 25-Nx; MTI-27-Nx KMKNO-06-Nx

Project Effects Link to CEAA 2012: 5(1)(c) Aboriginal Peoples

Reference to EIS Guidelines: Part 2, Section 5.1 Indigenous Groups and Engagement Activities

Reference to EIS: Section 3.3.8 Planned Future Engagement with Indigenous Groups, and Section 12.5 Environmental Monitoring and Follow-Up

Context and Rationale: Section 3.3.8 of the EIS states that Nexen will continue to communicate with Indigenous groups about the Project, through established and/or informal engagement processes, as required and requested. These will be to facilitate discussion of any Project-related monitoring and/or follow-up, as required. The specific nature, frequency and format of any such future engagement will be determined in discussion with the Indigenous groups themselves.

Section 12.5 of the EIS (Environmental Monitoring and Follow-up) states that "The various environmental monitoring initiatives outlined earlier in relation to the biophysical environment should also be indirectly applicable to this VC (Effects on Indigenous Peoples)". MTI states that the reader should be able to see a summary of what these mitigations are within this EIS Chapter; and that, apart from the mitigations that are situated in other sections of the EIS, the only measure provided is an "Indigenous Communities Fisheries Communication Plan". MTI recommends an Indigenous environmental monitoring program that formally and explicitly incorporates Indigenous knowledge and monitoring into the indigenous Communities Fisheries Communication Plan's feedback mechanisms through an adaptive management plan; community monitoring and reporting regarding changes in (e.g., swordfish; Atlantic salmon) harvesting (e.g., access, quality, quantity) over the life of the Project is needed over the life of the project.

An Indigenous advisory committee is needed to oversee the proposed monitoring program that includes MTI representatives.

Specific Question or Information Requirement: Consider the information from MTI and describe the on-going role of Indigenous groups in monitoring and follow-up plans, including for accidents and malfunctions, developed by Nexen.

Response: CNOOC Petroleum North America ULC (CNOOC) will share its plans for monitoring and follow-up programs, including plans for communication related to the unlikely occurrence of accidents and malfunctions, with Indigenous groups in upcoming and ongoing engagement for discussion and input. Over the life of the Project, CNOOC will keep interested Indigenous groups informed of implementation of monitoring and follow-up programs and will provide ongoing opportunities to share the results of those programs. CNOOC will be open to receiving and considering input and perspectives from Indigenous groups on these programs, as well as any other feedback about the effects of the Project. Please also refer to the response for Information Requirement (IR)-51 for additional information. Given the scope of the Project and its location over 400km offshore, CNOOC considers its proposed approach to involving Indigenous groups in monitoring and follow-up programs to be appropriate in the circumstances.

References:
No additional references.

2.9 Commercial Fisheries

2.9.1 Information Requirement: IR-55 (Part One Response – September 2018)

External Reviewer(s): Unknown

Project Effects Link to CEAA 2012: 5(2)(b)(i) Health and Socio-Economic Conditions

Reference to EIS Guidelines: Part 2, Section 6.3.8.2, Commercial Fisheries

Reference to EIS: Section 13.3.3 Presence and Operation of MODUs

Context and Rationale: Section 13.3.3 of the EIS states the presence and operation of one or more MODU(s) within the Project Area has the potential to interact with marine fisheries and other marine users by making limited areas temporarily unavailable for fishing or transit while equipment is present and operations are active. Safety zones are typically 500 metres in radius but can be as large as 1000 metres. As well, because more than one MODU might be operating at the same time; this would increase the total size of excluded area within the Project Area by a proportional amount.

Specific Question or Information Requirement: Provide additional information on what factors are considered in determining the size of the safety zone and when the decision will be made.

Response:

Factors considered in determining the size of the safety zone

Section 13.3.3 of the Environmental Impact Statement (EIS) indicates Safety Zones are at a minimum, 500m in radius from the outer edge of the mobile offshore drilling unit (MODU) installation. This is prescribed in the Newfoundland Offshore Petroleum Drilling and Production Regulations, C-NLOPB/CNSOPB Drilling and Production Guidelines, and echoed in the Collision Regulations. This minimum radius applies to MODU installations that utilize dynamic positioning to remain on station over the well location. If anchors are utilized, then Rule 43 of the Collision Regulations also states that safety zones must extend 50m beyond the boundaries of the anchor pattern of the installation which could extend the Safety Zone out to 1000m or possibly further.

Section 71(1) of the Newfoundland Offshore Petroleum Drilling and Production Regulations states that "the safety zone around an installation consists of the area within a line enclosing and drawn at 500 m from the outer edge of the installation". This does not necessarily limit the Safety Zone to this minimum size, if required for safety. For instance, Ruled 43 of the Collision Regulations state:

a) For the purpose of this Rule, with respect to an exploration or exploitation vessel that is in position for exploring or exploiting the non-living natural resources of the sea bed, a Safety Zone is the area that extends from the outer extremities of the exploration or exploitation vessel to the greater of:
    i. 500 metres in all directions; and
    ii. 50 metres beyond the boundaries of the anchor pattern of the vessel.
b) The Minister may establish a Safety Zone greater than the Safety Zone referred to in paragraph (a) if it is reasonably related to the nature and function of the exploration or exploitation vessel and is necessary to ensure navigational safety.

Most MODUs, particularly in the case of a dynamically positioned MODU, have been able to operate within the 500 m requirement. If the MODU requires anchoring, the Safety Zone would be at least 50 m beyond the anchor pattern. A Safety Zone conservatively sized 1000 m was employed in the EIS in Section 13.3.3 for the purposes of considering an area wherein fishing might not be possible. As stated, the area considered is effectively double the minimum stated requirement and it also assumes three simultaneously operating MODUs with separate 1000 m

Safety Zones to calculate a "worst case" area that might be affected for harvesters. However, even if each of these Safety Zones were five times the size in area, they would still occupy less than one per cent of the Project Area waters. In any case, CNOOC Petroleum North America ULC (CNOOC) will aim to implement the Safety Zone that meets the operational and safety requirements of its work.

When would the decision be made. CNOOC does not currently expect to require a Safety Zone larger than the 500 m defined by regulations. However, a decision related to expanding the size of a Safety Zone would generally be made prior to drilling and in compliance with the regulations cited above. The variables that CNOOC would consider for potentially expanding the size of a Safety Zone beyond the 500m would include:

- Forecast seasonal weather / sea state severity;
- Water depth at a shallow water wellsite location;
- Supporting operational activities including additional support vessels; and
- Mooring/Anchor pattern, if applicable.

CNOOC is not currently proposing to use more than one MODU for its Atlantic Canada operations and is currently proposing deeper water well locations for its initial wells which would require dynamic positioning and not a moored MODU.

References:

C-NLOPB and CNSOPB. 2017. Drilling and Production Guidelines. ISBN# 978-1-927098-76-9. Published by the Canada-Newfoundland and Labrador Offshore Petroleum Board and Canada-Nova Scotia Offshore Petroleum Board. Last amended on August 2017.

Government of Canada. 2014. Collision Regulations. C.R.C., c. 1416. Published by the Minister of Justice. Current to June 10, 2018. Last amended on January 29, 2014.

Newfoundland Offshore Petroleum Drilling and Production Regulations, Government of Canada, March 24, 2010.

2.9.2 Information Requirement: IR-56 (Part One Response – September 2018)

External Reviewer(s): FFAW -03, FFAW -04

Project Effects Link to CEAA 2012: 5(2)(b)(i) Health and Socio-Economic Conditions

Reference to EIS Guidelines: Part 2, Section 6.3.8.2, Commercial Fisheries

Reference to EIS: Section 13.3.7 Wellhead Decommissioning; Section 2.5.2.5 Well Abandonment or Suspension

Context and Rationale: Section 13.3.7 of the EIS states that the drilling locations where wellheads are removed will be opened to normal fishing and shipping activity as soon as the safety zone is rescinded.

Section 2.5.2.5 indicates that planned wellhead removal may take place immediately following drilling/testing or at a later date. It is unclear why the wellhead removal may occur later, and how much time could lapse before the wellhead is removed. Additional information is required with respect to any concerns associated with commercial fisheries access if the wellhead is not removed immediately.

Specific Question or Information Requirement: Provide clarification and additional information related to wellhead removal if it may be carried out at a later date. Describe possible timeline for wellhead removal if it is not completed immediately after drilling and well testing, the need for presence of a safety zone prior to wellhead removal, and potential reasons for delaying wellhead removal.

Provide an analysis of the potential effects of leaving wellheads in place for a period of time prior to removing them, with consideration of specific ELs under consideration and various water depths. The analysis should include information (statistics if available) on whether there has been damage to fishing gear in Atlantic Canada or elsewhere due to the presence of wellheads awaiting removal. It should also include information on whether there have previously been concerns raised by the fishing industry following the notification of the wellheads that were temporarily left in place.

Response:

Wellhead removal timeline. If wellhead removal is required, it would likely take place as part of the permanent abandonment of a well. Exploration wells are drilled to collect sufficient reservoir data for the purposes of determining if there are commercial quantities of hydrocarbons for supporting future commercial production activities. These exploration wells would remain intact until data collection activities have been completed. At times a well may be suspended for the purposes of returning for well testing or further evaluation at a later period in the project schedule. The potential for suspending a well for possible re-entry at a later date would be similar for wellheads within both EL 1144 and EL 1150.

Wellhead duration before removal, and potential reasons for delaying wellhead removal Most exploration and appraisal wells would be permanently abandoned as part of the initial drilling program using the MODU. However, the thick heavy wall casing strings attached to the wellheads may be a challenge for the typical mechanical cutter deployed from a MODU. As a result, it may be necessary to use a specially equipped support vessel with alternative cutting technologies. Favorable sea conditions are required to safely and efficiently carry out the wellhead removal operations using these alternative cutting technologies. The availability of support vessels with the necessary equipment along with predicted weather conditions will influence when the well head is removed. The wellheads could remain in place for 1 to 2 years beyond the initial drilling, and, in rare circumstances, may remain in place for the duration of the exploration / appraisal phase of the project. While the methods and technologies employed for wellhead removal will be similar for structures in both ELs 1144 and 1150,

given the generally shallower depths within EL 1150 – and depending on the depth of a particular wellhead – removal might proceed more expeditiously in EL 1150.

Need for presence of a safety zone prior to wellhead removal.
During operations, the MODU or vessel would maintain a Safety Zone as described in Section 2.5.2.1 of the Environmental Impact Statement (EIS) and further discussed in the response to IR-55. CNOOC Petroleum North America ULC (CNOOC) is unaware of a requirement for a Safety Zone around a properly suspended well with a wellhead in place. The locations of any wellheads left in place will be properly communicated to commercial fishers and other marine users as well as appropriate authorities through Notices to Mariners for inclusion on nautical charts.

Potential effects of leaving wellheads in place for a period of time prior to removing them. Section 13.2.7 of the EIS acknowledges that in-place wellhead infrastructure can pose a risk to bottom trawls in particular, which are the most common gear types currently used in and near the Flemish Pass and Flemish Cap. As discussed in Section 13.2.7 and described in Section 7.2 of the EIS (illustrated in the maps throughout that Section), the waters within and immediately adjacent to both EL 1144 and EL 1150 have recorded very little domestic fishing activity and relatively low levels of foreign fishing (EIS Figure 7.62) compared to other grounds on and near this area the Grand Banks (i.e. the Project Area and LSA). This is mainly because of the water depths (>1000m in most parts of EL 1144 and in much of EL 1150). At present, a portion (61 km2) of EL 1150 is also closed to bottom contact fishing owing to the presence of a NAFO VME closure area (see EIS Table 6.42; Figure 6.56). In the shallower waters of the (roughly) southeastern half of EL 1150 along the rise of the Flemish Cap, the available data indicate a slightly greater frequency of use by NAFO signatory harvesters (EIS Figure 7.62), but in these shallower depths, wellhead removal might be accomplished more quickly as noted above. In any case, the amount of actual fishing bottom lost would be small, and, as the Figure shows, alternative grounds are available nearby.

Considering these factors, and with full communication and charting of locations (as noted above and described in Section 13.2.7) to facilitate planning to avoid any wellheads left in place, the resulting loss of fishing opportunity would be small.

For the Newfoundland and Labrador Region of Atlantic Canada, discussions with representatives from C-NLOPB, the FFAW, Ocean Choice International, the NL Association of Seafood Producers, and Canning & Pitt Associates Inc. (who have administered most gear and vessel damage programs for operators offshore NL since the late 1990s) indicate that no one is aware of damage to fishing gear (or related claims) in Atlantic Canada due to the presence of wellheads awaiting removal. This also applies to the NS Region, according to discussions with CNSOPB. CNOOC is not aware of any specific concerns raised by fishing industry participants related to notifications about wellheads temporarily left in place.

References:
No additional references.

2.10 Accidents and Malfunctions – Emergency Planning and Response

2.10.1 Information Requirement: IR-57 (Part One Response – September 2018)

External Reviewer(s): C-NLOPB-7-Nx

Project Effects Link to CEAA 2012: Multiple VCs – Accidents and Malfunctions

Reference to EIS Guidelines: Part 2, Section 6.1, Mitigation Measures

Reference to EIS: Section 16.1.4.1 Nexen Emergency Response Hierarchy

Context and Rationale: The EIS states that, in the event of a spill, the proponent may use Eastern Canada Response Corporation (ECRC) expertise and equipment. The C-NLOPB has advised that the ECRC may be limited in its ability to respond outside the 200 nm EEZ.

Specific Question or Information Requirement: Confirm that organizations (such as ECRC) whose equipment and expertise may be used in case of a spill would have the ability to respond outside of the 200 nm EEZ. As applicable, update the discussion of responses to accidental events, taking into account any potential situation in which ECRC or alternative contractor is not able to respond.

Response:
Confirm the ability to respond in case of a spill outside of the 200 nm EEZ. All of the CNOOC Petroleum North America ULC (CNOOC) exploration licenses are located outside of the 200 nautical mile exclusive economic zone (EEZ), as illustrated in Figure 1.1 in the Environmental Impact Statement (EIS).

Prior to the start of drilling, CNOOC will be required to obtain an Operations Authorization (OA) from the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB). An Oil Spill Response Plan (OSRP) must be filed with the C-NLOPB as a component of the OA.

CNOOC will enter into several contractual arrangements to ensure a full Tier 2 oil spill response (OSR) capability, within the Canada EEZ and on the outer Canadian continental shelf (outside of the EEZ). CNOOC acknowledges that the Geographic Area of Responsibility for Eastern Canada Response Corporation (ECRC) (as a Transport Canada approved Response Organization under the *Canada Shipping Act, 2001* [Government of Canada 2001]) precludes ECRC sub-contracted personnel and ECRC owned equipment from being mobilized for spills originating outside of Canada's EEZ, unless specifically authorized by Transport Canada to do so. To ensure an equivalent, or better, Tier 2 OSR capability, CNOOC will establish the contractual arrangements outlined below.

CNOOC will enter into a Subscription Agreement (SA) with ECRC. CNOOC has commenced the process of establishing specific arrangements for contractual access to Production Operator owned Tier 2 OSR equipment (contractual arrangement with Grand Banks Production Operators - Suncor, Husky and Hibernia Management Development Company) and ECRC qualified sub-contractors for deploying and operating this equipment. The onshore command post-spill response management by ECRC is unaffected by the location of the spill (inside or outside of the EEZ).

Update the discussion of responses to accidental events. Specific arrangements will be established for both the mobilization of equipment and personnel to the locations outside of the EEZ. With respect to equipment, CNOOC will establish an operator sharing agreement with the Grand Banks Production Operators. Under this agreement, ECRC maintains and stores this Operator owned equipment without any limitations associated with the *Canada Shipping Act, 2001 (*Government of Canada 2001) for location of use. The support vessels used to deploy the equipment would be under direct contract to CNOOC and will not be limited by any aspect of the *Canada Shipping Act, 2001* (Government of Canada 2001) or spill location.

With respect to the offshore ECRC 'pool of resources', ECRC utilizes qualified sub-contractors as Supervisors on CNOOC contracted vessels to deploy and supervise the use of CNOOC owned Tier 2 OSR equipment, with the assistance of the vessel crews. These same sub-contractors, as used by ECRC, will be contracted through a third-party arrangement (not directly through ECRC) so that they may be deployed outside of the EEZ, without limitations. The spill management by ECRC remains the same, however their approved and qualified sub-contractors will be sub-contacted to CNOOC via the alternate third-party. The process is seamless, and in practical terms would achieve the same outcomes as if the spill originated within the EEZ. CNOOC will have a separate contract in place with ECRC for training of vessel crews for Tier 1 OSR, again using CNOOC owned equipment maintained on each vessel.

The OSRP will be prepared for the OA associated with any future exploration drilling activities executed by CNOOC. The OSRP will outline the arrangements made to utilize ECRC's pool of contracted resources outside of the EEZ.

CNOOC has initiated discussions to become a party to the Grand Banks Mutual Emergency Assistance Agreement that will allow it to draw on resources from other operators. In addition, other response resources that could be drawn upon include resources from Oil Spill Response Limited and Canadian Coast Guard Environmental Emergencies Branch. Based on these numerous response options there is no requirement to update the EIS.

References:

Government of Canada. 2001. *Canada Shipping Act*, 2001. S.C. 2001, c. 26. Published by the Minister of Justice. Current to June 20, 2018. Last Amended December 12, 2017. Available online: http://laws-lois.justice.gc.ca/PDF/C-10.15.pdf.

2.10.2 Information Requirement: IR-58 (Part One Response – September 2018)

External Reviewer(s): KMKNO-48-Nx

Project Effects Link to CEAA 2012: Multiple VCs – Accidents and Malfunctions

Reference to EIS Guidelines: Part 2, Section 6.6.1 Effects of Potential Accidents or Malfunctions

Reference to EIS: Section 16.6.2.2 Environmental Effects Assessment

Context and Rationale: Section 16.6.2.2 of the EIS states "[a]ny batch spill resulting from the Project would cause a temporary decrease in water (and thus habitat) quality around the spill site. This would be short-term in nature, lasting until the slick disperses when aided by surface wave action in the offshore environment."

The KMKNO has indicated that the information in the EIS could be interpreted as meaning that a slick would only be dispersed through surface wave action, and that no response actions would be taken to attempt to contain and recover the spill.

Further, Section 16.1.4.3 provides potential Oil Spill Response Plan tactics; however, it is not clear whether these measures may also be employed in response to a diesel spill.

Specific Question or Information Requirement: Describe the spill response tactics to be utilized in the event of a diesel spill.

Response: CNOOC Petroleum North America ULC (CNOOC) will prepare a Spill Impact Mitigation Assessment (SIMA) (also known as Net Environmental Benefit Analysis (NEBA)), which will evaluate benefits and drawbacks of different spill response tactics. The SIMA will be included as part of the Oil Spill Response Plan (OSRP) which is a component of the Operations Authorization (OA) approval process with the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB).

In the unlikely event of a spill, an assessment will be conducted to determine the most appropriate response tactics to be employed based on a variety of factors including, but not limited to, material spilled/released (i.e., diesel vs oil), spill/release location (i.e., surface vs subsea), responder safety, wind, sea state, slick thickness, spill trajectory, available spill equipment, and environmental sensitivity. This assessment will allow spill responders to choose the best response options that will result in the maximum possible benefit and minimize potential effects to the environment.

Potential spill response tactics that could be utilized in the event of a diesel spill include, but are not limited to the following:

- Oil spill response equipment deployment such as sorbent boom, oleophilic material for containment and recovery;
- Supply vessel prop washing to assist with natural dispersion of the diesel from the surface;
- Natural dispersion (wind and wave action);
- Use of chemical dispersants; and
- In situ burning.

References:
No additional references.

2.11 Accidents and Malfunctions – Vessels, SBMs, Riser & Equipment

2.11.1 Information Requirement: IR-59 (Part One Response – September 2018)

External Reviewer(s): Unknown

Project Effects Link to CEAA 2012: Multiple VCs – Accidents and Malfunctions

Reference to EIS Guidelines: Part 2, Section 6.6.1, Effects of Potential Accidents or Malfunctions

Reference to EIS: Section 16.2.2 Dropped Objects

Context and Rationale: The EIS describes surveys that may be undertaken during the project including, but not limited to drop camera /video systems, core sampling equipment, and other sampling gear. These activities are described in Section 8.6 Environmental Monitoring and Follow-up. However, there is no discussion in Section 16, or otherwise, in the EIS of the potential effects of accidental events associated with the loss of equipment, as a result of the execution of these activities described in Section 8.6, including if it is not recovered.

Section 16.2.2 of the EIS discusses the potential accidental event of dropped objects. The EIS outlines the potential causes and safeguards/contingencies that may aid in prevention of dropped objects; however, there is no discussion of the probability of such an occurrence or the potential environmental effects.

Specific Question or Information Requirement: Comment on the probability for a dropped object, and provide an analysis of associated environmental effects.

Response: Section 16.2 Accidental Events (see Appendix C of this Addendum) addresses Major Accident Hazards (MAH), which are unplanned events with escalation potential for multiple fatalities, substantial environmental damage, significant asset damage that may include the loss of the asset, and high negative financial and/or reputational effects. One of the discussed MAH scenarios addresses the risk of dropping large objects, both on the mobile offshore drilling unit (MODU) and into the sea. Dropping small inert objects like a video camera does not fall into the MAH category. These small inert pieces of metal fall to the seabed, resulting in minimal adverse environmental impact. If larger inert objects, such as drill pipe, core sampling equipment, etc., are lost overboard, efforts would be made to recover these objects. If the object is not recoverable due to technical or safety reasons, the object would be left on the seabed.

Dropped objects are primarily a safety concern and consequently are a key focus area for CNOOC Petroleum North America ULC (CNOOC). A robust risk assessment will be carried out in advance of drilling operations, including a number of dropped object scenarios. The subsequent mitigation measures will be implemented in the drilling program / procedures. The probability of a dropped object escalating into an MAH scenario with serious environmental consequences has been assessed as remote, as long as the safeguards and mitigations have been applied.

References:
No additional references.

2.12 Accidents and Malfunctions – Model Inputs

2.12.1 Information Requirement: IR-60 (Part One Response – September 2018)

External Reviewer(s): Unknown

Project Effects Link to CEAA 2012: Multiple VCs – Accidents and Malfunctions

Reference to EIS Guidelines: Part 2, Section 6.6.1, Effects of Potential Accidents or Malfunctions

Reference to EIS: Section 16.1.4.2 Emergency Response Contingency Plans

Context and Rationale: The EIS indicates the following metrics that are relevant to the scenario of a subsurface blowout:

- Water depths at drilling locations: 330 m to 1,200 m;
- Time to drill individual exploratory wells: 45 to 160 days; and
- Estimated time to mobilize a relief well MODU / equipment, drill the relief well, and permanently kill the well: 120 days.

Specific Question or Information Requirement: Provide a rationale as to why the estimated timeframe of 120 days to drill a relief well is less than the maximum time to drill a typical exploratory well, 160 days. Explain whether the MODU used for exploration drilling could remain operational after a blowout and could therefore be utilized to drill a relief well.

Response: As discussed in response to Information Requirement (IR)-02, the estimated maximum drilling duration of 160 days includes a detailed formation evaluation program which would include wireline logging, coring, well testing, as well as a geological sidetrack which all add to the initial drill period.

In the event of a well blowout, the onsite mobile offshore drilling unit (MODU) would likely incur some damage and would likely not be suitable to drill the relief well from an integrity or safety perspective. Consequently, another MODU would need to be mobilized to drill the relief well.

The relief well drilling duration assumes a similar duration as the original well, excluding the detailed formation evaluation, but adding time to account for a rig mobilization from the North Sea (United Kingdom (UK) or Norway) and a longer directional well. Relief wells also involve additional operations such as additional surveying, ranging, well kill, etc. all of which is expected to bring the estimated time duration to 120 days as noted in the Environmental Impact Statement (EIS).

References:
No additional references.

2.12.2 Information Requirement: IR-61 (Revised Response – February 2019)

External Reviewer(s): NRCan-10-Nx

Project Effects Link to CEAA 2012: Multiple VCs – Accidents and Malfunctions

Reference to EIS Guidelines: Part 2, Section 3.1, Project Components; and Section 3.2.1, Drilling and Testing Activities

Reference to EIS: Section 16.4.3 Model Data Input

Context and Rationale: The EIS shows the contents of crude oil "residuals" that are stated to be hydrocarbons that boil at temperatures >380°C and consist of aromatics ≥ 4 rings and aliphatics > C20 that are neither volatile nor soluble. NRCan advised that the description of the crude oil heavy ends is not sufficient to predict the fate of the oil in terms of degradability and tendency to sink.

Specific Question or Information Requirement: Provide further explanation to demonstrate why model outputs show oil degradability appearing to increase with increasing residuals contents when biodegradation studies demonstrate that oil degradability decreases with increasing residuals contents.

Response: The marine diesel contains 2.7% residuals (i.e., non-volatiles) and 97.3% volatiles, whereas the crude oil contains 37% residuals and 63% volatiles. In the model simulations, the marine diesel spills were initialized at the water surface as floating oil and the crude oil was released as droplets in the water column at depth. Thus, for the batch diesel spills, a large percentage of the volatiles, 62-74% of the oil, evaporated, with the remaining mass in the water column either as droplets ("entrained") or degraded. About 40% of the crude oil spills evaporated (from surfaced oil) by 60 days, and the other volatiles (23% of the oil) degraded in the water column along with some of the residuals. Most of the crude oil remaining in the water column at 60 days was of the residual fraction. Thus, the fraction of oil degraded was higher for the crude oil subsea releases than for the smaller batch diesel spills because much of the volatile mass in diesel that would degrade if released underwater was instead evaporated from floating oil. Also, the diesel spill simulations were run for 30 days, whereas the crude oil simulations were run for 60 days. At 30 days, 15% of the crude oil had degraded, while 15-40% of the diesel degraded by 30 days (with most of the rest of the diesel evaporated).

Following completion of the additional oil spill modelling for a longer duration unmitigated release, this IR was reviewed in the context of the additional work. No updates to this response are required.

References:
No additional references.

2.12.3 Information Requirement: IR-62 (Part One Response – September 2018)

External Reviewer(s): Unknown

Project Effects Link to CEAA 2012: Multiple VCs – Accidents and Malfunctions

Reference to EIS Guidelines: Part 2, Section 6.6.1, Effects of Potential Accidents or Malfunctions

Reference to EIS: Section 16.4.1 Locations and Scenarios; Section 16.3.1 Historical Spill Data – Canada NL Offshore Area.

Context and Rationale: Information presented in the EIS indicates that very small (<1 barrel, equal to 159 liters) and small (1-49.9 barrels, equal to approximately 159-7,934 liters) spills are the most common type of spill; 98 percent of recorded spills for the Canada-Newfoundland offshore area between 1997 and 2017 fell into these categories.

The proponent modelled marine diesel batch spills, based on release volumes of 100 liters and 1,000 liters. However, there is no rationale provided for selection of 100 L and 1,000 L as plausible "worst-case" scenarios for batch diesel spills.

Specific Question or Information Requirement: Update worst-case spill modelling and associated analysis for batch spills, taking into consideration the volume of diesel in past spills in offshore Newfoundland, or provide a robust rationale for the data inputs used in the oil spill models, including how they represent a worst-case scenario. Update the assessment of effects of accidents and malfunctions on relevant VCs, as applicable.

Response: Representative hypothetical release modeling of multiple volumes were conducted to bound the potential range of effects that are typical of small volume releases of marine diesel. The selection of 100 and 1,000 L releases are order-of-magnitude estimates of common releases that fall within the ranges of these most typical (>98% of recorded spills) release volumes. As noted, very small (<159 L) and small (159-7,934 L) releases are the most common type of spills and the selected release volumes could be considered representative of these.

References:
No additional references.

2.12.4 Information Requirement: IR-63 (Revised Response – February 2019)

External Reviewer(s): C-NLOPB-8-Nx, -09-Nx; DFO-07-Nx

Project Effects Link to CEAA 2012: Multiple VCs – Accidents and Malfunctions

Reference to EIS Guidelines: Part 2, Section 6.6.1 Effects of Potential Accidents or Malfunctions

Reference to EIS: Section 16.4.1 Locations and Scenarios

Context and Rationale: The EIS Guidelines require the EIS to identify plausible worst case scenarios for each accident and malfunction type, describing the quantity, mechanism, rate, form and characteristics of the contaminants likely to be released into the environment during the accident or malfunction.
The EIS blowout model scenarios consisted of two sites:

1. EL 1144 at 1,137 m depth; release duration of 30 days; release rate of 184,000 barrels per day.
2. EL 1150 at 378 m; release duration of 30 days, and release rate of 44,291 barrels per day.

The EIS states the rationale for the 30-day release duration is that it represents the time to cap the well in the event of a spill. However, the C-NLOPB and DFO have advised that a worst-case discharge scenario would be the time taken to drill a relief well and therefore modelling for both a capping stack (i.e. 30-day release) and for drilling a relief well (i.e. 120-day release) should be completed.

The C-NLOPB also advised that the model should be run until defined thresholds based on concentration and/or probability of oiling is reached.

Specific Question or Information Requirement: Conduct the fate and behaviour modelling to reflect the worst case discharge scenario that models the drilling of a relief well.

The spill model should be continued until the slick volume is reduced to a negligible amount or until a shoreline is reached.

Update the effects assessment as applicable.

Response: On August 10, 2017, CNOOC Petroleum North America ULC (CNOOC) and its consultants (AMEC Foster Wheeler and RPS) held an online workshop with fourteen regulatory representatives from five regulatory agencies (CEAA (3), C-NLOPB (1), DFO (5), ECCC (3), NRCan (2)) seeking feedback on the proposed oil spill modelling approach to be used by CNOOC for its Flemish Pass Exploration Drilling Project Environmental Impact Statement (EIS). The presentation detailed the proposed model data sets, release duration(s) and model run duration(s) and discussed the proposed study area boundaries. A number of comments and questions were received during the workshop with the primary focus being on input data sets. As a result, the models were run based on the August 2017 parameters.

On February 20, 2018, CNOOC filed its completed Environmental Impact Statement (EIS) with CEAA. Included as part of the EIS was the completed oil spill modelling results. In the first round of Information Requirements (IR) received from CEAA in June 2018, IR-63 specifically focused on the oil spill modelling approach including the duration(s) of the oil spill release and model run. CNOOC engaged in discussions with CEAA and the C-NLOPB in July/ August 2018 regarding IR-63 and the request that CNOOC conduct the fate and behaviour modelling to reflect the worst case discharge scenario that models the drilling of a relief well.

IR-64 requested the rationale for the selection of boundaries for stochastic modelling. DFO noted that for many figures provided in the EIS with stochastic results, the spatial extent of the statistics are truncated by the boundaries of the numerical domain. The C-NLOPB had also advised that the oil spill model should be run until the ecological thresholds defined in the EIS or the probability of shoreline oiling is reached.

CNOOC has repeated its oil spill modeling based on the longer release duration (120 days versus the previous 30 days) and has extended the model duration from 60 days to 160 days. In addition, CNOOC expanded the study area (i.e., model domain) boundaries as part of the revised oil spill modelling to address the concerns raised by DFO in IR-64. Originally, the model domain spanned from 42-57 °N and 28-72 °W. In the revised modelling, the model domain was expanded to include 35-60 °N and 15-72 °W encompassing Canadian, U.S., other national territorial seas, and International Waters. The Azores were included in this expanded extent.

Following completion of the revised oil spill modelling, CNOOC has updated the Accidental Events section (Section 16) of the EIS to include this additional modelling information. The results of this additional oil spill modelling work and the updated Section 16 are provided in Appendices B and C, respectively, of this Addendum.

References:

No additional references.

2.12.5 Information Requirement: IR-64 (Revised Response – February 2019)

External Reviewer(s): DFO-44 and -45 NX; C-NLOPB-09-Nx

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat, 5(1)(a)(ii) Aquatic Species

Reference to EIS Guidelines: Part 2, Section 6.6.1 Effects of Potential Accidents or Malfunctions

Reference to EIS: Appendix G – Section 4.1 Stochastic Analysis Results

Context and Rationale: DFO noted that for many figures provided in the EIS with stochastic results, the spatial extent of the statistics are truncated by the boundaries of the numerical domain. DFO further noted that the stochastic footprints reported are therefore incomplete. Table 16.3 of the EIS indicates that the modeling duration is 60 days. Section 16.4.4.1 states that "oil contamination above the identified threshold was predicted to extend beyond extent of the model domain."

DFO noted, with regards to shoreline contact, that the results suggest that only Sable Island would be affected by a potential oil spill. However, the simulations are stopped when the patch is approaching the coasts of Newfoundland and Labrador and Nova Scotia (e.g. Figure 4-4, Appendix G). Continuing the simulations after the release stops may lead to oil being in contact with the shore (it appears that simulations are stopped very early while most of the oil is still close to the release site). The C-NLOPB has advised that the model should be run until the ecological thresholds defined in the EIS or the probability of shoreline oiling is reached.

Specific Question or Information Requirement: Provide a rationale for the selection of boundaries for stochastic modelling. Discuss the limitations of the truncated spatial extent of spill dispersion results, including the implications for shoreline contact, including Sable Island.

Response: On August 10, 2017, CNOOC Petroleum North America ULC (CNOOC) and its consultants (AMEC Foster Wheeler and RPS) held an online workshop with fourteen regulatory representatives from five regulatory agencies (CEAA (3), C-NLOPB (1), DFO (5), ECCC (3), NRCan (2)) seeking feedback on the proposed oil spill modelling approach to be used by CNOOC for its Flemish Pass Exploration Drilling Project Environmental Impact Statement (EIS). The presentation detailed the proposed model data sets, release duration(s) and model run duration(s) and discussed the proposed study area boundaries. A number of comments and questions were received during the workshop with the primary focus being on input data sets. As a result, the models were run based on the August 2017 parameters.

On February 20, 2018, CNOOC filed its completed Environmental Impact Statement (EIS) with CEAA. Included as part of the EIS was the completed oil spill modelling results. In the first round of Information Requirements (IR) received from CEAA in June 2018, IR-63 specifically focused on the oil spill modelling approach including the duration(s) of the oil spill release and model run. CNOOC engaged in discussions with CEAA and the C-NLOPB in July/ August 2018 regarding IR 63 and the request that CNOOC conduct the fate and behaviour modelling to reflect the worst case discharge scenario that models the drilling of a relief well.

IR-64 requested the rationale for the selection of boundaries for stochastic modelling. DFO noted that for many figures provided in the EIS with stochastic results, the spatial extent of the statistics are truncated by the boundaries of the numerical domain. The C-NLOPB had also advised that the oil spill model should be run until the ecological thresholds defined in the EIS or the probability of shoreline oiling is reached.

As a result, CNOOC has repeated its oil spill modeling based on the longer release duration (120 days versus the previous 30 days) and has extended the model duration from 60 days to 160 days. In addition, CNOOC has expanded the study area (i.e. model domain) boundaries as part of the revised oil spill modelling to address the concerns raised by DFO in IR-64. Originally, the model domain spanned from 42-57 °N and 28-72 °W. In the revised modelling, the model domain was expanded to include 35-60 °N and 15-72 °W encompassing Canadian, U.S., other national territorial seas, and International Waters. Due to the increased release duration, the resulting increase in the total volume of oil hypothetically released (a four-fold increase), and the larger model domain, there was a higher predicted potential for oil to strand on shorelines. Shoreline exposure to oil was predicted for the Azores, Newfoundland, Labrador, and Nova Scotia.

The oil predicted to make contact with shorelines would be expected to be highly weathered, as even the minimum time estimates for first shoreline oil exposure ranged from approximately 15-51 days for the shores of Newfoundland. The oil that did make its way to shore would likely be patchy and discontinuous. Although release sites were closer to the Newfoundland and Labrador coastlines, the highest potential for shoreline oiling was predicted to occur along the Azores, primarily due to the prevailing westerlies (winds blowing to the east) and surface currents. However, for both Labrador and the Azores, oil was predicted to be extremely weathered by the time it reached shorelines. The shortest amount of time for oil to reach the Azores was 45 days and for Labrador was 68 days.

Following completion of the revised oil spill modelling, CNOOC has updated the Accidental Events section (Section 16) of the EIS to include this additional modelling information. The results of this additional oil spill modelling work and the updated Section 16 are provided in Appendices B and C, respectively, of this Addendum.

References:

No additional references.

2.13 Accidents and Malfunctions – Model Inputs

2.13.1 Information Requirement: IR-65 (Text Corrected – February 2019)

External Reviewer(s): ECCC-17-Nx

Project Effects Link to CEAA 2012: Multiple VCs-Accidents and Malfunctions

Reference to EIS Guidelines: Part 2, Section 6.6.1, Effects of Potential Accidents or Malfunctions

Reference to EIS: Section 16.6.2.1 Potential Issues and Interactions; Section 16.6.3.1 Potential Issues and Interactions

Context and Rationale: The EIS presents contradictory statements about the effectiveness of dispersants in oil degradation: Section 16.6.3.1 states "(a)pplication of chemical dispersants results in a far greater rate of biodegradation of oil, reducing the duration to a matter of weeks rather than of years (Baelum et al 2012)." While Section 16.6.2.1 states "(a)lthough it is generally agreed that dispersants increase the availability of the oil to the microbes in the water column by reducing the oil droplets size, there still remains some debate on the effects on oil degradation rates (Brakstad et al. 2014, 2015; Kleindienst et al. 2015; Seidal et al. 2016).

ECCC has offered two papers for consideration: Whitmer et al. 2018 and Fingas 2017, a synthesis paper which summarizes more recent publications (from 2014-2017), wherein the authors found that "(t)he effect of dispersants on biodegradation is still a matter of dispute, however all but one study in the current series, showed dispersants inhibit biodegradation".

Specific Question or Information Requirement: Update the discussion of biodegradation of oil with and without chemical dispersants taking into consideration the following documents:

- Fingas, M. (2017) A Review of Literature Related to Oil Spill Dispersants 2014-2017. Prince William Sound Regional Citizens' Advisory Council (PWSRCAC), Anchorage, Alaska. Pp. 264.
- Whitmer, E.R., Elias, B.A., Harvey, D.J., and Ziccardi, M.H. (2018) An experimental study of the effects of chemically dispersed oil on feather structure and waterproofing in Common Murres (*Uria aalge*). Journal of Wildlife Diseases, 54: 315-328.

Response: The objective of dispersant use is to break up and dilute oil into small droplets in the water column, preventing exposure of surface biota to floating and shoreline oil, and promoting biodegradation by (1) increasing the surface area of the oil (Brakstad et al. 2014, 2015; North et al. 2015; Lee et al. 2015; Hazen et al. 2016); (2) diluting the oil below toxic levels (Lee et al 2015); and (3) dispersing oil more widely such that nutrients (e.g., N, P, Fe) become less limiting (Baelum et al. 2012; Prince et al. 2013; Hazen et al. 2016). The surface area per volume ratio increases as oil is broken up into small droplets, which enhances microbial attack at the oil-water interface. Once dissolved into the water column, the hydrocarbons are not expected to biodegrade faster with dispersant present than they do without dispersant. In the case of a subsea release, subsea dispersant injection (SSDI) breaks up the oil into smaller droplets, which slows the oils' ascent to the surface, or if small enough, disperses the oil permanently at depth. SSDI disperses the oil into a large water volume at depth (diluting it and enhancing biodegradation) and reduces surface water, nearshore and shoreline exposure to floating oil and entrained/dissolved oil in the upper water column (French-McCay et al. 2018).

Study of the biodegradation rates of portions of the oil, once dispersed, examine the question of whether the dispersants have any effect on the rate of biodegradation. However, if oil and dispersant are contained within a small container or mesocosm, the dilution aspect is prevented and nutrients may become limiting without

augmentation. Further, the rates will vary with the chemical composition of the oil in the media and the mix and densities of microbes present. These aspects need to be considered when evaluating whether the total amount of spilled oil is reduced more quickly by dispersant use. Thus, some statements about how dispersants increase or decrease degradation rates need to be clarified. Do they refer to a weight-specific loss rate for specific hydrocarbon(s) or a loss rate of total oil? Are the inferences made based on reductions of specific microbial species numbers (which may not be those stimulated by the oil component mixture examined and/or dispersant addition)? Are the conditions of the experiments sufficiently similar to the field conditions after a spill?

Another source of confusion is that the term "biodegradation" can mean different things. To be clear, the transformation of compounds in the source oil to other substances or microbial biomass is termed "primary biodegradation". The transformation products may be toxic themselves, and they undergo further biodegradation, possibly by other microbial species. The complete breakdown of oil-derived compounds to CO2 is termed "remineralization". Some studies have quantified biodegradation as losses of certain measured compounds or as increases in microbial biomass (as summarized by Fingas 2017), whereas others measured CO2 production, i.e., the rate of remineralization (e.g., Baelum et al. 2012).

As pointed out by many (Hazen et al. 2010; Valentine et al. 2010, 2012; Baelum et al. 2012; Dubinsky et al. 2013; Bacosa et al. 2015; King et al. 2015; Kleindienst et al. 2015a,b, 2016a,b; Seidel et al. 2016; Hazen et al. 2016), the microbial community shifts in response to an addition of petroleum hydrocarbons. Some microbes increase rapidly and others may be suppressed by toxicity or dispersants. The microbial community also shifts as the composition of the hydrocarbon mixture changes. This complicates the interpretation of experiments with varying chemical compositions and microbial flora.

Thus, analysis of experimental results need to consider these aspects. The review by Fingas (2017) does not clarify these points, rather he summarizes the contents of published literature and categorizes the statements made by the authors of the papers, stating: "Of the studies reviewed, 11% show neutral results, 22 % show positive results (notably, all industry funded), and 67% of the studies show suppression of biodegradation by the presence of dispersants." One might consider biases on both sides of the argument, as well as the fact that statistics on the number of papers voicing opinions do not necessarily reflect a scientific conclusion. The details of the data, various methods, measurements made, and meanings of the term "biodegradation" need to be taken into account before conclusions can be drawn. Fingas (2017) makes broad statements about relative rates of biodegradation with and without dispersants without discussing any specific details or making a quantitative analysis.

Given these complications, the publications available, and the status of the science, it is certainly fair to say that there is debate on the effects of dispersants on oil biodegradation rates once oil is dispersed. However, weight-specific rates of biodegradation of some of the hydrocarbons in oil in an enclosed experimental system may not reflect the whole oil and conditions in the field (e.g., see Prince et al. 2016). Further, the concentration of dispersants in the environment are typically much lower than those used in experimental systems because of dilution. Additionally, the goal of dispersant use is to increase the overall percentage of the spilled oil that biodegrades. Even if the weight-specific biodegradation rates of some individual hydrocarbons are slower in the presence of dispersants, if dispersant application is effective, i.e., such that much of the bulk oil is in the water column (as opposed to floating or on shore), the amount of oil degraded overall would be much greater than the amount degraded in the water column (possibly at a higher gram-specific rate) without dispersants present. Floating oil biodegrades very slowly (NRC 2005). In the overall mass balance, effective dispersant use is expected to increase the overall amount of oil biodegraded, as opposed to that oil ending up floating or on shorelines (French-McCay et al. 2018).

Whitmer et al. (2018) describe experimental work where birds exposed to oil, a dispersant and oil mixture, or high concentrations of dispersant, experienced waterproofing impairment. Thus, they point out that a zero-risk assumption should not be used when seabirds are present within the dispersant application zone. These authors do not comment on whether biodegradation rates are enhanced by dispersants. Thus, the use of dispersants to break up oil, facilitate biodegradation, and prevent wildlife (including birds) exposures to oil would reduce overall impact to wildlife and shorelines. Dispersant applications on oil should avoid locations where there are relatively high densities of birds, as is the practice in spill response planning.

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2.13.2 Information Requirement: IR-66 (Part One Response – September 2018)

External Reviewer(s): ECCC-17-Nx

Project Effects Link to CEAA 2012: Multiple VCs-Accidents and Malfunctions

Reference to EIS Guidelines: Part 2, Section 6.6.1, Effects of Potential Accidents or Malfunctions

Reference to EIS: Section 16.6.2.1 Potential Issues and Interactions; Section 16.6.3.1 Potential Issues and Interactions

Context and Rationale: ECCC has advised that it is not known what the effects of dispersants alone may be on birds, and in particular on their plumage; dispersants are a surfactant and therefore may compromise the waterproofing of feathers, in a similar manner to that of oil. The synthesis of the effects of dispersants on marine and migratory birds should be made more robust.

Specific Question or Information Requirement: Provide an assessment of the effects of dispersants on migratory birds, including recent studies.

Response: Recent research has been undertaken to better understand the effects of dispersants on migratory birds (e.g. Wooten et al 2012; Fiorello et al 2016; Whitmer et al 2017). In an experimental study on Common Murres, Whitmer et al (2017) reported that exposure to high concentrations of the dispersant Corexit 9500A experienced an immediate loss of waterproofing and buoyancy which was life-threatening but reversible, with recovery occurring within two days of exposure. Exposure to lower concentrations did not result in significant loss of waterproofing or buoyancy. In the same study, exposure to oil and to a mix of oil and dispersant caused a dose-dependent loss of waterproofing and buoyancy that did not show signs of reversibility within the two days of the study prior to cleaning and release of the birds. Fiorello et al (2016) exposed captured Common Murres to either Corexit EC9500A, crude oil, or a combination of the two, and found that exposure to dispersant was related to development of conjunctivitis. Exposure to oil resulted in a similar increase in risk of developing conjunctivitis, and also an increased risk of development of corneal ulcers; no increased risk of corneal ulcers was noted with exposure to dispersant alone. Wooten et al (2012) found that application of the dispersant Corexit 9500 on fertilized mallard (*Anas platyrhynchos*) eggs caused a significant, dose-dependent decrease of hatching success; an application volume of 15.5 µL resulted in 50% mortality of embryos.

References:

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2.13.3 Information Requirement: IR-67 (Part One Response – September 2018)

External Reviewer(s): Unknown

Project Effects Link to CEAA 2012: Multiple VCs – Accidents and Malfunctions

Reference to EIS Guidelines: Part 2, Section 6.6.1, Effects of Potential Accidents or Malfunctions

Reference to EIS: Section 16.1.4.3 Potential OSRP Tactics

Context and Rationale: The use of dispersants to transform the surface oil to the water column for biodegradation is listed as a possible response measure. However, the effectiveness of dispersants in cold water may differ from those in warmer waters.

Specific Question or Information Requirement: Discuss the efficacy of dispersants in cold water.

Response: The parameters important to operational dispersant use and effectiveness include: dispersant performance and properties under the relevant conditions (salinity, water and air temperature, oil type); oil dispersability and weathering properties at relevant temperatures; access and contact between dispersant and oil; and sufficient mixing energy for the dispersion process. (Belore et al, 2009; Lewis and Daling, 2007; Sørstrøm et al, 2010).

Low air and sea temperatures will cause spilled oil to have a higher viscosity when compared to the same oil in more temperate conditions. Depending on air and sea temperatures, the oil may be below the Pour Point of the oil and could effectively be solid. Low air and sea temperatures will also slow down the rate of evaporation of the more volatile components of oil and the uptake of water to form water-in-oil emulsions when compared to the evaporation rate and water uptake that takes place under more temperate conditions (i.e., the oil does not weather as quickly). As a result, the time period after an oil is spilled and dispersant use is likely to be effective can be longer under cold air and sea temperatures. Dispersant effectiveness, as determined with various test methods, is generally high under low air and sea temperatures until the oil reaches a limiting viscosity value (i.e., high viscosity affecting dispersion) and that limiting viscosity value varies by test (Lewis and Daling, 2007).

References:

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Sørstrøm, S.E., P.J. Brandvik, I. Buist, P.S. Daling, D. Dickins, L-G. Faksness, S. Potter, J.F. Rasmussen and I. Singsaas, 2010: "Joint Industry Program. Oil Spill Response for Arctic and Ice-covered Waters". Summary Report – Oil in Ice JIP, SINTEF report A14181, ISBN no. 978-82-14-04759-2.

2.13.4 Information Requirement: IR-68 (Text Corrected – February 2019)

External Reviewer(s): Unknown

Project Effects Link to CEAA 2012: Multiple VCs – Accidents and Malfunctions

Reference to EIS Guidelines: Part 2, Section 6.6.1, Effects of Potential Accidents or Malfunctions

Reference to EIS: Section 16.1.4.3 Potential OSRP Tactics

Context and Rationale: As described in Section 16.1.4.3 of the EIS, in addition to other tools surface/aerial/subsurface dispersants may be used as a response tool in the event of a spill. However, the assessment of potential effects of dispersants on applicable VCs does not distinguish between these applications, which may present considerably different risks, effects, and benefits.

Specific Question or Information Requirement: Discuss differences in potential effects between subsea, surface and aerial dispersant application.

Response: After oil is spilled, it typically will undergo eight processes which can occur simultaneously to different degrees. The eight processes include: spreading/advection; evaporation; dissolution; dispersion; emulsification; photo-oxidation; sedimentation and shoreline stranding; and biodegradation. (Coolbaugh and McElroy, 2012).

The natural dispersion of oil in the water column can be aided by the application of dispersants. Commercial dispersant products are normally a combination of solvents and surfactants that can be sprayed on the sea surface or injected close to the wellhead in the event of a subsea release. Dispersants enhance the natural processes that occur when oil is spilled onto the sea surface or into the sea at depth. The mixing energy of wave action and currents will naturally promote the breakdown and dispersion of an oil mass into smaller droplets. The intent of dispersants is to accelerate that process. They are used to increase the portion of oil that is dispersed as small buoyant oil droplets which are rapidly diluted into the water column by currents and wave action. Dispersants do not reduce the total volume of oil in the environment but rather they increase the surface area of oil exposed to the environment, with the intent to accelerate oil biodegradation.

The method of dispersant application will depend on a number of factors including environmental conditions and the nature of the incident (i.e., was the oil spilled at or near the surface or is it resulting from a subsea release). The operational capability and overall effectiveness of surface and aerial dispersant applications are greatly influenced by environmental conditions including winds, sea state, precipitation, and the presence and size of areas to avoid such as biota or ice. Aerial applications have the ability to cover large areas quickly. Surface applications by vessel can be more focused on specific areas and can attempt to avoid larger surface obstructions such as ice. Aerial and surface applications are most effective on oil at the sea surface.

The goals of subsea dispersant injection in a subsea release are: to increase the effectiveness of dispersant treatment over that achievable at the sea surface; to reduce the amount of dispersant required to treat a certain amount of oil; to decrease the volume of oil that surfaces; reduce human and wildlife exposure to volatile organic compounds (VOCs) at the surface; disperse the oil over a large water volume at depth; enhance the biodegradation of the oil; and reduce surface, nearshore and shoreline exposure to floating and surface-water entrained/dissolved oil. Potential trade-offs include increased water column and benthic resource exposures to oil at depth. (Coolbaugh and McElroy, 2012).

References:

Coolbaugh, T and A. McElroy, 2012. Dispersant Efficacy and Effectiveness. Available online: https://crrc.unh.edu/sites/crrc.unh.edu/files/coolbaughmcelroy.pdf. Accessed June 2018.

2.14 Accidents and Malfunctions – Capping Stack

2.14.1 Information Requirement: IR-69 (Part One Response – September 2018)

External Reviewer(s): KMKNO-44-Nx

Project Effects Link to CEAA 2012: Multiple VCs – Accidents and Malfunctions

Reference to EIS Guidelines: Part 2, Section 6.6.1, Effects of Potential Accidents and Malfunctions

Reference to EIS: Section 16.1.4.2 Emergency Response Contingency Plans, Well Containment Procedure (Capping Stack)

Context and Rationale: The Newfoundland and Labrador government launched a plan to double offshore oil production by 2030 and the oil industry's target is to include more than 100 new exploration wells. A number of offshore exploration drilling projects are currently being proposed.

The EIS indicates that the mobilization and deployment of a capping stack is expected to range between 15 and 30 days depending on weather conditions, vessel availability and the state of the equipment. The KMKNO stated that recent innovations have resulted in the design of a lighter capping stack that can be transported via aircraft, the RapidCap™ Air Mobil Capping Stack. The KMKNO indicated that the lightweight capping stack can be flown from Houston within 24 hours decreasing the time required to cap a well.

Specific Question or Information Requirement: Discuss the economic and technical feasibility of options for decreasing capping stack response times, taking into consideration: the potential to use other capping stacks, establishing a capping stack facility in eastern Canada, having a capping stack available on a vessel for rapid deployment, or shipping a capping stack by air. Also, discuss if there have been any recent or ongoing innovations in capping stack technology and availability, and application to the Project.

Response: The well control emergency response plan is multi-pronged. Once enacted, it simultaneously initiates wellsite field assessment measures, mobilization of debris removal equipment, mobilization of tactical oil spill response measures including dispersant application equipment, mobilization of a mobile offshore drilling unit (MODU) for relief well efforts, and assembling, testing, and transporting the capping stack system to the incident location.

Capping stack systems and the related supplementary equipment are extremely specialized tools for well control intervention that are manufactured, tested and typically maintained by third party companies, such as Wild Well Control. In the event of a blowout, Wild Well Control, (Section 16.1.4.2 of the Environmental Impact Statement (EIS), has been sourced by CNOOC Petroleum North America ULC (CNOOC) to supply and operate, if necessary, a capping stack system for its Atlantic Canada wells. The selected capping stack system is the same system that was used to successfully cap the BP Deepwater Horizon well in the Gulf of Mexico. It is a ram based system and the most prevalent form of capping stack design for both land and subsea operations. It provides the ability to:

- Cap a flowing well;
- Flow the well back to surface should the well integrity be insufficient for shut-in;
- Kill the well;
- Install a hydrostatic barrier; and
- Install a mechanical barrier.

This is in contrast to other valve-based capping stack products on the market that can only cap a flowing well, flow back to surface, and install a hydrostatic barrier.

Wild Well Control has two capping stack facilities to service the offshore industry around the globe. The primary capping stack system will be sourced from their Montrose, United Kingdom (UK) facility and if needed CNOOC would have access to a contingency capping stack from their Singapore facility. Companies such as Wild Well Control choose their capping stack system facility locations based on their own business needs, internal requirements, and processes. They are mindful to maintain proximity to areas with high global offshore drilling activities with access to multi-purpose vessels of opportunity as well as manufacturing and maintenance facilities. These facilities are setup such that the equipment appropriate for the incident can be promptly adjusted and made ready for shipment.

A consortium of international operators has arrangements to access Wild Well Control's capping stacks if undergoing a similar incident. Wild Well Control is obligated to provide equipment and services to all consortium members from its strategically designated locations.

Capping stack systems can be transited via sea- or air-freight. Sea-freighting offers fewer transport legs, and in CNOOC's view, is the more direct transport option for initial response. By sea-freighting the capping stack from the quayside Montrose, UK facility, the capping stack system simply needs to be assembled and tested prior to loading on a vessel and sea-fastening. The construction of the capping stack takes place at the facility where the capping stack is routinely assembled, tested, and maintained giving access to expertise, equipment, and spares. Being situated in an area of the world with high offshore oil and gas activity lends itself to favorable access to many multi-purpose vessels. After the capping stack system is assembled, it is loaded once onto the multi-purpose vessel and sea fastened. Leaving the port of Montrose, the vessel will transit directly to the well location. The vessel will then arrive at the well location ready to deploy the capping stack.

Air-freighting is a faster mode of transportation compared to that of sea-freighting, but the faster shipment may not translate into faster capping times for a variety of reasons including availability of the required multi-purpose installation vessel in the region, on-going debris removal operations, need to break down to ship by air and re-assemble the capping stack in the region, etc.). The logistical complexity of air-freighting also introduces substantially increased handling of the capping stack system throughout its journey to the incident location. Air-freight is a favorable transport alternative and is the shipping mode of choice for CNOOC's contingency capping stack.

The capping stack is one piece of a broader well control emergency response plan. While the capping stack is being mobilized, there are other integral operations (e.g., site assessment, debris removal, tactical oil spill response measures, replacement MODU mobilized to the region) taking place. Therefore, having a capping stack in closer proximity to the wellsite does not necessarily translate into faster capping times.

As the industry evolves, innovative technologies will continue to emerge. Innovation in capping stack technology includes the advent of valve-based systems. These systems are often lighter and advertise short air-freighting transit times. However, these systems are very incident and well specific. They do not permit the same functionality as the ram-based systems. Strides in capping stack technology have also been made towards working in deeper water (~3800m) and with higher pressures (20K stack at ~138MPa). CNOOC will continue to evaluate these systems and will decide which systems are applicable for regional as well as global well operations and also timing of implementation.

References:

No additional references.

2.14.2 Information Requirement: IR-70 (Part One Response – September 2018)

External Reviewer(s): ECCC-15 Nx; Nutash-50-Nx; MFN-14-Nx

Project Effects Link to CEAA 2012: Multiple VCs – Accidents and Malfunctions

Reference to EIS Guidelines: Part 2, Section 6.6.1, Effects of Potential Accidents or Malfunctions

Reference to EIS: Section 16.1.4.2 Emergency Response Contingency Plans, Well Containment Procedure (Capping Stack)

Context and Rationale: The EIS states that a capping stack is a specialized piece of equipment used to "cap" (i.e. stop or divert) well flow while work is being undertaken to permanently kill the well (e.g. through relief well drilling). Technical information regarding the mobilization, deployment and mechanics of capping stacks has been presented, but no information has been provided on their expected operational lifespan, the timing of decommissioning, nor on any follow-up monitoring activities that would be required if the capping stack is removed from a wellhead.

It is important to understand the lifespan and decommissioning implications for wells that may become compromised due to blowout events so as to better understand and characterize any longer-term environmental effects that may occur, and may therefore need to be monitored for, at blowout-affected well sites.

Specific Question or Information Requirement: Given that a capping stack may have to remain affixed to a wellhead for an extended period of time should dynamic well kill measures prove unsuccessful, provide information on the operational lifespan of capping stacks and any contingencies in place to either extend their service or replace them.

Provide information on when a capping stack system may be decommissioned and describe any potential wellhead integrity monitoring efforts that would follow, including expected timeframes of such.

Response: The Wild Well Control capping stacks are designed for a minimum lifespan of 2 years installed under subsea service in the shut-in state and 6 months of continuous flowing service, as per API RP 17W. This period of time is sufficient to permit the ensuing plug and permanent abandonment of the subject well. The Wild Well Control capping stack also permits installation of hydrostatic and mechanical barriers and a means to kill the well through the capping stack in parallel with drilling a relief well.

Once installed, the capping stack would not be removed until proper barriers are installed in the well and with regulatory approval. Further requirements for the removal of equipment and subsequent well monitoring would be in accordance with Drilling and Production Guidelines (C-NLOPB, 2017).

References:

C-NLOPB and CNSOPB. 2017. Drilling and Production Guidelines. ISBN# 978-1-927098-76-9. Published by the Canada-Newfoundland and Labrador Offshore Petroleum Board and Canada-Nova Scotia Offshore Petroleum Board. Last amended on August 2017. Available online: http://www.cnlopb.ca/pdfs/guidelines/drill_prod_guide.pdf?lbisphpreq=1. Accessed June 2018.

2.14.3 Information Requirement: IR-71 (Part One Response – September 2018)

External Reviewer(s): ECCC-14-Nx; ECCC-16-Nx

Project Effects Link to CEAA 2012: Multiple VCs – Accidents and Malfunctions

Reference to EIS Guidelines: Part 2, Section 6.6.1, Effects of Potential Accidents or Malfunctions

Reference to EIS: Section 16.1.4.2 Emergency Response Contingency

Context and Rationale: Section 16.1.4.2 (Emergency Response Contingency Plan) of the EIS provides information related to the complement of tools and strategies for spill response. However, in several instances additional is required.

The EIS lists components of the Well Control Emergency Response Plan including a site survey, dispersant system deployment, and debris removal procedures; however, the EIS does not describe what timelines are associated with each of these, how they relate to the mobilization and initiation of the capping stack and relief well, and whether additional equipment would be required to be brought to the site for the activities (e.g. debris removal equipment).

The EIS states that "In the unlikely event that each of the preventative barriers fail and an uncontrolled well event has occurred, where secondary BOP control intervention systems (ROV intervention, remote acoustic activation of the BOP) were unsuccessful, Nexen would immediately commence with mobilizing multiple contingency plans, including well capping / containment and relief well operations." The EIS does not indicate the possible timeframe taken by secondary BOP control intervention systems, and how this may impact the stated 15 to 30 day timeline for mobilization and deployment of the capping stack.

The EIS indicates that if needed, a capping stack would be transferred by vessel with sufficient capability for direct or indirect installation directly from Montrose, United Kingdom to the wellsite. Alternatively, there is access to a contingency capping stack located in Singapore. The EIS does not indicate in what circumstances the contingency capping stack would be mobilized from Singapore, or the timeline associated with the decision to initiate mobilization and deployment.

The EIS states that the mobilization and deployment of the capping stack is expected to range from 15 to 30 days depending on weather conditions, vessel availability, and the state of the equipment (deployment system, capping stack, and BOP/wellhead); however, the assumptions made in calculating this range are not described. Further, the EIS does not describe the steps included in mobilization and deployment (e.g. final equipment preparation and testing, shipment to a port facility; loading on a vessel), and what the timeframes may be for each step.

The EIS notes that "(A) relief well may also be required to permanently eliminate the flow and would be initiated at the time of the blowout, in parallel with the deployment of the capping stack", indicating that there may be instances when a relief well is not required. However, there is no information on circumstances under which a relief well is needed or the factors considered in the decision to drill a relief well.

It is important to understand the response measure timeframes involved with the deployment of all subsea incident response apparatus so that well control preparation activities and associated timeframes can be fully appreciated and the magnitude of environmental effects resulting from any extended timelines can be properly determined and characterized to the greatest extent possible.

Specific Question or Information Requirement: Provide information on steps and timeframes involved in the deployment of subsea incident response equipment, such as the capping stack, including the following:

- the timeframe for employing secondary BOP control intervention systems and how this may impact the stated 15 to 30 day timeline for mobilization and deployment of the capping stack;
- the timelines associated with survey work, dispersant application and debris removal at the wellsite after a blow-out and how these steps relate to the mobilization and initiation of response measures (i.e. the capping stack and relief well);
- clarification on whether additional equipment would be required to be brought to the wellsite after a blow-out for use before the capping stack can be installed (e.g. for debris removal);
- a description of the steps included in the mobilization and deployment of the capping stack, including the timeframes related to each step;
- assumptions made in the calculation of the stated 15 to 30 day estimate for mobilization and deployment of the capping stack; and
- a description of the decision-making processes and timeline associated with the deployment of the contingency capping stack.

Response: Preparations for capping stack mobilization, site survey/assessment work, debris removal, tactical oil spill response measures (such as containment and recovery measures, dispersant application), and relief well drilling all begin simultaneously when the decision is made to mobilize the well control emergency response systems. A remotely operated vehicle (ROV) would be promptly commissioned to begin the seafloor site assessment and any intervention, which would take approximately 2 days. Concurrently, Wild Well Control would be mobilizing capping stack crews, preparing their equipment at their Montrose, United Kingdom (UK) facility, as well as shipping their relevant kits to the well site (i.e., Debris Removal equipment, Dispersant Application equipment).

It is estimated that debris removal operations (and potentially subsea dispersant application if approved) would begin within 4 to 5 days of call-out. Debris removal operations timelines are quite variable depending on the incident, the amount of debris to be removed, the availability of suitable support vessels and equipment and sea state. These activities would range from 1 day for light-duty situations (e.g., a piece of drill pipe left in the lower BOP or other minor debris) to 7 days for heavier-duty more severe incidents (e.g., the Lower Marine Riser Package remains affixed to the lower BOP with riser on the seabed needing to be cut and removed). The severity of the incident will dictate the type of equipment required to be shipped to location ahead of the capping stack system. Debris removal operations are independent of the mobilization, assembly, testing, load-out and transport of the capping stack system. The following provides a description of concurrent activities for well control emergency response:

- Initiate Wild Well Control well control incident response unit via their 24-hour emergency phone line;
- Mobilize a ROV to the site for site assessment;
- Implement site assessment measures as well as initiate air-freight mobilization of debris removal and dispersant application equipment to location while assembling, testing and loading the capping stack system for sea transport;
- Deploy equipment and perform debris removal operations (and dispersant application if approved) while transporting the capping stack system to location; and
- Capping stack arrives at location on multi-use support vessel and deploy, land and latch the capping stack system.

A time estimate to perform the previously described operations would be 30 days, which should account for delays in vessel/aircraft availability, mechanical issues, and weather delays that might occur.

The unavailability of, or damage to, the primary capping stack in Montrose, UK would automatically trigger the mobilization by air freight of the contingency capping stack system from Singapore. CNOOC Petroleum North America ULC (CNOOC) would have advanced knowledge of the status of the primary and secondary capping stacks and circumstances that threaten the delivery of the primary capping stack will initiate mobilization of the contingency capping stack from Singapore so as to not adversely affect the response schedule.

The response to Information Requirement (IR)-69 may provide additional information.

References:
No additional references.

2.14.4 Information Requirement: IR-72 (Part One Response – September 2018)

External Reviewer(s): C-NLOPB-6-Nx

Project Effects Link to CEAA 2012: All – Project Description Relevant to All Section 5 Effects

Reference to EIS Guidelines: Part 2, Section 3, Project Description

Reference to EIS: Section 16.1.4.2 Emergency Response Contingency Plans, Well Containment Procedure (Capping Stack)

Context and Rationale: The EIS Guidelines require a discussion on the use and feasibility of a capping stack to stop a blowout and resultant spills. Table 2.1 of the EIS indicates that water depths range from approximately 330 meters to 1,200 meters within the Project Area. The C-NLOPB has advised that the use of a regular capping stack in shallow water depths may not be possible because a vessel may not be able to operate over the well.

Specific Question or Information Requirement: Provide additional information on the technology available to cap a shallow-water well, including information available to support the effectiveness of the technology, with respect to the potential shallow depths in the ELs.

Discuss limitations associated with the use of a capping stack in particular in shallow water environments, including any differences in the steps taken to affix a capping stack in shallow water that may not be required when capping a deep water well (e.g. use of dispersants to reduce flow rate). Explain how the limitations of the technology could affect the length of time it may take to effectively cap a well.

If applicable, update the effects analysis to reflect these additional considerations.

Response: CNOOC Petroleum North America ULC (CNOOC) has continued to evaluate the available subsurface data and the current prospectivity across both EL 1144 and EL 1150 does not show CNOOC undertaking its preliminary exploratory wells (i.e. initial 2-3 wells) in water depths shallower than 700m. The data obtained from these preliminary wells will help to define the locations of any subsequent wells but the current expectation is that all of the proposed ten wells will remain in deeper water (i.e., >500 m). Thus, the need to employ shallow water technologies and techniques does not apply to this project.

The effects analysis provided in the Environmental Impact Statement (EIS) remains valid.

References:
No additional references.

2.15 Accidents and Malfunctions – Effects

2.15.1 Information Requirement: IR-73 (Part One Response – September 2018)

External Reviewer(s): NRCan-09-Nx

Project Effects Link to CEAA 2012: Potential effects to 5(1)(b) Federal Lands / Transboundary

Reference to EIS Guidelines: Part 2, Section 6.6.1, Effects of Potential Accidents or Malfunctions

Reference to EIS: Section 16.6 Environmental Effects Assessment, Section 16.1.4.3 OSRP Tactics

Context and Rationale: The EIS Guidelines require that the environmental effects of spill response measures outlined in the emergency response plan be considered (Section 6.6.1).

Section 16.1.4.3 of the EIS states that Nexen will conduct a Net Environmental Benefits Analysis (NEBA) and that the assessment will allow spill responders and stakeholders to choose the best response options that would result in the maximum possible benefit and minimal potential effects to the environment. However, the EIS does not explain how the Net Environmental Benefits Analysis is conducted, what is included in the assessment, how it enables spill responders and stakeholders to choose the best response option, nor how it achieves the objectives of maximizing benefits and minimizing potential environmental effects.

For example, NRCan has advised that in situ burning of crude oils could result in incompletely-combusted oil in the water.

Specific Question or Information Requirement: Describe the Net Environmental Benefits Analysis, including the following information:

- explain how a Net Environmental Benefits Analysis is conducted;
- explain what is included in the assessment;
- explain how it enables spill responders and stakeholders to choose the best response option;
- identify who the stakeholders are; and
- explain how it achieves the objectives of maximizing benefits and minimizing potential effects to the environment.

Response: CNOOC Petroleum North America ULC (CNOOC) will prepare a Spill Impact Mitigation Assessment (SIMA) (also known as a Net Environmental Benefit Analysis (NEBA) to encompass the range of issues considered during an oil spill response), as part of the CNOOC Oil Spill Response Plan (OSRP) which is a component of the Operations Authorization (OA) approval process. The OA application and its supporting materials are reviewed for completeness by the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB). The SIMA will evaluate the benefits and risks of each of the potential spill response tactics (which may include natural attenuation or use of dispersants) that could be utilized under a range of credible scenarios.

In oil spill response, once human health and safety are addressed, the over-riding concern is containment and mitigation in order to minimize environmental and social impacts. In the majority of spill scenarios, no single response option is likely to be completely effective. All potential response options have both limitations and benefits. Therefore, the best approach to minimize impacts is to have multiple response options available. The objective of a SIMA is to consider all available response options and identify those techniques that are predicted to provide the best opportunities to minimize overall consequences.

When a SIMA approach is used, the analysis is based on the structured use of a comparative risk framework. The basic premise of the analysis is that appropriate decisions are contingent upon determining how all available response options might be used to minimize damage and encourage recovery of the environmental and social-economic systems. The analysis is based on consideration of the predicted benefits and limitations of each of the available response options. In addition, it provides a qualitative assessment of the relative risk to each resource of concern from each potential response option, using "natural attenuation" (i.e., no human intervention) as the baseline for comparison. This allows a comparison of how each potential response option could affect resources of concern relative to the other available options.

A recent publication by the International Petroleum Industry Environmental Conservation Association (IPIECA 2018) describes the four stages of the SIMA process as:

1. Compile and evaluate data for relevant oil spill scenarios including fate and trajectory modelling, identification of resources at risk and determination of feasible response options. This would include:
    a. Collect information on the physical and biological environmental conditions as well as the human use of the area of interest.
        i. *This step is currently underway with the preparation and regulatory review of the Project Environmental Impact Statement (EIS).*
    b. Review previous spill case histories and experimental results which are relevant to the area and to the available response methods.
        i. *Past scientific studies and learnings from previous offshore spill incidents are reviewed and, as applicable the information is incorporated.*
2. Predict outcomes/impacts for the 'no intervention' (or 'natural attenuation') option as well as the effectiveness (i.e. relative mitigation potential) of the feasible response options for each scenario:
    a. On the basis of previous experience and professional judgement, predict the likely outcomes if the proposed response is used.
        i. *Based largely on professional judgment as well as learnings from other offshore spill incidents.*
3. Balance trade-offs by weighing and comparing the range of benefits and drawbacks associated with each feasible response option, including no intervention, for each scenario:
    a. Compare and weigh the advantages and disadvantages of all potential response options against the outcome of using no intervention.
        i. *This is a semi-qualitative process and relies heavily on the professional judgement and experience of the SIMA authors as well as input from key regulators and resource managers in the region gathered through engagement and review.*
4. Select the best response option(s) to form the strategy for each scenario, based on the combination of techniques that will minimize the overall ecological, socio-economic and cultural impacts and promote rapid recovery.

The SIMA is normally conducted using a risk matrix which evaluates the predicted interaction and risks of potential response options with the ecological resources. There are a wide range of potential factors that can influence risk management decisions associated with an oil spill response including: political issues; ecological issues; social issues; technological feasibility; regulatory and legal issues; cost and benefit. The SIMA analysis would normally be conducted at the regional level with key regulatory agencies to understand the individual areas of responsibility and inform the risk matrix of potential trade-offs between environmental, social, economic or aesthetic concerns. However, other interested stakeholders and Indigenous groups could be consulted during the drafting of the OSRP, or the SIMA Report, to seek additional comment. The interested stakeholders and Indigenous groups are expected to be the same as those involved in the review of the EIS.

Conceptually, the SIMA evaluation considers how each ecological resource (summarized by habitat) might respond when exposed to a specific response option. Once the risk matrix is completed and the resource and oil spill trajectory data evaluated, the SIMA authors and regulatory agencies use a "risk ranking" in order to qualitatively assign a level of concern to each box in the matrix. All rankings are relative to the baseline (i.e., natural attenuation of the oil spill), and address the question: are conditions better or worse for the resource when using the specific response option. The results of this ranking analysis are then used to develop recommendations regarding the best response options for different resources and scenarios.

It is important to recognize that during a spill, the best response almost always results when a combination of response techniques are used together to minimize ecological damage and promote the fastest overall recovery. So while the potential response options are considered individually in the SIMA, it is understood that multiple response options will likely be used during an actual spill. The SIMA analysis should conclude that successful implementation of any of the available potential response options will result in a reduction in consequences to the considered resources of concern, when compared to the baseline condition of no intervention. However, the response options are expected to vary in their potential effectiveness, based on operational or logistical considerations. As a result, all available response options should be considered when developing the oil spill response plan for the Project.

References:

IPIECA 2018. IOGP Report 593. Guidelines on implementing spill impact mitigation assessment (SIMA). London, UK.

2.15.2 Information Requirement: IR-74 (Text Corrected – February 2019)

External Reviewer(s): Unknown

Project Effects Link to CEAA 2012: Potential effects to 5(1)(b) Federal Lands / Transboundary

Reference to EIS Guidelines: Part 2, Section 6.6.1, Effects of Potential Accidents or Malfunctions

Reference to EIS: Section 16.6 Environmental Effects Assessment; Section 16.1.4.3 OSRP Tactics

Context and Rationale: While Section 16.1.4.3 of the EIS outlines the possible spill response tactics, such as in situ burning, the EIS does not consistently include a discussion related to the environmental effects for each tactic.

Specific Question or Information Requirement: Provide a discussion of the potential environmental effects of response measures on VCs.

With respect to in situ burning specifically, describe the potential for incomplete burning and resulting oil in the water and assess associated effects.

Describe proposed mitigation and follow-up, as applicable for response measures.

Response: As noted in the Environmental Impact Statement (EIS), response tools and strategies in the event of an oil spill may include, but are not limited to: well control, mechanical recovery, surface/aerial/subsea dispersants, in situ burning, and shoreline protection and recovery. Further, it is stated: "In order to assess the potential risks and consequences of the various response options, including chemical dispersants, as part of its pre-drilling regulatory applications, CNOOC Petroleum North America ULC (CNOOC) will conduct a Spill Impact Mitigation Assessment (SIMA) (also known as a Net Environmental Benefits Analysis (NEBA)). The SIMA will review the potential effects of various response options and develop approaches that minimize adverse effects to the environment. The response to Information Requirement (IR)-73 provides additional information on the SIMA.

Thus, this response will briefly describe the potential for environmental effects for each potential response tactic, focusing on those where there are potential concerns with respect to adverse impacts. Mechanical recovery, shoreline protection and recovery, and well control are generally accepted tactics and will be pursued according to spill response plans. The use of in situ burning, surface/aerial dispersants, and subsea application of dispersants could potentially have adverse effects on humans and the environment and would only be utilized according to specific protocols incorporated in the CNOOC Oil Spill Response Plan (OSRP).

<u>Oil Recovery</u>
Mechanical recovery of oil is a generally-accepted tactic that generally does not have adverse environment impacts. However, mechanical approaches increase exposure of humans to hydrocarbons, both due to direct contact with the bulk oil and to inhalation of volatiles evaporating from the oil. There are also severe logistical constraints to use of mechanical removal offshore, related to weather and sea conditions, containment and transportation of removed oil and water, travel distances and times, etc. Thus, typically, responders are able to remove less than 10% of the oil from large offshore spills (NRC 2005; Lee et al. 2015).

Shoreline recovery methods are well developed and will be included in the CNOOC OSRPs. All methods will be performed after consideration of potential adverse impacts. For example, steam cleaning of shorelines, such as was used following the Exxon Valdez oil spill, will not be used as it was demonstrated that this approach caused more environmental harm than good. Similarly, wetland cleaning methods need to consider the adverse impacts caused by bringing in heavy equipment and personnel to sensitive areas. These and other considerations are described in detail in Lee et al. (2015).

In-Situ Burning (ISB)

ISB rapidly reduces the mass of oil on the water surface. Oil is collected in booms and controlled burns are performed. ISB was successfully demonstrated by Environment and Climate Change Canada (ECCC) in a large-scale field experiment, the Newfoundland Offshore Burn Experiment (NOBE), on August 12, 1993 (Fingas et al. 1995, 1996, 1999) and during the BP Deepwater Horizon incident (Allen et al. 2011; Mabile 2013). Under favourable conditions, ISB is a fast, efficient and relatively simple way of removing spilled oil from the water to minimize the adverse effect of the floating oil on the environment. Furthermore, it greatly reduces the need for storage and disposal of the collected oil and the waste it generates.

Burning releases emissions to the atmosphere, including black soot particulates (black smoke) and partially-combusted materials and byproducts (nitrogen dioxide, sulfur dioxide, carbon monoxide, polycyclic aromatic hydrocarbons, ketones, aldehydes and other combustion by-products; Lee et al. 2015). ISB is not used if human populations are located near or downwind from the site. Burns are conducted well offshore away from shorelines, sensitive wildlife areas and human populations to mitigate potential exposure to emissions. Burning oil also results in residues (approximately 1-5% of the starting oil; Lee et al. 2015), incompletely combusted oil and gaseous emissions into the atmosphere that have raised environmental concerns (Gullet et al. 2017). This is particularly true if the residue sinks (Stout and Payne, 2016). However, adverse environmental effects from burn residues have not been analyzed to date and this is an area of current research.

Dispersants

The objective of dispersant use is to break up and dilute oil into the water column, preventing exposure of surface biota to floating and shoreline oil, and promoting biodegradation by (1) increasing the surface area of the oil (NRC 2005; Brakstad et al. 2014, 2015; North et al. 2015; Lee et al. 2015; Hazen et al. 2016); (2) diluting the oil below toxic levels (Lee et al 2015); and (3) dispersing oil more widely such that nutrients (e.g., N, P, Fe) become less limiting (Baelum et al. 2012; Prince et al. 2013; Hazen et al. 2016). The surface area per volume ratio increases as oil is broken up into small droplets, which enhances microbial degradation at the oil-water interface. Dispersing the oil into the water column allows microbes to have more access to the hydrocarbons (and associated compounds) in the oil. The rationale for using dispersants as an oil spill response tactic is to reduce wind-driven transport of surface oil to highly productive coastal waters and sensitive shoreline habitats by breaking the surface oil slick into small droplets to facilitate the transport of the oil into the water column. This would also reduce its exposure to surface water biota (e.g., sea birds; Lee et al. 2015).

Dispersant application on surface oil targets floating oil in areas where there is sufficient dilution potential (i.e., typically marine areas >10m deep) and where there are low densities of wildlife (i.e., birds, mammals, sea turtles) and other biota. For example, experimental work with seabirds has shown that birds exposed to oil, dispersant and oil mixture, or high concentrations of dispersant, can experience waterproofing impairment (Whitmer et al. 2018). Thus, to mitigate this impact, aerially-applied dispersants should not be used when seabirds are present within the dispersant application zone. Dispersant applications should avoid locations where there are relatively high densities of wildlife in general, as is the practice in spill response planning. When dispersant is applied to floating oil of sufficiently low viscosity such that it will disperse into small droplets within the water column, this helps to reduce exposure to floating oil and oil on the shoreline.

In the case of a subsea release, subsea dispersant injection (SSDI) can help to break up the oil into smaller droplets, which slows the oils' ascent to the surface, or if droplets are small enough, disperses the oil permanently at depth. SSDI disperses the oil into a large water volume at depth (diluting it and enhancing biodegradation) and reduces surface water, nearshore and shoreline exposure to floating oil and entrained/dissolved oil in the upper water column (French-McCay et al. 2018).

Tradeoffs to dispersant use include (1) the dispersed oil potentially increases exposure to organisms inhabiting the water column and (2) the dispersant may be an additional stressor added to the environment. However, modern dispersant formulations are of low toxicity, much less toxic than the hydrocarbons in the oil (NRC 2005). Furthermore, oil in the water column may be diluted to concentrations below the toxicity threshold limits of resident biota (Lee et al. 2015). SSDI increases exposure to organisms inhabiting deep water and benthic environments. However, densities of fish and invertebrates are much lower in deep offshore waters than near the surface (DWH NRDA Trustees 2016; French-McCay et al. 2018), mitigating this potential impact.

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2.15.3 Information Requirement: IR-75 (Revised Response – February 2019)

External Reviewer(s): NRCan IR-11-Nx; Nutash-50-Nx

Project Effects Link to CEAA 2012: Multiple VCs – Accidents and Malfunctions

Reference to EIS Guidelines: Part 2, Section 3.1, Project Components; and 3.2.1, Drilling and Testing Activities

Reference to EIS: Section 16.4.4.2 Summary of Deterministic Results

Context and Rationale: The EIS states that the majority of the oil entrainment in the water column from a spill would be due to wind induced surface-breaking waves. NRCan has advised that there are multiple reasons for oil components to become suspended in the water column, and even sink. Crude oils are known to be persistent following a blowout scenario.

Specific Question or Information Requirement: Provide additional analysis of the portion of the crude oil that would persist in the environment, including an analysis of the effects of the persistent components on VCs, and possible follow up monitoring.

Response: The persistence of oil in the environment is a function of the chemical composition of the oil itself and the movement and behavior (i.e. trajectory and fate) of the released oil in the environment. Mass balance predictions of the representative deterministic scenarios have been provided in Tables 4-3 of both RPS Trajectory and Fate reports (RPS (2017) Appendix G of the EIS and RPS (2019) Appendix B of this Addendum). The majority of the Bay du Nord crude oil was predicted to evaporate (35-43%) or degrade (32-38%) over the modelled 60-day simulations. Similarly, for the 160-day simulations, 43-51% was predicted to evaporate and 34-40% degrade. The remaining oil (i.e. the persistent fraction) was predicted to be "see-sawing" between the surface (0-6%) and entrained (20-27%) within the water column depending on the wind and wave conditions at the end of the simulation for the 60-day simulations. For the 160-day simulations surface oil was predicted to range from 7-12% and entrained oil within the water column was between 4-7%, depending on the wind/wave conditions at the time. The majority of the entrained oil in the water column from these spills was due to wind induced surface-breaking waves, as the largest portion of the release would surface within hours or days of release within each of the modelled simulations. A small portion of the oil was predicted to settle to the sediments (<0.2%), strand on shorelines (<0.9%), or leave the model domain (<1.8%) out of all scenarios.

The roughly 13-15% of the oil that was predicted to remain at the end of the 160-day simulations was predicted to be highly weathered. The compounds remaining would have a relatively low toxicity, solubility, and volatility (when compared to the lighter ends that would be present during the active phase of the release, where fresh oil was entering the environment) would include "heavier ends" such as asphaltenes, resins, waxes, and high molecular weight compounds.

For the marine diesel releases, less than 0.01 percent of marine diesel was predicted to remain on the surface after 30 days, with >99% either evaporating, degrading, or entraining into the water column.

References:
No additional references.

2.15.4 Information Requirement: IR-76 (Part One Response – September 2018)

External Reviewer(s): DFO-06-Ax-Nx; DFO-07-Ax-Nx; MTI-19-Nx

Project Effects Link to CEAA 2012: Multiple VCs – Accidents and Malfunctions

Reference to EIS Guidelines: Part 2, Section 6.3 Predicted Effects on Valued Components

Reference to EIS: Section 16.6.2.1 Potential Issues and Interactions, page 993; Section 16.6.2.2 Environmental Effects Assessment; Section 16.6.5.2 Environmental Effects Assessment

Context and Rationale: The predicted effect of seabed disturbance from a spill of SBMs on sensitive coral and sponge species is not discussed.

Similarly, Section 16.5 of the EIS report concludes no predicted effect from a drill fluid spill on Special Areas based on modelling results, with a high level of confidence."

The DFO has advised that a SBM spill could affect sensitive areas given the proximity to sensitive areas and the results of the modelling which show dispersion up to 500 metres with maximum and average thicknesses above the predicted no effects threshold.

MTI has asked about the cumulative effects of multiple drilling fluid releases on species important to MTI, including swordfish, Atlantic salmon, and Bluefin tuna.

Specific Question or Information Requirement: Discuss the potential effects of a SBM spill(s) on sensitive benthic species and species of importance to Indigenous groups. With respect to sensitive areas, discuss the effects of an SBM spill taking into consideration modelling results. Update the conclusion or provide a rationale for the conclusion of no predicted detectable adverse effect.

Response: Drill cuttings dispersion modelling was completed for two scenarios, presented in Appendix D of the Environmental Impact Statement (EIS), and summarized in Section 8.3.4.2 of the EIS. The two scenarios include a deepwater Jurassic example well and a shallow water Cretaceous example well that were modelled over four different seasons (March, June, September, and December). Water-based mud (WBM) cuttings released at the wellhead are predicted to settle within 500 m and over 90% settle within 100 m at the deepwater example well. Over 99 percent of the WBM cuttings released at the wellhead are predicted to settle within 200 m at the shallow water example well. Synthetic-based mud (SBM) cuttings released from the mobile offshore drilling unit (MODU) at the sea surface generally settle within 2 km, with over 90 percent settling within 500 m at the deepwater example well. The SBM cuttings released from the MODU at the sea surface settle generally within 1 km, with over 94 percent settling within 500 m at the shallow water example well. Average burial depths of 6.5 mm are considered to be the predicted no effect threshold (PNET) for non-toxic sedimentation based on benthic invertebrate species tolerances to burial, oxygen depletion and change in sediment grain size (Kjeilen-Eilertsen et al 2004; Smit et al 2006, 2008). However, as some species may be more susceptible to shallower burial depths, an average PNET burial depth of 1.5 mm is suggested to be a more conservative approach to assessing drilling discharges (Kjeilen-Eilertsen et al 2004; Smit et al 2006, 2008). This level coincides with assessments on more sensitive coral species where injury observed with sedimentation of less than 6.3 mm (Larsson and Purser 2011).

CNOOC Petroleum North America ULC (CNOOC) acknowledges that the drill cuttings model is a prediction tool and will be considered when developing the extent of pre-drill seabed investigation surveys. The dispersion modelling informs the placement of wellsites such that the physical presence and placement and eventual cuttings discharges should miss sensitive coral and sponge habitats and sensitive areas. Should such organisms be

observed within or in proximity to the planned wellsite location, a 100 m "set-back" from these will be applied to avoid or reduce the potential for direct interaction with these species or other potential effects (such as smothering or sedimentation from drill cuttings disposal or sedimentation). In the event moving the wellsite in this manner is not feasible, CNOOC will consult with the C-NLOPB to determine an appropriate course of action.

As discussed in the responses to Information Requirements (IRs)-12, -13, -15, and -79, Atlantic salmon, Atlantic bluefin tuna and swordfish are highly mobile pelagic species that exhibit avoidance behaviours. With the application of mitigation presented in the EIS, it is anticipated that potential effects to these species from drill cuttings will be negligible.

References:

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2.15.5 Information Requirement: IR-77 (Part One Response – September 2018)

External Reviewer(s): Unknown

Project Effects Link to CEAA 2012: Multiple VCs – Accidents and Malfunctions

Reference to EIS Guidelines: Section 6.6.1 Effects of Potential Accidents or Malfunctions

Reference to EIS: Section 16.6 Environmental Effects Assessment

Context and Rationale: In several tables (Table 16.17, 16.18, 16.19, 16.22 and 16.24) related to the analysis of the residual accidental event related environmental effects, the frequency of 100 litre diesel spills is categorized as N-O, indicating that they are "not likely to occur – occurs once".

However, Section 16.3.2 states that "spills less than one barrel in size (less than 159 litres) may occur one to two times per well, based on recent petroleum development experience off Newfoundland and Labrador".

Specific Question or Information Requirement: Provide a rationale for the categorization of the frequency of batch spills as "not likely to occur once" given recent production development experience, or update the predicted frequency of 100 litre diesel spills.

Response: As noted in Section 16.3.2 (see Appendix C of this Addendum), "the highest potential frequencies are for the smaller, operational spills. Spills less than one barrel in size (less than 159 litres) may occur one to two times per well, based on recent petroleum development experience off Newfoundland and Labrador (NL). Although these smaller spills may occur more often, the median volume is four litres." The section goes on to note that "Historical spill records for very small spills do not differentiate between production and exploration activities, and so the probability of very small spills during exploration activities may be overestimated."

The probability estimate provided for NL is based on cumulative data for a combined category of all exploration, delineation, and production drilling for the period 2000-2016. Exploratory drilling is a small percentage (time duration) of the overall category during that period and is expected to have a much lower probability of 100 litre diesel batch spills. In following, the assessment results (as identified in Tables 16.17, 16.24, 16.26, 16.31 and 16.33 of this Addendum (Appendix C)) note that the predicted frequency of 100 litre diesel batch spills from exploratory drilling is categorized as "N-O", indicating a lower frequency of "not likely to occur or occurs once".

References:
No additional references.

2.15.6 Information Requirement: IR-78 (Revised Response – February 2019)

External Reviewer(s): DFO-09-Nx, 04-Ax-Nx

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat, 5(1)(a)(ii) Aquatic Species

Reference to EIS Guidelines: Part 2, Section 6.6.1 Effects of Potential Accidents or Malfunctions

Reference to EIS: Section 16.6.4 Marine Mammals and Sea Turtles (including Species at Risk)

Context and Rationale: Section 16.6.4 of the EIS states that, "No designated critical habitat for marine mammals or sea turtles is present within or near the RSA".

However, spill trajectory modelling indicates a small possibility that oil could reach the Gully, Sable Island, Haldimand Canyon, and Shortland Canyon areas.

The EIS does not mention marine mammals and their critical habitat in these areas that could be affected by accidents or malfunctions.

In addition, confirmation is required on the shoreline oiling of Sable Island. The EIS states that for EL 1144 "The 99th percentile shoreline oiling case was identified in the late summer, where weather patterns were sufficient to transport oil to the south and west, where a small fraction of oil (less than 0.01 percent) was transported to the shores of Sable Island." (p. 966).

However, based on Table 16.11 page 958, there is no shoreline probability entered for summer scenarios. Page 977 states, "There was no shoreline oiling predicted from summer scenarios for the EL 1144 example well site."

Specific Question or Information Requirement: For EL 1144, clarify whether shoreline oiling on Sable Island could occur during summer months. Provide a description of marine mammal species at risk and their critical habitat in the Gully Marine Protected Area ,Sable Island , Haldimand Canyon and Shortland Canyon that could be impacted by an accidental event, and assess associated effects, as applicable.

Response: In the EL 1144 example wellsite 30 day modelling scenario (RPS 2018), shoreline oiling on Sable Island in >1% of the simulations was not predicted during summer months. Shoreline oiling > 1 g/m^2 was predicted on Sable Island during winter months in approximately 3% of the simulations. These predictions are based upon the five years of environmental data that were used in the modelling, as well as the specific set of model inputs based upon crude oil type, release rate, release duration, and model duration. In the 160 day modelling scenario (RPS 2019), however, no shoreline oiling was predicted on Sable Island, and no surface oil was predicted to reach the Scotian Shelf.

The Scotian Shelf, in particular the Gully Marine Protected Area, Haldimand Canyon and Shortland Canyon, provides critical habitat for the endangered Northern Bottlenose Whale (Scotian Shelf population), which has an estimated population of about 130 individuals (DFO 2016). The potential effects of accidental events on marine mammals (including the Northern Bottlenose Whale) are discussed in Section 16.6.4. In the very unlikely event that oil from a subsea release at the EL 1144 example well site were to reach critical habitat of the Northern Bottlenose Whale (Scotian Shelf population), the oil would be highly weathered and patchy due to the long time it would take for oil to reach the area. Effects of such an event would be adverse; depending factors such as the volume and location of spill, as well as environmental conditions at the time, these effects would be low to high in magnitude, extend to the RSA and potentially beyond, medium to long term in duration, reversible in nature. These predictions have been reached with a moderate level of confidence.

References:

DFO (Fisheries and Oceans Canada). 2016. Report on the Progress of Recovery Strategy Implementation for the Northern Bottlenose Whale (Hyperoodon ampullatus), Scotian Shelf Population, in Atlantic Canadian Waters for the Period 2010-2015. Species at Risk Act Recovery Strategy Report Series. Fisheries and Oceans Canada, Ottawa. iii + 47 pp.

2.15.7 Information Requirement: IR-79 (Revised Response – February 2019)

External Reviewer(s): MTI-28-NX

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat, 5(1)(a)(ii) Aquatic Species

Reference to EIS Guidelines: Part 2, Section 6.6.1 Effects of Potential Accidents or Malfunctions

Reference to EIS: Section 8.3.6 Well Testing

Context and Rationale: The MTI has advised that oil spills are known to impact cardiac tissues of Atlantic Bluefin tuna. Exposure to polycyclic aromatic hydrocarbons (PAHs) from crude oil spills disrupts cardiac function in Bluefin tuna (affects the regulation of cellular excitability, which can cause life-threatening arrhythmias) (Brette et al, 2014). The assessment in the EIS of effects on tuna is relatively limited, particularly in the context of spills. The EIS suggests that occurrence likelihood of tuna is low, and therefore effects on this species are negligible.

Specific Question or Information Requirement: Provide an assessment of how a spill could affect both individuals and populations of Atlantic Bluefin tuna in the event that a spill occurs when individuals are present. Discuss the potential biological effects of a spill on tuna.

Response: The Brette et al. (2014) study sought to more precisely define the mechanisms of crude oil cardiotoxicity and to evaluate the potential vulnerability of eggs, larvae, and juveniles in the vicinity of the 2010 BP Deepwater Horizon (DWH) spill. The researchers assessed the impact of field-collected DWH oil samples on in vitro cardiomyocyte preparations dissociated from the hearts of Pacific bluefin tuna (*Thunnus orientalis*) and yellowfin tuna (*T. albacares*). This study and several others (Carls et al., 2008, Hazen et al., 2016, Hicken et al., 2011, Incardona et al, 2009, Incardona et al., 2009, Incardona et al., 2014, and Norcross et al., 2011), noted serious cardiac effects on the embryonic and larval development of various fish species (Atlantic bluefin tuna (*T. Thynnus*), Pacific herring (*Clupea pallasi*), and zebrafish (*Danio rerio*)) following major spill events such as DWH and the 1989 Exxon Valdez spill.

The DWH was of particular concern as the oil spill was not only the largest yet to occur in the pelagic zone of an oceanic ecosystem (636 million litres) but coincided with the temporal spawning window for several species of fish including bluefin and yellowfin tunas, mahi mahi (*Coryphaena hippurus*), king and Spanish mackerels (*Scomberomorus cavalla; S. maculatus*), greater and lesser amberjack (*Seriola dumerili; S. fasciata*), sailfish (*Istiophorus albicans*), blue marlin (*Makaira nigricans*), and cobia (*Rachycentron canadum*) (Incardona et al, 2014).

Atlantic bluefin tuna are seasonal migrants to Canadian waters where they may form schools, generally of less than 50 individuals. They are fished from July through December over the Scotian Shelf, Gulf of St. Lawrence, Bay of Fundy and Newfoundland. The occurrence and abundance of bluefin tuna in any one of these locations varies considerably from one year to the next (COSEWIC, 2011). They consist of at least two discrete populations, one that spawns in the Gulf of Mexico (western population) and one or more that spawn in the Mediterranean Sea (eastern population). The vast majority of bluefish tuna found in Canadian waters are thought to originate in the Gulf of Mexico (COSEWIC, 2011).

Spawning for the western population is known to occur in the Gulf of Mexico; larvae and mature individuals have also been found in the Bahamas / Straits of Florida in suitable water temperatures at the time of spawning. There are no known spawning or rearing habitats for larval and juvenile stages in Canadian waters (COSEWIC, 2011).

While considerable research has been conducted on the effect of oil spills on embryonic and larval bluefin, Hazen et al (2016) states less is known about the impacts on juvenile or adult tuna. Hazen also notes that impacts may be limited as adult tuna are highly mobile and have high capability for avoidance. A literature search revealed no studies on the effects of oil spills on adult Atlantic bluefin tuna other than those individuals that have been exposed in embryonic stages.

With the absence of spawning grounds in the project area a large-scale effect on larval or juvenile tuna will not occur. As noted above, adult tuna are highly mobile, have a high capacity for avoidance, have no consistency in the waters they utilize, and migrate in relatively small schools, if at all. With application of mitigation presented in the EIS, it is anticipated that effects to bluefin tuna will be negligible.

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2.15.8 Information Requirement: IR-80 (Revised Response – February 2019)

External Reviewer(s): ECCC-02-Conf-Nx; Ekuna-11-Nx

Project Effects Link to CEAA 2012: 5(1)(a)(ii) Migratory Birds

Reference to EIS Guidelines: 6.1.4 Migratory Birds and their Habitat, 6.3.5 Migratory Birds, 6.6.1 Effects of Potential Accidents and Malfunctions

Reference to EIS: Section 11 Special Areas: Environmental Effects Assessment, Section 16.6.3 Section 11 Special Areas: Environmental Effects Assessment, Section 16.6.3 Marine and Migratory Birds (Including Species at Risk)

Context and Rationale: The EIS Guidelines require that direct and direct adverse effects on migratory birds, including population level effects that could be caused by all project activities, including effects of oil spills in the nearshore or that reach land on landbird species, are examined.

Environment and Climate Change Canada has indicated that Important Bird Areas and seabird colonies throughout the eastern Avalon peninsula could be affected by an accidental hydrocarbon spill.

A vessel collision was modelled, and results presented in the EIS, using the midpoint between St. John's and the Project Area as the vessel collision location. Results of the modelling indicate no shoreline contact. While it was shown that the trajectory would be eastward and seaward, the Innu First Nation of Ekuanitshit expressed concern with the distance from the coast, indicating that an analysis should include the effects of the spill on coastal habitats.

Specific Question or Information Requirement: Provide a discussion on the effect of a spill on coastal species and habitats, if a vessel collision was to occur close to shore.

Response: With the implementation of mitigation measures discussed in the revised Section 16.1 (Appendix C of this Addendum), including shoreline protection measures, it is extremely unlikely that oil would reach the shoreline and therefore residual effects on coastal seabird colonies are considered extremely unlikely. Nonetheless, the importance of eastern Newfoundland to seabirds cannot be overstated. As discussed in Section 6.2, tens of millions of seabirds nest on offshore islands and mainland cliffs, and several Important Bird Areas (IBAs) have been identified, as noted in the Information Requirement (IR).

The potential effect of a nearshore hydrocarbon spill on this area, if it were to occur, could be severe. However, the magnitude of the effect would depend on the volume spilled, the containment measures put in place, the volume of oil dispersed / recovered, the area of coastal habitat and shoreline affected, as well as the type and condition (i.e. weathering) of hydrocarbon involved. There would be an increased risk of mortality for individual birds that come into contact with the spill. Potential sublethal toxicity effects on metabolic rate and chick growth in marine birds is also possible, as chicks and eggs are more susceptible to negative effects of exposure to oil even at very low levels. This has the potential to result in changes in risk of mortality or injury, as well as on avifauna presence and abundance (behavioral effects), as hydrocarbon exposure could influence the occurrence and success of key life history stages of these species.

In the unlikely event of a spill that affects wildlife, CNOOC Petroleum North America ULC (CNOOC) will have contractual arrangements in place for expert personnel and equipment required to support an oiled wildlife response. Select personnel onboard the mobile offshore drilling unit (MODU) and vessels will receive training in oiled seabird handling prior to the commencement of any drilling program. Surveillance will be required to identify the location of any oiled wildlife and concentration of wildlife near the spill area. Responders may also attempt to

deter fauna from affected or potentially affected areas and apply pre-emptive capture and exclusion strategies. Any oiled wildlife that can be recovered will be transported to a treatment facility for rehabilitation.

With spill prevention plans and response procedures in place, potential effects of a nearshore hydrocarbon spill on marine and migratory birds are predicted to be adverse, low to high in magnitude, short- to medium-term in duration, to occur within the Project Area, and reversible. This prediction is made with a moderate level of confidence.

Following completion of the additional oil spill modelling for a longer duration unmitigated release, this IR response was reviewed in the context of the additional work. There were no updates required to the response.

References:
No additional references.

2.15.9 Information Requirement: IR-81 (Revised Response – February 2019)

External Reviewer(s): MMS-02-Nx

Project Effects Link to CEAA 2012: Multiple VCs – Accidents and Malfunctions

Reference to EIS Guidelines: Part 2, Section 6.6.1, Effects of Potential Accidents or Malfunctions

Reference to EIS: Section 16.4.4 Model Results

Context and Rationale: The MMS has asked about the probability that oil from a vessel spill or well blowout could reach the Gulf of St. Lawrence and the Gaspé Peninsula coast, even at concentrations below the ecological threshold.

Specific Question or Information Requirement: Discuss the probability that oil from a vessel spill or well blowout could reach the Gulf of St. Lawrence and the Gaspé Peninsula coast, if so, describe the potential environmental effects.

Response: On August 10, 2017, CNOOC Petroleum North America ULC (CNOOC) and its consultants (AMEC Foster Wheeler and RPS) held an online workshop with fourteen regulatory representatives from five regulatory agencies (CEAA (3), C-NLOPB (1), DFO (5), ECCC (3), NRCan (2)) seeking feedback on the proposed oil spill modelling approach to be used by CNOOC for its Flemish Pass Exploration Drilling Project Environmental Impact Statement (EIS). The presentation detailed the proposed model data sets, release duration(s) and model run duration(s) and discussed the proposed study area boundaries. A number of comments and questions were received during the workshop with the primary focus being on input data sets. As a result, the models were run based on the August 2017 parameters.

On February 20, 2018, CNOOC filed its completed Environmental Impact Statement (EIS) with CEAA. Included as part of the EIS was the completed oil spill modelling results. In the first round of Information Requirements (IR) received from CEAA in June 2018, IR-63 specifically focused on the oil spill modelling approach including the duration(s) of the oil spill release and model run. CNOOC engaged in discussions with CEAA and the C-NLOPB in July/ August 2018 regarding IR 63 and the request that CNOOC conduct the fate and behaviour modelling to reflect the worst case discharge scenario that models the drilling of a relief well.

IR-64 requested the rationale for the selection of boundaries for stochastic modelling. DFO noted that for many figures provided in the EIS with stochastic results, the spatial extent of the statistics are truncated by the boundaries of the numerical domain. The C-NLOPB had also advised that the oil spill model should be run until the ecological thresholds defined in the EIS or the probability of shoreline oiling is reached.

As a result, CNOOC has repeated its oil spill modeling based on the longer release duration (120 days versus the previous 30 days) and has extended the model duration from 60 days to 160 days. In addition, CNOOC has expanded the study area (i.e. model domain) boundaries as part of the revised oil spill modelling to address the concerns raised by DFO in IR-64. Originally, the model domain spanned from 42-57 °N and 28-72 °W. In the revised modelling, the model domain was expanded to include 35-60 °N and 15-72 °W encompassing Canadian, U.S., other national territorial seas, and International Waters. The Azores were included in this expanded extent.

Vessel spills were not investigated in the longer duration release modelling (160 days), however subsea releases from the EL 1144 and EL 1150 example well sites were modelled as 120 day releases for 160 days. No oil was predicted to enter the Gulf of St. Lawrence or reach the Gaspé Peninsula coast from 160-day subsea release. This prediction is based upon a stochastic assessment that included seven years of environmental data that were used in the modelling, as well as the specific set of model inputs based upon crude oil type, release rate, release duration, and model duration. Based upon the wind and current data within the region, which tend to transport the release to the east, it is unlikely that oil from the modelled subsea releases would enter the Gulf of St. Lawrence or reach the Gaspé Peninsula coast. A representative deterministic simulation was modelled for the vessel spill, which consisted of a release of marine diesel. This refined product is lighter and less persistent than the Bay du Nord crude oil. With enhanced evaporation, dissolution, and degradation, it is unlikely that marine diesel from a vessel spill would reach the Gulf of St. Lawrence and the Gaspé Peninsula coast. Therefore, there would be no predicted potential for environmental effects in these locations following the modelled releases.

Following completion of the revised oil spill modelling, CNOOC has updated the Accidental Events section (Section 16) of the EIS to include this additional modelling information. The additional oil spill modelling work and the updated Section 16 are included as Appendices B and C, respectively, of this Addendum.

References:

No additional references.

2.16 Effects of the Environment on the Project

2.16.1 Information Requirement: IR-82 (Part One Response – September 2018)

External Reviewer(s): ECCC-03

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat

Reference to EIS Guidelines: Section 6.1 – Project Setting and Baseline Conditions, Sub-section 6.1.1 – Project – Atmospheric Environment

Reference to EIS: Chapter 5 – Existing Physical Environment Section 5.3 – Climatology

Context and Rationale: Section 5.3 of the EIS provides climatology information. ECCC noted that the wind and wave climate analysis was based only on MSC50 data. In-situ data from offshore buoys or oil platforms within the Eastern Newfoundland Strategic Environmental Assessment area is required.

Specific Question or Information Requirement: Provide additional data from offshore buoys and oil platforms within the Eastern Newfoundland Strategic Environmental Assessment area.

Update the effects analysis including mitigation and monitoring, as appropriate, taking into account data from offshore buoys and oil platforms.

Response: The data assessed for the Project Area and summarized in Section 5.3 of the Environmental Impact Statement (EIS) characterize the conditions (winds with MSC50, other climatology parameters from International Comprehensive Ocean-Atmosphere Data Set (ICOADS)). Although historical measurements could augment the description, we would not expect material differences in the expected values or likely range of conditions from those already characterized in the EIS nor result in making any measurable changes to the effects analysis. Many of these historic data, such as Statoil (now Equinor) wells at the north of the Project Area and the Tuckamore B-27, Gabriel C-60 wells to the west, are of short record (on the order of 1-2 months or less), may not all be readily sourced (potential proprietary issues) or necessarily representative of the marine climate over the Project Area – depending on how far outside the Project Area we search.

References:
No additional references.

2.16.2 Information Requirement: IR-83 (Part One Response – September 2018)

External Reviewer(s): ECCC-04-NX

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat

Reference to EIS Guidelines: Section 6.1 – Project Setting and Baseline Conditions, Sub-section 6.1.1 – Project – Atmospheric Environment

Reference to EIS: Chapter 17 – Effects of the Environment on the Project Section 17, Section 17.3.2 Climatology, Weather and Oceanographic Conditions

Context and Rationale: Section 17.1.2 of the EIS states superstructure icing, which can result from freezing precipitation or a combination of low ambient air temperature, low sea surface temperatures, and wind-induced sea spray, can pose a risk to offshore operations. No further information is provided.

ECCC has advised that a monthly summary of the potential for freezing spray occurrence and associated intensity for the Project Area is required to better understand superstructure icing events that may occur. A suitable methodology (used in similar Environment Impact Statements) is to generate a synthetic climatology using a recognized model/nomogram for vessel icing [i.e. Overland (used by the National Weather Service) or the Modified Stallabrass model (used by ECCC)] and forced with the same met-ocean parameters derived from the ICOADS database as presented in Section 6.1.1. The results can be presented as categorical icing events such as those used in ECCC's marine forecast (light < 7 mm/h, moderate 7 to 20 mm/h, and severe > 20 mm/h) or (https://www.canada.ca/en/environment-climate-change/services/general-marine-weather-information/publications/guide-forecasts/chapter-8.html).

Section 17.3.2 of the EIS states that superstructure icing issues are considered and addressed through the selection of equipment and through appropriate operational procedures. The EIS does not provide any information on what measures may be included in operating procedures.

Specific Question or Information Requirement: Provide a monthly summary of the potential for freezing spray occurrence and associated intensity for the Project Area.

Update the analysis of the effects of the environment on the Project, including the identification of applicable mitigation measures, as appropriate.

Response: Marine icing, most frequently from freezing spray, is a marine condition that can hinder and limit shipboard or drilling installation activities, increase a vessel's weight and alter its centre of gravity. Freezing spray is most likely to occur in the Project Area from December through March. Air temperatures must be lower than -2°C to produce freezing spray in salt water. Icing conditions are worsened with colder temperatures, high winds, and large waves (Bowyer 1995).

A standardized way to determine the potential ice build-up rate has been developed by Overland (1990), who based his algorithm on empirical observations and the heat balance equation of an icing surface. This algorithm has been used to derive estimates of icing potential by using concurrent air and sea temperature and wind speed data from International Comprehensive Ocean-Atmosphere Data Set (ICOADS) observations from the Project Area. The results have been sorted into four different categories based on the severity (light, moderate, heavy, and extreme), and are summarized below.

The icing potential for vessels in the Project Area (Figure IR-83.1) is greatest from January through March with the greatest total icing potential being 23.8 % in February. The total icing potential ranges from 1.1 percent in May to 8.4 % in December, is 20.2 % in January, 14.1 percent in March and 6.6 % annually. The potential for moderate, heavy, or extreme icing is greatest in January at 5.3 % and 1.4 % annually. No icing potential is reported in the Project Area for June through October.

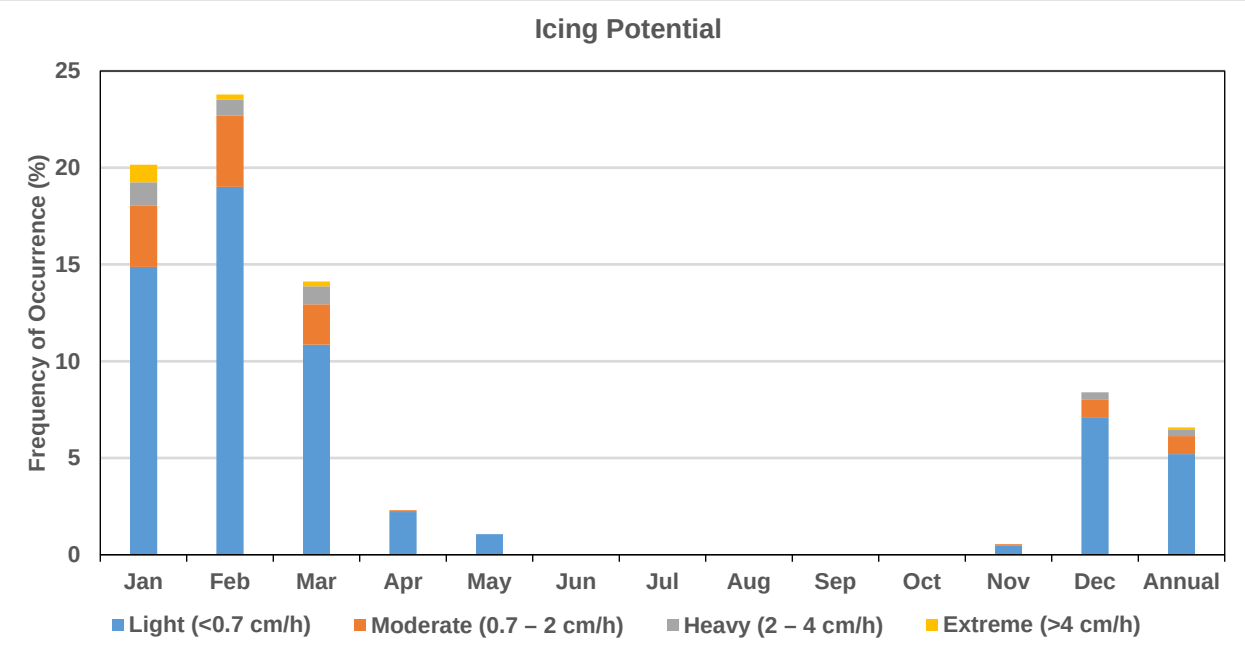


Figure IR-83.1 Icing Potential, Project Area

Marine icing conditions along the potential vessel route from St. John's to the Project Area will be similar to those experienced farther offshore as characterized above. This is due to the frequency of conditions of strong winds, low temperatures, and high seas - contributing factors for marine icing – to be encountered. Along the potential vessel route, a uniform potential of about 5 percent of the time for moderate icing or worse might be expected in January (Bowyer 1995). Further information on the regional icing potential environment in this area is provided in Section 4.1.5 of the Eastern Newfoundland SEA (Amec 2014).

Update on analysis of efforts of the environment on the project, including the identification of mitigation measures, as appropriate:

Climatology, Weather and Oceanographic Conditions (updated from Section 17.1.2 of the EIS)

Based on MSC50 hindcast data (Swail et al 2006), the mean annual wind speed (1-hour averages, 10 m elevation) for the Project Area is 8.9 m/s, while the maximum hourly wind speed is 34.3 m/s. The months with the highest mean wind speeds are typically January and February (11.7 and 11.5 m/s, respectively), which also have the highest maximum wind speeds (34.3 and 30.9 m/s, respectively). The most frequent wind directions for mean and maximum winds are predominately westerly and northwesterly respectively, but range from northwesterly to southeasterly. The range of wind conditions experienced along the potential vessel and aircraft traffic routes from Eastern Newfoundland to the Project Area are likely to be quite close to those experienced farther offshore, with the offshore winds being slightly higher. Exceedance values for wind speeds for various return periods are listed in Table 83.1 (see Section 5.3 for more details).

Table IR-83.1 Wind Speed Exceedance Values for Various Return Periods in the Project Area (Originally Table 17.1 of the EIS)

Return Period	1-year	10-year	50-year	100-year
Wind Speed	25.6 m/s	29.6 m/s	32.6 m/s	33.8 m/s

According to the ICOADS (1960-2016), air temperatures in the Project Area exhibit strong seasonal variations, with mean temperatures ranging from 0.9°C in February to 12.9°C in August. The coldest observed air temperature on record (-12.0°C) was in February, while in summer the values reach as high as 24.0°C. Throughout the year the mean daily minimum and maximum temperatures generally stay within about 3°C of the mean temperature, due in part to the moderating effects of the ocean. Over the potential vessel and aircraft routes for the Project, conditions are on average consistent with mean values between 0°C and 15°C year round (Bowyer 1995).

The ICOADS data also indicate that most of the observed precipitation events are in the form of rain, snow and drizzle, while other precipitation types, such as mixed rain, freezing rain, and hail occur far less frequently. Freezing rain is relatively infrequent in this area, occurring less than one percent of the time during any given month, and typically does not occur at all between July and November. Thunderstorms, which can generate hail and lightning, occur with similarly low frequencies, however there is a year-round potential of occurrence.

The Project Area is also susceptible to marine icing, most frequently in the form of freezing spray. The potential for superstructure and vessel icing is greatest from January through March, peaking in February at 23.8 %. December also has notable icing potential (8.4 %), while April, May and November are less susceptible (less than 3 %). No icing potential is reported in the Project Area for June through October.

The Project Area and surrounding areas have some of the highest occurrence rates of marine fog in North America, and fog can persist for days or weeks. This type of fog (advection fog) is most prevalent in spring and summer. Visibility is affected by the presence of fog, the number of daylight hours, as well as frequency and type of precipitation. Visibility within the Project Area varies considerably throughout the year. Good or fair visibility occur about 77.5 % of the time annually. Good visibility (greater than 10 km) is most frequent during the fall, and least frequent in spring and summer. Visibility is poorest in July with conditions being very poor or poor over half the time. Annually, visibility is very poor 12.7 percent of the time, poor 9.8 % of the time, fair 39.1 percent of the time, and good 38.4 percent of the time.

Based on MSC50 hindcast data (Swail et al 2006), monthly mean significant wave heights in the Project Area range from about 1.7 m in July to 4.5 m in January, with an annual mean of 3.0 m. The most severe sea states occur in December through February when maximum significant wave heights exceed 14.0 m. The largest waves are from the southwest through northwest directions with associated peak periods in the 15 to 17 s range. In contrast, the maximum significant wave height at 7.1 m is lowest in July, with an associated peak period of 12 s. Annually, mean wave heights are about two meters near St. John's compared with 3 to 3.5 m near the eastern portions of the Project Area. During fall and winter months, average wave heights can be expected to be 1.5 m higher than near St. John's, while maximum wave heights can be expected to be at least two meters higher. Exceedance values for significant wave heights for various return periods are listed in Table 83.2 below (see Section 5.3 for more details).

Table IR-83.2 Significant Wave Height Exceedance Values for Various Return Periods in the Project Area (Originally Table 17.2 of the EIS)

Return Period	1-year	10-year	50-year	100-year
Wave Height	11.6 m	14.1 m	15.9 m	16.7 m

The offshore Labrador Current, which flows near the Project Area, has average speeds of about 40 cm/s, mainly between the 400 and 1,200 m isobaths (Lazier and Wright 1993). Over areas of the Grand Banks with water depths less than 100 m, the mean currents are generally weak (less than 10 cm/s) and flow southward, dominated by wind-induced and tidal current variability (Seaconsult Ltd. 1988). In the vicinity of the Flemish Pass, the Labrador Current divides into two branches with the main branch flowing southwards as Slope Water Current and the side branch flows up to the east-northeast clockwise past the Sackville Spur and north-eastward around the Flemish Cap. The cores of the currents are located at an average depth of 100 m (Greenan et al 2016). According to the Bedford Institute of Oceanography (BIO) Ocean Data Inventory (ODI) database (Gregory 2004), currents measured near the Project Area have average speeds that range from eight to 43 cm/s for depths up to 500 m and range from 5 to 19 cm/s in deeper waters. Maximum current speeds of 97 cm/s were recorded February 1986, along the slope, eight kilometers southwest of the Project Area boundary at an instrument depth of 100 m. The deepest maximum current speeds are 60 cm/s measured near-bottom (1,369 m) located along the Sackville Spur at a mooring water depth of 1,400 m. These currents are substantially lower than many regions of the world and are well within the capability of modern mobile offshore drilling units (MODUs), including their dynamic positioning systems.

Mean sea surface temperatures range from approximately 1.8°C in February to 11.9°C in August. Minimum temperatures at the surface range from -1.8°C in February to 9.5°C in September. Maximum sea surface temperatures range from 4.6°C in March to 15.7°C in August. This seasonal temperature cycle with cooler winter temperatures and warmer temperatures in summer is observed down to 200 m. For depths greater than 200 m, sea temperature is only slightly variable by depth with monthly mean temperatures ranging from 3.3 to 4.0°C. Sea surface salinities range from a minimum of 31.0 psu in July to a maximum of 34.7 psu in April with monthly averages that range by approximately 1, from 33.0 psu in July to 33.9 psu in February. For depths below 200 m, the variability in salinity is even less, with mean values ranging from 34.7 to 35.2 psu and averaging 34.8 psu.

Water level variations due to tides in the Project Area are generally quite predictable. Overall, the water levels exhibit two high tides and two low tides per day, with one set of tides having a higher tidal range than the other. Total tidal amplitude is in the range of 40 cm. Storm surge amplitudes can be particularly high in coastal areas, but surges with comparatively smaller amplitudes can also occur offshore. The expected storm surge levels range between 50 cm (1 year return period) and 73 cm (100 year return period) (Seaconsult 1998; Bernier and Thompson 2006).

Climatology, Weather and Oceanographic Conditions (updated from Section 17.3.2 of the EIS)

Meteorological and oceanographic conditions in the Project Area will also be key considerations in the planning and execution of the offshore exploration and support activities that comprise this Project. This will include associated decisions about the required characteristics of the equipment to be used, including the eventual selection of the MODUs, support vessels, and aircraft as described earlier. Environmental conditions will also influence overall operational planning and decision-making throughout the life of the Project.

As noted previously, all MODUs, support vessels, aircraft and other equipment used for this Project will have the capacity to function within the environmental conditions that are known or likely to be encountered in the Project Area, and will adhere to all applicable regulatory requirements for safety and environmental protection. Proper operational planning as well as Project compliance with applicable international standards and Canadian regulations for equipment design and use with respect to extreme weather and oceanographic conditions will help to mitigate these risks. These include considerations and requirements related to operation in various environmental conditions including average and extreme ambient temperatures, precipitation (including snow and freezing precipitation), ice accretion, wind, waves, tides, currents, sea ice, icebergs and any combination thereof. These criteria must be met in order for the aforementioned Certificate of Fitness to be issued.

By closely monitoring regional and local marine weather and ice conditions and receiving customized and frequently updated weather forecasts and alerts, Project personnel will be able to make informed decisions to address any such adverse weather conditions. While equipment will be selected for safe operation in such conditions, an appropriate measure of flexibility will be incorporated into short- and medium-term operational planning to account for potential delays caused by severe conditions that may occur beyond the weather forecast timeframe. This flexibility will be dictated in part by seasonality (e.g. typically harsher conditions in the winter and spring) and will help allow for long-term Project plans to be executed safely and efficiently.

As also mentioned above, the MODU and equipment, including riser and mooring where applicable, will be designed to withstand potential environmental loads in accordance with the Newfoundland Offshore Certificate of Fitness Regulations and will be able to quickly and safely disconnect from the well as required to mitigate any potential risks.

Superstructure icing issues are considered and addressed in the selection of equipment and the development of appropriate operational procedures to ensure that they can operate safely and effectively under these conditions. Operators will be required to have suitable equipment to meet icing conditions and an experienced crew to address the conditions as they arise. Icing conditions and accumulation rates will also be monitored closely. Mitigating potential icing issues on the MODU will be covered in part by the Newfoundland Offshore Certificate of Fitness Regulations.

The regular monitoring of conditions and forecasts will inform the timing of Project-related vessel traffic as well as selection of specific navigation routes. Support vessels may also be affected by icing (as discussed above) which can result in slower vessel speeds, reduced maneuverability and problems with associated equipment (DFO 2012). The support vessels used for the Project will be equipped for safe operation in all weather conditions and sea states, including stability measures for operation in rough seas. The Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) requires that vessels have all relevant certificates in place as part of the pre-authorization process to ensure all-weather readiness. Any audits required are in addition to inspections conducted by CNOOC Petroleum North America ULC (CNOOC) as part of its own internal processes.

Aircraft must travel at reduced speeds in low visibility and may be prevented from landing on the MODU if visibility is below defined thresholds. Upon returning to St. John's Airport the inbound visibility criteria are a runway visual range of 1,000 feet and a ceiling of 200 feet. Visibility forecasts will be used to inform personnel of expected conditions at scheduled departure, transit and arrival times. To enhance operation in limited visibility, the MODU must also adhere to specific navigation lighting requirements, and support vessels must be fitted with obstruction and navigation lights as well as foghorns. Reducing aircraft speed, adjusting flight altitude, and employing radar and other navigation equipment will also assist in navigating safely in low visibility. In order to ensure continuous communication between required offshore personnel, radio communication systems will be in place on helicopters, support vessels, the MODU and shore bases.

In order to accommodate any weather delays in the transportation of supplies, adequate food and potable water stores must also be maintained on the MODU.

The Offshore Physical Environment Guidelines (NEB et al 2008) require that offshore operators implement a physical environment monitoring program. This includes monitoring of meteorological conditions and onsite weather observation, ice management, and other met ocean and marine monitoring and forecasting. Meteorological condition monitoring includes winds, precipitation, temperature, and visibility, while oceanographic monitoring includes waves and currents. Sea ice and iceberg monitoring will also take place, as discussed in the following section. The collection and analysis of detailed and site-specific information on climatic and meteorological conditions and oceanographic characteristics are also typically part of an operator's overall planning and design of an offshore program and its associated regulatory review and approval requirements. This

information contributes to appropriate equipment selection, program scheduling, and the development of operational procedures, all of which are key factors to help ensure safe operations and reduced risks to personnel, environment, equipment and vessels.

In addition to pre-commencement analysis and planning, meteorological and oceanographic monitoring programs are often implemented throughout offshore programs to forecast and plan for any severe environmental conditions. In situ monitoring and observations programs are essential to support weather and marine forecasting, which will be obtained from a contracted third-party forecaster. Environment and Climate Change Canada (ECCC) issues marine weather observations, forecast bulletins, special weather statements, watches, alerts, and warnings via the Meteorological Service of Canada (MSC's Automated Telephone Answering Device), Weatheradio (continuously broadcast over VHF or FM radio), and regional Storm Prediction Centres. The Newfoundland and Labrador Weather Office in Gander provides year-round marine weather and wave height information for waters around Newfoundland and Labrador, out to approximately 250 nautical miles (DFO 2015).

These forecasts will be monitored by the appropriate personnel onboard the MODU, support vessels and aircraft, as well as by CNOOC onshore operations and logistics teams, each of whom have the authority to suspend or modify operations if forecasted adverse weather conditions could compromise the safety of personnel or operations.

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2.17 Effects of the Environment on the Project

2.17.1 Information Requirement: IR-84 (Part One Response – September 2018)

External Reviewer(s): CEAA MTI-09-Nx; MTI-18-Nx; Nutash-29-Nx; C-NLOPB-5-Nx; FFAW-08

Project Effects Link to CEAA 2012: Section 5 (1)(a)(i) Fish and Fish Habitat, and (iii) Migratory Birds

Reference to EIS Guidelines: Part 2, Section 6.6.3 Cumulative Effects

Reference to EIS: Section 15: Cumulative Environmental Effects

Context and Rationale: The cumulative effects assessments for all VCs conclude that the cumulative effects of the Project and other projects and activities are unlikely to be significant. The analysis and conclusions are based partly on the limited spatial interactions/geographical overlap of environmental disturbances from the Project and other activities. As recognized by the EIS, cumulative effects can occur as a result of the large ranges of species as well as the mobile nature of individuals.

The EIS states that underwater noise from the drilling unit in excess of behavioural thresholds for marine mammals could extend tens of kilometers from the drilling unit. Noise emissions from existing production facilities and reasonably foreseeable exploratory drilling programs, as well as seismic activity operating simultaneously may not overlap specifically, but could result in cumulative effects by creating multiple zones of avoidance for marine species or masking of marine mammal communication throughout the Project Area.

Figure 15.1 illustrates petroleum projects as well as some fishing activity in the Project Area. While this is helpful in presenting some of the cumulative effects to which VCs may be exposed, it is does not consider all projects and activities (e.g. marine shipping, multi-year seismic programs with concurrent surveys that include support vessels), nor does it account for the extent of effects (e.g. the results from the modelling for the Project, referenced in the EIS and Appendix E, found that noise from the drilling unit could extend 56.8 km from the drilling unit). Further consideration should be given to how mapping could be expanded to illustrate the potential for overlapping cumulative effects on VCs as a result of several projects exerting discrete areas of influence simultaneously.

The Agency's Technical Guidance document on Assessing Cumulative Effects under CEAA 2012 (April 2017 draft) identifies methodological options for analysis of cumulative effects, including quantitative models and spatial analysis.

Specific Question or Information Requirement: Update the assessment of potential cumulative environmental effects on migratory birds (specifically Leaches Storm Petrel) and marine mammals using appropriate methodology (e.g. mapping, quantification and/or otherwise) taking into account:

- the spatial extent of effects from key activities (e.g. noise on whales, lights on birds) and associated cumulative effects of creating multiple zones of avoidance in the Project Area;
- the spatial range of populations, recognizing that effects on individuals from the same population in different areas would result in cumulative effects to the species;
- that some VCs would be affected by multiple activities (e.g. noise from drilling units, production facilities and seismic operations, as well as vessel interactions); and
- the Government of Newfoundland and Labrador's recent announcement of Advance 2030: A Plan for Growth in the Newfoundland and Labrador Oil and Gas Industry, including the vision of 100 new exploration wells drilled by 20301 (http://www.nr.gov.nl.ca/nr/advance30/).

For migratory birds, focus the assessment on Leaches Storm Petrel, as a key indicator species, given the status of this species and potential sensitivity to lighting.

With respect to the analysis of underwater noise on marine mammals, include consideration of various underwater noise sources occurring at the same time (e.g. multiple exploration units operating simultaneously, exploration drilling occurring at the same time as geophysical activities, marine shipping etc.) and associated cumulative effects on the species, including how and where thresholds for behavioral modifications or injury may be exceeded. Consider the potential accessibility of unaffected corridors between areas of influence on marine mammals and provide figures to illustrate potential projects/activities and associated zones of influences (e.g. range of effects) to which they could be exposed.

Discuss the need for mitigation and monitoring or follow-up, and update predictions regarding the significance of effects accordingly.

Response: Expanded assessment of potential cumulative effects for Marine Mammals and Migratory Birds (with emphasis on the Leach's Storm-petrel) is provided below.

Marine Mammals

With regard to the Project and other project and activities occurring within the regional study area (RSA), the primary potential interactions with, and effects on, marine mammals as a result of this Project relate primarily to possible injury or disturbance (behavioral effects) from the underwater noise generated during drilling and vertical seismic profiling (VSP) surveys, as well as other possible environmental emissions (waste discharges) from the mobile offshore drilling units (MODUs) and related vessel and aircraft traffic. Any potential for Project-valued component (VC) interactions is, however, likely to be highly transient and temporary for individuals, especially in consideration of the large-scale daily and seasonal fluctuations in presence within the RSA and the alternate habitats available. As described in Section 10.3.2 of the Environmental Impact Statement (EIS), mitigation measures will be applied across a number of Project components and activities and will help prevent or reduce potential interactions with this VC.

On-going and future activities in the RSA which may affect marine mammals include fisheries, vessel traffic, and other offshore oil and gas exploration and development. Most of the anticipated potential effects of these activities will occur within several kilometres of the source and are unlikely to overlap with the Project. However, propagation of underwater noise in the marine environment does have potential for overlap and interactions between sources. Individual marine mammals and sea turtles may also be exposed to multiple sources of underwater noise while in the RSA due to their widespread, mobile, and migratory nature, which could increase the risk of mortality or physical injury and may result in behavioural changes in individuals exposed to multiple noise sources. Behavioural effects from underwater sound would be temporary in nature; this, along with the known and likely spatial distribution of these activities, will reduce the potential for cumulative effects between the Project and other activities in the marine environment and will minimize the degree and duration of such effects.

Figure 15.1 in the EIS illustrates the various anthropogenic activities that were considered in the cumulative effects assessment. The current production projects, Hibernia, Terra Nova, White Rose, and Hebron, are located 80 km or more to the southwest of the Project Area. Offshore oil and gas production fields and exploration drilling installations have established safety zones from which other activities are excluded; maintaining these safety zones will help reduce the degree to which the potential noise emissions may overlap and interact, particularly with respect to thresholds for auditory injury. According to modelling conducted in the Scotian Basin by Zykov (2016), the predicted spatial extents of sound levels above thresholds for auditory injury are within 500 m of the source. Other projects are also anticipated to require standard mitigation measures (e.g., geophysical survey best practices), reducing the potential for individual marine mammals to be temporarily exposed to high sound pressure levels. Therefore, even in the event of multiple underwater noise sources occurring simultaneously (e.g.,

multiple exploration units operating simultaneously, exploration drilling occurring at the same time as geophysical activities, marine shipping etc.), the predicted spatial extents of sound levels above thresholds for auditory injury are small enough that extended zones of potential auditory injury are considered unlikely. Behavioural effects are possible due to these multiple sources of noise, as discussed in the EIS. Due to the relative proximity to the current production projects and the relatively high fishing activity (Figure 15.1), it is anticipated that the western portion of the Project Area will have greater potential for cumulative effects on marine mammals, particularly with respect to sound levels and associated behavioural effects.

Although the highly mobile nature of marine mammals increases the potential for individuals and groups to be affected by multiple perturbations, conversely, this trait allows them to avoid or pass through disturbed areas, reducing the potential for adverse effects. Many species show large annual migrations, and so the presence of species and individuals within the area of disturbance (and thus their availability for exposure to cumulative sound sources) is expected to change seasonally and even daily. The Project Area represents a very small percentage of the vast ranges of most marine mammal species found in the northwest Atlantic, and the area(s) of disturbance from Project activities at any one time would constitute a very small fraction of the Project Area. Further, no critical habitat for marine mammal species at risk (SAR) has been designated in or near the Project Area.

Due to the temporary nature of activities at any given location within the Project Area, it is expected that unaffected corridors between areas of influence would be available to marine mammals throughout the lifetime of the Project, particularly in the comparatively undisturbed portions of the Project Area. While some potential exists for overlap and interaction between underwater noise from the Project and other anthropogenic sources, any such effects are expected to be transient and temporary in nature. No significant adverse cumulative effects on individuals or populations are anticipated.

Marine and Migratory Birds

With regard to the Project and other project and activities occurring within the RSA, the primary potential interactions with, and effects on, marine and migratory birds relate to attraction effects associated with anthropogenic lighting, particularly where these may affect the same individuals or populations. The Leach's Storm-Petrel, a species recently designated Vulnerable by the International Union for Conservation of Nature (IUCN), has been noted to be particularly susceptible to attraction to artificial light sources, as stated in Section 6.2.2 of the EIS. Section 9.3.3 of the EIS provides a detailed summary of the existing and available literature on the potential effects of offshore lighting on marine-associated avifauna. Information on the distances at which birds are attracted to anthropogenic light sources is limited, although a recent global positioning system (GPS) tracking study on the related Cory's shearwater found that fledging birds from colonies up to 16 km away from the island of Tenerife were apparently susceptible to stranding due to light attraction (Rodriguez et al 2015). Attraction of birds to offshore lighting from oil and gas facilities has been demonstrated at distances of less than 2 km for gas flaring (Day et al 2015) to 5 km for a production platform with full lighting (30 kilo watts [Kw]) although attraction from distances of greater than 5 km could not be ruled out by the study design (Poot et al 2008). However, the Project activities will emit less light than a fully lit production platform, and therefore, the spatial extent of lighting attraction is predicted to be smaller.

The Leach's Storm-petrel is present throughout the year in the offshore waters of eastern Newfoundland; unlike most seabirds nesting in the region, breeding adults are known to forage hundreds of kilometres offshore (Pollet et al 2014; Hedd et al 2018). Four of the seven major colonies in Atlantic Canada have seen population declines in recent years; this has been attributed to several factors including predation, ingestion of marine contaminants such as mercury, collisions and strandings due to attraction to lighted structures, and contact with hydrocarbons (BirdLife International 2017). A recent tracking study undertaken by Hedd et al (2018) compares the foraging areas utilized by these seven colonies with respect to existing production platforms off Newfoundland and Labrador (NL) and Nova Scotia (NS). The core foraging areas of four of the seven colonies overlapped with the production facilities; three of these colonies are declining (Baccalieu Island NL, Gull Island in Witless Bay NL, and Country Island NS), while population trends are unknown for the fourth (Bird Island NS). Population trends for two of the

three colonies that do not regularly forage around existing production platforms, Bon Portage Island (NS) and Kent Island (NB), are unknown; the third colony, Middle Lawn Island (NL) is declining. The core foraging areas for these Leach's Storm-petrel colonies are extremely large, with foraging trips averaging more than 1,400 km per round trip and more than 500 km from the colonies (Hedd et al 2018).

Potential interactions with marine birds as a result of the Project will entail a localized and short-term disturbance at any one location and time, which reduces the potential for individuals and populations to be affected repeatedly and over the long term through multiple interactions with the Project. As well, the potential for, and degree and duration of, overlap between the effects of this Project and other existing or potential activities in the marine environment is reduced as a result of the transient and localized nature of the perturbation. Nonetheless, potential interactions may be particularly relevant to species like Leach's Storm-petrels which have high potential for attraction to lights and travel long distances on foraging trips, making them particularly vulnerable. Additionally, species with greater wintering site fidelity may be more vulnerable than species with greater intercolonial and interannual diversity in wintering areas (McFarlane Tranquilla et al 2014). However, because the foraging and wintering areas of marine bird species are so large, interactions between marine birds and the proposed Project as well as other ongoing projects will potentially disrupt only a small percentage of individuals. The effects are likely to be transient and temporary in nature without significant adverse cumulative effects on individuals or populations.

The potential for cumulative effects to occur within the Project Area would depend on the spatial and temporal interaction between the Project, other offshore exploration activities, other marine traffic, and commercial fishing activity; these may occur throughout the region, although the northwestern portion of the project area is currently subject to somewhat higher levels of anthropogenic activity (e.g. fishing). Hunting pressure on birds that frequent the Project Area also has potential to contribute to cumulative effects, particularly in the case of murres which are subject to the annual turr hunt in Newfoundland. Waterfowl are more commonly found in coastal habitats and less prone to interaction with the Project. The current production projects, Hibernia, Terra Nova, White Rose, and Hebron, are located 80 km or more to the southwest of the Project Area, and environmental disturbances that are relevant to this VC resulting from Project activities (including light emissions that may attract and/or disorient night-flying birds) will not overlap with those of the current production projects.

Overall, the Project is not anticipated to result in significant adverse effects on marine-associated avian species at risk (SAR) and is therefore unlikely to contribute to cumulative effects on these species. No critical habitat for avian species at risk is present within the Project Area / local study area (LSA) or RSA, and Ivory Gull and Red-necked Phalarope are the only such species that have the potential to frequent the Project Area. The Ivory Gull is generally associated with pack ice, and as such, it is more likely to occur in the northern regions of the Project Area. The primary threats identified in the species' Recovery Strategy include predation at the nest site, illegal shooting and other human disturbances, industrial activities, introduction of contaminants, climate change, and chronic oil pollution (Environment Canada 2014); of these, the latter may be contributed to by the Project as well as other projects and marine vessels within the regional study area. During fall migration, there is some potential for nocturnally migrating landbird species at risk to pass through, but the risk of interactions with this and other projects in the area is low.

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2.18 Mitigation

2.18.1 Information Requirement: IR-85 (Part One Response – September 2018)

External Reviewer(s): NunatuKavut-13-Nx

Project Effects Link to CEAA 2012: Section 5 - All

Reference to EIS Guidelines: Part 2, Section 6.4 Mitigation Measures

Reference to EIS: Section 4.3.3 Environmental Effects Assessment and Mitigation

Context and Rationale: The EIS Guidelines require that the mitigation measures included in the EIS be specific, achievable, measurable and verifiable, and described in a manner that avoids ambiguity in intent, interpretation, and implementation (Section 6.4). Mitigation measures are to be written as specific commitments that clearly describe how the proponent intends to implement them and the environmental outcome the mitigation measure is designed to address.

Overall, the EIS does not explain how mitigation would be implemented and the specific environmental effects that each mitigation measure is meant to address. Section 4.3.3 of the EIS briefly explains how technically and economically feasible mitigation has been integrated into the effects assessment; however, it does not explain the effectiveness of mitigation in a clear and defined way.

Some specific examples are included below:

- The EIS states that "existing and common vessel travel routes will be used wherever practical, vessels will seek to maintain a steady course and safe vessel speed" (section 10.3.8.2). Safe vessel speeds are not defined and it is not explained under what circumstances vessels would have to deviate from existing travel routes.
- In section 10.3.2 of the EIS, it states that "any low-level aircraft operations will… be avoided or minimized (except for approach and landing activities)." With respect to marine mammals and sea turtles, the EIS does not specify areas of environmental sensitivity that will be avoided in relation to helicopter flight paths or information on specific altitude and lateral distance limits that would be used to avoid sensitive sites. Additional clarity is needed to better understand the potential for adverse effects to marine mammals and sea turtles arising from project-related helicopter traffic and how it is proposed to mitigate those effects.

Specific Question or Information Requirement: Review proposed mitigation measures in relation to all VCs and provide an updated list of mitigation measures that are specific, achievable, measurable and verifiable, and described in a manner that avoids ambiguity in intent, interpretation and implementation. Ensure proposed mitigation measures are linked to the environmental effect(s) that they are meant to address and to proposed follow-up programs, as applicable.

In addition, address the specific questions below to enable a robust understanding of proposed commitments:

- Define "safe vessel speed" and explain which environmental effects these speeds propose to address (e.g. avoidance of marine mammals, fishers). Explain the location of "existing travel routes" and under what circumstances vessels may deviate from these travel routes. Explain under what circumstances it would not be possible to travel at the defined safe vessel speed.

- Specify areas of environmental sensitivity that have been identified in relation to helicopter flight paths and describe the factors that influence helicopter operators' ability to avoid them. Describe the potential environmental effects associated with and anticipated frequency of situations where sensitive areas/components cannot be avoided. Describe if there is any potential mitigation proposed to avoid disturbance to marine mammals and sea turtles.

Response:

Review of proposed mitigation measures. The proposed mitigation measures are presented throughout the effects assessment sections of the Environmental Impact Statement (EIS) (Chapters 8 to 15), and are summarized in Section 18.2. These include both general and specific mitigation measures that have been proposed based upon current industry best practices and standards, applicable regulatory requirements, those suggested through CNOOC Petroleum North America ULC (CNOOC) engagement with regulatory authorities, stakeholders and Indigenous groups (Chapter 3), and as defined through the professional judgment of the CNOOC and EIS study teams. The application of these mitigation measures is considered in a fully integrated manner in the environmental effects assessment, and the EIS identifies and commits to mitigations that are intended to help avoid or reduce predicted adverse effects (whether potentially significant or not) wherever possible and technically feasible.

As required under Section 19(1)(d) of the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) (Government of Canada 2012) and in the EIS Guidelines, the EIS identifies and proposes "mitigation measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the designated project", which the Act defines as: Measures for the elimination, reduction or control of the adverse environmental effects of a designated project, and includes restitution for any damage to the environment caused by those effects through replacement, restoration, compensation or any other means (Government of Canada 2012).

A detailed list of the proposed mitigation measures that will be implemented to avoid or reduce adverse environmental effects is provided in Table 18.2 of the EIS, which CNOOC maintains are "specific, achievable, measurable and verifiable", and which are therefore not considered to be general or ambiguous in nature. In terms of the request that CNOOC "ensure proposed mitigation measures are linked to the environmental effect(s) that they are meant to address and to proposed follow-up programs, as applicable", it should be noted that in most cases any one proposed mitigation measure will be relevant to avoiding or reducing multiple predicted effects of the Project on any particular valued component (VC). For example, the mitigation commitment that "operational discharges will be treated prior to release in accordance with the Offshore Waste Treatment Guidelines (OWTG) (NEB 2010)) and other applicable regulations and standards" will be relevant to mitigating all of the predicted effects of operational discharges on marine fish and fish habitat and on many of the other VCs that were considered in the EIS. It is therefore not typically required to attempt to link each individual mitigation measure back to a specific predicted environmental effect. However, the "Summary of Mitigation" provided in Section 18.2 does link particular mitigation measures to individual VCs, where possible and applicable. CNOOC will also use a "Commitments Tracking Register" to identify and track the mitigation measures and other commitments made in the EIS and/or which may otherwise be required as a result of the regulatory review of the Project.

Vessel operations. In terms of vessel speeds, there are no defined vessel speed limits that are formally imposed on the operations. As standard practice, transits are typically completed at speeds of between 10-12 knots. Occasionally the vessels will transit at best possible speed which will generally be 13-14 knots subject to conditions including sea state and visibility. Reducing vessel speed has been shown to reduce the frequency of marine mammal strikes (Vanderlaan and Taggart 2007; Vanderlaan et al. 2008, 2009; van der Hoop et al. 2012). Lethal strikes are considered infrequent at vessel speeds less than 25.9 km/hour (i.e., 14 knots) and rare at speeds less than 18.5 km/hour (i.e., 10 knots) (Laist et al. 2001). Optimum vessel speeds are determined based on environmental conditions, fuel efficiency and safety considerations. With regard to possible supply vessel routes, there are no defined shipping lanes in the area. Section 2.5.2.6 of the EIS states that: "Supply vessels that are

involved in Project activities will travel directly between an established port facility in Eastern Newfoundland and the mobile offshore drilling unit (MODU) operating within an EL in the Project Area, a practice which is common in the oil and gas industry that has been active in this region for several decades."

The reader is also referred to the response for IR-27 for additional detail on support vessel operation.

Helicopter Traffic. All helicopter flights are anticipated to be routed direct from the St. John's Airport (YYT) to the MODU and operated by third-party suppliers. As outlined in Section 2.5.2.6, aviation is regulated by Transport Canada and includes regulations and operational requirements for helicopter traffic. Standard practice altitude profiles are between approximately 610 metres (m) (or 2,000 feet) and 2,743 m (or 9,000 feet), with an odd number altitude being flown on the eastbound flight, and an even number altitude being flown on the westbound flight for separation purposes. During the approach phase to an offshore installation, the helicopter is typically only below 152 m (or 500 feet) for three to six minutes of a total round trip flight. Onshore approaches to YYT are flown at the same approach altitudes as commercial air traffic.

With respect to marine mammals and sea turtles, there is some potential for interaction with helicopter traffic as a result of both auditory and visual sensory disturbance. As discussed in Section 10.3.8, helicopter sound frequencies are mainly below 500 Hz, and transmission of these sounds into the marine environment depends primarily on altitude and sea surface conditions, with noise from helicopters being most intense just below the water surface and directly beneath the aircraft, with sounds attenuating over shorter distances underwater than in the air. Adherence to the planned flight altitudes stated above is anticipated to mitigate any potential effects of helicopter traffic on marine mammals and sea turtles.

As discussed in Section 9.3.8 of the EIS, offshore helicopter activity and its associated noise can potentially disturb nesting seabirds at colonies; flushing of breeding birds from the nest in response to loud noises such as helicopter flights can have immediate negative consequences including predation of eggs and chicks and decreased incubation and brooding. Although the reactions of birds to overhead helicopter traffic varies with factors such as species, location, habituation and frequency of flights and even individual variation, behavioural responses to helicopter traffic have been shown to occur at a distance of over 350 m for Common Murres. However, as outlined in Section 9.3.8.1, helicopters will abide by the *Seabird Ecological Reserve Regulations*, *2015* by not taking off or landing in known seabird colonies, and by flying at an altitude of greater than 300 m over seabird ecological reserves during sensitive times of year to avoid disturbance. For Cape St. Mary's and Baccalieu Island Ecological Reserves for example, this avoidance period is from April 1 to October 30; for Witless Bay Islands Ecological Reserve, the period is from April 1 to September 1, and for the Lawn Bay Ecological Reserve, the period is from March 15 to October 30. Known colony locations are shown in Section 6.2.7. With adherence to these mitigation measures, potential adverse effects on coastal breeding colonies and Important Bird Areas are therefore unlikely.

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3 RESPONSES TO REQUIRED CLARIFICATIONS

3.1 Project Description

3.1.1 Clarification Requirement: CL-01 (Part One Response – September 2018)

External Reviewer(s): Unknown

Project Effects Link to CEAA 2012: Section 5 - All

Reference to EIS Guidelines: Section 3.1 Designated Project

Reference to EIS: Section 2.7 Project Schedule

Context and Rationale: Section 2.7 of the EIS states that up to 10 wells may be drilled as part of the Project although this number, and the specific number per EL, may evolve as Project planning and implementation proceed.

Under Section 2.1 of the EIS Guidelines, the designated project is the mobilization, operation and demobilization of MODU(s) designed for year-round operations for the drilling, testing and abandonment of up to ten wells (exploration or delineation).

Specific Question or Information Requirement: Confirm whether 10 wells is the maximum number of wells that would be drilled.

Response: Section 1.2.2 of the Environmental Impact Statement (EIS) states that CNOOC Petroleum North America ULC (CNOOC) is proposing that a maximum of 10 wells (exploration and delineation) would be drilled. As defined within Section 1.2.2 the EIS, these 10 wells represent surface (seabed) wellhead locations and not subsurface bottom hole locations which may be associated with sidetracking from the main wellbore.

The response to Information Request (IR)-06 may provide additional information.

References:
No additional references.

3.1.2 Clarification Requirement: CL-02 (Part One Response – September 2018)

External Reviewer(s): Unknown

Project Effects Link to CEAA 2012: Section 5 - All

Reference to EIS Guidelines: Section 2.2 Alternative Means of Carrying Out the Project

Reference to EIS: Section 2.9 Potential Environmental Emissions and Waste Management; Section 2.10.7 Chemical Selection

Context and Rationale: Section 2.9 of the EIS states that chemicals used for drilling operations will be screened in accordance with Nexen's chemical management and selection process, and will adhere to the C-NLOPB requirements under the Offshore Chemical Selection Guidelines. Further, Section 2.10.7 of the EIS states that Nexen will develop a chemical screening and management plan that will meet or exceed all regulatory requirements.

Specific Question or Information Requirement: Provide information on Nexen's chemical management and selection process and the chemical screening and management plan, including a description of if and how they would enable the selection of lower toxicity chemicals, and the relationship to the Offshore Chemical Selection Guidelines.

Response: CNOOC Petroleum North America ULC (CNOOC) has not prepared its chemical screening and management plan at this point in the Project, but this plan will be developed in accordance with the Offshore Chemical Selection Guidelines for Drilling & Production Activities on Frontier Land (NEB 2009) as part of supporting documentation for the Operations Authorization (OA) application to the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB).

Chemicals that have the potential to be discharged to the marine environment will be selected in accordance with the above referenced guidelines to ensure they have the least effect on the receiving environment. CNOOC will work with all third party contractors as part of the chemical selection and screening process to ensure that where technically and economically feasible, the lowest toxicity chemicals will be used.

The response to Information Requirement (IR)-04 may provide additional information.

References:

NEB (National Energy Board), Canada-Nova Scotia Offshore Petroleum Board and Canada-Newfoundland and Labrador Offshore Petroleum Board. 2009. Offshore Chemical Selection Guidelines for Drilling & Production Activities on Frontier Lands. Available online: http://www.cnlopb.ca/pdfs/guidelines/ocsg.pdf?lbisphpreq=1. Accessed April 2018.

3.2 Alternative Means

3.2.1 Clarification Requirement: CL-03 (Part One Response – September 2018)

External Reviewer(s): Unknown

Project Effects Link to CEAA 2012: Section 5 - All

Reference to EIS Guidelines: Section 2.2 Alternative Means to Carrying Out the Project

Reference to EIS: Section 2.10.3, Drilling Waste Management

Context and Rationale: Clarification is required with respect to the information presented in Table 2.10, Identification and Evaluation of Drilling Waste Disposal Options. It is not clear if the alternatives are related to SBMs, water based muds, or both. It appears that the information in the table is applicable to SBMs only, as the table states it would be not technically feasible to return water based muds to shore.

Specific Question or Information Requirement: Provide clarification on the alternative means presented in Table 2.10 (i.e. whether they are applicable to SBMs, water based muds, or both).

Response: The information presented in Table 2.10 in the Environmental Impact Statement (EIS) (Identification and Evaluation of Drilling Waste Disposal Options), is related to both synthetic-based and water-based muds. Environmentally acceptable products are selected for use in the riserless sections so they are able to be discharged into the marine environment.

References:
No additional references.

3.3 Air Quality

3.3.1 Clarification Requirement: CL-04 (Part One Response – September 2018)

External Reviewer(s): NRCAN -03-Nx

Project Effects Link to CEAA 2012: Section 5 - All

Reference to EIS Guidelines: Part 2, 3.1. Project Components and Part 2, 3.2.1. Drilling and Testing Activities

Reference to EIS: Section 14.3.3.1 Semi-Submersible MODU Option; Section 14.3.3.2 Drill Ship MODU Option

Context and Rationale: Emission estimates for the semi-submersible MODU and drill ship MODU options were based on a NOx emission factor of 1.9 lb/MMBtu, which is based on engines employing engine retard to reduce NOx.

NRCan has advised that based on the use of a selective catalytic reduction system on the semi-submersible engines, as stated in Section 14.3.3.1 of the EIS, a lower emission factor should be used for the semi-submersible option. No NOx reduction technique is described in Section 14.3.3.2 for the drill ship option and thus a higher emission factor may be appropriate.

Specific Question or Information Requirement: Update the estimated emissions from semi-submersible and drill ship MODU operations, as appropriate. Describe NOx reduction techniques employed and the associated emission factors.

Response: Semi-submersible mobile offshore drilling unit (MODU) -NOx emissions are recalculated based on 3.2 lb/MMBtu emission factor (uncontrolled) (AP-42, Section 3.4) and 95% control efficiency for SCR (as per equipment manufacturer specifications) is applied. The resultant NOx emissions for the semi-submersible MODU using this approach are lower than presented in the original EIS report.

Drill ship MODU - NOx emissions are recalculated based on 3.2 lb/MMBtu emission factor (uncontrolled) (AP-42, Section 3.4). The resultant NOx emissions for the drill ship MODU using this approach are higher than presented in the original EIS report.

Fuel usage of the drill ship MODU is updated using the output rating of the engines. There are a total of six 10299 hp engines (6 x 10299 hp = 61794 hp = 46.08 MW). The Wartsila technical specifications cite a fuel consumption of 174 g/kWh; based on this data, the maximum fuel usage considering all six engines operating at 100% load is 238 m^3/day (Table CL-04.1).

Table CL-04.1 NOx Emissions Comparison Using the Output Rating of the MODU Engines

Activity	NOx emissions (based on engines employing engine retard to reduce NOx)	NOx emissions (revised)
Semi-submersible MODU	23KT	6.6KT (apply 95% control for SCR)
Drill Ship MODU	18KT	165KT (uncontrolled) (rounded up, table 14.8)

Updated emissions calculation tables are provided in the revised Section 14 (Sections 14.3.3.1, and 14.3.3.2 of Appendix A of this Addendum).

References:
No additional references.

3.3.2 Clarification Requirement: CL-05 (Part One Response – September 2018)

External Reviewer(s): NRCan-04-Nx

Project Effects Link to CEAA 2012: Section 5 - All

Reference to EIS Guidelines: Part 2, 3.1. Project Components; Part 2, 3.2.1. Drilling and Testing Activities

Reference to EIS: Section 14.3.4 Well Testing

Context and Rationale: Section 14.3.4 of the EIS estimates that two wells will be tested and 10,000 Mcf of gas and 36,000 barrels of oil are flared per tested well.

Specific Question or Information Requirement: Provide an explanation on how these volume estimates were obtained.

Response: For the purposes of the Environmental Impact Statement (EIS), CNOOC Petroleum North America ULC (CNOOC) assumed a maximum oil rate of 6,000 bpd for well flow testing. This is based on the view that a flow test is necessary to determine depletion and reservoir extent. It was assumed that two days of total flow would be planned, followed by an extended pressure buildup. It was also assumed that the total oil flared per test would be 12,000 bbls. A gas-oil ratio (GOR) of 280 scf/bbl was chosen based on CNOOC's regional understanding of GORs including Bay du Nord oil, resulting in an amount flared per test of 3,360 Mcf per test. Up to three tests per well are possible, which would result in an assumed total of 36,000 bbls of oil and 10,000 Mcf of gas per well.

The well test design will be based on information obtained from the exploration and appraisal activities, and as such the assumed test volumes may change depending on the characteristics of the reservoir being tested. CNOOC would also like to clarify that for the purposes of the EIS, only two of the proposed wells were proposed to be tested which is the current expectation. However, depending on the exploration results, more than two wells may be tested over the duration of the project.

References:
No additional references.

3.3.3 Clarification Requirement: CL-06 (Part One Response – September 2018)

External Reviewer(s): NRCAN -05-Nx

Project Effects Link to CEAA 2012: Section 5 - All

Reference to EIS Guidelines: Part 2, 3.1. Project Components; Part 2, 3.2.1. Drilling and Testing Activities

Reference to EIS: Section 14.3.7 Greenhouse Gases

Context and Rationale: Global Warming Potentials for methane and nitrous oxide (25 and 298 respectively) are taken from the IPCC Fourth Assessment Report (AR4) (2007). A more recent publication, IPCC Fifth Assessment Report (AR5) Climate Change 2013: The Physical Science Basis (2013) indicates values for methane and nitrous oxide that are 28 and 265 respectively.

Specific Question or Information Requirement: Provide a rationale for using the 2007 Fourth Assessment Report values (i.e. 25 and 298) instead of the 2013 Fifth Assessment Report values (i.e. 28 and 265) or provide updated tables from Section 14.3.7 based on 2013 values.

Response: Greenhouse gas (GHG) emissions are revised in accordance with Information Requirement (IR)-11 and Global Warming Potentials (GWP) as per 2013 data.

Updated Tables 14.10 – 14.11 are provided in the revised Section 14 (see Appendix A of this Addendum).

References
No additional references.

3.3.4 Clarification Requirement: CL-07 (Part One Response – September 2018)

External Reviewer(s): NRCan-06-Nx

Project Effects Link to CEAA 2012: Section 5 - All

Reference to EIS Guidelines: Part 2, 3.1. Project Components; Part 2, 3.2.1. Drilling and Testing Activities

Reference to EIS: Section 14.3.7 Greenhouse Gases

Context and Rationale: The EIS states that emission factors from the Guidance Document for Reporting Greenhouse Gas Emissions for Large Industry in Newfoundland and Labrador were used to calculate the greenhouse gas emissions for the MODU, supply vessel and helicopter. The source for greenhouse gas emission factors related to well testing is not provided.

Specific Question or Information Requirement: Confirm where the greenhouse gas emission factors for well testing were obtained.

Response: Greenhouse gas (GHG) emission factors related to well testing (gas flared and oil flared) are from Guidance Document for Reporting Greenhouse Gas Emissions for Large Industry in Newfoundland and Labrador (Government of Newfoundland and Labrador Office of Climate Change, March 2017):

- Gas flared:
  CO_2 Emission factor: table 5-3, page 25
  CH_4, and N_2O emission factors – table 5-4, page 25
- Oil flared:
  CO_2, CH_4, and N_2O emission factors – table 5-2, page 23

References:

Government of Newfoundland and Labrador Office of Climate Change (2017). A Guidance Document for Reporting Greenhouse Gas Emissions for Large Industry in Newfoundland and Labrador, March 2017.

3.3.5 Clarification Requirement: CL-08 (Part One Response – September 2018)

External Reviewer(s): NRCan-07-Nx

Project Effects Link to CEAA 2012: Section 5 - All

Reference to EIS Guidelines: Part 2, 3.1. Project Components and Part 2, 3.2.1. Drilling and Testing and Activities

Reference to EIS: Section 14.3.7 Greenhouse Gases

Context and Rationale: Section 14.3.7 of the EIS calculates greenhouse gas emissions from all sources using emission factors in terms of volume (e.g. g/L or g/m3). NRCan advises some of the total emission rates are not consistent with assumed volumes and this could result underestimation or overestimation of C02 emission rates.

For example:

- Using the assumed volume of gas and oil flared during well testing (specified in section 14.3.4 of the EIS) of 10,000 Mcf of gas and 36,000 barrels of oil per test in conjunction with the specified CO2 emission factors of 2482 g/m3 and 2663 g/L, results in a total CO2 emission rate of 31,889 tonnes while the proponent calculates 35,405 tonnes.
- Using the assumed supply vessels consumption (specified in section 14.3.5.1) of two wells at 160 days and eight wells at 75 days each with an average fuel consumption of 64 m3 per day, in conjunction with the supply vessel CO2 emission factor of 2663 g/L, results in a total CO2 emission rate of 156,797 tonnes of COs while the proponent reports 134,398 tonnes.

Specific Question or Information Requirement: Clarify the flared volumes and diesel volumes used for estimating total greenhouse gas emissions for the Project.

Response: Greenhouse gas (GHG) emissions for the Project were updated based on the revised fuel usage and additional information (refer to Information Requirement (IR)-11).

Please see below for the detail calculations for CO_2 emissions from flaring and supply vessels:

- Example1: Well testing CO_2 emissions calculations

  CO_2 emission factor (gas) = 2.482 kg/m^3
  CO_2 emission rate (gas)
  = 2.482 kg/m^3 x 10,000 Mcf/well x 1000 cf/1Mcf x 1 m^3/35.3 ft^3 x duration of testing for one well /2 days x 4 days flaring
  = 1,405,648 kg/project
  = 1,405.65 t/project

  CO_2 emission factor (oil) = 2663 g/L

  CO_2 emission rate (oil)
  = 2663 g/L x1 L/0.81kg (density) x 1 kg/1000g x 36,000 bbl/well x 1 t/7bbl duration of testing for one well /2 days x 4 days flaring
  = 33,815.87 t/project

  Total CO_2 emissions
  = 1405.65 t (gas) + 33815.87 t (oil)
  = 35,221.52 t

- Example 2: CO_2 emission calculations for supply vessels

  The supply vessels were calculated assuming 2 wells at 160 days and 8 wells at 75 days, with up to 3 return trips per week.

  Return trips for the whole project = 920 days /7 * 3
  = 394 return trips
  Using 48 hrs per trip,

  Total days = 394 return trips x 48/24
  = 788 days total project

  Project CO_2 emission rate (supply vessels)
  = 2663 g/L x 1 L/0.001m^3 x 78.27 m^3/day x 1 kg/1000g x 1 t/1000kg x 788 days
  = 164,245 t (project)

References:
No additional references.

3.3.6 Clarification Requirement: CL-09 (Part One Response – September 2018)

External Reviewer(s): ECCC-28-Nx

Project Effects Link to CEAA 2012: Air Quality CEAA 5; 5(1)(b) Federal Lands/Transboundary.

Reference to EIS Guidelines: Part 2, Section 6.3.8.1, Air Quality and Greenhouse Gas (GHG) Emissions.

Reference to EIS: 14.3.5.1 Vessels

Context and Rationale: Section 14.3.5.1 of the EIS states that it is expected that three offshore supply vessels will be used to support the MODU for the Project. ECCC has advised that in the bullet points outlining operating conditions and assumptions used to calculate worst case air emissions from supply vessels on page 860-861, it is not clear which bullets refer to all three vessels combined and which refer to the one proxy vessel. Specifically, it is not clear whether the bullet that estimates average daily fuel consumption as 64 m3/day refers to all three vessels or the one proxy vessel.

Specific Question or Information Requirement: Provide clarifying information on the estimated 64 m^3/day fuel use and whether it refers to the three supply vessels.

Response: The estimated 64 m^3/day fuel usage refers to the combined fuel usage of three identical vessels, with similar design and specifications to the proxy vessel provided. These vessels would conduct a variety of operations such as cargo operations, personnel transfers and standby support in close proximity of the mobile offshore drilling unit (MODU). The usage numbers were based on a typical normal operations fuel consumption.

The supply vessel fuel usage are updated based on total engines output 34,560kW (4 engines*2880 kW*3 supply vessels), as each supply vessel is equipped with four diesel engines rated at 2,880 kW per engine). The updated fuel usage with all engines operating at 100% is 78.27m^3/day.

Sample calculations for fuel usage:

Total engine output: 34,560kW
Diesel heating value: 137000 BTU/gal

Fuel usage = 34,560kW x 3415.179 BTU/hr/1 kW x 1 gal/137000 BTU (diesel heating value) x 0.00378 m^3/gal x 24 hr/1day
= 78.27 m^3/day

The emission rates were updated accordingly, and updated tables related to supply vessels emissions are provided in the revised Section 14 (see Table 14.6 of Appendix A of this EIS Addendum).

References:
No additional references.

3.3.7 Clarification Requirement: CL-10 (Part One Response – September 2018)

External Reviewer(s): ECCC-29-Nx

Project Effects Link to CEAA 2012: Air Quality CEAA 5; 5(1)(b) Federal Lands/Transboundary

Reference to EIS Guidelines: Part 2, Section 6.3.8.1, Air Quality and Greenhouse Gas (GHG) Emissions.

Reference to EIS: 14.3.3 Presence and Operation of MODUs

Context and Rationale: In several places, proxy equipment is used for the purpose of calculating the emissions (i.e. Wartsila, Stena Carron, Stena IceMax and Avalon Sea), which is reasonable. ECCC has requested that the proponent confirm that the equipment used for the Project would not have higher emissions of air pollutants than the proxy equipment used for the calculations.

Specific Question or Information Requirement: Confirm whether the equipment used for the Project would have higher emissions of air pollutants than the proxy equipment used for the calculations.

Response: CNOOC Petroleum North America ULC (CNOOC) has not selected its equipment for the Project at this time. It is currently expected that the air emissions presented in the Environmental Impact Statement (EIS), through the use of proxy equipment that have been or are in use in the region, are sufficiently conservative and representative of the potential air emissions for the equipment that CNOOC will eventually select through its contracting processes.

References:
No additional references.

3.4 Fish and Fish Habitat/Marine Mammals and Turtles

3.4.1 Clarification Requirement: CL-11 (Part One Response – September 2018)

External Reviewer(s): DFO-12-NX

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat, 5(1)(a)(ii) Aquatic Species

Reference to EIS Guidelines: Part 2, section 6.3 Predicted Effects on Valued Components – section 6.3.1 Fish and Fish Habitat

Reference to EIS: Section 8.2 Potential Environmental Changes, Effects and Associated Parameters

Context and Rationale: The EIS Guidelines require consideration of the effects of underwater noise and vibration emissions from project activities (i.e. drilling, vertical seismic profiling, offshore supply vessel operation, well abandonment) and how it may affect fish health and behaviour and consideration of how project-related effects may affect fish food sources.

The DFO has advised that a change in food availability and quantity could potentially result from sound emissions produced by vertical seismic profiling. This should be reflected in Table 8.2 "Potential Project-VC Interactions and Associated Effects: Marine Fish and Fish Habitat."

Specific Question or Information Requirement: Based on the advice provided by the DFO, review and update Table 8.2., as applicable. If no changes are proposed, provide a rationale for excluding potential effects of vertical seismic profiling on food availability for marine species.

Response: Potential Environmental Effects for Change in Food Availability and Quality were identified for Vertical Seismic Profiling in Table 8.2 of the Environmental Impact Statement (EIS).

No update to the table is required.

References:
No additional references.

3.4.2 Clarification Requirement: CL-12 (Part One Response – September 2018)

External Reviewer(s): DFO-11- Ax-NX

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat, 5(1)(a)(ii) Aquatic Species

Reference to EIS Guidelines: Section 6.1 Project Setting and Baseline Conditions

Reference to EIS: Sections 6.1.6.1 Grand Banks Shelf, 6.1.6.2 Flemish Cap and 6.1.6.3 Flemish Pass

Context and Rationale: There are inconsistencies between the text and associated tables in Section 6.1.6.1. For example, different dominant infaunal invertebrate species are listed for Kenchington et al. (2001) in Table 6.1 and final sentence on page 201. Similarly, different dominant macrofaunal invertebrate species are listed for Prena et al. (1999) in Table 6.2 and in the final sentence on page 202.

Specific Question or Information Requirement: Clarify the inconsistencies between the text and associated tables as applicable.

Response: The last line of text on page 201 (Section 6.1.6.1) in the Environmental Impact Statement (EIS) referencing Sarsi brittle stars, chalky macoma, and pale sea urchin should be altered to read:

- Sarsi brittle stars (*Ophiura sarsi*), Chalky macoma, and pale sea urchin (*Stongylocentrotus pallidus*) were noted by Kenchington et al (2001) as contributing substantially to biomass, however abundance numbers were not reported.
- "Biomass was dominated by propeller clams (*Cyrtodaria siliqua*) and sand dollars (*Echinarachnius parma*), while abundance was dominated by the polychaete *Prionospio steenstrupi* and the mollusc *Macoma calcarea*."

The following paragraph can be added to further explain Table 6.1 (Section 6.1.6.1):

- "The principal species included the polychaetes *Prionospio steenstrupi, Chaetozone setosa, Spio filicornis*, and *Nothria conchylega* as well as the amphipod *Priscillina armata*, the bivalve mollusc *Macoma calcarea*, and the sand dollar. *Macoma calcarea* and *Prionospio steenstrupi* usually had the greatest abundance. The total abundance per videograb sample (0.5 m^2) ranged between 252 and 2291 individuals, with an overall average of 1064, and declined sharply through the course of the study (Fig. 2) (Kenchington et al. 2001)."

The last sentence on page 202 should read: Prena et al. (1999) captured snow crab, brittle star, and pale sea urchins in the greatest quantities using an epibenthic sled.

References:
No additional references.

3.4.3 Clarification Requirement: CL-13 (Part One Response – September 2018)

External Reviewer(s): DFO-14- Ax-NX

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat, 5(1)(a)(ii) Aquatic Species

Reference to EIS Guidelines: Section 6.1 Project Setting and Baseline Conditions

Reference to EIS: Section 6.1.6.4 Key Invertebrate Species

Context and Rationale: The statement "There are relatively low abundances of Northern shrimp on the eastern Flemish Cap in comparison to the western Flemish Cap" is inconsistent with Figure 6.4 (p. 208).

Specific Question or Information Requirement: Clarify the abundance of Northern Shrimp on the eastern Flemish Cap in comparison to the western Flemish Cap.

Response: As seen in Figure 6.4 in the Environmental Impact Statement (EIS), Northern shrimp distributions on the Flemish Cap are variable year to year. The highest abundances of Northern shrimp in benthic tows have consistently been on the western side of the Flemish Cap. In 2012, 2013, and 2014, the highest per tow biomass and area of captured biomass were larger on the western cap compared to the eastern cap. In 2015 per tow biomass was lower throughout the cap, however the highest biomass numbers continued to be on the western cap.

References:
No additional references.

3.4.4 Clarification Requirement: CL-14 (Part One Response – September 2018)

External Reviewer(s): DFO-18 Ax NX

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat, 5(1)(a)(ii) Aquatic Species

Reference to EIS Guidelines: Part 2, Section 6.1.6 Marine Mammals

Reference to EIS: Section 6.3.1 Mysticetes (page 309, paragraph 2, final sentence)

Context and Rationale: From Figure 6.45 (page 312), it appears that Humpback Whales and not Blue Whales are found in the Project Area.

Specific Question or Information Requirement: Clarify whether Humpback and/or Blue Whales may be found in the Project Area.

Response: Marine mammal sightings in the Ocean Biogeographic Information System (OBIS) and Fisheries and Oceans Canada (DFO) Marine Mammals Sightings Database are collected on an opportunistic basis, and without systematic data collection (including recording of search effort and negative data), distribution of observations does not necessarily reflect distribution of species. On a large scale, i.e. within the regional study area, both Blue Whales and Humpback Whales are present, with Humpbacks being the more common of the two species in the area (Figure 6.45). Because these species are highly mobile, even though Blue Whale observations were not recorded within the Project Area it is assumed that both species may be found in the Project Area, as stated in Section 6.3.1 of the Environmental Impact Statement (EIS).

References:
No additional references.

3.4.5 Clarification Requirement: CL-15 (Part One Response – September 2018)

External Reviewer(s): DFO-19 Ax NX

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat, 5(1)(a)(ii) Aquatic Species

Reference to EIS Guidelines: Part 2, Section 6.1.6 Marine Mammals

Reference to EIS: Section 6.3.6 Important Areas and Times for Marine Mammals and Sea Turtles (page 320, paragraph 2, sentence 1)

Context and Rationale: The EIS states that "[f]rom Figures 6.45 to 6.48, it is evident that the greatest concentration of marine mammal sightings reported in DFO and Ocean Biographic Information System (OBIS) datasets was in the Southern Grand Banks area and within the 200 nautical mile limit, while most sea turtle sightings were south of the Grand Banks and off the continental shelf edge (p. 320)." From Figures 6.45 to 6.48, it is not obvious that the greatest concentration of marine mammal sightings is on the Southern Grand Banks.

Specific Question or Information Requirement: Clarify where the greatest concentration of marine mammals can be found in the RSA.

Response: The identified figures depict the locations of marine mammal and sea turtle sightings, but as noted in response to CL-14, sightings in the Ocean Biogeographic Information System (OBIS) and Fisheries and Oceans Canada (DFO) Marine Mammals Sightings Database are collected on an opportunistic basis, and without systematic data collection (including recording of search effort and negative data), the distribution of observations does not necessarily reflect distribution of species. Figures 6.45 to 6.48 in the Environmental Impact Statement (EIS) are useful to show the general range of species, but absolute abundance and density cannot be inferred from opportunistic sightings. The greatest concentrations of marine mammals within the regional study area (RSA) tend to be found in high-use foraging areas, such as the Ecologically and Biologically Significant Areas (EBSAs) described in Table 6.30 of the EIS.

References:
No additional references.

3.5 Commercial Fisheries

3.5.1 Clarification Requirement: CL-16 (Part One Response – September 2018)

External Reviewer(s): Unknown

Project Effects Link to CEAA 2012: 5(2)(b)(i) Health and Socio-Economic Conditions

Reference to EIS Guidelines: Part 2, Section 6.3.8.2, Commercial Fisheries

Reference to EIS: Section 13.3.3 Presence and Operation of MODUs

Context and Rationale: The EIS states that incompatible structures (i.e. underwater cables, shipwrecks and UXO) will be avoided.

Specific Question or Information Requirement: Provide clarification as to how incompatible structures such as underwater cables, shipwrecks and UXO would be located and avoided

Response: Once a wellsite location has been selected, a seabed investigation will be conducted in advance of any drilling activity to detect any incompatible structures. A seabed investigation is usually conducted using a drop camera or video unit.

This equipment would be deployed from either a support vessel or the mobile offshore drilling unit (MODU) for a visual inspection of the seabed prior to initiating drilling activities. Hydrographic charts that cover the wellsite location would also be examined for any previously identified obstructions. If any incompatible structures are found, a minimum setback distance will be established based on the nature of the structure and discussions with relevant regulatory agencies.

Preventing interactions with known / charted incompatible submarine structures (such as subsea cables, documented in Section 7.3.6 of the Environmental Impact Statement (EIS)) have been considered during the planning and design stages. Section 13.3.3 of the EIS states any unknown incompatible structures would be located and identified through "a process of seabed investigation before any equipment is installed or drilling begins. If any incompatible structures are found, they will be avoided. In the case of a suspected unexploded ordnance (UXO) being identified, the response will follow Notices to Mariners Annual Edition (2017) Section 37, with the location immediately reported to the Department of National Defence (DND)."

The reader is also referred to the responses to IR-02 and IR-18 for additional detail on seabed investigations.

References:
No additional references.

3.6 Accidents and Malfunctions

3.6.1 Clarification Requirement: CL-17 (Part One Response – September 2018)

External Reviewer(s): Unknown

Project Effects Link to CEAA 2012: Multiple VCs – Accidents and Malfunctions

Reference to EIS Guidelines: Part 2, Section 6.6.1, Effects of Potential Accidents or Malfunctions

Reference to EIS: Section 16 Accidental Events

Context and Rationale: Section 6.6.1 of the EIS Guidelines requires that the EIS describes the existing mechanisms and arrangements with response organizations for emergency response within the spatial extent of the project. Section 16.1.4.1 of the EIS states that Tier 2 & 3 response resources are expected to include mutual aid agreements with other oil and gas companies operating in the region. However, the capacity in which other operators may be involved is not described.

Specific Question or Information Requirement: Provide information on mutual aid agreements that may be implemented with other operators in the region, in particular with respect to drill rig assistance that may be required the event of emergency drilling of a relief well.

Explain any potential limitations that may restrict aid assistance from other operators in the region in the event of a spill.

Response: As discussed in the response to Information Requirement (IR)-57, CNOOC Petroleum North America ULC (CNOOC) has initiated discussions to become a participating party in the Grand Banks Operators Mutual Emergency Assistance Agreement (herein referred to as the Agreement). The premise behind this Agreement is for various operators in the Grand Banks region to provide assistance to each other in the event of an emergency.

Under this Agreement, assistance provided by other operators will depend on the situation, however, it may include providing:

- current, or forecasted, ice, weather and/or oceanographic information;
- medical evacuation support from an offshore location; and
- personnel, vessels, equipment, facilities, and other company or contracted resources to assist during the emergency response operation.

To utilize other operators' resources in the event of an emergency, a notice and informal request is required to be made, which is typically by telephone. Formal written confirmation is also completed by the requesting operators' Incident Commander. Under the terms of the Agreement, each operator agrees to use reasonable effort to make the designated resources available. However, resources will only be provided to the extent that the responding operator's operation is not jeopardized or its personnel or facilities are put at risk.

The type of mobile offshore drilling unit (MODU) required to drill a relief well will be identified in advance of the start of drilling. CNOOC may also utilize other MODUs that are contracted globally, provided they meet technical requirements. CNOOC will meet with the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) on a regular basis to discuss various emergency response aspects including MODU availability for drilling a relief well.

References:
No additional references.

3.6.2 Clarification Requirement: CL-18 (Part One Response – September 2018)

External Reviewer(s): ECCC-18-Nx

Project Effects Link to CEAA 2012: Multiple VCs - Accidents and Malfunctions

Reference to EIS Guidelines: Part 2, Section 6.6.1, Effects of Potential Accidents or Malfunctions

Reference to EIS: Appendix G – Oil Spill Modelling - Section 3.4 – Wind Data; and Appendix G – Oil Spill Modelling, Section 3.5 - Currents

Context and Rationale: In Section 3.4 of Appendix G, it is noted that the spatial and temporal resolution of the wind input used to force the oil spill model, "CFSR [Climate Forecast System Reanalysis] time series acquired for this study was available at 0.5° horizontal resolution at 6-hourly intervals". It is also noted that the CFSR winds were used in the hydrodynamic modelling (HYCOM) as described in Section 3.5. In Section 3.5 of the EIS, the proponent notes the forcing field used to drive the hydrodynamic model, "(s)urface forcing is derived from 1-hourly CFSR wind data with a horizontal resolution of 0.3125°". ECCC advised there was no rationale provided why there were differences in the temporal and spatial resolution of the wind forcing used between the two different models and questioned whether it was a limitation of the oil spill model, or whether the wind field used in the HYCOM model at a different reference height than that used in the oil spill model which might account for the different resolutions of the CFSR data.

Specific Question or Information Requirement: Provide a rationale as to why a lower resolution data set was used for the oil spill model versus a higher one for the HYCOM model when the apparent source of data (CFSR) was the same.

Response: The U.S. Navy Global HYCOM (HYbrid Coordinate Ocean Model) circulation model (i.e., HYCOM hydrodynamic model) and the U.S. National Centers for Environmental Prediction Climate Forecast System Reanalysis model (i.e., CFSR wind model) are two separate data products. Each model is generated by different groups of scientists using different input data sets, to model different fluids (air vs. water). The spatial and temporal resolution of the models do not match exactly, nor should they. The movement of ocean currents does not "force" winds, however winds can and do "force" the movement of water. Hydrodynamic models use wind speed and direction as an input dataset to drive upper ocean movement (i.e., surface currents). Specifically, the HYCOM model uses the CFSR wind model as the wind forcing. Therefore, to ensure consistency within the forcing datasets, the HYCOM and CFSR models were used in tandem as forcings to the oil spill model.

If a different wind data set were used, then the forcings would not be coupled or consistent. In essence, surface water would be transported based upon CFSR winds (and other HYCOM inputs), while the oil would be transported by a combination of HYCOM currents (driven by CFSR winds) and winds from the hypothetical other wind model. This de-coupling would be inconsistent and would be a limitation to the oil spill model.

The 6-hourly CFSR winds at 0.5 degree spatial resolution were used in this modeling exercise as opposed to the 1-hour winds at 0.3125 degree spatial resolution for several reasons. Primarily, the data in question has a different projection, which results in gaussian stretching in latitude at the northern regions, due to the curvature of the earth. This would result in non-uniform spatial coverage with this high-resolution dataset. Secondarily, the coarser resolution wind data that was used in this analysis is optimal for storage file size and model run time. Additional resolution would inflate storage sizes and increase run times (i.e. the time it takes to actually simulate these releases). The result of this would be only very small differences in the oil spill trajectory over long periods of time (e.g. months to years). While the finer scale features in the high-resolution winds may capture a small amount of mesoscale variability, the intent of this analysis is to capture longer time-scale and spatial patterns in wind/wave

coupling and the potential for entrainment of oil. This dataset is not required to capture these features. Finally, based upon the spatial and temporal scales of the oil spill analysis, and use of daily HYCOM currents, the use of this higher resolution would not add value to the variability of the oil spill results.

References:

BIO, 2018. Bedford Institute of Oceanography, Ocean Data Inventory, Accessed January 2018 at: http://www.bio.gc.ca/science/data-donnees/base/run-courir-en.php.

EMODNET, 2018. European Marine Observation Data Network: Central Portal. Accessed January 2018. http://www.emodnet.eu/data.

Tajalli-Bakhsh, T., M. Horn, and M. Monim, 2018. "Metocean Analysis Offshore Newfoundland: An investigation of HYCOM currents and CFSR winds". Prepared for: ExxonMobil Canada Ltd., Nexen Energy ULC, and Statoil Canada Ltd.

3.6.3 Clarification Requirement: CL-19 (Revised Response – February 2019)

External Reviewer(s): DFO-01-Nx

Project Effects Link to CEAA 2012: Multiple VCs - Regional Study Area (Accidents and Malfunctions)

Reference to EIS Guidelines: Part 1, Section 3.2.3 Spatial and Temporal Boundaries

Reference to EIS: Section 4.3.1.1 Study Areas

Context and Rationale: The EIS Guidelines require that the spatial boundaries will identify the areas that could potentially be affected by a worst-case scenario for each accident type.

In defining the RSA, the EIS states "The RSA also encompasses the predicted zone of influence of a potential oil spill event, as summarized and assessed in Section 16.4 and modelled in detail in Appendix G, and specifically the ecological and socioeconomic thresholds for the 95th percentile case for both surface (oil thickness) and water column exposure." (Table 4.3).

However, figures presented in Section 16 and Appendix G, indicate that the predicted zone of influence for an oil spill event lies beyond the boundaries of the RSA.

Specific Question or Information Requirement: Update the map and text describing the RSA, taking into consideration spill modelling results.

Response: On August 10, 2017, CNOOC Petroleum North America ULC (CNOOC) and its consultants (AMEC Foster Wheeler and RPS) held an online workshop with fourteen regulatory representatives from five regulatory agencies (CEAA (3), C-NLOPB (1), DFO (5), ECCC (3), NRCan (2)) seeking feedback on the proposed oil spill modelling approach to be used by CNOOC for its Flemish Pass Exploration Drilling Project Environmental Impact Statement (EIS). The presentation detailed the proposed model data sets, release duration(s) and model run duration(s) and discussed the proposed study area boundaries. A number of comments and questions were received during the workshop with the primary focus being on input data sets. As a result, the models were run based on the August 2017 parameters.

On February 20, 2018, CNOOC filed its completed Environmental Impact Statement (EIS) with CEAA. Included as part of the EIS was the completed oil spill modelling results. In the first round of Information Requirements (IR) received from CEAA in June 2018, IR-63 specifically focused on the oil spill modelling approach including the duration(s) of the oil spill release and model run. CNOOC engaged in discussions with CEAA and the C-NLOPB in July/ August 2018 regarding IR 63 and the request that CNOOC conduct the fate and behaviour modelling to reflect the worst case discharge scenario that models the drilling of a relief well.

IR-64 requests rationale for the selection of boundaries for stochastic modelling. DFO noted that for many figures provided in the EIS with stochastic results, the spatial extent of the statistics are truncated by the boundaries of the numerical domain. The C-NLOPB has advised that the model should be run until the ecological thresholds defined in the EIS or the probability of shoreline oiling is reached.

CNOOC repeated its oil spill modeling based on the longer release duration (120 days versus the previous 30 days) and extended the model duration from 60 days to 160 days. In addition, CNOOC has expanded the study area (i.e. model domain) boundaries as part of the revised oil spill modelling to address the concerns raised by DFO in IR-64. Originally, the model domain spanned from 42-57 °N and 28-72 °W. In the revised modelling, the model domain was expanded to include 35-60 °N and 15-72 °W encompassing Canadian, U.S., other national territorial

seas, and International Waters. In general, released oil was predicted to cover similar regions as the previous modelling, however with the model domain extending further to the east, there was a "new" potential for oil to reach the Azores at levels that may exceed socioeconomic and ecological thresholds. The oil that would be transported this far to the east would likely be highly weathered, patchy, and discontinuous, with minimum times to the Azores of approximately 45 days.

Following completion of the revised oil spill modelling, CNOOC has updated the Accidental Events section 16 of the EIS to include this additional modelling information. The results of this additional oil spilling modelling work and the updated Section 16 are included as Appendices B and C, respectively, in this revised addendum document.

References:

No additional references.

3.6.4 Clarification Requirement: CL-20 (Part One Response – September 2018)

External Reviewer(s): DFO-05- Ax-Nx; Ekuanitshit-07-Nx

Project Effects Link to CEAA 2012: Multiple VCs – Accidents and Malfunctions

Reference to EIS Guidelines: Part 2, Section 6.6.1 Effects of Potential Accidents or Malfunctions

Reference to EIS: Section 16.6.2.1 Potential Issues and Interactions – Existing Knowledge of the Effects of Dill Fluids (SBMs) on Marine Fish and Fish Habitat; Section 16.6.4.2 Environmental Effects Assessment

Context and Rationale: Section 16.6.2.1 of the EIS states, "The effects considered here relate exclusively to an accidental discharge of SBM (i.e., drill fluid only)." It would seem that the base fluid only, is being considered.

However, on pages 993 and 1009 the EIS refers to SBMs as being a dense fluid, for example "SBMs, however, are a heavy, dense fluid which sinks rapidly so the effects on the water's surface would be limited as it sinks through the water column."

DFO has advised that base drill fluids are typically less dense (~0.8 g/ml) than water, and that it is not clear throughout the section whether only the base drill fluid is being considered or the fluid plus the additives that are typical in drill muds are being considered.

Specific Question or Information Requirement: Clarify that that the synthetic based mud (SBM) modelling and the associated effects analysis includes consideration of additives, as per description in Appendix H. If the effects analysis is based on the drill fluid only, advise whether additional environmental effects or changes in expected discharge are anticipated with the additional of other additives."

Response: The synthetic based mud (SBM) accidental spill modelling study considered the physical dispersion of the SBM as a negatively buoyant fluid, based on the full composition of the mud including the drilling fluid and additives.

References:
No additional references.

3.6.5 Clarification Requirement: CL-21 (Part One Response – September 2018)

External Reviewer(s): C-NLOPB-10-Nx

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat, 5(1)(a)(ii) Aquatic Species, 5(1)(a)(iii) Migratory Birds

Reference to EIS Guidelines: Part 2 - Content of the Environmental Impact Statement - 6.6.1 Effects of Potential Accidents or Malfunctions

Reference to EIS: Section 16.4.3 Model Input Data

Context and Rationale: Section 16.4.3 of the EIS (page 954) indicates that Bay du Nord crude oil was used for the well event modelling, and provides the physical properties of the oil. However, no rationale was provided for the selection of Bay du Nord crude oil in the modelling of the blowout event.

Specific Question or Information Requirement: Provide a rationale to support the selection and use of Bay du Nord crude oil for the well blow out modelling.

Response: The Bay du Nord is the closest reservoir to EL 1144 and EL 1150. The reservoirs at Bay du Nord are mainly Tithonian which are sourced from the same Kimmeridgian formation expected in EL 1144 and EL 1150. As such, the Bay du Nord crude oil was considered most representative of potential production from ELs 1144 and 1150.

References:
No additional references.

3.6.6 Clarification Requirement: CL-22 (Text Corrected – February 2019)

External Reviewer(s): DFO-40-NX

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat, 5(1)(a)(ii) Aquatic Species

Reference to EIS Guidelines: Part 2, Section 6.6.1 Effects of Potential Accidents or Malfunctions

Reference to EIS: Appendix G – Section 3.3 Ice Cover

Context and Rationale: The EIS states that "(o)il trapped in or under sea ice will weather more slowly than oil released in open water."

The EIS also states that "(f)rom 0 to ~30% coverage, the ice has no effect on the advection or weathering of surface floating oil. From approximately 30 to 80% ice coverage, oil advection is forced to the right of ice motion in the northern hemisphere, surface oil thickness generally increases due to ice-restricted spreading, and evaporation and entrainment are both reduced by damping/shielding the water surface from wind and waves. Above 80% ice coverage, surface oil moves with the ice and evaporation and entrainment cease." DFO has indicated that this may only be true for landfast ice. In the open ocean, the oil may disperse faster because of an increased effect of wind on the ice compared to an oil slick alone. A reference should be provided to support these statements.

Specific Question or Information Requirement: Provide references to support the statements in EIS as noted in the context of this information requirement.

Response: Ice coverage information available in coupled hydrodynamics and ice models (e.g. Canadian Ice Service) is typically resolved at relatively large scales (>1 km). While detailed information regarding ice coverage and conditions are not available from these models, the information provided can be used as an indicator of whether oil would move predominantly with the surface water currents or with the ice. A rule of thumb followed by past modeling studies is that oil will generally drift with ice when ice coverage is greater than 30% (Drozdowski et al., 2011; Venkatesh et al., 1990). A recent review by experts on oil transport in ice-covered waters (CRRC, 2016) concluded that from 0-30% ice coverage, oil moves as though it is in open water, and at 80% and higher ice coverage oil transport is almost totally controlled by the ice. There is no agreement on how oil moves with intermediate ice coverage between 30% and 80%, i.e., in the MIZ. There is no specific field calibration for this guidance, although theoretical arguments have been made (Venkatesh et al., 1990; CRRC, 2016). "The presence of frazil or brash ice between larger floes would increase control of the oil as compared to open water." (CRRC, 2016).

In the presence of sea ice, weathering processes (e.g., evaporation and emulsification) and physical processes such as spreading and entrainment are slowed (Spaulding, 1988). Wave-damping, the limitations on spreading dictated by the presence of sea ice, and temperature appear to be the primary factors governing observed spreading and weathering rates (Sorstrom et al., 2010).

The OILMAP and SIMAP models use the ice coverage data (at the available resolution) to determine whether floating (or ice-trapped) oil is transported by the surface water currents or the ice. Immobile landfast ice that seasonally extends out from the coast may act as a natural barrier where oil can collect. In the model, when oil encounters landfast ice it is assumed to trap at or move along the ice edge (depending on the current and wind directions at the location and time). If oil becomes entrapped within landfast ice (by surfacing there or as landfast ice extends over the area), it remains immobile until the ice retreats. When landfast ice is no longer present at the location of trapped oil, the oil is released back into the water as floating oil.

Laboratory and field studies have shown that oil weathering properties are strongly influenced by the low temperature, reduced oil spreading, and reduced wave action caused by moderate to high ice coverage (Brandvik et al., 2010a; Brandvik and Faksness, 2009; Faksness et al., 2011). The weathering processes (e.g., evaporation and emulsification) in pack ice conditions, in particular, were shown to be considerably slower in terms of evaporation, water uptake, and viscosity and pour point changes. In OILMAP and SIMAP, in ice coverage within the marginal ice zone, a linear reduction in wind speed from the open-water value to zero in pack ice is applied to simulate shielding from wind effects. This reduces the evaporation, volatilization, emulsification, and entrainment rates due to reduced wind and wave energy.

In the oil in ice experiments by Brandvik et al. (2010a, b), the evaporative loss of oils showed a significant difference between different ice conditions. The results indicate the difference in evaporative loss is mainly caused by the difference in oil film thickness, reflective of reduced spreading rate with oil slick thickening under higher ice coverage. Thus, this reduction in evaporative loss is reflected in model results via the reduced rate of spreading and constraints on surface area imposed by the ice cover.

SINTEF Sea Lab experiments (FEX2009, Brandvik et al., 2010b) showed that the presence of high ice coverage (90%) considerably slowed the rate and extent of the emulsification process as indicated from the percentage water uptake, presumably due to the significant wave damping and hence a reduction in wave mixing energy available for creating emulsions.

Degradation of subsea and ice-bound oil occurs during all ice conditions, at rates occurring at the location (i.e., floating versus subsea) without ice present. The rates are model inputs; biodegradation rates developed by French McCay et al. (2015, 2016, 2017) based on literature review are typically used.

References:

Brandvik, P.J., Daling, P.S. and Myrhaug, J.L., 2010a. Mapping weathering properties as a function of ice conditions: a combined approach using a flume basin verified by large scale field experiments, AMOP. Environment Canada, Halifax, NS, pp. 701-723.

Brandvik, P.J., P.S. Daling, L.G. Faksness, J Fritt-Rasmussen, R.L. Daae, and F. Leirvik. 2010b. Experimental oil release in broken ice – a large-scale field verification of results from laboratory studies of oil weathering and ignitability of weathered oil spills. SINTEF Materials and Chemistry, Oil in Ice – JIP Report No. 26, 38pp. Availalble at: http://www.sintef. no/project/JIP_Oil_In_Ice/dokumenter/publications/ JIP-rep-no-26-FEX2009-weathering-ISB-final.pdf.

Brandvik, P.J. and Faksness, L.-G., 2009. Weathering processes in Arctic oil spills: Meso-scale experiments with different ice conditions. Cold Regions Science and Technology, 55(1): 160-166.

Coastal Response Research Center (CRRC), 2016. State-of-Science for Dispersant Use in Arctic Waters: Physical Transport and Chemical Behavior. Coastal Response Research Center, University of New Hampshire, Durham, NH. February 29, 2016, 18p.

Drozdowski, A., Nudds, S., Hannah, C. G., Niu, H., Peterson, I., Perrie, W. 2011. Review of Oil Spill Trajectory Modelling in the Presence of Ice. Canadian Technical Report of Hydrographic and Ocean Sciences. 274: vi + 84p.

Faksness, L.-G., Brandvik, P.J., Daae, R.L., Leirvik, F. and Børseth, J.F., 2011. Large-scale oil-in-ice experiment in the Barents Sea: Monitoring of oil in water and MetOcean interactions. Marine Pollution Bulletin, 62(5): 976-984.

French McCay, D., Jayko, K., Li, Z., Horn, M., Kim, Y., Isaji, T., Crowley, D., Spaulding, M., Fontenault, J., Shmookler, R. and Rowe, J., 2015. Technical Reports for Deepwater Horizon Water Column Injury Assessment WC_TR.14: Modeling Oil Fate and Exposure Concentrations in the Deepwater Plume and Rising Oil Resulting from the Deepwater Horizon Oil Spill; Date of Report: September 29, 2015. Project No, 2011-144. RPS ASA, 55 Village Square Drive, South Kingstown, RI 02879. DWH-AR0285776.

French McCay, D.P, Z. Li, M. Horn, D. Crowley, M. Spaulding, D. Mendelsohn, and C. Turner. 2016. Modeling Oil Fate and Subsurface Exposure Concentrations from the Deepwater Horizon Oil Spill. In: Proceedings of the 39th AMOP Technical Seminar on Environmental Contamination and Response, Environment Canada. 39:115-150.

French McCay, D. K. Jayko, Z. Li, M. Horn, T. Isaji, M. Spaulding. 2017. Simulation Modeling of Ocean Circulation and Oil Spills in the Gulf of Mexico – Appendix II Oil Transport and Fates Model Technical Manual. Prepared by RPS ASA for the US Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM 20xx-xxx. xxx pp.

Sørstrøm, S.E., Brandvik, P.J., Buist, I., Daling, P.S., Dickins, D., Faksnes, L.-G., Potter, S., Rasmussen, J.F. and Singaas, I., 2010. Joint industry program on oil spill contingency for Arctic and ice-covered waters. Oil in ice -JIP Summary report. Report no. 32. SINTEF Materials and Chemistry. October 04, 2010. Available online: http://www.sintef.no/globalassets/project/jip_oil_in_ice/dokumenter/publications/jip-rep-no-32-summary-report.pdf.

Venkatesh, S., H. El-Tahan, G. Comfort, and Abdelnour, R. 1990. Modelling the Behaviour of Oil Spills in Ice-Infested Waters. Atmosphere-Ocean, Canadian Meteorological and Oceanographic Society. 28(3): 303-329.

3.6.7 Clarification Requirement: CL-23 (Part One Response – September 2018)

External Reviewer(s): DFO-41-Nx, and -43-NX

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat, 5(1)(a)(ii) Aquatic Species

Reference to EIS Guidelines: Part 2, Section 6.6.1 Effects of Potential Accidents or Malfunctions

Reference to EIS: Appendix D – Section 3.5 Currents

Context and Rationale: The EIS states that "(t)he boundary where these two currents converge produces extremely energetic and variable frontal systems and eddies on smaller scales, on the order of kilometers (Volkov, 2005). Due to these eddies, local transport may advect parcels of water in nearly any direction." DFO indicated that it is unclear whether the numerical simulations have enough spatial resolution to resolve these 'extremely energetic eddies', or whether the currents used (daily average) have enough temporal resolution to resolve these eddies.

The EIS states, "…oil transport was defined by the daily currents throughout each modelled simulation". This is a major limitation that should be quantified and discussed. Daily currents do not resolve high-resolution motions such as inertial or tidal currents (e.g. trapped diurnal tide known to travel around Flemish Cap; Wright and Xu, 2004). It is unclear whether the daily currents take into account these extremely energetic frontal systems.

Specific Question or Information Requirement: Provide a discussion of whether the numerical simulations have enough spatial and temporal resolution to resolve the 'extremely energetic eddies' referred to in the EIS. The limitations of using lower-resolution data should be discussed, including implications for effects predictions.

Response: The spatial extent of boundary current eddies can be on the order of kilometers. The 1/12° equatorial resolution of the HYCOM hydrodynamic gridding provides gridded ocean data with an average spacing of ~7km between each point. Several studies have demonstrated that at least 1/10° horizontal resolution is required to resolve boundary currents and mesoscale variability in a realistic manner (Hurlburt and Hogan, 2000; Smith and Maltrud, 2000; Chassignet and Garaffo, 2001). For eddies that are of a smaller scale than ~7km, the HYCOM model would not directly capture these features. However, from a broader-scale trajectory perspective, this is not required. The movement of water within an eddy is circular by nature. Therefore, while the rate of circulation (i.e. velocity of water) may be greater than that of the general circulation outside of the eddy, it is irrelevant to the broader scale modelled transport processes as oil in the eddy would tend to be trapped, circulating within the grid cell. The general circulation (i.e. movement of the eddy itself) would be resolved by the average current within the single grid cell. In addition, the randomized advective dispersion accounts for the variability in currents below the spatial and temporal resolution of each dataset. Because HYCOM does not resolve the trapping of oil in these small-scale features results of the modelled simulations would tend to have a higher degree of dispersion and would therefore cover larger areas. For eddies that are larger than approximately 14 km in diameter, the HYCOM gridding could capture the circular nature of the circulation in the multiple grid points that would be used to model it.

In general, the resolution of underlying forcing data has the potential to influence the results of trajectory and fates simulations. If extremely coarse resolution gridding is used, intricate flow paths may be straightened, and velocities would tend to be closer to the mean. If extremely fine resolution gridding is used, smaller scale features will be resolved. However, there is a balance and a "law of diminishing returns" when modelling these processes. When higher spatial and temporal resolutions are used, larger amounts of data required, the number of time steps must increase (i.e. shorter time steps are required with higher spatial resolution data to account for the distance traveled in each time steps to ensure particles do not skip grid cells), and the amount of time required to model

also increases.

A metocean study was conducted to investigate the forcing mechanisms used in the modeling (i.e. currents and winds). Through the use of current roses, monthly statistics of average and 95th percentile wind speeds, and comparisons to field measurements of wind and current speed and direction, it was found that the HYCOM Reanalysis current data and CFSR wind data were adequately resolving the speed and direction of natural oceanic features and winds in the North Atlantic (EMODNET, 2018; BIO 2018). In addition, because CFSR winds were one of the main driving forces used in the HYCOM Reanalysis model, an additional level of consistency was maintained.

References:

BIO, 2018. Bedford Institute of Oceanography, Ocean Data Inventory, Accessed January 2018 at: http://www.bio.gc.ca/science/data-donnees/base/run-courir-en.php.

EMODNET, 2018. European Marine Observation Data Network: Central Portal. Accessed January 2018. http://www.emodnet.eu/data.

Hurlburt, H.E., Hogan, P.J., 2000. Impact of 1/8 to 1/64 resolution on Gulf stream model-data comparisons in basin-scale Atlantic Ocean models. Dynamics of Atmospheres and Oceans, No. 32, pp. 283-329.

Smith, R.D. Maltrud, M.E., 2000. Numerical simulations of the North Atlantic Ocean at 1/10. Journal of physical Oceanography, no. 30, pp.1532-1561.

3.6.8 Clarification Requirement: CL-24 (Part One Response – September 2018)

External Reviewer(s): CL-KMKNO-41-Nx, -42-Nx; MFN-23-Nx

Project Effects Link to CEAA 2012: Multiple VCs – Accidents and Malfunctions

Reference to EIS Guidelines: Part 2, Section 6.6.1 Effects of Potential Accidents or Malfunctions

Reference to EIS: Section 16.1.4 Contingency Planning and Emergency Response

Context and Rationale: The KMKNO and the Miawpukek First Nation have indicated that it is not clear from the EIS how the proponent intends to involve Indigenous groups in the development and the implementation of contingency plans. It noted that:

- the proponent should indicate how it will involve Indigenous groups in the development and implementation of the Oil Spill Response Plan (OSRP)and other emergency response and contingency plans, including emergency response and preparedness planning, exercises and training; and
- the proponent should indicate if Indigenous groups will be provided with the approved versions of contingency and response plans.

Specific Question or Information Requirement: Confirm the level of involvement of Indigenous groups in the development and implementation of the OSRP and other emergency response and preparedness plans, exercises and training. Confirm if Indigenous groups will be provided with versions of these plans when they are finalized.

Response: Oil spill response is based on an established set of global industry standards. Many Indigenous groups in Atlantic Canada are already familiar with these global standards and practices through previous engagement and training with other operators in the region. At recent engagement workshops with Indigenous groups, CNOOC Petroleum North America ULC (CNOOC) (and other operators) shared an overview of their approach to oil spill response, in the unlikely event of an emergency. CNOOC's oil spill response plans are currently being developed and will form part of the Operations Application (OA) to the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB). CNOOC commits to sharing its final oil spill response plans with Indigenous groups for discussion and will consider input from those groups.

CNOOC will continue to engage with Indigenous communities throughout the life of the Project and will explore opportunities to provide education in oil spill response with interested Indigenous groups. This may take the form of training, workshops or exercises to more fully integrate these communities into CNOOC's program.

References:
No additional references.

3.6.9 Clarification Requirement: CL-25 (Part One Response – September 2018)

External Reviewer(s): CL-KMKNO-43-Nx

Project Effects Link to CEAA 2012: Multiple VCs – Accidents and Malfunctions

Reference to EIS Guidelines: Part 2, Section 6.6.1 Effects of Potential Accidents or Malfunctions

Reference to EIS: Section 16.1.4.1 Nexen Emergency Response Hierarchy

Context and Rationale: Section 16.1.4.1 of the EIS defines the three-tiered system employed by Nexen to categorize and respond to any type of incident. The KMKNO stated that the definitions provided do not appear to account for an incident that requires national but not international resources.

Specific Question or Information Requirement: Clarify whether an incident that requires national but not international resources is considered a Tier 2 or Tier 3 incident.

Response: Section 16.1.4.1 of the Environmental Impact Statement (EIS) states any incident requiring national but not international resources would still be considered a Tier 3 incident. If an incident can be managed with regional resources, it would be classified as a Tier 2 incident and if an incident can be managed with on-site resources, it would be classified as a Tier 1 incident.

References:
No additional references.

3.6.10 Clarification Requirement: CL-26 (Part One Response – September 2018)

External Reviewer(s): DFO-02-Nx; DFO-34-Ax-Nx

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat, 5(1)(a)(ii) Aquatic Species

Reference to EIS Guidelines: Part 1, section 4.3 Study Strategy and Methodology.

Reference to EIS: Page 954, section 16.4.3 Model Input Data; Appendix G – Section 3.5 Currents

Context and Rationale: The EIS does not provide sufficient rationale for the selection of the oceanographic inputs in the models used compared to other available datasets, including inputs used for the spill trajectory model.

The EIS states that, "[w]hile this subset of data is not the most recent five years of data, currents and winds in the study area are very similar to those from 5-10 years ago and the data used in this study would be representative of environmental conditions present today."

Specific Question or Information Requirement: Provide rationale that the data inputs used are applicable and best suited to modelling in the Project Area, with consideration of predicted future conditions sufficient to provide a degree of certainty or validation in the predictions made, and provide a margin of error associated with the predictions.

Provide additional justification for use of datasets from 2006-2010, including appropriate references.

Response: The U.S. Navy Global HYCOM (HYbrid Coordinate Ocean Model) circulation model (i.e. HYCOM hydrodynamic model) and the U.S. National Centers for Environmental Prediction Climate Forecast System Reanalysis model (i.e. CFSR wind model) were selected for use in the oil spill modeling. The date range of data included the most recent set from 2006-2010 from the HYCOM reanalysis. These two datasets are widely known to be robust global hydrodynamic and wind predictions. A metocean study was conducted to investigate the forcing mechanisms used in the modeling (i.e. currents and winds) to verify that they were sufficiently robust to capture the environmental conditions present in the NW Atlantic Ocean. Through the use of current roses, monthly statistics of average and 95th percentile wind speeds, and comparisons to field measurements of wind and current speed and direction, it was found that the HYCOM Reanalysis current data and CFSR wind data were adequately resolving the speed and direction of natural oceanic features and winds in the North Atlantic (EMODNET, 2018; BIO 2018). In addition, because CFSR winds were one of the main driving forces used in the HYCOM Reanalysis model, an additional level of consistency was maintained. At this time, no dataset is known of that "predicts future conditions" with an adequate spatial and temporal extent that is sufficient for this type of oil spill modeling analysis.

References:

BIO, 2018. Bedford Institute of Oceanography, Ocean Data Inventory, Accessed January 2018 at: http://www.bio.gc.ca/science/data-donnees/base/run-courir-en.php.

EMODNET, 2018. European Marine Observation Data Network: Central Portal. Accessed January 2018. http://www.emodnet.eu/data.

3.7 Effects of the Environment on the Project

3.7.1 Clarification Requirement: CL-27 (Part One Response – September 2018)

External Reviewer(s): CL-ECCC-05-NX

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat, 5(1)(a)(ii) Aquatic Species

Reference to EIS Guidelines: Part 2, Section 6.6.2 Effects of the environment on the project

Reference to EIS: Section 5.6.2 Icebergs

Context and Rationale: The EIS notes that there is a moderate risk for marine traffic due to icebergs anytime between January and June. ECCC has advised that according to Figure 5.37, there appears to be an inconsistency between the number of sightings per month and the declaration of moderate risk. There is no rationale why January is considered moderate risk with 22 iceberg sightings but July and August are not considered moderate risk with 53 and 23 sightings respectively.

Specific Question or Information Requirement: Provide clarification why January is considered moderate risk with 22 iceberg sightings but July and August are not considered moderate risk with 53 and 23 sightings respectively.

Response: The iceberg risk is generally greatest during the months of March through June although, depending on the iceberg season and location offshore, icebergs may be present for marine traffic anytime between January and August.

References:
No additional references.

3.8 Mitigation

3.8.1 Clarification Requirement: CL-28 (Part One Response – September 2018)

External Reviewer(s): C-NLOPB-2-Nx

Project Effects Link to CEAA 2012: 5(1)(a)(i) Fish and Fish Habitat

Reference to EIS Guidelines: Part 2 - Content of the Environmental Impact Statement -6.1.2 Marine environment

Reference to EIS: Section 5.5.4 Seawater Properties (Temperature, Salinity, pH, Turbidity)

Context and Rationale: Section 5.5.4 of the EIS describes statistical summaries of sea temperature and salinity derived from the Ocean Data Inventory of the Bedford Institute of Oceanography (DFO 2016) for depths down to 1,000 m. However, Section 6.1.3 of the EIS states, "[t]he Flemish Pass is a perched slope basin that reaches approximately 1,300 m depths…".

Specific Question or Information Requirement: Clarify whether there are data available for the entirety of the water column, (i.e. down to 1,300 m). If data is available, then it should be provided.

Response: Statistical summaries of sea temperature and salinity were derived from the Ocean Data Inventory (ODI) of the Bedford Institute of Oceanography (BIO) (DFO 2016) for a rectangular area surrounding the Project Area. The period 1900 to 2016 for depths down to 1,300 m was queried with data for depths down to 1,180 m returned in the query.

Table CL-28.1 is a revision of Table 5.12 from the Environmental Impact Statement (EIS) and presents monthly depth profile statistics of mean, minimum and maximum sea temperature for the Project Area together with a count of the number of months for which there are data for the given month and depth range. Mean sea surface temperatures range from 1.8°C in February to 11.9°C in August. Minimum temperatures at the surface range from -1.8°C in February to 9.5°C in September. Maximum sea surface temperatures range from 4.6°C in March to 15.7°C in August. This seasonal temperature cycle with cooler winter temperatures and warmer temperatures in summer is observed down to 200 m. For depths greater than 200 m, sea temperature is only slightly variable by depth with monthly mean temperatures ranging from 3.3 to 4.0°C.

Table CL-28.1 Monthly Sea Temperature Profile Statistics

Depth (m)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Temperature (°C)												
0	3.4	1.8	2.1	1.9	3.4	5.6	10.5	11.9	11.6	8.5	5.5	5.1
20	3.0	1.8	2.0	1.6	3.1	4.1	8.0	7.0	9.1	8.4	5.4	4.5
40	3.0	1.9	2.0	1.6	2.4	2.5	4.0	1.7	6.8	6.5	4.8	4.7
60	2.8	1.7	2.2	1.7	2.0	1.9	2.8	1.1	2.8	4.7	3.8	4.3
80	3.0	2.1	2.3	2.0	2.2	2.0	2.6	1.3	2.2	3.6	3.1	3.9
100	2.9	2.3	2.4	2.2	2.3	2.1	2.7	1.5	2.5	3.4	2.8	3.6
200	3.7	2.9	3.4	3.0	3.2	3.0	3.5	3.4	3.9	3.7	3.5	4.0
300	3.8	3.4	3.5	3.4	3.5	3.4	3.7	3.7	3.8	3.8	3.7	4.0
400	3.9	3.5	3.6	3.5	3.6	3.5	3.7	3.6	3.9	3.7	3.9	3.9
500	3.8	3.7	3.8	3.6	3.6	3.5	3.6	3.7	4.0	3.7	3.8	3.8
600	3.7	3.7	3.8	3.5	3.6	3.5	3.7	3.7	3.9	3.6	3.8	3.7
700	3.7	3.6	3.6	3.5	3.4	3.6	3.6	3.6	-	3.6	3.7	3.6
800	3.5	3.5	3.6	3.5	3.5	3.5	3.6	3.6	-	3.5	3.6	3.5

Depth (m)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
900	3.5	3.3	3.3	3.5	3.4	3.4	3.5	3.5	3.7	3.5	3.6	3.4
1000	3.4	-	3.3	3.3	3.4	3.4	3.4	3.5	-	3.4	3.5	3.4
1100	3.4	-	3.0	3.2	3.1	3.4	3.3	3.5	-	3.4	3.5	3.2
1180	3.4	-	2.9	3.5	3.3	-	3.4	-	-	3.4	3.4	3.3
Minimum Temperature (°C)												
0	-0.4	-1.8	-0.9	-1.5	-0.9	0.9	4.0	7.6	9.5	2.8	0.8	1.3
20	-0.3	-1.7	-0.9	-1.6	-1.1	-0.2	2.3	2.5	3.5	1.4	1.2	1.0
40	-0.3	-1.6	-0.8	-1.7	-1.1	-1.6	-1.4	-1.5	3.4	-0.1	0.3	0.3
60	-0.1	-1.6	-0.9	-1.6	-1.7	-1.6	-1.7	-1.5	-0.8	-0.4	-1.0	0.4
80	0.5	-1.6	-0.9	-1.5	-1.6	-1.5	-1.5	-1.5	-1.1	-0.2	-0.9	0.2
100	0.7	-1.6	-0.8	-1.4	-1.1	-1.1	-1.1	-1.2	-0.4	1.2	-0.7	-0.2
200	1.6	-0.1	2.2	-0.2	0.7	0.4	0.1	0.0	3.4	2.3	1.3	2.0
300	2.8	1.7	2.3	1.4	2.0	1.6	1.8	1.8	3.5	2.8	2.4	2.8
400	3.5	2.5	2.6	2.6	2.8	2.0	2.7	2.4	3.8	3.4	2.9	3.4
500	3.5	2.7	3.6	3.2	3.1	3.1	3.0	3.0	4.0	3.4	3.2	3.3
600	3.5	3.5	3.4	3.1	3.3	3.2	3.1	3.1	3.8	3.3	3.2	3.2
700	3.4	3.4	3.2	3.2	3.2	3.5	3.2	3.2	-	3.3	3.4	3.1
800	3.4	3.3	3.3	3.3	3.3	3.1	3.2	3.3	-	3.3	3.3	3.2
900	3.3	3.3	3.0	3.3	3.3	3.1	3.2	3.3	3.7	3.3	3.5	3.2
1000	3.4	-	3.0	3.1	3.2	3.3	3.2	3.3	-	3.3	3.3	3.1
1100	3.4	-	3.0	3.1	3.1	3.4	3.1	3.3	-	3.3	3.5	3.0
1180	3.4	-	2.9	3.4	3.3	-	3.1	-	-	3.3	3.3	3.0
Maximum Temperature (°C)												
0	6.5	5.8	4.6	8.6	7.5	11.6	15.1	15.7	14.3	11.8	9.9	10.8
20	6.4	5.8	4.6	9.8	6.8	9.0	13.1	14.0	14.1	11.3	10.0	8.4
40	6.4	5.1	4.6	7.8	5.6	6.6	9.3	11.7	10.9	9.8	9.9	8.5
60	6.5	5.8	4.6	7.8	5.6	6.8	7.3	6.6	6.1	9.5	9.9	8.0
80	6.1	5.8	4.6	5.0	6.0	6.7	6.5	5.7	3.8	7.6	8.2	6.2
100	4.7	5.7	4.3	4.8	4.4	6.2	6.8	5.3	3.2	6.3	7.1	6.3
200	5.1	4.7	4.7	5.1	4.8	4.8	5.1	5.6	4.4	5.6	4.9	5.4
300	4.3	4.8	4.6	4.7	4.3	4.4	4.9	4.9	4.3	5.0	4.8	4.9
400	4.7	4.6	4.5	4.2	4.2	4.3	4.7	4.4	4.1	4.5	4.7	4.4
500	4.3	4.3	4.3	4.2	3.9	4.0	4.6	4.2	4.0	4.1	4.6	4.5
600	4.3	4.0	4.3	4.1	3.8	3.9	4.3	4.1	4.0	4.0	4.6	4.6
700	4.1	3.9	4.1	3.9	3.6	3.9	4.2	4.1	-	3.9	4.0	4.0
800	3.7	3.8	3.9	3.8	3.6	3.6	4.1	3.9	-	3.8	3.9	3.9
900	3.6	3.3	3.6	3.7	3.6	3.7	4.0	3.8	3.7	3.7	3.8	3.8
1000	3.5	-	3.7	3.5	3.5	3.5	3.8	3.7	-	3.7	3.6	3.8
1100	3.5	-	3.0	3.3	3.1	3.4	3.6	3.6	-	3.6	3.5	3.6
1180	3.4	-	2.9	3.6	3.4	-	3.6	-	-	3.6	3.5	3.6
Number of Data Months												
0	76	57	47	211	131	166	292	71	16	46	139	71
20	55	49	52	187	116	170	296	106	15	44	125	65
40	52	49	48	194	96	157	290	107	6	42	128	70
60	55	45	47	188	95	157	287	92	13	45	127	72
80	58	45	49	197	116	167	281	96	15	45	136	76
100	55	50	38	194	98	161	279	95	13	43	136	75
200	48	45	30	141	87	153	249	57	9	39	111	62
300	46	27	23	84	75	136	199	50	7	35	99	58

Depth (m)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
400	34	28	12	42	47	84	115	32	3	31	67	45
500	28	21	9	36	22	46	101	29	2	31	39	40
600	19	12	7	15	22	44	54	26	2	28	26	37
700	15	9	7	12	4	14	30	23	-	24	9	31
800	13	8	4	10	14	15	29	21	-	23	9	26
900	12	1	5	6	2	8	22	13	1	18	5	19
1000	12	-	7	5	7	9	10	15	-	17	4	16
1100	7	-	1	2	1	1	4	7	-	7	2	11
1180	6	-	1	5	2	-	7	-	-	4	4	5

As a companion to the above sea temperature data, Table CL-28.2, a revision of Table 5.13 of the EIS, presents monthly depth profile statistics of mean, minimum and maximum salinity for the Project Area. Sea surface salinities range from a minimum of 31.0 in July to a maximum of 34.7 in April with monthly averages that range by approximately 1, from 33.0 in July to 33.9 in February. For depths below 200 m, the variability in salinity is even less, with mean values ranging from 34.7 to 35.2 and averaging 34.8.

These temperature and salinity statistics represent the normal conditions across the Project Area. Local seawater properties will exhibit some spatial (both across the Project Area and by depth) and temporal variability. In addition, as reflected by the number of data months reported in Table 5.13, not all months or depths are well-sampled. For example, while there are 10,397 data months for depths 0 to 500 m, there are just 856 data months over the entire year for depths below 500 m.

Table CL-28.2 Monthly Salinity Profile Statistics

Depth (m)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Salinity (psu)												
0	33.9	33.7	33.9	33.6	33.7	33.3	33.0	32.6	32.5	33.6	33.5	33.7
20	33.9	33.8	33.9	33.7	33.7	33.4	33.3	33.0	33.0	33.6	33.6	33.8
40	34.0	33.9	34.0	33.8	33.9	33.7	33.7	33.5	33.7	33.8	33.7	33.9
60	34.1	34.0	34.1	33.9	34.0	33.9	33.9	33.8	34.0	34.1	33.9	34.0
80	34.2	34.0	34.2	34.1	34.1	34.0	34.1	34.0	34.2	34.3	34.1	34.2
100	34.3	34.1	34.2	34.2	34.2	34.2	34.3	34.1	34.3	34.5	34.3	34.4
200	34.7	34.6	34.6	34.6	34.6	34.6	34.7	34.6	34.8	34.8	34.7	34.7
300	34.8	34.7	34.7	34.7	34.8	34.7	34.8	34.8	34.8	34.8	34.8	34.8
400	34.8	34.7	34.7	34.8	34.8	34.8	34.8	34.8	34.9	34.8	34.8	34.8
500	34.9	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.9	34.8	34.8	34.8
600	34.8	34.9	34.8	34.8	34.9	34.8	34.9	34.9	34.9	34.9	34.8	34.8
700	34.8	34.9	34.9	34.9	34.9	34.9	34.9	34.9	-	34.9	34.8	34.8
800	34.8	34.9	34.8	34.9	34.9	34.9	34.9	34.9	-	34.9	34.9	34.8
900	34.8	34.9	34.9	34.9	35.2	34.9	34.9	34.9	34.9	34.9	34.9	34.8
1000	34.8	-	34.9	34.9	34.9	34.9	34.9	34.9	-	34.9	34.9	34.9
1100	34.9	-	34.5	34.9	34.9	34.9	34.9	34.9	-	34.9	34.9	34.9
1180	34.9	-	34.8	34.9	34.9	-	34.9	-	-	34.9	34.9	34.9
Minimum Salinity (psu)												
0	32.4	33.0	32.8	32.1	32.6	32.3	31.0	31.3	31.5	32.7	32.4	32.5
20	33.2	33.0	32.9	32.3	32.6	32.4	31.9	32.0	32.2	32.8	32.6	32.7
40	33.3	33.1	33.2	32.9	32.8	32.7	32.4	32.8	33.5	33.1	32.9	33.0
60	33.3	33.1	33.2	33.0	32.9	33.0	32.8	33.0	33.1	33.2	33.3	33.3
80	33.4	33.1	33.4	33.2	33.1	33.0	33.0	33.1	33.3	33.7	33.4	33.5
100	33.8	33.2	33.5	33.3	33.3	33.1	33.3	33.3	33.6	33.7	33.4	33.7

Depth (m)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
200	34.2	33.8	34.3	33.5	34.1	34.0	34.1	34.0	34.7	34.4	34.2	34.3
300	34.5	34.3	34.4	34.3	34.4	34.2	34.3	34.4	34.8	34.5	34.5	34.6
400	34.7	34.4	34.5	34.6	34.7	34.5	34.6	34.6	34.8	34.7	34.6	34.7
500	34.8	34.5	34.6	34.7	34.7	34.8	34.7	34.7	34.9	34.7	34.6	34.8
600	34.8	34.8	34.6	34.8	34.8	34.8	34.7	34.7	34.9	34.7	34.7	34.8
700	34.6	34.8	34.8	34.8	34.9	34.8	34.8	34.8	-	34.9	34.8	34.8
800	34.8	34.9	34.6	34.9	34.8	34.8	34.8	34.7	-	34.8	34.8	34.8
900	34.8	34.9	34.8	34.9	34.9	34.8	34.8	34.9	34.9	34.9	34.9	34.8
1000	34.8	-	34.8	34.9	34.8	34.9	34.9	34.9	-	34.7	34.8	34.8
1100	34.9	-	34.5	34.9	34.9	34.9	34.9	34.9	-	34.9	34.9	34.8
1180	34.9	-	34.8	34.9	34.9	-	34.9	-	-	34.9	34.9	34.8
Maximum Salinity (psu)												
0	34.6	34.2	34.6	34.7	34.6	34.3	34.4	34.1	33.3	34.3	34.4	34.3
20	34.6	34.5	34.7	34.7	34.8	34.4	34.5	34.2	33.8	34.3	34.4	34.3
40	34.6	34.8	34.6	34.7	34.4	34.5	34.6	34.7	34.0	34.3	34.4	34.4
60	34.6	34.8	34.6	34.7	34.6	34.6	34.7	34.7	34.3	34.8	34.5	34.4
80	34.6	34.8	34.6	34.7	34.6	34.7	34.7	34.7	34.5	34.9	34.7	34.7
100	34.6	34.8	34.7	34.8	34.7	34.7	34.8	34.8	34.5	34.8	34.9	34.8
200	35.0	34.9	34.9	34.9	34.9	34.8	35.1	35.1	34.9	34.9	35.0	34.9
300	34.9	34.9	35.0	35.0	34.9	34.9	35.1	34.9	34.9	34.9	34.9	34.9
400	35.1	34.9	34.9	35.0	34.9	34.9	35.1	34.9	34.9	34.9	34.9	34.9
500	35.1	35.0	35.0	35.0	34.9	34.9	35.1	34.9	34.9	34.9	34.9	34.9
600	34.9	35.0	35.0	34.9	34.9	34.9	35.1	34.9	34.9	34.9	34.9	34.9
700	34.9	34.9	34.9	34.9	34.9	34.9	34.9	34.9	-	34.9	34.9	34.9
800	34.9	34.9	35.0	34.9	34.9	34.9	35.0	34.9	-	34.9	34.9	34.9
900	34.9	34.9	34.9	34.9	35.6	34.9	34.9	34.9	34.9	34.9	34.9	34.9
1000	34.9	-	34.9	34.9	34.9	34.9	34.9	34.9	-	34.9	34.9	34.9
1100	34.9	-	34.5	34.9	34.9	34.9	34.9	34.9	-	34.9	34.9	34.9
1180	34.9	-	34.8	34.9	34.9	-	34.9	-	-	34.9	34.9	34.9
Data Months												
0	76	57	47	211	131	166	292	71	16	46	139	71
20	55	49	52	187	116	170	296	106	15	44	125	65
40	52	49	48	194	96	157	290	107	6	42	128	70
60	55	45	47	188	95	157	287	92	13	45	127	72
80	58	45	49	197	116	167	281	96	15	45	136	76
100	55	50	38	194	98	161	279	95	13	43	136	75
200	48	45	30	141	87	153	249	57	9	39	111	62
300	46	27	23	84	75	136	199	50	7	35	99	58
400	34	28	12	42	47	84	115	32	3	31	67	45
500	28	21	9	36	22	46	101	29	2	31	39	40
600	19	12	7	15	22	44	54	26	2	28	26	37
700	15	9	7	12	4	14	30	23	-	24	9	31
800	13	8	4	10	14	15	29	21	-	23	9	26
900	12	1	5	6	2	8	22	13	1	18	5	19
1000	12	-	7	5	7	9	10	15	-	17	4	16
1100	7	-	1	2	1	1	4	7	-	7	2	11
1180	6	-	1	5	2	-	7	-	-	4	4	5

References:

No additional references.

EIS ADDENDUM APPENDIX A

CNOOC INTERNATIONAL
FLEMISH PASS EXPLORATION DRILLING PROJECT (2018-2028)
ENVIRONMENTAL IMPACT STATEMENT

SECTION 14 ATMOSPHERIC ENVIRONMENT: ENVIRONMENTAL EFFECTS ASSESSMENT (REVISED)

(Part One Response – September 2018)

SECTION 14 ATMOSPHERIC ENVIRONMENT: ENVIRONMENTAL EFFECTS ASSESSMENT (REVISED)

The atmospheric environment includes various components of the physical environment, including air quality and greenhouse gases (GHGs) and air temperature, acoustic and light conditions. The main potential interactions between planned Project activities and the atmospheric environment relate to air emissions associated with the presence and operation of the mobile offshore drilling unit (MODU) and their associated on-board equipment, as well as vessel and aircraft traffic and other Project-related activities such as well testing and evaluation. This Section considers the potential effects of the Project on these aspects of the physical environment, including each of the sub-components referenced above.

During the technical review of the Environmental Impact Statement (EIS), it was agreed to revise the emissions from semi-submersible MODU, drill ship MODU, and supply vessels based on the maximum power ratings of the engines. Following this revised approach, the fuel consumption of these units and emissions of GHGs are updated accordingly. It was assumed that engines are operating at 100% load. The latest Global Warming Potentials (GWPs) are used for GHGs calculations. Comparing level emissions from semi-submersible MODU, and drill ship MODU, the drill ship now appears to become a "worst case" scenario for the project. So it was necessary to update this Section.

Changes to the information/data for emissions calculations:

- Semi-Submersible MODU Option (Section 14.3.3.1)
  - ✓ Maximum fuel consumption 190.78 m3/day; and
  - ✓ For NOx emission calculations – used US EPA AP-42 uncontrolled emission factor and applied 95% control for SCR.
- Drill Ship MODU Option (Section 14.3.3.2)
  - ✓ Maximum fuel consumption 237.57 m3/day; and
  - ✓ For NOx emission calculations – used US EPA AP-42 uncontrolled emission factor.
- Vessels (Section 14.3.5.1)
  - ✓ Maximum fuel consumption 78.27 m3/day; and
  - ✓ For NOx emission calculations – used US EPA AP-42 uncontrolled emission factor.
- Greenhouse Gases (Section 14.3.7)
  - ✓ GHG emissions are updated based on the revised fuel consumption for Semi-Submersible MODU, Drill Ship MODU, and Supply Vessels; and
  - ✓ GHG Emissions are updated based on the latest GWPs.

The above mentioned revisions do not affect the effects assessment presented in Section 14.3 of the report.

In addition to the importance and function of the atmospheric environment in and of itself, there are clear interactions and inter-relationships between it and other components of the natural and socioeconomic environments, including several of the other valued components (VCs) considered elsewhere in this Environmental Impact Statement (EIS). Potential effects on this VC may, for example, have potential effects on the marine biota that may come into contact with Project-related emissions, as well as for physical health and well-being of adjacent

people and communities. The atmospheric environment can therefore represent a potential pathway for Project-related environmental effects to interact with and affect other aspects of the biological and socioeconomic environments. Where applicable, the potential for Project-related atmospheric emissions to affect other environmental components has been considered as part of the environmental effects assessments for these other VCs.

Heat emissions from the MODUs and other equipment, such as those generated by engines and flaring, will be dissipated to the atmosphere without any anticipated interactions with receptors or resulting environmental effects. On-board lighting will also be required for any and all Project activities that occur at night, and must be in place and activated for safety and regulatory compliance reasons. Light emissions from the MODUs will include platform lighting, as well as those which may be associated with any flaring that is required during well testing. Light will also be generated by the supply vessels for navigation and deck lighting purposes, Flaring activity during a formation flow test will also generate light and thermal emissions. In addition, atmospheric noise will likewise be generated by the operation of the MODU and associated equipment. Heat, light and noise emissions resulting from the Project are not assessed further within the atmospheric environment VC itself. They are, however, considered as part of the effects assessments for other VCs, where they constitute environmental disturbances that may have adverse effects on the VC in question (such as for marine birds, see Chapter 9).

Section 14.1 Environmental Assessment Study Areas and Effects Assessment Criteria

This section defines the Study Areas (spatial and temporal boundaries) for the environmental effects assessment for this VC, as well as the evaluation criteria that are used to define and determine the significance of the Project's predicted environmental effects.

Section 14.1.1 Spatial Boundaries

Several spatial assessment boundaries have been defined for the environmental effects assessment, which reflect the varying ways and scales in which the Project may influence the atmospheric environment. These are defined as follows (Figure A-14.1).

Project Area: This area encompasses the overall geographic area offshore Eastern Newfoundland within which all planned Project-related exploration activities will take place. This includes ELs 1144 and 1150, within which drilling will occur, as well as a surrounding 20 km buffer area to account for any ancillary activities (such as walk away VSP surveys) that may extend outside the boundaries of the ELs themselves. While the Project Area is defined as an overall polygon that encompasses all such activities over the course of the Project, the various activities associated with the drilling of each individual well and other planned components will occupy fairly small areas within this overall area, as described in Chapter 2. The assessment also considers related supply vessel and aircraft traffic to and from this offshore Project Area.

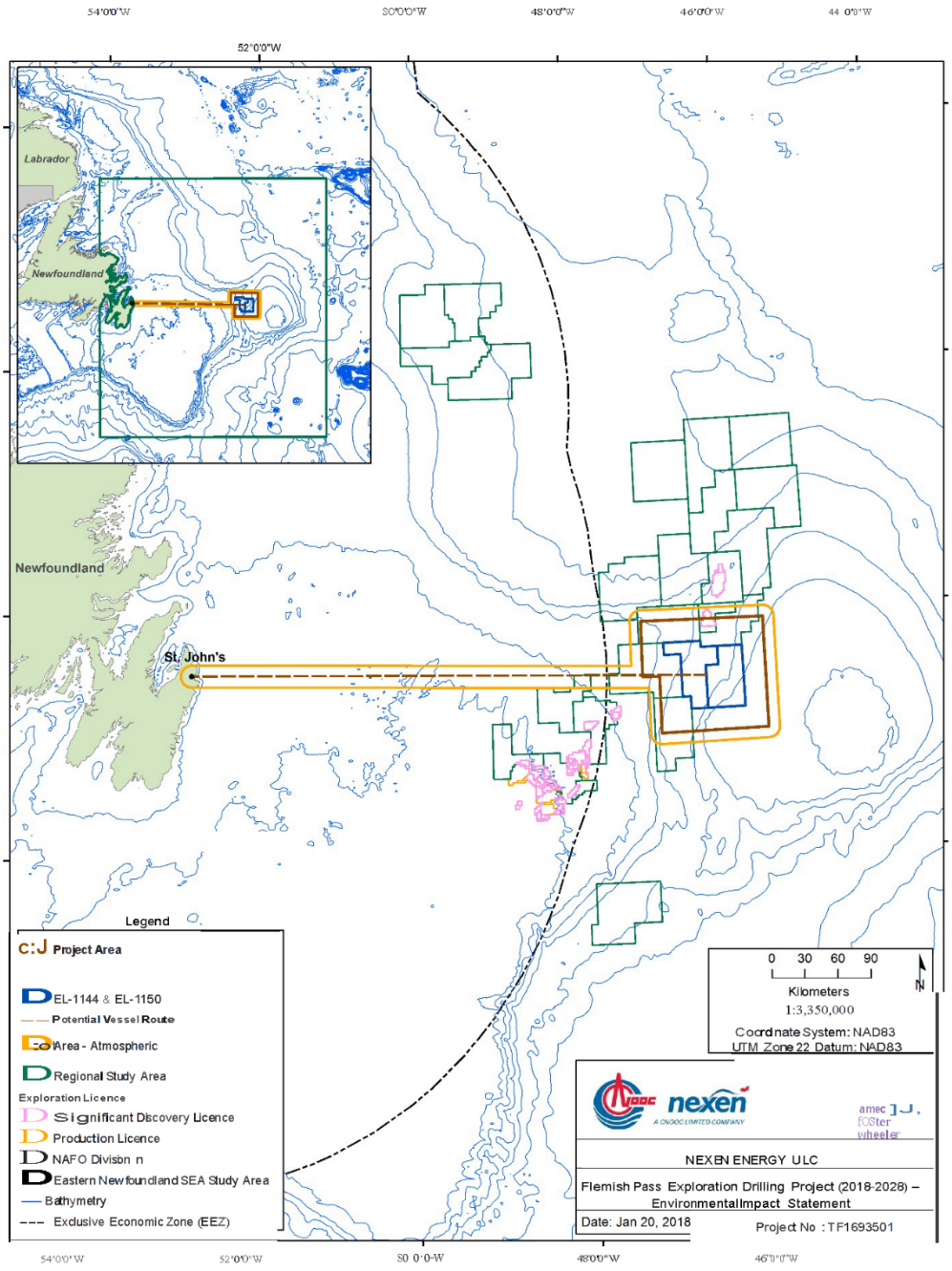


Figure A-14.1 Atmospheric Environment: Environmental Assessment Study Areas

Local Study Area (LSA): This area represents the anticipated environmental zone of influence of the Project's planned components and activities with respect to this VC. It therefore encompasses the overall geographic area over which Project-related atmospheric emissions will occur. Atmospheric emissions during planned activities will likely be detectable only within several kilometers of the source and the immediate vicinity of the associated vessel and aircraft traffic routes to the ELs. For this VC, the LSA is therefore (conservatively) defined as the offshore Project Area and the associated vessel and aircraft traffic route, and an appropriately 10 km area around these.

Regional Study Area (RSA): The overall RSA for the environmental effects assessment is as defined and illustrated earlier in Section 4.3.1 and encompasses both the LSA for this VC as defined above, as well as other projects and activities off Eastern Newfoundland whose relevant environmental effects (atmospheric emissions) may interact directly with those of this Project.

Section 14.1.2 Temporal Boundaries

The temporal boundaries for the effects assessment encompass the potential duration of Project-related activities in the Project Area (2018-2028, see Section 2.7), as well as the likely timing of any resulting environmental effects.

Section 14.1.3 Environmental Effect Significance Definitions

It is within the above described spatial and temporal boundaries that the Project's potential environmental effects on this VC and their significance are assessed and evaluated.

Where they exist, applicable environmental legislation and regulations can help set criteria and thresholds related to any atmospheric emissions from a project, and for evaluating their potential significance. Although failure to meet an applicable regulatory criterion may be an important regulatory compliance issue, it may however not have measurable or material environmental implications in the context of a specific area or environmental component or condition.

Significant environmental effects are considered to be those that could cause a change in the VC that would alter its status or integrity beyond an acceptable and sustainable level. For the purposes of this EIS, significant environmental effects on the atmospheric environment are defined as those that would cause one or more of the following:

> *Air Quality: A Project-related, detectable decrease to existing air quality conditions that results in measurable, repeated and prolonged exceedances of applicable regulatory standards and guidelines, and/or changes in ambient air quality that are predicted to result in detectable adverse effects on one or more of the other VCs considered in this EIS.*
>
> *GHG Emissions: A Project-related incremental increase in GHG emissions that results in a quantifiable increase to overall anthropogenic climate change influences at the provincial and/or national level.*

Section 14.2 Potential Environmental Changes, Effects and Associated Parameters

As described in Section 2.9.1, atmospheric emissions resulting from planned Project activities will include exhaust from the MODU(s), supply vessels and aircraft and their associated equipment (such as on-board power generators), as well as emissions from the storage and flaring of hydrocarbons associated with well testing if and as required. An estimate of the various air emissions that will be associated with the Project, by key component and activity, is provided in this chapter.

The potential environmental effects of the Project on this VC are summarized in Table A-14.1, along with the identification of key parameters through which these Project-related changes and effects may be reflected.

Table A-14.1 Potential Project-Related VC Environmental Changes and Resulting Effects: Atmospheric Environment

Potential Environmental Changes	Potential Environmental Effects	Associated Parameter(s)
• The Project has the potential to affect air quality through emissions of air pollutants associated with MODU operations, vessel and aircraft traffic, and other equipment use, as well as well testing.	*Change in Air Quality*	• Types and levels of Project-related emissions, in relation to ambient conditions and any applicable regulations and standards
• The Project will release GHGs associated with MODU operations, vessel and aircraft traffic, and other equipment use, as well as well testing.	*Change in GHG Levels*	

An overview of the potential for each of the Project's planned components and activities to result in one or more of the above noted potential environmental effects on this VC is presented in Table A-14.2.

Table A-14.2 Potential Project-VC Interactions and Associated Effects: Atmospheric Environment

Planned Project Component /Activity	Potential Environmental Effects	
	Change in Air Quality	Change in GHG Levels
Presence and Operation of MODUs (including lights, noise, air emissions, positioning / mooring, on-site vessels, seabed investigation)	●	●
Drilling and Associated Marine Discharges (including fluids and cuttings)		
Vertical Seismic Profiling	●	●

Table A-14.3 Potential Environmental Effects by Project Activity

Planned Project Component /Activity	Potential Environmental Effects	
	Change in Air Quality	Change in GHG Levels
Well Evaluation and Testing	●	●
Well Abandonment or Suspension	●	●
Supply and Servicing	●	●

Section 14.3 Environmental Effects Assessment and Mitigation

The potential effects of the Project's planned components and activities on the atmospheric environment are assessed and evaluated in the following subsections.

Section 14.3.1 Approach and Methods

As noted above, atmospheric emissions will occur throughout the course of planned Project activities, the primary sources of which will be the engines of the MODU and the associated supply vessels and aircraft. Depending on the type of formation flow test carried out, atmospheric emissions could also result if flaring is undertaken, and for the purposes of this EIS it is assumed that flaring would be required.

Calculated estimates of atmospheric emissions from planned Project activities are provided in the following subsections, with the analysis focusing on those activities that are most relevant to potential emissions to the atmospheric environment, namely:

- Presence and Operation of MODU(s);
- Well Evaluation and Testing; and
- Supply and Servicing.

Anticipated emissions from these sources include products of fuel combustion, mainly criteria air contaminants (particulate matter, carbon monoxide [CO], sulphur oxides [SO_x], nitrogen oxides [NO_x]) and GHGs. Three classes of particulates were considered: total particulate matter (TPM), fine particulate matter less than 10 microns (PM_{10}) and fine particulate matter less than 2.5 microns ($PM_{2.5}$). Other emissions from fuel combustion may include trace metals and volatile organic compounds (VOCs); however, these are expected to be minor and have not been quantified.

Section 14.3.2 Summary of Key Mitigation

Mitigation measures that will be implemented to help avoid or reduce potential environmental effects on the atmospheric environment include:

- The frequency of vessel and aircraft traffic transits associated with the Project will be minimized to the extent possible.
- Flaring will be kept to the minimum amount necessary to characterize the hydrocarbon accumulation and as necessary for the safety of the operation. High efficiency burners will be used when flaring is required.
- Engines will be operated and maintained according to manufacturer's recommendations.
- Emission sources will comply with applicable limits set out in *Canada's Vessel Pollution and Dangerous Chemicals Regulations*.
- Sulphur content in diesel fuel used for the Project will meet current regulatory requirements (as per Regulation SOR/2002-254).

Section 14.3.3 Presence and Operation of MODU(s)

As described in Section 2.5, the Project may involve the drilling of up to 10 wells over its planned temporal duration. Specific wellsite locations and well designs will be selected and defined as Project planning activities move forward. Wells may be drilled using either a harsh environment semi-submersible and/or a drill ship MODU, which will be provided and operated by a third party drilling contractor.

Section 14.3.3.1 Semi-Submersible MODU Option

As the particular MODU(s) to be used for the Project have not yet been selected the analysis included in this section is based on the consideration of a representative, or "proxy" MODU. The West Aquarius, operated by Seadrill (see Figure 2.3, Section 2.5.1 in the EIS), has been selected as a proxy semi-submersible MODU due to its previous experience operating in this region and in similar environmental conditions as those found in the Project Area. (Specifications available at *http://www.seadrill.com/~/media/Files/S/Seadrill/our-fleet/technical-sheet/west-aquarius-spec-7-17-15.pdf)*.

The West Aquarius is powered by eight diesel-fueled Wartsila engines, each having a power output rating of 6,312 horsepower (hp). The following conservative operating conditions and assumptions were used to calculate the potential "worst case" atmospheric emissions from the semi-submersible MODU:

- Wartsila engines have the lowest fuel consumption over a wide operating range;
- Engines are equipped with SCR system to reduce NO_x emissions;
- All engines are running simultaneously, at full capacity, for 24 hours per day;
- The maximum daily fuel consumption is 190 m^3/day (167 MT/day);
- Sulphur content in diesel fuel used in the engines will meet current regulatory requirements; and
- The amount and duration of drilling is based on two wells at 160 days each (including a well test) and eight wells at 75 days each, totally 920 drilling days for the Project overall.

The emissions estimates for the MODU presented in Table A-14.4 were calculated using factors from the United States Environmental Protection Agency (US EPA) "AP-42 Compilation of Air Emission Factors" for large stationary diesel engines (US EPA 1996) and the above listed assumptions.

Table A-14.4 Estimated Emissions from Semi-submersible MODU Operations

Group	Compound	Emission Factor*		Emission Rate		
				Hourly (kg/hr)	Daily (active day) (t/day)	Project (Total t)
Criteria Air Contaminants	NO_x	3.20E+00	lb/MMBtu	299.16	7.18	6605.46
	CO	8.50E-01	lb/MMBtu	1589.29	38.14	35091.50
	SO_2	1.01E-01	lb/MMBtu	188.84	4.53	4169.70
	TPM	1.00E-01	lb/MMBtu	186.98	4.49	4128.41
	PM_{10}	8.22E-02	lb/MMBtu	153.71	3.69	3393.95
	$PM_{2.5}$	7.98E-02	lb/MMBtu	149.15	3.58	3293.25

*US EPA AP-42, Section 3.4 "Large Stationary Diesel and All Stationary Dual-fuel Engines", Table 3.4-1
Used for Diesel fuel: 1 gallon = 137,000 BTU
NOx - used 95% control for SCR

Section 14.3.3.2 Drill Ship MODU Option

As mentioned above, a drill ship could be used for some or all of the wells drilled as part of this Project. As noted, the particular MODU to be used for the Project has not yet been selected, the analysis included in this chapter is based on the consideration of a representative or "proxy" MODU. Again, given their previous experience operating in this region and/or in similar environmental conditions as those found in the Project Area, the Stena Carron (specifications available at: *http://www.stena- drilling.com/fleet-availability/stena-carron)* or Stena IceMax (specifications available at: *http://www.stena-drilling.com/fleet-availability/stena-icemax)* were used as proxy drill ship MODUs for the purposes of this analysis.

The main power engines for these ships are as follows:

- *Stena Carron*: 6 x Wartsila 16V32 x 7.45 MW; and
- *Stena IceMAX*: 6 x Wartsila 16V32C x 7.68 MW.

The following conservative operating conditions and assumptions were used to calculate "worst case" atmospheric emissions from this representative drill ship MODU:

- All engines are running simultaneously, at full capacity, for 24 hours per day;
- The maximum daily fuel consumption is 238 m^3/day (208 MT/day) (based on Stena IceMAX engines outputs);
- Sulphur content in diesel fuel used in the engines will meet current regulatory requirements; and
- The amount and duration of drilling is based on two wells at 160 days each (including a well test) and eight wells at 75 days each, totally 920 drilling days for the Project overall.

The emissions estimates presented in Table A-14.5 were calculated (based on Stena IceMAX engines outputs) using factors from the US EPA "AP-42 Compilation of Air Emission Factors" for large stationary diesel engines (US EPA 1996) and considering the above listed assumptions.

Table A-14.5 Estimated Emissions from Drill Ship MODU Operations

Group	Compound	Emission Factor		Emission Rate		
				Hourly (kg/hr)	Daily (active day) (t/day)	Project (Total t)
Criteria Air Contaminants	NO_x	3.20E+00	lb/MMBtu	7450.38	178.81	164504.42
	CO	8.50E-01	lb/MMBtu	1979.01	47.50	43696.49
	SO_2	1.01E-01	lb/MMBtu	235.15	5.64	5192.17
	TPM	1.00E-01	lb/MMBtu	232.82	5.59	5140.76
	PM_{10}	8.22E-02	lb/MMBtu	191.40	4.59	4226.19
	$PM_{2.5}$	7.98E-02	lb/MMBtu	185.73	4.46	4100.81

As illustrated in the tables above, when compared to the estimated semi-submersible MODU emissions, there are higher emission rates estimated for all criteria air compounds when the drill ship MODU option is considered. GHGs emissions are therefore also expected to be higher from the drill ship MODU than from the semi-submersible MODU. Based on the above revised calculations and comparison, the drill ship MODU was selected as the "worst case" emissions scenario to be carried forward for further assessment.

Section 14.3.4 Well Evaluation and Testing

If there is an indication of significant hydrocarbons found during an exploration drilling program, a well flow test may be conducted to sample and identify formation fluids (which may contain hydrocarbons and/or water) and to measure produced flow rates. During such testing, produced fluid is flowed back to the MODU, where hydrocarbons are separated from any produced water and samples are collected and analyzed. Produced hydrocarbons and some produced water are flared using high-efficiency burners supplied by a third party company.

The following operating conditions and assumptions were used to calculate emissions from any such well testing that may be carried out as part of this Project:

- For the purposes of these calculations, two wells are tested and each test is expected to last up to two days (total number of well testing days therefore equals four);
- An estimated 10,000 Mcf (10,000,000 cubic feet) of gas and 36,000 barrels of oil are flared per tested well; and
- High efficiency burners were not used in the emission calculations.

The emissions estimates presented in Table A-14.6 were calculated using factors from the US EPA "AP- 42 Compilation of Air Emission Factors" for natural gas combustion (Section 1.4) and fuel oil combustion (Section 1.3) and considering the various operating conditions and assumptions referenced above. These numbers provide the most conservative estimate based on regular type burners. The mitigation measure to use the high efficiency burners is a standard approach to guarantee that the Project emissions are projected to be less than conservatively estimated in the EIS.

Table A-14.6 Estimated Emissions from Well Testing

Group	Compound	Emission Factor		Emission Rate		
		Gas* lb/10^6scf	Oil** lb/1000gal	Hourly (kg/hr)	Daily (active day) (t/day)	Project (Total t)
Criteria Air Contaminants	NO_x	100	55	796.01	19.10	76.42
	CO	84	5	79.45	1.91	7.63
	SO_2	0.6	157.00	2,245.31	53.89	215.55
	TPM	1.9	12.41	177.66	4.26	17.05
	PM_{10}	1.9	12.41	177.66	4.26	17.05
	$PM_{2.5}$	1.9	12.41	177.66	4.26	17.05
*US EPA AP-42, Section 1.4 "Natural Gas Combustion". **US EPA AP-42, Section 1.3 "Fuel Oil Combustion".						

Section 14.3.5 Supply and Servicing

The offshore exploration program will involve vessel and aircraft use, including supply traffic to, from, and within the Project Area.

Section 14.3.5.1 Vessels

During active drilling operations it is expected that three offshore supply vessels will support the MODU. One vessel will provide dedicated standby support in close proximity to the MODU (included and considered in the preceding sections under MODU operation), while two additional offshore supply vessels will perform materials and personnel transfer operations between the MODU and a not yet identified shorebase in Eastern Newfoundland. For each well (active MODU) these materials and personnel transfer operations are expected to result in up to three return trips per week throughout the duration of a drilling operation.

These supply and service vessels will be provided and operated by a third party contractor. As the particular vessels to be used for the Project have not yet been selected, the analysis included in this chapter is again based on the consideration of a "proxy" vessel. The Avalon Sea, operated by Secunda (see Figure 2.3, Section 2.5.1), has been selected as a proxy supply vessel for the purposes of these emissions calculations, due to its previous experience operating in this region and in similar environmental conditions as those found in the Project Area (Specifications available at: *http://www.secunda.ca/vessel-avalon.php)*.

The Avalon Sea is powered by four diesel fueled engines, each having a power output rating of 2,880 kilowatts (kW). The vessel is also equipped with an auxiliary and emergency generator with power output ratings of 700 kW and 200 kW, respectively. The following conservative operating conditions and assumptions were used to calculate worst case air emissions from the supply vessels:

- All engines are running simultaneously and at full capacity (three supply vessels in operation at the same time);
- The travel distance for the supply vessel used for the assessment is 527 km each way;
- The average travelling speed is 24 kilometres per hour (km/hr), which is the maximum speed for this vessel, and thus conservative regarding fuel consumption);
- The amount and duration of use is based on two wells at 160 days each (including a well test);
- and eight wells at 75 days each (total 920 days);
- Estimated three 48 hours/each round trips per week during the days when an active MODU is at a wellsite location, which corresponds to 144 hours per week, or 18,925 hours total for the duration of the project;
- The maximum daily fuel consumption is 78 m^3/day (68MT/day); and
- Sulphur content in diesel fuel used in the engines will meet current regulatory requirements.

The estimated emissions presented in Table A-14.7 were calculated using factors from the US EPA "AP-42 Compilation of Air Emission Factors" for large stationary diesel engines (US EPA 1996) and considering the various operating conditions and assumptions referenced above. The total number of operating days for supply vessels (based on the number of trips and the average speed) is 789 days.

Table A-14.7 Estimated Emissions from Supply Vessels

Group	Compound	Emission Factor		Emission Rate		
				Hourly (kg/hr)	Daily (active day) (t/day)	Project (Total t)
Criteria Air Contaminants	NOx	3.20E+00	lb/MMBtu	2,454.60	58.91	46421.49
	CO	8.50E-01	lb/MMBtu	652.00	15.65	12330.71
	SO_2	1.01E-01	lb/MMBtu	77.47	1.86	1465.18
	TPM	1.00E-01	lb/MMBtu	76.71	1.84	1450.67
	PM_{10}	8.22E-02	lb/MMBtu	63.06	1.51	1192.59
	$PM_{2.5}$	7.98E-02	lb/MMBtu	61.19	1.47	1157.21
*US EPA AP-42, Section 3.4 "Large Stationary Diesel and All Stationary Dual-fuel Engines", table 3.4-1 Used for Diesel fuel: 1 gallon = 137000 BTU						

Section 14.3.5.2 Aircraft

Helicopters will also be used for the transportation of personnel and key materials to and from the MODU(s) as required throughout the course of the Project. Aircraft support will be supplied by a third party licensed operator under contract to CNOOC Petroleum North America ULC (CNOOC) and is expected to be based at an existing facility at St. John's International Airport. Based on current practice in the Newfoundland and Labrador offshore oil industry, it is assumed that the Sikorsky S-92 helicopter will be used (Specifications available at: http://www.cougar.ca/Fleet/sikorsky-s92.asp). It is estimated that there would be up to three helicopter transits per day to an active MODU. The following conservative operating conditions and assumptions were used to calculate worst case emissions from the helicopters:

- The travel distance for the supply vessel used for the assessment is 527 km each way;
- The average travelling speed is 252 km/hr;
- Fuel consumption rate for the Sikorsky helicopter is 735 kilograms per hour;
- Estimated three round trips per day during the days for which there is an active MODU at a wellsite location;
- The amount and duration of use is based on two wells at 160 days each (including a well test) and eight wells at 75 days each (total 920 days); and
- Sulphur content in fuel used in the engines will meet current regulatory requirements.

The emissions calculations presented in Table A-14.8 were estimated using data from "Guidance on the Determination of Helicopter Emissions" (Rindlisbacher and Chabby 2015) for all compounds except SO_2. The data from Rindlisbacher and Chabby (2015) are direct measurements based on source testing and specific to the make and model of the helicopter. Since data for SO_2 were unavailable from Rindlisbacher and Chabby (2015), emissions were calculated using the methodology in the article "Quantifying Atmospheric Emissions in Oil Gas Industry" (Thapa 2016) which is based on fuel consumption and sulphur content.

Based on above information (distance, number of trips, and speed) the operating hours for the helicopter are calculated to be 12.5 hours per day which corresponds to 8,214 hours of helicopter usage over the duration of the Project, based on 5 days per week of helicopter operation. It is recognized that the particular hours of operations per day might change due to daylight constraints and other considerations. It is expected that during drilling operations there would be a maximum of 10 flights per week for personnel transfers with flying occurring on five days per week, so the assumptions used for emission calculations are considered conservative.

Table A-14.8 Estimated Emissions from Helicopter Operations

Group	Compound	Emission Factor	Emission Rate		
			Hourly* (kg/hr)	Daily (active day) (t/day)	Project (Total t)
Criteria Air Contaminants	NO_x	Note 1	10.59	0.13	45.65
	CO	Note 1	1.10	0.01	4.74
	SO_2	1.20E-01 t/t	0.87	297.97	417.16
	TPM	Note 1	0.27	0.003	1.17
	PM_{10}	Note 2	0.27	0.003	1.17
	$PM_{2.5}$	Note 2	0.27	0.003	1.17

* Guidance on the Determination of Helicopter Emissions" (Rindlisbacher & Chabby 2015).

Notes:

1. Hourly emission rates were taken from a helicopter emissions study by Rindlisbacher & Chabby (2015) that measured a shortlist of compounds from various engine models.
2. Particulate sizes were below $PM_{2.5}$ in the helicopter emissions guidance document (Rindlisbacher & Chabby 2015), therefore, the total particulate emission rate was applied to PM_{10} and $PM_{2.5}$.
3. The SO_x emission factor was taken from a publication "Quantifying Atmospheric Emissions in Oil Gas Industry" (Thapa 2016), that calculates the SO_x emission factor (t emissions/t fuel) from air transport using the formula 2 x S where S is the sulphur content in fuel.

Section 14.3.6 Summary

The revised overall worst case atmospheric emissions resulting from the Project were conservatively estimated as described above and are presented in Table A-14.9.

Table A-14.9 Worst Case Project Emissions of Criteria Air Contaminants

Activity	Project Emission Rate (t/project)			
	NO_x	**CO**	**SO_2**	**TPM**
Drill Ship MODU	164,504.42	43,696.49	5,192.17	5,140.76
Well Testing	46,421.95	12,330.83	1,465.19	1,450.69
Supply Vessels	46,421.49	12,330.71	1,465.18	1,450.67
Helicopters	76.42	7.63	215.55	17.05
Project Total	**211,047.98**	**56,039.57**	**7,170.87**	**6,609.66**

Section 14.3.7 Greenhouse Gases

For the analysis of GHGs, the following definitions have been used in this assessment:

- *Carbon dioxide equivalent (CO_{2e})*: A unit of measure used to allow the addition of, or the comparison between, gases that have different global warming potentials (GWPs). Since many GHGs exist and their GWPs vary, the emissions are added in a common unit, CO_2e. To express GHG emissions in units of CO_{2e}, the quantity of a given GHG (expressed in units of mass) is multiplied by its global warming potential.
- *Global warming potential (GWP)*: Calculated as the ratio of the time-integrated radiative forcing (i.e., the amount of heat-trapping potential, measured in units of power per unit of area, e.g. watts per square meter) that would result from the emission of 1 kilogram (kg) of a given GHG to that from the emission of 1 kg of CO2. GWPs were taken from the Intergovernmental Panel on Climate Change's Fourth Assessment Report "Climate Change 2013: Synthesis Report" (IPCC2013) as shown in Table A-14.10.

Table A-14.10 Global Warming Potentials

Greenhouse Gas	Formula	100 year GWP
Carbon dioxide	CO_2	1
Methane	CH_4	28
Nitrous Oxide	N_2O	265

Emissions are calculated as the sum total mass of each of the gases or gas species multiplied by their respective GWP.

The emission factors from the *Guidance Document for Reporting Greenhouse Gas Emissions for Large Industry in Newfoundland and Labrador* (Government of Newfoundland and Labrador Office of Climate Change 2017) used to calculate the GHG emissions for the MODU, supply vessel and helicopter are presented in Table A-14.11 and the calculated emissions, by individual GHG, for all Project activities are presented in Table A-14.12.

This guidance document provides guidance similar to some Canadian provinces (Ontario, British Columbia and Quebec), and some US states which are members of the Western Climate Initiative Inc. (WCI). It is also similar to the guidance provided by Environment and Climate Change Canada. The WCI provides technical services to support the implementation of US state and Canadian provincial GHG emissions trading programs, including a GHG reporting protocol.

Table A-14.11 GHG Emission Factors

GHG	Project Activity				
	Semi-Submersible MODU/Drill Ship MODU (g/L)	Supply Vessels (g/L)	Helicopters (g/L)	Well Testing	
				Gas (g/m^3)	Oil (g/L)
CO_2	2663	2663	2534	2482	2663
CH_4	0.13	0.13	0.08	6.5	0.13
N_2O	0.4	0.4	0.23	0.06	0.4

Table A-14.12 Project total GHG Emissions by Activity

Activity	Emission Rate (t/project) for the Project			
	CO_2	CH_4	N_2O	CO_2e
Drill Ship MODU	582,032	29	87	606,014
Well Testing	35,405	6	5.1	37,076
Supply Vessels	164,244	8	25	171,011
Helicopters	8,727	0.28	0.79	8,970
Project Total	790,224	43	118	822,711

The overall GHG emissions over the period 2018 to 2028 of the project are conservatively estimated to be 823 kilotonnes (kt) CO_2e (average 75 kt CO_2e annually). These GHG predictions are informational and provided to place the Project in an industry, provincial and regional context. The current Federal guidance document (FTPTCCCEA 2003) states that "…unlike most project-related environmental effects, the contribution of an individual project to climate change cannot be measured." To provide context for the relative magnitude of Project GHG emissions, the total annual GHG emissions for 2015 for the Province of Newfoundland and Labrador was 10.3 Mt CO_2e and the total Canadian GHG inventory was 722 Mt CO_2e that same year (ECCC 2017); the Project represents approximately 0.72 percent of the provincial inventory and 0.01 percent of the national 2015 inventory. In 2015, 189 Mt CO_2e was attributed to the oil and gas sector; the Project represents approximately 0.04 percent of the oil and gas sector GHG emissions in 2015.

The aggregate GHG emissions from the Project are compared with provincial and federal targets for 2020 and 2030 as shown in Table A-14.13.

Table A-14.13 GHG Emissions Comparison to Provincial, Federal and Global Targets

	Provincial		Federal	
	2020	2050	2020	2030
	8.6 Mt	7.5 Mt	622 Mt	524 Mt
Project	0.87%	1.00%	0.012%	0.014%

Section 14.4 Environmental Effects Evaluation

This section summarizes the residual effects of the Project on the atmospheric environment and presents a determination of significance for the environmental effects assessment for this VC.

Section 14.4.1 Regulatory and Policy Contexts

The Project will operate in accordance with the *Canadian Environmental Protection Act*. ECCC sets health-based air quality objectives for pollutant concentrations in ambient air for fine particulate matter ($PM_{2.5}$), sulphur dioxide (SO_2) and ozone with work underway to develop standards for nitrogen dioxide. These Canadian Ambient Air Quality Standards (CAAQS) are concentration based values driving the improvement of air quality across the country. In addition, Project-related emissions will be in compliance with the IMO relevant regulations and emission limits under MARPOL.

The *Greenhouse Gas Pollution Pricing Act*, assented on June 21, 2018, to mitigate climate change through the pan-Canadian application of pricing mechanisms to a broad set of greenhouse gas emission sources. At the federal level, GHG emission reduction targets have also been set and include the following (ECCC 2016):

- *Canada:* 17 percent reduction below the 2005 level by 2020 at the 15th Conference of the Parties, sessions conducted as part of the United Nations Framework Convention on Climate Change, an international treaty established in 1992 to address climate change (ECCC 2017);
- *Canada:* 30 percent reduction below the 2005 level by 2030 at 21st Conference of the Parties (ECCC 2017); and
- N*ewfoundland and Labrador:* 10 percent reduction below the 1990 level by 2020 and a 75- 85 percent reduction below the 2001 level by 2050 as set out in "Charting Our Course: Climate Change Action Plan 2011" (CCEEET 2011).

The federal regulation SOR/2002-254 set limits for sulphur content in diesel fuel for use on-road, off- road, in rail (locomotive), marine vessels, and stationary engines in order to decrease SO_2 emissions. As per the regulation, the marine vessels have to use fuel with sulphur content no more than 1,000 ppm (phased in May 31, 2014).

In Newfoundland and Labrador, air quality is regulated by the *Air Pollution Control Regulations* which were established in 2004. GHGs are regulated by the *Management of Greenhouse Gas Act*. However, given the offshore location of the Project it is not likely that these provincial regulations will apply to it.

Section 14.4.2 Residual Environmental Effects Summary

Atmospheric emissions from planned Project activities will produce a localized, transient effect on air quality. Due to the distance from shore, air quality effects on onshore areas and receptors are very unlikely. Since the predicted GHG emissions from the Project are low and insignificant in comparison to broader GHG targets, the Project will have virtually no effect on current estimates of future global climate change.

Section 14.4.3 Determination of Significance

As described above and summarized in Table A-14.13 below, the Project is not likely to result in significant adverse environmental effects on this VC. This conclusion has been determined with a high level of certainty based on the nature and scope of the Project, knowledge about the existing environment within the LSA and RSA, and current understanding of the effects of similar projects on the VC.

Section 14.5 Environmental Monitoring and Follow-up

No specific environmental monitoring or follow-up related to this VC is considered necessary in relation to the Project.

Table A-14.14 Environmental Effects Assessment Summary: Atmospheric Environment

ENVIRONMENTAL EFFECTS ASSESSMENT SUMMARY *	
Summary of Existing Conditions and Environmental Context • The existing ambient air quality within the Project Area can be generally categorized as good, and is likely occasionally and locally influenced by exhaust emissions from marine vessel and aircraft traffic and from the operations of the existing oil production platforms and other sources.	**Key Mitigation Measures (see Section 14.3.2)** • The frequency of vessel and aircraft traffic transits associated with the Project will be minimized to the extent possible. • Flaring will be kept to the minimum amount necessary to characterize the hydrocarbon accumulatin and as necessary for the safety of the operation. High efficiency burners will be used when flaring is required. • Engines will be operated and maintained according to manufacturer's recommendations. • Emission sources will comply with applicable limits set out in Canada's *Vessel Pollution and Dangerous Chemicals Regulations*. • Sulphur content in diesel fuel used for the Project will meet current regulatory requirements (as per Regulation SOR/2002-254).

Project Component or Activity	**Potential Environmental Effects**	**Residual Environmental Effects Summary Descriptors**						
		Nature	**Magnitude**	**Geographic Extent**	**Duration**	**Frequency**	**Reversibility**	**Certainty**
Presence and Operation of MODUs (including lights, noise, air emissions, positioning /mooring, on-site vessels, seabed investigation)	• Change in air quality • Change in GHG levels	A	L	L-LSA	S	C	R	H
Drilling and Associated Marine Discharges (including fluids and cuttings)	• None expected	N	-	-	-	-	-	H
Vertical Seismic Profiling	• Change in air quality • Change in GHG levels	A	L	L-LSA	S	S	R	H
Well Evaluation and Testing	• Change in air quality • Change in GHG levels	A	L	L-LSA	S	S	R	H

ENVIRONMENTAL EFFECTS ASSESSMENT SUMMARY *								
Well Abandonment or Suspension	• Change in air quality • Change in GHG levels	A	L	L-LSA	S	S	R	H
Supply and Servicing	• Change in air quality • Change in GHG levels	A	L	L-LSA	S	R	R	H

Evaluation of Significance

Not Significant

- Atmospheric emission from planned Project activities will produce a localized, transient effect on air quality. Due to the distance from shore, air quality effects on onshore areas and receptors are very unlikely.
- Since the predicted GHG emission from the Project are low and insignificant in comparison to GHG targets, the Project will have virtually no effect on current estimates of future global climate change.
- The Project is not likely to result in significant adverse environmental effects on this VC.

*****The results of the environmental effects assessment summarized above apply to Project activities related to both EL 1144 and EL 1150, unless otherwise indicated.

Key

Nature / Direction:		Frequency:		Certainty in Predictions:	
P	Positive	N	Not likely to occur	L	Low level of confidence
A	Adverse	O	Occurs once	M	Moderate level of confidence
N	Neutral (or No Effect)	S	Occurs sporadically	H	High level of confidence
		R	Occurs on a regular basis	N/A	Not Applicable
		C	Occurs continuously		

Magnitude:		Duration:	
N	Negligible	S	Short-term (for duration of the activity / disturbance)
L	Low	M	Medium-term (Beyond duration of the activity / disturbance – weeks/months)
M	Medium	L	Long-term (Beyond duration of the activity / disturbance – years)
H	High	P	Permanent (Recovery unlikely)

Geographic Extent:		Reversibility:	
L	Localized, in Immediate Vicinity of Activity	R	Reversible (Will recover to baseline)
PA	Within Project Area	I	Irreversible (Permanent)
LSA	Within LSA		
RSA	Within RSA or Beyond		

Section 14.6 References

CCEEET (Office of Climate Change, Energy Efficient and Emissions Trading) (2011). Charting Our Course: Climate Change Action Plan 2011 The Office of Climate Change, Energy Efficiency and Emissions Trading.

ECCC (Environment and Climate Change Canada) (2016). Technical Guidance on Reporting Greenhouse Gas Emissions.

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FTPTCCCEA (The Federal-Provincial-Territorial Committee on Climate Change and Environmental Assessment) (2003). Incorporating Climate Change Considerations in Environmental Assessment: General Guidance for Practitioners. November 2003.

Government of Newfoundland and Labrador Office of Climate Change (2017). A Guidance Document for Reporting Greenhouse Gas Emissions for Large Industry in Newfoundland and Labrador, March 2017.

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Rindlisbacher, T. and L. Chabby (2015). Guidance on the Determination of Helicopter Emissions. Edition 2, December 2015. Report prepared for the Swiss Confederation.

Thapa, P. (2016). Quantifying Atmospheric Emissions in the Oil Gas Industry, Memorial University of Newfoundland, September 2016.

US EPA (United States Environmental Protection Agency) (1996). AP 42, Chapter 3: Stationary Internal Combustion Sources, Section 3.4 Large Stationary Diesel and All Stationary Dual-fuel Engines, Fifth Edition, Volume I, October 1996.

EIS ADDENDUM APPENDIX B

CNOOC INTERNATIONAL
FLEMISH PASS EXPLORATION DRILLING PROJECT (2018-2028)
ENVIRONMENTAL IMPACT STATEMENT

TRAJECTORY MODELLING: RELIEF WELL MODELLING SCENARIO

(February 2019)

NOTE: Due to its size, this additional oil spill modelling report has been kept as a separate electronic file.

EIS ADDENDUM APPENDIX C

CNOOC INTERNATIONAL
FLEMISH PASS EXPLORATION DRILLING PROJECT (2018-2028)
ENVIRONMENTAL IMPACT STATEMENT

SECTION 16 ACCIDENTAL EVENTS:
ENVIRONMENTAL EFFECTS ASSESSMENT (REVISED)

(February 2019)

NOTE: Due to its size, this revised section has been kept as a separate electronic file.