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8.0 ASSESSMENT OF POTENTIAL EFFECTS ON MARINE FISH AND FISH HABITAT

Marine fish and fish habitat was selected as a VC in consideration of the ecological value provided to marine ecosystems, the socio-economic importance of fisheries resources (i.e., target fish species), the potential for interactions with Project activities and components, and requirements in the EIS Guidelines. The Project Area, Local Assessment Area (LAA), and Regional Assessment Area (RAA) are known to be used by many fish and invertebrate species, including those fishery species of commercial, recreational, and Aboriginal (CRA) importance or species that support them.

The *Fisheries Act* and its associated regulations provide protection to CRA fisheries by managing fish resources and the habitats that support them. Under the *Fisheries Act*, "fish" includes all life stages of fish, shellfish, crustaceans, and marine animals, while "habitat" includes the abiotic and biotic quality and areas that fish directly or indirectly use to live, including nursery, rearing, spawning, migration, and foraging areas. The potential effects of the Project on marine fish and fish habitat are relevant to the provisions of the *Fisheries Act* and are considered in this Chapter. Some species and their habitats may also have legislative protection under the *Species at Risk Act* (SARA) or the Newfoundland and Labrador *Endangered Species Act* (NL ESA).

The existing environment for marine fish and fish habitat is presented in Section 6.1, which provides an overview of species that occur within the Project Area, LAA, and RAA, including species of CRA importance, Species at Risk (SAR) and Species of Conservation Concern (SOCC).

The presence and abundance of marine fish species and associated abiotic and biotic habitat characteristics vary considerably across the eastern Newfoundland offshore area, which transitions from relatively shallow shelf areas to the continental slope and deeper waters. This VC considers relevant fish species (including SAR and SOCC), plankton, algae, benthos, and relative components of their habitat, such as water and sediment quality. Marine plants are not present in the Project Area given the water depths in the Orphan Basin, and routine Project activities are not expected to interact with marine plants in nearshore environments.

Although the effects assessment in this section considers the potential environmental effects on fisheries resources, the potential environmental effects on Indigenous and commercial fisheries are assessed separately in Chapters 12 and 13, respectively. Potential effects on special areas that include protection of fish and fish habitat as part of their conservation objectives are assessed in Chapter 11.

8.1 Scope of Assessment

8.1.1 Regulatory and Policy Setting

There are two regulatory regimes with authority over marine fish and fish habitat within the Project Area, LAA, and RAA. The Government of Canada manages fish stocks within the Exclusive Economic Zone (EEZ). Within these areas, the Canadian federal *Fisheries Act* provides protection to CRA fisheries by

managing the fish resources and habitats that support these activities. Outside Canada's EEZ, groundfish, pelagic fish, and benthic invertebrates are managed by the Northwest Atlantic Fisheries Organization (NAFO).

Section 35 of the *Fisheries Act* focuses on protecting the productivity of CRA fisheries, including a prohibition against causing serious harm to fish, the death of fish, or any permanent alteration to or destruction of fish habitat that are part of or support a CRA fishery. As noted in Section 1.5.3 of this EIS, the federal government recently announced proposed changes to the *Fisheries Act* which include returning to comprehensive protection against harming all fish and fish habitat. Projects that cause serious harm to fish are required to offset that harm to maintain and enhance the productivity of the fishery (DFO 2013). The *Fisheries Act* (section 36[3]) also prohibits the deposition of a deleterious substance in waters frequented by fish.

Marine fish SAR are protected under SARA. SARA focuses on the protection of species and associated habitat whose populations are not secure. Sections 32, 33, and 58 of SARA contain provisions to protect species listed on Schedule 1 of SARA and their critical habitat. As discussed in Section 6.1, on July 11, 2018 proposed critical habitat was identified for the northern wolffish and the spotted wolffish. If a Project is likely to affect a listed species or its designated critical habitat, ministerial notification is required under section 79 of SARA. In this case, the adverse effects of the Project on the listed species and its designated critical habitat must be identified, and if the Project is to be carried out, must take measures to avoid, reduce, and monitor these effects.

Marine fish SAR may also be formally protected under the NL ESA. A list of all marine fish SAR that may occur in the Orphan Basin is provided in Section 8.3.4.

8.1.2 Influence of Consultation and Engagement on the Assessment

Questions and comments related to marine fish and fish habitat were noted during BP's Project-related engagement with government departments and agencies, stakeholder organizations, and Indigenous groups (see Chapter 3 for further details). These primarily include concerns regarding the potential effects of the Project on migratory fish species, particularly in the unlikely event of an accidental spill (Chapter 15), and the inclusion of traditional knowledge in impact assessments. Indigenous groups, in particular, raised concerns around potential effects on migratory species, such as Atlantic salmon and American eel, that are important subsistence and commercial species. Concern was noted about effects of the Project on water quality, fish and fish habitat, and marine plants. Additional details on questions and concerns raised during engagement can be found in Chapter 3.

8.1.3 Potential Effects, Pathways and Measurable Parameters

Potential interactions between planned offshore oil and gas activities and pathways of potential effects on marine fish and fish habitat include (adapted from Amec 2014):

- destruction, contamination, or alteration of marine habitats and benthic organisms due to discharge and deposition of drill cuttings and/or fluids as well as the deployment and use of other Project equipment

- contamination of fish / invertebrates and their habitats due to other discharges in the environment during planned oil and gas exploration drilling and other associated survey and support activities
- the attraction of marine fish to MODUs and vessels, with increased potential for injury, mortality, contamination, and other interactions
- temporary avoidance of areas by marine fish due to underwater sound or other disturbances, which may alter their presence and abundance as well as disturbing movements / migrations, feeding, or other activities
- changes in the availability, distribution, or quality of food sources and/or habitats for fish and invertebrates as a result of planned activities and their associated environmental emissions.
- injury, mortality, or other disturbances to marine fish as a result of exposure to sound within the water column during VSP (vertical seismic profiling) survey activity

As a result of these considerations, the assessment of Project-related effects on marine fish and fish habitat is focused on the following potential effects:

- change in risk of mortality or physical injury
- change in habitat quality and use

These effects reflect *Fisheries Act* prohibitions against causing serious harm to fish or any permanent alteration to, or destruction of fish habitat that are part of or support a CRA fishery and allow for consideration of effects on fish SAR. The measurable parameters used for the assessment of the environmental effects presented above, and the rationale for their selection, are provided in Table 8.1. Effects of accidental events are assessed separately in Section 15.5.1.

Table 8.1 Potential Effects, Effects Pathways and Measurable Parameters for Marine Fish and Fish Habitat

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Risk of Mortality or Physical Injury	• Direct Project effects on fish mortality, injury, or health due to interaction with individuals (e.g., smothering from deposition of cuttings / drill muds; VSP sound exposure [with impact relative to distance to VSP sound source and exposure period]) or indirectly through a change in habitat quality (e.g., degradation of habitat quality affecting fish health)	• Mortality (may be either direct measurement or qualitative assessment) focused on population level changes

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Habitat Quality and Use	• Change in fish habitat due to physical disturbance, destruction of benthic habitats or deposition of cuttings / drill muds • Change in fish habitat quality due a change in the chemical composition of water and sediment • Increased risk of exposure to underwater sound at levels capable of causing sensory disturbance	• Areal extent (ha) of alteration or destruction of fish habitat • Areal extent (ha) of fish habitat affected by changes in water quality and/or sediment quality • Area of habitat affected by underwater sound emissions at sound exposure levels which could result in potential behavioural effects on fish

8.1.4 Boundaries

Spatial and temporal boundaries for the assessment of marine fish and fish habitat are discussed in the following sections.

8.1.4.1 Spatial Boundaries

Project Area: The Project Area (Figure 8.1) encompasses the immediate area in which Project activities may occur. Well locations have not been identified but will occur within the ELs in the Project Area. The Project Area includes ELs 1145, 1146, 1148, and 1149. The Project Area has been delineated to provide a 20 km buffer around each EL.

Local Assessment Area (LAA): The LAA (Figure 8.1) is the maximum area within which environmental effects from routine Project activities and components can be predicted or measured within a reasonable degree of accuracy and confidence. It consists of the Project Area and adjacent areas where Project-related environmental effects are reasonably expected to occur based on available information, including effects thresholds, predictive modelling, and professional judgement. The LAA also includes transit routes to and from the Project Area.

Regional Assessment Area (RAA): The RAA (Figure 8.1) is the area within which residual environmental effects from operational activities and accidental events may interact with marine fish and fish habitat that are outside of the Project Area. The RAA also accounts for residual environmental effects related to routine activities that could interact cumulatively with the residual environmental effects of other past, present, and future (certain or reasonably foreseeable) physical activities.

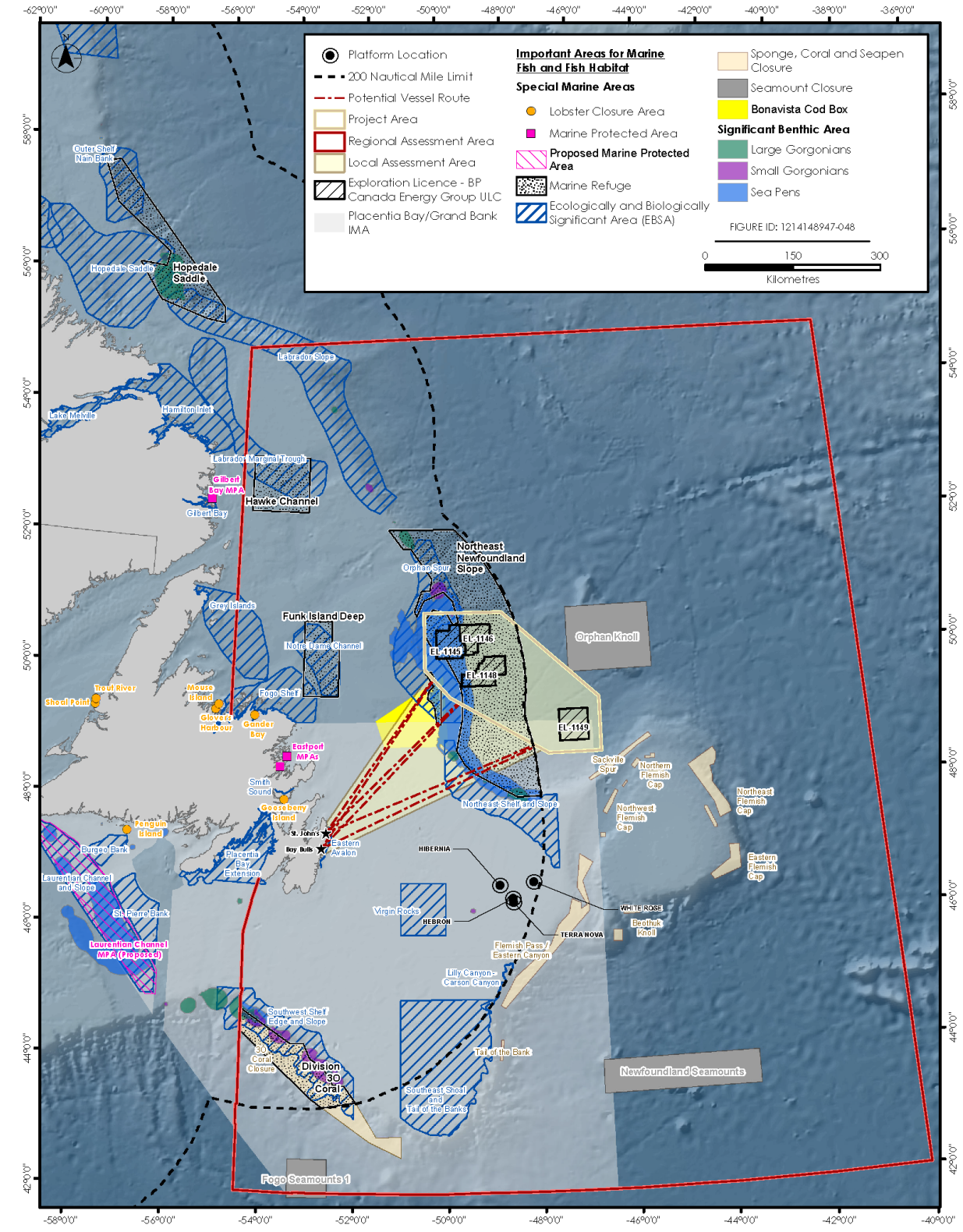

Figure 8.1 Marine Fish and Fish Habitat Spatial Boundaries

8.1.4.2 Temporal Boundaries

The temporal boundaries for the assessment of potential Project-related environmental effects on marine fish and fish habitat encompass all Project phases, including well drilling, testing, and abandonment. BP is currently planning a one-well program with an initial well proposed for 2020 but could potentially drill up to 20 wells between 2020 and 2026. Well testing (if required, dependent upon drilling results) could also occur at any time during the temporal scope of this EIS. Wells may be decommissioned and abandoned at any time within the temporal boundaries. Each well is anticipated to take approximately 60 days to drill and VSP surveys typically take approximately one day per well. Drilling operations will not be continuous throughout the entire seven-year scope of the Project and will depend partially on rig availability and results from previous wells. While drilling activities have the potential to be conducted at any time of the year, BP's preference is to conduct drilling between May and October.

Marine fish are found in and around the Project Area year-round carrying out various stages of their life histories. Details on the life histories of select marine fish species present in the Project Area and RAA, including their sensitive life stages and their relation to the Project Area, are provided in Section 6.1.

8.1.5 Residual Effects Characterization

The definitions used to characterize environmental effects as part of this effects assessment for marine fish and fish habitat are provided in Table 8.2. These characterizations will be used throughout the chapter when describing potential residual environmental effects on marine fish and fish habitat from routine Project activities. These characterizations are also applicable for accidental events, as discussed in Section 15.5.1.

Table 8.2 Characterization of Residual Effects on Marine Fish and Fish Habitat

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual environmental effect relative to baseline	**Positive** – a residual environmental effect that moves measurable parameters in a direction beneficial to marine fish and fish habitat relative to baseline **Adverse** – a residual environmental effect that moves measurable parameters in a direction detrimental to marine fish and fish habitat relative to baseline
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions	**Negligible** – no measurable change **Low** – a detectable change but within the range of natural variability **Moderate** – a detectable change beyond the range of natural variability, but with no associated adverse effect on the viability of the affected population **High** – A detectable change that is beyond the range of natural variability, with an adverse effect on the viability of the affected population
Geographic Extent	The geographic area in which a residual environmental effect occurs	**PA –** residual environmental effects are restricted to the Project Area **LAA –** residual environmental effects extend into the LAA **RAA –** residual environmental effects extend into the RAA

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Frequency	Identifies how often the residual effect occurs and how often during the Project	**Unlikely event** – effect is unlikely to occur **Single event** – effect occurs once **Multiple irregular event** – effect occurs at no set schedule **Multiple regular event** – effect occurs at regular intervals **Continuous** – effect occurs continuously
Duration	The period required until the measurable parameter or the VC returns to its existing condition, or the residual effect can no longer be measured or otherwise perceived	**Short term** - for duration of the activity, or for duration of accidental event **Medium term** - beyond duration of activity up to end of Project, or for duration of threshold exceedance of accidental event – weeks or months **Long term** - beyond Project duration of activity, or beyond the duration of threshold exceedance for accidental events - years **Permanent** - recovery to baseline conditions unlikely
Reversibility	Pertains to whether a measurable parameter or the VC can return to its existing condition after the project activity ceases	**Reversible –** will recover to baseline conditions before or after Project completion **Irreversible –** permanent
Ecological and Socio-economic Context	Existing condition and trends in the area where residual effects occur	**Undisturbed** – The VC is relatively undisturbed in the RAA, not adversely affected by human activity, or is likely able to assimilate the additional change **Disturbed** – The VC has been previously disturbed by human development or human development is still present in the RAA, or the VC is likely not able to assimilate the additional change

In consideration of the descriptors listed above, as well as requirements under SARA and associated regulation and recovery, the following criteria have been established to define a significant adverse residual environmental effect on marine fish and fish habitat.

For the purpose of this effects assessment, a significant adverse residual effect on marine fish and fish habitat is defined as a Project-related environmental effect that:

- causes a significant decline in abundance or change in distribution of fish populations within the RAA, such that a natural recruitment may not re-establish the population(s) to its original level within one generation
- jeopardizes the achievement of self-sustaining population objectives or recovery goals for SAR
- results in permanent and irreversible loss of critical habitat as defined in a recovery plan or an action strategy
- results in serious harm to fish or fish habitat as defined by the *Fisheries Act* that is unauthorized, unmitigated, or not compensated through offsetting measures in accordance with Fisheries and Oceans Canada's (DFO) Fisheries Protection Policy Statement (DFO 2013)

8.2 Project Interactions with Marine Fish and Fish Habitat

Table 8.3 identifies, for each potential effect, the physical activities that may interact with marine fish and fish habitat and could result in the identified environmental effects. These interactions are indicated by a checkmark and are discussed in detail in Section 8.3, in the context of effects pathways, standard and project-specific mitigation / enhancement, and residual effects. A justification for no effect is provided following Table 8.3.

Table 8.3 Project-Environment Interactions with Marine Fish and Fish Habitat

Physical Activities (refer to Section 4.1.1 for the Scope of the Project)	Potential Environmental Effects	
	Change in Risk of Mortality or Physical Injury	Change in Habitat Quality and Use
Presence and operation of a MODU (including drilling, associated safety zone, and MODU lighting)	✓	✓
Vertical Seismic Profiling (VSP) operations	✓	✓
Discharges (e.g., drill muds / cuttings, liquid discharges)	✓	✓
Well evaluation and testing (including flaring)	-	-
Well abandonment and decommissioning	-	✓
Supply and servicing operations (including helicopter transportation and PSV operations)	-	✓
Notes: ✓ = Potential interaction – = No interaction		

If during an exploration program there is sufficient indication of hydrocarbon presence, formation flow testing will be undertaken to sample and identify formation fluids (which may contain hydrocarbons and/or water) and to measure flow rates. Formation flow testing may or may not include flaring; if flaring is required, produced hydrocarbons will be separated from produced water on the MODU. Compared to production drilling operations, the amount of produced water generated during exploration drilling is typically very small (Statoil Canada Ltd. 2017). Any produced water generated will be sent to the MODU's flare, treated for disposal in accordance with the *Offshore Waste Treatment Guidelines* (OWTG), or shipped to shore.

Well evaluation and testing is not predicted to interact with marine fish and fish habitat in a way that could cause a change in risk of mortality or physical injury or a change in habitat quality and use. During well evaluation and testing activities, the atmospheric and light emissions from these activities will occur above the water and will not interact with marine fish or their habitat. The potential effects of lights from vessels are addressed under the potential environmental effects from the presence and operation of a MODU.

The abandonment program has not yet been defined for the Project. BP's wellhead removal strategy for wellheads considers water depth and the likelihood of potential interactions with fishing activities. Given the

water depths in the Project Area, BP may seek approval from the C-NLOPB to leave the wellhead in place in water depths greater than 900 m. If approved, the only infrastructure that will be left on the seafloor will be a wellhead approximately 1.5 to 3.7 m in height and will take up a permanent footprint of less than 1 m². All other subsea infrastructure will be removed; the blowout preventer (BOP) will only be removed once the cement plugs are in place.

If wellheads are to be removed, a mechanical casing / wellhead cutting device from the MODU will be used. The seafloor will then be inspected by a remotely operated vehicle (ROV) or other equipment to verify that no obstructions or equipment remain in place. As Project planning continues, final details about the well abandonment program will be confirmed with the C-NLOPB. Well decommissioning will be carried out as per BP's internal procedures and with the *Newfoundland Offshore Petroleum Drilling and Production Regulations*.

Well abandonment is not predicted to interact with marine fish and fish habitat in a way that could cause a change in risk of mortality or physical injury. Well abandonment activities are not anticipated to produce underwater sound or discharges that would pose a risk of physical injury or mortality to marine fish. Although the well abandonment program has not yet been defined (refer to Section 2.4.4), well abandonment is anticipated to have minimal interaction with habitat quality and use for marine fish. The potential effects of well abandonment activities on habitat quality and use are discussed in Section 8.3.3.

Supply and servicing operations are not predicted to interact with marine fish and fish habitat in a way that could cause a change in risk of mortality or physical injury. The transmission of sound produced by helicopters into the marine environment is related primarily to the aircraft altitude and sea surface conditions (Richardson et al. 1995). Underwater sound levels from helicopters are generally higher just below the water surface and directly beneath the aircraft (Richardson et al. 1995). It has been found that single or occasional overhead flights would cause no more than a brief behavioural response in marine mammals (Richardson et al. 1995), and it can be inferred that there would be less of an effect on marine fish, in general, though pelagic species that may occur near the surface (i.e., sharks and tunas) may elicit a similar, brief behavioural response. Helicopter operations will have very limited interaction with the marine environment and associated marine fish species. The underwater sound levels associated with PSV traffic is not expected to be at levels that would cause injury or mortality to marine fish species. Fish are expected to temporarily avoid the immediate areas subject to PSV traffic, thereby reducing the risk of fish mortality due to vessel strikes or contact with propeller blades. Supply and servicing operations could result in a change in habitat quality and use, which is discussed in Section 8.3.3.

8.3 Assessment of Residual Environmental Effects on Marine Fish and Fish Habitat

The following section assesses the environmental effects on marine fish and fish habitat identified as arising from potential interactions in Table 8.32. Given the similarities in Project description, proximity of activities on Orphan Basin and Flemish Pass, and currency of data, the EIS incorporates learnings from previous EA documents for similar exploration drilling projects in Atlantic Canada, including comments received during Indigenous and stakeholder review processes, with updates incorporated as applicable due to Project and geographic differences, scientific updates, and refined EA methods.

8.3.1 Project Pathways

8.3.1.1 Change in Risk of Mortality or Physical Injury

A change in risk of mortality of physical injury for individual marine fish may result from the presence and operation of a MODU, VSP surveys, and Project-related discharges. The presence and operation of a MODU will generate underwater sound that may affect the quality of the underwater acoustic environment for fish species, and VSP operations will also temporarily generate increased sound levels. If fish in close proximity to the VSP array do not move away from the sound source before being exposed to high sound levels, these sound levels may result in mortality or physical injury from acute changes in pressure. Lighting associated with the presence and operation of a MODU also has potential to attract prey of predatory fish species and which could increase predation. Benthic species (e.g., fish, shellfish, sponges, and corals) may also experience mortality or physical injury from crushing or smothering from waste management activities, particularly the discharge of drill cuttings and muds. Other routine liquid discharges, such as cooling and ballast water, will be managed in accordance with the OWTG, Transport Canada's *Ballast Water Control Management Regulations* and/or the *International Convention for the Prevention of Pollution from Ships* (MARPOL), and are not expected to cause mortality or physical injury to marine fish.

8.3.1.2 Change in Habitat Quality and Use

A change in habitat quality and use for marine fish may result from the operation and presence of the MODU, VSP surveys, Project-related discharges, well abandonment, and supply and servicing operations. The operation of the MODU will result in light and sound emissions into the water column. Project-related discharges will include waste management and the deposition of drill cuttings and muds. VSP surveys will temporarily generate high levels of underwater sound. Depending on the well abandonment program, which has yet to be defined (refer to Section 2.4.4), potential removal of the wellhead structure(s) could generate underwater sound and potential abandonment of the wellhead(s) in place could cause a change in benthic habitat. During supply and servicing operations, underwater sound associated with vessel movement will be generated.

Cold-water corals and deep-sea sponges also provide habitat for other species, so any Project-related effects on corals or sponges could result in a change in habitat quality and use, in addition to the change in risk of mortality or physical injury assessed above. Different species of cold-water corals provide habitats of varying physical size and life spans (Roberts et al. 2009); as a result, the fauna associated with some corals is more diverse than others (De Clippele et al. 2015). For example, De Clippele et al. (2015) recorded video at 18 locations on the Norwegian continental margin and found that the fauna associated with gorgonians was more diverse than that associated with sea pens. The fauna associated with sea pens consisted mainly of shrimps and ophiuroids, for which sea pens provide shelter and a feeding platform (De Clippele et al. 2015). Despite these differences, De Clippele et al. (2015) argue that both sea pens and larger structure-forming corals (i.e., gorgonians) play an important role as habitat.

Within the Project Area there is overlap with a Significant Benthic Area for sea pens in EL 1145 and small portions of ELs 1146 and EL 1148 (Figure 8.1). Baillon et al. (2012) found direct evidence that some commercially-harvested fish species were using sea pens and sea pen meadows (aggregations of sea pens) as nursery grounds. Forty-three percent of fish harvesters interviewed in Colpron (2016) reported

areas containing sea pens to be good fishing grounds for a variety of commercially-harvested species (i.e., Atlantic cod, Atlantic halibut, and Northern shrimp) in the Northern Gulf of St. Lawrence.

8.3.2 Mitigation

In consideration of the environmental effects pathways outlined above, the following mitigation measures and standard practices will be employed to reduce the potential environmental effects of the Project on marine fish and fish habitat.

Presence and Operation of a MODU

- BP will conduct an imagery-based seabed survey at the proposed wellsite(s) to confirm the absence of shipwrecks, debris on the seafloor, unexploded ordnance, and sensitive environmental features, such as habitat-forming corals or species at risk. The survey will be carried out prior to drilling and will encompass an area within a 500-m radius from the wellsite. If any environmental or anthropogenic sensitivities are identified during the survey, BP will notify the C-NLOPB immediately to discuss an appropriate course of action. This may involve further investigation and/or moving the wellsite if it is feasible to do so. This survey will also provide baseline data for coral and sensitive benthic habitat that may be present and be used to inform discussions on potential follow-up and monitoring with respect to drill waste discharges.
- Lighting will be reduced to the extent that worker safety and safe operations are not compromised. Reduction of light may include avoiding use of unnecessary lighting, shading, and directing lights towards the deck.

Vertical Seismic Profiling Operations

- VSP activities will be planned and conducted in consideration of the Statement of Canadian Practice with Respect to the Mitigation of Seismic Sound in the Marine Environment (SOCP; DFO 2007; refer to Section 10.3.2). A ramp-up procedure (i.e., gradually increasing seismic source elements over a period of approximately 30 minutes until the operating level is achieved) will be implemented before any VSP activity begins. This measure is aimed at reducing the potential for auditory impairment to marine animals (including fish) in close proximity to the source at the onset of activity. It is based on the assumption that the gradual increase in emitted sound levels will provide an opportunity for marine animals to move away from the sound source before potentially injurious sound levels are achieved close to the source.

Discharges

- Selection and screening of chemicals to be discharged, including drill fluids, will be in accordance with the *Offshore Chemical Selection Guidelines* (NEB et al. 2009). Where feasible, lower toxicity drilling muds and biodegradable and environmentally friendly properties within muds and cements will be used. The chemical components of drilling fluids, where feasible, will be those that have been rated as being least hazardous under the Offshore Chemical Notification Scheme (OCNS) and Pose Little or No Risk to the Environment by the Convention for the Protection of the Marine Environment of the North-East Atlantic (refer to Section 2.9 for more information on chemical selection).
- Operational discharges will be treated prior to release in accordance with the OWTG and other applicable regulations and standards such as MARPOL, of which Canada has incorporated provisions under the *Canada Shipping Act*. Waste discharges that do not meet regulatory requirements will not be discharged and will be brought back to shore for disposal. The development and implementation of a Project-specific environmental protection plan (EPP) and waste management plan (WMP) will be designed to prevent unauthorized waste discharges (refer to Section 2.8 for details on waste discharges and management).
- SBM drill cuttings will be returned to the MODU and treated in accordance with the OWTG before being discharged into the marine environment. The concentration of SBM on cuttings will be monitored onboard the MODU, and in accordance with OWTG, no excess or spent SBM will be discharged, and any of this excess or spent SBM that cannot be reused will be brought back to shore for disposal. WBM drill cuttings will be discharged without treatment.
- Putrescible solid waste, specifically food waste generated offshore on the MODU and PSVs, will be disposed according to OWTG and MARPOL requirements. In particular, maceration of kitchen waste will be conducted in accordance with MARPOL and OWTG. There will be no discharge of macerated food waste within 3 nm from land.
- The transfer of hazardous wastes will be conducted in accordance with the *Transportation of Dangerous Goods Act*, and any applicable approvals for the transportation, handling, and temporary storage of hazardous waste will be obtained, as required.

8.3.3 Characterization of Residual Project-related Environmental Effects

8.3.3.1 Change in Risk of Mortality or Physical Injury

Presence and Operation of a MODU

Underwater sound from the presence and operation of a MODU may be generated from equipment operations, dynamic positioning systems, and drilling operations. The sound associated with drilling operations, vessel operation, and other equipment used during exploration drilling activities can be transported through the water column and could result in disturbance to marine fish near the MODU.

Sound source parameters representative of the Project were compared to the parameters of two studies with similar sound source and environmental parameters: the Scotian Basin Exploration Drilling Project (Zykov 2016) and the Nexen Energy ULC Flemish Pass Exploration Drilling Project (Matthews et al. 2017) (refer to Appendix C). Due to differences in water depth, the sound environment in the West Orphan Basin (ELs 1145, 1146, and 1148) is most similar to that of the Flemish Pass, while that of the East Orphan Basin

(EL 1149) is most similar to the Scotian Basin (Matthews et al. 2018). Modelled results from these studies provide a preliminary assessment of sound propagation features in the West and East Orphan Basins for the Project.

It is generally recognized that the establishment of a single-sound exposure criterion for marine fish to predict physical or behavioural changes is impossible given the variation of sound characteristics from different types of sound sources and interspecific differences in how sound affects fish (Popper et al. 2014). As there is no direct evidence of mortality or potential mortal injury to fish due to exposure to sound from vessels, Popper et al. (2014) propose qualitative guidelines based on distance from the sound source to describe the relative risk to marine fish of potentially experiencing mortality, impairment, and behavioural effects from exposure to continuous sources of underwater sound.

The operation of the MODU will include continuous sound generated by dynamic positioning (DP) and drilling activities. Considering the qualitative guidelines recommended by Popper et al. (2014) and the acoustic modelling conducted for similar exploration drilling projects in the eastern Newfoundland offshore area, potential physical injury effects on fish associated with MODU operations would likely be very localized. Exposure to sound at such levels would be transient, as it is expected that mobile fish would respond behaviourally at lower thresholds and move away before injury could occur. There has been no direct evidence of fish mortality as a result of exposure to continuous underwater sound (Popper and Hastings 2009; Popper et al. 2014). However, available data reviewed by Popper et al. (2014) provide evidence of continuous underwater sound causing temporary thresholds shifts (TTS) and auditory tissue effects in goldfish (*Carassius auratus*) and/or catfish (*Pimelodus pictus*). One study observed a maximum TTS of approximately 16 dB in combination with recoverable loss of sensory hair cells in the ear of goldfish after 48 hours of exposure to continuous underwater sound with an SPL of 170 dB re 1 µPa rms (Smith et al. 2006, in Popper et al. 2014). Another study observed a 26 dB TTS in goldfish and a 32 dB TTS in catfish following 12 hours of exposure to continuous underwater sound at 158 dB re 1 µPa rms SPL (Amoser and Ladich 2003, in Popper et al. 2014). The source SPL associated with the operation of a MODU is estimated to be 196.7 dB re 1 µPa @ 1 m rms (Matthews et al. 2018).

Although physical effects on small fish may occur if they remain in the immediate vicinity of the MODU during vessel movement and DP, mobile fish are generally expected to respond to sounds from the activation of thrusters by moving away from the area immediately around the thrusters before injury can occur. The turbulence generated by the thrusters make it unlikely that there will be aggregations of fish surrounding the thrusters.

The responses of marine fish species to underwater sound vary by species, life stage, intensity of sound, and distance from the source; however, in general, most mobile fish species are generally expected to avoid underwater sound at levels lower that those at which injury or mortality may occur (BP 2016). Therefore, physical harm associated with peak SPLs is unlikely to occur, and any potential impact on fish populations is highly unlikely.

Residual effects associated with the presence and operation of a MODU on a change in risk of mortality and physical injury to marine fish and fish habitat is predicted to be adverse, low in magnitude, restricted to the Project Area, medium-term in duration, occur more than once at irregular intervals, and reversible.

Vertical Seismic Profiling Operations

VSP is expected to generate the highest levels of underwater sound associated with the Project. While intense, the VSP sound source will be activated intermittently, with survey operations occurring over a relatively short period of time, approximately one day required for each well. VSP surveys will be conducted as required throughout the life of the Project. Sound source parameters representative of the Project were compared to the parameters of two studies with similar sound source and environmental parameters: the Scotian Basin Exploration Drilling Project (Zykov 2016) and the Nexen Energy ULC Flemish Pass Exploration Drilling Project (Matthews et al. 2017). Although Popper et al. (2014) propose threshold values in terms of both SPL and SEL for received sound from air gun source arrays used during seismic surveys, it is important to note that these guidelines are derived from data from several sources, the primary ones being studies involving pile driving (Halvorsen et al. 2011, 2012a, 2012b, in Popper et al. 2014). The source SPL associated with VSP operations is estimated to be 247.8 dB re 1 µPa peak @ 1 m (broadside) (Matthews et al. 2018). Popper et al. (2014) propose a 207 dB re 1 µPa peak SPL threshold for recoverable injury of fish species most sensitive to sound (i.e., those with a swim bladder involved in hearing) that are exposed to impulsive underwater sound from seismic air gun sources. The received SPL to which fish are exposed due to an operational VSP with a source SPL of 247.8 dB re 1 µPa peak @ 1 m will depend on various factors, including the distance between the source and receiver.

Received sound levels are unlikely to result in physical effects to the majority of mobile fish species due to the expectation that they would avoid underwater sound at lower levels than those at which injury or mortality may occur. Prior to the survey and as mitigation, a ramp-up period for the VSP source will be initiated to deter mobile fish from the area, reducing the risk of individuals being exposed to harmful levels of sound above threshold levels associated with potential injury effects.

Marine plankton, including ichthyoplankton, could also be affected by sound during VSP activities, as research has indicated that exposure to underwater sound associated with seismic air gun source arrays may result in a change in risk of mortality for marine plankton in the immediate vicinity of the seismic activity. Sound exposure guidelines for eggs and larvae determined by Popper et al. (2014) suggest that potential mortality or physical injury to eggs and larvae from seismic sources may result from a cumulative SEL greater than 210 dB re 1 µPa²s or peak SPLs greater than 207 dB re 1 µPa. Underwater sound generated by the seismic source arrays used in VSP may cause mortality of fish eggs, larvae, or fry in very close proximity (<5 m) to the sound source (Kostyuchenko 1973; Booman et al. 1996). Zooplankton and ichthyoplankton can be killed within a distance of less than two metres from the source and incur sub-lethal injuries within five metres of the sound source (Østby et al. 2003 cited in Boertmann and Mosbech 2011). There is also evidence that sound exposure during larval development could increase mortality risk by producing body malformation in marine invertebrates (de Soto et al. 2013). Scallop larvae that were exposed to playbacks of seismic pulses showed developmental delays and 46% showed body abnormalities (de Soto et al. 2013). The potential mortality associated with the VSP sound source is not considered to have an effect on recruitment in marine fish populations (Dalen et al. 1996).

Residual environmental effects associated with VSP activity on a change in risk of mortality or physical injury to marine fish and fish habitat is predicted to be adverse, low in magnitude, occur within the Project Area, occur more than once at irregular intervals, be short-term in duration, and reversible.

Discharges

Potential adverse environmental effects on the marine environment from exploration drilling are primarily related to the effects of physical disturbance of the water column and benthic environment from discharge of drill cuttings and muds. Other potential liquid discharges from offshore vessels and equipment relate to the possible release of oily water and other substances through produced water (if applicable), deck drainage, bilge water, ballast water and liquid wastes. These discharges will be managed in accordance with the OWTG. Waste that cannot be discharged overboard will be stored and transported to shore for disposal in an approved facility (Section 2.9). If a biocide is used to treat seawater used for cooling purposes on the MODU, chemical selection will be in accordance with the *Offshore Chemical Selection Guidelines*.

Although produced water typically accounts for the largest volume of waste from offshore oil and gas production operations (Neff 2002), this issue is far less of a concern for exploration drilling, where produced water may only be found during a formation flow test and volumes are small (Morandin and O'Hara 2016). Small amounts of produced water may be flared if BP conducts a formation flow test. If volumes of produced water are large, some produced water may be treated on the MODU so it can be discharged at sea in accordance with the OWTG or shipped to shore for appropriate disposal. Produced water is therefore not expected to be an issue for this exploration program.

Marine water column organisms (e.g., phytoplankton, zooplankton, ichthyoplankton, pelagic invertebrates and fish) are generally at low risk of harm from drill cuttings due to rapid dilution and dispersal of drill cuttings; mobile water column organisms usually avoid or move away from plumes of suspended drill cuttings, thereby also reducing risk of harm (IOGP 2016). However, zooplankton, larvae and pelagic invertebrates unable to avoid exposure can experience temporary physical effects (interference with respiration and feeding) associated with elevated concentrations of total suspended solids and an associated increase in turbidity in the water column. The decreased light penetration caused by the turbidity of the cuttings plume may temporarily decrease primary production of phytoplankton and clog the gills or digestive tract of zooplankton (IOGP 2016).

Metals, including barium, and organic ingredients of drilling fluids and cuttings, other than PAHs, are not usually bioaccumulated from drill cuttings on the seafloor (IOGP 2016). Modern WBM and SBM have a low toxicity to the water column and benthic marine organisms (IOGP 2016). The lack of bioaccumulation and low toxicity of cuttings substances indicates that direct toxicity of WBM or SBM to benthic fauna is unlikely (IOGP 2016). However, it is difficult to distinguish between cuttings toxicity and the indirect effects on benthic communities caused by sediment alteration and organic enrichment (IOGP 2016).

Of particular interest is the accumulation of drill solids on the seafloor which can cause stress and disturbance to benthic fauna through direct toxicity from drilling muds and cuttings, burial (smothering), changes due to sediment grain size, nutrient enrichment, and oxygen depletion (Neff et al. 2004; Neff 2010; Smit et al. 2008). The effects of smothering can include mortality, reduced growth rates, reduced larval settlement, and a change in fauna composition (Neff et al. 2004). It is possible that some species may die from the mass of the discharges crushing them, while others may die because they cannot penetrate through the deposited layer that is burying them.

It has been found during production drilling that WBM cuttings may seriously affect biomarkers in filter feeding bivalves and cause elevated sediment oxygen consumption and mortality in benthic fauna; effects levels occur within 0.5-1 km of the discharge point (Bakke et al. 2013). Modern WBM and SBM are prepared with high quality barite with much lower trace metal content than historical sources, with most metals of concern being at concentrations similar to those of fine-grained marine sediments (IOGP 2016). The trace metals in the barite are in the form of insoluble sulfides and hydroxides, which renders the metals largely unavailable to exposed marine organisms (IOGP 2016). When considering the bioaccumulation of chemicals from drill cuttings in marine organisms, several bioaccumulation bioassays using WBM cuttings found that metal concentration in the tissues of exposed animals were very similar to those in the tissues of unexposed animals (IOGP 2016).

In the eastern Newfoundland offshore, the results of Environmental Effects Monitoring (EEM) at three producing oilfields (Hibernia, Terra Nova, White Rose) have shown that sediments have been mostly non-toxic to Microtox, laboratory amphipods, and juvenile polychaetes (Suncor Energy 2011; HMDC 2012; Husky Energy 2013). EEM results at the Hibernia and Terra Nova oilfields have shown no clear association between Microtox toxicity and indices of oil and gas activities, and evidence suggests that any observed Microtox responses were related to natural factors (Suncor Energy 2011; HMDC 2012).

Ellis et al. (2012) reviewed the results of sediment sampling from 72 production and exploration drilling platforms to assess the zone of influence of sediment contamination and biological effects on benthic communities. The zone of influence for WBM was determined to be 2-20 km from point of discharge, while zone of influence was smaller for SBM at 200-2000 m (Ellis et al. 2012). The zone of biological effects on benthic community diversity and abundance ranged from 100-1000 m for both WBM and SBM; these effects included changes in benthic species diversity, abundance, and alterations to community structure (Ellis et al. 2012). Functional changes to benthic community structure included a loss of suspension-feeding species and increases in deposit feeders and polychaetes (Ellis et al. 2012).

The environmental changes associated with the discharge of drill muds and cuttings are detectable during the earlier phases of drilling within a localized area (e.g., within a 500-m radius), but these effects subside with time, generally one to four years (Bakke et al. 1986; Hurley and Ellis 2004; Renaud et al. 2008; Bakke et al. 2011; Bakke et al. 2013).

It has been calculated that an average burial depth of 9.6 mm or less is unlikely to cause net adverse effects to benthic organisms attributable to sedimentation (Neff et al. 2004). This is an average value and some species may experience adverse effects at shallower depths (e.g., Smit et al. 2006 references a threshold of 6.5 mm). Drill waste dispersion modelling conducted for the Project considered the extent of various thicknesses of the deposition of drill cuttings on the seafloor in a radius from the discharge site (Appendix B). The locations of representative drill sites in the West and East Orphan Basins used for modelling are shown in Table 2.7 in Section 2.8.2.

It is predicted that sediment thicknesses greater than 6.5 mm could extend up to 128 m from the discharge point or cover an area of approximately 0.69 ha in the West Orphan Basin, and 55 m from the discharge point or approximately 0.64 ha per well in the East Orphan Basin under low ambient surface current conditions. Sediment thicknesses of 100 mm or greater are confined to a maximum distance of 32 m from the discharge point or cover an area of approximately 0.07 ha in the West Orphan Basin. For the East

Orphan Basin, sediment thicknesses of 100 mm or greater were confined to a maximum distance of 14 m from the discharge point or cover an area of approximately 0.07 ha. Differences in modelling results between the West and East Orphan Basin sites are due to differences in water depth between the West Orphan Basin representative site (1,360 m) and the East Orphan Basin representative site (2,785 m) (cutting particles released at the surface in deeper water are distributed over a wider area), and current regime (a higher current regime at the West Orphan Basin aids dispersion).

In the West Orphan Basin, particularly in EL 1145 and the southwest portion of EL 1148, corals and sponges are present and there are significant benthic areas for sea pens, as shown in Figure 6.5 in Section 6.1.6. As a result, there is potential for the smothering or disturbance of corals and sponges in these ELs in the immediate area of wellsites. As noted above, sediment thicknesses of 6.5 mm could extend 128 m from the discharge point and could cover an area of 0.64 ha per well; corals and sponges within this localized area may be affected by the deposition of drilling waste. Benthic mortality rates as a result of these discharges are not predicted to result in irreversible changes to local populations, although it is acknowledged that there are fewer data on effects of drilling waste on corals and sponges, and recovery rates for these communities are expected to be longer (Gates and Jones 2012; Cordes et al. 2016; Henry et al. 2017).

Lophelia pertusa is the most widely studied structure-forming cold-water coral and many reefs are located near in the vicinity of production platforms and exploration areas in Norwegian waters (Järnegren et al. 2017). Like other habitat-forming corals, this species provides habitat for a diverse and abundant assemblage of invertebrates and fish, including commercially valuable species (Järnegren et al. 2017). When looking at impacts of high sediment loads on the early life stages of corals it was determined that an increased sediment load for a duration of 24 hours caused substantial larval mortality (50% of exposed larvae) (Järnegren et al. 2017). There was an age-dependent difference in the sensitivity of larvae, with younger larvae more susceptible to lower concentrations of drill cuttings, while the older larvae were more affected at higher concentrations (Järnegren et al. 2017). Järnegren et al. (2017) emphasize that an understanding of reproductive cycles and spawning events in structure-forming cold-water corals (i.e, large gorgonians) would improve the ability to understand the effects of oil and gas activities on corals. Physical disturbance and the discharge of drilling muds has also been shown to decrease diversity and density of organisms associated with structure-forming deep-sea sponges at a community level. (Vad et al. 2018).

Although little is known about the effects of drilling waste on sea pens, they are a specialized group of octocorals adapted to live on soft sediments and several species have shown the ability to withdraw partially or completely into the sediment (within seconds or minutes) to avoid disturbance (Chimienti et al. 2018). This burrowing behaviour suggests that sea pens may be less vulnerable to sedimentation compared to other types of corals.

The recovery of benthic communities from burial, changes in sediment properties, and organic enrichment occurs by recruitment of new colonies from planktonic larvae and immigration from nearby undisturbed sediments (IOGP 2016).

BP will conduct an imagery-based seabed survey at the proposed wellsite(s) to confirm the absence of sensitive environmental features, such as habitat-forming corals or species at risk. The survey will be carried out prior to drilling and will encompass an area within a 500-m radius from the wellsite. If any environmental or anthropogenic sensitivities are identified during the survey, BP will notify the C-NLOPB

immediately to discuss an appropriate course of action. This may involve further investigation and/or moving the wellsite if it is feasible to do so. This survey will also provide baseline data for coral and sensitive benthic habitat that may be present and be used to inform discussions on potential follow-up and monitoring with respect to drill waste discharges.

Residual effects associated with discharges on a change in risk of mortality or physical injury to marine fish and fish habitat is predicted to be adverse, low in magnitude, restricted to the Project Area, medium-term to long-term in duration, occur more than once at irregular intervals, and be reversible.

8.3.3.2 Change in Habitat Quality and Use

Presence and Operation of a MODU

The quality of the underwater acoustic environment for marine fish may be affected by drilling operations and the dynamic positioning activity of the MODU. Drilling could occur at any time of the year and the sound generated would be continuous during the drilling of each well (approximately 60 days per well).

Predicting behavioural changes in fish and use of fish habitat is challenging given the variation in sound characteristics from different types of sound sources and interspecific differences in how sound is perceived and how it may affect different species. Avoidance behaviour (e.g., diving, horizontal movements) of fish to approaching vessels have been reported in the literature, though reactions vary based on species, environmental conditions, and the physiological state of affected fish (De Robertis and Handegard 2013). Behavioural responses in individual fish can also vary based on the context of the exposure to the sound source. For example, the same fish may react differently when exposed to the same level of sound while aggregated for spawning versus during foraging or feeding activities (Hawkins and Popper 2014).

Avoidance and short duration startle responses by some marine fish species may occur in close proximity to the sound source during the start-up of the initial period of drilling (Müeller-Blenkle et al. 2008; Fewtrell and McCauley 2012). McCauley et al. (2000a) noted a general response to received SPLs of 156 to 161 dB re µPa @ 1 m rms. It is anticipated that fish will become accustomed to the sound source and that avoidance and startle responses will cease over the course of the drilling (Chapman and Hawkins 1969; McCauley et al. 2000a, 2000b; Fewtrell and McCauley 2012). The source SPL associated with the operation of a MODU for the Project is estimated to be 196.7 dB re 1 µPa @ 1 m rms (Matthews et al. 2018). Based on qualitative guidelines recommended by Popper et al. (2014), potential behavioural effects on marine fish from exposure to continuous underwater sound are not predicted to extend beyond the Project Area. Given the localized and temporary nature of the drilling activity, displacement of fish from habitats and population level disturbances are unlikely.

Habitat quality and use may also be affected from the lights of the MODU as marine fish may experience physiological stress from the artificial lighting introduced into the water column. Groups of fish often react to the presence of artificial lighting by schooling and moving towards the light source. The feeding, schooling, predator avoidance, and migratory behaviours of marine fish can be altered by sharp light contrasts created by over-water structures due to shading during the day and artificial lighting at night (Nightingale and Simenstad 2002; Hanson et al. 2003). Marine fish, and especially juveniles and larvae, rely on visual cues for feeding, and shadows can create and light-dark interface that may increase

predation, and increase starvation by reducing feeding opportunities (NOAA 2008). The migratory behaviour of some fish species may prefer deeper water away from shaded areas during the day, and lighted areas could affect migratory movements at night, which could contribute to increased risk of predation.

Residual environmental effects associated with the presence and operation of a MODU on a change in habitat quality or use to marine fish and fish habitat is predicted to be adverse, low in magnitude, occur within the Project Area or LAA, medium-term in duration, occur more than once at irregular intervals, and reversible.

Vertical Seismic Profiling Operations

Guidelines for received sound levels that cause behavioural effects in fish are very limited. The US NMFS uses a criterion for behavioural response of 150 dB re 1 Pa (Stadler and Woodbury 2009), although as pointed out by Popper et al. (2014), it is unclear if this is a peak or rms level and the criterion does not specify a particular behaviour, it simply assumes there is potential to experience a behavioural response. The source SPL associated with VSP operations for the Project is estimated to be 247.8 dB re 1 µPa peak @ 1m (broadside) (Matthews et al. 2018). Popper et al. (2014) recommend qualitative guidelines for received levels of impulsive underwater sound from seismic air gun sources causing behavioural effects on fish. Based on these guidelines, the risk of behavioural effects would be high within tens of metres of the air gun source array for most fish species. For fish with swim bladders involved in hearing, this high risk of behavioural change could extend to hundreds of metres from the sound source. It is unlikely that behavioural effects on fish as a result of exposure to sound from VSP source arrays would extend beyond the Project Area.

As noted above (change in risk of mortality or injury), received sound levels are unlikely to result in physical effects to the majority of mobile fish species due to the expectation that they would avoid underwater sound at lower levels than those at which injury or mortality may occur. Nevertheless, surveys may cause a temporary change in habitat quality and use for marine fish near VSP operations.

Sound pressure levels from VSP activities are expected to result in a short-term change in habitat quality and use for marine fish (particularly fish eggs and larvae in close proximity to the air gun array used for VSP). This temporary change in habitat quality and use may result in sensory disturbance that triggers behavioural responses in marine fish and invertebrates. Mobile fish species may exhibit a variety of responses when exposed to sound from seismic source arrays, including VSP, though VSP operates at levels lower than the sound sources typically used in marine seismic exploration. The responses of marine fish to underwater sound are known to vary by species, life stage, history of exposure to similar sound sources, and the duration, intensity, frequency, and geographic extent of the underwater sound exposure, and as a result, there are currently no established sound thresholds for behavioural disturbance of fish (Popper et al. 2014; Carroll et al. 2017). Impulsive underwater sounds, such as those generated during VSP, have resulted in localized and temporary avoidance by a variety of fish species including salmonids, herring, and flatfish, by changing the direction of swimming to areas away from the sound source (Feist et al. 1996; McCauley et al. 2000a; 2000b). Other observed responses include a short duration “startle” response that includes the flexion of body followed by a burst of faster swimming, and an “alarm” response with intense variable movements (Feist et al. 1996; Schwarz and Greer 1984; McCauley et al. 2000a;

2000b). Residual environmental effects associated with VSP activity on a change in habitat quality and use to marine fish and fish habitat is predicted to be adverse, low in magnitude, occur within the Project Area or LAA, short-term in duration, occur more than once at irregular intervals, and reversible.

Discharges and Emissions

For exploration drilling, the primary discharges resulting in changes in habitat quality relate to drilling muds and cuttings and components of these discharges causing physical or chemical changes in the water column and/or sediment. The duration of water column exposure to drill waste can range from minutes to several days, whereas the sediment exposure to drill waste can persist for months or years (Smit et al. 2006). A temporary increase in suspended particulate matter and turbidity in the water column will occur as drilling mud and cuttings disperse and settle rapidly through the water column to accumulate on the seafloor. Deposition of drill cuttings can change sediment grain size and physical or chemical properties of sediments, causing a change in the abundance, composition and diversity of the benthic community (IOGP 2016) within a localized area.

As first described in Section 6.1.6.1, there is a high abundance and diversity of structure-forming benthic invertebrate species that occur in the Orphan Basin and in surrounding areas, including cold-water corals, sponges, and sea pens. Within the Project Area, corals are present in northwest section of EL 1145 and 1146 on the Northeast Newfoundland Shelf and Slope. EL 1145 appears to contain the highest diversity of corals of BP's four ELs in the Orphan Basin. Within the boundaries of EL 1145, there are records of soft corals, scleractinian stony corals, gorgonians, and sea pens (Figure 6.5 in Section 6.1.6). A Significant Benthic Area for sea pens has been designated at the edge of Northeast Newfoundland Shelf and Slope, and there is overlap in the western portion of the Project Area (Figure 8.1). This sea pen area encompasses EL 1145, and small portions of EL 1146 and EL 1148 overlap with this area (Figure 8.1). As a result, there could be a change in habitat quality or use for habitat provided by sea pens in these areas.

BP has conducted Project-specific drill waste dispersion modelling. Potential adverse effects described above for a change in risk of mortality and injury also have the potential to result in a change in habitat and use within a localized area. BP will conduct an imagery-based seabed survey at the proposed wellsite(s) to confirm the absence of sensitive environmental features, such as habitat-forming corals or species at risk. The survey will be carried out prior to drilling and will encompass an area within a 500-m radius from the wellsite. If any environmental or anthropogenic sensitivities are identified during the survey, BP will notify the C-NLOPB immediately to discuss an appropriate course of action. This may involve further investigation and/or moving the wellsite if it is feasible to do so.

As described in Section 2.8 and summarized above (change in risk or mortality or injury), BP's EPP and WMP will include requirements for managing marine discharges and emissions in accordance with the OWTG and MARPOL, as applicable. Discharges are expected to be temporary, non-bioaccumulating, non-toxic and highly-diluted. If residual hydrocarbons are present in discharges, such as deck drainage and bilge water, they will be in low volumes and concentrations and not exceed limits stated in the OWTG and MARPOL.

Residual environmental effects associated with discharges on a change in habitat quality and use to marine fish and fish habitat is predicted to be adverse, low in magnitude, restricted to the Project Area, medium-to long-term in duration, occur more than once at irregular intervals, and reversible.

Well Abandonment and Decommissioning

It is expected that well abandonment activities could cause a temporary, localized disturbance. The abandonment program has not yet been defined. BP's wellhead removal strategy for wellheads considers water depth and the likelihood of potential interactions with fishing activities. In water depths greater than 900 m, BP may seek approval from the C-NLOPB to leave the wellhead in place. Following well abandonment, it is anticipated that the wellhead, if left in place, will provide hard substrate that is suitable for colonization by benthic communities.

Residual environmental effects associated with well abandonment on a change in habitat quality and use to marine fish and fish habitat is predicted to be neutral to adverse, low in magnitude, restricted to the Project Area, long-term in duration, occur more than once at irregular intervals, and reversible. Residual environmental effects associated with removal of wellhead infrastructure (if applicable), including underwater sound emissions, would be short-term in duration.

Supply and Servicing Operations

Supply and servicing operations will increase vessel traffic within the Project Area and LAA and may therefore locally affect fish habitat quality and use around PSVs due to increased vessel sound. The sound source generated by PSVs will be irregular throughout the life of the Project, and the source levels associated with PSV operation for the Project are estimated to be 188.6 dB re 1 µPa²s (Matthews et al. 2018). Although underwater sound generated by PSV traffic will introduce additional sound to the acoustic environment, this increase will be low given the relatively small increment in vessel traffic as a result of Project activities. Marine fish may react differently to vessels, depending on the species, and the environmental conditions and physiological state of the fish at the time of the interaction (De Robertis and Handegard 2013). The likely reaction to vessel sound is either temporary displacement or avoidance of the area in which the disturbing sound level is occurring. Any change in habitat quality and use from PSV traffic would represent a small increment over similar effects from existing levels of marine traffic in the RAA.

Residual environmental effects associated with supply and servicing operations on a change in habitat quality and use to marine fish and fish habitat is predicted to be adverse, low in magnitude, occur within the LAA, medium-term in duration, occur more than once at irregular intervals, and be reversible.

8.3.4 Species at Risk: Overview of Potential Effects and Key Mitigation

There are 24 marine fish SAR and/or SOCC that may be present in the Project Area. These include species listed under SARA, the NL ESA, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and the International Union for the Conservation of Nature (IUCN) Red List (Table 8.4). Of these, the following four marine fish SAR are listed under Schedule 1 of SARA and formally protected at the federal level: Atlantic wolffish; northern wolffish; spotted wolffish; and white shark. Table 6.7 in Section

6.1.8 summarizes information on the biology and distribution of the 24 marine fish SAR and/or SOCC within the Project Area.

The three species of wolffish are found on a variety of bottom types with associations with hard substrates during spawning (Statoil Canada Ltd. 2017). These species are long lived and slow growing and primarily a demersal species (Kulka et al. 2004; COSEWIC 2012a, 2012b, 2012c). Northern wolffish have been mainly observed to occur at depths of 500-1,000 m, while spotted wolffish occur at depths of 150-350 m (Kulka et al. 2007). Atlantic and spotted wolffish lay egg clusters on hard substrates and subsequently guard the eggs (Statoil Canada Ltd. 2017). After hatching, wolffish larvae become pelagic and are commonly found on continental slopes. The life history of northern wolffish is poorly understood but may be similar to that of the other two wolffish species (Kulka et al. 2004). The Northern Grand Banks encompasses an area proposed to be designated as critical habitat for both northern and spotted wolffish. The proposed northern wolffish critical habitat overlaps a small portion the Project Area along a portion of the Northeast Newfoundland Slope. This area of overlap represents 1.425% of the 665.80 km² of proposed critical habitat area. The proposed critical habitat was delineated using the Area of Occurrence approach based on the number of wolffish present at sea bottom temperature and depth. A proposed recovery strategy for northern wolffish and spotted wolffish and a management plan for the Atlantic wolffish have been prepared to promote wolffish population growth and recovery (DFO 2018). As noted in the draft recovery strategy, a combination of natural and human-induced mortality have caused the wolffish populations to decline. The leading cause of human-induced mortality is the incidental capture of wolffish in many fisheries. Starting in 2003-2004, it became a requirement to release wolffish caught as incidental bycatch in Canadian waters; however, a significant portion of fishing mortality for wolffish occurs outside Canada's EEZ where there is no requirement to release wolffish and bycatch is thought to be unreported (DFO 2018). Other threats to wolffish in eastern Canadian waters include: the accidental release of petrochemicals, dissolved metals, and other solids during oil and gas activities; underwater sound emissions from seismic exploration; and ocean dumping (DFO 2018).

Wolffish eggs and adults are associated with bottom habitats and larvae are pelagic; therefore, different Project activities could potentially interact with wolfish at various life stages and a change in risk of mortality or physical injury or a change in habitat quality and use could result. However, the geographic distribution of wolfish species is quite large, with high concentrations occurring outside the Project Area, and, with the use of mitigation described above (Section 8.3.2), any interactions with wolfish species in the Project Area would be localized and short-term. Distribution of northern wolffish is in the Northwest Atlantic as well as in the eastern Atlantic, including Greenland, Iceland, the Faroes, Finnmarken, Murman Coast, and Novaya Zemlya (DFO 2018). Spotted wolffish occur off west Greenland (northern limit at approximately latitude 72°N), on the northeast Newfoundland and Labrador Shelves (centre of concentration), the Grand Banks, on the Flemish Cap, in the Gulf of St. Lawrence, and on the Scotian Shelf (DFO 2018).

Table 8.4 Marine Fish Species at Risk and of Conservation Concern with Potential to Occur in the Orphan Basin

Common Name	Scientific Name	SARA Schedule 1 Status	COSEWIC Designation	NL ESA Designation	IUCN Red List Designation	Summary of Presence and Potential Interactions
Acadian redfish	*Sebastes fasciatus*	No Status	Threatened	Not Listed	Not Assessed	• Prefers the shelf slopes and deep channel areas, but undergoes large vertical diurnal migrations • Internal fertilization. Larval release between spring and summer and are primarily found in surface waters • Potential life stage interactions include larvae (pelagic), and juveniles / adults (pelagic) • Limited potential for Project interaction (mobile species, Project mitigation measures)
American eel	*Anguilla rostrata*	No Status	Threatened	Vulnerable	Endangered	• Larvae drift along the Gulf Stream to coastal areas before migrating into freshwater. Larvae and juveniles are concentrated in the water column in the upper 140 m at night and 350 m during the day • Potential life stage interactions include larvae (pelagic) and juveniles / adults (pelagic) • Limited potential for Project interaction (mobile species, Project mitigation measures, no critical habitat)
American plaice (Newfoundland and Labrador population)	*Hippoglossoides platessoides*	No Status	Threatened	Not Listed	Not Assessed	• Adults typically prefer depths of 100-300 m, but have been found as deep as 1,400 m • Spawning occurs on the Newfoundland Shelf in April or May • Potential life stage interactions include eggs (pelagic), larvae (pelagic), and juveniles / adults (demersal) • Limited potential for Project interaction (mobile species, Project mitigation measures, no critical habitat)

Common Name	Scientific Name	SARA Schedule 1 Status	COSEWIC Designation	NL ESA Designation	IUCN Red List Designation	Summary of Presence and Potential Interactions
Atlantic bluefin tuna	*Thunnus thynnus*	No Status	Endangered	Not Listed	Endangered	• Individuals captured in continental shelf waters of the Gulf of St. Lawrence, Scotian Shelf and the Grand Bank • No known spawning or rearing habitats for early life stages in Canadian waters • Potential life stage interactions include juveniles / adults (pelagic) • Limited potential for Project interaction (mobile species, project mitigation measures)
Atlantic cod (Newfoundland and Labrador population)	*Gadus morhua*	No Status	Endangered	Not Listed	Vulnerable	• Adult cod occupy a diverse range of habitats with no particular depth or bottom substrate preferences. Mainly observed at depths <500 m offshore • Broadcast spawner. Eggs in the water column from April to November. • Potential life stage interactions include eggs (pelagic), larvae (pelagic), and juveniles / adults (demersal) • Limited potential for Project interaction (mobile species, Project mitigation measures, no critical habitat)
Atlantic halibut	*Hippoglossus hippoglossus*	Not Listed	Not at Risk	Not Listed	Endangered	• Distribution of pelagic Atlantic halibut larvae is mostly between 5 and 50 m • Juveniles and adults are closely associated with the seabed. Typically found at depths of 100 to 700 m, though may be present at depths up to 1,000 m • Limited potential for Project interaction (mobile species, Project mitigation measures, no critical habitat)

Common Name	Scientific Name	SARA Schedule 1 Status	COSEWIC Designation	NL ESA Designation	IUCN Red List Designation	Summary of Presence and Potential Interactions
Atlantic salmon (South Newfoundland population)	*Salmo salar*	No Status	Threatened	Not Listed	Least Concern	• Post-smolt from rivers in Maine, Bay of Fundy, Atlantic coast of Nova Scotia, and some rivers in Newfoundland migrate near the coast of eastern Newfoundland, arriving near the Funk Islands in the southern Labrador Sea in early August • Adult salmon have been found in abundance in two general locations during their spring spawning migration; approximately 480 km east of the Strait of Belle Isle and slightly east of the 200 m isobath (depth contour) along the eastern edge of the Grand Bank • Potential life stage interactions include juveniles / adults (demersal) • Limited potential for interaction (mobile species, Project mitigation measures, no critical habitat)
Atlantic salmon (Gaspe-Southern Gulf of St. Lawrence)	*Salmo salar*	No Status	Special Concern	Not Listed	Least Concern	
Atlantic salmon (Outer Bay of Fundy)	*Salmo salar*	No Status	Endangered	Not Listed	Least Concern	
Atlantic salmon (Eastern Cape Breton)	*Salmo salar*	No Status	Endangered	Not Listed	Least Concern	
Atlantic salmon (Nova Scotia Southern Upland)	*Salmo salar*	No Status	Endangered	Not Listed	Least Concern	
Atlantic salmon (Quebec Eastern North Shore population)	*Salmo salar*	No Status	Special Concern	Not Listed	Least Concern	
Atlantic salmon (Quebec Western North Shore population)	*Salmo salar*	No Status	Special Concern	Not Listed	Least Concern	
Atlantic salmon (Anticosti Island population)	*Salmo salar*	No Status	Endangered	Not Listed	Least Concern	

Common Name	Scientific Name	SARA Schedule 1 Status	COSEWIC Designation	NL ESA Designation	IUCN Red List Designation	Summary of Presence and Potential Interactions
Atlantic wolffish	*Anarhichas lupus*	Special Concern	Special Concern	Not Listed	Not Assessed	• Long lived and limited potential for interaction (mobile species, Project mitigation measures, no critical habitat)
Basking shark (Atlantic population)	*Cetorhinus maximus*	No Status	Special Concern	Not Listed	Vulnerable	• Circumglobal, temperate, migratory pelagic species • Have been observed throughout Atlantic waters including the Gulf of St. Lawrence, Bay of Fundy, Scotian Shelf and Grand Banks, generally during the summer months • Frequently encountered at the surface during summer months in the Project Area • Limited potential for interaction (mobile species, Project mitigation measures, no critical habitat)
Bigeye tuna	*Thunnus obesus*	No Status	Not Listed	Not Listed	Vulnerable	• Migratory, pelagic oceanic species that is found in 13 ºC to 29ºC water • Mostly found in depths shallower than 500 m but can dive deeper • Would occur in the Project Area generally during warm water seasons • Limited potential for interaction (mobile species, Project mitigation measures, no critical habitat)
Blue shark (Atlantic population)	*Prionace glauce*	No Status	Not at Risk	Not Listed	Near Threatened	• Distributed worldwide in temperate and tropical oceans, primarily in surface waters and offshore • Range in Canada includes Gulf Stream-associated waters off Nova Scotia and Newfoundland • Found at depths from surface to at least 600 m depth • Limited potential for interaction (mobile species, Project mitigation measures, no critical habitat)

Common Name	Scientific Name	SARA Schedule 1 Status	COSEWIC Designation	NL ESA Designation	IUCN Red List Designation	Summary of Presence and Potential Interactions
Common lumpfish	*Cyclopterus lumpus*	No Status	Threatened	Not Listed	Not Assessed	• Distribution ranges from southwest Greenland and Baffin Island, along the coasts of Newfoundland and Labrador, the Flemish Cap, down to the Gulf of St. Lawrence, Nova Scotia, and New Brunswick. • Occur in waters ranging from less than 20 m to over 300 m • Tolerate low salinity waters • Females lay on average approximately 100,000 eggs per spawning season • Spawning occurs in nearshore and inshore areas
Cusk	*Brosme brosme*	No Status	Endangered	Not Listed	Not Assessed	• Northern species found in the Subarctic and boreal shelf waters of the North Atlantic Ocean • Slow moving, sessile species that does not undergo extensive local movements, seasonal, or spawning migrations • Spawning occurs over banks during spring / summer • Limited potential for interaction (mobile species, Project mitigation measures, high abundance areas outside the Project Area, no critical habitat)
Deepwater redfish (Northern population)	*Sebastes mentella*	No Status	Threatened	Not Listed	Least Concern	• Prefers the shelf slopes and deep channel areas, but undergoes large vertical diurnal migrations • Internal fertilization. Larval release between spring and summer and are primarily found in surface waters • Potential life stage interactions include larvae (pelagic), and juveniles / adults (pelagic) • Limited potential for Project interaction (mobile species, project mitigation measures)

Common Name	Scientific Name	SARA Schedule 1 Status	COSEWIC Designation	NL ESA Designation	IUCN Red List Designation	Summary of Presence and Potential Interactions
Northern wolffish	*Anarhichas denticulatus*	Threatened	Threatened	Not Listed	Not Assessed	• Long-lived and slow-growing species that mainly inhabit bottom habitats. Common between >500-1,000 m depths • Average migrations <8 to 800 km • Spawns September through November • Potential life stage interactions include eggs (demersal), larvae (pelagic), and juveniles / adults (demersal) • Proposed critical habitat has been established for this species • Limited potential for Project interaction (mobile species, Project mitigation measures, no critical habitat) • Project Area overlaps with recently proposed designated critical habitat (refer to Section 6.1.10)
Porbeagle shark	*Lamna nasus*	No Status	Endangered	Not Listed	Vulnerable	• Abundant on the continental shelf of the Grand Bank. Rarely captured at surface or depths >200 m • Mating occurs during the summer and early fall and sharks migrate to pupping grounds in the Sargasso Sea • Potential life stage interactions include juveniles / adults (pelagic) • Limited potential for interaction (mobile species, project mitigation measures)

Common Name	Scientific Name	SARA Schedule 1 Status	COSEWIC Designation	NL ESA Designation	IUCN Red List Designation	Summary of Presence and Potential Interactions
Roughhead grenadier	*Macrourus berglax*	No Status	Special Concern	Not Listed	Not Assessed	• Captured at depths between 200 and 2,000 m and mainly observed between 400-1,200 m • Mainly distributed on northeast and eastern slopes of the Grand Banks. Spawning grounds suggested to lie on the southern and southeastern slopes of the Grand Bank • Potential life stage interactions include eggs (pelagic), larvae (pelagic), and juveniles / adults (demersal) • Limited potential for interaction (mobile species, no critical habitat, Project mitigation measures)
Roundnose grenadier	*Coryphaenoides rupestris*	No Status	Endangered	Not Listed	Endangered	• Captured at depths between 180 and 2,200 m and mainly observed at 400-1,200 m depths • In Canadian waters, it is most abundant in the northern part of the range (Labrador and Northeast Newfoundland shelves, Davis Strait) • Potential life stage interactions include eggs (pelagic), larvae (pelagic), and juveniles / adults (demersal) • Project interaction (mobile species, no critical habitat, Project mitigation measures)

Common Name	Scientific Name	SARA Schedule 1 Status	COSEWIC Designation	NL ESA Designation	IUCN Red List Designation	Summary of Presence and Potential Interactions
Shortfin mako shark (Atlantic population)	*Isurus oxyrinchus*	No Status	Special Concern	Not Listed	Vulnerable	• Associated with warm waters (17 ºC -22 ºC) in and around the Gulf Stream including the continental shelf of Nova Scotia, Grand Banks and the Gulf of St. Lawrence • Sharks in Canadian waters are at the northern extent of the population and considered a small portion of the total population • Potential life stage interactions include juveniles / adults (pelagic) • Project interaction (mobile species, project mitigation measures)
Smooth skate (Funk Island Deep Population)	*Malacoraja senta*	No Status	Endangered	Not Listed	Endangered	• Captures in Canadian RV surveys of the Project Area were restricted to depths less than 500 m • Resident species but not numerically dominant in Canadian or NAFO waters in Project Area • Lays 40-100 large egg capsules per year • Not commercially important in the region
Spotted wolffish	*Anarhichas minor*	Threatened	Threatened	Not Listed	Not Assessed	• Long lived and slow growing species that mainly inhabit soft bottom habitats. Common between 200-750 m depths • Spawning aggregations on the Northeast Shelf and Slope EBSA in the spring. Spawns from June, July, and August • Potential life stage interactions include eggs (demersal), larvae (pelagic), and juveniles / adults (demersal) • Limited potential for interaction (mobile species, Project mitigation measures, no critical habitat) • DFO recently proposed designated critical habitat for spotted wolfish, which is located within the RAA (refer to Section 6.1.10)

Common Name	Scientific Name	SARA Schedule 1 Status	COSEWIC Designation	NL ESA Designation	IUCN Red List Designation	Summary of Presence and Potential Interactions
Thorny skate	*Amblyraja radiata*	No Status	Special Concern	Not Listed	Vulnerable	• Slow-growing species that occupies depths of 18-1,400 m and inhabits a broad range of substrates including sand, shell, gravel and mud • Distributed continuously from Baffin Bay, Davis Strait, Labrador Shelf, Grand Banks, Gulf of St. Lawrence, Scotian Shelf and Bay of Fundy to Georges Bank, over a wide range of depths • Skates lay egg capsules on the seafloor year-round and all life stages occupy demersal habitats • Potential life stage interactions include eggs (demersal), larvae (demersal), and juveniles / adults • Limited potential for interaction (project mitigation measures, no critical habitat)
White shark (Atlantic population)	*Carcharodon carcharias*	Endangered	Endangered	Not Listed	Vulnerable	• Occurs in inshore to offshore waters • Recorded in Newfoundland waters from the Northeast Newfoundland Shelf and the St. Pierre Bank • Potential life stage interactions include juveniles / adults (pelagic) • Limited potential for interaction (mobile species, Project mitigation measures)
Winter skate (Eastern Scotian Shelf – Newfoundland population)	*Leucoraja oscellata*	No Status	Endangered	Not Listed	Endangered	• Globally restricted to the northwest Atlantic • Found from southern Newfoundland to the Canada / US border • Eggs deposited throughout the year in its southern range, eggs deposited in late summer to fall off Newfoundland • Limited potential for interaction (mobile species, Project mitigation measures)
Notes: Data from the SARA Registry (http://www.sararegistry.gc.ca/sar/index/default_e.cfm) as of April 10, 2018						

White sharks occur in both inshore and offshore waters from the intertidal to the upper continental slope, at depths ranging from the surface down to 1,280 m (COSEWIC 2006). In general, most white sharks occupy waters off the east coast of the United States; however, white sharks can occur in Canadian waters during the summer months and may occur in the Project Area and RAA. In Newfoundland waters, white sharks have been recorded from the Northeast Newfoundland Shelf and Slope and the St. Pierre Bank (COSEWIC 2006), and distributional data from the Newfoundland Fisheries Observer Program from 1980-2004 show that white sharks are also found on the Flemish Cap (COSEWIC 2009). Ocearch (2017) has also tracked female white sharks from the continental shelf and slopes south of Newfoundland to the Flemish Cap. White sharks are an apex predator with a wide prey base feeding primarily on teleost fish, other elasmobranchs (sharks, rays, and skates), and marine mammals (COSEWIC 2006). White sharks may also feed on cephalopods (squid and octopus), molluscs, decapods (lobster, crab, and shrimp), marine birds, and reptiles (COSEWIC 2006).

White sharks are a highly mobile pelagic species that may migrate through the Project Area. The main threat to white sharks is fishing, including being caught as bycatch in commercial pelagic longline fisheries or as unmonitored sport fish (COSEWIC 2006). White sharks have a tendency to investigate boats and other floating objects which often brings them to the surface where they can be hooked, shot, or harpooned (COSEWIC 2006). White sharks, as long-lived apex predators, may bioaccumulate pollutants in their tissues, as Zitko et al. (1972 in COSEWIC 2006) found that muscle and liver tissue from white sharks taken in the Bay of Fundy-Gulf of Maine are had higher levels of polychlorinated biphenyls (PCBs) and chlorinated hydrocarbon pesticides than other fishes. However, the health impacts of these toxins in sharks has not been investigated.

As this species is highly mobile, with widely available prey, and with no critical habitat identified in the Project Area or RAA, white sharks are unlikely to be adversely affected by the Project with the implementation of mitigation measures identified in Section 8.3.2.

Additional details on other listed species that may occur in the Project Area and RAA, including their timing of presence in the region, have been previously described in Section 6.1.8. As with secure fish species and the SAR species described above, the SOCC listed above may also interact with Project activities based on occupation of various habitats at different life history stages. The same planned mitigation measures will be used to avoid or reduce such adverse interactions on SOCC. Additional details on swordfish, bluefin tuna, Atlantic salmon and American eel are provided in Section 12.3 (Indigenous Peoples and Community Values VC).

8.3.5 Summary of Project Residual Environmental Effects

Table 8.5 summarizes the environmental effects assessment and prediction of residual environmental effects resulting from interactions between the Project and marine fish and fish habitat. Based on the characterization of the potential interactions between Project activities and marine fish and fish habitat, the Project may result in adverse environmental effects that could cause a change in risk of mortality and physical injury and a change in habitat quality and use for marine fish. In consideration of the implementation of applicable mitigation measures, and adherence to industry standards, the residual effect of a change in risk of mortality or physical injury as a result of Project activities is considered to be low in magnitude. The residual environmental effects of a change in risk of mortality or physical injury will be

restricted primarily to the Project Area but could extend into the LAA during PSV operations. The duration of effects may vary from short-term events such as VSP surveys, to medium-term, irregular events such as the operation of the MODU. Likewise, any residual environmental effects of a change in habitat quality and use are predicted to be low in magnitude, occur within the Project Area or parts of the LAA, short to long-term in duration, and reversible after the completion of the Project. No permanent alteration or destruction of fish habitat is predicted to occur as a result of Project activities.

Table 8.5 Summary of Residual Environmental Effects on Marine Fish and Fish Habitat including Species at Risk

Residual Effect	Residual Environmental Effects Characterization						
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in Risk of Mortality or Physical Injury							
Presence and operation of a MODU	A	L	PA	MT	IR	R	D
VSP operations	A	L	PA	ST	IR	R	D
Discharges	A	L	PA	MT-LT	IR	R	D
Change in Habitat Quality and Use							
Presence and operation of a MODU	A	L	PA-LAA	MT	IR	R	D
VSP operations	A	L	PA-LAA	ST	IR	R	D
Discharges	A	L	PA	MT-LT	IR	R	D
Well abandonment and decommissioning	A	L	PA	ST-LT	IR	R	D
Supply and servicing operations	A	L	LAA	MT	IR	R	D

KEY:
See Table 8.2 for detailed definitions
N/A: Not Applicable

Direction:
P: Positive
A: Adverse

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PA: Project Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term
MT: Medium-term
LT: Long-term
P: Permanent

Frequency:
UL: Unlikely
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological / Socio-Economic Context:
D: Disturbed
U: Undisturbed

8.4 Determination of Significance

With the application of the mitigation measures identified in Section 8.3.2 and environmental protection measures, the residual environmental effects of a change in risk of mortality or physical injury and a change in habitat quality and use on marine fish and fish habitat from Project activities are predicted to be not significant.

The primary interactions that may have adverse environmental effects on marine fish and fish habitat include underwater sound, lighting, and discharges in the environmental associated with the Project, including those that may interact with sensitive benthic organisms and habitats (e.g., cold-water corals and sponges). The localized extent and short-term duration of Project activities, the dynamic marine environment of the eastern Newfoundland offshore area, and planned implementation of mitigation measures will result in interactions with marine fish and fish habitat that are low in magnitude and spatially and temporally limited. The number of individuals, or area of habitat that may be affected by Project activities, is not expected to have an overall or population-level effect on marine fish and fish habitat, and planned Project activities will not result in a detectable decline in overall abundance or changes to the spatial and temporal distributions of fish populations in the Project Area, LAA, or RAA.

The potential for interactions between marine fish SAR and Project activities is limited, in spite of overlapping proposed critical habitat for the northern wolffish (Section 8.3.4). Therefore, the Project is not predicted to have implications on the overall abundance, distribution, or health of marine fish SAR or their eventual recovery.

Residual environmental effects on marine fish and fish habitat from Project activities are predicted to be not significant. This determination has been made with a moderate level of confidence in recognition of a good understanding of the general effects of exploration drilling and VSP operation on marine fish and fish habitat, the effectiveness of mitigation measures discussed in Section 8.3.2, and knowledge of the existing environment within the Project Area, LAA, and RAA. There is some uncertainty regarding effects associated with drilling discharges on deep-water corals and sponges and a relative lack of information on behavioural effects from continuous sound on marine fish.

8.5 Follow-Up and Monitoring

BP is proposing to implement a follow-up program to address uncertainty regarding residual effects of drill waste discharges on the marine benthic environment in consideration of the proximity of Significant Benthic Areas to BP's Project Area and concerns raised by Indigenous groups about potential effects on cold-water corals. As noted in Section 8.3.2, BP will conduct an imagery-based seabed survey at the proposed wellsite(s) to confirm the absence of sensitive environmental features, such as habitat-forming corals or species at risk prior to drilling. If any environmental sensitivities are identified during the survey, BP will notify the C-NLOPB immediately to discuss an appropriate course of action. This may involve further investigation and/or moving the wellsite if it is feasible to do so. This survey will also serve to provide baseline data for coral and sensitive benthic habitat that may be present and be used to inform discussions on potential follow-up with respect to drill waste discharges. BP plans to conduct a visual survey of the seafloor using an ROV after drilling activities to assess the visual extent of sediment dispersion and validate

drill waste modelling predictions. The specific details of the follow-up program will be determined in consultation with the C-NLOPB and DFO in consideration of the pre-drill survey results.

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9.0 ASSESSMENT OF POTENTIAL EFFECTS ON MARINE AND MIGRATORY BIRDS

Marine and migratory birds was selected as a VC due to their ecological value to marine and coastal ecosystems, the economic and cultural importance of recreational and subsistence hunts, vulnerability to artificial light attraction, vulnerability to oil on water, regulatory considerations, and requirements in the EIS Guidelines. The Marine and Migratory Birds VC includes oceanic (i.e., beyond the continental shelf), neritic (continental shelf), and littoral zone (intertidal, splash, and spray zones) seabirds, waterfowl, loons, grebes, and shorebirds that are protected under the *Migratory Birds Convention Act, 1994* (MBCA) and additional marine-associated birds not protected under the MBCA (i.e., cormorants). The term "migratory" is defined here as: protected under the MBCA whether or not a listed species under consideration undertakes seasonal or moult migrations. This VC also considers all marine and migratory birds listed under Schedule 1 of SARA, COSEWIC, the NL ESA or the Newfoundland and Labrador *Wild Life Act*.

The highly productive Grand Banks and adjacent waters are known to support large numbers of seabirds in all seasons (Lock et al. 1994; Fifield et al. 2009). Several million seabirds nest along the coasts of the eastern and northeastern Newfoundland, and forage on the Grand Banks and adjacent areas during and following the nesting season. There are also many non-breeding seabirds in the RAA during the summer months. During this time most of the world's population of great shearwater and large numbers of sooty shearwater nesting in the South Atlantic are thought to migrate to Newfoundland waters. During the winter months, seabirds from the Arctic and subarctic of eastern Canada, and from Greenland, gather in the RAA. Of those seabirds, the non-breeding, sub-adults, especially northern fulmar and black-legged kittiwake, are present in the RAA year-round. Some species of Arctic-nesting shorebirds (plovers and sandpipers) undertake trans-oceanic flights during fall migration from eastern North America to South America (Williams and Williams 1978; Richardson 1979), so some passage offshore through the RAA may be expected. A total of nine species designated at risk provincially or federally have the potential to occur in the RAA or the Project Area, including harlequin duck, Barrow's goldeneye, piping plover, red knot, buff-breasted sandpiper, red-necked phalarope, ivory gull, Ross's gull, and peregrine falcon. Some of these species have distributions or migratory routes that lie primarily outside of the Project Area, although most have been recorded in the Project Area on rare occasion. Other shorebird and landbird species at risk in Newfoundland and Labrador are not likely to occur in the RAA or Project Area.

This VC is linked to the Marine Fish and Fish Habitat VC (Chapter 8) in recognition of prey species on which marine and migratory birds may rely. This VC is also linked to the Special Areas VC (Chapter 11), as Important Bird Areas are included as special areas.

9.1 Scope of Assessment

9.1.1 Regulatory and Policy Setting

Migratory birds are protected federally under the MBCA, which is administered by Environment and Climate Change Canada (ECCC). The MBCA and associated regulations provide protection to all birds listed in the Canadian Wildlife Service (CWS) *Occasional Paper No. 1, Birds Protected in Canada under the MBCA*.

Migratory and non-migratory birds protected by the MBCA include most seabirds (except cormorants and pelicans), all waterfowl, all shorebirds, and most landbirds (birds with principally terrestrial life cycles). Other bird species (and other wildlife) not protected under the federal act, such as cormorants, are protected under the provincial *Wild Life Act*. The MBCA and associated regulations state that no person may disturb, destroy, or take / have in their possession a migratory bird (alive or dead) or part thereof, or its nest or eggs, except under authority of a permit. Section 5.1 of the MBCA describes prohibitions related to depositing substances harmful to migratory birds: "No person or vessel shall deposit a substance that is harmful to migratory birds, or permit such a substance to be deposited, in waters or an area frequented by migratory birds or in a place from which the substance may enter such waters or such an area".

To help facilitate compliance with the MBCA and reduce risk of incidental take of migratory birds, nests and eggs, ECCC has developed *Avoidance Guidelines* (ECCC 2017a). A permit is also required under the MBCA and *Migratory Bird Regulations* to authorize the capture and handling of migratory birds. The C-NLOPB has developed *Measures to Protect and Monitor Seabirds in Petroleum Related Activity in the Canada-Newfoundland and Labrador Offshore Area* (C-NLOPB n.d.) which communicate the C-NLOPB's expectations of operators regarding seabird protection (including obtaining a valid permit) and explain how the C-NLOPB liaises with ECCC-CWS on such matters.

SAR include all species listed under Schedule 1 of the federal SARA as endangered, threatened, or of special concern; or listed under the NL ESA as endangered, threatened, or vulnerable. SOCC include those that are listed as endangered, threatened, or of special concern by COSEWIC, but not yet listed in Schedule 1 of SARA. Both federal and provincial legislation protect SAR and SOCC, including migratory birds.

Wildlife species that are protected federally under SARA are listed in Schedule 1 of the Act. SARA seeks to prevent species from being extirpated or becoming extinct; to provide for the recovery of species that are extirpated, endangered, or threatened as a result of human activity; and to manage species of special concern to prevent them from becoming endangered or threatened. Sections 32, 33 and 58 of SARA contain provisions to protect species listed on Schedule 1 of SARA, and their critical habitat. Under section 79 of SARA, Ministerial notification is required if a project is likely to affect a listed wildlife species or its critical habitat. This notification must identify the adverse effects of the project on the listed wildlife species and its critical habitat and, if the project is carried out, measures that will be taken to avoid or lessen those effects, along with monitoring commitments.

The NL ESA provides protection to species listed as endangered, threatened, or vulnerable under the Act, as well as their core habitat. The conservation and recovery of species assessed and listed under the NL ESA is coordinated by the Wildlife Division of the Newfoundland and Labrador Department of Fisheries and Land Resources.

9.1.2 Influence of Consultation and Engagement on the Assessment

Questions and comments related to marine and migratory birds were noted during BP's Project-related engagement with government departments and agencies, stakeholder organizations and Indigenous groups (see Chapter 3 for further details). These include concerns regarding the potential effects of the Project on migratory bird species which are important to Indigenous groups as a food source and for cultural reasons (Section 7.4), particularly in the unlikely event of a large oil spill (see Chapter 15). ECCC has

emphasized assessing the potential effects of artificial lighting aboard offshore oil industry exploration and production facilities and support vessels on Leach's storm-petrel, particularly in consideration of the recent decline in the number of nesting pairs at the world's largest colony on Baccalieu Island. In recent years, seabird researchers have suggested that sheens from produced water and drill cuttings are more common than originally thought and requested that the potential effects of a worst-case scenario on marine birds be assessed. During the initial consultation for this Project, ECCC expressed interest in further discussion of oil dispersants and their effects on birds.

9.1.3 Potential Effects, Pathways and Measurable Parameters

Routine Project activities and components have potential to interact with migratory birds and their associated habitat due to attraction to artificial lighting of the MODU and PSVs, operational discharges during well drilling and testing operations, underwater sound emissions from VSP operations, and interactions with PSV and helicopter activities during supply and servicing.

The EIS Guidelines issued by the Canadian Environmental Assessment Agency in December 2016 identify and specify a number of issues and potential effects on this VC that are also considered in the EIS (refer to section 6.3.5 of the EIS Guidelines [Appendix A]).

Direct and indirect adverse effects on migratory birds could be caused by Project activities through the following effects pathways:

- physical displacement because of vessel presence (e.g., disruption of foraging activities)
- nocturnal disturbance (e.g., increased opportunities for predators, attraction to the MODU or PSVs and subsequent collision) associated with illumination levels from artificial lighting during different weather conditions and seasons and during different project activities (e.g., drilling, formation flow testing with flaring)
- exposure to spilled contaminants (e.g., fuel, oils) and operational discharges (e.g., drilling waste, deck drainage, gray water, black water)
- attraction of predator species near the MODU or PSVs
- collision risk with Project infrastructure (e.g., the MODU or PSVs)
- physical or behavioural effects due to increased underwater sound from VSP surveys

As a result of these considerations, the assessment of Project-related effects on marine and migratory birds is focused on the following potential effects:

- change in risk of mortality or physical injury
- change in habitat quality and use

The measurable parameters used for the assessment of the environmental effects presented above, and the rationale for their selection, are provided in Table 9.1. Effects of accidental events are assessed separately in Section 15.5.2.

Table 9.1 Potential Effects, Effects Pathways and Measurable Parameters for Marine and Migratory Birds

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Risk of Mortality or Physical Injury	Interactions between the extent, duration, or timing of Project activities and the environment that result in direct effects to the health or condition of marine and migratory birds (i.e., collisions, strandings, incineration, or increased predation due to attraction to artificial lighting or flaring; oiling or toxic effects due to drilling discharges or accidental spill; exposure to underwater sound during VSP)	Mortality or injury detected during the Project
Change in Habitat Quality and Use	Interactions between the extent, duration, or timing of Project activities and the environment that result in chemical, physical, or sensory changes to migratory bird habitat (i.e., changes in food availability due to artificial lighting, VSP, or discharges; attraction to sheen or slick; disorientation due to artificial lighting or flaring; sensory disturbance from atmospheric and underwater sound)	Change in area of habitat (qualitative) used for feeding, breeding, resting, or travelling Strandings detected during the Project

9.1.4 Boundaries

Spatial and temporal boundaries for the assessment with respect to marine and migratory birds are discussed in the following sections.

9.1.4.1 Spatial Boundaries

Project Area: The Project Area (Figure 9.1) encompasses the immediate area in which Project activities may occur. Well locations have not been identified but will occur within the ELs in the Project Area. The Project Area includes ELs 1145, 1146, 1148 and 1149. The Project Area has been delineated to provide a 20 km buffer around each EL.

Local Assessment Area (LAA): The LAA (Figure 9.1) is the maximum area within which environmental effects from routine Project activities and components can be predicted or measured with a reasonable degree of accuracy and confidence. It consists of the Project Area and adjacent areas where Project-related environmental effects are reasonably expected to occur based on available information, including effects thresholds, predictive modelling, and professional judgement. The LAA also includes transit routes to and from the Project Area. The main Project-related environmental emissions and interactions that potentially affect marine and migratory birds and their potential prey (fish, cephalopods, plankton) include emissions of light from artificial lighting and flaring, and waste materials that may be generated by the MODU and PSVs.

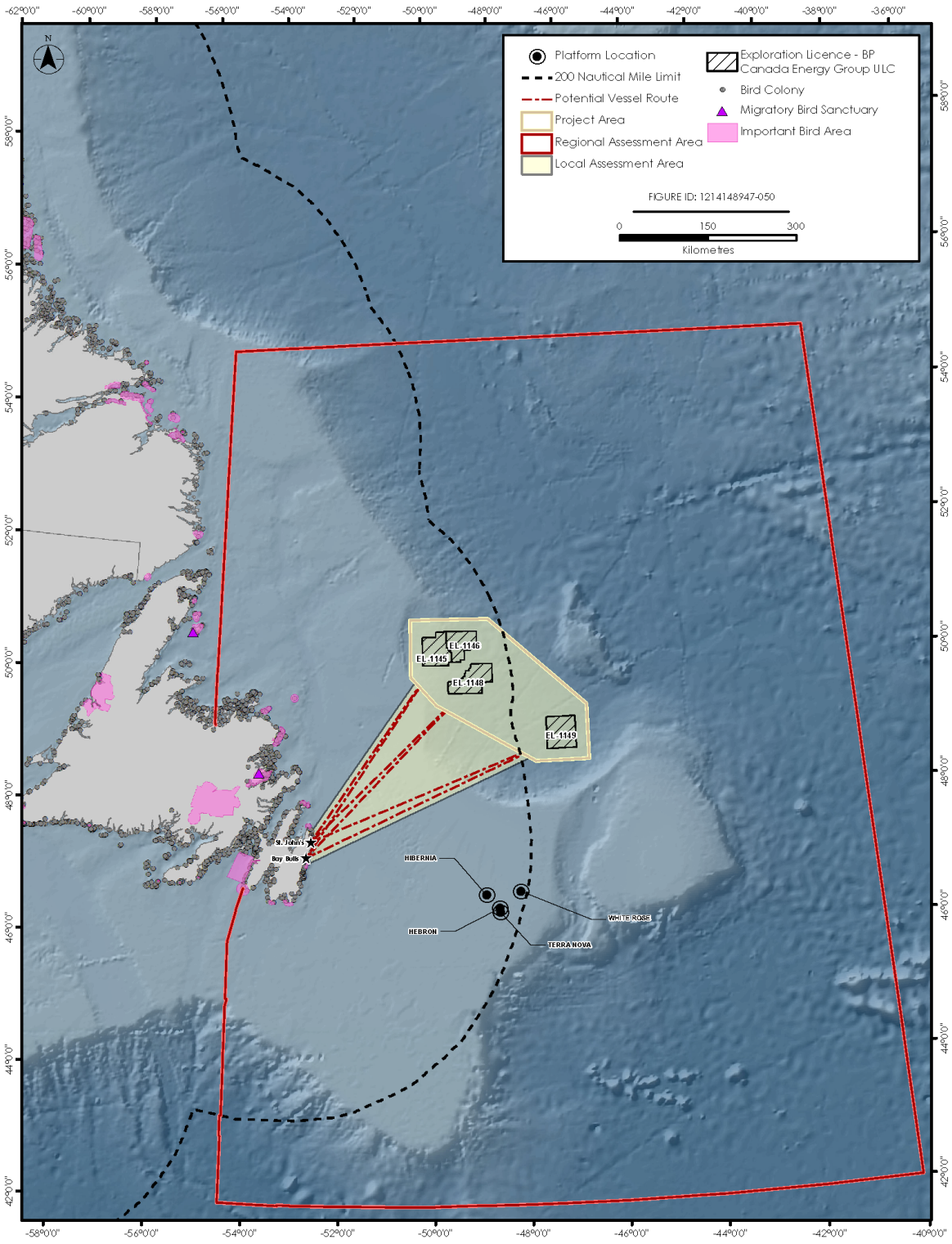

Figure 9.1 Marine and Migratory Birds Spatial Boundaries

Regional Assessment Area (RAA): The RAA (Figure 9.1) is the area within which residual environmental effects from operational activities and accidental events may interact with marine and migratory birds that are outside of the Project Area. The RAA also accounts for residual environmental effects related to routine activities that could interact cumulatively with the residual environmental effects of other past, present, and future (certain or reasonably foreseeable) physical activities.

9.1.4.2 Temporal Boundaries

The temporal boundaries for the assessment of potential Project-related environmental effects on marine and migratory birds encompass all Project phases, including well drilling, testing, and abandonment. BP is currently planning a one-well program with an initial well proposed for 2020 but could potentially drill up to 20 wells between 2020 and 2026. Well testing (if required, dependent upon drilling results) could also occur at any time during the temporal scope of this EIS. Wells may be decommissioned and abandoned at any time within the temporal boundaries. Each well is anticipated to take approximately 60 days to drill and VSP surveys typically take approximately one day per well. Drilling operations will not be continuous throughout the entire seven-year scope of the Project and will depend partially on various factors including weather, rig availability and results from previous wells. While drilling activities have the potential to be conducted at any time of the year, BP's preference is to conduct drilling between May and October.

Migratory birds can be found in and around the Project Area year-round engaged in various stages of their life cycles. Section 6.2 provides details of marine and migratory bird species known to occur, and the timing of their presence, within the Project and Assessment Areas. Refer to Section 6.2.4 for details regarding the specific marine and migratory bird SAR and SOCC known to occur in the RAA, including their sensitive periods and relation to the Project Area.

9.1.5 Residual Effects Characterization and Significance Definition

The definitions used to characterize environmental effects as part of this effects assessment for marine and migratory birds are provided in Table 9.2. These characterizations will be used throughout the chapter when describing potential residual environmental effects on marine and migratory birds from routine Project activities. These characterizations are also applicable for accidental events, as discussed in Section 15.5.2.

Table 9.2 Characterization of Residual Effects on Marine and Migratory Birds

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual environmental effect relative to baseline	**Positive** – a residual environmental effect that moves mortality, injury, health, or habitat quality in a direction beneficial to marine and migratory birds relative to baseline **Adverse** – a residual environmental effect that moves mortality, injury, health, or habitat quality in a direction detrimental to marine and migratory birds relative to baseline

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Magnitude	The amount of change in mortality, injury, health, or habitat quality of marine and migratory birds relative to existing conditions	**Negligible** – no measurable change **Low** – a detectable change but within the range of natural variability **Moderate** – a detectable change beyond the range of natural variability, but with no associated adverse effect on the viability of the affected population **High** – A detectable change that is beyond the range of natural variability, with an adverse effect on the viability of the affected population
Geographic Extent	The geographic area in which a residual environmental effect occurs	**PA –** residual environmental effects are restricted to the Project Area **LAA –** residual environmental effects extend into the LAA **RAA –** residual environmental effects extend into the RAA
Frequency	Identifies how often the residual effect occurs and how often during the Project	**Unlikely event** – effect is unlikely to occur **Single event** – effect occurs once **Multiple irregular event** – effect occurs at no set schedule **Multiple regular event** – effect occurs at regular intervals **Continuous** – effect occurs continuously
Duration	The period of time required until the mortality, injury, health, or habitat quality of marine and migratory birds returns to its existing condition, or the residual effect can no longer be measured or otherwise perceived	**Short term** - for duration of the activity, or for duration of accidental event **Medium term** - beyond duration of activity up to end of Project, or for duration of threshold exceedance of accidental event – weeks or months **Long term** - beyond Project duration of activity, or beyond the duration of threshold exceedance for accidental events - years **Permanent** - recovery to baseline conditions unlikely
Reversibility	Pertains to whether mortality, injury, health, or habitat quality of marine and migratory birds can return to its existing condition after the project activity ceases	**Reversible –** will recover to baseline conditions before or after Project completion **Irreversible –** permanent
Ecological and Socio-economic Context	Existing condition and trends in the area where residual effects occur	**Undisturbed** – The VC is relatively undisturbed in the RAA, not adversely affected by human activity, or is likely able to assimilate the additional change **Disturbed** – The VC has been previously disturbed by human development or human development is still present in the RAA, or the VC is likely not able to assimilate the additional change

In consideration of the descriptors listed above, as well as consideration of requirements under MBCA, SARA, NL ESA, and associated regulations and recovery plans, the following threshold has been established to define a significant adverse residual environmental effect on marine and migratory birds.

For the purposes of this effects assessment, a significant adverse residual environmental effect on marine and migratory birds is defined as a Project-related environmental effect that:

- causes a detectable decline in abundance or change in the spatial and temporal distribution of marine and migratory birds within the overall RAA, such that natural recruitment may not re-establish the population(s) to its original level within one generation
- jeopardizes the achievement of self-sustaining population objectives or recovery goals for listed (SAR) species such that the overall abundance, distribution and health of that species and its eventual recovery within the RAA is adversely affected
- results in permanent and irreversible loss of critical habitat as defined in a recovery plan or an action strategy for a listed (SAR) species such that the overall abundance, distribution and health of that species and its eventual recovery within the RAA is adversely affected

9.2 Project Interactions with Marine and Migratory Birds

Table 9.3 identifies, for each potential effect, the physical activities that might interact with marine and migratory birds and result in the identified environmental effects. These interactions are indicated by checkmarks, and are discussed in detail in Section 9.3, in the context of effects pathways, standard and project-specific mitigation / enhancement, and residual effects. A justification for no effect is provided following Table 9.3.

Table 9.3 Project-Environment Interactions with Marine and Migratory Birds

Physical Activities (refer to Section 4.1.1 for the Scope of the Project)	Environmental Effects	
	Change in Risk of Mortality or Physical Injury	Change in Habitat Quality and Use
MODU presence and operation (including drilling, associated safety zone, and MODU lighting)	✓	✓
Vertical Seismic Profiling (VSP) operations	✓	✓
Discharges (e.g., drill muds / cuttings, liquid discharges)	✓	✓
Well evaluation and testing (including flaring)	✓	✓
Well abandonment and decommissioning	–	–
Supply and servicing operations (including helicopter transportation and PSV operations)	✓	✓
Notes: ✓ = Potential interaction – = No interaction		

Well abandonment will occur underwater at sufficient depths to prevent interaction with marine and migratory birds, including diving species. Of the marine and migratory birds which are likely to occur in the vicinity of the Project regularly, alcids would spend the most amount of time underwater and are among the deepest divers. The maximum estimated diving depth are approximately 50 m for black guillemot and 60 m for Atlantic puffin; razorbill is known to dive to depths of at least 120 m, and common murre to 180 m or deeper (Piatt and Nettleship 1985). Water depths range from 100 m to more than 3,000 m in the Project Area but drilling and well abandonment will take place beyond the depth of diving seabirds (e.g., 180 m or shallower) found in the area and is therefore not predicted to interact with migratory birds, including diving seabirds.

9.3 Assessment of Residual Environmental Effects on Marine and Migratory Birds

The following section assesses the environmental effects on marine and migratory birds identified as arising from potential interactions in Table 9.3. Given the similarities in Project description, proximity of activities on Orphan Basin and Flemish Pass, and currency of data, the EIS incorporates learnings from previous EA documents for similar exploration drilling projects in Atlantic Canada, including comments received during Indigenous and stakeholder review processes, with updates incorporated as applicable due to Project and geographic differences, scientific updates, and refined EA methods.

9.3.1 Project Pathways

9.3.1.1 Change in Risk of Mortality or Physical Injury

The presence and operation of a MODU and PSVs has the greatest potential to result in changes to risk of mortality or physical injury for marine and migratory birds because they are known to congregate around drilling and production platforms as a result of night lighting, food, and other visual cues, potentially making them subject to increased risk of mortality due to physical strikes of structures, predation by other marine bird species, and incineration from flares (Wiese et al. 2001; Ronconi et al. 2015). In addition to direct (e.g., collisions) and indirect interactions with the MODU and PSVs, the Project has potential to result in a change in risk of mortality or physical injury for marine and migratory birds through exposure to residual hydrocarbons associated with drill muds and cuttings and other discharges, exposure to underwater sound caused by VSP operations (although the likelihood of such an exposure is limited by the short duration of VSP operations in combination with the short duration of submersion by diving marine birds), and collisions with transiting helicopters.

9.3.1.2 Change in Habitat Quality and Use

A change in habitat quality and use for marine and migratory birds could potentially occur as a result of Project activities, particularly due to the influence of atmospheric and underwater sound, artificial lighting, and discharges associated with the MODU and PSVs. In particular, these changes in the marine habitat could potentially influence bird behaviour (most likely result in attraction). Helicopter traffic also has the potential to affect habitat quality and use by marine and migratory birds.

9.3.2 Mitigation

In consideration of the environmental effects pathways outlined above, the following mitigation measures and standard practices will be employed to reduce the potential environmental effects of the Project on marine and migratory birds.

Presence and Operation of a MODU

- Lighting will be reduced to the extent that worker safety and safe operations are not compromised. Reduction of light may include avoiding use of unnecessary lighting, shading, and directing lights towards the deck.
- Seabirds stranded on the MODU and PSVs will be recovered using the methods from *Procedures for Handling and Documenting Stranded Birds Encountered on Infrastructure Offshore Atlantic Canada* (ECCC 2016).

Vertical Seismic Profiling Operations

- VSP activities will be planned and conducted in consideration of the *Statement of Canadian Practice with Respect to the Mitigation of Seismic Sound in the Marine Environment* (SOCP; DFO 2007b; refer to Section 10.3.2). Although these mitigation measures are primarily designed to reduce the risk of injury to marine mammals, implementation of a ramp-up procedure (as described in Sections 8.3.2 and 10.3.2) may also reduce the likelihood of a marine bird diving in close proximity to the source at its highest operating sound level.

Discharges

- Refer to the waste management mitigation measures identified in the Marine Fish and Fish Habitat VC (Section 8.3.2).

Well Evaluation and Testing

- If flaring is required, BP will discuss flaring plans with the C-NLOPB including steps to reduce adverse effects on migratory birds. This may involve restricting flaring to the minimum required to characterize the wells' hydrocarbon potential and as necessary for the safety of the operation, minimizing flaring during periods of migratory bird vulnerability, and the use of a water curtain to deter birds from the general vicinity of the flare.

Supply and Servicing Operations

- Routes of helicopters transiting to and from the MODU will avoid transiting near migratory bird nesting colonies and will comply with provincial *Seabird Ecological Reserve Regulations, 2015*, and, ECCC's *Avoidance Guidelines* for seabird and waterbird colonies. Appropriate flight altitudes and horizontal buffer zones will be established to minimize disturbance to colonies in accordance with the *Seabird Ecological Reserve Regulations, 2015* and the ECCC's *Avoidance Guidelines*. Specific details will be provided in the environmental protection plan (EPP).
- PSV routes transiting to and from the MODU will be planned to avoid passing within 300 m of migratory bird nesting colonies during the nesting period and will comply with provincial *Seabird Ecological*

Reserve Regulations, 2015 and federal guidelines in order to minimize disturbance to colonies (ECCC 2017b). Specific details will be provided in the EPP.

- Lighting on PSVs will be reduced to the extent that safety of operations is not compromised. Reduction of light may include avoiding use of unnecessary lighting, shading, and directing lights towards the deck.
- Stranded birds will be recovered on PSVs as outlined above for the MODU.

9.3.3 Characterization of Residual Project-related Environmental Effects

9.3.3.1 Change in Risk of Mortality or Physical Injury

Presence and Operation of a MODU

The primary potential interactions between marine and migratory birds and the presence and operation of a MODU relate to the nocturnal attraction of birds due to artificial lighting (including flaring where applicable) which can lead to strandings, collision, increased opportunities for predation and exposure to other vessel-based threats.

Marine and migratory bird attraction to offshore platforms and vessels is well documented (Imber 1975; Wiese et al. 2001; Gauthreaux and Belser 2006; Montevecchi 2006; Montevecchi et al. 2009; Bruinzeel and van Belle 2010; Rodríguez et al. 2015; Ronconi et al. 2015). Attraction of nocturnally-active birds may result in direct mortality or injury through collisions with facility infrastructure, predation, or through stranding on the platform (i.e., birds are unable to return to the sea) (Baird 1990; Montevecchi et al. 1999; Wiese et al. 2000; Davis et al. 2017). Although Bruinzeel and van Belle (2010) reported that most landbird mortality on offshore platforms was due to collision, disoriented birds may fly continuously around lights, depleting energy resources, delaying foraging or migration, and potentially increasing their susceptibility to predation (Bourne 1979; Sage 1979; Wiese and Montevecchi 1999; Wiese et al. 2001; Jones and Francis 2003; Bruinzeel and van Belle 2010).

Among marine birds, attraction to artificial lighting and related grounding appears to be widespread among procellariform species such as fulmarine and gadfly petrels, shearwaters, and prions (Procellariidae), storm-petrels (Hydrobatidae), and diving-petrels (Pelecanoididae), with the exception of albatrosses (Diomedeidae). This behaviour has been observed in more than 40 species (Imber 1975; Reed et al. 1985; Telfer et al. 1987; Le Corre et al. 2002; Black 2005; Montevecchi 2006; Rodríguez and Rodríguez 2009; Miles et al. 2010; Rodríguez et al. 2015) and suggests that some aspect of the orientation system common to procellariform birds may be disoriented by artificial light. Light attraction has also been reported in the Atlantic puffin in coastal areas near nesting colonies in both Scotland and Newfoundland (Miles et al. 2010; Wilhelm et al. 2013).

The stranding of seabirds from artificial lighting can occur at all times of the year but tends to be more common at the end of the nesting season (Telfer et al. 1987; Le Corre et al. 2002; Miles et al. 2010). In the Newfoundland and Labrador offshore area, strandings of Leach's storm-petrels on drilling and production platforms and geophysical vessels peak sharply when fledglings and adults abandon nesting colonies from mid-September to mid-October (Davis et al. 2017). In studies in which the age of the grounded seabirds has been determined, the majority of individuals have been newly fledged young, particularly in strandings

near seabird nesting colonies, suggesting that juvenile inexperience is a factor (Imber 1975; Telfer et al. 1987; Wiese et al. 2001; Gauthreaux and Belser 2006; Poot et al. 2008; Rodríguez and Rodríguez 2009; Miles et al. 2010; Rodríguez et al. 2015).

Many nocturnally-active bird species navigate using visual cues, so some authors suggest that artificial lights are being mistaken for celestial cues (Wiese et al. 2001; Gauthreaux and Belser 2006; Poot et al. 2008). It has also been suggested that nocturnally-foraging seabirds such as shearwaters and storm-petrels may mistake the lighting for bioluminescent prey (Imber 1975; Wiese et al. 2001; Gauthreaux and Belser 2006; Poot et al. 2008).

Meteorological conditions as well as lunar cycles are believed to influence the degree of bird attraction to artificial lighting. Reed et al. (1985) concluded full moon conditions decreases attraction to lights, although the exact reason for this was not fully understood. Supporting this conclusion are several studies which report that marine bird strandings appear to peak when moonlight levels are lowest (i.e., around the time of the new moon) (Telfer et al. 1987; Rodríguez and Rodríguez 2009; Miles et al. 2010; Wilhelm et al. 2013). Species prone to stranding may be more active on darker nights. For example, the arrival and departure of small procellariform species at active nests occurs primarily at night, presumably to reduce predation on the eggs, nestlings and adults. This activity is lowest around the time of the full moon (Imber 1975; Bretagnolle 1990), so a preference among seabirds to be active on darker nights may be a mechanism for avoiding nocturnal predators (Watanuki 1986; Mougeot and Bretagnolle 2000; Oro et al. 2005).

Several studies report greater numbers of bird strandings around artificial lighting when there is a low cloud ceiling, particularly when accompanied by fog or rain (Telfer et al. 1987; Black 2005; Poot et al. 2008; Davis et al. 2017). In fog or drizzle, the moisture droplets in the air refract the light and greatly increase the illuminated area, thereby extending the distance to which artificial light interacts with birds (Wiese et al. 2001). In an unpublished study, Marquenie and van de Laar (2004, cited in Poot et al. 2009), investigated migrating bird behaviour around offshore installations in the North Sea and observed milling behaviour of dense (and often mixed species) flocks only occurring during overcast nights and most concentrated between midnight and dawn.

The wavelength and intensity of lighting have also been shown to influence the degree of attraction. White and red-coloured lights are associated with the highest levels of attraction, which may increase the likelihood of mortality, while blue and green lights appear to result in considerably less attraction (Gauthreaux and Belser 2006; Poot et al. 2008; Marquenie et al. 2013). Experimentation showed that high pressure sodium lights (colour temperature 2000 K, i.e., warm) attracted fewer short-tailed shearwaters than metal halide (4500 K, cool) or light emitting diode lights (4536 K, cool) (Rodríguez et al. 2017). High pressure sodium lights emitted much less energy below 575 nm than the other two types. Bird attraction has been found to be highly correlated with lighting intensity, and when platform lighting is reduced from full illumination to only beacon and obstruction lights the number of birds observed circling the platform has been greatly reduced (Marquenie and van de Laar 2004; Marquenie et al. 2013)). Shielding lights downward has also been shown to reduce attraction (Reed et al. 1985).

In the Newfoundland and Labrador offshore area marine birds commonly strand on drilling and production platforms, and on fishing vessels and PSVs. From 2003 to 2014, a total of 2,048 birds of 31 species were recorded in the bird salvage logs of five MODUs and three offshore production facilities on Jeanne d'Arc

and Orphan Basins (Davis et al. 2017). Platform personnel typically find and recover only those birds encountered in the course of their customary duties, although if a large-scale stranding is noted, additional effort is made to find and recover birds (R. Dunphy, 2016, ExxonMobil Canada, pers. comm.). Of those birds recovered, 1,986 were marine birds consisting of 11 species and the remainder were landbirds or shorebirds (20 species). Of the marine birds, 86% (1,706 individuals) were identified as Leach's storm-petrels or unknown storm-petrel. The remainder of the marine birds consisted of species that strand on offshore facilities only when their plumage is oiled or when they collide with the structures in poor visibility (46 individuals of Atlantic puffin, murre species, dovekie, and shearwater species), or due to illness (208 individuals of various gull species were associated with an avian cholera outbreak in 2007). Stranding events appear to be episodic with the number of strandings per day on any given platform ranging from 0 to 122 individuals. The latter occurred on 2 October 2006 on the *SeaRose* FPSO. In addition, 60% of all storm-petrels stranded between 2003 and 2014 were recorded during 2006. Strandings were also seasonal. The vast majority (95%) of strandings occurred during the months of September and October, peaking from 10 September to 13 October. The beginning of this peak period corresponds to the earliest published date of fledging at the nesting colony on Great Island in Witless Bay, Newfoundland (Huntington et al. 1996). After fledglings and adults abandon the colonies many begin their southward migration.

Bird salvage logs from geophysical exploration vessels and PSVs from 2003 to 2014 have also been summarized (Davis et al. 2017). The vessels were engaged in the Newfoundland and Labrador offshore area in exploration programs initiated as early as 7 May and terminated as late as 26 November; however, most were conducted during some portion of the months of June through September. In total, seabird stranding monitoring spanned 2,197 days over 38 voyages. However, unlike the drilling and production platforms, these vessels employed dedicated, systematic searches daily by trained biologists. However, detailed weather observations throughout the night were not recorded. Storm-petrel strandings on these vessels showed similar numbers and seasonality of strandings. Over the 11 year period 1,029 birds were found stranded on these vessels, of which 1,012 were marine birds, and 994 individuals were Leach's storm-petrels. Strandings peaked sharply from 21 September to 10 October despite few vessels conducting programs after September. Almost all the storm-petrels stranded on the streamer and air gun array decks of seismic vessels, which are open only at the stern, or in similar partially-enclosed spaces. Very few stranded on open decks of geophysical vessels or on PSVs despite the fact that storm-petrels are frequently seen approaching the lights on the open afterdecks of those vessels. This suggests that the storm-petrels are stranding on vessels and platforms because they enter partially-enclosed spaces and are then unable to find their way out to the open sea.

It is difficult to quantify the mortality rate of birds attracted to artificial lighting because the available estimates rely on recovery of birds on platforms and vessels, and it is not known how many birds are killed but not recovered due to scavenging or falling into the sea (Bruinzeel et al. 2009; Bruinzeel and van Belle 2010; Ellis et al. 2013). These recoveries are often conducted on an incidental basis, which provides limited spatial and temporal coverage compared to a systematic observer-based monitoring system (Ronconi et al. 2015). Of those marine birds that are recovered from platforms and vessels, most are not injured during the stranding. Of the 994 storm-petrels that stranded on geophysical vessels and PSVs, 15.7% were found dead or died during rehabilitation (Davis et al. 2017). Of the 1,706 storm-petrels stranded on MODUs or production facilities, 11.7% were found dead or died in care, 0.6% were sent to shore for rehabilitation (ultimate fate unknown), and fate was not recorded for 0.4%. Most of that mortality was due to the birds'

plumage being fouled by hydraulic fluid upon landing on the deck or in drip-trays under the numerous winches on streamer and air gun array decks, then succumbing to hypothermia as a result. However, since the large majority of birds that were uninjured and unoiled were unable to escape the vessels, it is clear that they would also have died were they not retrieved and returned to the sea. Leach's storm-petrels attracted to the Newfoundland and Labrador offshore area drilling and production platforms also suffer predation in late summer and fall from great black-backed gulls attracted by the fish drawn to the surface at night by the artificial lighting (Montevecchi et al. 1999; Davis et al. 2017). However, the success rate of the gulls in capturing storm-petrels is unknown.

On-board lighting will be required for Project activities that occur at night and during periods of reduced visibility and must be in place to meet safety and regulatory requirements. The greatest potential for interaction between artificial light emissions from the MODU and marine and migratory birds is in the attraction of Leach's storm-petrels. As discussed in Section 6.2.2, this species feeds primarily in the deep waters off of the continental shelf. As a result, individuals nesting in Newfoundland colonies travel to the waters beyond the Grand Banks to forage, then return to the colonies to provision their nestlings. Large numbers nest at Baccalieu Island, and the nearest deep waters to theses colonies are found in Orphan Basin. That area is also an area to which some fledglings and adults will disperse during colony abandonment at the end of the nesting season.

The distance at which birds can be affected by light from a MODU or vessel is uncertain. Bruinzeel and van Belle (2010) found that the distance at which birds become disoriented ranges from 200 m in dense fog to 1,000 to 1,400 m in lighter fog to light rain, to up to 4.5 km in overcast skies with no celestial cues and otherwise good visibility. Poot et al. (2008) showed that 30 kW of electric lighting affects migrating landbirds out to at least 5 km, but greater distances cannot be ruled out (Poot et al. 2008; Hedd et al. 2011; Ronconi et al. 2015). Fledgling Cory's shearwaters are attracted to artificial lighting from at least 10 km away (Rodríguez et al. 2015).

Recovery of stranded storm-petrels on MODUs and their release mitigates much of the stranding, but an unknown proportion of storm-petrels are killed or injured from collisions and fall into the water, fall prey to gulls, or are not encountered during customary personnel duties. Strandings appear to be episodic, introducing additional uncertainty about the effect of the Project MODU on the Leach's storm-petrel population in Newfoundland. There is some potential for the attraction of landbirds in passage migration, particularly during the fall. However, most landbird migration passes to the west of the RAA, so it is unlikely that large numbers of birds will be affected.

Based on the information and analysis summarized here, and with the implementation of appropriate mitigation measures as summarized in Section 9.3.2, the overall magnitude of the effect of the presence and operation of a drilling installation on marine and migratory birds is anticipated to be low. There may be a slight increase in mortality / injury levels due to collisions, disorientation, and potential predation, although, based on previous monitoring, the mortality rate is anticipated to be low as most stranded birds encountered on platforms and vessels are released successfully.

Residual effects associated with the presence and operation of a MODU on a change in risk of mortality and physical injury to marine and migratory birds are predicted to be low in magnitude, localized to storm-

petrel nesting colonies, PSV routes and the RAA, short- to medium-term in duration, irregular in frequency, and reversible.

Vertical Seismic Profiling Operations

As discussed in Section 2.8.5.1.2, VSP surveys will result in localized underwater sound emissions for approximately one day per well.

There are no studies of whether sound (especially underwater sound) can cause injury to marine birds (ExxonMobil Canada Ltd. 2017). However, temporary hearing impairment can occur in avifauna that are exposed to sound in air (Saunders and Dooling 1974; Dooling and Therrien 2012)). Studies have found that avian species vary in their susceptibility to hearing damage due to in air sound exposure (Ryals et al. 1999). The available evidence suggests that the underwater hearing of birds is poorer than in air, given that the middle ear constricts under the increased pressure associated with diving (Dooling and Therrien 2012). Unlike some other marine animals, seabirds are not known to communicate vocally underwater, and a heightened auditory sensitivity in water is thus unlikely to have developed (ExxonMobil Canada Ltd. 2017).

Based on current scientific knowledge regarding the effects of underwater sound on birds (Stemp 1985, Turnpenny and Nedwell 1994, Lacroix et al. 2003), diving marine and migratory birds appear to be less sensitive to underwater sound emissions than fish, marine mammals, or sea turtles. Marine and migratory birds are therefore assumed to be less susceptible to a potential change in risk of mortality or physical injury from underwater sound than fish or marine mammals and sea turtles.

No mortality or injuries of marine bird from the underwater sound energy from VSP surveys have been reported. To mitigate potential effects from VSP activities, air gun operations will incorporate a ramp-up in consideration of the *Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment* (SOCP, DFO 2007). The gradual increase in emitted underwater sound levels will provide an opportunity for diving marine birds to move away from the sound source before associated underwater sound reaches levels that are potentially physically damaging to marine birds diving in close proximity to the source. Above the water, atmospheric sound from the air gun array is substantially reduced or muffled such that it is expected to have little or no effect on birds that have their heads above water or are in flight.

These activities will have a short duration (approximately one day) and will occur in a small area. VSP surveys will typically be conducted opportunistically from PSVs or in some cases may require the use of dedicated vessels and equipment. The associated potential for negative interactions with these vessels will be negligible. No change in mortality or injury levels for marine and migratory birds in the Project Area / LAA is therefore anticipated as a result of VSP surveys.

Residual effects associated with VSP activities on marine and migratory birds is predicted to be negligible to low in magnitude, localized within portions of the Project Area, short-term, irregular in frequency, and reversible.

Discharges

All emissions from Project PSVs and the MODU will be in accordance with the OWTG and MARPOL as applicable. As well, discharges and emission are expected to be temporary, localized, non-toxic, and subject to dilution in the open ocean.

Cement, WBM and cuttings released at the seafloor will be far below the maximum diving range of most seabirds, and therefore will not interact with marine-associated birds (or their habitats). Water depths in the Project Area range from approximately 80 m to over 3,000 m. Thick-billed murres, the deepest-diving seabirds found in the Project Area, rarely reach depths of 200 m (Gaston and Hipfner 2000 in ExxonMobil Canada Ltd. 2017). SBM has a synthetic base fluid as a component, but SBM cuttings are treated prior to discharge, and have only a small (and permitted) fraction of residual SBM when discharged. Discharging the SBM-related drill cuttings below the water's surface further mitigates the potential for marine and migratory birds to come into contact with the chemical components of SBM. With appropriate screening and selection of chemicals (including use of non-toxic drilling fluids) in accordance with the *Offshore Chemical Selection Guidelines*, and proper disposal of drill muds and cuttings in accordance with the OWTG, effects on birds due to disposal of drill muds and cuttings and associated waste materials are considered unlikely.

Other potential liquid discharges from offshore vessels and equipment relate to the possible release of oily water and other substances through produced water (if applicable), deck drainage, bilge water, ballast water and liquid wastes. These discharges will be managed in accordance with the OWTG. Waste that cannot be discharged overboard will be stored and transported to shore for disposal in an approved facility (Section 2.9).

Although produced water typically accounts for the largest volume of waste from offshore oil and gas production operations (Neff 2002), and in calm conditions, discharges within allowable levels can result in formation of hydrocarbon sheens (ERIN Consulting Ltd. and OCL Services Ltd. 2003; Morandin and O'Hara 2016). This issue is far less of a concern for exploration drilling, where produced water may only be found during a formation flow test and volumes are small (Morandin and O'Hara 2016). Small amounts of produced water may be flared if BP conducts a formation flow test. If volumes of produced water are large, some produced water may be treated on the MODU so it can be discharged at sea in accordance with the OWTG or shipped to shore for appropriate disposal. Produced water is therefore not expected to be an issue for this exploration program.

The treated discharge of some operational wastes may cause surface sheening, typically under calm conditions; however, the potential for sheen formation is very unlikely with proper treatment and management of operational discharges in accordance with the OWTG. Small amounts of oil from sheens has been shown to affect the structure and function of seabird feathers (O'Hara and Morandin 2010), which has the potential to result in water penetrating plumage and displacing the layer of insulating air, resulting in loss of buoyancy and hypothermia. This can in turn cause a heightened metabolic rate (increased energy expenditure), as well as behavioural changes such as increased time spent preening at the expense of foraging and breeding, and potentially death, especially in the winter months when conditions are colder and thermoregulation is most difficult (Morandin and O'Hara 2016). Chicks and eggs are most susceptible to negative effects of exposure to oil (even at low levels) (Morandin and O'Hara 2016).

Controlled-dose studies, including a study commissioned by the Environmental Studies Research Find (ESRF) on the effects of sheens on marine birds, show that 5 ml of oil can have negative external and internal effects on individual birds (O'Hara and Morandin 2010; Morandin and O'Hara 2016). As a result, an individual bird coming into contact with a sheen with a thickness of 0.1 µm and picking up all of the oil in an area of 50 m² on its plumage could acquire 5 ml of oil (Morandin and O'Hara 2016). Such a bird could suffer hypothermia, it could ingest oil by attempting to remove it through preening, or transfer the oil to eggs or nestlings and, as a result, could experience negative impacts (Morandin and O'Hara 2016).

Although Fraser et al. (2006) suggested that sheens have the potential to cause mortality, Morandin and O'Hara (2016) could not conclude whether the impacts of sheens on individuals have had long-term population effects through small reductions in adult fecundity or survivorship. First, there is a lack of data on the occurrence of oiling of seabirds around platforms (Morandin and O'Hara 2016). Second, data are lacking on the frequency, likelihood, persistence, fate, and thickness of sheens resulting from discharges of produced water and drilling muds. Third, there is a lack of quantitative studies on the direct effects of sheens on seabirds. Last, there is also a lack of studies on the effects of sheens on the abundance of pelagic seabirds in Atlantic Canada. Calculating the probability of marine birds encountering sheens from produced water with confidence is also difficult because of the patchy and ephemeral nature of their distributions at small geographic scales. Their distributions are dependent on the influences of weather and prey distribution, which are themselves poorly known. Although the results of recent surveys of seabirds at-sea on have been published, geographic coverage and effort were low during the winter months, reducing confidence in the utility of these data for predicting species- and site-specific distribution and abundance (Fifield et al. 2009).

Atmospheric emissions associated with the Project include exhaust from power and heat generation from the drilling installation(s), and from PSVs and aircraft traffic. It is unlikely that such emissions will have any measurable effect on marine and migratory birds, as the emissions will be within regulatory standards, transient in nature, and short-term at one location.

With the proper implementation of mitigation measures summarized in Section 9.3.2, the overall magnitude of the effect of drilling and other marine discharges on marine and migratory birds is anticipated to be low. These effects will be prevented or minimized through the waste management and discharge treatment measures in compliance with OWTG and adherence to associated MARPOL requirements.

Residual effects associated with drilling and associated marine discharges are primarily related to the generation of sheens, which could potentially result in changes in marine and migratory bird risk of mortality or physical injury. Any such effects are predicted to be low in magnitude, irregular, localized to the Project Area, short term in duration, and reversible.

Well Evaluation and Testing

Formation flow testing may occur during drilling of the well, or it may be carried out at a later date upon re-entering a suspended well, and in certain situations, flaring may be required. In Atlantic Canada, nocturnal migrants, and nocturnally-active seabirds such as Leach's storm-petrel are the marine and migratory birds most at risk of attraction to flares, although the potential mortality resulting from such interactions is poorly understood. Available estimates often rely on recovery of birds on platforms and vessels, and it is not known

how many birds are killed but not recovered due to scavenging or landing in the ocean (Bruinzeel et al. 2009; Ellis et al. 2013).

Some authors suggest that some of the birds attracted by artificial lighting on drilling and production platforms gas flaring at night may be incinerated (Russell 2005; Montevecchi 2006). Systematic visual monitoring of North Sea gas flares has detected no incineration (Hope Jones 1980; Wallis 1981). Such monitoring has not been conducted in the Gulf of Mexico, but two burned songbirds were found in a study of the use of offshore oil platforms by landbird passage migrants (Russell 2005). However, mortality at flares appears to be episodic. Bird mortality at an onshore flare stack in Alberta has been documented (Bjorge 1987). However, necropsies of 56 of the birds revealed equivocal evidence of collisions and no evidence of burning. The injuries observed were instead consistent with hydrogen sulfide poisoning. In September 2013, 7,500 nocturnally-migrating songbirds died at a gas flare at the Canaport liquid natural gas plant in Saint John, New Brunswick (CBC News 2013). Atmospheric conditions included fog and overcast sky. Many of the birds were burned, but many showed no external injuries. Mactavish and Lang (2015) studied attraction of birds to offshore flares through a series of nighttime observations in October to November of 2015 using infrared and regular binoculars. The authors observed that Leach's storm-petrels, as well as small numbers of shorebirds and migrating landbirds, did approach the flares but no associated mortality was observed.

As with offshore lighting discussed above, a number of factors influence the potential severity of marine bird interactions with flares including the time of year, location (i.e., whether concentrations of birds are present near the flare), height and weather conditions Mortality can also increase during migration, particularly when poor weather conditions force birds to fly relatively low (Wiese et al. 2001). Risk of mortality due to artificial light sources such as flares may also be higher in the latter part of the night because most nocturnal migrants climb to their migrating height soon after takeoff and then undertake a gradual descent shortly after midnight (Weir 1976).

As with emissions from artificial lighting discussed above, the greatest potential for interactions is with Leach's storm-petrel. Required flaring activities will be short in duration (approximately five days per well, if flaring occurs at all), and associated bird attraction will be limited to within several kilometres of the MODU. Mitigation measures regarding flaring will be adhered to throughout the Project, including the use of high efficiency burners. Additionally, BP will notify the C-NLOPB in advance of plans to flare associated with well testing for exploration drilling. When flaring, BP uses a water curtain to protect personnel and equipment on the MODU by limiting the transfer of radiated heat from the flare, thereby mitigating risk of fire. A secondary benefit of a water curtain may be potential deterrence of birds from the general vicinity of the flare based on the positioning of the water curtain. The effects of formation flow testing with flaring on marine and migratory birds are therefore anticipated to be low.

Residual effects associated with formation flow testing with flaring are primarily related to attraction of marine and migratory birds to flares, which may result in changes to risk of mortality or physical injury. Any such effects are predicted to be low in magnitude, localized to a portion of the Project Area, short term in duration, irregular in frequency, and reversible.

Supply and Servicing Operations

The Project will involve PSV and aircraft use (presence and movements), including supply and support traffic to, from and within the Project Area potentially at all times of year over the course of the Project (although BP's preference is to conduct drilling between May and October). This traffic may affect seabirds through lighting, atmospheric and underwater sound, and other associated environmental emissions and discharges. The various bird species that occupy the Project Area will not likely be affected by PSV activity or associated aircraft use, due to its transitory nature and thus, its short-term presence at any one location, and because it is generally in keeping with the overall marine traffic that has occurred throughout the region for years.

The potential effects due to nocturnal artificial lighting sources on the PSVs are anticipated to be similar to those resulting from lighting on MODU, which were discussed above. For the most part, PSVs are not stationary, except for occurrences when PSVs must maintain station (stand-by vessel and VSP activities), meaning that any disturbances will be highly transient in nature but will extend across a wider area along the identified PSV traffic routes. Mitigation measures outlined in Section 9.3.2 will be in place during Project operations to reduce the effects of bird attraction due to offshore lighting from PSVs. During Project operations offshore, regular searches of vessel decks will be undertaken and accepted protocols for the collection and release of birds that become stranded will be implemented by qualified and experienced personnel, in accordance with applicable regulatory guidance and requirements and the CWS bird handling permit.

The release of organic wastes by PSVs and activities can attract birds, which may increase the potential for interactions including risk of predation, collision, and exposure to contaminants. However, this will be minimized with proper waste management practices and adherence to associated MARPOL requirements.

PSV traffic for the MODU represents a negligible contribution to the overall vessel traffic off Eastern Newfoundland, and Project-related PSV traffic will use existing and established routes wherever possible. Helicopters will avoid coastal seabird colonies during the nesting season as per the *Seabird Ecological Reserve Regulations*, 2015 and CWS guidelines as discussed in Section 9.3.2.

Residual effects associated with supply and servicing activities are primarily related to potential attraction / disorientation of birds due to lighting which may result in a change to risk of mortality or physical injury. This effect is predicted to be low in magnitude, localized in extent to the LAA, short-term, irregular in frequency, and reversible.

9.3.3.2 Change in Habitat Quality and Use

Presence and Operation of a MODU

Changes in habitat quality and use due to the presence and operation of a MODU are generally associated with artificial lighting and atmospheric and underwater sound emissions from the MODU which can result in behavioural changes in marine and migratory birds. Effects of waste discharges from the MODU are discussed separately below.

Attraction of nocturnally-active marine and migratory birds to artificial lighting is discussed in detail above (change in risk of mortality or injury). Daytime marine bird densities within 500 m of offshore platform are often many times higher than before the installation of the platforms or further away from platforms, suggesting that the birds are attracted to foraging opportunities or to the shelter found downwind of platforms (Tasker et al. 1986; Baird 1990; Wiese and Montevecchi 1999); all in ExxonMobil Canada Ltd. 2017).

The presence of offshore platforms can also provide new habitats for birds (Russell 2005 in ExxonMobil Canada Ltd. 2017). Structures may be used as roosting and resting sites by gulls (Burke et al. 2012 in ExxonMobil Canada Ltd. 2017) as stopover locations for migrating landbirds who may forage around the platforms (Russell 2005; Bruinzeel and van Belle 2010; in ExxonMobil Canada Ltd. 2017), or even potentially as hunting grounds for predatory species such as large gull species and vagrant, passage migrant peregrine falcons, which take advantage of concentrations of birds around the structures (Russell 2005 in ExxonMobil Canada Ltd. 2017). Foraging opportunities may also be enhanced around platforms because they themselves may become artificial reefs around which new invertebrate and fish assemblages are established (Fabi et al. 2002, 2004; in ExxonMobil Canada Ltd. 2017). In the Newfoundland and Labrador offshore area, great black-backed gulls congregate in large flocks at MODUs and production platforms during late summer (post-breeding dispersal) and fall (migration) to forage at night on fish, such as Atlantic saury, that attracted to the surface by artificial light emissions from the platforms (Montevecchi et al. 1999; Davis et al. 2017). Diving thick-billed murres are attracted to underwater lights during the Arctic polar night, but dovekies are not, suggesting that some diving marine bird species could potentially be attracted to the MODU at night for foraging opportunities (Ostaszewska et al. 2017).

The creation of new habitats and increased food availability (of prey species) associated with presence and operation of a MODU will be short-term at a Project drilling location and may result in both positive and negative effects on marine and migratory birds, especially during fall migration when the large pulse of young-of-the-year birds increases population sizes. Enhancement of the local food supply and provision of roosting and resting sites may attract some species to platforms, but the benefits in terms of energy gains may be offset by increased exposure to risk of various kinds of mortality and energetic costs due to deviation from normal movement and migration patterns.

Some researchers have documented displacement of birds due to offshore platforms (Bramford et al. 1990 in ExxonMobil Canada Ltd. 2017). Alcids, for example, are prone to disturbance from vessel and traffic which may at least partially explain observed avoidance behaviour around platforms (Ronconi and St. Clair 2002; Bellefleur et al. 2009; in ExxonMobil Canada Ltd. 2017). Alcid distribution along survey transects to platforms on the Grand Banks were more strongly related to ocean temperature than with proximity to

platforms (Burke et al. 2005 in ExxonMobil Canada Ltd. 2017), although these attraction effects differed among species and seasons (Burke et al. 2012 in ExxonMobil Canada Ltd. 2017). Similarly, Baird (1990 in ExxonMobil Canada Ltd. 2017) found that puffins, unlike most seabird species, occurred at lower densities within 10 km of the platform than farther away. Observed densities of dovekie, northern fulmar, shearwaters, and storm-petrels on the Scotian Shelf were lower within 10 km of platforms compared to regions further away, suggesting some avoidance of platforms by certain species, although the effects of habitat preferences were not assessed (Amec 2011).

Some marine bird species, especially alcids, may be displaced from the area around the active MODU during drilling operations and along PSV supply routes through general avoidance responses. However, the effect of habitat displacement on marine-associated birds is likely to be minor due to its small footprint (Hedd et al. 2011; Ronconi et al. 2015). Because the MODU will not be situated in one location for extended periods of time, disturbance will be short-term and transient in nature.

Based on the information and analysis summarized here, and with the implementation of appropriate mitigation measures as summarized in Section 9.3.2, the overall magnitude of the effect of the presence and operation of a drilling installation on marine and migratory birds is anticipated to be low. Some localized and short-term behavioural effects (change in presence and abundance) are also likely to occur, with some species displaced from the Project Area / LAA and others attracted by lighting which will reduce the degree to which foraging opportunities are enhanced by the presence and operation of a drilling installation. The localized, transient, and short-term nature of these disturbances at one location and time during the Project considerably reduces the potential for adverse effects upon marine and migratory birds (individuals or populations). It is therefore unlikely that individuals will be attracted or displaced over extended areas or timeframes. Given that the likely zone of influence of the Project at one time or location will represent a small proportion of the feeding, breeding or migration area of species, birds will not be displaced from key habitats or during important activities or be otherwise affected in a manner that causes detectable adverse 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.

Residual effects associated with the presence and operation of a MODU are primarily related to artificial light emissions and the potential creation of an artificial reef. These may result in changes in habitat quality and use by marine and migratory birds. These changes are predicted to be low in magnitude, localized to storm-petrel nesting colonies and foraging habitat, and the RAA, short- to medium-term in duration, irregular in frequency, and reversible.

Vertical Seismic Profiling Operations

Various studies have reported no measureable behavioural responses of various bird species during operations involving air gun seismic sources. For example, shearwaters have been observed with their heads underwater within 30 m of seismic vessels and no response was noted (Stemp 1985). The same lack of response during seismic testing was observed of guillemots, fulmars, and kittiwakes (Turnpenny and Nedwell 1994) and long-tailed ducks (Lacroix et al. 2003).

Hearing sensitivity has only recently been measured in seabirds. Crowell (2016) measured in-air auditory brainstem response in seabird species that included long-tailed duck, lesser scaup, red-throated loon, and

northern gannet. This study found that hearing sensitivity of these species is greatest between 1,500 and 3,000 Hz. Underwater hearing thresholds in great cormorant are similar to seals and toothed whales in the 1-4 kHz frequency range (Anderson Hansen et al. 2016; Johansen et al. 2016). Great cormorants were also found to respond to underwater sounds and may have special adaptations for hearing underwater (Anderson Hansen et al. 2016; Johansen et al. 2016). The frequency range of signals from an air gun VSP source is expected to be between 10 and 25,000 Hz.

VSP surveys will be conducted for each well drilled and are expected to take approximately one day per well. As discussed above, at least one species of marine bird has been reported as negatively affected by the underwater sound energy from marine seismic. Above the water, air gun source array sound is reduced to that which is likely to have little or no effect on birds that have their heads above water or are in flight. Effects of sound disturbance on the nesting or foraging behaviour of surface-feeding marine birds are also unlikely, given that the above-water sound levels of geophysical source arrays are minimal. As described in Chapter 8, significant effects to fish resources are not expected to occur because of the Project, and so changes in the availability, location, or quality of food sources for marine birds are not likely.

These activities will have a short duration (approximately one day) and involve a much smaller source array with energy focused down the well itself. The associated potential for negative interactions with marine and migratory birds will be negligible. No change to avifauna presence and abundance, in the Project Area / LAA is therefore anticipated as a result of VSP operations.

Any changes in habitat quality and use as a result of sound exposure from VSP survey activities are predicted to be negligible in magnitude, localized within the Project Area, short-term, irregular in frequency, and reversible. Changes in habitat and food availability and quantity from VSP activities are likewise not anticipated because the activity will be extremely localized and short-term, with negligible environmental interactions.

Discharges

Solid and domestic waste will be collected on-board drilling installations and vessels, and waste materials will be separated and recycled where possible. Non-hazardous and hazardous waste solids will be shipped to shore for disposal at approved waste management facilities. Non-hazardous industrial waste will be directed to an approved municipal waste disposal site, while hazardous waste will be directed through an approved hazardous waste collection contractor. Waste food and sewage will be macerated and discharged overboard after treatment in accordance with the OWTG and MARPOL and is expected to be quickly degraded by bacteria and other biological activity after release. Effects to the fish species upon which avifauna depend may also indirectly affect birds (Chapter 8). Discharge of organic wastes (sewage and food scraps) may result in enhancement of the local food supply and attraction of birds to vessels and platforms. However, this effect will only occur during the drilling program (up to 60 days per well) and be localized in nature.

The production of sheens from routine discharges will be unusual given adherence to the OWTG and MARPOL requirements for waste management. However, if they do occur, this could result in avoidance and/or attraction of marine birds. Northern fulmar, shearwaters and storm-petrels are attracted to sheens. The visual appearance of a hydrocarbon sheen would resemble a sheen of biological origin and may initially

attract such species (Nevitt 1999). However, these species also search for food by olfaction, relying on the smell of chemicals found in their foods, such as dimethyl sulfide (e.g., Leach's storm-petrel; Nevitt and Haberman 2003). Upon investigation of a visually identified hydrocarbon sheen, such birds would find that its odour does not resemble that of any food item (Hutchison and Wenzel 1980). As a result, these birds would be unlikely to come in contact with a sheen during foraging. Other birds may not be attracted at all and may temporarily avoid the localized affected area.

Residual effects associated with drilling and other marine discharges on a change in habitat quality and use for marine and migratory birds is anticipated to be low given adherence to waste management requirements. Any such effects are also predicted to be localized to the Project Area, short term in duration, irregular in frequency, and reversible.

Well Evaluation and Testing

Formation flow testing may occur during the drilling program, and in certain situations, flaring may be required. As discussed previously, nocturnal flaring introduces artificial lighting to the marine environment and has the potential to attract marine and migratory birds (particularly storm-petrels), diverting them from their movements between foraging areas and nesting colonies. Changes to habitat quality and use by marine and migratory birds are therefore predicted to be low in magnitude, short term in duration localized to portions of the Project Area, irregular in frequency, and reversible.

Supply and Servicing Operations

The Project will involve PSV and helicopter transit to and from the MODU in the Project Area, potentially any time of year over the life of the Project. Helicopter routes will lie at least 14 km southeast of the Cape St. Francis IBA and at least 38 km north of the Witless Bay Ecological Reserve IBA (the nearest IBA with seabird nesting colonies). PSV routes will lie about 27 and 35 km, respectively, from those IBAs. This traffic may affect seabirds through lighting, atmospheric and underwater sound, and other associated environmental emissions and discharges. The various bird species that occupy the Project Area will not likely be affected by PSV activity or associated aircraft use, due to its transitory nature and thus, its short-term presence at any one location, and because it is generally consistent with the overall marine traffic that has occurred throughout the region for years.

Helicopters may interact with the marine and migratory birds through aircraft overflights and potential disturbance of normal nesting, foraging or resting activities. Possible disturbance effects include increased energy expenditure of birds due to escape reactions, increased heart rate, decreased food intake due to interruptions, and temporary loss of suitable habitat (Ellis et al. 1991; Trimper et al. 2003; Komenda-Zehnder et al. 2003). For example, helicopter atmospheric sound emissions can disturb seabirds at nesting colonies. However, seabird reactions to helicopters and other aircraft is variable due to a number of factors including species, previous exposure levels, and the location, altitude, and number of flights (Hoang 2013). Perhaps the most obvious behavioural effects of helicopter atmospheric sound on birds is flushing of breeding birds from their nests, which can have immediate negative effects such as predation of eggs or nestlings, and reduced time spent incubating eggs or brooding nestlings (Burger 1981; Brown 1990; Bolduc and Guillemette 2003; Beale 2007; Burger et al. 2010). Nestlings may also be exposed to adverse weather. During flushing, adults may inadvertently knock eggs and nestlings from the nest, which may cause them

to fall from a cliff or expose them to attacks by neighboring nesting pairs (Burger 1981; Carney and Sydeman 1999). Disturbance effects may disrupt rates of foraging and provisioning nestlings or fledglings (Davis and Wiseley 1974; Lynch and Speake 1978; Belanger and Bedard 1990; Delaney et al. 2002; Goudie 2006). Unfamiliar atmospheric sound may deter birds from using preferred habitats and may alter migration routes, causing affected birds to expend greater energy (Larkin 1996; Beale 2007). Visible behavioural responses to aircraft operations, such as flushing, may be prompted at a distance of 366 m for common murre (Rojek et al. 2007), although there is variability in between and within species (Blumstein et al. 2005; Hoang 2013).

Similar to presence of the MODU, when PSVs are on location (e.g., the standby vessel monitoring the safety zone at the MODU), vessel lighting at night can attract fish to the surface, which in turn attracts great black-backed gull and other gull species (Davis et al. 2017).

The release of organic wastes by PSVs and activities can attract birds, which may increase the potential for interactions including risk of predation, collision, and exposure to contaminants. However, this will be minimized with proper waste management practices and adherence to associated MARPOL requirements.

Project-related PSV traffic represents a negligible contribution to the overall vessel traffic off Eastern Newfoundland. PSVs will use established shipping lanes wherever possible, and, along with Project-related helicopters, will avoid coastal seabird colonies during the nesting season as per the *Seabird Ecological Reserve Regulations, 2015* discussed and CWS guidelines in Section 9.3.2. These routes are at least 27 km from the nearest seabird ecological reserve. Adherence to established PSV routes will avoid passing within 300 m of kittiwake nesting colonies lying outside that reserve. For helicopter routes, the regional CWS office will be consulted for separation distances from nesting colonies, as per CWS guidelines.

Residual effects associated with supply and servicing activities are primarily related to potential attraction of birds to organic waste discharge as a potential food source wastes leading to increased food availability, fish attraction to PSV lighting at slow vessel speeds (while on stand-by) leading to increased food availability for birds, and to disturbance due to vessel and helicopter movements. These may result in changes in habitat quality and use for marine and migratory birds. These changes are predicted to be low in magnitude, localized in extent to the LAA, short-term, irregular in frequency, and be reversible.

9.3.4 Species at Risk: Overview of Potential Effects and Key Mitigation

Table 9.4 lists marine and migratory bird SAR and SOCC that could potentially occur in the RAA, indicating their likely presence and potential interaction with Project activities. As discussed in Section 6.2.4 (and summarized in Table 9.4), there is low potential for SAR or SOCC to interact with the Project because of these species' low densities in the Project Area, LAA, and RAA and because there are no critical habitats or nesting sites of SAR or SOCC in the RAA. The MODU and PSVs may potentially provide a temporary rest platform benefitting red knot, buff-breasted sandpiper, and peregrine falcon in passage migration. Ivory gull and Ross's gull are associated with pack ice, which is not likely to occur as far south and east as the Project Area or LAA (including PSV route). These areas are outside the current range of piping plover. Harlequin duck, and Barrow's goldeneye are very rare in the LAA, but if individuals occur during moult migration or seasonal migration, they may benefit from sheltering from wind and waves by the MODU or

PSVs. Red-necked phalarope, which is more likely to be found offshore than most of the listed bird SAR, is not known to be attracted to offshore vessels or platforms.

Major threats identified in associated recovery strategies and action plans for these bird species at risk relate primarily to flooding or pollution of coastal habitats, hunting, or at-sea pollution. Given the distance of most Project activities occurring offshore, Project interactions with these bird species at risk are expected to be negligible but are most likely to occur during species migration activities. The Project is not predicted to result in direct or indirect effects on the survival or recovery of federally listed species. Mitigation proposed to reduce light emissions, recover stranded birds, manage discharges, and restrict PSV and helicopter routes (refer to Section 9.3.2) will also help to protect bird species at risk.

The residual effects of the Project on marine and migratory bird species at risk are predicted to be adverse, negligible in magnitude, extend to the RAA, an unlikely event, short term in duration, and reversible.

Table 9.4 Bird Species at Risk and of Conservation Concern with Potential to Occur in the RAA

Species	NL ESA	Federal Status		Summary of Presence and Potential Interactions
		SARA Listing	COSEWIC Assessment	
Harlequin duck (eastern pop.)	Vulnerable	Special Concern (Schedule 1)	Special Concern	• Breeds inland but moves to coastal waters to moult and overwinter • Unlikely to occur in the Project Area (potential vagrant during migration) • Low potential for interaction with PSVs in nearshore waters; could potentially be affected in the unlikely event of a spill reaching coastal waters
Barrow's goldeneye (eastern pop.)	Vulnerable	Special Concern (Schedule 1)	Special Concern	• During non-breeding season (late fall, winter and early spring) may potentially be present in coastal waters of the RAA • Low potential for interaction with PSVs in nearshore waters; could potentially be affected in the unlikely event of a spill reaching coastal waters
Piping plover (*melodus* ssp.)	Endangered	Endangered (Schedule 1)	Endangered	• Breeds on sandy beaches primarily along the southwestern and western portions of the Island of Newfoundland • Unlikely to occur in the Project Area or even migrate through the RAA • Low potential for interaction with routine Project activities; could potentially be affected in the unlikely event of a spill reaching onshore breeding habitat
Red knot (*rufa* ssp.)	Endangered	Endangered (Schedule 1)	Endangered	• Occurs in Newfoundland during fall migration (1 August to 30 October), preferring open sandy inlets, coastal mudflats, sand flats, salt marshes, sandy estuaries and areas with rotting kelp deposits

Species	NL ESA	Federal Status		Summary of Presence and Potential Interactions
		SARA Listing	COSEWIC Assessment	
				• Most migration takes place west of the RAA, although individuals have been sighted at-sea • Unlikely to occur in the Project Area • Low potential for interaction with routine Project activities; could potentially be affected in the unlikely event of a spill reaching onshore habitat during fall migration
Buff-breasted sandpiper	None	Special Concern (Schedule 1)	Special Concern	• Small numbers pass through eastern Canada during fall migration; have been occasional sightings in the Orphan Basin in fall migration • Unlikely to occur in the Project Area • Low potential for interaction with routine Project activities; could potentially be affected in the unlikely event of a spill reaching coastal waters
Red-necked phalarope	None	None	Special Concern	• Form large flocks at sea and prey on zooplankton in areas of convergences and upwellings during migration and during winter months • Could occur in small numbers in the RAA and potentially the Project Area
Ivory gull	Endangered	Endangered (Schedule 1)	Endangered	• Breeds in the arctic and winters at sea • Expected to be present in the northern part of the RAA in small numbers in late winter or early spring when sea ice is present • Low potential for interaction with Project activities given likely seasonality of presence in the RAA
Ross's gull	None	Threatened (Schedule 1)	Threatened	• Breeds in arctic and subarctic habitats but has been recorded at a wintering area reaching from the Labrador Sea to Orphan Basin • Could potentially be present in the RAA and Project Area in the winter • Low potential for interaction with Project activities given likely low occurrence and seasonality of presence in the RAA
Peregrine falcon	Vulnerable	Special Concern (Schedule 1)	Special Concern	• Migrates along the coast of Newfoundland during fall • Observed in small numbers in the offshore • If present, could potentially be attracted to the MODU and/or PSVs to rest or prey on landbirds seeking refuge in these areas

9.3.5 Summary of Project Residual Environmental Effects

Table 9.5 summarizes the environmental effects assessment and prediction of residual environmental effects resulting from interactions between the Project and marine and migratory birds. The greatest

potential for environmental effects on marine and migratory birds is related to artificial lighting associated with presence and operation of a MODU which may result in nocturnal attraction and stranding of birds (including Leach's storm-petrels) on the MODU. This will be mitigated through daily searches, and recovery, rehabilitation, and release of birds adhering to protocols detailed in ECCC's *Procedures for Handling and Documenting Stranded Birds Encountered on Infrastructure Offshore Atlantic Canada* (ECCC 2016). As described in Chapter 8, significant effects to fish resources are not expected to occur as a result of the Project, and so changes in the availability, location, or quality of food sources for marine birds are not likely.

Table 9.5 Summary of Residual Environmental Effects on Marine and Migratory Birds, including Species at Risk

Residual Effect	Residual Environmental Effects Characterization						
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in Risk of Mortality or Physical Injury							
Presence and operation of a MODU	A	L	RAA	ST-MT	IR	R	D
VSP operations	A	N-L	PA	ST	IR	R	D
Discharges	A	L	PA	ST	IR	R	D
Well evaluation and testing	A	L	PA	ST	IR	R	D
Supply and Servicing Operations	A	L	LAA	ST	IR	R	D
Change in Habitat Quality and Use							
Presence and operation of a MODU	A	L	RAA	ST-MT	IR	R	D
VSP operations	A	N	PA	ST	UL	R	D
Discharges	A	L	PA	ST	UL	R	D
Well evaluation and testing	A	L	PA	ST	IR	R	D
Supply and servicing operations	A	L	LAA	ST	IR	R	D

KEY:
See Table 9.2 for detailed definitions
N/A: Not Applicable

Direction:
P: Positive
A: Adverse

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PA: Project Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term
MT: Medium-term
LT: Long-term
P: Permanent

Frequency:
UL: Unlikely
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological / Socio-Economic Context:
D: Disturbed
U: Undisturbed

9.4 Determination of Significance

Based on the nature of the interactions between the Project and marine and migratory birds, and the planned implementation of mitigation, and residual changes to risk of mortality or physical injury, or to habitat quality and use, the Project is not likely to result in significant adverse effects on marine and migratory birds. Although Project-related components, activities and emissions may result in some localized, short-term interactions with marine and migratory birds in parts of the Project Area and LAA primarily as a result of bird attraction to offshore lighting and other components, the Project is not predicted to result in a detectable decline in overall bird abundance or changes in the spatial and temporal distributions of bird populations within this area. The potential for interactions between individuals of species at risk and the Project is limited, and no identified critical habitat is present in the Project Area, LAA, or RAA. The Project is therefore not predicted to jeopardize the overall abundance, distribution, or health of species at risk. With mitigation and environmental protection measures, the residual environmental effects on marine and migratory birds (including species at risk) are predicted to be not significant.

This overall determination is made with a moderate level of confidence given uncertainties in predicting the impact of attraction to artificial lighting and flaring on the MODU. As noted in previous studies, the proportion of marine and migratory birds that are attracted to artificial lighting or flares and, as a result, potentially die and fall into the sea or are consumed by scavengers may be under-reported, as may be the proportion of birds that strand on MODUs but are not found in time to prevent rehabilitation and release, or not found at all. Existing literature also highlights uncertainties and raises questions about the influence of atmospheric conditions on stranding events and the episodic nature of stranding / mortality events.

9.5 Follow-up and Monitoring

For the duration of the drilling program for each well, routine systematic checks will be conducted for stranded birds on the MODU and PSVs by trained personnel in accordance with *Procedures for Handling and Documenting Stranded Birds Encountered on Infrastructure Offshore Atlantic Canada* (ECCC 2016) and associated permit conditions under the MBCA authorizing the capture and handling of migratory birds. Results of the monitoring program will be shared publicly to help further improve the understanding of bird strandings and mortality in the Newfoundland and Labrador offshore area.

9.6 References

9.6.1 Personal Communications

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10.0 ASSESSMENT OF POTENTIAL EFFECTS ON MARINE MAMMALS AND SEA TURTLES

The Marine Mammals and Sea Turtles VC includes baleen whales, large toothed whales, dolphins, porpoises, seals, and sea turtles. This VC also considers marine mammals and sea turtles listed under Schedule 1 of SARA and considered at risk by COSEWIC. Marine mammals and sea turtles were selected as a VC in recognition of the important habitat for these species in the offshore waters of Newfoundland and Labrador; the cultural and recreational value placed on these species by Indigenous peoples and the general public; the potential vulnerability of marine mammals to underwater sound; regulatory considerations, including consideration of SAR and SOCC; and the EIS Guidelines, which require assessment of effects of the Project on marine mammals and sea turtles.

As noted in Section 6.3 of the EIS, 24 species of marine mammals are known to occur within or near the Project Area, including 19 species of cetaceans (whales, dolphins, and porpoises) and five species of seals. Most marine mammals use the area seasonally; however, some occur offshore year-round. Three species of sea turtles may also occur within or near the Project Area, however, only the leatherback sea turtle regularly occurs adjacent to the RAA-it is considered rare in the Project Area.

This VC is linked to the Marine Fish and Fish Habitat VC (Chapter 8) because marine mammals and sea turtles prey on fish and invertebrates. This VC is also linked to the Special Areas VC (Chapter 11), as some special areas encompass important habitat for marine mammals.

10.1 Scope of Assessment

10.1.1 Regulatory and Policy Setting

Marine mammals and sea turtles and their habitat are protected under the federal *Fisheries Act* and SARA. The *Fisheries Act* includes provisions that prohibit serious harm to fish (i.e., the death of fish or permanent alteration to, or destruction of, fish habitat) that are part of a commercial, recreational, or Aboriginal fishery. Marine mammals and sea turtles as “marine animals” are considered “fish” for the purposes of the SARA. SARA includes provisions to protect species listed on Schedule 1 of SARA as well as their critical habitat, which is defined as “habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species’ critical habitat in a recovery strategy or action plan for the species” (section 2(1)).

SAR include all species listed under Schedule 1 of the federal SARA as endangered, threatened, or of special concern. Species of Conservation Concern (SOCC) include those that are listed as endangered, threatened, or of special concern by COSEWIC, but not yet listed in Schedule 1 of SARA. Wildlife species that are protected federally under SARA are listed in Schedule 1 of the Act. SARA seeks to prevent species from being extirpated or becoming extinct; to provide for the recovery of species that are extirpated, endangered, or threatened as a result of human activity; and to manage species of special concern to prevent them from becoming endangered or threatened. Sections 32, 33 and 58 of SARA contain provisions to protect species listed on Schedule 1 of SARA, and their critical habitat. Under section 79 of SARA,

Ministerial notification is required if a project is likely to affect a listed wildlife species or its critical habitat. This notification must identify the adverse effects of the project on the listed wildlife species and its critical habitat and, if the project is conducted, measures that will be taken to avoid or lessen those effects, along with monitoring commitments.

The marine mammal and sea turtle VC considers species that are secure as well as those listed under SARA or identified by COSEWIC as at risk. However, SAR and SOCC are given special attention and emphasis in the identification, analysis and evaluation of potential Project effects and required mitigation measures.

10.1.2 Influence of Consultation and Engagement on the Assessment

Questions and comments related to marine mammals and sea turtles were noted during BP's Project-related engagement with government departments and agencies, stakeholder organizations and Indigenous groups (see Chapter 3 for further details). Several Indigenous communities indicated concerns about potential Project-related effects on marine mammals, particularly on SARA-listed species including the blue whale and North Atlantic right whale. Some Indigenous communities also indicated that they harvest seals as a country food and therefore also expressed concern about potential effects on seals.

10.1.3 Potential Effects, Pathways and Measurable Parameters

Routine Project activities and components have potential to interact with marine mammals and sea turtles primarily due to underwater sound associated with the presence and operation of a MODU, VSP survey, PSV operations, and to a lesser extent, helicopter overflights. These potential disturbance sources, as well as operational discharges, could result in direct and indirect (e.g., changes to habitat quality) effects on marine mammals and sea turtles. There is also risk of morality or physical injury as a result of collisions with PSVs. The Project could also result in changes in the availability, distribution or quality of prey (refer to Chapter 8 for an assessment of effects on prey species).

As a result of these considerations, the assessment of Project-related effects on marine mammals and sea turtles is focused on the following potential effects:

- change in risk of mortality or physical injury
- change in habitat quality and use

The measurable parameters used for the assessment of the environmental effects presented above, and the rationale for their selection, are provided in Table 10.1. Effects of accidental events are assessed separately in Section 15.5.3.

Table 10.1 Potential Effects, Effects Pathways and Measurable Parameters for Marine Mammals and Sea Turtles

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Risk of Mortality or Injury	• Interactions between Project activities and the environment that result in direct effects to the health or condition of marine mammals and sea turtles. This may occur through collisions with vessels, exposure to underwater sound levels at or above established acoustic thresholds for hearing impairment.	• Estimated underwater sound levels relative to acoustic thresholds associated with potential injury impacts for marine mammals and sea turtles • Expected species occurrence and relative abundance (qualitative) in the areas ensonified by Project activity sound sources where effects are predicted to occur • Mortality or injury detected during the Project
Change in Habitat Quality and Use	• Interactions between Project activities and the environment that result in acoustic or water quality changes to marine mammal and sea turtle habitat. This may include direct behavioural effects (e.g., avoidance) related to increased sound levels from Project activities and indirect effects related to changes in prey quantity and quality that may be related to increased sound levels and/or drilling discharges.	• Change in water quality • Estimated underwater sound levels relative to acoustic thresholds, and available scientific understanding of potential behavioural responses to sound, for marine mammals and sea turtles • Expected species occurrence and relative abundance (qualitative) in the areas ensonified by Project activity sound sources where effects are predicted to occur • Change in area of habitat (qualitative) used for feeding, breeding, or migration

10.1.4 Boundaries

Spatial and temporal boundaries for the assessment of marine mammals and sea turtles are discussed in the following sections.

10.1.4.1 Spatial Boundaries

Project Area: The Project Area (Figure 10.1) encompasses the immediate area in which Project activities may occur. Well locations have not been identified but will occur within the ELs in the Project Area. The Project Area includes ELs 1145, 1146, 1148 and 1149. The Project Area has been delineated to provide a 20 km buffer around each EL.

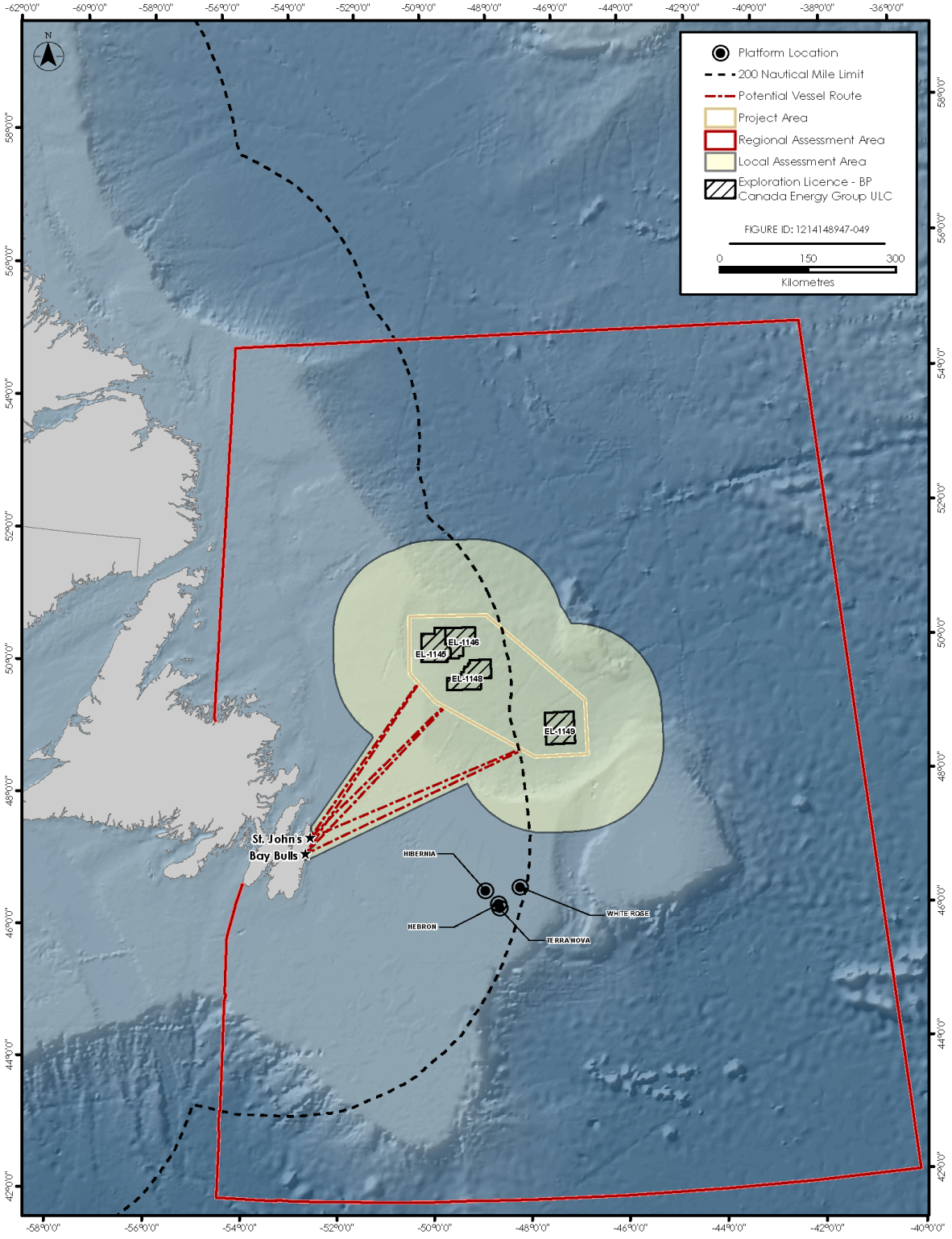

Figure 10.1 Marine Mammals and Sea Turtles Spatial Boundaries

Local Assessment Area (LAA): The LAA (Figure 10.1) is the maximum area within which environmental effects from routine Project activities and components can be predicted or measured with a reasonable degree of accuracy and confidence. It consists of the Project Area and adjacent areas where Project-related environmental effects are reasonably expected to occur based on available information, including effects thresholds, predictive modelling, and professional judgement. The LAA also includes transit routes to and from the Project Area. The main Project-related environmental interactions that potentially affect marine mammals and sea turtles and their prey include underwater sound that will be generated by the MODU, PSVs, and VSP surveys. The LAA for the marine mammal and sea turtle VC is defined as a 150 km radius buffer around the ELs as well as the associated vessel and aircraft routes to the Project Area.

Regional Assessment Area (RAA): The RAA (Figure 10.1) is the area within which residual environmental effects from operational activities and accidental events may interact with marine mammals and sea turtles that are outside the Project Area. The RAA also accounts for residual environmental effects related to routine activities that could interact cumulatively with the residual environmental effects of other past, present, and future (certain or reasonably foreseeable) physical activities.

10.1.4.2 Temporal Boundaries

The temporal boundaries for the assessment of potential Project-related environmental effects on marine mammals and sea turtles encompass all Project phases, including well drilling, testing, and abandonment. BP is currently planning a one-well program with an initial well proposed for 2020 but could potentially drill up to 20 wells between 2020 and 2026. Well testing (if required, dependent upon drilling results) could also occur at any time during the temporal scope of this EIS. Wells may be decommissioned and abandoned at any time within the temporal boundaries. Each well is anticipated to take approximately 60 days to drill and VSP surveys typically take approximately one day per well. Drilling operations will not be continuous throughout the entire seven-year scope of the Project and will depend partially on rig availability and results from previous wells. While drilling activities have the potential to be conducted at any time of the year, BP's preference is to conduct drilling between May and October.

Marine mammals and sea turtles can be found year-round in the RAA carrying out various life cycle processes, although summer is an important period in waters offshore Newfoundland where many migratory species come to feed before returning to more southern latitudes for the winter. Pinnipeds may be more common during winter and spring. Refer to Section 6.3 for details regarding the specific marine mammal and sea turtle species known to occur in the RAA, including their sensitive life stages in relation to the Project Area.

10.1.5 Residual Effects Characterization and Significance Definition

The definitions used to characterize environmental effects as part of this effects assessment for marine mammals and sea turtles are provided in Table 10.2. These characterizations will be used throughout the chapter when describing potential residual environmental effects on marine mammals and sea turtles from routine Project activities. These characterizations are also applicable for accidental events, as discussed in Section 15.5.3.

Table 10.2 Characterization of Residual Effects on Marine Mammals and Sea Turtles

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual environmental effect relative to baseline	**Positive** – a residual environmental effect that moves mortality, injury, health, or habitat quality in a direction beneficial to marine mammals and sea turtles relative to baseline **Adverse** – a residual environmental effect that moves mortality, injury, health, or habitat quality in a direction detrimental to marine mammals and sea turtles relative to baseline
Magnitude	The amount of change in mortality, injury, health, or habitat quality of marine mammals and sea turtles relative to existing conditions	**Negligible** – no measurable change **Low** – a detectable change but within the range of natural variability **Moderate** – a detectable change beyond the range of natural variability, but with no associated adverse effect on the viability of the affected population **High** – A detectable change that is beyond the range of natural variability, with an adverse effect on the viability of the affected population
Geographic Extent	The geographic area in which a residual environmental effect occurs	**PA –** residual environmental effects are restricted to the Project Area **LAA –** residual environmental effects extend into the LAA **RAA –** residual environmental effects extend into the RAA
Frequency	Identifies how often the residual effect occurs and how often during the Project	**Unlikely event** – effect is unlikely to occur **Single event** – effect occurs once **Multiple irregular event** – effect occurs at no set schedule **Multiple regular event** – effect occurs at regular intervals **Continuous** – effect occurs continuously
Duration	The period of time required until the mortality, injury, health, or habitat quality of marine mammals and sea turtles returns to its existing condition, or the residual effect can no longer be measured or otherwise perceived	**Short term** - for duration of the activity, or for duration of accidental event **Medium term** - beyond duration of activity up to end of Project, or for duration of threshold exceedance of accidental event – weeks or months **Long term** - beyond Project duration of activity, or beyond the duration of threshold exceedance for accidental events - years **Permanent** - recovery to baseline conditions unlikely
Reversibility	Pertains to whether mortality, injury, health, or habitat quality of marine mammals and sea turtles can return to its existing condition after the project activity ceases	**Reversible –** will recover to baseline conditions before or after Project completion **Irreversible –** permanent

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Ecological and Socio-economic Context	Existing condition and trends in the area where residual effects occur	**Undisturbed** – The VC is relatively undisturbed in the RAA, not adversely affected by human activity, or is likely able to assimilate the additional change **Disturbed** – The VC has been previously disturbed by human development or human development is still present in the RAA, or the VC is likely not able to assimilate the additional change

In consideration of the descriptors listed above, as well as consideration of requirements under SARA and associated regulations and recovery plans, the following threshold has been established to define a significant adverse residual environmental effect on marine mammals and sea turtles.

For the purposes of this effects assessment, a significant adverse residual environmental effect on the marine mammal and sea turtle VC is defined as a Project-related environmental effect that:

- causes a detectable decline in abundance or change in the spatial and temporal distribution of marine mammals and sea turtles within the overall RAA, such that natural recruitment may not re-establish the population(s) to its original level within one generation
- jeopardizes the achievement of self-sustaining population objectives or recovery goals for listed (SAR) species such that the overall abundance, distribution and health of that species and its eventual recovery within the RAA is adversely affected
- results in permanent and irreversible loss of critical habitat as defined in a recovery plan or an action strategy for a listed (SAR) species such that the overall abundance, distribution and health of that species and its eventual recovery within the RAA is adversely affected

10.2 Project Interactions with Marine Mammals and Sea Turtles

Table 10.3 identifies the physical activities that may interact with marine mammals and sea turtles and result in the identified environmental effects. These interactions are indicated by checkmarks, and are discussed in detail in Section 10.3, in the context of effects pathways, standard and project-specific mitigation measures, and residual effects. A justification for no effect is provided following Table 10.3.

Discharge of drill muds and cuttings as well as other routine discharges are not predicted to interact with marine mammals and sea turtles leading to a change in the risk of mortality or injury; potential effects of discharges will be mitigated by treatment in accordance with the OWTG. Treated discharges may result in temporary and localized reduction in water and sediment quality but this will not result in mortality or injury in marine mammals and sea turtles. Potential effects of these discharges on marine mammal and sea turtle prey are discussed in Section 10.3.3, in the context of change in habitat quality and use.

Table 10.3 Project-Environment Interactions with Marine Mammals and Sea Turtles

Physical Activities (refer to Section 4.1.1 for the Scope of the Project)	Environmental Effects	
	Change in Risk of Mortality or Physical Injury	Change in Habitat Quality and Use
MODU presence and operation (including drilling, associated safety zone, and MODU lighting)	✓	✓
Vertical Seismic Profiling (VSP) operations	✓	✓
Discharges (e.g., drill muds / cuttings, liquid discharges)	–	✓
Well evaluation and testing (including flaring)	–	–
Well abandonment and decommissioning	–	✓
Supply and servicing operations (including helicopter transportation and PSV operations)	✓	✓
Notes: ✓ = Potential interaction – = No interaction		

As described in Section 2.4.3, well testing involves flowing the well fluids through temporary test equipment located on the MODU and requires flaring of gases or other hydrocarbons that come to surface for safe disposal. As these activities occur some distance above sea level, there is no potential for interaction with marine mammals or sea turtles.

Well abandonment typically involves setting a series of cement and mechanical plugs within the wellbore. If a wellhead is removed, it will be done by using mechanical means. As such, well abandonment activities are not anticipated to produce sounds that pose a mortality or injury risk to marine mammals and sea turtles. Potential effects of well abandonment activities on marine mammals and sea turtles are discussed in Section 10.3.3, in the context of change in habitat quality and use.

10.3 Assessment of Residual Environmental Effects on Marine Mammals and Sea Turtles

The following section assesses the environmental effects on marine mammals and sea turtles identified as arising from potential interactions in Table 10.2. Given the similarities in Project description, proximity of activities on Orphan Basin and Flemish Pass, and currency of data, the EIS incorporates learnings from previous EA documents for similar exploration drilling projects in Atlantic Canada, including comments received during Indigenous and stakeholder review processes, with updates incorporated as applicable due to Project and geographic differences, scientific updates, and refined EA methods.

JASCO Applied Sciences was engaged to characterize the existing underwater soundscape in the Project Area and predict underwater sound transmission loss for representative source levels for different sound sources expected to be in operation during the Project (Matthews et al. 2018; Appendix C).

10.3.1 Project Pathways

10.3.1.1 Change in Risk of Mortality or Physical Injury

There are two primary pathways from Project activities that may result in change in the risk of mortality or physical injury for marine mammals and sea turtles: ship strikes and underwater sound generated by VSP operations and the transiting of PSVs to and from the Project Area have the potential to strike a marine mammal or sea turtle, resulting in injury or mortality. The pathway of effect in the case of a ship strike is a result of physical contact with the vessel. Exposure to underwater sound produced by an air gun source array during VSP operations has the potential to cause temporary changes in marine mammal or sea turtle hearing sensitivity (temporary threshold shifts, or TTS) as well as the possibility of permanent auditory injury (permanent threshold shift, or PTS). Similarly, exposure to sound from the MODU could in theory result in auditory injury, although this is highly unlikely. There are no documented cases of marine mammal and sea turtle mortalities causally-linked to sound generated during oil and gas exploration activities.

10.3.1.2 Change in Habitat Quality and Use

A change in habitat quality and use for marine mammals and sea turtles may occur from Project activities, particularly due to the influence of underwater sound associated with the MODU, VSP, PSVs, and the potential removal of wellhead infrastructure (if applicable). Marine mammals use the underwater acoustic environment, as they use and produce sounds both passively and actively to communicate, navigate, locate prey and predators, and gather information about their surroundings (Richardson et al. 1995; Nowacek et al. 2007; Tyack 2008; Shannon et al. 2016). The importance of underwater sound to sea turtles is not well known but is thought to be less important than for marine mammals. The introduction of anthropogenic sound, including that from offshore exploration activities and vessel traffic has the potential to result in adverse effects on marine mammals and sea turtles. This assessment focuses on potential changes in behaviour and distribution of the animals (i.e., “disturbance”) that are of sufficient magnitude to be “biologically important”. Consideration is also given to masked communication of marine mammals which is the obscuring of sounds of interest by interfering sounds, generally at similar frequencies.

10.3.2 Mitigation Measures

In consideration of the environmental effects pathways outlined above, the following mitigation measures and standard practices will be employed to reduce potential effects on marine mammals and sea turtles.

Vertical Seismic Profiling Operations

- As required in the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2017), mitigation measures applied during geophysical surveys (VSP) will be consistent with those outlined in the *Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment* (SOCP) (DFO 2007). The following are key mitigation measures that will be employed during VSP surveys:
  - Marine Mammal Observers (MMOs) will be used to monitor and report on marine mammal and sea turtle sightings during VSP surveys to advise shutdown and ramp-up procedures

- A ramp-up procedure (i.e., gradually increasing seismic source elements over a period of approximately 30 minutes until the operating level is achieved) will be implemented before any VSP activity begins. This measure is aimed at reducing the potential for auditory impairment to marine animals in close proximity to the source at the onset of activity. It is based on the assumption that the gradual increase in emitted sound levels will provide an opportunity for marine animals to move away from the sound source before potentially injurious sound levels are achieved close to the source. This procedure will include a pre-ramp up observation period. Ramp-up will be delayed if any marine mammal or sea turtle is detected within 500 m of the air gun array.
- MMOs will implement a pre-ramp up watch of 60 minutes prior to ramp-up. The longer 60-minute pre-ramp up watch versus the minimum 30-minute period required in the SOCP will be used to account for the longer dive times of beaked whales (and other deep-diving marine mammal species) expected to occur in the Project Area. This is recommended by DFO (Moors-Murphy and Theriault 2017) in a recent review of the SOCP.
- Shut down procedures (i.e., shutdown of source array) will be implemented if a marine mammal or sea turtle listed on Schedule 1 of SARA is observed within 500 m of the air gun array.
- Passive acoustic monitoring (PAM) will be used to detect vocalizing marine mammals during conditions of low visibility (e.g., fog and darkness).

Discharges

- Refer to the waste management mitigation measures identified in the Marine Fish and Fish Habitat VC (Section 8.3.2).

Supply and Servicing Operations

- PSVs will use existing shipping lanes as practicable; where these do not exist, PSVs will follow a straight-line approach to and from the Project Area.
- During transit to / from the Project Area, PSVs will travel at vessel speeds not exceeding 22 km/hour (12 knots), except as needed in the case of an emergency. In the event that a marine mammal or sea turtle is detected in proximity to the vessel, vessel speed will be reduced to avoid the marine mammal or sea turtle.

10.3.3 Characterization of Residual Project-related Environmental Effects

10.3.3.1 Change in Risk of Mortality or Physical Injury

Presence and Operation of a MODU

As discussed in Section 2.8.5, the MODU will produce continuous (i.e., non-impulsive) sound during operations. It is assumed the broadband sound source level for the MODU would be 196.7 dB re 1 µPa @ 1 m rms SPL. This MODU source level has been used in recent acoustic modelling studies conducted for offshore exploration drilling programs in the Scotian Basin (Zykov 2016) and in the Flemish Pass (Quijano et al. 2017) and is considered conservative for effects assessment purposes in that reported values have been lower (Richardson et al. 1995; Hildebrand 2009; OSPAR 2009; Kyhn et al. 2011; MacDonnell 2017). Based on published threshold values for auditory injury (PTS) for marine mammals (Table 10.4), it is highly unlikely that marine mammals would experience hearing impairment from exposure to sound from a MODU.

Based upon a modelling study undertaken for the Flemish Pass, estimated sound levels from the MODU did not reach the SPL_{peak} auditory injury thresholds for non-impulsive sounds for all marine mammal groups (see Tables 11 and 12 in Matthews et al. 2017). Similarly, modelling results indicate that most marine mammals would have to occur and remain within approximately 200 m of the MODU for a 24-hour period to experience sound levels above the thresholds associated with PTS based on the SEL_{cum} injury (see Tables 11 and 12 in Matthews et al. 2017). Cetaceans with high-frequency hearing, such as harbour porpoise, are at somewhat higher risk of incurring PTS in the presence of sound within the hearing frequency range based on lower SPL_{peak} and SEL_{cum} threshold values. It is anticipated that most marine mammals will avoid the immediate area around the MODU (detailed below under change in habitat quality and use), thereby further minimizing the likelihood of marine mammals incurring hearing impairment. Although less is known about the effects of underwater sound on sea turtle hearing and behaviour, it is assumed turtles, should they occur in the Project Area, would also exhibit localized avoidance of the MODU. In summary, it is highly unlikely that marine mammals or sea turtles are at risk of incurring auditory injury from exposure to underwater sound from the MODU.

Residual effects associated with the presence and operation of a MODU on a change in risk of mortality and physical injury to marine mammals and sea turtles are predicted to be adverse, negligible in magnitude, localized to the Project Area, an unlikely event, short-to medium-term in duration, and reversible.

Vertical Seismic Profiling Operations

As discussed in Section 2.8.5, VSP surveys use air guns (arranged in a source array) which produce intermittent impulsive sound at high levels. However, the associated size and total volume of the source array used during a VSP survey are typically much smaller than those used in a traditional offshore seismic survey, and thus VSP operations tend to produce lower sound levels. In addition to utilizing a smaller source array than traditional seismic surveys, VSP operations occur over much shorter time frames (e.g., days instead of months) and are conducted over a much smaller spatial scale (i.e., limited to the wellsite). While these factors greatly reduce the likelihood that marine mammals and sea turtles will incur hearing impairment effects from VSP, the potential does exist. During the Project, VSP will approximately take a day per well to complete. Further description of VSP is provided in Section 2.4.2.

Temporary or permanent hearing impairment is possible when marine mammals are exposed to sound levels above certain threshold levels (refer to Appendix 4 of LGL 2015 for details). A TTS in hearing has been demonstrated and studied in a limited number of captive odontocete and pinniped species exposed to sounds (reviewed in Southall et al. 2007). There is no specific evidence that exposure to sound pulses from an air gun source array can cause PTS in any marine mammal, even with large arrays of air guns. However, given the likelihood that some mammals (e.g., harbour porpoise and seals) close to an air gun array might incur at least mild TTS, there has been further speculation about the possibility that some individuals occurring very close to air guns might incur PTS (e.g., Richardson et al. 1995; Gedamke et al. 2011). Single or occasional occurrences of mild TTS are not indicative of permanent auditory damage; however, repeated, or (in some cases) single exposures to a level well above that causing TTS onset, might elicit PTS (e.g., Kastak and Reichmuth 2007; Kastak et al. 2008).

At the present state of knowledge, it is necessary to assume that any impact is directly related to total received energy, although there is recent evidence that auditory effects in a given animal are not a simple function of received acoustic energy (Finneran 2015). Frequency, duration of the exposure, and occurrence of gaps between individual sound signals within a period of exposure can also influence the auditory effect (Mooney et al. 2009; Finneran and Schlundt 2010, 2011, 2013; Finneran et al. 2010a,b; Finneran 2012, 2015; Kastelein et al. 2012a,b, 2013a,b,c, 2014, 2015, 2016a,b; Ketten 2012; Supin et al. 2016). It is also inappropriate to assume that onset of TTS occurs at similar received levels in all cetaceans (cf. Southall et al. 2007). TTS information for odontocetes is primarily derived from studies on the bottlenose dolphin and beluga, and that for pinnipeds has mostly been obtained from California sea lions and elephant seals (Appendix 4 LGL 2015 for details). Studies on bottlenose dolphins by Finneran et al. (2015) indicate that the potential for air gun source arrays to cause auditory effects on dolphins could be lower than previously thought. Based on behavioural studies, Finneran et al. (2015) reported no measurable TTS in three bottlenose dolphins after exposure to 10 impulses from a seismic air gun source. However, auditory evoked potential measurements were more variable, with one dolphin showing a small (9 dB) threshold shift at 8 kHz. There have been several studies on TTS which indicate that received levels that elicit onset of TTS are lower in porpoises than for other odontocetes (e.g., Lucke et al. 2009; Kastelein et al. 2012a, 2013a, 2014, 2015; Tougaard et al. 2016). Evidence from more prolonged (non-pulse and pulse) exposures suggested that harbour seals incur TTS at somewhat lower received levels than do small odontocetes exposed for similar durations (e.g., Kastak et al. 1999, 2005, 2008; Ketten et al. 2001; Kastelein et al. 2013c).

Popov et al. (2017) reported that TTS produced by exposure to a fatiguing noise was larger during the first session of an exposure (or naïve subject state) with a beluga whale than TTS that resulted from the same sound in subsequent sessions (experienced subject state). Similarly, several other studies have shown that some marine mammals (e.g., bottlenose dolphins, false killer whales) can decrease their hearing sensitivity in order to mitigate the impacts of exposure to loud sounds (e.g., Nachtigall and Supin 2014, 2015). When Reichmuth et al. (2016) exposed captive spotted and ringed seals to single air gun pulses with SELs of 165–181 dB re 1 μPa^2s and SPLs (peak to peak) of 190–207 dB re 1 µPa, no low-frequency TTS was observed.

There is substantial overlap in the frequencies that sea turtles detect versus the frequencies in air gun pulses. Sounds from an air gun array might cause temporary hearing impairment in sea turtles if they do not avoid the immediate area around the air guns. However, monitoring studies show that some sea turtles do show localized movement away from approaching air guns (Appendix 5 in LGL 2015). At short distances from the source, received sound levels diminish rapidly with increasing distance. In that situation, even a small-scale avoidance response could result in a substantial reduction in sound exposure.

Nowacek et al. (2013) concluded that current scientific data indicate that air guns have a low probability of directly harming marine life, except at close range. Several aspects of the planned monitoring and mitigation measures for seismic surveys are designed to detect marine mammals and sea turtles occurring near the air gun array, and to avoid exposing them to sound pulses that might, at least in theory, cause hearing impairment. Many cetaceans and (to a limited degree) pinnipeds and sea turtles also show some avoidance of the area where received levels of air gun sound are high enough to cause potential hearing impairment.

In those cases, the avoidance responses of the animals themselves will reduce the possibility of hearing impairment.

Assessments of hearing impairment are typically based on whether sound levels reach or exceed established thresholds. Canada has not developed or formally adopted guidelines regarding acoustic thresholds for hearing impairment to marine mammals and sea turtles, and there is no single standard for assessing effects on marine mammals and sea turtles. This assessment considers the most relevant and available scientific information. A summary of the criteria used in this assessment and the rationale for the selection is provided below for marine mammals and sea turtles.

The United States National Marine Fisheries Service (NMFS) guidelines provide the most current guidance on threshold levels of underwater sound for the onset of TTS and PTS in marine mammals (NMFS 2016). Much of the basis for these guidelines comes from recommendations by Southall et al. (2007) as well as those presented by Finneran (2016). Dual metrics for threshold values are provided: peak sound pressure levels (SPL_{peak}); and cumulative (over 24 hours) sound exposure levels (SEL_{cum}). Conclusions are based on whichever metric is first exceeded. For example, onset of PTS (i.e., injury) is assumed to occur if a received sound exposure exceeds the peak SPL criterion, or the SEL criterion, or both criteria. Acoustic threshold levels for the onset of PTS proposed by NMFS (2016) are summarized in Table 10.4. As with most acoustic thresholds, these values serve as a guide only and in many cases are based on limited data.

Table 10.4 Acoustic Threshold Levels for Permanent Threshold Shift (PTS) Onset

Hearing Group	PTS Onset Threshold Levels (NMFS Acoustic Guidelines [2016[1]])			
	Impulsive Sound		Non-impulsive Sound	
	dB SPL_{peak}	dB SEL_{cum}	dB SPL_{peak}	dB SEL_{cum}
Low-frequency Cetaceans	219	183	219	199
Mid-frequency Cetaceans	230	185	230	198
High-frequency Cetaceans	202	155	202	173
Phocids (in water)	218	185	218	201

Notes:
dB (decibel) SPL_{peak} has a reference value of 1 µPa
dB SEL_{cum} has a reference value of 1 μPa^2s
1 Final guidelines released by NMFS in July 2016 update their draft thresholds (NOAA 2015, 2016) and replace their previous interim dB SPL_{rms} criteria for injury (i.e., 180 dB SPL_{rms} for cetaceans and 190 dB SPL_{rms} for pinnipeds [NOAA n.d.])

Threshold criteria provided by NMFS (2016) were developed specifically for marine mammals. As soon as adequate data are available, NMFS intends to establish similar acoustic thresholds for onset of PTS in other species, such as sea turtles and marine fish (NOAA 2015). Under the American National Standards Institute-Accredited Committee S3, Subcommittee 1, an Animal Bioacoustics Working Group has established sound exposure guidelines for sea turtles that adopt some of Southall et al.'s (2007) approaches for marine mammals. Because little is known about hearing and the effects of underwater sound in sea turtles, the Animal Bioacoustics Working Group has thus far only developed numeric thresholds for potential sea turtle mortality in relation to explosions, air guns, and pile driving (Popper et al. 2014).

Acoustic modelling of a 1,500 in³ air gun array with a sound pressure source level (broadside; 10-2000 Hz) of 247.8 dB re 1 µPa @ 1 m SPL_{peak} was undertaken for this EIS (Matthews et al. 2018, Appendix C) and transmission loss (TL) was compared to acoustic modelling studies for the Scotian Basin Exploration Drilling Project (Zykov 2016) and the Nexen Energy ULC Flemish Pass Exploration Drilling Project (Matthews et al. 2017). Matthews et al. (2018) concluded that distances to sound level isopleths in EL 1145 are expected to be similar to those modelled for May in the Flemish Pass and longer than those modelled in the Scotian Basin (in both August and February). Distances to sound level isopleths in EL 1149 are expected to be shorter than those in May in Flemish Pass and those in Scotian Basin (in both August and February) (refer to Table 2.16, and Matthews et al. 2018, Appendix C). Based upon this comparative analysis of sound TL amongst offshore areas in Nova Scotia and Newfoundland, VSP modelling results from Flemish Pass (i.e., a 2,400 in^3 air gun array) were used as a proxy in the effects assessment here.

Estimated sound levels from the VSP air gun array (2,400 in^3) were above SPL_{peak} injury thresholds (PTS onset) for impulsive sounds for most marine mammal groups within 20 m of the array (see Tables 11 and 12 in Matthews et al. 2017). Sound level was predicted to decrease to below the SPL_{peak} injury threshold for cetaceans with high-frequency hearing was predicted to occur slightly farther away (i.e., within 120 m of the air gun array). Considering the SEL_{cum} metric for injury, once again, most marine mammals would have to occur and remain within close range of the air gun array, approximately 140 m to 400 m, to in theory incur auditory injury (PTS; see Tables 11 and 12 in Matthews et al. 2017). This also assumes that marine mammals occur within these distances of the VSP air gun array for a 24-hour period; this is considered an unlikely scenario. Cetaceans that are considered low-frequency hearing specialists (i.e., baleen whales) are thought to be at higher risk of incurring auditory injury from VSP sounds because most of the acoustic energy in air guns occurs at lower frequencies. Modelling results suggest that if a baleen whale occurs within approximately 5-6 km of the VSP air gun array (possibly up to 9.7 km based on R_{max} value) for a 24-hour period (i.e., the full duration of the VSP survey) there is risk of auditory injury (PTS). Once again, this is considered an unlikely scenario because baleen whales will likely exhibit localized avoidance of the VSP air gun array. The amount of acoustic energy received depends on where in the sound field, both horizontally and vertically, an animal is when the sound source is active. If PTS were to occur, it would likely to be measured in a few decibel loss in hearing sensitivity, not profound loss, because most predicted incidents of auditory injury would occur at greater distances from the source (BOEM 2017).

As noted above, Popper et al. (2014) have proposed guidelines for threshold levels that may cause mortality and potential mortal injury in sea turtles. They propose thresholds of 210 dB SEL_{cum} and 207 $dB_{peak,}$ which are consistent with those proposed for fish species whose swim bladder is not involved with hearing. Sound levels from VSP operations are predicted to be below these levels at distances beyond a couple of hundred metres (Matthews et al. 2017). It has been proposed that the rigid external anatomy of sea turtles may afford protection from the potential effects of impulsive sound (Popper et al. 2014). Thresholds for non-mortal injury of sea turtles are not available, but the relative risk has been categorized as ‘high’ in the ‘near’ field (10s of metres from the source), and ‘low’ at both ‘intermediate’ (100s of metres) and ‘far’ (1000s of metres) distances (Popper et al. 2014).

Based on the information and analysis summarized here, and with the implementation of mitigation measures (Section 10.3.2), it is unlikely that VSP surveys will result in injuries (PTS) for marine mammals or sea turtles. To mitigate potential effects from VSP activities, air gun operations will incorporate a ramp-

up in consideration of the *Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment* (SOCP, DFO 2007). Ramp-up will be delayed if any marine mammal or sea turtle is detected within 500 m of the air gun array. Air gun(s) will be shut down if a marine mammal or sea turtle listed as endangered or threatened on SARA Schedule 1 is detected within the 500-m zone around the air gun array. Overall, the risk of marine mammals and sea turtles incurring hearing impairment (injury) is considered low. This risk is further reduced for SAR given the rare occurrence of these species, with the exception of fin whales (Schedule 1, special concern), in the PA.

Residual effects associated with underwater sound from VSP operations related to changes in the risk of mortality and injury are predicted to be negligible to low in magnitude, localized to the Project Area, an unlikely event, short-to medium-term in duration, and reversible.

Supply and Servicing Operations

The Project will involve PSV use including supply and support traffic to, from and within the Project Area at all times of year over the course of Project activities. Exposure to vessel sounds is not expected to result in mortality or PTS (i.e., injury; Richardson et al. 1995), however, mortality or injury of marine mammals and sea turtles can occur as a result of vessel strikes. Although there are no known concentration areas for marine mammals along the PSV transit route, it is possible that groups of foraging marine mammals may be encountered along the route during summer months, in particular. Sea turtles are considered rare along the transit route and in the Project Area.

Mysticetes are known to be more vulnerable to vessel strikes than odontocetes and pinnipeds (Laist et al. 2001; Jensen and Silber 2003; Vanderlaan and Taggart 2007). All baleen whale species that may occur in the Project Area are documented to have been struck by ships (Jensen and Silber 2003), with fin whales being the most frequently struck followed by humpback and right whales (Laist et al. 2001; Jensen and Silber 2003; Panigada et al. 2006; Douglas et al. 2008). While it is not clear why whales are unable to avoid ship strikes, even when vessels are traveling slowly, there is evidence showing that strikes may be more likely in areas where large numbers of whales congregate to feed (Panigada et al. 2006) as well as evidence that vessel sound signatures are louder from the side and stern of the vessel than from the bow (Allen et al. 2012; McKenna et al. 2012), making detection of an approaching vessel more difficult for a whale in front of the vessel. Most lethal and severe injuries to large whales resulting from documented ship strikes have occurred when vessels were travelling at ≥14 knots (25.9 km/hour; Laist et al. 2001). Reducing 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; van der Hoop et al. 2015). Lethal strikes are considered infrequent at vessel speeds <14 knots and rare at speeds <10 knots (18.5 km/h; Laist et al. 2001).

The International Whaling Commission (IWC) maintains a global ship strike database that contains almost 1,200 verified incidents as of 2016 (Van Waerebeek and Leaper 2007; Ritter and Panigada 2016). In 2017, the IWC released its Strategic Plan to Mitigate the Impact of Ship Strikes on Cetacean Populations (Cates et al. 2017). The Plan advocates reducing the spatial overlap between high numbers of whales and vessels as the best means to mitigate ship strikes, with vessel speed restrictions as an alternate strategy in areas where spatial separation is not possible.

In their most recent five-year (2011-2015) baleen whale serious injury and mortality determinations, National Oceanic and Atmospheric Administration (NOAA) Fisheries reported an average of six large whale mortalities per year resulting from ship strikes along the east coast of North America, and another seven ship strikes in the region resulting in injury (either serious or nonserious) to the whale (Henry et al. 2017). The actual number of ship strike mortalities is likely much greater due to underreporting, the impossibility of recovering all carcasses, and the difficulty in determining cause of death in many cases. NOAA Fisheries reported that, on average, about 41 large whale mortalities per year during 2011-2015 had insufficient information to determine cause of death (Henry et al. 2017). While nearly all species of large whale have been victims of collisions with ships (Laist et al. 2001), of greatest concern is the North Atlantic right whale.

Ship strikes (and entanglements in commercial fishing gear) are thought to be major contributors to the North Atlantic right whale population's failure to recover in the post-whaling era (Kraus 1990; Caswell et al. 1999; IWC 2001; Elvin and Taggart 2008; Kraus et al. 2016). Right whales may be especially vulnerable to ship strikes because of behaviours that may make them less aware of their surroundings (Knowlton 1997), the amount of time they spend just below the surface where they are vulnerable to ship strikes and cannot be seen (Baumgartner et al. 2017b; Parks et al. 2012a), and their failure to react to closely approaching vessels (Nowacek et al. 2004; Vanderlaan and Taggart 2007). Ship strikes were found to represent the ultimate cause of death for 21 (52.5%) of the 40 North Atlantic right whales necropsied between 1970 and December 2006 (Campbell-Malone et al. 2008).

In June 2017, NOAA Fisheries declared an unusual mortality event (UME) for North Atlantic right whales that is ongoing (NOAA Fisheries 2018). As of June 2018, there were 19 dead stranded right whales (12 in Canada, 7 in the U.S.), most in the Gulf of St. Lawrence region. Eleven of the 19 right whales were necropsied with final results still pending for most. A report on six of the 12 whales that stranded in Canada is available, which found definitive evidence of blunt force trauma, suggestive of a ship strike, in four of the six whales and likely blunt force trauma in a fifth whale that was too decomposed to provide a definitive conclusion (Daoust et al. 2017). It is noteworthy that in the 2008-2014 data from Atlantic Canada examined in the DFO report mentioned previously (Themelis et al. 2016), there was only a single report of a right whale ship strike, which was non-fatal. The changing distribution of this species over the last several years has required a shift in strategy to monitor and manage this species (Pettis et al. 2017) and the 2017 incidents have accelerated this. It is unlikely that a right whale will occur in the Project Area and PSV routes; however, the possibility exists.

There is potential for Project vessels to strike sea turtles resulting in injury or mortality. Propeller and collision injures from boats and ships are common in sea turtles, at least in U.S. waters (NMFS 2008). In Australia, Hazel et al. (2007) demonstrated that the proportion of green sea turtles maneuvering to avoid a vessel decreased with increased vessel speed suggesting that turtles may not avoid faster moving vessels.

Based on the information and analysis summarized here, and with the implementation of mitigation measures (Section 10.3.2), it is highly unlikely that PSVs transiting to and from the Project Area and within the Project Area will strike a marine mammal or a sea turtle. PSVs will travel at speeds lower than those typically associated with lethal ship strikes to marine mammals. Also, vessel crew will keep a watch for marine mammals and sea turtles and reduce speed and/or alter course as appropriate to avoid collision. Overall, the risk of marine mammals and sea turtles incurring injury or experiencing mortality is considered

quite low. This risk is further reduced for SAR given that the rare occurrence of these species, with the exception of fin whales (Schedule 1, special concern).

Residual effects associated with the presence of PSVs related to changes in the risk of mortality and injury are predicted to be negligible to low in magnitude, localized to the LAA, an unlikely event, short-to medium-term in duration, and reversible.

10.3.3.2 Change in Habitat Quality and Use

Presence and Operation of a MODU

Changes in habitat quality and use due to the presence and operation of a MODU are primarily associated with sound emissions from the MODU, which can result in behavioural changes in marine mammals and sea turtles. Effects of waste discharges from the MODU are discussed below (discharges).

Behavioural responses of marine mammals to sound are difficult to predict in the absence of site and context-specific data. Response to sound, if any, depends on species, state of maturity, experience, current activity, reproductive state, time of day, and many other factors (Richardson et al. 1995; Wartzok et al. 2004; Southall et al. 2007; Weilgart 2007; Ellison et al. 2012). If a marine mammal responds to an underwater sound by changing its behaviour or moving a small distance, the impacts of the change are unlikely to be biologically important to the individual, let alone the stock or population (e.g., New et al. 2013a). However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on individuals and populations could be serious (Lusseau and Bejder 2007; Weilgart 2007; New et al. 2013b; Nowacek et al. 2015; Forney et al. 2017).

Drilling will be conducted by either a semi-submersible unit or a drillship. It is anticipated that the MODU will maintain station via the use of dynamic positioning (DP). Sounds from MODUs are non-impulsive or continuous in nature. As discussed in Section 2.8.5, based on measurements acquired during drilling of Shell Canada's Monterey Jack exploration well in the Scotian Basin, MacDonnell (2017) reported that the drillship Stena *IceMax* had a broadband source level of 187.7 dB re 1 µPa @ 1 m rms SPL. Similarly, Kyhn et al. (2011) reported that the drillship *Stena Forth* had broadband source levels of 184 dB re 1 µPa @ 1 m rms SPL during drilling and 190 dB re 1 µPa @ 1 m rms SPL during maintenance work. Through an Environmental Studies Research Fund (ESRF) initiative, the soundscape of the Newfoundland, Labrador, and Nova Scotia offshore was investigated via the use of 20 underwater recorders in 2015-2017. Although the findings of the overall study are not available, the acoustic modelling study conducted for this Project, summarizes data acquired from three acoustic recorders that were located within or adjacent to the Project Area (Figure 1 in Matthews et al. 2018). DP thrusters from the semi-submersible drilling platform West Hercules located 209 km from an acoustic recorder (located in 2000 m water depth between EL 1146 and EL 1148) were faintly detectable but did not increase the overall broadband sound levels.

It is quite possible that marine mammals (and sea turtles) may exhibit changes in behaviour in response to sounds produced by a MODU. There has been limited systematic study of marine mammal response to drilling activity; however, available information suggests that effects are localized and temporary. Kapel (1979) reported numerous baleen whales – mainly fin, minke, and humpback whales – within visual range of active drillships off West Greenland. Offshore California, the response zone around a semi-submersible

drilling unit was much less than 1 km for grey whales (Malme et al. 1983, 1984). Humpback whales showed no clear avoidance response to received drillship broadband sounds of 116 dB re 1 µPa (Malme et al. 1985).

Bowhead whales exhibit variable response to drilling sounds. Some bowheads have been observed less than a kilometre from drillships and others have demonstrated avoidance at 10 km (summarized in Richardson et al. 1995). Playback experiments of drilling sounds indicated that bowheads generally did not respond to sound exposures in the 100 to 130 dB re: 1 µPa rms range, although there were some observations which indicated minor behavioural changes (Richardson et al. 1990). The proximal part of the migration corridor of bowhead whales in the Alaskan Beaufort Sea has been monitored during construction, drilling, and production activities at an artificial island (Northstar) just inshore of the migration corridor (Richardson and Williams 2004). The primary objective of the monitoring program was to determine if, at high-noise times, underwater sound propagating from Northstar and its support vessels deflected the southern part of the bowhead migration corridor. An acoustical localization method was used to determine the locations of calling bowhead whales (Greene et al. 2004). Overall, the results showed evidence consistent with slight offshore displacement of the proximal edge of the bowhead migration corridor at some times when levels of underwater sound were unusually high (Richardson 2008). The southern edge of the call distribution ranged from 0.76 to 2.35 km farther offshore, apparently in response to industrial sound levels. This result however, was only achieved after intensive statistical analyses, and it is not clear that this represented a biologically material effect.

Beluga whales were exposed to playback sounds from a semi-submersible drill rig in an Alaskan river (Stewart et al. 1982). During the two tests, belugas swimming toward the sound source did not react overtly until they were within 50 to 75 m and 300 to 500 m, respectively; some belugas altered course to swim around the source, some increased swimming speed, and one reversed direction of travel. Reactions to sound from the semi-submersible drill unit were less pronounced than were reactions to motorboats with outboards (Stewart et al. 1982). Dolphins and other toothed whales have shown little to no behavioural response to drill rigs and their support vessels, particularly when there are not negative consequences from close approach to the activities (Richardson et al. 1995).

Ringed seals were often seen near drillships drilling in the Arctic in summer and fall (several reports summarized by Richardson et al. 1995). Ringed seals and bearded seals approached and dove within 50 m of a projector transmitting drilling sound into the water (received sound levels were 130 dB re 1 µPa). Studies of seals near active seismic vessels (Harris et al. 2001; Moulton and Lawson 2002) confirm that seals are tolerant of offshore industrial activities.

There are currently no available systematic data on sea turtle responses to sound from MODUs.

Behavioural disturbance thresholds have commonly been used in marine mammal effects assessments of offshore geophysical programs in Atlantic Canada, as well as Pacific Canada, Arctic Canada, and the US (e.g., Stantec 2012, 2014a, 2014b; LGL 2014, BP 2016). The U.S. NMFS included thresholds for behavioural disturbance in their guidelines for assessing effects of sound on marine mammals. Applied to both cetaceans and pinnipeds, these generic threshold levels are 120 dB re 1 µPa (rms) for non-impulsive sounds (e.g., shipping, drilling) and 160 dB re 1 µPa (rms) for impulsive sounds (e.g., air guns used in VSP). In this assessment, these thresholds are considered as a guide for the assessment of potential

effects of sound on behavioural responses of marine mammals, rather than an absolute indicator of such effects occurring. Where species-specific information on received sound levels is available, this information is considered as recommended in Southall et al. (2007).

To assist with the effects assessment, JASCO Applied Sciences was engaged to model underwater sound transmission loss (TL) for a representative MODU and to compare the findings to other modelling studies recently undertaken in the Flemish Pass and the Scotian Basin (Matthews et al. 2018; Appendix C). For the purpose of this assessment, it is assumed that the broadband source level for the MODU would be 196.7 dB re 1 µPa @ 1 m rms SPL. This MODU source level has been used in recent acoustic studies conducted for offshore exploration drilling programs on the Scotian Basin (Zykov 2016) and in the Flemish Pass (Quijano et al. 2017) and is considered conservative for effects assessment purposes in that reported values have been lower.

The TL coefficients for MODU operations in EL 1149 (17.4-17.9) are similar to those modelled in the Scotian Basin (Zykov 2016) and Flemish Pass (Matthews et al. 2017). Assuming that the same or similar MODU will be used by BP, it is expected that distances to sound level isopleths would be in the range of those predicted for May in Flemish Pass and for August in Scotian Basin (Matthews et al. 2018). The 120 dB re 1 µPa (rms) sound level (using R_{max}—most conservative estimate) estimate ranged from ~47-61 km from the MODU (Table 2.15 in Section 2.8.5). Using the more representative $R_{95\%}$ distance estimate, the 120-dB threshold typically would be reached at 23-40 km from the MODU (Zykov 2016; Matthews et al. 2018). Based on review of the literature cited above, it is unlikely that marine mammals, particularly odontocetes and seals, would avoid MODU activity out to these distances; any avoidance is expected to occur closer to the MODU. Also, as described in Section 2.8.5, sound from the MODU in EL 1145, EL 1146, and EL 1148 is expected to be "bounded" by the continental shelf, west of the site. More specifically, sounds from the MODU that reach the continental shelf, west of the Project Area, is predicted to rapidly attenuate between the 200 and 50 m isobaths. Baleen whales, which are typically more abundant on the continental shelf would therefore, in most cases be exposed to lower sound levels in shelf waters from the MODU which will be located in deeper waters. In summary, sound from the MODU is expected to result in localized avoidance by marine mammals. Sea turtles, considered rare in the Project Area, would also be expected to exhibit localized avoidance.

Underwater sound, whether of anthropogenic or natural origin, may interfere with the abilities of marine mammals to receive and process relevant sounds. There is some potential that underwater sound from the MODU may mask sounds important to marine mammals. All marine mammal species produce sound, and sound production has been associated with important biological functions such as foraging, mating, rearing of young, social interaction, and group cohesion (Erbe et al. 2016). As such, masking could potentially impact individual fitness. Introduced underwater sound at higher levels and with the same frequency and signal characteristics of relevant biological sounds will, through masking, reduce the effective communication distance of a marine mammal species. Masking may occur if the frequency of the source is close to that used as a signal by the marine mammal and if the anthropogenic sound is present for a significant fraction of the time (Richardson et al. 1995; Clark et al. 2009; Jensen et al. 2009; Gervaise et al. 2012; Hatch et al. 2012; Rice et al. 2014; Erbe et al. 2016; Tenessen and Parks 2016). The hearing systems of baleen whales are undoubtedly more sensitive to low-frequency sounds than are the ears of the small odontocetes that have been studied directly. The sounds important to toothed whales and pinnipeds are

predominantly at much higher frequencies than are the dominant components of MODU sounds, thus limiting the potential for masking. The potential for masking of marine mammal calls and/or important environmental cues is considered limited from the MODU given the relatively low source level and attenuation of sound to levels below measured ambient levels in the region (Section 4.3 in Matthews et al. 2018). Some baleen and toothed whales are known to continue calling in the presence of anthropogenic sounds. Some cetaceans are also known to change their calling rates, shift their peak frequencies, or otherwise modify their vocal behaviour in response to anthropogenic sounds (e.g., Blackwell et al. 2015). In addition, masking release mechanisms (e.g., spatial release from masking, comodulation masking release, orientation towards the sound) are employed by marine mammals to enhance signal detection and reduce the amount of masking (Erbe et al. 2016).

Based on the information and analysis summarized here, the overall magnitude of the effect of the presence and operation of a MODU on marine mammals and sea turtles is anticipated to be low. Some localized and short-term behavioural effects (change in presence and abundance) are likely to occur, with some species displaced from the immediate area around the MODU. The localized, transient, and short-term nature of these disturbances at one location and time during the Project considerably reduces the potential for adverse effects upon marine mammals and sea turtles (individuals or populations). It is therefore unlikely that individuals will be displaced over extended areas or timeframes. Given that the likely zone of influence of the Project at one time or location will represent a small proportion of the feeding, breeding or migration area of species, marine mammals and sea turtles will not be displaced from key habitats or during important activities or be otherwise affected in a manner that causes detectable adverse effects to overall populations in the region.

Residual effects associated with presence and operation of a MODU are primarily related to underwater sound. These may result in changes in habitat quality and use by marine mammals and sea turtles. These changes are predicted to be low in magnitude, generally localized to the Project Area but possibly extending up to approximately 40 km into the LAA (if a well is located along the westernmost limit of EL 1145, the northernmost limit of EL 1145, the northernmost limit of EL 1146, the easternmost limit of EL 1149, or the southernmost limit of EL 1149), short- to medium-term in duration, a multiple irregular event, and reversible.

Vertical Seismic Profiling Operations

Most information on marine mammal behavioural response to air gun sounds comes from studies of 2D and 3D seismic surveys versus the more localized, shorter duration, and smaller air gun arrays typically used during VSP. Detailed reviews of marine mammal and sea turtle response to seismic surveys are provided in Appendices 4 and 5 of LGL (2015a), respectively; an overview with emphasis on newly available information is provided below.

Baleen whales generally tend to avoid operating air guns, but avoidance radii are quite variable (Appendix 4 of LGL 2015 for details). Whales are often reported to show no overt reactions to pulses from large arrays of air guns at distances beyond a few kilometers, even though sound levels from the sound source remain above ambient sound levels out to much longer distances. However, baleen whales often react to sound from seismic source array by deviating from their normal migration route and/or interrupting their feeding and moving away. In the cases of migrating gray and bowhead whales, the observed changes in behaviour appeared to be of little or no biological consequence to the animals. They simply avoided the sound source

by displacing their migration route to varying degrees, but within the natural boundaries of the migration corridors (Malme et al. 1984; Malme and Miles 1985; Richardson et al. 1995). Stone (2015) examined data from 1,196 seismic surveys in the UK and adjacent waters and reported statistically significant responses to air gun arrays of 500 in^3 or more in volume for minke and fin whales. This included lateral displacement, change in swimming or surfacing behaviour, and indications that cetaceans remained near the water surface. Dunlop et al. (2015, 2016) reported that humpback whales responded to a vessel operating a 20 in^3 air gun by decreasing their dive time and speed of southward migration. However, the same responses were obtained during control trials without an active air gun source, suggesting that humpbacks responded to the source vessel rather than the air gun. Matos (2015) reported no change in sighting rates of minke whales in Vestfjorden, Norway during ongoing seismic surveys outside of the fjord. Similarly, no large changes in grey whale movement, respiration, or distribution patterns were observed during a 4D seismic survey off Sakahlin Island, Russia (Bröker et al. 2015; Gailey et al. 2016). Although sighting distances of gray whales from shore increased slightly during a two-week seismic survey, this result was not statistically significant (Muir et al. 2015). However, there may have been a possible avoidance response to high sound levels in the area (Muir et al. 2016). Vilela et al. (2016) cautioned that environmental conditions should be considered when comparing sighting rates during seismic surveys, given that spatial modeling showed that differences in sighting rates of rorquals (fin and minke whales) during seismic periods and non-seismic periods during a survey in the Gulf of Cadiz could be explained by environmental variables.

Little systematic information is available on reactions of odontocetes to sound from impulsive sound sources. However, there are systematic studies on sperm whales, and there is an increasing amount of information about responses of various odontocetes to seismic surveys based on monitoring studies (Appendix 4 of LGL 2015 for details). Seismic operators and MMOs on seismic vessels regularly see dolphins and other small toothed whales near operating air gun source arrays, but in general there is a tendency for most delphinids to show some avoidance of seismic vessels with a source array in operation. In most cases, the avoidance radii for delphinids appear to be small, on the order of 1 km or less, and some individuals show no apparent avoidance. The beluga, however, is a species that (at least at times) shows avoidance of seismic vessels at longer distances (tens of kilometres) (Miller et al. 2005). Captive bottlenose dolphins and beluga whales exhibited changes in behaviour when exposed to pulsed sounds similar in duration to those typically used in seismic surveys, but the animals only exhibited aversive behaviours after exposure to high received levels of sound (e.g., Finneran et al. 2000, 2002, 2005).

As highlighted above, odontocete reactions to sound from large air gun source arrays are variable and, at least for delphinids, seem to be confined to a smaller radius than has been observed for the more responsive mysticetes and some other odontocetes. Small and medium-sized odontocetes, including beaked whales, showed a significant response (e.g., lateral displacement, localized avoidance, or change in behaviour) to sound from large air gun arrays of 500 in^3 or more in volume, with the exception of Risso's dolphin (Stone 2015). When investigating the auditory effects of multiple underwater pulses from an air gun source on bottlenose dolphins, Finneran et al. (2015) reported that, at the highest exposure condition (peak sound pressure levels from 196–210 dB re 1 µPa), two of the three dolphin individuals that were studied exhibited anticipatory behavioural reactions to sounds being presented at fixed time intervals (as is typically the case for seismic sources during marine seismic surveys). Preliminary data from the Gulf of Mexico showed a correlation between reduced sperm whale acoustic activity during periods with air gun operations (Sidorovskaia et al. 2014). Thompson et al. (2013) reported decreased densities and reduced acoustic

detections of harbour porpoise in response to the presence of a seismic survey in Moray Firth, Scotland, at ranges of 5–10 km, although animals returned to the area within a few hours (Thompson et al. 2013).

Pinnipeds tend to be less responsive to air gun sounds than many cetaceans and are not likely to show a strong avoidance reaction to the air gun array (Appendix 4 of LGL 2015 for details). Visual monitoring from seismic vessels typically has shown only slight (if any) avoidance of active seismic sources by pinnipeds, and only slight (if any) changes in behaviour. Stone (2015) found that grey seals were displaced during the use of large air gun source arrays of 500 in^3 or more in volume as indicated by the lower detection rate during periods of seismic activity. Lalas and McConnell (2015) made observations of New Zealand fur seals from a seismic vessel operating a 3,090 in^3 air gun array in New Zealand during 2009. The results from the study were inconclusive in showing whether New Zealand fur seals respond to seismic sounds. When Reichmuth et al. (2016) exposed captive spotted and ringed seals to single air gun pulses, only mild behavioural responses were observed.

Available information demonstrates that marine mammal and sea turtles exhibit variable behavioural responses to air gun sounds; however, avoidance responses are typically localized and temporary. Using the NMFS recommended behavioural response criteria of 160 dB re 1 µPa rms SPL for impulsive sounds and based on the modelling study and comparative analysis undertaken for this EIS (Matthews et al. 2018), marine mammals may avoid an area of approximately 3.5–9 km (using R_{max} - most conservative estimate) from the VSP air gun array (Table 2.16 in Section 2.8.5). Using the more representative estimate ($R_{95\%}$), the 160-dB threshold typically would be reached at 3–6 km from the VSP air gun array (Zykov 2016; Matthews et al. 2018). Also, as described in Section 2.8.5, sound from a VSP source in EL 1145, EL 1146, and EL 1148 is expected to be “bounded” by the continental shelf, west of the site. More specifically, sounds from VSP that reach the continental shelf, west of the Project Area, is predicted to rapidly attenuate between the 200 and 50 m isobaths. Baleen whales, which are typically more abundant on the continental shelf would therefore, in most cases be exposed to lower sound levels in shelf waters from the VSP which will be located in deeper waters. Any avoidance is predicted to be temporary particularly given the very short duration of VSP surveys (approximately one day).

Because of the intermittent nature and low duty cycle of air gun pulses, marine mammals can emit and receive sounds in the relatively quiet intervals between pulses. However, in exceptional situations, reverberation occurs for much or all of the interval between pulses (e.g., Simard et al. 2005; Clark and Gagnon 2006), which could increase the risk of masking relevant biological sound. Situations with prolonged strong reverberation are infrequent. However, it is common for reverberation to cause some lesser degree of elevation of the background level between air gun pulses (e.g., Gedamke 2011; Guerra et al. 2011, 2016), and this weaker reverberation presumably reduces the detection range of calls and other natural sounds to some degree.

Some baleen and toothed whales are known to continue calling in the presence of seismic sources, and their calls usually can be heard between the source pulses. In addition, some cetaceans are known to change their calling rates, shift their peak frequencies, or otherwise modify their vocal behaviour in response to air gun sounds (e.g., Blackwell et al. 2015). Based on reviewed research, the potential for masking of marine mammal calls and/or important environmental cues is considered low from the proposed VSP

survey. Thus, masking is unlikely to be an important issue for marine mammals exposed to the sounds from VSP surveys, particularly considering that each survey will typically be approximately one day in duration.

Based on available data, it is possible that sea turtles would exhibit behavioural changes and/or localized avoidance near a VSP survey (Appendix 5 of LGL 2015 for details). To the extent that there are any adverse effects on sea turtles, operations involving air guns in or near areas where turtles concentrate are likely to have the greatest impact. Nelms et al. (2016) suggested that sea turtles could be excluded from critical habitats. There are no specific data that demonstrate the consequences to sea turtles if surveys with large or small arrays of air guns occur in important areas at biologically important times of year. However, sea turtles are considered rare in the Project Area; if they do occur there, responses are also expected to be localized and temporary, particularly given the short duration of VSP surveys.

As described in Chapter 8, significant effects to prey (fish, invertebrate) resources are not expected to occur because of the Project, and so changes in the availability, location, or quality of prey for marine mammals and sea turtles related to VSP surveys are unlikely.

Based on the information and analysis summarized here, the mitigation measures summarized in Section 10.3.2, and the short-term and localized nature of VSP, the overall magnitude of the effect of VSP on marine mammals and sea turtles is anticipated to be low. Some localized and short-term behavioural effects (change in presence and abundance) are likely to occur, with some species displaced from the immediate area around the VSP air gun array. The localized, transient, and short-term nature of any behavioural responses at one location and time during the Project considerably reduces the potential for adverse effects upon marine mammals and sea turtles (individuals or populations). It is therefore unlikely that individuals will be displaced over extended areas or timeframes. Given that the likely zone of influence of the Project at one time or location will represent a small proportion of the feeding, breeding or migration area of species, marine mammals and sea turtles will not be displaced from key habitats or during important activities or be otherwise affected in a manner that causes detectable adverse effects to overall populations in the region.

Residual effects associated with VSP are primarily related to underwater sound. These may result in changes in habitat quality and use by marine mammals and sea turtles. These changes are predicted to be adverse but low in magnitude, localized to the Project Area, short- to medium-term in duration, irregular in frequency, and reversible.

Discharges

All discharges from Project PSVs and the MODU will be in accordance with the OWTG and MARPOL as applicable. Discharges are expected to be temporary, localized, non-toxic, and subject to dilution in the open ocean.

Drilling wastes such as cement, WBM and cuttings released at the seafloor are unlikely to affect marine mammals and sea turtles. Water depths in the ELs where exploration drilling would occur range from approximately 1,000 m to over 3,000 m. Drilling activities are unlikely to produce concentrations of heavy metals in muds and cuttings that are harmful to marine mammals (Neff et al. 1980 in Hinwood et al. 1994). None of the marine mammals that regularly occur in the Project Area are known to feed on benthos in the area. The bearded seal, which is considered a benthic feeder, may occasionally occur in the Project Area,

but typically occurs much farther north near ice and forages at water depths <200 m. These activities are expected to have minimal environmental effect on marine mammals and sea turtles.

SBM has a synthetic base fluid as a component, but SBM cuttings are treated prior to discharge, and have only a small (and permitted) fraction of residual SBM when discharged. Discharging the SBM-related drill cuttings below the water's surface further mitigates the potential for marine mammals and sea turtles to contact the chemical components of SBM. With screening and selection of chemicals (including use of non-toxic drilling fluids) in accordance with the *Offshore Chemical Selection Guidelines*, and proper disposal of drill muds and cuttings in accordance with the OWTG, effects on marine mammals and sea turtles due to disposal of drill muds and cuttings and associated waste materials are considered unlikely.

Other potential liquid discharges from offshore vessels and equipment relate to the possible release of oily water and other substances through produced water (if applicable), deck drainage, bilge water, ballast water and liquid wastes. These discharges will be managed in accordance with the OWTG. Waste that cannot be discharged overboard will be stored and transported to shore for disposal in an approved facility (Section 2.8.4).

There is limited potential for interactions and effects of organic wastes disposed of from the MODU on marine mammals and sea turtles. Some prey species may be exposed to drill cuttings and discharges in the water column and in localized areas around the wellsites within the PA; they would not be affected to an extent that would result in a change in the quantity or quality of marine mammal and sea turtle prey. There is some potential that marine mammal prey may be attracted to discharged food wastes, but any effects are considered negligible.

Residual effects associated with drilling and other marine discharges on marine mammals and sea turtle habitat quality and use is predicted to be negligible. Any such effects (adverse or positive) are predicted to be unlikely events, negligible in magnitude, restricted to the Project Area, short term in duration, and reversible.

Well Abandonment and Decommissioning

As noted earlier, there is little potential for marine mammals and sea turtles to interact with well abandonment activities. There is some potential that marine mammals may temporarily avoid a localized area around the wellhead during mechanical separation of the wellhead from the seabed due to underwater sound and other sensory disturbance. The change in habitat quality and use as a result of well abandonment is predicted to be adverse, negligible in magnitude, restricted to the Project Area, unlikely to occur, short-term in duration, and reversible.

Supply and Servicing Operations

The Project will involve PSV use including supply and support traffic to, from and within the Project Area at all times of year during the Project life. In addition to PSV traffic, the Project will require helicopter use along the transit route from St. John's to the Project Area at various times of year. Sound generated from PSVs and to a lesser extent, helicopters, has potential to result in changes to marine mammal and sea turtle habitat quality and use.

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). Responses depend on the speed, size, and direction of travel of the vessel relative to the marine mammal; slow approaches tend to elicit fewer responses than fast, erratic approaches (Richardson et al. 1995). Seals often show limited to no response to vessels but can also show signs of displacement in response to vessel traffic. Toothed whales sometimes show no avoidance reactions and occasionally approach vessels; however, some species are displaced by vessels. Baleen whales often interrupt their normal behaviour and swim rapidly away from vessels that have strong or rapidly changing sound emission characteristics, 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.

Sound from shipping, through masking, can also reduce the effective communication distance of a marine mammal if sound levels are higher than relevant biological sound signals, the frequency of the sound source is close to that used by the animal, and the sound is present for a significant fraction of time (e.g., Richardson et al. 1995; Clark et al. 2009; Jensen et al. 2009; Gervaise et al. 2012; Hatch et al. 2012; Rice et al. 2014; Erbe et al. 2016; Jones et al. 2017; Putland et al. 2017). In addition to the frequency and duration of the masking sound, the temporal pattern and location of the introduced sound also play a role in the extent of the masking (e.g., Branstetter et al. 2013, 2016; Finneran and Branstetter 2013). Auditory masking, particularly the physical acoustic and/or biological processing aspects of auditory masking in marine mammals and/or fish with respect to exploration and production sound sources in marine mammals and fish, is poorly understood and is therefore a focus area of research (e.g., Joint Industry Programme on E&P Sound and Marine Life 2018). However, the potential for masking of marine mammal calls and/or important environmental cues is considered limited from PSVs given the relatively low source level and attenuation of sound to levels below measured ambient levels in the region (refer to Section 4.3 in Matthews et al. 2018; Appendix C). As discussed previously, some baleen and toothed whales are known to continue calling in the presence of anthropogenic sounds. Some cetaceans are also known to change their calling rates, shift their peak frequencies, or otherwise modify their vocal behaviour in response to anthropogenic sounds (e.g., Blackwell et al. 2015). In addition, masking release mechanisms (e.g., spatial release from masking, comodulation masking release, orientation towards the sound) are employed by marine mammals to enhance signal detection and reduce the amount of masking (Erbe et al. 2016).

Baleen whales are thought to be more sensitive to sound at low frequencies that are predominantly produced by vessels than are toothed whales (e.g., MacGillivray et al. 2014), possibly causing localized avoidance of PSVs. Reactions of gray and humpback whales to vessels have been studied (see Richardson et al. 1995 and Southall et al. 2007 for reviews). More recently, Dunlop et al. (2015) reported that southward migrating humpback whales off Australia decreased their dive time and swim speed slightly in response to a source vessel, which was not operating airguns. However, there is limited information available on the reactions of right whales and rorquals (e.g., fin and blue whales). North Atlantic right whales can often be approached by slowly moving vessels, but swim away from vessels that approach quickly (Watkins 1986). They tend to show little responses to close passages of small steady-moving boats when mating or feeding (Mayo and Marx 1990; Gaskin 1991). The responses of North Atlantic right whales in the Bay of Fundy to ships, sounds from conspecifics, and a signal designed to alert the whales were monitored using multi-sensor acoustic recording tags (Nowacek et al. 2004). The whales reacted overtly to the signal by swimming to the surface, likely increasing rather than decreasing the risk of collision with ships. The whales reacted

mildly to controlled exposure to sounds of conspecifics but showed no response to controlled sound exposure to ships as well as actual ships (Nowacek et al. 2004). Right whales have been known to increase the source levels of their calls, shift their peak frequencies, or otherwise change their vocal behaviour in the presence of elevated ambient sound levels (e.g., Parks et al. 2007, 2011, 2012b, 2016; Tenessen and Parks 2016).

Williamson et al. (2016) studied the effect of close approaches by small research vessels on the behaviour of humpback whales and suggested that close approaches by small vessels may cause small and temporary behavioural changes in humpback whales, although for female-calf groups, the behavioural change may be greater and longer lasting.

Off New England, fin whales had shorter than usual surfacing and dive times when whale-watch and other vessels were nearby (Stone et al. 1992). Watkins (1981) and Watkins et al. (1981) noted that fin whales showed little response to slowly moving vessels but avoided boats that altered course or speed quickly. During marine mammal monitoring from a high-speed, catamaran car ferry transiting the Bay of Fundy during the summers of 1998–2002, most baleen whales (including fin, humpback and minke whales) sighted from the ferry appeared to exhibit avoidance behaviour including heading away, changing heading, or diving (Dufault and Davis 2003). Fin whale sightings in the western Mediterranean were negatively correlated with the number of vessels in the area (Campana et al. 2015). Fin and blue whales in the St. Lawrence estuary either moved away from ships or remained near a vessel but changed direction or dove; the most marked reactions occurred when vessels approached quickly or erratically (Edds and Macfarlane 1987). Fin whales and blue whales have been shown to increase the source levels of their calls, shift their peak frequencies, or otherwise change their vocal behaviour in the presence of elevated sound levels such as from shipping (e.g., McKenna 2011; Castellote et al. 2012; Melcón et al. 2012). Physical presence of vessels, not just ship sounds, has also been shown to disturb the foraging activity of blue whales (Lesage et al. 2017). McKenna et al. (2015) noted a dive response by blue whales when a vessel approached, but no lateral avoidance, which could lead to an increase in collision risk.

There are few systematic studies on sea turtle reactions to ships and boats, but it is thought that response would be minimal relative to responses to sound from air guns. Hazel et al. (2007) evaluated behavioural responses of green turtles to a research vessel approaching at slow, moderate, or fast speeds (4, 11, and 19 km/h, respectively). Proportionately fewer turtles fled from the approaching vessel as speed increased, and turtles that fled from moderate to fast approaches did so at significantly shorter distances from the vessel than those that fled from slow approaches. The authors concluded that sea turtles cannot be relied on to avoid vessels with speeds greater than 4 km/h. However, studies were conducted in a 6 m aluminum boat powered by an outboard engine, which would presumably be more challenging for a sea turtle to detect than a PSV. Lester et al. (2013) reported variable behavioural responses of a semi-aquatic turtles to boat sounds.

Routine transportation activities associated with helicopter support have potential to result in change in habitat quality or use for marine mammals and sea turtles because of disturbance. Sounds produced by helicopters are primarily related to rotor and propeller blade revolutions, with frequencies mainly below 500 Hz (Richardson et al. 1995). Transmission of sound produced by helicopters into the marine environment is related primarily to the aircraft altitude and sea surface conditions (Richardson et al. 1995).

Underwater sound from helicopters is generally stronger just below the water surface and directly beneath the aircraft, with sounds attenuating over shorter distances than airborne sounds (Richardson et al. 1995). Available information indicates that single or occasional aircraft overflights will cause no more than brief behavioural responses in baleen whales, toothed whales and seals (summarized in Richardson et al. 1995). In a study in the Beaufort Sea, the majority of behavioural responses elicited in beluga whales and bowhead whales by an overhead helicopter occurred when the helicopter flew at altitudes below 150 m and at lateral distances less than 250 m (Patenaude et al. 2002). As with other sources of underwater sound, the degree of sensitivity of cetaceans to sounds produced by aircrafts can depend on their state of activity at the time of exposure; individuals in a resting state (as opposed to foraging, socializing, or travelling) seem to demonstrate the highest sensitivity to such disturbances (Würsig et al. 1998; Luksenburg and Parsons 2009). Cetaceans most commonly respond to sounds produced by overhead aircrafts by diving (Luksenburg and Parsons 2009). Other behavioural responses include short surfacing periods, changes in state of activity, and breaching (Luksenburg and Parsons 2009).

There are no systematic data on sea turtle reactions to helicopter overflights. Given the hearing sensitivities of sea turtles, they can likely hear helicopters, at least when the helicopters are at lower altitudes and the turtles are in relatively shallow waters. It is unknown how sea turtles would respond, but single or occasional overflights by helicopters would likely only elicit a brief behavioural response.

Project-related PSV traffic represents a negligible contribution to the overall vessel traffic off Eastern Newfoundland. PSVs will use existing shipping lanes as practicable; where these do not exist, PSVs will follow a straight-line approach to and from the Project Area. Vessels will maintain a steady course and constant speed whenever possible. Furthermore, during transit to / from the Project Area, PSVs will travel at vessel speeds not exceeding 22 km/hour (12 knots), except as needed in the case of an emergency. In the event that a marine mammal or sea turtle is detected in proximity to the vessel, vessel speed will be reduced.

Based on the information and analysis summarized here, as well as the mitigation measures summarized in Section 10.3.2, the overall magnitude of the effect of the PSVs and helicopters on marine mammals and sea turtles is anticipated to be low. Some localized and short-term behavioural effects (change in presence and abundance) are likely to occur, with some species displaced from the immediate area around a PSV. The localized, transient, and short-term nature of these disturbances at one location and time during the Project considerably reduces the potential for adverse effects upon marine mammals and sea turtles (individuals or populations). It is therefore unlikely that individuals will be displaced over extended areas or timeframes. Given that the likely zone of influence of the Project at one time or location will represent a small proportion of the feeding, breeding or migration area of species, marine mammals and sea turtles will not be displaced from key habitats or during important activities or be otherwise affected in a manner that causes detectable adverse effects to overall populations in the region.

Residual effects associated with supply and servicing activities on a change in habitat quality and use are primarily related to underwater sound. These changes are predicted to be low in magnitude, localized to the LAA, short-term in duration, a multiple irregular event, and reversible.

10.3.4 Species at Risk: Overview of Potential Effects and Key Mitigation

Table 10.5 lists marine mammal and sea turtle SAR and SOCC that could potentially occur in the RAA, indicating their likely presence and potential interaction with Project activities. As discussed in Section 6.3.7 and summarized in Table 10.5, with the exception of fin whales and humpback whales, there is generally low potential for SAR or SOCC to interact with the Project because of these species' low densities in the RAA, Project Area, and LAA and because there is no identified critical habitat in the RAA.

Table 10.5 Marine Mammal and Sea Turtle Species at Risk and of Conservation Concern with Potential to Occur in the RAA

Species	RAA and Project Area		*SARA* Status[a]	COSEWIC Status[b]	Summary of Potential Interactions
	Occurrence	Season			
Baleen Whales (Mysticetes)					
North Atlantic Right Whale	Rare	Summer	Schedule 1: Endangered	Endangered	• Low potential for interaction with Project activities given rare occurrence in the Project Area • Proposed mitigation (Section 10.3.2) will reduce risk of effects from underwater sound (VSP), discharges, and supply and servicing (PSV transit)
Humpback Whale	Common	Year-round, but mostly May-Sept	Schedule 3: Special Concern	Not at Risk	• High potential for interaction with Project activities given common occurrence in the Project Area and RAA • Proposed mitigation (Section 10.3.2) will reduce risk of effects from underwater sound (VSP), discharges, and supply and servicing (PSV transit)
Fin Whale	Common	Year-round, but mostly summer	Schedule 1: Special Concern	Special Concern	• High potential for interaction with Project activities given common occurrence in the Project Area and RAA • Proposed mitigation (Section 10.3.2) will reduce risk of effects from underwater sound (VSP), discharges, and supply and servicing (PSV transit) •
Blue Whale	Uncommon	Year-round	Schedule 1: Endangered	Endangered	• Low potential for interaction with Project activities given uncommon occurrence in the Project Area • Proposed mitigation (Section 10.3.2) will reduce risk of effects from underwater sound (VSP), discharges, and supply and servicing (PSV transit)

Species	RAA and Project Area		*SARA* Status[a]	COSEWIC Status[b]	Summary of Potential Interactions
	Occurrence	Season			
Toothed Whales (Odontocetes)					
Northern Bottlenose Whale	Uncommon	Year-round	Schedule 1: Endangered [c] / No Status [d]	Endangered [c] / Special Concern [d]	• Low potential for interaction with Project activities given uncommon occurrence in the Project Area • Proposed mitigation (Section 10.3.2) will reduce risk of effects from underwater sound (VSP), discharges, and supply and servicing (PSV transit)
Sowerby's Beaked Whale	Rare	Year-round	Schedule 1: Special Concern	Special Concern	• Low potential for interaction with Project activities given rare occurrence in the Project Area • Proposed mitigation (Section 10.3.2) will reduce risk of effects from underwater sound (VSP), discharges, and supply and servicing (PSV transit)
Killer Whale	Uncommon	Year-round	No Status	Special Concern	• Low potential for interaction with Project activities given uncommon occurrence in the Project Area • Proposed mitigation (Section 10.3.2) will reduce risk of effects from underwater sound (VSP), discharges, and supply and servicing (PSV transit)
Harbour Porpoise	Uncommon	Year-round, but mostly spring-fall	Schedule 2: Threatened	Special Concern	• Low potential for interaction with Project activities given uncommon occurrence in the Project Area • Proposed mitigation (Section 10.3.2) will reduce risk of effects from underwater sound (VSP), discharges, and supply and servicing (PSV transit)
Sea Turtles					
Leatherback Sea Turtle	Rare	April to December	Schedule 1: Endangered	Endangered	• Low potential for interaction with Project activities given rare occurrence in the Project Area • Proposed mitigation (Section 10.3.2) will reduce risk of effects from underwater sound (VSP), discharges, and supply and servicing (PSV transit)
Loggerhead Sea Turtle	Rare	Summer and fall	Schedule 1: Endangered	Endangered	• Low potential for interaction with Project activities given rare occurrence in the Project Area • Proposed mitigation (Section 10.3.2) will reduce risk of effects from underwater sound (VSP), discharges, and supply and servicing (PSV transit)

[a] Species designation under the *Species at Risk Act* (SARA website; Government of Canada 2018).

[b] Species designation by COSEWIC (Committee on the Status of Endangered Wildlife in Canada; COSEWIC website 2018.

[c] Scotian Shelf population.

[d] Davis Strait-Baffin Bay-Labrador Sea population.

Relevant threats identified for marine mammal and sea turtle species at risk in associated recovery strategies and action plans under SARA include acoustic disturbance, marine pollution, and vessel strikes. Mitigation proposed to mitigate underwater sound disturbance associated with VSP air gun source arrays, manage discharges, and reduce PSV speeds (refer to Section 10.3.2) will help to protect marine mammal and sea turtle species at risk.

The residual effects of the Project on marine mammal and sea turtle species at risk are predicted to be adverse, low in magnitude, extend to the LAA, an unlikely to perhaps irregular event, short term in duration, and reversible.

10.3.5 Summary of Project Residual Environmental Effects

Table 10.6 summarizes the environmental effects assessment and prediction of residual environmental effects resulting from interactions between the Project and marine mammals and sea turtles. The greatest potential for environmental effects on the Marine Mammals and Sea Turtles VC related to underwater sound is from the MODU and PSVs and to a lesser extent from the very short duration VSP surveys. It is possible that marine mammals may exhibit localized and temporary avoidance of the MODU, PSVs, and VSP survey. Similarly, in the unlikely event that a sea turtle occurred in the Project Area, there could be localized avoidance of Project activities. The risk of injury and mortality from ship strikes is considered very low, particularly since PSVs will travel at 12 knots and will maintain a constant course and speed whenever possible. Similarly, the likelihood of a marine mammal and sea turtle incurring permanent hearing impairment (PTS) from exposure to air gun pulses from VSP surveys is very low, given the short duration of the activity and the implementation of mitigation in accordance with the SOCP. In summary, with the implementation of the various mitigation measures, the Project is not predicted to result in adverse population-level environmental effects on marine mammals and sea turtles, including species at risk.

Table 10.6 Summary of Residual Environmental Effects on Marine Mammals and Sea Turtles, including Species at Risk

Residual Effect	Residual Environmental Effects Characterization						
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in Risk of Mortality or Injury							
Presence and operation of a MODU	A	N	PA	ST-MT	UL	R	D
VSP operations	A	N-L	PA	ST-MT	UL	R	D
Supply and servicing operations	A	N-L	LAA	ST-MT	UL	R	D
Change in Habitat Quality and Use							
Presence and operation of a MODU	A	L	PA-LAA	ST-MT	IR	R	D
VSP operations	A	L	PA	ST-MT	IR	R	D

Residual Effect	Residual Environmental Effects Characterization						
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Discharges	A	N	PA	ST	UL	R	D
Well abandonment and decommissioning	A	N	PA	ST	UL	R	D
Supply and servicing operations	A	L	LAA	ST	IR	R	D

KEY:
See Table 10.2 for detailed definitions
N/A: Not Applicable

Direction:
P: Positive
A: Adverse

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PA: Project Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term
MT: Medium-term
LT: Long-term
P: Permanent

Frequency:
UL: Unlikely
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological / Socio-Economic Context:
D: Disturbed
U: Undisturbed

10.4 Determination of Significance

Based on the nature of the interactions between the Project and marine mammals and sea turtles, the planned implementation of mitigation measures, and predicted residual changes to risk of mortality or injury, and to habitat quality and use, the Project is unlikely to result in significant adverse effects on marine mammals and sea turtles. Although Project-related activities may result in localized, short-term effects on some marine mammals and possibly sea turtles in the PA possibly extending to the LAA, the number of individuals that may be affected, and the temporary and reversible nature of these effects, indicates that the Project will not result in a detectable decline in overall marine mammal and sea turtle abundance or changes in the spatial and temporal distributions of marine mammal and sea turtle populations. The potential for interactions between individuals of species at risk and the Project is limited, and no identified critical habitat is present in the Project Area, LAA, or RAA. The Project is therefore, not predicted to jeopardize the overall abundance, distribution, or health of species at risk. With mitigation and environmental protection measures, the residual environmental effects on marine mammals and sea turtles (including species at risk) are predicted to be not significant.

This overall determination is made with a moderate level of confidence given there are several key uncertainties in predicting the effects of the Project on marine mammals and sea turtles. Firstly, there is a paucity of baseline data on marine mammal and sea turtle use of the Project Area. Therefore, there is

uncertainty as to whether the Project Area or certain portions of the Project Area are regularly used and important foraging areas, migratory corridors, and/or breeding areas for marine mammals. The Project Area has not been systematically surveyed for marine mammals. Another key data gap is the lack of information on marine mammal response to MODUs in Atlantic Canada and limited data from other jurisdictions have been used as a proxy for assessing effects. Data on hearing impairment for marine mammals and particularly sea turtles is limited. As a result of these data gaps, there is scientific uncertainty in the frequency and magnitude of residual effects of underwater sound from the MODU, PSVs, and VSP surveys on marine mammals and sea turtles. Numerous studies referenced in this EIS show high levels of variability of response to underwater sound from MODU / drillship, vessel, and air gun source activities.

10.5 Follow-up and Monitoring

BP will develop a marine mammal and sea turtle monitoring plan to be implemented during VSP surveys as outlined in Section 10.3.2. The Plan will include MMO requirements, shutdown and ramp-up procedures and reporting requirements.

In the unlikely event of a collision with a marine mammal or sea turtle, BP will contact the Canadian Coast Guard within 24 hours following the collision.

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11.0 ASSESSMENT OF POTENTIAL EFFECTS ON SPECIAL AREAS

The Special Areas VC considers areas that have been noted for their biological and ecological importance. These areas have been designated, and in some cases protected, under international, federal, and/or other applicable legislation due to this importance. This VC includes designated Ecologically and Biologically Significant Areas (EBSA), Vulnerable Marine Ecosystems (VME), NAFO coral and sponge closure areas, and marine refuge areas. These special areas are described in Section 6.4 and illustrated in Figure 11.1. Special areas have been selected as a VC due to the presence of these areas within and near the Project Area, and concerns regarding Project activities occurring within or near these areas.

As discussed in Section 6.4, there are special areas that overlap with portions of the Project Area and LAA (Figure 11.1). These areas include:

- Orphan Spur (EBSA)
- Orphan Knoll Seamount Closures (NAFO VME)
- Northeast Newfoundland Slope Closure (marine refuge)
- Bonavista Cod Box (experimental closure)
- Northeast Shelf and Slope (EBSA)
- Eastern Avalon (EBSA)

Both the Orphan Knoll Seamount Closure and the Northeast Newfoundland Slope Closure marine refuge are designated to protect sensitive benthic features such as corals and sponges. The Orphan Spur EBSA is designated due to high concentrations of corals, and aggregations of marine fish species, including species at risk. The Bonavista Cod Box is an experimental closure area to commercial fishing activity, and is a spawning area for Atlantic cod, American plaice, and redfish. Within the Project Area, ELs 1145, 1146, and 1148 fall within the area of the Northeast Newfoundland Slope Closure marine refuge, while a small portion of the Orphan Spur EBSA overlaps with EL 1145. The boundaries of EL 1149 do not intersect with any designated special areas. There are two additional special areas that overlap the LAA but are not within the Project Area; these include a portion of the Northeast Shelf and Slope EBSA and a portion of the Eastern Avalon EBSA, which is located along the coast of the island.

Additional special areas identified within the RAA (Section 6.4) are not expected to interact with routine Project activities but could potentially be affected in the unlikely event of an accidental event (Section 15.5.4); Chapter 11 presents the assessment of effects from routine Project activities and therefore focuses on special areas within and near the Project Area. The assessment of effects on special areas is closely linked to the assessment of marine fish and fish habitat (Chapter 8), marine and migratory birds (Chapter 9), and marine mammals and sea turtles (Chapter 10). These VCs include species of conservation interest that may also use special areas. These sections are cross-referenced throughout the effects assessment of special areas.

11.1 Scope of Assessment

11.1.1 Regulatory and Policy Setting

There are multiple regulatory instruments from the federal government of Canada, and the provincial government of Newfoundland and Labrador, that enable protection of Canada's lands and waters. A summary of applicable legislation is provided below in Table 11.1, with more details in Table 6.19 of Section 6.4.

Table 11.1 Federal and Provincial Legislation to Establish Canadian Protected Areas

Legislation / Regulation	Type of Area	Department / Agency
Federal Legislation		
Oceans Act, 1996, c.31	*Oceans Act* Marine Protected Area, Marine Refuges	DFO
Fisheries Act, 1985, c.43	Fisheries Closure Areas, Marine Refuges	DFO
Canada Wildlife Act, R.S., 1985, c. W-9	Migratory Bird Sanctuary	ECCC
Canada National Marine Conservation Areas Act, 2002, c. 18	National Marine Conservation Area	Parks Canada Agency (PCA)
Canada National Parks Act, 2000, c.32	National Park	PCA
Canada Wildlife Act, R.S., 1985, c. W-9	National Wildlife Area	ECCC
Species at Risk Act (SARA)	Protected critical habitat	DFO, PCA, and ECCC
Provincial Legislation		
Provincial Parks Act (1970)	Provincial Park	Parks and Natural Areas Division
Wilderness and Ecological Reserves Act (1980)	Wilderness Reserve, Ecological Reserve	Parks and Natural Areas Division
Lands Act (1991)	Public Reserve, Special Management Area	Parks and Natural Areas Division
Wild Life Act (1970)	Wildlife Park, Wildlife Reserve	Wildlife Division

Internationally, special areas are designated by NAFO and protected through NAFO's Conservation and Enforcement Measures. These measures are updated annually and apply to all fishing vessels that operate in waters under NAFO jurisdiction. These Conservation and Enforcement Measures outline the current special areas that NAFO has identified.

11.1.2 Influence of Consultation and Engagement on the Assessment

Questions and comments related to special areas were noted during BP's Project-related engagement with government departments and agencies, stakeholder organizations, and Indigenous groups (see Chapter 3 for further details). Key issues raised to date regarding special areas relate primarily to interactions with commercial fishing activities. The designation of special areas can, in some cases (e.g., Northeast Newfoundland Slope Closure marine refuge), result in reduction of fishing access, thereby contributing to potential cumulative effects on fishing. Related to concerns surrounding fishing restrictions, is the perceived imbalance of conservation measures (e.g., restrictions on fishing in conservation measures with little to no specific restrictions on exploration activities or other ocean uses). BP is cognizant of benthic sensitivities and fisheries closures within the Project Area and is working closely with DFO and the C-NLOPB to identify appropriate mitigation to reduce adverse environmental effects on the benthic environment within the Northeast Newfoundland Slope Closure marine refuge.

11.1.3 Potential Effects, Pathways and Measurable Parameters

Routine Project-related activities have the potential to affect the ability of special areas to provide and maintain important ecological and biological functions for the species that use these areas. As a result of these considerations, the assessment of Project-related effects on special areas is focused on the following potential effect:

- change in habitat quality

Potential effects on a change in risk of mortality or physical injury, and behavioural effects to marine species within special areas are addressed in Chapters 8, 9, and 10.

The measurable parameters used for the assessment of the environmental effects presented above, and the rationale for their selection, are provided in Table 11.2. Effects of accidental events are assessed separately in Section 15.5.4.

Table 11.2 Potential Effects, Effects Pathways and Measurable Parameters for Special Areas

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Habitat Quality	• Interactions between the extent, duration, or timing of Project activities that could result in direct loss or alteration of habitat • Change in use of special areas due to physical disturbance, destruction of benthic habitats or deposition of cuttings / drill muds • Increase of underwater sound at levels capable of causing behavioural disturbance for species that use special areas	• Area of habitat affected (m²) • Change in chemical composition of sediment and water (unit depends on the contaminant) • Sound level (dB) and extent (km from sound source) of underwater sound affecting marine fish, marine mammals, and/or sea turtles

11.1.4 Boundaries

Spatial and temporal boundaries for the assessment of special areas are discussed in the following sections.

11.1.4.1 Spatial Boundaries

Project Area: The Project Area (Figure 11.1) encompasses the immediate area in which Project activities may occur. Well locations have not been identified but will occur within the ELs in the Project Area. The Project Area includes ELs 1145, 1146, 1148 and 1149. The Project Area has been delineated to provide a 20 km buffer around each EL.

Local Assessment Area (LAA): The LAA (Figure 11.1) is the maximum area within which environmental effects from routine Project activities and components can be predicted or measured with a reasonable degree of accuracy and confidence. It consists of the Project Area and adjacent areas where Project-related environmental effects are reasonably expected to occur based on available information, including effects thresholds, predictive modelling, and professional judgement. The LAA also includes transit routes to and from the Project Area.

Regional Assessment Area: The Regional Assessment Area (RAA) (Figure 11.1) is the area within which residual environmental effects from operational activities and accidental events may interact with special areas that are outside the Project Area. The RAA also accounts for residual environmental effects related to routine activities that could interact cumulatively with the residual environmental effects of other past, present, and future (certain or reasonably foreseeable) physical activities.

11.1.4.2 Temporal Boundaries

The temporal boundaries for the assessment of potential Project-related environmental effects on special areas encompass all Project phases, including well drilling, testing, and abandonment. BP is currently planning a one-well program with an initial well proposed for 2020 but could potentially drill up to 20 wells between 2020 and 2026. Well testing (if required, dependent upon drilling results) could also occur at any time during the temporal scope of this EIS. Wells may be decommissioned and abandoned at any time within the temporal boundaries. Each well is anticipated to take approximately 60 days to drill and VSP surveys typically take approximately one day per well. Drilling operations will not be continuous throughout the entire seven-year scope of the Project and will depend partially on rig availability and results from previous wells. While drilling activities have the potential to be conducted at any time of the year, BP's preference is to conduct drilling between May and October.

Special areas provide important habitat year-round, although some areas are more sensitive or commonly used by species during specific times of the year. Refer to Section 6.4 for information on species use of special areas.

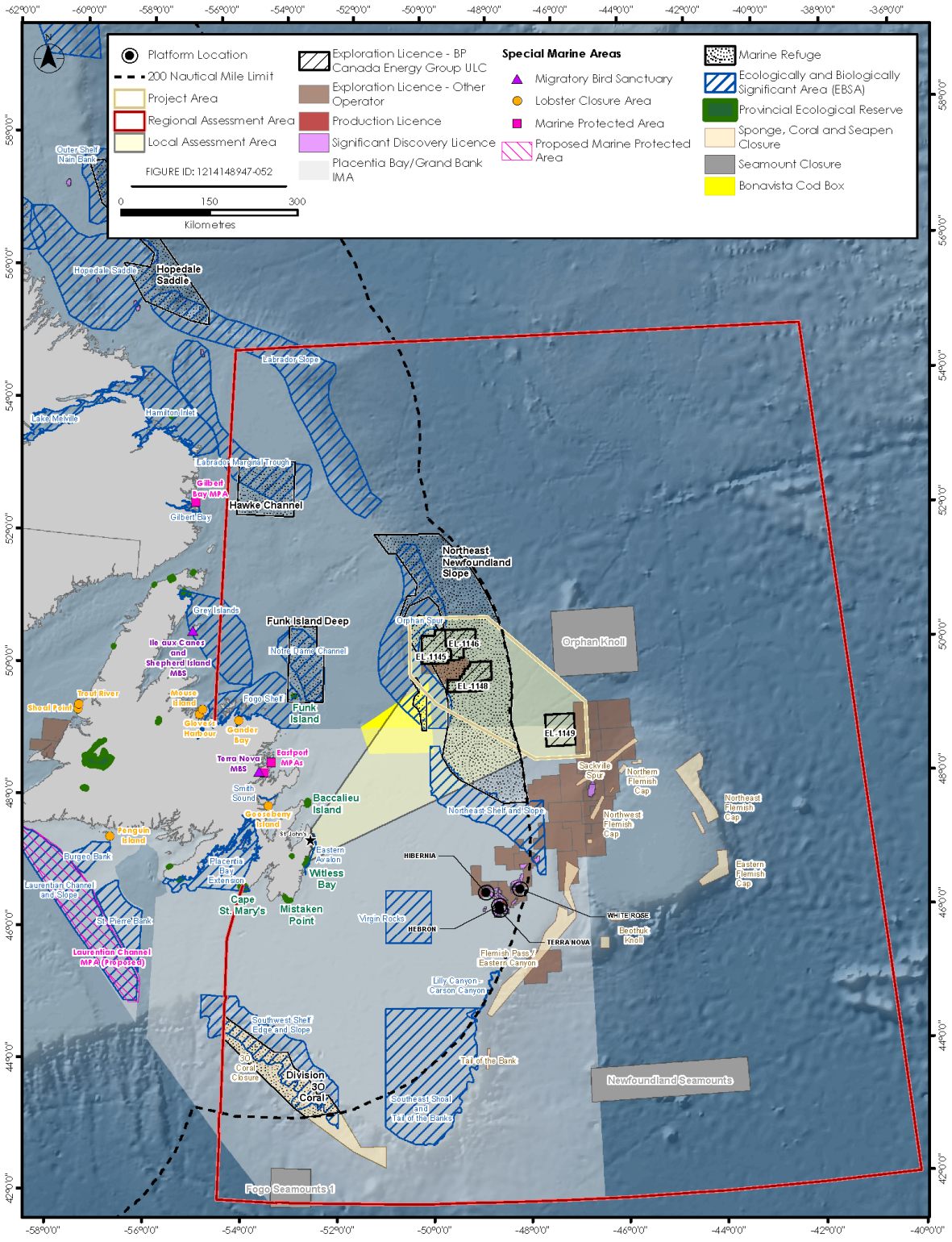

Figure 11.1 Special Areas Spatial Boundaries

11.1.5 Residual Effects Characterization and Significance Definition

The definitions used to characterize environmental effects as part of this effects assessment for special areas are provided in Table 11.3. These characterizations will be used throughout the chapter when describing potential residual environmental effects on special areas from routine Project activities. These characterizations are also applicable for accidental events, as discussed in Section 15.5.4.

Table 11.3 Characterization of Residual Effects on Special Areas

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual environmental effect relative to baseline	**Positive** – a residual environmental effect that moves measurable parameters in a direction beneficial to special areas relative to baseline **Adverse** – a residual environmental effect that moves measurable parameters in a direction detrimental to special areas relative to baseline
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions	**Negligible** – no measurable change **Low** – a detectable change but within the range of natural variability **Moderate** – a detectable change beyond the range of natural variability, but with no associated adverse effect on the viability of the affected population **High** – A detectable change that is beyond the range of natural variability, with an adverse effect on the viability of the affected population
Geographic Extent	The geographic area in which a residual environmental effect occurs	**PA** – residual environmental effects are restricted to the Project Area **LAA** – residual environmental effects extend into the LAA **RAA** – residual environmental effects extend into the RAA
Frequency	Identifies how often the residual effect occurs and how often during the Project	**Unlikely event** – effect is unlikely to occur **Single event** – effect occurs once **Multiple irregular event** – effect occurs at no set schedule **Multiple regular event** – effect occurs at regular intervals **Continuous** – effect occurs continuously
Duration	The period of time required until the measurable parameter or the VC returns to its existing condition, or the residual effect can no longer be measured or otherwise perceived	**Short term** - for duration of the activity, or for duration of accidental event **Medium term** - beyond duration of activity up to end of Project, or for duration of threshold exceedance of accidental event – weeks or months **Long term** - beyond Project duration of activity, or beyond the duration of threshold exceedance for accidental events - years **Permanent** - recovery to baseline conditions unlikely
Reversibility	Pertains to whether a measurable parameter or the VC can return to its existing condition after the project activity ceases	**Reversible –** will recover to baseline conditions before or after Project completion **Irreversible –** permanent

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Ecological and Socio-economic Context	Existing condition and trends in the area where residual effects occur	**Undisturbed** – The VC is relatively undisturbed in the RAA, not adversely affected by human activity, or is likely able to assimilate the additional change **Disturbed** – The VC has been previously disturbed by human development or human development is still present in the RAA, or the VC is likely not able to assimilate the additional change

In consideration of the descriptors listed above, the following threshold has been established to define a significant adverse residual environmental effect on special areas.

For the purposes of this effects assessment, a significant adverse residual effect on special areas is defined as a Project-related environmental effect that:

- alters the valued habitat physically, chemically or biologically, in quality or extent, to such a degree that there is a decline in abundance lasting more than one generation of key species (for which the special area was designated) or a change in community structure, beyond which natural recruitment (reproduction and immigration from unaffected areas) would not sustain the population or community in the special area and would not return to its original level within one generation; or
- results in permanent and irreversible loss of critical habitat (if present) as defined in a recovery plan or an action strategy.

11.2 Project Interactions with Special Areas

Table 11.4 identifies, for each potential effect, the physical activities that might interact with special areas and result in the identified environmental effect. These interactions are indicated by checkmark and are discussed in detail in Section 11.3, in the context of effects pathways, standard and Project-specific mitigation / enhancement, and residual effects. A justification for no effect is provided following Table 11.4.

Table 11.4 Project-Environment Interactions with Special Areas

Physical Activities (refer to Section 4.1.1 for the Scope of the Project)	Environmental Effects
	Change in Habitat Quality
MODU presence and operation (including drilling, associated safety zone, and MODU lighting)	✓
Vertical Seismic Profiling (VSP) operations	✓
Discharges (e.g., drill muds / cuttings, liquid discharges)	✓
Well evaluation and testing (including flaring)	–
Well abandonment and decommissioning	✓
Supply and servicing operations (including helicopter transportation and PSV operations)	✓
Notes: ✓ = Potential interaction; – = No interaction	

Well evaluation and testing is not anticipated to interact with special areas in a way that could result in an adverse environmental effect. Special areas that have been identified as overlapping the Project Area, where well evaluation and testing would occur, are not identified as being important aggregation points for marine and migratory birds. Effects of well evaluation and testing on marine and migratory birds are discussed in Section 8.3. Well testing, if required, is conducted within a closed system, sending well samples back to the MODU for testing. Flaring occurs outside of the marine environment (i.e., outside the water column and the benthic environment), which does not promote an interaction with special areas. Given the distance of the Project from the coastline (approximately 343 km from the island of Newfoundland), flaring or air emissions are not expected to interact with special areas that exist onshore or along the coast of Newfoundland and Labrador.

11.3 Assessment of Residual Environmental Effects on Special Areas

The following section assesses the environmental effects on special areas identified as arising from potential interactions in Table 11.3. Given the similarities in Project description, proximity of activities on Orphan Basin and Flemish Pass, and currency of data, the EIS incorporates learnings from previous EA documents for similar exploration drilling projects in Atlantic Canada, including comments received during Indigenous and stakeholder review processes, with updates incorporated as applicable due to Project and geographic differences, scientific updates, and refined EA methods. Effects on species (including species at risk and SOCC) that may occur within the special areas, and how species use these areas, are assessed within their respective VC chapters. This includes Fish and Fish Habitat (Section 8.3), Marine and Migratory Birds (Section 9.3), and Marine Mammals and Sea Turtles (Section 10.3).

11.3.1 Project Pathways

Change in Habitat Quality

A change in habitat quality for special areas could potentially occur because of Project activities affecting the marine environment. The primary pathway for Project-related activities to affect the physical quality of special areas is the presence and operation of a MODU (light and sound emissions), the discharge of drill muds and cuttings and other emissions (localized effects on water and sediment quality), VSP surveys (underwater sound emissions), PSV operations (underwater sound emissions associated with vessel movement), and well abandonment (underwater sound and change in benthic habitat).

11.3.2 Mitigation

In consideration of the environmental effects pathways outlined above, the following mitigation measures and standard practices will be employed to reduce potential effects on special areas.

Presence and Operation of a MODU

- BP will conduct an imagery-based seabed survey at the proposed wellsite(s) to confirm the absence of shipwrecks, debris on the seafloor, unexploded ordnance, and sensitive environmental features, such as habitat-forming corals or species at risk. The survey will be carried out prior to drilling and will encompass an area within a 500-m radius from the wellsite. If any environmental or anthropogenic sensitivities are identified during the survey, BP will notify the C-NLOPB immediately to discuss an appropriate course of action. This may involve further investigation and/or moving the wellsite if it is feasible to do so. This survey will also provide baseline data for coral and sensitive benthic habitat that may be present and be used to inform discussions on potential follow-up and monitoring with respect to drill waste discharges.

Vertical Seismic Profiling Operations

- VSP activities will be planned and conducted in consideration of the Statement of Canadian Practice with Respect to the Mitigation of Seismic Sound in the Marine Environment (SOCP; DFO 2007; refer to Section 10.3.2).

Discharges

- Refer to the waste management mitigation measures identified in the Marine Fish and Fish Habitat VC (Section 8.3.2).

Well Abandonment and Decommissioning

- Once wells have been drilled and evaluation programs completed (if applicable), the wells will be plugged and abandoned in line with applicable BP practices and C-NLOPB requirements.

Supply and Servicing Operations

- Routes of helicopters transiting to and from the MODU will avoid transiting near migratory bird nesting colonies and will comply with provincial *Seabird Ecological Reserve Regulations, 2015*, and, ECCC's *Avoidance Guidelines* for seabird and waterbird colonies. Appropriate flight altitudes and horizontal buffer zones will be established to minimize disturbance to colonies in accordance with the Seabird *Ecological Reserve Regulations, 2015* and the ECCC's *Avoidance Guidelines*. Specific details will be provided in the environmental protection plan (EPP).
- PSV routes transiting to and from the MODU will be planned to avoid passing within 300 m of migratory bird nesting colonies during the nesting period and will comply with provincial *Seabird Ecological Reserve Regulations*, *2015* and federal guidelines in order to minimize disturbance to colonies (ECCC 2017b). Specific details will be provided in the EPP.

As the value of special areas is linked to the marine species that use them, mitigation measures that are specific to marine fish and fish habitat (Section 8.3.2), marine and migratory birds (Section 9.3.2), and marine mammals and sea turtles (Section 10.3.2) will also reduce potential adverse effects to special areas important to these species.

11.3.3 Characterization of Residual Project-related Environmental Effects

11.3.3.1 Change in Habitat Quality

Presence and Operation of a MODU

Underwater sound would be generated by the MODU through drilling operations and the use of dynamic positioning to keep the MODU on station. This underwater sound has potential to affect habitat quality of special areas within the Project Area, which may in turn affect the species that use these special areas. Results of this interaction may include underwater sound at levels that result in species avoiding the areas. Potential physical or behavioural effects on fish, marine mammal, and sea turtle species, can indirectly affect the quality of special areas, if species avoid or no longer use them due to increased underwater sound levels. Therefore, the effects of underwater sound on special areas are linked to those effects on marine fish and fish habitat (Section 8.3), and marine mammals and sea turtles (Section 10.3), respectively. The effects of underwater sound on fish, marine mammals, and sea turtles depends on a variety of factors, including sound frequency, ocean conditions, species, stage of life, reproductive stage, etc. (Davis et al. 1998; Southall et al. 2007; Weilgart 2007). The presence and operation of a MODU itself may not have a direct interaction on the physical area, but the potential increase of underwater sound may affect the overall quality of the area, and the species within it.

A change in habitat quality of special areas could therefore occur in the Northeast Newfoundland Slope Closure marine refuge primarily related to the propagation of underwater sound from the MODU activity. This area contains cold water corals and sponges, which provide ecological importance in the form of benthic habitat for marine species, and a productive marine environment. The Orphan Spur EBSA is also in close proximity to ELs 1145, 1146, and 1148. This EBSA is known to support aggregations of fish species, including species at risk. However, a change in underwater sound in the area would be temporary, with the highest sound levels being localized close to the wellsite and is not predicted to result in permanent or irreversible loss of habitat for fish, or marine mammals and sea turtles. Underwater sound emissions would occur continuously while drilling is conducted, and therefore the presence of such sound would be reversible once the MODU has completed drilling operations and sound levels return to pre-Project levels. The short-term nature of drilling activity, and the irregular occurrence of drilling activity would promote a short duration interaction with special areas.

Currently, there are no Migratory Bird Sanctuaries (MBS) or Important Bird Areas (IBAs) within the Project Area or along the potential transit routes to the Project Area. The nearest MBS is the Terra Nova MBS, which is 298 km away from the Project Area within which the MODU would be located. The nearest IBA is Funk Island, approximately 194 km away from the Project Area (Section 6.2). The potential effects from light emitted from the MODU is expected to be low in magnitude, irregular in nature and restricted to within the Project Area and will not interact with special areas designated for marine and migratory birds.

Residual environmental effects associated with the presence and operation of a MODU on a change in habitat quality for special areas is predicted to be low to moderate in magnitude, within the Project Area, short-term in duration, and occurring irregularly as there is no set drilling schedule. These effects are expected to be reversible once Project activities cease and conditions return to pre-drilling levels.

Vertical Seismic Profiling Operations

The potential effect of Project-related VSP surveys on special areas within the Project Area, include those effects of underwater sound on fish, marine mammals, and sea turtles that may inhabit these special areas during the time of a survey. An increase of underwater sound levels from a VSP survey, and the potential for behavioural effects from marine species such as avoidance or masking, may also affect the overall quality and use of special areas by these species. Potential effects of Project-related VSP surveys on marine fish and fish habitat, and marine mammals and/or sea turtles are discussed in Sections 8.3 and 10.3, respectively, and are cross-referenced in the assessment of this VC. The effects assessment from both these VCs found that there would be no significant residual adverse environmental effects from VSP surveys.

There is potential for VSP surveys to occur within the special areas that overlap with the Project Area, primarily the Northeast Newfoundland Slope Closure marine refuge, which could temporarily affect the habitat quality of that area to support fish and mammal species using it. This residual effect is anticipated to be low in magnitude, short-term (i.e., approximately one day per well), with the highest level of sound being localized within the Project Area, occurring irregularly (the VSP schedule will be dependent on the drilling schedule), and reversible once the survey activity ends and sound levels return to pre-survey conditions. VSP survey activities will adhere to the *Statement of Canadian Practice on Mitigation of Seismic Noise in the Marine Environment*, as appended to the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2017).

Discharges

Discharges that result from offshore exploration drilling operations, including drill muds and cuttings, have the potential to adversely alter sediment and water quality in special areas that overlap with BP's ELs (EL 1145, 1146, and 1148). The effects of Project-related discharges for marine fish and fish habitat, and marine mammals and sea turtles have been assessed in Sections 8.3 and 10.3.

Slow moving or sessile organisms, such as benthic fauna, have a higher potential for interaction with drill mud and cuttings discharges compared to mobile species. Corals and sponges have the potential to be smothered by drilling wastes if they are located close to the wellsite. Sediment quality also has the potential to be altered in terms of oxygen depletion and nutrient enrichment, which may reduce species diversity and abundance (Neff et al. 2000, 2004). Measurable changes to benthic macrofauna are most often confined to within a 250 m radius and seldom detected beyond 500 m of the drill site (Olsgård and Gray 1995; Bakke et al. 2013). Water depth also influences the dispersion and thickness of drill cuttings in a given area. Effects on benthic communities from drilling wastes are typically more detectable in waters less than 600 m. In water depths greater than 1,000 m, such as in the Orphan Basin, cuttings are generally deposited in a thinner layer and over a larger area (IAOGP 2016). Laboratory experiments indicate the potential for polyp mortality on corals caused by drill cuttings (Larsson and Purser 2011) as well as alterations in feeding behaviours, coral physiology and disruption of calcification (Dodge and Szmant-Froelich 1985). The tolerance of individual species to the constituents of drill cuttings has also been found to be highly variable between species (Rogers 1990).

Smit et al. (2008, in IAOGP 2016) determined a threshold level of approximately 6.5 mm of sediment burial is required to cause mortality to benthic macrofauna. This is similar to the 6.3 mm threshold that has been used in Norwegian environmental risk assessment models for drilling activity on the Norwegian Continental Shelf (Teh and Koh 2016). Drill cutting dispersion modelling for the Project was undertaken for two scenarios: the West Orphan Basin site (1,360 m depth) and the East Orphan Basin (2,785 m depth). The results indicate that drill cuttings measuring approximately 6.5 mm from the West Orphan Basin could extend up to 128 m from the wellsite, covering approximately 0.69 ha per well, and approximately 55 m and 0.64 ha per well for the East Orphan Basin. Cuttings measuring 100 mm in thickness from the West Orphan Basin have the potential to extend 32 m from the wellsite and cover an area of approximately 0.07 ha. For the East Orphan Basin, the extent was approximately 14 m, also covering approximately 0.07 ha per well. In comparison, the Northeast Newfoundland Slope Closure, that overlaps with the Project Area and LAA, is approximately 4,683,300 ha.

Results from Husky's EEM programs for the White Rose oil development project demonstrate few effects on benthic invertebrate communities and their habitats as a result of offshore drilling operations. The spatial extent of contamination measured in the 2014 EEM was within original EA predictions in that hydrocarbon contamination extended to 5.8 km from source, barium contamination extended to 1 km from source, and the percent of fines in sediment extended to 0.7 km from source (Husky 2017). Note that these are based on 38 wells being drilled since 2004. These results are similar to those of the Terra Nova EEM, which indicated the highest levels of barium and hydrocarbon contamination extended to 1 to 2 km from source (DeBlois et al. 2014). Of the 53 samples taken during this program, all but two samples were determined to be non-toxic to amphipod survival. The spatial extent of effects on benthic invertebrates at White Rose is generally consistent with the literature on effects of contamination from offshore oil developments.

Recovery time for benthic macrofauna communities from effects associated with offshore drilling activities has been found to be relatively quick in most cases (IAGOP 2016). In areas such as deep water (greater than 600 m) where drilling muds and cuttings are more widely dispersed, ecological recovery begins soon after drilling and can be well advanced within a year (IAOGP 2016). Hurley and Ellis (2004) and Garcia et al. (2011) also confirmed in separate studies of the effects of drill cuttings on benthic communities that the recovery of benthic communities return close to pre-drill conditions within a year after drilling had taken place. However, it is acknowledged that there are fewer data on effects and recovery from deposition of drilling wastes on deep-water corals and sponges, with recovery rates for these communities expected to be longer than in other environments.

Other discharges associated with routine Project activities, such as organic matter, deck drainage, bilge water, produced water, etc., are also regulated by the C-NLOPB under the OWTG, to reduce the potential effects of discharged wastes on the marine environment. Discharges of materials at sea will comply with the standards set out in the OWTG to reduce potential effects on the marine environment. Waste not highlighted in the OWTG as being disposable will not be discharged to the ocean and will be brought to shore for treatment and disposal. Discharges into the marine environment may result in a temporary and localized reduction in water or sediment quality within special areas that overlap with the Project Area. However, these changes are not anticipated to result in a substantial change of habitat quality for marine species that use these areas.

Given the evidence from the relevant models and scientific literature, and currently available findings from Husky's ongoing EEM program for White Rose, and the Terra Nova EEM, drilling cuttings and mud discharges are expected to be localized near the drill site.

Residual environmental effects associated with discharges on a change in habitat quality for special areas is predicted to be low-to-moderate in magnitude, occurring irregularly as there is no set drilling schedule, short-to medium-term in duration, and reversible (baseline conditions are anticipated to return once a well has been completed).

Well Abandonment and Decommissioning

All wells drilled during the life of the Project will be plugged and abandoned upon completion of well evaluation activities (if applicable). All abandonment activities will be conducted in line with BP's practices and C-NLOPB requirements. As discussed in Section 2.4.4., BP may seek permission from the C-NLOPB to leave the wellhead in place after well plugging and abandonment. If the wellhead is left in place, it would provide additional hard substrate on the seafloor, which could be used for colonization by benthic fauna that prefer hard surfaces to grow.

Residual environmental effects associated with well abandonment on a change in habitat quality for special areas is predicted to be low in magnitude, localized to the wellsite in the Project Area, long-term in duration, irregular (once per well with no set schedule), and will be reversible as the wellhead, if left in place, would remain there in perpetuity and provide colonization opportunities for benthic species such as corals. Residual environmental effects associated with removal of wellhead infrastructure (if applicable), including underwater sound emissions, would be short-term in duration.

Supply and Servicing Operations

The potential effects of supply and servicing operations on special areas within the Project Area, include those effects of underwater sound on fish, marine mammals, and sea turtles that may use these special areas. An increase of underwater sound levels as PSVs move back and forth from the Project Area to the shore base, and the potential for behavioural effects from marine species, may also affect the overall quality and use of special areas by these species. Potential vessel transit routes intersect one additional special area, the Northeast Shelf and Slope EBSA, which is known to support aggregations of groundfish marine mammals, and corals (Section 6.1). While this EBSA lies outside the Project Area, the potential for effects is the same as discussed above for MODU presence and operation in the Project Area, relating to underwater sound levels in the area and the effect it may have on the species that use the area. The potential effects of underwater sound on marine fish and fish habitat, and marine mammals and sea turtles from supply and servicing operations are discussed in Section 8.3 and 10.3. The transitions of PSVs and aircraft from the Project Area to the shore base would also involve coming closer to special areas such as IBAs and MBSs along the coast, which may increase the potential for an interaction with marine and coastal bird species. The effects from supply and servicing on marine birds is discussed in Section 9.3. The effects assessments for these VCs found that there would not be significant residual adverse environmental effects resulting from supply and servicing activities. As there would not be measurable effects on the species that use these special areas, then there would also unlikely be substantial effects on the surrounding marine habitats including special areas. The transient nature of PSVs and aircraft would promote a short-term

interaction at any one location, not lasting for more than a few hours as they pass through and over areas along transit routes between the MODU and the shore base. Mobile marine species can move away from a vessel as PSVs approach and underwater sounds begins to increase in intensity.

The number of PSVs and aircraft required for the Project will represent a small increase above existing vessel traffic in the area. Supply and servicing is expected to have a short-term and localized effect on special areas, and the species that use them.

Residual environmental effects associated with supply and servicing on a change in habitat quality for special areas is predicted to be low in magnitude, within the LAA as PSVs and aircraft move between the MODU and the shore base, short-term in duration, occurring regularly when drilling is occurring but overall for the entire temporal period for the Project more on an irregular basis, and reversible once supply and servicing operations have finished.

11.3.4 Summary of Project Residual Environmental Effects

Table 11.5 summarizes the environmental effects assessment and prediction of residual environmental effects resulting from interactions between the Project and special areas. Based on the characterization of the potential interactions between Project activities and special areas, the Project has potential to result in residual adverse effects through a change in habitat quality for special areas that exist within the Project Area and along vessel transit routes in the LAA. This includes the Orphan Spur EBSA, Northeast Shelf and Slope EBSA, Orphan Knoll Seamount Closure, Northeast Newfoundland Slope Closure marine refuge area, and the Bonavista Cod Box. With the implementation of applicable mitigation measures described in Section 11.3.2 (e.g., pre-drill ROV surveys), and adherence to industry standards for offshore oil and gas activities in Newfoundland and Labrador, the residual adverse environmental effects are considered to be low in magnitude for most Project components and activities, short to medium-term in duration, reversible, and primarily occur within an undisturbed ecological and socio-economic setting.

Table 11.5 Summary of Residual Environmental Effects on Special Areas

Residual Effect	Residual Environmental Effects Characterization						
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in Habitat Quality							
Presence and operation of a MODU	A	L-M	PA	ST	IR	R	D
VSP operations	A	L	PA	ST	IR	R	D
Discharges	A	L-M	PA	ST-MT	IR	R	D
Well abandonment and decommissioning	A	L	PA	ST-LT	IR	R	D
Supply and servicing operations	A	L	LAA	ST	IR	R	D

KEY:
See Table 11.3 for detailed definitions
N/A: Not Applicable

Direction:
P: Positive
A: Adverse

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PA: Project Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term
MT: Medium-term
LT: Long-term
P: Permanent

Frequency:
UL: Unlikely
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological / Socio-Economic Context:
D: Disturbed
U: Undisturbed

11.4 Determination of Significance

Given the irregular schedule and short-term duration of drilling activities, the nature of Project interactions with special areas, and the implementation of mitigation and environmental protection measures, residual environmental effects on special areas are predicted to be not significant.

This prediction of significance has been determined with a moderate level of confidence based on analysis of scientific literature and EEM results that exist specific to offshore Newfoundland and Labrador projects within the RAA (although generally in shallower waters than the Project Area), and Project-specific modelling. There is some uncertainty regarding potential coral and sponge presence in the Project Area and a lack of available EEM information from drilling activities in deep-water environments with sensitive benthic habitat in the RAA. The use of a pre-drill ROV survey will help identify coral or sponge colonies that may exist within a 500-m radius of the proposed wellsite for each well.

11.5 Follow-up and Monitoring

BP is proposing to implement a follow-up program to address uncertainty regarding residual effects of drill waste discharges on the marine benthic environment in consideration of the proximity of Significant Benthic Areas to BP's Project Area and concerns raised by Indigenous groups about potential effects on cold-water corals. As noted in Section 11.3.2, BP will conduct an imagery-based seabed survey at the proposed wellsite(s) to confirm the absence of sensitive environmental features, such as habitat-forming corals or species at risk prior to drilling. If any environmental sensitivities are identified during the survey, BP will notify the C-NLOPB immediately to discuss an appropriate course of action. This may involve further investigation and/or moving the wellsite if it is feasible to do so. This survey will also serve to provide baseline data for coral and sensitive benthic habitat that may be present and be used to inform discussions on potential follow-up with respect to drill waste discharges. BP plans to conduct a visual survey of the seafloor using an ROV after drilling activities to assess the visual extent of sediment dispersion and validate drill waste modelling predictions. The specific details of the follow-up program will be determined in consultation with the C-NLOPB and DFO in consideration of the pre-drill survey results.

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12.0 ASSESSMENT OF POTENTIAL EFFECTS ON INDIGENOUS PEOPLES AND COMMUNITY VALUES

Indigenous peoples and community values is included as a VC in recognition of the cultural, social, and economic importance of marine life and fishing to Indigenous peoples and in recognition of potential or established Aboriginal and treaty rights. As prescribed in the EIS Guidelines and in CEAA 2012, the following factors are required to be addressed, as applicable to the Project:

5 (1) For the purposes of this Act, the environmental effects that are to be taken into account in relation to an act or thing, a physical activity, a designated project or a project are…

> *(c) with respect to aboriginal peoples, an effect occurring in Canada of any change that may be caused to the environment on*
>
> > *(i) health and socio-economic conditions,*
> >
> > *(ii) physical and cultural heritage,*
> >
> > *(iii) the current use of lands and resources for traditional purposes, or*
> >
> > *(iv) any structure, site or thing that is of historical, archaeological, paleontological or architectural significance*.

The EIS Guidelines identified five Indigenous groups in Newfoundland and Labrador, 13 groups in Nova Scotia, 16 groups in New Brunswick, two groups in Prince Edward Island and five groups in Quebec that have the potential to be affected by Project activities. These communities hold commercial communal and/or food, social, and ceremonial (FSC) licenses in the RAA or for species that may migrate through the RAA. Species harvested for commercial communal purposes in the RAA include capelin, groundfish, herring, mackerel, seal, shrimp, snow crab, swordfish, tuna, and whelk (Section 7.4.7.1). There is no known FSC harvesting occurring in the RAA; however, some species are anadromous and can potentially migrate through the area. Two migratory fish species that are harvested in geographic proximity to Indigenous communities have been highlighted during Indigenous engagement as being of specific concern due to potential interaction with Project activities: American eel and Atlantic salmon. This VC assesses the potential effects of the Project's planned activities on these Indigenous communities and their activities, including access to and availability of commercial communal and FSC fishing activities. In addition to the direct effects from routine Project activities on Indigenous fishing, indirect effects to socio-economic conditions are also considered in this assessment, including the socio-economic impacts to the Indigenous communities due to effects on commercial communal and FSC fishing.

This VC is closely linked to the Commercial Fisheries and Other Ocean Users VC (Chapter 13), and to the availability and quality of marine resources, such as marine fish, marine mammals and sea turtles, and marine birds (Chapters 8 to 10).

12.1 Scope of Assessment

12.1.1 Regulatory and Policy Setting

Two jurisdictions have regulatory authority related to marine fisheries that apply to the RAA. The Government of Canada has jurisdiction over commercial fishing activities within its 200 nm Exclusive Economic Zone (EEZ). Canada also has jurisdiction over commercial fisheries for sedentary species up to the extent of the defined continental shelf. Within its jurisdiction, the Government of Canada has the authority to set total allowable catches, quota, and licenses to fishing enterprises. This includes the allocation of commercial communal licenses to Indigenous communities and enterprises. Beyond the EEZ, the Northwest Atlantic Fisheries Organization (NAFO) has primary jurisdiction over commercial fisheries for non-sedentary species and has the authority to designate protected areas. The Project Area is in NAFO Subdivisions 3KLM. Within these Subdivisions, there is a large marine refuge area, the Northeast Newfoundland Slope Closure marine refuge, which overlaps with an extensive portion of the Project Area, including ELs 1145, 1146, and 1148. This area is closed to bottom fishing activity and is regulated under the *Oceans Act*.

The federal *Fisheries Act* focuses on protecting the productivity of commercial, recreational, or Aboriginal (CRA) fisheries including a prohibition against causing serious harm to fish that are part of or support a CRA fishery without authorization. Fisheries and Oceans Canada (DFO) manages Indigenous fishing in accordance with the Aboriginal Fishing Strategy, which recognizes Aboriginal and Treaty rights and places priority on Aboriginal rights to fish for FSC purposes. As described in Section 7.4, treaty rights to hunt, fish, and gather in pursuit of a moderate livelihood have been recognized through Supreme Court of Canada decisions. There are no identified FSC fisheries in the RAA; however, species harvested for FSC purposes may migrate through the Project Area.

The *Technical Guidance for Assessment the Current Use of Lands and Resources for Traditional Purposes under CEAA 2012* and *Technical Guidance for Assessing Physical and Cultural Heritage or any Structure, Site or Thing that is of Historical, Archeological, Paleontological or Architectural Significance under CEAA, 2012*, influenced the EA process including the scoping and assessment of this VC. Other relevant guidelines with respect to Indigenous engagement is the *Aboriginal Consultation and Accommodation – Updated Guidelines for Federal Officials to Fulfill the Duty to Consult* (AANDC 2011) and the Government of Newfoundland and Labrador's *Aboriginal Consultation Policy on Land and Resource Development Decisions* (Government of Newfoundland and Labrador 2013).

12.1.2 Influence of Consultation and Engagement on the Assessment

Questions, issues, and concerns related to Indigenous peoples and community values were noted during BP's Project-related engagement with government departments and agencies, stakeholder organizations, and Indigenous groups (see Chapter 3 for further details). Through ongoing engagement with Indigenous groups, it has been communicated that Indigenous interests and concerns extend beyond potential interactions with effects on commercial communal and/or FSC fishing practices (the act or ability to fish). Concerns were raised by most Indigenous groups about potential adverse effects from planned Project activities or accidental events on marine species. This included migratory species identified as being

culturally or commercially significant, such as Atlantic salmon, Atlantic eel, Atlantic bluefin tuna, swordfish, as well as blue whale, North Atlantic right whale, and cold-water corals. Miawpukek First Nation, Sipekne'katik First Nation, Qalipu First Nation and the Mi'kmaq and Innu of Quebec in particular, expressed concerns regarding potential impacts on migratory birds that are traditionally and currently harvested. Potential impacts, particularly in the event of an accident / malfunction, on Aboriginal rights and interests including FSC fishing, commercial fishing, and subsequent impacts to community well-being and socio-economic conditions were noted throughout engagement activities. Inquiries about compensation for both economic and cultural loss in instances where fishing activity is adversely affected as a direct result of the Project were identified. Chapter 3 provides additional information on issues and concerns raised during Indigenous engagement.

12.1.3 Potential Effects, Pathways and Measurable Parameters

As with commercial fisheries (Chapter 13), the Project could affect commercial communal fisheries resources by direct or indirect effects on fished species and/or effects on fishing activity from displacement from fishing areas, gear loss or damage, and availability of fisheries resources. Although there is no known FSC fishing occurring in the Project Area, routine Project activities may interact with migratory species, including marine fish, marine mammals, and marine birds, traditionally and currently harvested by Indigenous communities at their traditional harvesting sites. The selection of effects for this VC also reflects: the variations in fishing locations by Indigenous groups, which include nearshore areas and offshore areas; the multiple purposes for the use of marine resources, which include commercial communal and FSC species; and the cultural, social, and economic aspects of each of these fisheries.

Given routine Project-related activities will occur in the marine environment, over 340 km from the nearest Indigenous community on the Island of Newfoundland, and even further from such communities in Labrador, the Maritime provinces, and Quebec, effects from routine activities are unlikely to directly affect the physical or social health and well-being of Indigenous persons or communities except potentially indirectly as a result of effects on commercial communal or FSC fishing. There are no known physical and cultural sites, including structures, sites, or things of historical, archaeological, paleontological, or architectural significance within the Project Area or LAA. Therefore, there are no pathways of effects from routine Project activities to changes in structures, sites or things of historical, archaeological, paleontological or architectural significance due to the offshore location of the Project and localized extent of routine Project interactions.

As a result of these considerations, the assessment of Project-related effects on Indigenous peoples and community values is focused on the following potential effects:

- change in commercial communal fisheries
- change in current use of lands and resources for traditional purposes

Either of these changes could potentially indirectly lead to changes in health and socio-economic conditions or cultural heritage of affected Indigenous communities. These indirect effects are considered in the assessment as relevant. The measurable parameters used for the assessment of the environmental effects presented above, and the rationale for their selection, are provided in Table 12.1. Effects of accidental events are assessed separately in Section 15.5.5.

Table 12.1 Potential Effects, Effects Pathways and Measurable Parameters for Indigenous Peoples and Community Values

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Commercial Communal Fisheries	• Direct or indirect loss in availability of commercial communal fisheries resources arising from Project activities (e.g., through effects on target species or fishing access)	• Change in access to area used for commercial communal fisheries (ha) • Change in catch rates (qualitative) • Area of fish habitat permanently affected (m²) • Mortality of commercially important species (qualitative) • Damage to fishing gear (qualitative) • Employment and business activity and income levels / revenues (qualitative) • Change in community revenues (qualitative)
Change in Current Use of Lands and Resources for Traditional Purposes	• Direct or indirect loss in availability of FSC fisheries resources arising from Project activities	• Change in availability of culturally important species (i.e., through mortality or change in migration patterns) (qualitative) • Degree of reduced access to FSC resources, and associated effect to social, spiritual, or cultural value (qualitative) (e.g., lower health outcomes, dietary change, loss of cultural or spiritual practice)

12.1.4 Boundaries

Spatial and temporal boundaries for the assessment of Indigenous peoples and community values are discussed in the following sections.

12.1.4.1 Spatial Boundaries

Project Area: The Project Area (Figure 12.1) encompasses the immediate area in which Project activities may occur. Well locations have not been identified but will occur within the ELs in the Project Area. The Project Area includes ELs 1145, 1146, 1148 and 1149. The Project Area has been delineated to provide a 20 km buffer around each EL.

Local Assessment Area (LAA): The LAA (Figure 12.1) is the maximum area within which environmental effects from routine Project activities and components can be predicted or measured with a reasonable degree of accuracy and confidence. It consists of the Project Area and adjacent areas where Project-related environmental effects are reasonably expected to occur based on available information, including effects thresholds, predictive modelling, and professional judgement. The LAA also includes transit routes to and from the Project Area.

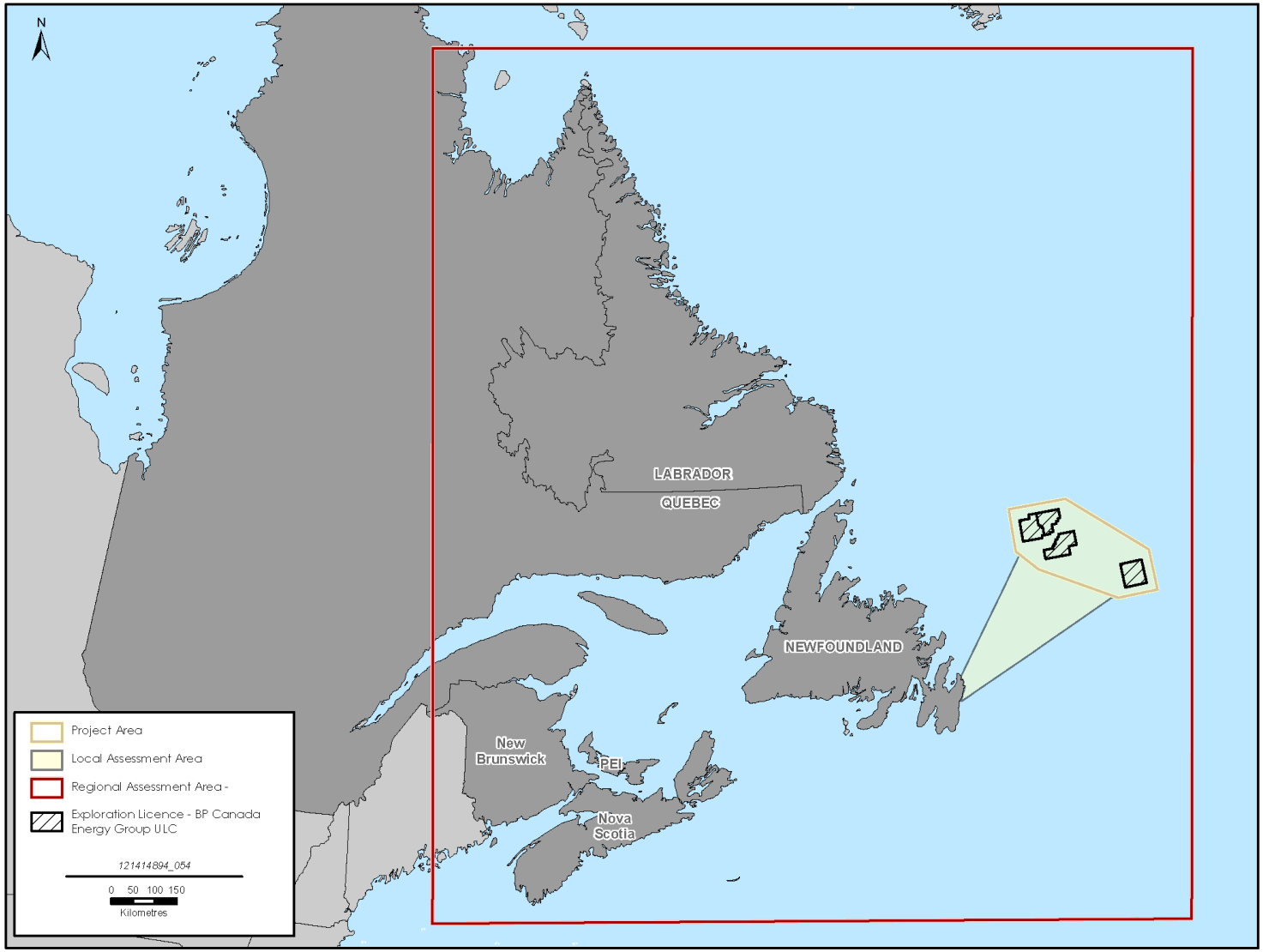

Figure 12.1 Indigenous Peoples and Community Values Spatial Boundaries

Regional Assessment Area (RAA): The RAA (Figure 12.1) is the area within which residual environmental effects from operational activities and accidental events may interact with Indigenous communities that are outside the Project Area. The RAA also accounts for residual environmental effects related to planned activities that could interact cumulatively with the residual environmental effects of other past, present, and future (i.e., certain, or reasonably foreseeable) physical activities. The environmental effects assessment for this VC also considers the spatial distribution and overall geographic extent of the Indigenous groups under consideration, including their communities, activities, and the distribution and movements of the various marine-associated resources that are used for traditional purposes. Therefore, the RAA for this VC includes the overall Atlantic Canada region, encompassing the Indigenous communities and their activities throughout relevant parts of Newfoundland and Labrador, the Maritime Provinces and Quebec.

12.1.4.2 Temporal Boundaries

The temporal boundaries for the assessment of potential Project-related environmental effects on Indigenous peoples and community values encompass all Project phases, including well drilling, testing, and abandonment. BP is currently planning a one-well program with an initial well proposed for 2020 but could potentially drill up to 20 wells between 2020 and 2026. Well testing (if required, dependent upon drilling results) could also occur at any time during the temporal scope of this EIS. Wells may be decommissioned and abandoned at any time within the temporal boundaries. Each well is anticipated to take approximately 60 days to drill and VSP surveys typically take approximately one day per well. Drilling operations will not be continuous throughout the entire seven-year scope of the Project and will depend partially on rig availability and results from previous wells. While drilling activities have the potential to be conducted at any time of the year, BP's preference is to conduct drilling between May and October.

The assessment of effects on Indigenous people and community values also considers important or sensitive periods associated with commercial communal or FSC species and/or fishing activities.

12.1.5 Residual Effects Characterization and Significance Definition

The definitions used to characterize environmental effects as part of this effects assessment for Indigenous peoples and community values are provided in Table 12.2. These characterizations will be used throughout the chapter when describing potential residual environmental effects on Indigenous peoples and community values from routine Project activities. These characterizations are also applicable for accidental events, as discussed in Section 15.5.5.

Table 12.2 Characterization of Residual Effects on Indigenous Peoples and Community Values

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual environmental effect relative to baseline	**Positive** – a residual environmental effect that moves measurable parameters in a direction beneficial to Indigenous peoples and community values relative to baseline **Adverse** – a residual environmental effect that moves measurable parameters in a direction detrimental to Indigenous peoples and community values relative to baseline
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions	**Negligible** – no measurable change **Low** – the residual environmental effect will not reduce the ability to undertake traditional land and resource use (TLRU) or commercial communal fisheries activities **Moderate** – the residual environmental effect will reduce the ability to undertake TLRU or commercial communal fisheries activities **High** – the residual environmental effect will eliminate TLRU or commercial communal fisheries activities
Geographic Extent	The geographic area in which a residual environmental effect occurs	**PA** – residual environmental effects are restricted to the Project Area **LAA** – residual environmental effects extend into the LAA **RAA** – residual environmental effects extend into the RAA
Frequency	Identifies how often the residual effect occurs and how often during the Project	**Unlikely event** – effect is unlikely to occur **Single event** – effect occurs once **Multiple irregular event** – effect occurs at no set schedule **Multiple regular event** – effect occurs at regular intervals **Continuous** – effect occurs continuously
Duration	The period of time required until the measurable parameter or the VC returns to its existing condition, or the residual effect can no longer be measured or otherwise perceived	**Short term** - for duration of the activity, or for duration of accidental event **Medium term** - beyond duration of activity up to end of Project, or for duration of threshold exceedance of accidental event – weeks or months **Long term** - beyond Project duration of activity, or beyond the duration of threshold exceedance for accidental events - years **Permanent** - recovery to baseline conditions unlikely
Reversibility	Pertains to whether a measurable parameter or the VC can return to its existing condition after the project activity ceases	**Reversible –** will recover to baseline conditions before or after Project completion **Irreversible –** permanent

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Ecological and Socio-economic Context	Existing condition and trends in the area where residual effects occur	**Undisturbed** – The VC is relatively undisturbed in the RAA, not adversely affected by human activity, or is likely able to assimilate the additional change **Disturbed** – The VC has been previously disturbed by human development or human development is still present in the RAA, or the VC is likely not able to assimilate the additional change

In consideration of the descriptors listed above, the following threshold has been established to define a significant adverse residual environmental effect on Indigenous peoples and community values.

For the purposes of this effects assessment, a significant adverse residual environmental effect on Indigenous peoples and community values is defined as a Project-related environmental effect that involves:

- loss of access to areas relied on for traditional use practices or the permanent loss of traditional use areas within a large portion of the LAA and RAA for a season;
- adverse effects on socio-economic conditions of affected Indigenous communities, such that there are associated, detectable, and sustained decreases in the quality of life of a community;
- a decrease in established employment and business activity in commercial communal fisheries (e.g., due to fish mortality and/or dispersion of stocks) such that there is a detectable adverse effect upon the economy of the affected Indigenous community; or
- unmitigated damage to fishing gear.

12.2 Project Interactions with Indigenous Peoples and Community Values

Table 12.3 identifies, for each potential effect, the physical activities that might interact with Indigenous peoples and community values and result in the identified effect. These interactions are indicated by checkmark and are discussed in detail in Section 12.3 in the context of effects pathways, standard and Project-specific mitigation / enhancement, and residual effects.

No potential interaction has been identified for well evaluation and testing for a change in commercial communal fisheries given activities associated with well evaluation and testing are not anticipated to interact with the marine environment. Therefore, well evaluation and testing for change in commercial communal fisheries has not been carried through the assessment. There is potential interaction between well evaluation and testing with the harvest of marine birds, and therefore has been carried through assessment for change in current use of lands and resources for traditional purposes.

Table 12.3 Project-Environment Interactions with Indigenous Peoples and Community Values

Physical Activities (refer to Section 4.1.1 for the Scope of the Project)	Environmental Effects	
	Change in Commercial Communal Fisheries	Change in Current Use of Lands and Resources for Traditional Purposes
MODU presence and operation (including drilling, associated safety zone, and MODU lighting)	✓	✓
Vertical Seismic Profiling (VSP) operations	✓	✓
Discharges (e.g., drill muds / cuttings, liquid discharges)	✓	✓
Well evaluation and testing (including flaring)	–	✓
Well abandonment and decommissioning	✓	✓
Supply and servicing operations (including helicopter transportation and PSV operations)	✓	✓
Notes: ✓= Potential interaction – = No interaction		

12.3 Assessment of Residual Environmental Effects on Indigenous Peoples and Community Values

The following section assesses the environmental effects on Indigenous peoples and community values identified as arising from potential interactions in Table 12.2. Given the similarities in Project description, proximity of activities on Orphan Basin and Flemish Pass, and currency of data, the EIS incorporates learnings from previous EA documents for similar exploration drilling projects in Atlantic Canada, including comments received during Indigenous and stakeholder review processes, with updates incorporated as applicable due to Project and geographic differences, scientific updates, and refined EA methods.

12.3.1 Project Pathways

12.3.1.1 Change in Commercial Communal Fisheries

Commercial communal fishing activity includes deploying, setting, retrieving / hauling, and/or accessing gear in designated fishing grounds, and travel to and from those fishing grounds. Project interactions that might interrupt or prevent that process, such as having grounds closed to fishing, impediments to or from fishing grounds, lost or damaged fishing gear, or lost or reduced catch, are the focus of this assessment. Adverse effects to marine fish, including targeted fishery species, is discussed in Chapter 8 (Marine Fish and Fish Habitat). Revenue generated from commercial communal fishing activity is also a main source of revenue for many Indigenous communities; therefore, indirect socio-economic impacts are also qualitatively considered in this assessment. Indigenous groups with commercial communal fishing licenses relevant to this assessment are described in Section 7.4.

A change in commercial communal fisheries could occur from Project activities affecting the marine environment, including:

- the presence and operation of a MODU (fisheries exclusions and underwater sound effects on fisheries species)
- VSP operations (underwater sound)
- discharge of drill muds and cuttings (effects on water and sediment quality on fisheries species) and other discharges and emissions (effects on water quality)
- well abandonment (potential underwater sound associated with removal of wellhead infrastructure and/or a change in benthic habitat associated with leaving the wellhead in place)
- supply and servicing operations (Project supply vessel operations resulting in underwater sound associated with vessel movement causing fisheries species to avoid the area)

12.3.1.2 Change in Current Use of Lands and Resources for Traditional Purposes

Current use of lands and resources for traditional purposes includes those harvesting activities to collect resources that provide nourishment, or for use in traditional ceremonies and social events. Although there are no known traditional fisheries, also known as FSC fisheries, in the Project Area, species that are traditionally harvested elsewhere have the potential to migrate through the Project Area. These include marine fish, marine mammals, and migratory birds. Routine Project activities that might interact with these migratory species are the focus of this assessment. It also considers the social, spiritual, and cultural value of the FSC fishery to the Indigenous communities; however, it is difficult, if not impossible, to express the importance of this fishery as a monetary value, because it reflects the very nature of Indigenous culture. A qualitative assessment of social and cultural value is provided based on the potential impacts to the current use of lands and resources for traditional purposes.

A change in current use of lands and resources for traditional purposes could occur as a result of Project activities affecting the marine environment including the presence and operation of a MODU (underwater sound effects on FSC fisheries species), VSP operations (underwater sound), discharge of drill muds and cuttings (effects on water and sediment quality for FSC fisheries species), other discharges and emissions (effects on water quality), PSV operations (underwater sound associated with vessel movement causing FSC fisheries species to avoid the area), well abandonment (potential underwater sound associated with removal of wellhead infrastructure and/or a change in benthic habitat associated with leaving the wellhead in place), and supply and servicing operations (including helicopter transportation and Project supply vessel operations).

12.3.2 Mitigation

In consideration of the environmental effects pathways outlined above, the following mitigation measures and standard practices will be employed to reduce potential effects on Indigenous peoples and community values. Mitigation measures identified in the assessment on marine fish and fish habitat (Section 8.3) will also be incorporated to help reduce the potential for interaction with commercial communal fish species. These mitigation measures are consistent with measures proposed to reduce potential adverse effects on Commercial Fisheries and Other Ocean Users (refer to Chapter 13).

- BP will continue to engage Indigenous communities to share Project details as applicable and facilitate coordination of information sharing. An Indigenous Fisheries Communication Plan will be used to facilitate coordinated communication with fishers
- BP will provide details of the safety zone to the Marine Communication and Traffic Services for broadcasting and publishing in the Notices to Shipping and Notices to Mariners. Details of the safety zone will also be communicated during ongoing engagement with Indigenous fishers
- Project-related damage to fishing gear, if any, will be compensated in accordance with the *Compensation Guidelines with Respect to Damages Relating to Offshore Petroleum Activity* (C-NLOPB and CNSOPB 2002)
- PSVs will use existing shipping lanes as practicable; where these do not exist, PSVs will follow a straight-line approach to and from the Project Area
- to maintain navigational safety at all times during the Project, obstruction lights, navigation lights and foghorns will be kept in working condition on board the MODU and PSVs. Radio communication systems will be in place and in working order for contacting other marine vessels as necessary

12.3.3 Characterization of Residual Project-related Environmental Effects

12.3.3.1 Change in Commercial Communal Fisheries

Presence and Operation of a MODU

There is potential for a disruption of commercial communal fishing activities if drilling activities displace fishing in the areas around drill sites. A 500-m radius safety zone will be established around the MODU (when it is present and operational), within which commercial communal fishing activities will be excluded. This will result in localized commercial communal fisheries exclusion within an area of approximately 0.8 km² (80 ha) for up to approximately 60 days for each well drilled. Given the bottom fishing closure within the Northeast Newfoundland Slope Closure and the extensive overlap of this area with the Project Area, the exclusion zone will be relevant to pelagic fisheries only. Although fishing effort may be prevented within this safety zone, it is anticipated to be a temporary and localized fishing exclusion and is not likely to have a substantial effect on commercial communal fishing activities and fisheries resources. BP will provide details of the safety zone to the Marine Communication and Traffic Services for broadcasting and publishing in the Notice to Shipping and Notice to Mariners. Details of the safety zone will also be communicated during ongoing engagement with Indigenous and non-Indigenous fishers, and through the implementation of the Indigenous Fisheries Communications Plan.

Biophysical and behavioural effects associated with underwater sound on fish species, including commercial communal species, are discussed in Chapter 8 (Marine Fish and Fish Habitat). Fish can be affected by underwater sound emissions from the MODU, which may cause fisheries species to avoid the area around the MODU, particularly during the start-up of drilling. This avoidance behaviour is expected to be temporary as fish become habituated to the continuous sound levels from the MODU and startle responses cease (Chapman and Hawkins 1969; McCauley *et al*. 2000a, 2000b; Fewtrel and McCauley 2012). Given the temporary and localized nature of this effect, it is not expected to affect fisheries species to the extent that commercial communal fishers would experience a measurable change in availability of

fisheries resources (through species mortality or dispersion of stocks) and therefore Indigenous communities would not experience adverse socio-economic effects.

As discussed in Section 7.4, Indigenous communities hold commercial communal licenses for several species, including groundfish, halibut, mackerel, herring, capelin, seal, lobster, scallop, snow crab, shrimp, swordfish, tuna, and Arctic char. Swordfish and tuna, are two species known to occur in the RAA that were noted through Indigenous engagement activities as being of primary commercial communal importance and are two species most likely to migrate across larger geographic areas and therefore potentially be targeted for fishing outside the Project Area. These species therefore are the focus in the assessment for this VC.

Swordfish are a migratory species that are distributed widely throughout the Atlantic Ocean and can occur in waters offshore Newfoundland and Labrador. Indigenous groups hold commercial communal fishing licences for swordfish in NAFO Areas that overlap with the Project Area and the RAA. As discussed in Section 7.4.7, commercial landing locations for swordfish, including those landings fished under a commercial communal licence, between 2011 and 2015, have been located primarily in NAFO subdivisions 3O and 3N, outside of the Project Area. While commercial landings for swordfish are an indication of swordfish distribution, the species has a wide range and can be found along the edge of the continental shelf. The potential exists for swordfish to be found in areas that overlap with the Project Area; however, the overall distribution and migration patterns for swordfish is a large area, including most of the North Atlantic Basin (Dewar et al. 2011; Trenkel et al. 2014).

As discussed in Section 7.4.7, commercial landings for tuna species in offshore waters of Newfoundland and Labrador have generally been concentrated in NAFO area 3O, which is outside of the Project Area, and in the southwest portion of the RAA. As tuna are a highly migratory species, and they have been found in the offshore waters of Newfoundland and Labrador, the species could migrate through the Project Area in search of prey species. Given the overall migration range for swordfish and tuna, it is unlikely that large numbers of these species would interact or be adversely affected by the presence and operation of a MODU. Therefore, this activity is not predicted to decrease the availability of swordfish or tuna as a resource for commercial communal fishing and result in associated adverse socio-economic impacts to the Indigenous communities.

Residual effects associated with the presence and operation of a MODU on a change in commercial communal fisheries, including associated socio-economic effects, on Indigenous peoples and community values is predicted to be low in magnitude, within the Project Area, occurring at irregularly throughout the life of the Project, short-term in duration, and reversible (e.g., avoidance behaviour exhibited by fisheries species, as well as the establishment of the safety zone associated with the presence of the MODU, will not have a permanent, irreversible effect on commercial communal fisheries).

Vertical Seismic Profiling Operations

Similar to the discussion for operation and presence of a MODU, underwater sound levels associated with the VSP surveys can interact with commercial communally-fished species. Underwater sound could startle fish, causing them to avoid the area and thereby reduce catchability. Section 8.3 discusses potential startle and alarm responses of marine fish resulting from VSP surveys. Fish species, including commercial communal species, may move away from an area due to the presence of underwater sound.

VSP surveys use equipment similar to that used in seismic operations (i.e., an air gun source array); however, the size and volume of the array are much smaller than a traditional seismic survey. The VSP is focused around a wellbore and underwater sound effects are therefore localized around the drill site. VSP operations are typically of short duration, normally taking approximately a day to complete the profiling, which is much shorter than a typical seismic exploration program. Physical and behavioural changes in commercial communal fisheries species resulting from VSP surveys would be expected to be low and associated socio-economic effects are also anticipated to be low (refer Chapter 8 Marine Fish and Fish Habitat).

Residual effects associated with VSP operations on a change in commercial communal fisheries, including associated socio-economic effects, is predicted to be negligible to low in magnitude, occur within the Project Area, occur more than once at irregular intervals, short-term in duration, and reversible.

Discharges

The discharge of drilling waste and other discharges and emissions may result in temporary and localized effects on water quality and/or sediment quality and therefore could potentially affect commercial communal fisheries species within a localized area. Drill waste modelling conducted for this Project considered the extent of various thicknesses of the deposition of drill cuttings on the seafloor in a radius from the discharge site. As presented in Appendix B and discussed in Section 8.3, it was predicted that sediment thicknesses of 6.5 mm could extend up to 128 m from the discharge point or cover an area of approximately 0.69 ha in the West Orphan Basin, and 55 m from the discharge point or approximately 0.64 ha per well in East Orphan Basin under low ambient surface current conditions. Sediment thicknesses of 100 mm or greater are confined to a maximum distance of 32 m from the discharge point or cover an area of approximately 0.07 ha in the West Orphan Basin. For the East Orphan Basin, sediment thicknesses of 100 mm or greater were confined to a maximum distance of 14 m from the discharge point or cover an area of approximately 0.07 ha. The Project will adhere to the OCSG and OWTG, which have been developed to protect the marine environment and will limit adverse effects on fisheries species. As noted in Section 8.3, these effects are expected to be low in magnitude and localized to the Project Area.

Results of environmental effects monitoring programs undertaken for various drilling programs in Atlantic Canada (Hurley and Ellis 2004) concluded that effects on fish health and fish habitat are negligible from marine discharges. The availability of commercial communal fisheries resources is not expected to be affected by discharges.

Residual effects associated with discharges on a change in commercial communal fisheries, including associated socio-economic effects, is predicted to be low in magnitude, occur within the Project Area, occur more than once at irregular intervals, be medium-term in duration, and be reversible.

Well Abandonment and Decommissioning

Once a well has been drilled to total depth and well evaluation programs completed (if applicable), it will be plugged and abandoned in line with applicable BP practices and C-NLOPB requirements. The abandonment program has not yet been defined. BP's wellhead removal strategy considers water depth and the likelihood of potential interactions with fishing activities. As discussed in Section 2.4.4., BP may seek permission from the C-NLOPB to leave the wellhead in place after well plugging and abandonment.

Should the wellhead be kept in place, it could interact with commercial communal fishing activity in the Project Area through a change in fish habitat (i.e., small structure above the seabed). Given the bottom fishing closure within the Northeast Newfoundland Slope Closure and the extensive overlap of this area with the Project Area, this potential interaction is relevant to pelagic fisheries only. However, because of the localized effects around the wellsite, and the water depths in the Project Area, changes to commercial communal fishing are anticipated to be low.

Residual effects associated with well abandonment on a change in commercial communal fishing, including associated socio-economic effects, is predicted to be negligible to low in magnitude, restricted to the Project Area, occur more than once at irregular intervals, short to long-term in duration, and reversible.

Supply and Servicing Operations

The operation of PSVs will increase vessel traffic in the Project Area and LAA and may therefore locally affect commercial communally-fished species habitat quality and use. It is likely that two to three PSVs will be required, with one vessel on stand-by at the drilling vessel at all times. It is estimated that the PSVs will make a total of two to three round trips per week between the MODU and the shorebase. The increase in vessel traffic has the potential to interfere with fishing gear and may restrict fishing vessel navigation. The PSVs will follow the most direct vessel traffic routes between the shorebase and the Project Area and adhere to standard navigation procedures, thereby reducing potential conflicts with commercial communal fisheries.

Helicopter transportation is predicted to have negligible effects on fisheries given the lack of interaction with marine fish or fishing activities.

Residual effects associated with supply and servicing on a change in commercial communal fisheries, and associated socio-economic effects, is predicted to be negligible to low in magnitude, occur within the LAA, occur more than once at irregular intervals, short-term in duration, and reversible.

12.3.3.2 Change in Current Use of Lands and Resources for Traditional Purposes

Presence and Operation of a MODU

As discussed in Section 8.3, fish can be affected by underwater sound emissions from the MODU, which may cause migratory species to avoid the area around the MODU, particularly during the start-up of drilling. This avoidance behaviour is expected to be temporary because fish become habituated to the continuous sound levels from the MODU and startle responses cease (Chapman and Hawkins 1969; McCauley *et al*. 2000a, 2000b; Fewtrel and McCauley 2012). Given the temporary and localized nature of this effect, it is not expected to affect migratory fish species to the extent that FSC fishers would experience a measurable change in availability of fisheries resources (through species mortality or dispersion of stocks) and therefore would not indirectly result in associated social and cultural impacts to the Indigenous communities.

As discussed in Section 7.4, Indigenous communities hold FSC licenses for several species. Two fish species were noted through Indigenous engagement activities to be of importance from a cultural or spiritual perspective: the Atlantic salmon and American eel. Both species are known to occur in the RAA and therefore are a focus in the assessment for this VC.

Atlantic salmon populations (*Salmo salar*) breed and spend the early part of their life cycle in freshwater systems throughout Atlantic Canada, eastern Québec, and the northeastern seaboard of the United States. A detailed discussion on the general ocean distribution and migration for the various populations of Atlantic salmon is provided in Section 6.1.9, noting that there is potential for the occurrence of several Atlantic salmon populations in the Project Area, including the South Newfoundland population, the Gaspe-Southern Gulf of St. Lawrence population, the Outer Bay of Fundy population, the Eastern Cape Breton population, the Nova Scotia Southern Upland population, the Quebec Eastern North Shore population, the Quebec Western North Shore population and the Anticosti Island population. Salmon have the potential to be affected by underwater sound emissions from the presence and operation of a MODU. However, like most mobile fish species, salmon are generally expected to avoid underwater sound at lower levels than those at which injury may occur. Behavioural effects would be of limited duration due to the short-term nature of the activities (i.e., approximately 60 days) and the migratory nature of the salmon. Therefore, potential effects on salmon population from the presence and operation of a MODU are unlikely.

As discussed in Section 6.1.9, the American eel (*Anguilla rostrate*) lives primarily in freshwater and estuarine environments and has a broad distribution throughout the northwest Atlantic Ocean, stretching from Venezuela to Greenland and Iceland (COSEWIC 2012). If present in the Project Area, it is not expected that a localized potential area of avoidance would substantially affect their behaviour during migration through a relatively wide corridor (e.g., kilometres). It is possible that eels migrating from southern waters would attempt to avoid the MODU, although it is not expected this small area will interfere with migration, such that the species at a population level distributed over a much wider geographic area would be affected. Therefore, potential effects on American eel population from the presence and operation of a MODU are unlikely.

Seals are harvested by Indigenous communities for FSC purposes. As discussed in Section 6.3.5, five seal species occur in the Project Area: harp, hooded, grey, ringed, and bearded seals. The harp seal and hooded seal are expected to be common in the Project Area. Potential effects from the presence and operations of

the MODU on marine mammals (including seals) is discussed in Section 10.3. Residual effects on marine mammals was predicted to be low in magnitude; therefore, potential impacts to harvested seal species are similarly predicted to be low in magnitude.

The presence and operation of a MODU could interact with traditional bird harvesting activities through nocturnal attraction of birds due to artificial lighting. Species commonly harvested by Indigenous communities include goose, ducks, loons, seagulls, murres, mergansers, and scoters (Section 7.4.7). Within the RAA, murres are common in the Project Area, including thick-billed murre and common murre. Section 9.3 describes the residual effects from the presence and operation of a MODU on marine and migratory birds. The magnitude of the effect of the presence and operation of a drilling installation on marine and migratory birds is anticipated to be low in consideration of the implementation of mitigation such as following the Best Practices for Stranded Birds Encountered Offshore Atlantic Canada.

Residual effects associated with the presence and operation of a MODU on a change in current use of lands and resources for traditional purposes, including associated impacts to social and cultural values, is predicted to be low in magnitude, occur within the Project Area, and be irregular throughout the Project, short-term in duration, and reversible (e.g., avoidance behaviour exhibited by fisheries species will not have a permanent, irreversible effect on FSC fisheries).

Vertical Seismic Profiling Operations

Underwater sound levels associated with VSP surveys could cause startle and alarm responses by migratory fish. As discussed in Section 8.3, received sound levels are unlikely to result in physical effects to the majority of mobile fish species due to the expectation that whey would avoid underwater sound at lower levels than those at which injury or mortality may occur (BP 2016). Similarly, as discussed in Section 10.3, with the implementation of mitigation measures (Section 10.3.2), it is unlikely that VSP surveys will result in injuries (PTS) for marine mammals or sea turtles. Therefore, behavioural changes to FSC fisheries species resulting from VSP surveys are expected to be low, and potential impacts to social and cultural values are also anticipated to be low.

Sounds produced by VSP surveys also have the potential to interact with migratory birds, particularly diving birds which are expected to hear a sound pulse if they are underwater at the time the pulse arrives. Murres are the only traditionally harvested diving species in the Project Area. They are known to regularly dive to a depth of 100 m and have been recorded underwater for up to 202 seconds (Gaston and Jones 1998). Common murres have been known known to dive to a depth of 180 m or deeper (Piatt and Nettleship 1985). However, given the ramp-up period to the seismic survey, it is unlikely that these birds will feed underwater when the seismic source is activated, because this would deter them from the area and reduce their exposure to potentially harmful underwater sound waves. As discussed in Section 9.3, residual effects from these surveys are likewise not anticipated because the activity will be extremely localized and short-term (approximately one day per well), with negligible environmental interactions.

Residual effects associated with VSP operations on a change in current use of lands and resources for traditional purposes, including associated impacts to social and cultural values, is predicted to be low in magnitude, occur within the Project Area, occurs more than once at irregular intervals, be short-term in duration, and reversible.

Discharges

The discharge of drilling waste and other discharges and emissions may result in temporary and localized effects on water quality and/or sediment quality and therefore could potentially affect FSC species within a localized area. The Project will adhere to the OCSG and OWTG, which have been developed to protect the marine environment.

Drill waste modelling conducted for this Project considered the extent of various thicknesses of the deposition of drill cuttings on the seafloor in a radius from the discharge site. As discussed in Section 8.3, it was predicted that sediment thicknesses of 6 mm could extend up to 156 m from the discharge point or cover an area of approximately 0.7586 ha in the West Orphan Basin, and 61 m from the discharge point or approximately 0.7118 per well in East Orphan Basin under low ambient surface current conditions. Sediment thicknesses of 100 mm or greater are confined to a maximum distance of 32 m from the discharge point over an area of approximately 0.07 ha in the West Orphan Basin. For the East Orphan Basin, sediment thicknesses of 100 mm or greater were confined to a maximum distance of 14 m from the discharge point over an area of approximately 0.07 ha**.** Results of environmental effects monitoring programs undertaken for various drilling programs in Atlantic Canada (Hurley and Ellis 2004) concluded that effects on the health of migratory fish species including Atlantic salmon and eels are negligible given brief exposure due to the transitory nature of these species.

As discussed in Section 9.3, the primary effects related to discharges and emissions on marine and migratory birds is associated with the potential production of surface sheens. Small amounts of oil from sheens has been shown to affect the structure and function of seabird feathers (O'Hara and Morandin 2010), which has the potential to result in water penetrating plumage and displacing the layer of insulating air, resulting in loss of buoyancy and in hypothermia. These effects will be prevented or reduced through the waste management, discharge treatment measures, and compliance with the OWTG. With the implementation of mitigation, the overall magnitude of the effect of drilling and other marine discharges on marine and migratory birds is anticipated to be low.

With the implementation of mitigation including adherence to the OWTG, the overall magnitude of the effect of drilling and other marine discharges on FSC species is anticipated to be low. It is therefore unlikely that discharges and emissions will reduce the availability of species harvest for FSC purposes.

Residual effects associated with discharges on a change in current use of lands and resources for traditional purposes, including associated impacts to social and cultural values, is predicted to be low in magnitude, occur within the Project Area, occur more than once at irregular intervals, and be medium-term in duration, and reversible.

Well Evaluation and Testing

Given the lack of interaction between well evaluation and testing activities and the marine environment, there is negligible interaction with migratory fish and marine mammal species.

As discussed above in reference to the presence and operation of a MODU, and in Section 9.3, migratory birds can be attracted to artificial light, in this case flaring, although the potential mortality resulting from such interactions is poorly understood. Required flaring activities (if applicable) will be short in duration

(approximately five days per well), and associated bird attraction will be limited to within several kilometers of the MODU. Mitigation measures will be implemented to reduce adverse effects on marine and migratory birds should flaring be required (refer to Section 9.3.2). The effects of formation flow testing with flaring (if conducted) on marine associated birds, and therefore traditional harvesting, are therefore anticipated to be negligible.

Residual effects associated with well evaluation and testing on a change in current use of lands and resources for traditional purposes, including associated impacts to social and cultural values, is predicted to be low in magnitude, restricted to the Project Area, occur more than once at irregular intervals, be short-term in duration, and be reversible.

Well Abandonment and Decommissioning

As described above (change in commercial communal fisheries), once wells have been drilled to total depth and well evaluation programs completed (if applicable), the well will be plugged and abandoned in line with applicable BP practices and C-NLOPB requirements. As discussed in Section 2.4.4., BP may seek permission from the C-NLOPB to leave the wellhead in place after well plugging and abandonment. As discussed in Section 8.3, should wellheads be kept in place, the abandonment of wells could result in a change in fish habitat (i.e., small structure above the seabed).

Well abandonment will occur underwater at sufficient depths to prevent interaction with marine and migratory birds, including diving species.

Residual effects associated with well abandonment on a change in current use of lands and resources for traditional purposes, including associated impacts to social and cultural values, is predicted to be negligible to low in magnitude, restricted to the Project Area, occur more than once at irregular intervals, be short to long-term in duration, and be reversible.

Supply and Servicing Operations

The operation of PSVs will increase vessel traffic in the Project Area and LAA and may therefore locally affect migratory species habitat quality and use around the PSV. It is likely that two to three PSVs will be required, with one vessel on stand-by at the drilling vessel, at all times. It is estimated that the PSVs will make a total of two to three round trips per week between the MODU and the shorebase. As discussed in Section 8.3, potential environmental effects on fish attributable to PSV would represent only a small incremental increase over similar effects currently associated with existing high levels of marine traffic and shipping activity throughout the RAA. Therefore, the potential for supply and servicing to interact with traditional fisheries and associated socio-economic impacts is anticipated to be low.

Residual effects associated with supply and servicing on a change in current use of lands and resources for traditional purposes, including associated impacts to social and cultural values, is predicted to be low in magnitude, occur within the LAA, occurs more than once at irregular intervals, short-term in duration, and reversible.

12.3.4 Overview of Potential Effects on Indigenous Peoples and Community Values

Based on the assessment presented above, this section summarizes the potential effects of routine Project activities on Indigenous communities and their activities as prescribed in the EIS Guidelines and in section 5(1) of CEAA 2012, including:

(i) health and socio-economic conditions

(ii) physical and cultural heritage

(iii) the current use of lands and resources for traditional purposes, or

(iv) any structure, site or thing that is of historical, archaeological, paleontological or architectural significance.

Effects of accidental events are assessed separately in Chapter 15.

12.3.4.1 Health and Socio-Economic Conditions

Given that routine Project-related activities will occur in the marine environment over 340 km from the nearest Indigenous community on the Island of Newfoundland, and even further from such communities in Labrador, the Maritime provinces, and Quebec, it is unlikely that effects from routine activities will directly affect the physical or social health and well-being of Indigenous persons or communities. Activities will occur in a localized area, over a short period of time, and the standard mitigation practices will be implemented to reduce adverse effects. Due to its distance offshore, the Project is also unlikely to affect receptors that would be sensitive to atmospheric air or sound emissions from routine Project activities. Routine Project activities are predicted to result in no significant adverse environmental effects on marine fish, marine mammals and sea turtles, or migratory birds (see Chapters 8-10), including the overall presence, distribution, and quality of these species. Routine Project activities are therefore not anticipated to result in changes to the environment that would influence human health and well-being of Indigenous peoples.

Routine Project activities are not predicted to result in changes to the socio-economic conditions in the Indigenous communities. Given the offshore location of Project activities, routine activities are not predicted to interact with on-land or near-shore Indigenous activities that contribute to the socio-economic conditions, including with services and infrastructure within or used by Indigenous people and their communities. Residual effects on marine fish and fish habitat, including species harvested for commercial communal and FSC purposes, are determined likely to be temporary and of low magnitude. Residual effects on Indigenous fisheries resources would also then be comparable to effects on marine fish and fish habitat. Additionally, access to fishing ground is anticipated to be localized and temporary in nature. Given the low likelihood of residual effects on Indigenous fisheries from routine activities, associated potential effects to socio-economic conditions such as employment and business activity and income, community revenue, and availability of culturally important species in the Indigenous communities are anticipated to be low.

12.3.4.2 Physical and Cultural Heritage

As described in the *Technical Guidance for Assessing Physical and Cultural Heritage or any Structure, Site or Thing that is of Historical, Archeological, Paleontological or Architectural Significance under CEAA, 2012*, heritage is associated with important aspects of human history and culture and can encompass social, economic, political, environmental, scientific, natural, and cultural dimensions. Cultural landscape also often describes a geographical area that has been modified, influenced, or given special cultural meaning by people (Agency 2015a). As discussed in Section 7.4, there are no known heritage sites in the Project Area or LAA. Routine Project activities are also not anticipated to result in changes to the environment that would influence physical and cultural heritage due to the Project's location over 340 km from the nearest Indigenous community on the Island of Newfoundland, and even further from such communities in Labrador, the Maritime provinces, and Quebec.

12.3.4.3 Current Use of Lands and Resources for Traditional Purposes

As described in the *Technical Guidance for Assessing the Current Use of Lands and Resources for Traditional Purposes under CEAA, 2012*, current use of lands and resources for traditional purposes, and the exercise of treaty rights, is associated with an Indigenous group's practices, traditions, or customs, which are part of an Indigenous group's distinctive culture and fundamental to their social organization and the sustainment of present and future generations (Agency 2015b). "Current use" is defined as the use (i.e., activities involving the harvest of resources and travelling to engage in these or other kinds of activities) of lands and resources throughout the proposed project's lifecycle and includes uses by Indigenous peoples that are actively being carried out or are likely to be carried in a reasonably foreseeable future (Agency 2015b). A detailed discussion of the potential effects from routine Project activities and current use of lands and resources for traditional purposes is provided in Section 12.3.3. Current use of lands and resources related to traditional fisheries, also known as FSC fisheries, includes harvesting activities to collect resources that provide nourishment, or for use in traditional ceremonies and social events. A change in current use of lands and resources for traditional purposes could occur from routine Project activities affecting the marine environment. However, with the implementation of mitigation, effects were predicted, in general, to be negligible to low in magnitude, localized (within the LAA), short-term in duration, and reversible. Routine Project activities, therefore, are not predicted to interact with current use of lands and resources for traditional purposes by an Indigenous community.

As discussed in Section 7.4, Indigenous groups in Newfoundland and Labrador, the Maritime Provinces, and Quebec, have an Aboriginal right to fish for food, social and ceremonial purposes, and Indigenous groups in the Maritime Provinces and the Gaspe Peninsula in Quebec have the right to fish for a 'moderate livelihood' established through Peace and Friendship Treaties, or in the case of the Nunatsiavut Government through Land Claims Agreements. Based on the Agency's initial review of potential or established Aboriginal and/or treaty rights, the Agency determined that there is a low likelihood of interaction between the Project under normal operations, and potential or established Aboriginal and/or treaty rights for each Indigenous group (Agency pers. comm. 2018).

12.3.4.4 Any Structure, Site or Thing of Historical, Archaeological, Paleontological or Architectural Significance

Any structure, site, or thing of historical, archaeological, paleontological, or architectural significance includes something that may be movable (e.g., tools) or immovable (e.g., cultural landscape), above (e.g., historic building) or below ground (e.g., burial site), and on land or in water, and is distinguished from other lands and resources by the value placed on it (Agency 2015a). There are no known physical and cultural sites, including structures, sites, or things of historical, archaeological, paleontological, or architectural significance in the Project Area or LAA. Routine Project activities are unlikely to adversely affect any structure, site or thing that is of historical, archaeological, paleontological, or architectural significance because of the offshore location of the Project and the localized extent of Project interactions.

12.3.5 Summary of Project Residual Environmental Effects

Table 12.4 summarizes the effects assessment for Project effects and prediction of residual effects resulting from those interactions between the Project and Indigenous peoples and community values. The Project will result in adverse effects to a change in commercial communal fisheries and change in current use of lands and resources for traditional purposes, however, these effects are not predicted to occur to the extent that they would result in measurable effects on socio-economic conditions for Indigenous communities or Aboriginal or treaty rights. In consideration of the implementation of mitigation, the residual effects are predicted to be negligible to low in magnitude for each Project activity, generally occur within the Project Area or LAA, be of short to long-term in duration, and be reversible. The ecological and socio-economic context is predicted to be disturbed because of previous or existing human development and activities present in the RAA, such as shipping traffic and commercial fisheries.

Table 12.4 Summary of Residual Environmental Effects on Indigenous Peoples and Community Values

Residual Effect	Residual Environmental Effects Characterization						
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in Commercial Communal Fisheries							
Presence and operation of MODU	A	L	PA	ST	IR	R	D
VSP operations	A	N-L	PA	ST	IR	R	D
Discharges	A	L	PA	MT	IR	R	D
Well abandonment and decommissioning	A	N-L	PA	ST-LT	IR	R	D
Supply and servicing operations	A	N-L	LAA	ST	IR	R	D

Residual Effect	Residual Environmental Effects Characterization						
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in Current Use of Lands and Resources for Traditional Purposes							
Presence and operation of MODU	A	L	PA	ST	IR	R	D
VSP operations	A	L	PA	ST	IR	R	D
Discharges	A	L	PA	MT	IR	R	D
Well evaluation and testing	A	L	PA	ST	IR	R	D
Well abandonment and decommissioning	A	N-L	PA	ST-LT	IR	R	D
Supply and servicing operations	A	L	LAA	ST	IR	R	D

KEY:
See Table 12.2 for detailed definitions
N/A: Not Applicable

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PA: Project Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term
MT: Medium-term
LT: Long-term
P: Permanent

Frequency:
UL: Unlikely
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological / Socio-Economic Context:
D: Disturbed
U: Undisturbed

12.4 Determination of Significance

Residual effects from routine Project activities on Indigenous peoples and community values are not anticipated to result in loss of access to areas relied on for traditional use practices or the permanent loss of traditional use areas within a large portion of the LAA and RAA for an entire season. Adverse effects on socio-economic conditions are unlikely to affect Indigenous communities, such that there are associated, detectable, and sustained decreases in the quality of life of a community. A decrease in established employment and business activity in commercial communal fisheries (e.g., due to fish mortality and/or dispersion of stocks) is not predicted such that there is a detectable adverse effect upon the economy of the affected Indigenous community. With mitigation and environmental protection measures, the residual environmental effects on Indigenous peoples and community values are predicted to be not significant.

The prediction of a not significant effects on Indigenous peoples and community values is determined with a high level of confidence based on a good understanding of the general effects on commercial and traditionally harvested species inhabiting the LAA and the effectiveness of mitigation measures including those discussed in Sections 12.3.2.

12.5 Follow-up and Monitoring

Given the high level of confidence for a prediction of no significant adverse environmental effects on Indigenous peoples and community values, and the implementation of standard mitigation, ongoing engagement with communities, and the implementation of an Indigenous Fisheries Communication Plan, no follow-up and monitoring are proposed for routine Project activities.

12.6 References

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13.0 ASSESSMENT OF POTENTIAL EFFECTS ON COMMERCIAL FISHERIES AND OTHER OCEAN USERS

Commercial fisheries and other ocean users is considered a VC because of the commercial and cultural importance that commercial fishing has for the province of Newfoundland and Labrador, and the importance of other ocean activities such as offshore research, subsea communications, military training, and shipping activities that occur in offshore waters. Project activities have potential to interact with commercial fishing and other ocean uses.

Commercial fisheries in this assessment refer to wild fisheries, with species being harvested by Canadian vessels within Canada's EEZ, and by both Canadian and non-Canadian vessels fishing outside of the EEZ. These fisheries also include commercial fishing pursued under commercial communal licences issued by DFO to Indigenous groups in Newfoundland and Labrador and in the Maritime provinces. These commercial communal licences are commonly provided to commercial fishing enterprises, who exercise the licence on behalf of the Indigenous community. Landings under a commercial communal licence are therefore included in aggregate commercial fishing data reported by DFO. Commercial Indigenous fisheries are directly related to the Indigenous Peoples and Community Values VC (Chapter 12).

Commercial fishing activity relies on fish health and quality, and potential biological effects on fish and fish habitat from Project activities could indirectly affect commercial fishing success. This VC is therefore linked to the Marine Fish and Fish Habitat VC (Chapter 8). Potential biological effects on fish and fish habitat discussed in Chapter 8 are not repeated in this VC assessment.

As discussed in Section 7.2, commercial fishing activity occurs in the waters of offshore Newfoundland and Labrador, including areas that overlap the Project Area and larger RAA. The large portion of commercial fishing activity occurs on the Grand Banks, and along the continental shelf break (Figure 7.5). This includes areas of the shelf break that overlap with the Project Area. Snow crab and northern shrimp constitute most landings, in offshore Newfoundland and Labrador, and internationally. Other prominent species harvested include groundfish such as Greenland halibut, Atlantic halibut, deepwater redfish, and flounder. Most of these species are fished using bottom trawls for groundfish, and modified trawls designed for shrimp harvesting. Snow crab are harvested using fixed crab pots that are laid on the seabed and marked at the surface by a buoy. Snow crab fishing occurs during late spring and into the summer months, usually from April to August. Other fisheries are typically year-round, with most fishing taking place in the summer months due to relatively higher productivity.

A large portion of the Project Area, including ELs 1145,1146, and 1148, overlaps with a newly designated marine refuge area, the Northeast Newfoundland Slope Closure (Section 6.4). Within this area, bottom contact fishing activity has been prohibited. EL 1149 is outside the marine refuge area and Canada's EEZ.

13.1 Scope of the Assessment

13.1.1 Regulatory and Policy Setting

Marine fisheries in the RAA are governed by two jurisdictions. The Government of Canada has regulatory authority over commercial fishing activity within its 200 nm EEZ. Canada also has jurisdiction over sedentary species outside the 200 nm EEZ and up to the extent of its defined continental shelf. Outside of the EEZ, NAFO holds primary jurisdiction over commercial fishing activities for several non-sedentary species, and the authority to designate protected areas and closure areas to protect environments and environmental features from commercial fishing activity. The Northwest Atlantic Ocean is divided into a series of NAFO divisions, subdivisions, and unit areas (Figure 13.1) that are used to regulate and assess fishing activity throughout Newfoundland and Labrador. The Project Area is within NAFO Subdivisions 3KLM, while the RAA overlaps with portions of NAFO Areas 2J+3KLMNO. Within these Subdivisions, there is a large marine refuge area, the Northeast Newfoundland Slope Closure marine refuge, which overlaps with an extensive portion of the Project Area, including ELs 1145, 1146, and 1148. This area is closed to bottom fishing activity and is regulated under the *Oceans Act*.

The federal *Fisheries Act* focuses on protecting the productivity of fish that are part of Commercial, Recreational, and Aboriginal (CRA) fisheries. Section 35 of this Act prohibits activities by persons that may cause serious harm to fish that are part of a CRA fishery. As noted in Section 1.5, the *Fisheries Act* is currently undergoing legislative review, with proposed amendments to restore protection to all fish and fish habitat. The *Atlantic Fishery Regulations, 1985* provide for the management and allocation of fishery resources off the Atlantic coast of Canada, including those off Newfoundland and Labrador. These regulations outline the licence and vessel registration process, and gear requirements to allow a person to fish commercially within Atlantic Canada. These regulations are enforced by DFO.

Fishery resources are protected from uncontrolled fishing activity through various measures such as area closures, setting Total Allowable Catch (TAC) and fishing quotas, fishing season restrictions, and gear and/or vessel restrictions. Domestic closures have been established in accordance with the *Fisheries Act* and *Oceans Act*, restricting bottom fisheries activities in certain areas of offshore Newfoundland and Labrador to protect the existing environment and its ecological functions (Section 6.4). TACs, quotas, and area closures have historical relevance in the waters of offshore Newfoundland and Labrador, specifically the collapse of groundfish stocks in the 1990s, which resulted in moratoria on a variety of groundfish species, some of which remain in effect (e.g., Atlantic cod and American plaice). DFO has created Integrated Fisheries Management Plans to help monitor and help guide the recovery and management of various commercial fish species throughout the Newfoundland and Labrador region. These plans use scientific knowledge of a species, along with industry data on capacity and harvesting methods for the species, to create management strategies for the fishery. Internationally, NAFO also has powers to set TACs and allocate quotas for species to help manage and reduce the potential for overfishing. NAFO has created and enforced fisheries closure areas for areas outside of the EEZ. These areas are designed to restrict or eliminate bottom fishing activities to protect sensitive benthic environments and the ecological functions that they provide to fish species.

13.1.2 Influence of Consultation and Engagement on the Assessment

Questions and comments related to commercial fisheries and other ocean users were noted during BP's Project-related engagement with government departments and agencies, stakeholder organizations, and Indigenous groups (see Chapter 3 for further details). Key issues raised to-date regarding commercial fisheries and other ocean users relate primarily to interactions with commercial fishing activities. The designation of special areas can, in some cases (e.g., Northeast Newfoundland Slope Closure), result in reduction of fishing access. There have been concerns among some stakeholders that the combination of fisheries closure areas along with safety zones from oil and gas activities can potentially contribute to cumulative effects on fishing. Related to concerns surrounding fishing restrictions is the perceived overweighting of restrictions on fishing in conservation measures compared with fewer specific restrictions on petroleum exploration activities or other ocean uses. BP is aware of benthic sensitivities and fisheries closures within the Project Area and will work closely with DFO and the C-NLOPB to identify appropriate mitigation to reduce adverse environmental effects on the benthic environment within the Northeast Newfoundland Slope Closure marine refuge. Fisheries stakeholders noted that there is a history of fishing activity in the general area, including along the shelf break. They indicated that if wells drilled by BP are deeper than 1,500 m, then there is a reduced potential for interaction with commercial fishing activity.

13.1.3 Potential Effects, Pathways, and Measurable Parameters

Routine Project activities can interact with commercial fisheries resources either directly through effects on fishing activity itself (e.g., through displacement from fishing areas, gear loss or damage), and/or indirectly from physical or behavioural effects on species (e.g., changes in fish health or quality, fish avoiding popular areas due to underwater sound or changes in water quality). These direct and/or indirect effects have potential to result in a demonstrated economic loss to commercial fishing interests. Likewise, physical, or behavioural effects on fish could indirectly affect research activities. Oil and gas activities may also restrict certain areas for research or military exercises, which may result in changes in schedules, or moving to different areas.

As a result of these considerations, the assessment of Project-related effects on commercial fisheries and other ocean users is focused on the following potential effect:

- change in availability of resources

Biological and behavioural effects on fish species, including those that are of commercial importance, are described in the VC assessment for marine fish and fish habitat (Section 8.3) and will be cross-referenced below. The measurable parameters used for the assessment of the environmental effects presented above, and the rationale for their selection, are provided in Table 13.1. Effects of accidental events are assessed separately in Section 15.5.6.

Table 13.1 Potential Effects, Effects Pathways and Measurable Parameters for Commercial Fisheries and Other Ocean Users

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change of Availability of Resources	• Interactions between the extent, duration, or timing of Project activities that result in direct or indirect loss in availability of resources	• Change in access to area used for commercial fisheries and other ocean activities (ha) • Change in catch rates (qualitative) • Change in quality of research • Damage or loss to gear and/or equipment • Delays in schedule for commercial fishing and other ocean activities

13.1.4 Boundaries

Spatial and temporal boundaries for the assessment of commercial fisheries and other ocean users are discussed in the following sections.

13.1.4.1 Spatial Boundaries

Project Area: The Project Area (Figure 13.1) encompasses the immediate area in which Project activities may occur. Well locations have not been identified but will occur within the ELs in the Project Area. The Project Area includes ELs 1145, 1146, 1148, and 1149. The Project Area has been delineated to provide a 20 km buffer around each EL.

LAA: The LAA (Figure 13.1) is the maximum area within which environmental effects from routine Project activities and components can be predicted or measured with a reasonable degree of accuracy and confidence. It consists of the Project Area and adjacent areas where Project-related environmental effects are reasonably expected to occur based on available information, including effects thresholds, predictive modelling, and professional judgement. The LAA also includes transit routes to and from the Project Area.

RAA: The RAA (Figure 13.1) is the area within which residual environmental effects from operational activities and accidental events may interact with commercial fishing and other human-based ocean activities that are outside the Project Area. The RAA also accounts for residual environmental effects that could interact cumulatively with the residual environmental effects of other past, present, and future (certain or reasonably foreseeable) physical activities. For the assessment of commercial fisheries and other ocean users, the RAA is comprised of NAFO Subdivisions 2J+3KLMNO.

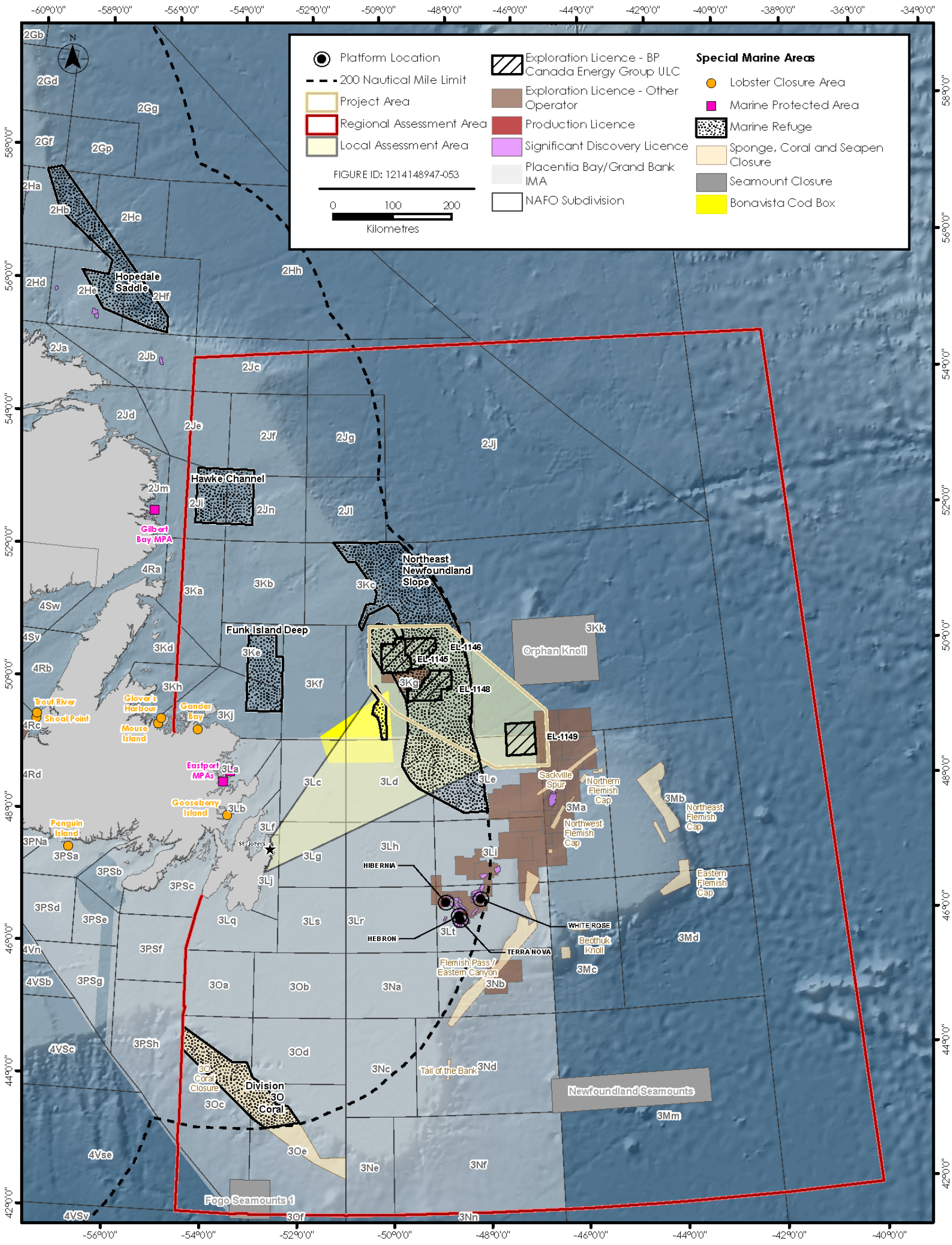

Figure 13.1 Commercial Fisheries and Other Ocean Users Spatial Boundaries

13.1.4.2 Temporal Boundaries

The temporal boundaries for the assessment of potential Project-related environmental effects on commercial fisheries and other ocean users encompass all Project phases, including well drilling, testing, and abandonment. BP is currently planning a one-well program with an initial well proposed for 2020 but could potentially drill up to 20 wells between 2020 and 2026. Well testing (if required, dependent upon drilling results) could also occur at any time during the temporal scope of this EIS. Wells may be decommissioned and abandoned at any time within the temporal boundaries. Each well is anticipated to take approximately 60 days to drill and VSP surveys typically take approximately one day per well. Drilling operations will not be continuous throughout the entire seven-year scope of the Project and will depend partially on rig availability and results from previous wells. While drilling activities have the potential to be conducted at any time of the year, BP's preference is to conduct drilling between May and October.

13.1.5 Residual Effects Characterization and Significance Definition

The definitions used to characterize environmental effects as part of this effects assessment for commercial fisheries and other ocean users are provided in Table 13.2. These characterizations will be used throughout the chapter when describing potential residual environmental effects on commercial fisheries and other ocean users from routine Project activities. These characterizations are also applicable for accidental events, as discussed in Section 15.5.6.

Table 13.2 Characterization of Residual Effects on Commercial Fisheries and Other Ocean Users

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual environmental effect relative to baseline	**Positive** – a residual environmental effect that moves measurable parameters in a direction beneficial to special areas relative to baseline **Adverse** – a residual environmental effect that moves measurable parameters in a direction detrimental to special areas relative to baseline
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions	**Negligible** – no measurable change **Low** – a detectable change but within the range of natural variability **Moderate** – a detectable change beyond the range of natural variability, but with no associated adverse effect on the viability of the affected population. **High** – A detectable change that is beyond the range of natural variability, with an adverse effect on the viability of the affected population
Geographic Extent	The geographic area in which a residual environmental effect occurs	**PA –** residual environmental effects are restricted to the Project Area **LAA –** residual environmental effects extend into the LAA **RAA –** residual environmental effects extend into the RAA

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Frequency	Identifies how often the residual effect occurs and how often during the Project	**Unlikely event** – effect is unlikely to occur **Single event** – effect occurs once **Multiple irregular event** – effect occurs at no set schedule **Multiple regular event** – effect occurs at regular intervals **Continuous** – effect occurs continuously
Duration	The period of time required until the measurable parameter or the VC returns to its existing condition, or the residual effect can no longer be measured or otherwise perceived	**Short term** - for duration of the activity, or for duration of accidental event **Medium term** - beyond duration of activity up to end of Project, or for duration of threshold exceedance of accidental event – weeks or months **Long term** - beyond Project duration of activity, or beyond the duration of threshold exceedance for accidental events - years **Permanent** - recovery to baseline conditions unlikely
Reversibility	Pertains to whether a measurable parameter or the VC can return to its existing condition after the project activity ceases	**Reversible –** will recover to baseline conditions before or after Project completion **Irreversible –** permanent
Ecological and Socio-economic Context	Existing condition and trends in the area where residual effects occur	**Undisturbed –** The VC is relatively undisturbed in the RAA, not adversely affected by human activity, or is likely able to assimilate the additional change **Disturbed –** The VC has been previously disturbed by human development or human development is still present in the RAA, or the VC is likely not able to assimilate the additional change

In consideration of the descriptors listed above, the following threshold has been established to define a significant adverse residual environmental effect on commercial fisheries and other ocean users.

For the purposes of this effects assessment, a significant adverse residual effect on commercial fisheries and other ocean users is defined as a Project-related environmental effect that results in:

- an adverse change in commercial fishing activity including overall timing and intensity, resulting in a measurable reduction in overall activity levels of commercial fishing activity, and/or the economic returns gained from commercial fishing activities due to reduction in quality or quantity of commercial fish landings, for one or more fishing seasons. Can include unmitigated damage to fishing gear; or
- an adverse change in other ocean uses such as marine-based research or military training, including location and timing of these activities, that results in a measurable reduction in the quality or applicability of these activities over multiple years.

13.2 Project Interactions with Commercial Fisheries and Other Ocean Users

Table 13.3 identifies, for each potential effect, the physical activities that might interact with the commercial fisheries and other ocean users and result in the identified environmental effect. These interactions are indicated by checkmark and are discussed in detail in Section 13.3, in the context of effects pathways, standard and project-specific mitigation / enhancement, and residual effects. A justification for no effect is provided following Table 13.3.

Table 13.3 Project-Environment Interactions with Commercial Fisheries and Other Ocean Users

Physical Activities (refer to Section 4.1.1 for the Scope of the Project)	**Environmental Effects**
	Change in Availability of Resources
Presence and operation of a MODU (including drilling, associated safety zone, and MODU lighting)	✓
Vertical Seismic Profiling (VSP) operations	✓
Discharges (e.g., drill muds / cuttings, liquid discharges)	✓
Well evaluation and testing (including flaring)	-
Well abandonment and decommissioning	✓
Supply and servicing operations (including helicopter transportation and PSV operations)	✓
Note: ✓ = Potential interaction – = No interaction	

Well evaluation and testing has not been included in this VC as having a potential interaction with commercial fishing activities or other ocean uses. Flaring takes place in the airspace above the MODU, outside of the marine environment, and encompasses a small direct footprint within the 500-m radius safety zone of the MODU. As a result, there is no interaction predicted that could result in an effect noted in Table 13.3.

13.3 Assessment of Residual Environmental Effects on Commercial Fisheries and Other Ocean Users

The following section assesses the environmental effects on commercial fisheries and other ocean users identified as arising from potential interactions in Table 13.2. Given the similarities in Project description, proximity of activities on Orphan Basin and Flemish Pass, and currency of data, the EIS incorporates learnings from previous EA documents for similar exploration drilling projects in Atlantic Canada, including comments received during Indigenous and stakeholder review processes, with updates incorporated as applicable due to Project and geographic differences, scientific updates, and refined EA methods.

13.3.1 Project Pathways

Change in Availability of Resources

Commercial fishing activity includes deploying, setting, retrieving / hauling, and/or accessing gear in designated fishing grounds, and travel to and from those fishing grounds. Ocean research activities can also include similar processes, and other ocean uses can include shipping and planned military activities. Project interactions that might interrupt or prevent these processes, such as having grounds closed to fishing, impediments to or from fishing grounds, lost or damaged gear and equipment, or lost or reduced catch, are the focus of this assessment. Adverse effects to marine fish, including targeted fishery species, are discussed in Chapter 8 (Marine Fish and Fish Habitat VC).

A change in availability of resources for commercial fisheries and other ocean users could occur as a result of Project activities and components affecting the surrounding marine environment, including:

- the presence and operation of a MODU (associated safety zones restricting access and underwater sound effects on fish species; potential physical contact with existing submarine infrastructure)
- VSP operations (underwater sound effects with potential change in fish distribution)
- Project-related discharges (potential change in fish distribution)
- well abandonment (sound associated with abandonment and permanent infrastructure on the seabed)
- supply and servicing operations (underwater sound effects with potential change in fish distribution).

13.3.2 Mitigation

In consideration of the environmental effects pathways outlined above, the following mitigation measures and standard practices will be employed to reduce potential effects on commercial fisheries and other ocean users. Mitigation measures identified in the assessment on marine fish and fish habitat (Section 8.3) will also be incorporated to help reduce the potential for interaction with fish that may be of commercial value.

- BP will continue to engage commercial fishers to share Project details, as applicable and determine the need for a fisheries liaison officer during mobilization and demobilization of the MODU. This engagement will be coordinated through One Ocean, Fish, Food and Allied Workers-Unifor, Ocean Choice International, Association of Seafood Producers, and Groundfish Enterprise Allocation Council. A Fisheries Communication Plan will be used to facilitate coordinated communication with fishers.
- BP will maintain ongoing communications with the NAFO Secretariat, through DFO as the Canadian representative, regarding planned Project activities, including timely communication of drilling locations, safety zone, and decommissioned wellsites.
- BP will provide details of the safety zone to the Marine Communication and Traffic Services for broadcasting and publishing in the Notices to Shipping and Notices to Mariners. Details of the safety (exclusion) zone will also be communicated during ongoing engagement activities with commercial and Indigenous fishers.
- BP will develop and implement a compensation program for damages resulting from Project activities. This compensation program will be developed in consideration of C-NLOPB guidelines, including the *Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activities* (C-NLOPB and CNSOPB 2017).

- A safety zone will be established around the MODU in accordance with the *Newfoundland Offshore Petroleum Drilling and Production Regulations*.
- BP will conduct a pre-drill survey at each wellsite to confirm the avoidance of subsea infrastructure (e.g., cables, UXOs, shipwrecks).
- BP will contact DFO regarding timing and locations of planned DFO research surveys.
- BP will contact DND regarding timing of planned offshore military exercises.
- PSVs will use existing shipping lanes as practicable; where these do not exist, PSVs will follow a straight-line approach to and from the Project Area.
- During transit to / from the Project Area, PSVs will travel at vessel speeds not exceeding 22 km/hour (12 knots).
- To maintain navigational safety at all times during the Project, obstruction lights, navigation lights and foghorns will be kept in working condition on board the MODU and PSVs. Radio communication systems will be in place and in working order for contacting other marine vessels as necessary.
- BP will communicate locations of suspended and/or abandoned wellsite locations to the appropriate authorities for inclusion on nautical charts for use by commercial fishers and other mariners.

13.3.3 Characterization of Residual Project-related Environmental Effects

13.3.3.1 Change in Availability of Resources

Presence and Operation of a MODU

The presence and operation of a MODU can affect the availability of resources for both commercial fishing activities and other ocean uses. This can be through direct interference through the establishment of safety zones associated with the MODU (when it is present and operational), restricting access to certain areas for commercial fisheries and other ocean activities. The potential also exists for the MODU to damage fishing gear, vessels, and equipment in the unlikely event of a direct interaction. This interaction would most likely occur during transit of the drilling installation from one area to another, before the MODU is set in place and the safety zone is established. The presence and operation of a drilling installation may also lead to changes in the location or abundance of marine resources due to underwater sound effects on fish species, which could affect their distribution in certain areas.

When a MODU is set on location at the wellsite, a 500-m radius safety zone will be established prior to commencement of drilling and throughout the operation of the MODU. This will result in localized fisheries exclusion within an area of approximately 0.8 km² (80 ha) for approximately 60 days for each well drilled. These safety zones prohibit vessels from entering the zone and prohibits other activities occurring within this zone.

The establishment of this safety zone can result in a change of availability of resources if commercial fishers are displaced from an area where they historically fish, particularly if in place during times of the year when commercial fishing activity is highest (e.g., the summer months), and in fisheries where the season is shorter (e.g., the snow crab fishery). This potential loss of access to fisheries resources could result in fishers having to delay a portion of their fishing season in that area or can cause fishers to re-route and move to a different area to fish. The outcomes of these interactions could include increased cost associated

with moving equipment and vessels and waiting for the safety zone to be removed. This could result in lower economic returns for commercial fishers for the season. The MODU also can result in damage to fishing equipment while it is in transit to a drill site. This interaction would likely apply to fixed fishing gear, such as crab pots, which are left in place for several days before they are retrieved.

The presence of the MODU, due to its safety zone, can have similar interactions and outcomes with other ocean activities such as research programs and planned military exercises. The presence of a safety zone in a certain area may require researchers and the military to re-route their program or wait until the safety zone is removed before they can begin their operations. This could result in delayed schedules, or part of a research program being compromised if it is time sensitive. These could all lead to cost implications for these other ocean users.

While there is potential for safety zones to affect the availability of resource to commercial fishers and other ocean users, the Project Area, which includes BPs ELs, is in an area where there are relatively low levels of commercial fishing activity (Figure 7.5 in Section 7.2). The highest levels of domestic commercial fishing activity taking place within the Project Area are along the shelf break, overlapping with the northwest section of the Project Area near the boundaries of ELs 1145, 1146, and 1148. Within the ELs themselves, there is not a large amount of fishing activity. EL 1149 is in an area where there is little domestic harvesting activity (Figure 7.5). The addition of the new Northeast Newfoundland Slope Closure, which overlaps with ELs 1145, 1146, and 1148 (Figure 6.30 in Section 6.4), restricts bottom fishing activity within the area. This will substantially reduce the amount of harvesting activity taking place within the area that those ELs are located and will reduce the potential for interaction with commercial fishers.

Standard mitigation measures, such as ongoing communication with DFO, DND, and commercial fishing industry representatives, will further help to reduce the risk of and interaction between the presence and operation of a MODU and other ocean activities that may be occurring in the area. Scheduled Project activities, including the planned location and timing of drilling activities, will be communicated in advance to the commercial fishing industry and other ocean users. Potential damage to gear, vessels, or other marine assets, although unlikely, would be managed through applicable compensation policies and procedures that will be developed by BP in accordance with applicable C-NLOPB policies and regulations.

In addition to a safety zone, the presence and operation of a MODU could result in other pathways for environmental interactions on available marine resources, including underwater sound from the operation of the MODU, and light emissions. Sound and light emissions have the potential to result in behavioural effects on target fish species for commercial fishing or research programs. During drilling operation, discharges from the MODU, such as organic and liquid wastes, and light emissions, may have the ability to attract fish species to a localized area for a short period of time. This attraction may apply to migrating and pelagic fish species that are attracted to the lights of the drilling installation and the organic discharges, or invertebrates that become attached to the subsea structure or plankton concentrated around the platform. The combination of drilling installation colonization opportunities and artificial light emissions from the MODU may indirectly cause a “reef effect” whereby fish aggregate underneath in response to increased foraging and shelter opportunities (Picken and McIntyre 1989; Røstad et al. 2006; Slabbekoorn et al. 2010). This movement and aggregation of fish species may have an indirect effect on commercial harvesting activities, if fish species move from surrounding areas to the MODU within the safety zone. This would

reduce the access of these species to commercial harvesters, and potentially marine researchers, as they are prohibited from carrying out activities within the safety zone. This could result in a lower catch rate for certain fisheries, or reduced quality of research if certain fish species are not accessible.

The effects of light and underwater sounds on fish are assessed in the Marine Fish and Fish Habitat VC (Section 8.3), which concluded that there would not be significant adverse environmental effects on marine fish species from interactions associated with the presence and operation of a MODU. Disturbances to fish species would likely be localized and of short duration at any one location, returning to normal conditions once the MODU has left the area. Therefore, it is unlikely that marine resources will be affected or disrupted in a manner that would then result in effects on the overall availability or quality of a marine resource for commercial fishers or other ocean users. Mitigation measures noted in Section 13.3.2, including timely and ongoing communication with other industry stakeholders, will further reduce potential interactions that could occur as a result of the presence and operation of a MODU.

Residual effects associated with the presence and operation of a MODU on a change in availability of resources is predicted to be low in magnitude, within the Project Area, short-term in duration, occurring as multiple irregular events, and reversible once drilling operations cease.

Vertical Seismic Profiling Operations

Underwater sound associated with a VSP survey could startle fish, causing them to avoid the affected area and thereby reduce catchability. The potential behavioural effects on fish species are discussed in Section 8.3. Underwater sound may cause fish species, including commercially harvested species, to move away from an area for a period of time. Underwater sound does not appear to have the same avoidance effects on invertebrate species, which has been the primary commercial harvest in offshore Newfoundland and Labrador for several years. As discussed in Section 8.3, received sound levels are unlikely to result in physical effects to the majority of mobile fish species due to the expectation that whey would avoid underwater sound at lower levels than those at which injury or mortality may occur (BP 2016).

VSP surveys use equipment similar to that used in seismic operations (i.e., an air gun source sound array); however, the associated size and volume of the array are much smaller than a traditional seismic survey. The VSP is focused around a wellbore; therefore, sound effects are localized towards the drill site (refer to Section 2.8.5 and Appendix C for more information on underwater sound emissions from VSP surveys).

Behavioural effects on commercial fisheries from underwater sound were investigated by Christian et al. (2003) including pre- and post-exposure catchability of snow crab during commercial fishing season. This investigation concluded that catch-per-unit-effort (CPUE) did not decrease after snow crabs were exposed to seismic survey sound. Morris et al. (2018) undertook a similar study to measure the effects of seismic exposure on the snow crab fishery off the coast of Newfoundland. The study involved a repeated Before-After-Control Impact study over two years to assess industry-scale seismic exposure to snow crab on catch rates along the Grand Banks of Newfoundland. The results of the study did not support the hypothesis from snow crab harvesters that seismic activity had a negative effect on catch rates of snow crab, in both the short-term (i.e., days) and long-term (i.e., weeks) timeframes. The study suggests that if there are effects resulting from seismic exposure on snow crab, they are smaller than changes to snow crab populations related to natural variations and other external stressors. Engås et al. (1991) studied the effects of seismic

exposure on cod catches off the coast of Norway and found that catch rates decrease by at least 50% within the seismic survey area, lasting for approximately 24 hours within a 10 km radius. Løkkeborg et al. (2010) conducted a similar study and found that fish species exhibit behavioural responses to source array exposure; while gillnet catches increased primarily from increased fish activity, longline catches decreased overall. VSP surveys will occur over a one-day period (per well) and are much more localized than large-scale 2D and 3D seismic surveys.

While source array activity could injure fish species if they are close to the sound source, it is likely that mobile fish will disperse from the source during array ramp-up or vessel approach and avoid harm. VSP activity could reduce catches if fish exhibit behavioural changes such as avoidance or a change in distribution.

With the small amount of commercial harvesting activity occurring within the Project Area, and the further reduction in commercial fishing activity in ELs 1145, 1146, and 1148 due to the Northeast Newfoundland Slope Closure, it is unlikely that effects on fish species from VSP surveys would affect distribution in a way that would create a substantial change in availability of resources for commercial fishers and or other ocean users such as researchers, as there is a low amount of research activity occurring within the Project Area (Section 7.3). The temporary nature of the VSP survey (approximately one day per well), also promotes a short-term interaction. Early and ongoing communication between other industries will also help reduce the potential for interaction with commercial fishers and other ocean users.

Residual effects associated with VSP operations on a change in availability of fisheries resources is predicted to be low in magnitude, within the Project Area, short-term in duration (approximately a day per well), occurring at irregular intervals, and reversible following completion of the VSP survey.

Discharges

The discharge of drill muds and cuttings, and other discharges from the MODU and PSVs, can result in a change in sediment and water quality of the surrounding area. These changes can, in turn, potentially affect the quality of commercial fish species, and potential conditions for research activities. As discussed in the assessment of marine fish and fish habitat (Section 8.3), the effects from these discharges are expected to be low in magnitude and localized within the Project Area. There were no predicted significant adverse environmental effects on fish and fish habitat from discharges associated with routine Project activities.

Results from multiple EEM programs conducted for offshore drilling and production programs on the east coast of Canada have concluded that there have been negligible effects on commercial species such as American plaice and snow crab (Buchanan et al. 2003; Hurley and Ellis 2004; DeBlois et al. 2014). The most recent results from the White Rose EEM show that there continues to be no significant body burden (chemical) differences in plaice fillets or crab tissue collected in the White Rose field and reference areas, and no significant differences were noted in the taste of each species in panel tests (Husky Energy 2017). The EEM results indicate that changes in sediments and benthic community from drill cuttings have not resulted in adverse effects for commercial fisheries.

Other discharges and emissions have the potential to result in temporary and localized effects on water quality. This includes organic matter such as grey or black water, bilge water, deck drainage, BOP fluid,

and cement. Marine discharges from the MODU will be in accordance with MARPOL and the OWTG. Marine discharges from the PSVs will be in accordance with MARPOL. The effects assessment of waste discharges on marine fish and fish habitat is in Section 8.3. Discharges from MODUs and PSVs are not expected to result in significant adverse environmental effects to fish and fish habitat.

The effects from discharges on fish species is discussed in Section 8.3 and are expected to be short-term, and reversible once the MODU has moved out of an area, with no significant adverse environmental effects resulting from discharges on fish species predicted. Therefore, potential effects to fishery resources are unlikely. Furthermore, the presence of three ELs within a marine refuge area that prohibits bottom fishing activity, combined with the low levels of commercial fishing and offshore research activities within the Project Area, reduces the potential interaction with commercial fisheries.

Residual effects associated with discharges on a change in availability of fisheries resources is predicted to be low in magnitude, within the Project Area, short-term in duration, occurring irregularly as there is no set drilling schedule, and reversible following Project completion.

Well Abandonment and Decommissioning

All wells drilled during the life of the Project will be plugged and abandoned upon completion of well evaluation activities (if applicable). Abandonment activities will be conducted according to BP's practices and C-NLOPB requirements. The abandonment program has not yet been defined. BP's wellhead removal strategy considers water depth and the likelihood of potential interactions with fishing activities. As discussed in Section 2.4.4., BP may seek permission from the C-NLOPB to leave the wellhead in place after well plugging and abandonment for wells drilled in water depths of 900 m or deeper. If the wellhead is left in place, it would result in a piece of infrastructure that would protrude from the seafloor, which would have to potential to interact with fishing and/or research equipment, potentially causing damage. Based on discussions with fisheries representatives (Chapter 3), there would not be a large amount of interaction with commercial fishing activities in these water depths, as most harvesting activity is located along the shelf break and bottom-contact fishing is prohibited within the Northeast Newfoundland Slope Closure.

The depth of waters within BP's ELs, the prohibition of bottom fishing activities within the new Northeast Newfoundland Slope Closure, including within the boundaries of EL 1145, EL 1146, and EL 1148 and the relatively reduced amount of fishing activity occurring within the boundaries of BPs ELs, indicates that it is unlikely that wellhead abandonment will result in an interaction with commercial fishing and offshore research activity in a way that would result in a substantial change to availability of resource. BP will provide the locations for each decommissioned well to fishers and the Canadian Hydrographic Service and issue a Notice to Mariners. These initiatives will allow mobile-gear and fixed-gear fishers to avoid these locations or plan activities around the abandoned wellhead.

Residual effects associated with well abandonment on a change in availability of resources is predicted to be low in magnitude, localized to the wellsite in the Project Area, short to long-term in duration (if wellhead is left in place), irregular (once per well with no set schedule), and will be reversible over time (assuming wellhead would remain in place in perpetuity). There is a low level of interactions occurring between well abandonment and commercial fishing or other ocean users, as there are low levels of commercial fishing

activity occurring in the LAA and within BP ELs, and within deeper waters. The presence of a marine refuge area in the LAA, prohibiting bottom-fishing activity, further reduces the potential for an interaction.

Supply and Servicing Operations

Supply and servicing can interact with commercial fishing activity and other ocean use through potential direct interference with fishing gear or offshore research equipment or if PSVs are moving through areas where military activities are planned to take place.

The addition of PSV traffic to and from the area will provide a small increase to existing marine traffic levels. Commercial fishers are aware of supply vessels moving throughout offshore Newfoundland and Labrador and have become accustomed to operating around PSVs. The implementation of standard industry measures and operation of vessels will reduce the likelihood of an interaction. PSVs will follow established vessel traffic routes to and from the Project Area. Once near the Project Area, the PSV will select the route most appropriate for reaching the destination. PSVs will adhere to standard at-sea protocol and procedures, thereby reducing potential conflicts with commercial fisheries and other ocean users. In the unlikely event of an interaction between a PSV and fishing gear causing damage, compensation for damages will be managed in accordance with the *Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activity* (C-NLOPB and CNSOPB 2017).

Helicopter transportation is predicted to have negligible effect on fisheries given the lack of interaction with the marine environment (including fish).

Residual effects associated with supply and servicing on a change in availability of fisheries resources is predicted to be low in magnitude, within the LAA, short-term in duration, occurring irregularly, and reversible following Project completion.

13.3.4 Summary of Project Residual Environmental Effects

Table 13.4 summarizes the environmental effects assessment and prediction of residual environmental effects resulting from interactions between the Project and commercial fisheries and other ocean users. Based on the characterization of the potential interactions between Project activities and commercial fisheries and other ocean users, the Project can result in residual adverse effects through a change in availability (including a change in quality of marine resources) that exist within the LAA. This includes resources that may be used for commercial fishing activity, offshore marine research, and military training exercises. With the implementation of applicable mitigation measures described in Section 13.3.2, and adherence to industry standards and best practices for offshore oil and gas activities in Newfoundland and Labrador, the residual adverse environmental effects are considered to be low in magnitude, located within the Project Area and LAA, short-term in duration (with the exception of well abandonment), occurring at irregular intervals, reversible (with the exception of well abandonment), and primarily occurring within a disturbed ecological and socio-economic setting (presence of some commercial fishing activity and offshore research).

Table 13.4 Summary of Residual Environmental Effects on Commercial Fisheries and Other Ocean Users

Residual Effect	Residual Environmental Effects Characterization						
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in Availability of Resources							
Presence and operation of a MODU	A	L	PA	ST	IR	R	D
VSP operations	A	L	PA	ST	IR	R	D
Discharges	A	L	PA	ST	IR	R	D
Well abandonment and decommissioning	A	L	PA	ST-LT	IR	R	D
Supply and servicing operations	A	L	LAA	ST	IR	R	D

KEY:
See Table 13.2 for detailed definitions
N/A: Not Applicable

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PA: Project Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term
MT: Medium-term
LT: Long-term
P: Permanent

Frequency:
UL: Unlikely
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological / Socio-Economic Context:
D: Disturbed
U: Undisturbed

13.4 Determination of Significance

Residual effects from routine Project activities on commercial fisheries and other ocean users are not anticipated to result in local fishers being displaced or unable to use portions of the areas currently commercially fished for all or most of a fishing season; local fishers experiencing a change in the availability of fisheries resources (e.g., fish mortality and/or dispersion of stocks) so that resources cannot continue to be used at current levels within the Study Area for more than one fishing season; or unmitigated damage to fishing gear. Given the irregular schedule and short-term duration of drilling activities, the localized nature of Project interactions with commercial fishing activity, and the implementation of mitigation, such as communication with commercial fishers and other ocean users, and environmental protection measures, residual environmental effects on commercial fisheries and other ocean users are predicted to be not significant.

This prediction of significance has been determined with a high level of confidence based on the current knowledge of the offshore environment and interactions between oil and gas and other industries offshore, analysis of scientific literature and EEM results that exist specific to offshore Newfoundland and Labrador projects within the RAA, and analysis of current fishing activity within the Project Area. The implementation of the new marine refuge area, that covers a large portion of the Project Area, will reduce the amount of commercial fishing activity that may have occurred in the Project Area before thereby reducing the potential for an interaction.

13.5 Follow-up and Monitoring

Given the high level of confidence for a prediction of no significant adverse environmental effects on commercial fisheries and other ocean users, and the implementation of standard mitigation, ongoing engagement with fisheries stakeholders and other ocean users, and the implementation of a Fisheries Communication Plan, no follow-up and monitoring are proposed for routine Project activities.

13.6 References

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14.0 CUMULATIVE ENVIRONMENTAL EFFECTS

In addition to assessing Project-specific environmental effects, section 19(1)(a) of CEAA 2012 requires that the EA of a designated project consider "any cumulative environmental effects that are likely to result from the designated project in combination with other physical activities that have been or will be carried out".

This chapter identifies past, present, and certain or reasonably foreseeable future physical activities (i.e., projects or activities) with residual environmental effects that could interact cumulatively with the residual environmental effects of the Project and assesses the significance of the associated potential cumulative environmental effects on the affected VCs.

14.1 Cumulative Effects Assessment Scope and Methods

The Agency's (2014) draft guide entitled *Technical Guidance for Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012* (Technical Guidance Document) and the Agency's (2015) Operational Policy Statement (OPS) entitled *Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012* were taken into consideration during development of the cumulative effects assessment (CEA) scope and methods for this EIS.

This CEA builds on those recently conducted for Equinor (formerly Statoil) (2017), ExxonMobil (2017a), Nexen (2018), and Husky (2018 [pending]), which assesses cumulative effects for offshore exploration drilling projects within a similar RAA. It also builds on the CEA conducted for BP (2016), which assessed cumulative effects for a similar project in Atlantic Canadian waters (i.e., the Scotian Basin).

14.1.1 Identification of Valued Components

The CEA considers all six of the VCs for which Project-related environmental effects were assessed in Chapters 8 to 13, since potential residual (but not significant) adverse environmental effects were predicted for each these VCs:

- Marine Fish and Fish Habitat
- Marine and Migratory Birds
- Marine Mammals and Sea Turtles
- Special Areas
- Indigenous Peoples and Community Values
- Commercial Fisheries and Other Ocean Users

No other components of the biophysical or socio-economic environments have been identified as having the potential to be directly and adversely affected by the Project in such a way that would necessitate or justify their inclusion as VCs in the CEA. Section 4.2.2 provides the rationale for the selection of VCs and the exclusion of VCs focused specifically on federal species at risk, marine plants, air quality and greenhouse gas emissions, and the human environment.

14.1.2 Spatial and Temporal Boundaries

The OPS (Agency 2015) requires determination of spatial and temporal boundaries for the assessment of cumulative environmental effects. In particular, the OPS indicates that "spatial boundaries need to encompass the potential environmental effects on the selected VC of the designated project in combination with other physical activities that have been or will be carried out". Temporal boundaries "should take into account past and existing physical activities, as well as future physical activities that are certain or reasonably foreseeable [and] should also take into account the degree to which potential environmental effects related to these physical activities will overlap those predicted from the designated project" (Agency 2015).

The Technical Guidance Document (Agency 2014) suggests various methods to determine spatial boundaries for CEA, including activity-centered spatial boundaries that are determined based on the distribution of physical activities in the vicinity of the project. The Technical Guidance Document notes that this approach may be useful if the project is located in a remote area with few interacting physical activities, as is the case for this Project.

The specific spatial and temporal boundaries that are presented for each VC in the respective VC analysis chapter in Chapters 8 to 13 have also been applied to the assessment of cumulative environmental effects for each VC, including the Project Area, LAA, and RAA.

Specific spatial assessment boundaries (i.e., LAAs) were established for each VC, in Chapters 8 to 13, based on the potential extent of Project-related effects on the VC. The RAA is larger than the spatial boundaries for Project-related effects in order to establish a regional context for the overall assessment, as well as to encompass the other physical activities outside of the Project Area and LAAs that have potential to interact cumulatively with the Project (refer to Section 14.1.3). The definition of the RAA is particularly relevant with respect to the assessment of cumulative environmental effects:

Regional Assessment Area (RAA): The RAA is the area within which residual environmental effects from Project activities and components may interact cumulatively with the residual environmental effects of other past, present, and future (i.e., certain or reasonably foreseeable) physical activities. Although the RAA is intended to be much broader than the LAA, which focuses on the extent of potential effects associated with routine Project activities for each VC, it is possible that effects from larger scale unplanned events (e.g., well blowout) could extend beyond the RAA.

The RAA was delineated to accommodate the relatively large area that could be affected in the unlikely event of a substantial spill. The RAA also includes each of the VC-specific LAAs within its boundaries, thus taking into account the overlapping environmental effects from the Project and other physical activities on each VC within their respective LAAs.

The migratory range of some VCs may extend beyond the RAA boundaries and there is potential for individuals of these species to be affected by the combined residual environmental effects of the Project and effects from other stressors within and beyond the RAA boundaries (e.g., migrating sea turtles). However, in many cases, these "external" stressors along the migratory route are reflected in the discussion of species' status and population descriptions. Residual effects from other physical activities (e.g., fishing,

shipping, oil and gas activities) identified within the LAAs and RAA would also resemble residual effects from stressors outside the RAA. The RAA also reflects an area within which BP and/or the Government of Canada could reasonably influence environmental management of species, and for which there is greater certainty around effects predictions and mitigative solutions.

14.1.3 Sources of Potential Cumulative Effects

In accordance with the OPS (Agency 2015), the CEA considers other physical activities that have been, are being, and are likely to be carried out. With respect to future physical activities that are likely to be carried out, the CEA considers:

- future physical activities that are certain, meaning that the physical activity will proceed or that there is a high probability that it will proceed (e.g., the proponent has received the necessary authorizations or is in the process of obtaining those authorizations)
- future physical activities that are reasonably foreseeable, meaning that the physical activity is expected to proceed (e.g., the proponent has publicly disclosed its intention to seek the necessary EA or other authorizations to proceed)

Table 14.1 identifies other (non-Project) past, present, and future physical activities that are considered in the CEA because they have potential to result in residual environmental effects that may interact cumulatively with (i.e., overlap spatially and temporally with) the residual environmental effects of the Project within the RAA. The locations of the many abandoned subsea cables and two active subsea fibre optic cables (i.e., Greenland Connect and Hibernia Canada Express) that are present in the RAA are shown separately on Figure 7.43 in Section 7.3.5.

Where the particular locations and/or geographic extents of these other physical activities are defined or known (at present and/or within the temporal boundaries of the Project), this information is summarized on Figure 14.1, including overall distances from the centre of the Project Area. For example, Figure 14.1 includes the locations of the four offshore production projects (which are also shown on all EIS base maps), commercial fishing activity (see also more detailed Figures in Section 7.2), and other human components and activities (refer to Section 7.2).

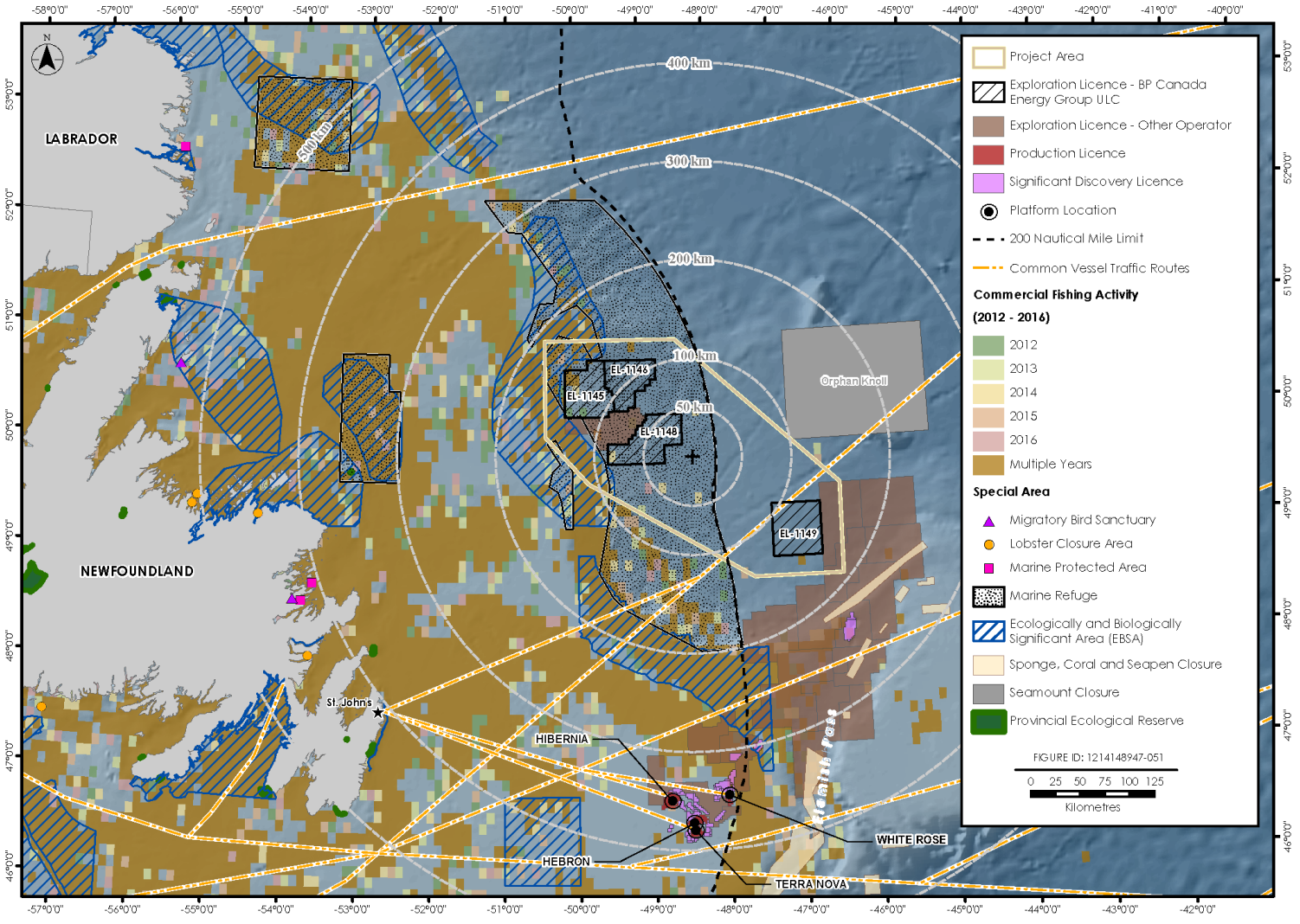

Figure 14.1 Other Physical Activities Considered in the Cumulative Effects Assessment

Table 14.1 Other Past, Present, and Future Physical Activities in the RAA

Physical Activity	Proponent / Operator	Overview	VCs Potentially Subject to Residual Effects from Physical Activity						Potential for Spatial and Temporal Overlap of Residual Effects
			Marine Fish & Fish Habitat	Marine & Migratory Birds	Marine Mammals & Sea Turtles	Special Areas	Indigenous Peoples & Community Values	Commercial Fisheries & Other Ocean Users	
Production from Hibernia Oilfield	Hibernia Management and Development Company Ltd. (HMDC)	• Discovered in 1979, the Hibernia oilfield is located approximately 315 km east-southeast of St. John's, NL. • The development phase of the Hibernia project commenced in late 1990 and continued until the mating of the gravity-based structure (GBS) and its topsides at Bull Arm, NL in 1997, after which the platform was towed to and installed at its site on the Grand Banks in June of that year. • With estimated recoverable reserves of approximately 1.4 billion barrels, commercial production from the Hibernia oilfield commenced in November 1997 and is ongoing. • Components on the Hibernia project include the original Hibernia Platform and the subsequently developed Hibernia Southern Extension excavated drill centre. • Production from the Hibernia South Extension commenced in 2011.	✓	✓	✓	✓	✓	✓	• With the potential exception of residual environmental effects associated with PSV transit, the residual environmental effects of the Project are not expected to overlap spatially with those of existing oil production projects because: - the Hibernia project is located approximately 243 km from the closest edge of the Project Area and approximately 269 km from the nearest BP-owned Project EL (EL1149) - the Terra Nova project is located approximately 265 km from the closest edge of the Project Area and approximately 290 km from the nearest BP-owned Project EL (EL 1149) - the White Rose project is located approximately 223 km from the closest edge of the Project Area and approximately 247 km from the nearest BP-owned Project EL (EL 1149) - the Hebron project is located approximately 258 km from the closest edge of the Project Area and approximately 283 km from the nearest BP-owned Project EL (EL 1149). However, certain VCs may nonetheless be affected by sequential exposure to the residual environmental effects of both physical activities. The life cycles of several species of fish, marine mammals, sea turtles, and marine and migratory birds include long-distance movement within the RAA, and the same individuals may be exposed to the residual environmental effects of multiple physical activities during the course of their migrations within the RAA. Similarly, because the customary or traditional fishing grounds of any given commercial or Indigenous fisher may encompass a broad area or include multiple areas, there is potential for some fishers to be adversely affected by the residual environmental effects of multiple physical activities during the course of their harvesting activities within the RAA. Thus, despite the lack of direct spatial overlap, the residual effects of the Project still have potential to interact cumulatively with the residual effects of production from existing oil production projects offshore Newfoundland. • All of the offshore petroleum production projects in the RAA are ongoing and anticipated to be carried out at least partially during the period from 2020 to 2026: - Hibernia has been producing oil year-round since 1997 and is expected to be in production until at least 2040 - Terra Nova produced oil year-round from 2002 to 2014 and has an estimated production life of 25 years (it is assumed for the purposes of this CEA that oil production from Terra Nova will resume at some point between 2018 and 2026) - White Rose has been producing oil year-round since 2005 and is expected to be in production until at least 2020, likely followed by several additional years of production from the West White Rose extension - Hebron has been producing oil year-round since 2017 and has an estimated production life of 25 years. Residual environmental effects from these other physical activities are therefore expected to overlap temporally with the residual environmental effects of the Project.
Production from Terra Nova Oilfield	Suncor Energy Inc. (Suncor)	• Discovered in 1984 and declared a significant discovery in 1985, the Terra Nova oilfield has reserve estimates of approximately 500 million barrels of recoverable oil. It is located approximately 350 km southeast of St. John's and 35 km southeast of Hibernia. • Components of the Terra Nova project include an FPSO and multiple drill centres; wells are drilled within these drill centres using a semisubmersible drilling platform. • Production from the Terra Nova FPSO began in January 2002.	✓	✓	✓	✓	✓	✓	
Production from White Rose Oilfield	Husky Energy Inc. (Husky)	• Discovered in 1984, an SDL for the White Rose oilfield was issued in January 2004. • The White Rose oilfield is located approximately 350 km east-southeast of St. John's, and approximately 50 km from the Hibernia and Terra Nova fields. • Components of the White Rose project include a FPSO and five excavated drill centres. • The White Rose oilfield and its satellite extensions are operated using an FPSO, and first oil was produced in November 2005 followed by the North Amethyst expansion in May 2010. • The West White Rose extension will access further resources to the west of the field, using a fixed drilling rig tied back to the existing FPSO. First oil is expected in 2022 (Husky n.d.).	✓	✓	✓	✓	✓	✓	
Production from Hebron Oilfield	ExxonMobil Canada Properties (ExxonMobil)	• First discovered in 1980, the Hebron oilfield is estimated to contain more than 700 million barrels of recoverable resources. • Components of the Hebron project include a drilling and production platform (a GBS similar to but smaller than the Hibernia GBS). • The Hebron platform was towed to field in June 2017. The Hebron project is designed for an oil production rate of 150,000 barrels of oil per day. • The Hebron project produced first oil on November 27, 2017 (ExxonMobil 2017b).	✓	✓	✓	✓	✓	✓	

Physical Activity	Proponent / Operator	Overview	VCs Potentially Subject to Residual Effects from Physical Activity						Potential for Spatial and Temporal Overlap of Residual Effects
			Marine Fish & Fish Habitat	Marine & Migratory Birds	Marine Mammals & Sea Turtles	Special Areas	Indigenous Peoples & Community Values	Commercial Fisheries & Other Ocean Users	
Offshore Petroleum Exploration – Geophysical Survey Programs	Various petroleum and exploration companies	• Offshore geophysical survey programs are often planned and conducted to get an overall understanding of regional geology and hydrocarbon potential, and to help identify sites or zones that may warrant further investigation, such as through eventual exploration drilling activities (see below). • These may include 2D, 3D, and possibly 4D seismic surveys for geophysical data acquisition (refer to Table 14.2), as well as associated geochemical, environmental, and geotechnical survey activities. • While exploration projects and activities are typically proposed and approved through the EA process as multi-year programs that can cover quite large offshore areas, the type and level of activity conducted each year can also vary and is usually a fraction of the overall scope assessed. • For general illustration, over the period 2014 to 2017, approximately 1.8 million km of geophysical survey data (including 2D, 3D, side-scan sonar, multibeam, sub-bottom profiling, gravity and magnetic data, and controlled-source electromagnetic data) was collected in the Eastern Newfoundland offshore region and approximately 160,000 km of geophysical survey data was collected in the Jeanne d'Arc Basin area (C-NLOPB 2018a). • These types of offshore exploration activities have been widely carried out off Eastern Newfoundland and elsewhere, typically use relatively standard equipment and techniques, and are subject to general environmental protection requirements and mitigation measures that are based in regulation and other guidelines. Project-specific EAs for these projects in the Newfoundland and Labrador offshore area therefore typically conclude that with the implementation of these mitigation measures, they are not likely to result in significant adverse environmental effects (see http://www.cnlopb.ca/assessments). • There are a number of offshore geophysical programs off the eastern Newfoundland offshore area that are in progress, being subject to EA review, or recently approved as of the time of Project EIS writing (see Table 14.3).	✓	✓	✓	✓	✓	✓	• Based on review of the project and study area boundaries proposed in the respective EAs for each of the geophysical survey programs identified in Table 14.3, the residual environmental effects of underwater sound (i.e., change in habitat quality and use for marine species) from these other physical activities (within several kilometres of the Project) could overlap spatially with the residual effects of the Project. • Of the 15 ongoing and proposed geophysical survey programs in the RAA (Table 14.3), those in closest proximity to the Project are: - Navitas' potential future (unnamed) 3D seismic survey in EL 1147, which is located within the Project Area and directly abuts on Project ELs 1145, 1146, and 1148 - Chevron's Capelin 3D Seismic Survey in EL 1138, which is located approximately 30 km outside of the Project Area. • As is the case for the Hibernia, Terra Nova, White Rose, and Hebron offshore petroleum production projects considered above (refer to top four rows of this table), the life cycles of several species of fish, marine mammals, sea turtles, and marine and migratory birds include long-distance movement within the RAA, and the same individuals may be exposed to the residual environmental effects of multiple physical activities during the course of their migrations within the RAA. Similarly, because the customary or traditional fishing grounds of any given commercial or Indigenous fisher may encompass a broad area or include multiple areas, there is potential for some fishers to be adversely affected by the residual environmental effects of multiple physical activities during the course of their harvesting activities within the RAA. Thus, even where there is lack of direct spatial overlap, the residual effects of the Project still have potential to interact cumulatively with the residual effects of geophysical survey programs. • All of the geophysical survey programs identified in Table 14.3 are proposed to be carried out at least partially during the period from 2020 to 2026. Residual environmental effects from these other physical activities are therefore expected to overlap temporally with the residual environmental effects of the Project. • Past geophysical surveys are not included in the CEA since residual effects from such surveys are temporary. The residual effects of past geophysical surveys generally did not last beyond cessation of those surveys and therefore will not overlap temporally with the residual effects of the Project. Thus, there are no predicted cumulative effects associated with past geophysical surveys.

Physical Activity	Proponent / Operator	Overview	VCs Potentially Subject to Residual Effects from Physical Activity						Potential for Spatial and Temporal Overlap of Residual Effects
			Marine Fish & Fish Habitat	Marine & Migratory Birds	Marine Mammals & Sea Turtles	Special Areas	Indigenous Peoples & Community Values	Commercial Fisheries & Other Ocean Users	
Offshore Petroleum Exploration – Exploration and Delineation Drilling Programs	Various petroleum companies	• As of June 19, 2018, a total of 463 wells had been drilled in the Canada-NL offshore area, including 171 exploration wells, 57 delineation wells, and 237 development wells (C-NLOPB 2018b). • The type and amount of offshore exploration activity can vary considerably from year to year throughout the eastern Newfoundland offshore area. • Over the three-year period of April 1, 2015 to April 1, 2018, 44 wells were drilled (or re-entered) in the Eastern Newfoundland and Jeanne d'Arc Basin C-NLOPB land tenure areas, including 12 exploration and delineation wells (C-NLOPB 2018b). • As noted above, these types of offshore exploration activities have been widely carried out off Eastern Newfoundland and elsewhere, typically use relatively standard equipment and techniques, and are subject to general environmental protection requirements and mitigation measures that are based in regulation and other guidelines. Project-specific EAs for these projects in the Newfoundland and Labrador offshore area therefore typically conclude that with the implementation of these mitigation measures, they are not likely to result in significant adverse environmental effects (see http://www.cnlopb.ca/assessments). • The eastern Newfoundland offshore area is subject to ongoing and planned offshore exploration and delineation drilling programs which are in progress, being subject to EA review, or recently approved as of the time of Project EIS writing (see Table 14.3).	✓	✓	✓	✓	✓	✓	• Of the five ongoing and proposed exploration and delineation drilling programs in the RAA (Table 14.3), those in closest proximity to the Project are: - ExxonMobil's Eastern Newfoundland Offshore Exploration Drilling Program in ELs 1135 and 1137, the former of which is located approximately 110 km from the Project Area; and - Nexen's Flemish Pass Exploration Project in ELs 1144 and 1150, which are located approximately 110 km and 115 km outside of the Project Area, respectively. • Therefore, with the potential exception of PSV transit, the residual environmental effects of the Project are not expected to overlap spatially with the residual environmental effects of offshore petroleum exploration and delineation drilling programs. However, certain VCs may nonetheless be affected by sequential exposure to the residual environmental effects of these physical activities. The life cycles of several species of fish, marine mammals, sea turtles, and marine and migratory birds include long-distance movement within the RAA, and the same individuals may be exposed to the residual environmental effects of multiple physical activities during the course of their migrations within the RAA. Similarly, because the customary or traditional fishing grounds of any given commercial or Indigenous fisher may encompass a broad area or include multiple areas, there is potential for some fishers to be adversely affected by the residual environmental effects of multiple physical activities during the course of their harvesting activities within the RAA. Thus, despite the lack of direct spatial overlap, the residual effects of the Project still have potential to interact cumulatively with the residual effects of offshore petroleum exploration and delineation drilling programs. • All of the exploration and delineation drilling programs identified in Table 14.3 are proposed to be carried out at least partially during the period from 2020 to 2026. Residual environmental effects from these other physical activities are therefore expected to overlap temporally with the residual environmental effects of the Project.
Commercial Fishing Activity	Various commercial fisheries licence holders (including Indigenous commercial communal fisheries licence holders)	• Commercial fisheries (including Indigenous commercial communal fisheries) within and around the RAA are extensive and diverse, involving a variety of participants, species, and gear types, as described in detail (including associated mapping) in Sections 7.2 and 7.4 of this EIS. There is no known FSC harvesting occurring in the RAA.	✓	✓	✓	✓	✓		• The use of bottom-contact fishing gear is prohibited within the portion of the Project Area that overlaps with the Northeast Newfoundland Slope Closure marine refuge (i.e., approximately 52% of the Project Area; refer to Section 6.4.1.3). The Bonavista Cod Box, which overlaps approximately 0.4% of the Project Area, is closed to all fishing activity except for snow crab trapping (refer to Section 6.4.4.4). The Orphan Knoll Seamount Closure (NAFO VME), which overlaps approximately 0.01% of the Project Area, is closed to bottom-fishing (refer to Section 6.4.3.2). Figure 6.30 shows the locations of these and other special areas. Commercial fishing activities will also be excluded from the 500-m radius safety zone surrounding the Project MODU. Except where noted above, commercial fishing activity has potential to occur anywhere else in the Project Area; however, commercial fishing activity within the Project Area from 2012 to 2016 was primarily concentrated along the northwestern edges of the Project Area (refer to Figure 7.5 in Section 7.2.4). • Residual environmental effects related to underwater sound, emissions of artificial night lighting, and operational discharges originating from commercial fishing vessels within or near the Project Area, as well as direct physical interactions with targeted fish species and non-targeted bycatch, have potential to interact cumulatively with the residual environmental effects of the Project on marine species. Deep-sea fishing activity, particularly with bottom-contact fishing gear, can also cause changes to the seabed, impacts on epifauna, impacts on infauna, and changes in community characteristics (Clark et al. 2016) in and around the Project Area. Residual environmental effects from commercial fisheries are therefore expected to overlap spatially with the residual environmental effects of the Project.

Physical Activity	Proponent / Operator	Overview	VCs Potentially Subject to Residual Effects from Physical Activity						Potential for Spatial and Temporal Overlap of Residual Effects
			Marine Fish & Fish Habitat	Marine & Migratory Birds	Marine Mammals & Sea Turtles	Special Areas	Indigenous Peoples & Community Values	Commercial Fisheries & Other Ocean Users	
									• There is a long history of commercial fishing in and around the RAA. Commercial fishing activities occur year-round, are currently ongoing, and will continue for the foreseeable future. Residual environmental effects from commercial fisheries are expected to overlap temporally with the residual environmental effects of the Project on each VC.
Hunting Activity	Various Indigenous and non-Indigenous hunters	• Wildlife (especially seabird and seal) populations off Newfoundland and Labrador are subject to hunting activity.		✓	✓				• Although little or no hunting activity is expected to occur in the far offshore locations that comprise the Project Area, these activities do affect the bird and seal populations that occur in, and move to and through, the RAA. Thus, despite the lack of direct spatial overlap, the residual effects of hunting in the RAA still the Project still have potential to interact cumulatively with the residual effects of hunting activity in the RAA. • There is a long history of hunting activities being conducted in and around the RAA. These activities are currently ongoing (on a seasonal basis) and will continue for the foreseeable future. Residual environmental effects from other ocean users are expected to overlap temporally with the residual environmental effects of the Project on each VC.
Other Ocean Uses	Various other ocean users	• In addition to commercial fishing activity, various other ocean users also carry out activities in the Newfoundland and Labrador offshore area and the RAA, including: - research activities undertaken by DFO annually, as well as by industries and other academic institutions - military training exercises - marine shipping and transportation, including commercial shipping vessels, cruise ships, and other vessels used for recreational or tourist purposes - aircraft traffic - the presence and operation of subsea fibre optic cables and infrastructure. • The activities of these other ocean users generate varying levels and frequencies of underwater sound emissions (refer to Table 14.4).	✓	✓	✓	✓	✓	✓	• Other ocean users will be excluded from the 500-m radius safety zone surrounding the Project MODU. Activities associated with other ocean users have potential to occur anywhere else in the Project Area. • Residual environmental effects related to underwater sound, emissions of artificial night lighting, and operational discharges originating from the vessels of other ocean users within or near the Project Area have potential to interact cumulatively with the residual environmental effects of the Project on marine species. Residual environmental effects from other ocean users are therefore expected to overlap spatially with the residual environmental effects of the Project on each VC. • There is a long history of activities being carried out by other ocean users in and around the RAA. These activities occur year-round, are currently ongoing, and will continue for the foreseeable future. Residual environmental effects from other ocean users are expected to overlap temporally with the residual environmental effects of the Project.

Source: Overview column adapted from Statoil (2017), with other sources cited, where applicable

The recent Strategic Environmental Assessment (SEA) undertaken by the C-NLOPB for Eastern Newfoundland (Amec 2014) describes the geophysical surveys that may be conducted as part of offshore oil and gas exploration activities in and around the RAA. These descriptions have been adapted for incorporation into Table 14.2.

Table 14.2 Overview of Geophysical Survey Methods

Type of Geophysical Survey	Overview
Seismic Survey	• Components include a seismic vessel, a sound source, receivers (hydrophones) and associated supporting elements and activities. • An offshore seismic survey vessel is typically approximately 75 to 90 m (250 to 300 ft) in length, depending on local conditions and the characteristics of the survey and associated equipment requirements. • High-energy sound sources (air source arrays) are towed approximately 100 to 200 m behind a survey vessel while it travels along a track line in a prescribed grid crossing known or suspected hydrocarbon accumulations. • Multiple (often 20 to 30) air source array units are typically used, with individual source unit volumes ranging from about 70 to 250 cubic inches with a combined chamber volume of between 2,000 and 5,000 cubic inches and operating at about 2,000 pounds per square inch (psi). Based on these specifications, the total pressure per source for those array source volumes would be between 137 to 172 Bar-meters, and the peak-to-peak SPL output will be between approximately 240 and 260 dB re 1 µPa @ 1 m. • Each of these receiver arrays are typically between 5 and 10 km long and several hundred metres wide and are towed approximately 5-15 m below the water surface. • The sound source is activated at regular intervals (typically every 25 m) and directs high energy (low frequency) sound pulses toward the seafloor which can penetrate below the surface. • The reflected sound energy is recorded by sensitive hydrophones (streamers, up to several kilometres in length) which are towed behind the vessel. • Seismic surveys may be classified as 2D, 3D or 4D surveys based on the density of measurements made over a given area and/or over a period of time.
Gravity Survey	• Measures and records variations in the Earth's gravitational field due to density differences between diverse subsurface rock types. • Detects gravity anomalies, which occur when the density of geological body differs greatly from its surroundings and cause a change in the Earth's gravitational field. • Gravitational anomalies allow the interpreter to gain ideas about the size, depth and rock type of various features. • Gravity data can be collected from an aircraft or a marine vessel using a gravimeter. • Due to the relative ease of collecting from a ship, gravity data is often recorded in conjunction with a marine seismic acquisition program.
Magnetic Survey	• Investigates subsurface geology by mapping anomalies in the Earth's magnetic field that result from varying magnetic properties in the underlying rocks. • Magnetic data can provide large-scale information about regional geologic structure. • Magnetic surveys can be performed on land, at sea and in the air using a magnetometer and are often completed in conjunction with other surveys.

Type of Geophysical Survey	Overview
Electromagnetic Survey	• Measures the ground's response to propagating electromagnetic fields. • Controlled-source electromagnetics is a marine geophysical technique used to map potential hydrocarbon accumulations below the seafloor. A dipole source that transmits an electromagnetic field is towed by the ship just above the seafloor. The field is altered by the underlying lithology, subsequently detected and recorded by a receiver array positioned on the seafloor.
Source: Amec 2014	

Table 14.3 identifies the offshore geophysical survey programs and offshore petroleum exploration and delineation drilling programs in the RAA that are the subject of ongoing or recently completed EAs and that have temporal boundaries that overlap with those of the Project. These ongoing and future physical activities have potential to contribute to cumulative environmental effects in the RAA.

Table 14.3 Ongoing and Proposed Offshore Petroleum Exploration Activities in the RAA

Proponent	Project Name	Temporal Boundaries
Geophysical Survey Programs		
Husky Oil Operations Limited	Jeanne d'Arc Basin / Flemish Pass Regional Seismic Program	2012 to 2020
Hibernia Management and Development Company Ltd.	2D / 3D / 4D Seismic Projects for the Hibernia Oil and Gas Production Field	2013 to remaining life of field
Suncor Energy	Eastern Newfoundland Offshore Area 2D / 3D / 4D Seismic Program	2014 to 2024
ExxonMobil Canada Ltd.	Eastern Newfoundland Offshore Geophysical, Geochemical, Environmental and Geotechnical Program	2015 to 2024
MG3	Geochemical Data Acquisition and Seabed Sampling for Basin Modelling in Labrador Offshore	2015 to 2024
WesternGeco Canada[1]	Eastern Newfoundland Offshore Seismic Program	2015 to 2024
WesternGeco Canada[1]	Southeastern Newfoundland Offshore Seismic Program	2015 to 2024
Polarcus UK Ltd.	Eastern Newfoundland Offshore 2D, 3D, and 4D Seismic Program	2016 to 2022
CGG Services (Canada) Inc.	Newfoundland Offshore 2D, 3D, and 4D Seismic Program	2016 to 2025
Seitel Canada Ltd.	East Coast Offshore 2D, 3D, and 4D Seismic Program	2016 to 2025
Mutliklient Invest AS	Newfoundland and Labrador Offshore Seismic Program	2017 to 2023
Fugro Geosurveys	Offshore Seafloor and Seep Sampling Program	2017 to 2027

Proponent	Project Name	Temporal Boundaries
Chevron Canada Limited (Chevron)	Capelin 3D Seismic Survey of EL 1138 Offshore Newfoundland and Labrador	2018 to 2021
Nexen Energy ULC	Eastern Newfoundland Offshore Geophysical, Geochemical, Environmental and Geotechnical Program	2018 to 2027
Navitas Petroleum Canada Ltd. (Navitas)	To be determined[2]	To be determined, but term of EL is 2017 to 2026
Exploration and Delineation Drilling Programs		
Husky Oil Operations Limited (Husky)	Delineation / Exploration Drilling Program for Jeanne d'Arc Basin Area	2008 to 2020
Husky	Husky Energy Exploration Drilling Project	2018 to 2025
Nexen Energy ULC (Nexen)	Flemish Pass Exploration Drilling Project	2018 to 2028
Statoil Canada Ltd. (Statoil; now referred to as Equinor)	Flemish Pass Exploration Drilling Project	2018 to 2028
ExxonMobil Canada Ltd. (ExxonMobil)	Eastern Newfoundland Offshore Exploration Drilling Program	2018 to 2029

Source: C-NLOPB 2018c

[1] The seismic operator may withdraw from operating in the RAA over the life of the Project.

[2] Navitas was awarded EL 1147 for a 9-year term, effective January 15, 2017, through the C-NLOPB's 2016 Call for Bids process. Navitas is currently in negotiations with other parties regarding its intention to conduct a 3D seismic survey in the EL (Natural Resources Magazine 2017). Further details regarding its planned exploration activities are not yet publicly available.

Equinor Canada Ltd. (Equinor, formerly Statoil Canada Ltd.) and its partner Husky recently initiated an environmental assessment development the Bay du Nord field. The Bay du Nord Development includes offshore construction, installation, hook-up and commissioning, drilling, production operations, maintenance and decommissioning activities, as well as supporting surveys, field work, supply and servicing activities, and may also include potential future development activities (Equinor 2018).

The other physical activities identified in Table 14.1 generate varying levels of underwater sound that have potential to contribute to cumulative effects on certain VCs. The use of seismic air source arrays during geophysical surveys generates some of the highest SPLs that are likely to occur in the RAA (Table 14.4).

Table 14.4 Overview of the Acoustic Properties of Some Anthropogenic Sounds in the Marine Environment

Sound	Source Level (SPL) (dB re 1 µPa-m) [1]	Bandwidth (Hz)	Major Amplitude (Hz)	Duration (ms)	Directionality
Offshore Construction					
TNT (1 – 100 lbs)	272 – 287 Peak	2 – 1,000	6 – 21	~ 1 – 10	Omnidirectional
Pile driving [2]	228 Peak / 243 – 257 P-to-P	20 – >20,000	100 – 500	50	Omnidirectional
Offshore Industrial Activities					
Dredging	168 – 186 rms	30 – >20,000	100 – 500	Continuous	Omnidirectional

Sound	Source Level (SPL) (dB re 1 µPa-m) [1]	Bandwidth (Hz)	Major Amplitude (Hz)	Duration (ms)	Directionality
Drilling [3]	145 – 190 rms	10 – 10,000	<100	Continuous	Omnidirectional
Wind turbine	142 rms	16 – 20,000	30 – 200	Continuous	Omnidirectional
Small boats and ships [4] (length ≤100 m)	160 – 180 rms	20 – >10 00	>1000	Continuous	Omnidirectional
Large vessels [4] (length >100 m)	180 – 190 rms	6 – >30,000	>200	Continuous	Omnidirectional
Sonar					
Military sonar (low-frequency)	215 Peak	100 – 500	–	600 – 1,000	Horizontally focused
Military sonar (mid-frequency)	223 – 235 Peak	2,800 – 8,200	3,500	500 – 2,000	Horizontally focused
Echosounder	235 Peak	Variable	Variable 1,500 – 36,000	5 – 10	Vertically focused
Seismic Surveys					
Air source array	260 – 262 P-to-P	10 – 100,000	10 – 120	30 – 60	Vertically focused [1]
Other Activities					
Acoustic deterrent / harassment devices	132 – 200 Peak	5,000 – 30,000	5,000 – 30,000	Variable 15 – 500	Omnidirectional
Tidal and wave energy devices [5]	165 – 175 rms [5]	10 – 50,000	–	Continuous	Omnidirectional

Source: OSPAR Commission 2009

Notes:

1 Nominal source.

2 Source levels vary depending on the diameter of the pile and the method of pile driving (impact or vibro-piling). The frequency spectrum ranges from less than 20 Hz to more than 20 kHz with most energy around 100 – 200 Hz.

3 Higher source levels from use of bow thrusters on drillships.

4 Output characteristics depend on ship type, size, mode of propulsion, operational characteristics, speed, and other factors.

5 Projection based on literature data levels back-calculated at 1 m.

14.1.4 Assessing Cumulative Effects on Each VC

The assessment of cumulative effects on each VC includes consideration of the following:

- the context for cumulative environmental effects
- potential Project-related contributions to cumulative effects
- other projects and activities and their effects
- potential cumulative environmental effects (including special consideration of potential cumulative environmental effects on SAR)

A cumulative effects summary and evaluation is also provided for each VC.

14.1.4.1 Context for Cumulative Environmental Effects

Existing environmental conditions for the marine physical environment, marine biological environment, and socio-economic environment in the RAA have been, and continue to be, shaped by the cumulative environmental effects of historical physical activities previously carried out in the RAA and ongoing physical activities presently being carried out in the RAA. Likewise, future physical activities in the RAA will influence future environmental conditions in the RAA. Chapters 5, 6, and 7 describe existing conditions in the RAA to characterize the setting for the Project, support an understanding of the receiving environment, and provide sufficient context for the CEA by enabling an understanding of how current environmental conditions might be affected by the Project in combination with other past, present, and future physical activities within the RAA.

It is assumed that the existing status or baseline conditions of each VC reflect the influence of other past and present physical activities within the RAA. The first-level subsections under Sections 14.2 to 14.7 (e.g., Sections 14.2.1 to 14.7.1, respectively) provide a brief overview of how the residual environmental effects of various past and present physical activities (as identified in Table 14.1) have affected or are affecting each VC in the RAA, independently of the residual environmental effects that will be contributed by the Project. This information provides additional context to support the CEA.

14.1.4.2 Potential Project-related Contributions to Cumulative Effects

The second-level subsections under Sections 14.2 to 14.7 (e.g., Sections 14.2.2 to Sections 14.7.2, respectively) consider how the existing status or baseline conditions of each VC, as shaped by the residual environmental effects of various past and present physical activities in the RAA, may change following the introduction of the Project (as a result of the potential Project-related residual environmental effects that are described for each VC in Chapters 8 to 13).

14.1.4.3 Other Projects and Activities and Their Effects

Further context for the CEA is provided through consideration of the certain or reasonably foreseeable future physical activities in the RAA that may result in residual environmental effects on the same VCs that will be subject to potential Project-related residual effects (refer to Table 14.1). The third-level subsections under Sections 14.2 to 14.7 (e.g., Sections 14.2.3 to Sections 14.7.3, respectively) provide an overview of the potential residual environmental effects associated with other (non-Project) certain or reasonably foreseeable future physical activities in the RAA and consider the spatial and temporal characteristics of these potential residual effects on each relevant VC.

14.1.4.4 Potential Cumulative Environmental Effects

The following two considerations with respect to each VC are used as criteria to determine whether the residual effects of the Project have potential to interact with the residual effects of another physical activity in the RAA to contribute to cumulative environmental effects:

1. Whether the Project could result in a demonstrable or measurable residual environmental effect on the VC; and
2. Whether the residual environmental effect of the Project is likely to act cumulatively with the residual environmental effect of another past, present, or future physical activity on the VC (i.e., whether the residual environmental effects of the Project and the other physical activity are likely to overlap spatially and temporally).

An assessment of cumulative environmental effects is not warranted for any given VC unless both of the criteria above are satisfied. As indicated in Section 14.1.1, potential Project-related residual adverse environmental effects are predicted for each of the six VCs assessed in Chapters 8 to 13; therefore, the first criterion above has been met for each VC. Table 14.1 identifies the other past, present, and future physical activities in the RAA that meet the second criterion.

In cases where the predicted residual environmental effects of the Project on the VC will likely accumulate or interact with those of one or more other physical activities in the RAA (i.e., when the two criteria are met for a VC), the potential cumulative effects of the Project in combination with these other activities are assessed. This includes considering the potential implications for the VC resulting from multiple sources and types of environmental change, including the likely future condition of the environment both with and without the Project. Where available and applicable, the assessment uses relevant scientific, engineering, community, stakeholder, and Indigenous knowledge and perspectives.

The potential for residual environmental effects from the Project to cause a change in cumulative environmental effects that could affect the quality or sustainability of the VC is evaluated. The evaluation considers the context for cumulative environmental effects in the RAA, the nature and extent of the potential cumulative interactions, and technically and economically feasible mitigation measures that BP will implement to avoid or reduce potential environmental (including cumulative) effects.

The mitigation measures are intended to avoid or reduce the potential effects of the Project (as identified and considered in Chapters 8 to 13), and thus the Project's contribution to cumulative environmental effects. Where relevant, however, the assessment also identifies and considers additional mitigation that may be required and applicable to cumulative effects only, as well as other relevant mitigation that may be the responsibility of parties other than BP or its contractors, as applicable and as required in the EIS Guidelines.

Information on other projects and activities and their known or likely environmental effects and planned mitigation measures has been obtained through existing and publicly available information sources. The CEA considers the nature, location, and timing of these other projects and their environmental effects in relation to the Project, as well as environmental protection measures which are known and/or required to be implemented in relation to them, including those required under applicable legislation, regulations, and other requirements. The assessments of cumulative effects presented here are therefore not based on information or assumptions regarding mitigation measures by other proponents that would require discussions with, or confirmation by, other parties.

Residual cumulative environmental effects are characterized through application of the specific analysis criteria (i.e., magnitude, geographic extent, duration, frequency, reversibility, and context) defined for each VC in its respective VC analysis chapter. The significance of potential cumulative environmental effects is

then determined based on the same VC-specific thresholds used for the assessment of Project-related environmental effects in Chapters 8 to 13.

14.2 Marine Fish and Fish Habitat

14.2.1 Context for Cumulative Environmental Effects

The Marine Fish and Fish Habitat VC, as described in Chapter 8, includes fish as defined under the *Fisheries Act* (i.e., fish, shellfish, crustaceans, and marine animals; any parts of fish, shellfish, crustaceans, and marine animals; and the eggs, sperm, spawn, larvae, spat, and juvenile stages of fish, shellfish, crustaceans, and marine animals) and the habitats upon which they depend, including spawning, rearing, nursery, food supply, overwintering, migration corridors, and any other area on which fish depend directly or indirectly in order to carry out their life processes. These include commercially, traditionally, and/or ecologically important fish species that are considered secure, as well as those listed as SAR.

The RAA contains several important habitat areas for fish, including various designated special areas (e.g., MPAs, marine refuges and lobster area closures, EBSAs, significant benthic areas, and NAFO VMEs). The Project Area overlaps the following designated special areas that are known to be of particular importance to marine fish and fish habitat: Northeast Newfoundland Slope Closure marine refuge, Orphan Spur EBSA, Bonavista Cod Box, and Orphan Knoll Seamount Closure. Potential vessel transit routes intersect one additional special area, the Northeast Shelf and Slope EBSA, which is known to support aggregations of corals, Greenland halibut, and spotted wolffish (refer to Section 6.1).

Marine fish and fish habitat in the Project Area, RAA, and in the larger Northwest Atlantic have been and are being affected by a variety of natural processes and human activities that have influenced the presence, distribution, and abundance of fish species, as well as the overall size and health of fish populations, both collectively and individually to varying degrees. The following are examples of natural processes and human activities that have affected and are affecting fish and fish habitat in and around the RAA, for both secure species and SAR:

- the North Atlantic Oscillation atmospheric phenomenon (Amec 2014)
- climate change and related effects (e.g., ocean acidification) (Amec 2014)
- historical and current commercial fishing activity, including bycatch and changes to benthic habitat from bottom-contact fishing
- offshore petroleum exploration and production, including associated geophysical surveys and routine operational discharges
- commercial shipping and general vessel traffic, including associated routine operational discharges
- other human activities, both planned and routine (refer to the other offshore activities listed in Table 14.1), as well as illegal activities and accidental events (e.g., spills)

One of the mechanisms through which several of these (and other) natural processes and human activities affect marine fish and fish habitat is through the emission of underwater sound. The underwater sound comparative assessment completed for the Project (Matthews et al. 2018; Appendix C) considered ambient underwater sound levels and various contributors to the underwater soundscape of the Project Area derived from data measured at two ESRF recording stations between 2015 and 2017. Anthropogenic contributors

to the underwater soundscape include vessel traffic, seismic surveys, and oil and gas extraction activity, while naturally occurring ambient sound contributors include wind, other environmental phenomena, and fin whales. Based on measurements at the recording stations, there are four dominant sound sources affecting the soundscape in the Project Area and which are expected to be present in the foreseeable future. The Project's sounds will add to these sources to create the cumulative soundscape in the area. These sources are (Matthews et al. 2018):

- Fin whales: Fin whales sing from October to March on the Grand Banks. They seem to favour the shallow waters on the Grand Banks compared to the deeper waters off the continental shelf. Their constant notes raise the total sound level in the 10-45 Hz band by 5-10 dB in winter across the Grand Banks and Scotian Shelf. Whales close to a recorder can temporarily increase the one-minute sound levels to 130 or 140 dB re 1 µPa.
- Shipping and oil and gas extraction facilities: Shipping, including supply vessels for the Project, are generally transient sources that are detectable at any one location over a period of several hours. Close to the Project ELs and existing oil and gas extraction facilities, the sounds from vessels and dynamic positioning systems are continuously present.
- Seismic surveys: The seismic surveys detected at the recording stations were over 100 km away and were still a dominant sound source in the recorded soundscape. Seismic array sound's peak frequency is near 50 Hz (Dragoset 1984, in Matthews et al. 2018); however, the frequency range increases as the source vessel gets closer to a measurement location. The measurements reported here included energy up to 1 kHz. This sound source is variable in space and time depending on where the seismic source is located. It is expected that 2D and 3D seismic surveys will continue offshore Newfoundland for the foreseeable future each summer.
- Ambient noise: Median sound levels increase 3-5 dB in winter due to higher wind speeds and storms. The peak frequency band for wind noise is 200-2000 Hz. See Hildebrand (2009, in Matthews et al. 2018) and Cato (2008, in Matthews et al. 2018) for an overview of ocean ambient noise and anthropogenic sound sources.

As explained in Section 6.1.2, changes in trophic linkages and communities often reflect the interactions of various past and ongoing projects and activities with fish and fish habitat. Substantive changes to the abundance of any group of organisms can result in effects to other levels of the food web. Changes in the abundance of organisms can occur over a range of time scales, from diurnal migrations within the water column to shifts in habitat characteristics or predator-prey ratios over decades. Recent shifts in the Northwest Atlantic occurred between the mid-1980s to early 1990s, where the ecosystem structure shifted with a decrease in groundfish stocks. Several studies in the Northwest Atlantic have suggested that the increase in shrimp biomass was a consequence of lower predation attributable to the collapse of groundfish stocks such as cod (Lilly et al. 2000; Myers and Worm 2003; Frank et al. 2005), although climate fluctuations may also have been partially responsible (Rose et al. 2000). Additional prey species, including pelagic fish and invertebrates such as sand lance, herring, shrimp, and snow crab, were shown to increase in abundance (Koen-Alonso et al. 2010; Templeman 2010; Dawe et al. 2012; Nogueira et al. 2017). In more recent years, rising water temperatures and restrictions on harvesting are favouring the return of a groundfish-dominated system (Koen-Alonso et al. 2010; Templeman 2010; Dawe et al. 2012; Nogueira et al. 2017). The rising water temperatures in the Northwest Atlantic put the region in the top 1% globally in terms of increasing sea-surface temperatures (Pershing et al. 2015; EPA 2016). Warming sea surface

temperatures in this region have been linked to a northward shift in both fish species distribution and commercial fishing industry catch (Nye et al. 2009; Pinsky and Fogarty 2012; Pershing et al. 2015).

The effects of previous activities and natural environmental influences are reflected in the existing baseline environmental conditions for the Marine Fish and Fish Habitat VC, as described in Section 6.1. This includes considering the current condition (e.g., health or quality) of potentially affected fish populations and their habitats, as well as their potential resiliency or sensitivity to further environmental change resulting from the Project in combination with other ongoing and future projects and activities that may affect the same VC. Specific information on physical characteristics of fish habitat (e.g., marine geology, and geomorphology, sediment and marine water quality) are described in Chapter 5.

14.2.2 Potential Project-related Contributions to Cumulative Effects

As described in Chapter 8, routine Project activities and components have potential to interact with marine fish and fish habitat, primarily resulting from underwater sound emissions from the MODU, PSV traffic, VSP surveys, and drilling discharges. Operational solid and liquid discharges from the MODU and PSVs (e.g., ballast water, bilge and deck water, and grey / black water) can also interact with marine fish and fish habitat. Thus, the Project has potential to result in the following residual adverse environmental effects on marine fish and fish habitat:

- a residual change in risk of mortality or physical injury associated with the presence and operation of the MODU, VSP surveys, and Project-related discharges
- a residual change in habitat quality and use associated with the presence and operation of the MODU, VSP surveys, Project-related discharges, well abandonment, and supply and servicing operations

The Project-specific environmental effects assessment for this VC includes a summary of Project residual environmental effects in Section 8.3.5 and a determination of significance in Section 8.4. With the implementation of mitigation (refer to Section 8.3.2), the residual environmental effects of routine Project activities on marine fish and fish habitat are predicted to be not significant.

14.2.3 Other Projects and Activities and their Effects

Table 14.5 summarizes how past, present, and future projects and activities in the RAA have potential to cause a residual change in risk of mortality or physical injury and residual change in habitat quality and use affecting marine fish and fish habitat.

Table 14.5 Marine Fish and Fish Habitat: Residual Effects from Other Projects and Activities in the RAA

Physical Activity	Potential Residual Environmental Effect(s)	Explanation of Potential Residual Environmental Effect(s)	VC-specific Spatial and Temporal Considerations (Refer to Table 14.1 for General Consideration of Potential for Spatial and Temporal Overlap)
Offshore Petroleum Production Projects (Production from Hibernia, Terra Nova, White Rose, and Hebron Oilfields)	• Change in risk or mortality or physical injury • Change in habitat quality and use	• ESRF data (reported in Matthews et al. 2018; Appendix C) indicate that offshore oil and gas drilling facilities and marine vessels (including PSVs) are key identifiable anthropogenic sources of underwater ambient sound that are dominant in the soundscape and are expected to be present in the foreseeable future (refer to Section 5.3.10.3). • Active drilling is occurring at Hibernia, White Rose, and Hebron, and Terra Nova may resume oil production at any time. Given that the offshore petroleum production facilities for these projects do not use DP, the underwater sound levels generated by their drilling activities are generally assumed to be slightly lower than those generated by Project-related drilling activities. These levels nonetheless have potential to cause a change in habitat quality and use for marine fish. • Underwater sound levels generated by the PSVs operating in support of these offshore petroleum production projects in the RAA are assumed to be similar to those generated by Project PSVs. These underwater sound levels may cause a localized temporary change in habitat quality and use for fish within a limited area (refer to Section 8.3 for a consideration of thresholds for physical and behavioural effects on fish, respectively). • Underwater sound levels generated by VSP surveys conducted in association with oil production drilling activities are assumed to be similar to those generated by Project-related VSP surveys. These underwater sound levels could result in a change in habitat quality and use and a change in risk of mortality or physical injury for marine fish (particularly fish eggs and larvae in close proximity to the air-gun array). These effects would be short-term (VSP typically takes approximately one day to a few days per well), localized in close proximity to the sound source, and reversible, with no predicted lasting effects once VSP surveys are complete. • Routine operational discharges from offshore petroleum production facilities and PSVs (e.g., produced water, grey and black water, ballast water, bilge water, and deck drainage) are discharged in accordance with the OWTG and MARPOL and are therefore unlikely to cause a change in risk of mortality or physical injury for fish. • Routine operational discharges may cause a change in habitat quality and use for marine fish within a localized area around the offshore petroleum production facilities and PSVs. EEM programs conducted for offshore petroleum production projects in the RAA have indicated localized minor effects on habitat quality. • It is generally anticipated that habitat altered by the deposition of drill muds and cuttings will become available for use as fish habitat immediately following the completion of drilling operations and will eventually be recolonized by benthic communities. • Offshore petroleum production facilities and associated subsea infrastructure may have a “reef and refuge” effect by attracting fish to an area that is protected from no fishing (safety zone), creating a localized change in habitat quality and use for fish.	• Potential residual effects from offshore petroleum production drilling projects are similar to those potentially associated with the Project. Unlike the Project, however, production facilities and their associated effects are confined to a fixed location and are relatively longer-term in nature. • With respect to the timeline for recolonization by benthic communities following the deposition of drill muds and cuttings, benthic recovery in relatively shallow waters has been documented as occurring within as few as approximately one to four years (Bakke 1986, Neff et al. 2000, Hurley and Ellis 2004, Renaud et al. 2008, Bakke et al. 2011, Lee et al. 2011). Although little is known about the timeline for recolonization by benthic communities in deep-water environments, benthic recovery is generally expected to take longer at greater depths and in colder waters due to lower rates of metabolism and growth (Gates and Jones 2012). For slow-growing and long-lived species of large benthic organisms, such as sponges, corals, and crinoids, Clark et al. (2016) estimate that it may take centuries or millennia for benthic communities to recover following large-scale removal of attached epifauna from hard substrates in deep-water environments (e.g., through the use of bottom-contact fishing gear). However, benthic recovery following the discharge of drill muds and cuttings, and the completion offshore drilling projects in general, is anticipated to take much less time since these activities do not entail the removal of large swathes of attached epifauna. Neff et al. (2000) also note that complete recovery of deep-water benthic animals requires many years because they reproduce and grow slowly, but that this recovery is likely to be initiated shortly after completion of cuttings discharges and is expected to be well advanced within three to five years once the synthetic material has degraded to low concentrations. **Production from Hibernia Oilfield** • The following is an overview of key results from the Hibernia 2014 EEM program (HMDC 2017): - Toxic Microtox and amphipod survival assay responses were observed as far as 6 km away from the Hibernia platform. For the Hibernia Southern Extension (HSE), the farthest amphipod survival tests indicative of toxicity occurred at a distance of 1 km, and significant near-field effects on sediment parameters were also noted within 1 km. - Sediment toxicity testing has shown barium levels from drill cuttings not significantly different from total barium baseline (1994) concentrations up to 1 km from platform, with the highest levels of barium found approximately 250 m from the Hibernia platform and HSE. - Fuel range hydrocarbons were detected in sediments out to 1 km from the Hibernia platform and HSE. - The water sampling program confirmed the levels of many analytes are elevated in surface samples collected nearest to the discharge point. However, this effect was found to be very localized (<50 m) with fast decreasing contaminant concentrations away from the point of discharge. - Fuel range hydrocarbons and lube range hydrocarbons were present in all livers of American plaice collected from the Hibernia platform and HSE areas, as well as in almost all livers from fish collected in the reference areas located 16 km away from the Hibernia platform on the north and west radii. Overall the results indicate that the hydrocarbon levels in fish livers are similar for American plaice from the reference area when compared to fish livers from the Hibernia platform area. However, liver tissue from the HSE area had a significantly higher level of fuel range hydrocarbons compared to reference area samples in 2014. - The results of the fish health survey carried out in 2014 indicated that the overall health of American plaice is similar in the Hibernia platform area, HSE area, and the more distant reference areas. **Production from Terra Nova Oilfield** • The following is an overview of key results from the Terra Nova 2014 EEM program (Suncor 2017): - Concentrations of barium decreased to background levels within approximately 3 km from drill centres; concentrations of >C10-C21 hydrocarbons decreased to levels near the laboratory detection limit (0.3 mg/kg) within approximately 4.5 km from drill centres. Higher sulphides and lower redox occurred at a few stations within 1 to 2 km of drill centres. - There was little to no evidence of project-related sediment toxicity, as measured through laboratory tests with luminescent bacteria (Microtox) and amphipods. However, there was evidence of project effects on in-situ benthic invertebrates near drill centres, with abundances of some taxa increasing and abundances of other taxa decreasing near drill centres and at higher barium and >C10-C21 hydrocarbon concentrations. Effects on the most affected taxa were apparent within 1 to 2 km of drill centres. - Analyses of water samples indicated that seawater physical and chemical characteristics at EEM study area stations and reference area stations, located approximately 20 km southeast and southwest of the Terra Nova site, were similar. - Iceland scallop resources were not tainted and there was no evidence of muscle tissue contamination in 2014. No contamination or tainting was noted for American plaice and American plaice health, as measured through a combination of health indicators, was similar between the Terra Nova EEM study area and the more distant reference areas.

Physical Activity	Potential Residual Environmental Effect(s)	Explanation of Potential Residual Environmental Effect(s)	VC-specific Spatial and Temporal Considerations (Refer to Table 14.1 for General Consideration of Potential for Spatial and Temporal Overlap)
			Production from White Rose Oilfield • The following is an overview of key results from the White Rose 2014 EEM program (Husky 2017): - Analysis of sediment physical and chemical characteristics showed that concentrations of drill mud hydrocarbons and barium were elevated near active drill centres and concentrations decreased with distance from drill centres, as expected. The estimated distance over which hydrocarbons concentrations in sediment were correlated with distance from active drill centres (i.e., the threshold distance) extended to an average 5.8 km in 2014. The distance over which barium concentrations were correlated with distance from active drill centres extended to an average of 1 km. - In 2014, project effects on sediment lead concentrations were noted, but threshold distances for lead have consistently decreased from a maximum 1.5 km in 2006 to a minimum 0.6 km in 2014; unchanged from 2012. For the first time, project effects on sediment fines concentrations were noted in 2014, with an estimated threshold distance of 0.7 km from the nearest active drill centre. - There was no evidence of project effects on water quality. - Analyses of fish tissue chemistry, taste and fish health characteristics for American plaice and snow crab collected within 4 km of drill centres revealed no compelling evidence of effects of project activities on commercial fish. **Production from Hebron Oilfield** • It is estimated that WBM based drill cuttings deposition would be 12.8 km² total around the platform and drilling installations being used (ExxonMobil 2011). • WBM cuttings will be discharged overboard in accordance with the OWTG. Disposal of SBM drill cuttings will be by reinjection into wells with some disposal of treated SBM drill cuttings into the environment (ExxonMobil 2011).
Offshore Petroleum Exploration – Geophysical Survey Programs	• Change in risk or mortality or physical injury • Change in habitat quality and use	• Discharges from survey and support vessels will be made in accordance with MARPOL and are therefore unlikely to cause a change in risk of mortality or physical injury for fish. Discharges may temporarily degrade water quality within a localized area around survey and support vessels, thereby potentially causing temporary behavioural effects (e.g., avoidance / displacement or attraction) for fish within the immediate area. • Vessel-related emissions of artificial light and underwater sound will affect habitat quality in such a way that has potential to disturb fish and cause temporary behavioural effects (e.g., localized avoidance / displacement or attraction) (Amec 2014). • ESRF data (reported in Matthews et al. 2018; Appendix C) indicate that seismic surveys are a dominant anthropogenic source of underwater ambient sound that are expected to be present in the foreseeable future (refer to Section 5.3.10.3). Air source array operations during seismic surveys increase sound levels in the underwater acoustic environment in such a way that has potential to disturb fish and cause temporary behavioural effects (e.g., localized avoidance / displacement and alteration of migration / spawning activities) and/or physiological effects (e.g., damage to hearing structures). Fish eggs and larvae near the air source array are particularly susceptible to potential injury or mortality from seismic sound (Amec 2014).	• Although the relatively large survey areas covered by some types of offshore geophysical surveys and the known propagation of underwater sound in the marine environment can increase the potential for spatial interactions between their effects and those of other projects and activities in the RAA, most survey activities operate for a short period of time in any one location, thus potentially resulting in a transient and relatively short-term disturbance within localized portions of the survey area. However, as reported in Matthews et al. (2018) (Appendix C of the EIS), acoustic recordings conducted in the RAA demonstrate that underwater sound from seismic source arrays are a dominant sound source in the soundscape.

Physical Activity	Potential Residual Environmental Effect(s)	Explanation of Potential Residual Environmental Effect(s)	VC-specific Spatial and Temporal Considerations (Refer to Table 14.1 for General Consideration of Potential for Spatial and Temporal Overlap)
Offshore Petroleum Exploration – Exploration and Delineation Drilling Programs	• Change in risk or mortality or physical injury • Change in habitat quality and use	• ESRF data (reported in Matthews et al. 2018; Appendix C) indicate that offshore oil and gas drilling facilities and marine vessels (including PSVs) are key identifiable anthropogenic sources of underwater ambient sound that dominate the soundscape and are expected to be present in the foreseeable future (refer to Section 5.3.10.3). • The presence and operation of MODUs engaged in offshore petroleum exploration and delineation drilling activities could potentially result in a change in habitat quality and use and a change in risk of mortality or physical injury for marine fish, due to the generation of temporary, localized underwater sound during MODU operations, subsequently affecting the quality of the underwater acoustic environment within the RAA. Sound levels generated by other offshore exploration drilling activities are generally assumed to be similar to those generated by Project-related drilling activities. • Underwater sound generated by the PSVs operating in support of these offshore petroleum exploration projects in the RAA are assumed to be similar to those generated by Project PSVs. Operation of PSVs could result in short-term, localized changes in habitat quality and use for marine fish, due to increased vessel traffic within the RAA, and subsequent increased underwater sound emissions. • Underwater sound levels generated by VSP surveys, where required in support of offshore petroleum exploration and delineation drilling, are assumed to be similar to those generated by Project-related VSP surveys. These underwater sound levels could result in a change in habitat quality and use and a change in risk of mortality or physical injury for marine fish (particularly fish eggs and larvae in close proximity to the air source array). These effects would be short-term (VSP typically takes approximately one day to a few days per well), localized in close proximity to the sound source, and reversible, with no predicted lasting effects once VSP surveys are complete. • Routine operational discharges will be in accordance with OWTG and MARPOL requirements and will be non-bio-accumulating, and non-toxic, resulting in localized and temporary water quality effects. However, associated Changes in Habitat Quality and Use by fish are generally predicted to be not significant with adherence to standard practices and guidelines. • The discharge of drill muds and cuttings from offshore petroleum exploration and delineation drilling projects is generally expected to result in a localized and temporary change in habitat quality and use and a change in risk of mortality or physical injury for marine fish around the respective MODUs. • It is generally anticipated that habitat altered by the deposition of drill muds and cuttings will become available for use as fish habitat immediately following the completion of drilling operations and will eventually is be recolonized by benthic communities. • Well abandonment could potentially result in a change in habitat quality and use or a change in risk of mortality or physical injury for marine fish, depending on the method of abandonment. If the wellhead is mechanically separated from the seabed, it is expected that fish would avoid the immediate area where well abandonment activities are taking place. If the wellhead is kept in place, it is expected to be colonized by benthic epifauna.	• Residual effects from other exploration drilling programs are generally anticipated to be similar in nature and extent (including similar spatial and temporal scales) to predicted Project-related residual environmental effects on marine fish and fish habitat (refer to Chapter 8) • Exploration drilling activities are typically relatively short-term and localized. This can reduce the potential for individuals and populations to be affected simultaneously and repeatedly by multiple physical activities. • With respect to the timeline for recolonization by benthic communities following the deposition of drill muds and cuttings, benthic recovery in relatively shallow waters has been documented as occurring within as few as approximately one to four years (Bakke 1986, Neff et al. 2000, Hurley and Ellis 2004, Renaud et al. 2008, Bakke et al. 2011, Lee et al. 2011). Although little is known about the timeline for recolonization by benthic communities in deep-water environments, benthic recovery is generally expected to take longer at greater depths and in colder waters due to lower rates of metabolism and growth (Gates and Jones 2012). For slow-growing and long-lived species of large benthic organisms, such as sponges, corals, and crinoids, Clark et al. (2016) estimate that it may take centuries or millennia for benthic communities to recover following large-scale removal of attached epifauna from hard substrates in deep-water environments (e.g., through the use of bottom-contact fishing gear). However, benthic recovery following the discharge of drill muds and cuttings, and the completion offshore drilling projects in general, is anticipated to take much less time since these activities do not entail the removal of large swathes of attached epifauna. Neff et al. (2000) also note that complete recovery of deep-water benthic animals requires many years because they reproduce and grow slowly, but that this recovery is likely to be initiated shortly after completion of cuttings discharges and is expected to be well advanced within three to five years once the synthetic material has degraded to low concentrations.

Physical Activity	Potential Residual Environmental Effect(s)	Explanation of Potential Residual Environmental Effect(s)	VC-specific Spatial and Temporal Considerations (Refer to Table 14.1 for General Consideration of Potential for Spatial and Temporal Overlap)
Commercial Fishing Activity	• Change in risk or mortality or physical injury • Change in habitat quality and use	• Commercial fisheries within the RAA cause a direct change in risk of mortality or physical injury for targeted fish species as well as any non-targeted fish species that may be taken as bycatch. The use of mobile bottom-contact fishing gear that is dragged along the seafloor (e.g., trawlers) for certain commercial groundfish fisheries can remove plants, corals, and sessile food items; overturn rocks; level rock outcrops; crush, bury, or expose benthic organisms; and re-suspend sediments, thereby causing a change in habitat quality and use and change in risk of mortality or physical injury for marine benthos. • Fishing vessels may cause a localized change in habitat quality and use for marine fish through the generation of underwater sound from engines and propellers during transiting. • Although underwater sound levels produced during the transiting of fishing vessels are below the thresholds for physical injury to marine fish, sound levels from other physical activities that may be carried out by fishing vessels (e.g., depth sounding, bottom profiling, and side scan sonar) are high enough to cause injury or mortality to fish at close ranges (refer to Table 14.4). • Routine operational discharges from fishing vessels (e.g., grey and black water, ballast water, bilge water, and deck drainage) will be discharged in accordance with MARPOL and are therefore unlikely to cause a change in risk of mortality or physical injury for marine species. However, discharges may cause a change in habitat quality and use for marine fish within a localized area around fishing vessels.	• Although the presence of mobile bottom-contact fishing gear is relatively more transient, the residual environmental effects of this type of commercial fishing activity on marine fish and fish habitat (particularly benthic fish habitat) is generally more disruptive, longer term, and more spatially extensive than the temporary and localized residual effects to fish and fish habitat associated with the use of fixed fishing gear. • The potential residual change in habitat quality and use associated with sensory disturbance and emissions / discharges from fishing vessels is expected to be short-term and transient at any given location, as is the potential residual change in risk of mortality or physical injury associated with high underwater SPLs.
Hunting Activity	• Not applicable	• Potential effects associated with the presence and transiting of hunting vessels, including associated emissions and discharges, are equivalent to the potential effects associated with the vessels of other ocean users in the RAA and are therefore not considered separately in the CEA.	• Not applicable
Other Ocean Uses	• Change in risk or mortality or physical injury • Change in habitat quality and use	• The vessels of other ocean users may cause a localized change in habitat quality and use for marine fish through the generation of underwater sound from engines and propellers during transiting. • Although the underwater sound levels produced by the types of vessels most commonly used by other ocean users are generally below the thresholds for physical injury to marine species (refer to Table 14.4), the sound levels of other physical activities that may be carried out by these ocean users (e.g., naval sonar) are high enough to cause injury or mortality to fish in certain circumstances. • Routine operational discharges from the vessels of other ocean users (e.g., grey and black water, ballast water, bilge water, and deck drainage) will be discharged in accordance with MARPOL and are therefore unlikely to cause a change in risk of mortality or physical injury for marine species. However, discharges may cause a change in habitat quality and use for marine fish within a localized area around the vessels of other ocean users.	• The highly transitory nature of the vessels of other ocean users reduces potential residual effects on marine fish and fish habitat in any particular location and at any particular time. • The potential residual change in habitat quality and use associated with sensory disturbance and emissions / discharges from the vessels of other ocean users is expected to be short-term and transient at any given location, as is the potential residual change in risk of mortality or physical injury associated with high underwater SPLs.

14.2.4 Potential Cumulative Environmental Effects

14.2.4.1 Cumulative Change in Risk of Mortality or Physical Injury

The Project has potential to interact with one or more other physical activities contributing to fish mortality and injury in the RAA (i.e., underwater sound emissions from various sources, discharges of drill muds and cuttings from other offshore drilling projects, and/or direct mortality or injury from commercial fishing activities), and therefore result in a cumulative change in risk of mortality or physical injury for marine fish. For immobile species and species with very limited ranges in areas that are affected by multiple physical activities at once, individuals may be exposed to the residual effects of the Project and the residual effects of one or more other physical activities either simultaneously or individually over an extended period of time. For mobile species (particularly those whose ranges cover a large extent of the RAA), individuals may be sequentially exposed to the residual effects of the Project and the residual effects of one or more other physical activities throughout their movement life cycle. However, this cumulative change in risk of mortality or physical injury for marine fish is not expected to affect population viability for marine fish species in the RAA. The relative contribution of the Project to the cumulative change in risk of mortality or physical injury for marine fish in the RAA is considered minor in comparison to the contribution of other activities such as commercial fisheries.

Some of the underwater sound emissions generated by offshore petroleum exploration and production drilling, geophysical surveys, fisheries, and other ocean users during vessel transiting and other activities (e.g., depth sounding, bottom profiling, naval or side scan sonar, air source arrays) generate SPLs that may be harmful to fish at close ranges (refer to Table 14.4). VSP operations, which may be conducted for offshore exploration and production drilling projects (including the Project), will generate sound levels that may result in physical damage to fish at very close proximity to individual sound sources. However, the possibility of cumulative interaction is uncertain and considered unlikely due to the infrequent nature and short duration (i.e., approximately one day to a few days per well) of VSP operations, which may not be completed for each Project well or for each well associated with other offshore drilling projects.

With respect to other physical activities in the RAA that generate underwater sound at levels that may cause a change in risk of mortality or physical injury for marine fish, it is expected that the presence of an approaching vessel or drilling activity will locally displace some species from the area around operating VSP, seismic, sounding, profiling, or sonar sound sources before they are exposed to sound levels associated with mortality or injury effects in close proximity to those sound sources, and that most species will respond behaviourally to avoid underwater sound at lower levels than those at which injury or mortality might occur. The implementation of ramp-up procedures for the VSP source array in accordance with the SOCP will mitigate potential underwater sound effects on fish, marine mammals, sea turtles, and diving birds in close proximity to Project and non-Project seismic sources.

The underwater sound levels produced by Project-related and various VSP operations being conducted for other projects each may cause a potential cumulative change in risk of mortality or physical injury to fish eggs / larvae within a few metres of the respective seismic source, although such effects for each sound source would be expected to be in the range of natural variability (not affecting population viability). Fish eggs / larvae are immobile and are therefore more susceptible to harm in close proximity to these sound

sources than other life stages of mobile fish; however, the sound sources themselves are far enough apart that, even if there was some temporal overlap of activities, there will be no spatial overlap (based on predicted propagation of underwater sound levels) of direct residual environmental effects on fish eggs / larvae. A cumulative change in risk of mortality or physical injury associated with simultaneous exposure of fish eggs / larvae (or simultaneous exposure of other immobile individuals) to underwater sound from multiple VSP sources is therefore considered unlikely to occur as a result of the varying spatial and temporal scale of VSP operations.

The establishment of a 500-m radius safety zone around the MODU, within which non-Project activities are excluded, will further reduce potential cumulative effects on individuals associated with simultaneous exposure to underwater sound emissions from Project-related VSP operations and from other physical activities generating sound in the RAA, as well as prevent the spatial overlap of residual environmental effects on fish eggs / larvae. However, individuals of mobile species may still be exposed to high sound levels from the Project and one or more physical activities throughout their life cycle (particularly for species whose ranges cover a large extent of the RAA), and thus be subject to a cumulative change in risk of mortality or physical injury. As described below, these same individuals also have potential to be exposed to a cumulative change in risk of mortality or physical injury from the deposition of drill muds and cuttings and/or commercial fishing activity.

As is explained in Section 2.8.2, the deposition of Project-related drill muds and cuttings may smother marine benthos at deposition thicknesses of 6.5 mm or more within:

- up to a 128-m radius around the discharge point in ELs 1145, 1146, and 1148 in West Orphan Basin and
- up to a 55-m radius around the discharge point in EL 1149 in East Orphan Basin

Given that the residual Project-related change in risk of mortality or physical injury associated with sediment (drill waste) dispersion and deposition is anticipated to be contained within the 500-m radius Project safety zone and approximately 100 km or more away from other exploration and production drilling projects, the affected area is not likely to overlap spatially with similar residual effects from other physical activities. However, this residual Project-related change in the risk of mortality or physical injury for marine fish could nonetheless combine with the effects of sediment deposition from other offshore drilling projects, as well as other potentially fatal or physically damaging activities affecting fish in the RAA (e.g., high levels of underwater sound from various sources and commercial fishing activity), to contribute to a cumulative change in the overall risk of mortality or physical injury for benthic and other fish species in the RAA in general. Any such cumulative change in risk of mortality or physical injury associated with the deposition of Project-related drill muds and cuttings is predicted to be primarily limited to the Project Area and to be short- to medium-term in duration.

The change in risk of mortality or physical injury predicted for the Project could also combine with the general mortality and injury effects of commercial fisheries on targeted species and non-targeted bycatch, including the harmful effects that bottom-contact fishing can have on benthic organisms, resulting in adverse cumulative effects. However, the Project Area has not historically been subject to a high level of bottom-contact fishing, and this activity is now prohibited within the Northeast Newfoundland Slope Closure that encompasses ELs 1145, 1146 and 1148. Potential cumulative environmental interactions between the

Project and bottom-contact fisheries will be further limited by the presence of the 500-m radius safety zone excluding other third party physical activities (which is more relevant in this case for EL 1149 outside the Northeast Newfoundland Slope Closure), as well as the localized nature of the deposition of drill muds and cuttings around the wellsite. The residual effects of Project-related drill muds and cuttings discharged inside the safety zone are localized and unlikely to overlap spatially with the residual effects of bottom-contact fishing outside of the safety zone at the individual or population level within the wider RAA. The potential interactions between Project-induced mortality or injury of fish eggs / larvae in the RAA (e.g., from VSP operations carried out in support of the Project), and the commercial harvesting and bycatch of adult fish (including benthic species) in the RAA will are unlikely to contribute to the cumulative change in risk of mortality for marine fish populations.

14.2.4.2 Cumulative Change in Habitat Quality and Use

The Project has potential to interact with one or more other physical activities contributing to sensory disturbances in the RAA (i.e., underwater sound emissions from various sources, routine operational discharges from various sources, and/or direct alteration of benthic habitat from bottom-contact commercial fishing activities) and therefore may result in a cumulative change in habitat quality and use for marine fish. For immobile species and species with very limited ranges in areas that are subject to multiple sources of potential sensory disturbance at once, individuals may be exposed to the residual effects of the Project and the residual effects of one or more other physical activities simultaneously. For mobile species (particularly those whose ranges cover a large extent of the RAA), individuals may be sequentially exposed to the residual effects of the Project and the residual effects of one or more other physical activities throughout their life cycle. However, based on the relative increment of activity levels associated with the Project, the contribution of the Project to this cumulative change habitat quality and use for marine fish in the RAA is considered minor in comparison to the contribution of other activities such as commercial fisheries.

As reported in Matthews et al. (2018) (Appendix C), the ESRF funded a two-year program aimed recording the underwater soundscape on Canada's East Coast. As part of the ESRF study, JASCO deployed 20 acoustic recorders along Canada's east coast, including one station that was located within BP's Project Area. Based on measurements at the ESRF stations, Matthews et al. (2018) found there were several identifiable sources in the Project Area that are dominant sound sources in the soundscape and these sources are expected to be present in the foreseeable future: fin whales; shipping and oil and gas extraction platforms; and seismic surveys (Matthews et al. 2018). Shipping, including supply vessels like PSVs that are proposed to be used for the Project, are generally transient sources that are detectable at any one location over a period of several hours. Closer to the exploration drilling areas and existing oil and gas extraction platforms in the Newfoundland offshore area, the sounds from vessels and DP systems are continuously present (Matthews et al. 2018). Underwater sound from seismic source arrays was a dominant sound source in the soundscape. Although the underwater sound emissions from the Project will be relatively short-term and reversible, they will contribute to an already disturbed soundscape in the marine environment.

Although routine discharges and underwater sound emissions from the Project are not likely to be detected outside the Project Area, individuals of species whose ranges cover a large extent of the RAA may be exposed to discharges and/or emissions (including underwater sound) from one or more physical activities,

as well as other direct habitat disturbances (e.g., from bottom-contacting commercial fishing activity), throughout their life cycle. The Project will introduce an additional source of sensory disturbance (e.g., emissions and discharges) that these individuals have potential to encounter. Mobile fish and other marine wildlife may temporarily avoid localized areas subject to degraded water quality and/or underwater sound. The cumulative environmental effects of the Project in combination with other physical activities may therefore include a temporary reduction in the amount of habitat available within the RAA (i.e., due to temporary avoidance of multiple areas at once). This cumulative change in habitat quality and use has potential to disrupt reproductive, foraging and feeding, and/or migratory behaviours if the availability of important habitat areas is affected; however, this is not expected to occur for the following reasons:

- It is anticipated that routine discharges from the Project and from other physical activities will be in compliance with the requirements of OWTG and/or MARPOL (as applicable), at levels that are intended to be prevent damage of the marine environment, including marine fish and fish habitat.
- Routine discharges are predicted to disperse quickly, causing only localized effects in water quality around the source. Given that the concentrations of individual discharges are expected to be rapidly diluted in the open ocean, routine discharges from the Project are not expected cause a substantial cumulative change in habitat quality and use.
- As is explained in Section 2.8.2, drill waste deposition modelling results indicate that a sediment deposition thickness of 1 mm from Project-related discharge of drill muds and cuttings may extend:
  - up to a 625-m radius around the discharge point in ELs 1145, 1146, and 1148 in the West Orphan Basin and
  - up to 147-m radius around the discharge point in EL 1149 in the East Orphan Basin.
  - Sediment thicknesses under 6.5 mm are not anticipated to result in benthic smothering but do have potential to result in a change in habitat quality and use for benthic organisms within the affected areas. It is expected that 80% of the predicted 625-m radius spatial extent in the West Orphan Basin (and 100% of the predicted 147-m radius spatial extent in the East Orphan Basin) will be located within the 500-m radius safety zone around the MODU within which other third-party physical activities are excluded, thereby limiting potential cumulative interactions between Project-related drill muds and cuttings discharged inside the safety zone and discharges from other third party physical activities outside the safety zone. It is also expected that Project-related discharges of drill muds and cuttings will be at low water column concentrations outside of the 500-m radius safety zone, thus further reducing the potential cumulative change in habitat quality and use caused by interaction with the discharges of other physical activities.
- Any potential cumulative change in habitat quality and use caused by interaction between Project-related drill waste discharges and the sediments temporarily resuspended during bottom-contact fishing activity outside of the 500-m radius safety zone would likely be negligible based on the limited sedimentation expected beyond the safety zone and the closure of approximately 53% of the Project Area to bottom-contact fishing activities.
- Potential interactions between Project-related drill waste discharges and underwater sound from the vessels of fisheries and other ocean users operating outside of the 500-m radius safety zone would similarly be limited due to the low water column concentrations of Project-related discharges outside of the safety zone, the exclusion of non-Project activities within the safety zone, the closure of approximately 53% of the Project Area to bottom-contact fishing activities, and the transient nature of underwater sound associated with vessel movements. Although Project-related discharges could also

interact with physical activities generating higher SPLs outside of the safety zone (e.g., third party seismic, sounding, profiling, or sonar sound sources) to cause a cumulative change in habitat quality and use within the 625-m and 147-m radius spatial extents for 1 mm sediment deposition thickness, these cumulative interactions will be transient and negligible in terms of overlapping effects on habitat quality.

- In general, the presence of Project and non-Project vessels in any particular area is anticipated to be medium-term and transient in nature, thus limiting water quality and sound effects (and associated cumulative changes in habitat quality and use) at any given location, including areas of importance for reproduction, feeding, and migration of fish.
- Underwater sound emissions produced during operation of the Project MODU and other offshore petroleum exploration and production drilling projects in the RAA will be longer lasting and generated from a stationary source for the duration of drilling activities at each well. Although fish are not expected to approach close enough to these offshore facilities to be exposed to sound levels capable of causing auditory injury, the sound emissions may cause behavioural responses such as temporary habitat avoidance or changes in activity state. However, the localized areas potentially affected by the Project, other offshore drilling projects, and other physical activities represent a relatively small proportion of the total amount of habitat available within the RAA.

In consideration of the above, cumulative water quality, underwater sound, and direct benthic disturbance effects are considered unlikely to substantially disrupt the use of important habitat areas by fish.

14.2.5 Species at Risk

As described in the existing environment description for fish and fish habitat (Section 6.1.8), four fish SAR (i.e., Atlantic wolffish, northern wolffish, spotted wolffish, and white shark) and 20 SOCC have potential to occur in the Project Area and/or RAA. Details regarding the marine fish SAR and SOCC that may occur in the Project Area and/or RAA, including summaries of their distribution, habitat, ecology, and general life history information, are provided in Section 6.1.8 and Section 8.3.4.

The main potential cumulative environmental interactions between the Project, other physical activities in the RAA, and marine fish SAR are the same as for the secure species that comprise the Marine Fish and Fish Habitat VC.

The Orphan Spur EBSA is a known aggregation area for northern, spotted, and striped wolffish that is partially overlapped by the Project Area. The Northeast Shelf and Slope EBSA is known to support high aggregations of spotted wolffish and intersected by the potential PSV transit routes. While Project activities could potentially occur in these designated special areas, they would generally be localized and short-term in nature and therefore unlikely to interact cumulatively with the residual effects of other physical activities on wolffish in the EBSAs. The establishment of a 500-m radius safety zone around the Project MODU will further reduce the potential for direct spatial and temporal overlap of effects from different physical activities within these known wolffish aggregation areas. Only a small portion of the proposed critical habitat is within the Project Area and is unlikely to interact cumulatively with the residual effects of other physical activities on wolffish.

No critical habitat or special areas of importance for white shark have been identified in the RAA (refer to Section 6.1.8).

All of the marine fish SAR with potential to occur within the RAA are highly mobile in their adult stages. Given the highly localized and short-term nature of planned Project activities and their likely environmental effects (along with the planned implementation of mitigation measures outlined previously), the Project is not anticipated to affect these SAR substantially. Identified critical habitat for such species and the residences of other key habitats of individuals or populations are also not anticipated to be substantially adversely affected. Potential Project-related residual effects on these SAR are expected to be negligible in comparison to residual effects on these SAR resulting from commercial fisheries and climate change. Therefore, the Project is not predicted to make a perceptible contribution to potential cumulative effects on these SAR.

14.2.6 Cumulative Effects Summary and Evaluation

Cumulative environmental effects on fish and fish habitat are predicted to be adverse, low to moderate in magnitude, occurring within the VC-specific LAA, sporadic to regular in frequency, short- to medium-term in duration, and reversible. With the application of proposed Project-related mitigation and environmental protection measures, the residual cumulative environmental effects on marine fish and fish habitat (including SAR) are predicted to be not significant. Therefore, no additional mitigation measures beyond those in place to mitigate the Project's direct effects are needed to address potential cumulative effects.

Table 14.6 summarizes the results of the CEA for this VC.

Table 14.6 Marine Fish and Fish Habitat: Summary of Potential Cumulative Environmental Effects

Summary of Potential Cumulative Environmental Effects	
Context for Cumulative Environmental Effects	• The existing biological environment for fish and fish habitat is described in Section 6.1. Physical characteristics of fish habitat are described in Chapter 5. • The RAA contains several important habitat areas for fish, including various designated special areas (e.g., MPAs, marine refuges and lobster area closures, EBSAs, significant benthic areas, and NAFO VMEs) as well as draft critical habitat for northern and spotted wolffish SAR that has been identified on the Northeast Newfoundland Shelf and Slope. • Existing fish presence and abundance for secure species and SAR has been and is being affected by directed fisheries and bycatch, various other human activities (including associated emissions and effluents), climate change, and oceanographic conditions. • Fishing pressures and oceanographic conditions continue to influence fish distribution and abundance in the Project Area and overall region. Overall, groundfish populations have been recovering in the Northwest Atlantic.
Residual Environmental Effects of the Project	• The primary interactions that may have adverse environmental effects on marine fish and fish habitat include underwater sound, lighting, and environmental discharges associated with the Project, including those that may interact with sensitive benthic organisms and habitats (e.g., cold-water corals and sponges). • The Project may result in a residual adverse change in risk of mortality or physical injury and a residual adverse change in habitat quality and use for marine fish and fish habitat, including secure species and SAR. These residual effects are predicted to be not significant and the Project is not expected to result in residual population-level effects on marine fish. • This significance determination has generally been made with a moderate to high level of confidence based on a good understanding of available information on the effects of exploration drilling and VSP operation on marine fish and fish habitat, the effectiveness of mitigation measures discussed in Section 8.3, and knowledge of the existing environment within the Project Area, LAA, and RAA. However, the confidence level is reduced to moderate in some cases to account for the lack of research around appropriate effects thresholds for continuous sound on marine fish and limited information about long-term effects of underwater sound.
Other Projects / Activities	**Potential for Interaction with Effects of Project:**
Offshore Petroleum Production Projects (Production from Hibernia, Terra Nova, White Rose, and Hebron Oilfields)	Y – Offshore petroleum production operations are located at substantial distances outside of the Project Area and LAA, with highly localized environmental effects as determined from ongoing EEM programs. For mobile species (particularly those whose ranges cover a large extent of the RAA), individuals may be sequentially exposed to the residual effects of the Project and the residual effects of one or more offshore petroleum production projects throughout their life cycle.

Summary of Potential Cumulative Environmental Effects	
Offshore Petroleum Exploration –Geophysical Survey Programs	Y – Some potential for interaction, although localized and short-term nature of these activities and their effects, along with planned and required separation measures and other mitigation measures, will reduce potential for interaction. For mobile species (particularly those whose ranges cover a large extent of the RAA), individuals may be sequentially exposed to the residual effects of the Project and the residual effects of geophysical survey programs throughout their life cycle. For immobile species and species with very limited ranges in areas that are subject to residual effects from the Project and geophysical survey programs at once, individuals may be exposed to the residual effects of the Project and the residual effects of geophysical survey programs activities simultaneously.
Offshore Petroleum Exploration – Exploration and Delineation Drilling Programs	Y – Some potential for interaction, although localized and short-term nature of these activities and their effects, along with planned and required separation measures and other mitigation measures, will reduce potential for interaction. For mobile species (particularly those whose ranges cover a large extent of the RAA), individuals may be sequentially exposed to the residual effects of the Project and the residual effects of other exploration drilling projects throughout their life cycle.
Commercial Fishing Activity	Y – Some potential for interaction, although these activities are restricted within portions of the Project Area and occur mostly outside of the ELs. Safety zones around the MODU will limit the potential for overlapping and concurrent environmental effects. For mobile species (particularly those whose ranges cover a large extent of the RAA), individuals may be sequentially exposed to the residual effects of the Project and the residual effects of commercial fishing activity throughout their life cycle. For immobile species and species with very limited ranges in areas that are subject to residual effects from the Project and commercial fishing activity at once, individuals may be exposed to the residual effects of the Project and the residual effects of commercial fishing activity simultaneously.
Hunting Activity	Not applicable.
Other Ocean Uses	Y – Some potential for interaction, although these activities and their effects are highly localized and transient. Safety zones around Project activities measures will limit the potential for overlapping and concurrent environmental effects. For mobile species (particularly those whose ranges cover a large extent of the RAA), individuals may be sequentially exposed to the residual effects of the Project and the residual effects of the activities of other ocean users throughout their life cycle. For immobile species and species with very limited ranges in areas that are subject to residual effects from the Project and the activities of other ocean users at once, individuals may be exposed to the residual effects of the Project and the residual effects of the activities of other ocean users simultaneously.
Cumulative Effects Summary	The residual cumulative environmental effects on marine fish and fish habitat that have potential to occur as a result of the residual effects of the Project on the VC in combination with the residual effects of other projects or activities on the VC are predicted to be not significant.

14.3 Marine and Migratory Birds

14.3.1 Context for Cumulative Environmental Effects

The Marine and Migratory Birds VC, as described in Chapter 9, includes oceanic (occur beyond the continental shelf), neritic (occur on the continental shelf), and littoral zone (occur in intertidal, splash, and spray zones) seabirds, waterfowl, loons, grebes, and shorebirds that are protected under the MBCA, as well as additional marine-associated birds not protected under the MBCA (e.g., cormorants). These include ecologically, traditionally, and recreationally important bird species that are considered secure, as well as those listed as SAR.

As described in Section 6.2, the marine waters off eastern Newfoundland are important to many marine and migratory bird species at various times of the year. Several million seabirds nest in colonies along the coasts of the eastern and northeastern Newfoundland, and forage on the Grand Banks and adjacent areas during and following the nesting season. In addition to local breeding birds, there are many non-breeding seabirds in the RAA during the summer months. Other marine-associated birds that may occur in or around the RAA include: waterfowl that nest in coastal Newfoundland in relatively small numbers but winter in coastal waters in large numbers, and generally occur away from the coast only as vagrants in small numbers; loons and grebes that also winter in coastal Newfoundland waters; shorebirds (plovers and sandpipers) that occur on and around insular Newfoundland as breeders, migrants in passage, or winter residents; and landbirds such as raptors and songbirds associated with coastal habitats that may be encountered in coastal areas of the RAA.

In addition to several major seabird colonies, the RAA also contains various designated special areas of importance to marine and migratory birds (e.g., marine and migratory bird sanctuaries, EBSAs, provincial ecological reserves, and IBAs). The Project Area does not overlap with any designated special areas that are known to be of particular importance to marine and migratory birds.

The distribution, abundance, and health of marine and migratory birds and their populations are influenced by natural phenomena (e.g., weather, food availability, and oceanographic variation) as well as human activities and their associated disturbances within the often extensive ranges of marine and migratory bird species (e.g., legal and illegal hunting; fishing activity, including fisheries bycatch; vessel traffic, including residual hydrocarbons and other contaminants in routine operational discharges from vessels; offshore petroleum exploration and production activities and associated effluents and emissions; pesticides; and other pollution). One of the mechanisms through which several of these (and other) natural processes and human activities affect diving marine birds is through the emission of underwater sound. As described in Section 14.2.1, the underwater sound comparative assessment completed for the Project (Matthews et al. 2018; Appendix C) identified four key sources of underwater sound that dominate the soundscape in the Project Area: fin whales; shipping and oil and gas extraction facilities; seismic surveys; and ambient noise.

Wiese and Ryan (2003) report that the amount of persistent oil in the marine environment is very high along Newfoundland coastlines due to the density of marine traffic off Newfoundland associated with shipping activity between Europe and North America. Oiled seabirds have washed up on beaches in Newfoundland for many decades and most of the oil on the feathers of these seabirds is heavy fuel oil mixed with

lubricants, which Wiese and Ryan (2003) believe originates from the illegal pumping of waste oil and oil-water mixtures of bilges from large trans-Atlantic tankers and cargo / container vessels. Beached bird surveys conducted between 1984 and 1999 indicate that chronic oil pollution along the southeast coast of Newfoundland is among the highest in world (Wiese and Ryan 2003). The oiling rate of dead birds found during beached bird surveys was 62% over the entire 16-year period, 74% during the last five years of the period, and peaked at 85% in 1995. Murres and other auks exhibited the highest oiling rates (Wiese and Ryan 2003). Waterfowl, loons, and grebes are also relatively vulnerable to oil pollution because, like alcids, they spend a great deal of time feeding or resting on or under the surface of the water. However, they rarely occur outside of coastal waters and are therefore unlikely to be found in or near the Project Area. In addition to being vulnerable to chronic oil pollution, murre and waterfowl populations are also subject to pressure from hunting activity in the RAA.

The populations of most marine-associated bird species occurring off Eastern Newfoundland are generally considered stable overall (Section 6.2), although the Leach's storm-petrel population has declined in recent years (ECCC-CWS unpublished data). That species is thought to be particularly vulnerable to the potential effects of offshore activities through attraction to artificial light sources resulting in collision and strandings. In addition, because they may forage hundreds of kilometres from the nest site during the breeding season (Pollet et al. 2014) there may be risk of exposure of adults and eggs to oil from spills and routine discharges (Morandin and O'Hara 2016).

The effects of previous activities and natural environmental influences are reflected in the existing baseline environmental conditions for the marine and migratory bird VC, as described in Section 6.2. This includes considering the current condition (e.g., health or quality) of potentially affected bird populations and their habitats, as well as their potential resiliency or sensitivity to further environmental change resulting from the Project in combination with other ongoing and future projects and activities that may affect the same VC.

14.3.2 Potential Project-related Contributions to Cumulative Effects

As described in Chapter 9, routine Project activities and components have potential to interact with marine and migratory birds and their associated habitat due to attraction to the lights and flares of the MODU and PSVs, operational discharges during well drilling and testing operations, underwater sound emissions from VSP operations, and interactions with PSV and helicopter activities during supply and servicing. Thus, the Project has potential to result in the following residual adverse environmental effects on marine and migratory birds:

- a residual change in habitat quality and use associated with the presence and operation of the MODU, VSP surveys, Project-related discharges, well testing and flaring, and supply and servicing operations
- a residual change in risk of mortality or physical injury associated with the presence and operation of the MODU, VSP surveys, Project-related discharges, well testing and flaring, and supply and servicing operations

The Project-specific environmental effects assessment for this VC includes a summary of Project residual environmental effects in Section 9.3.5 and a determination of significance in Section 9.4. With the implementation of mitigation (refer to Section 9.3.2), the residual environmental effects of routine Project activities on marine and migratory birds are predicted to be not significant.

14.3.3 Other Projects and Activities and their Effects

Table 14.7 summarizes how past, present, and future projects and activities in the RAA have potential to cause a residual change in risk of mortality or physical injury and residual change in habitat quality and use affecting marine and migratory birds.

14.3.4 Potential Cumulative Environmental Effects

14.3.4.1 Cumulative Change in Risk of Mortality or Physical Injury

As discussed in Section 14.2.4 for marine fish and fish habitat, underwater sound emissions from Project-related VSP operations will contribute to the underwater sound emissions of other physical activities generating high levels of underwater sound in the RAA to potentially result in a cumulative change in risk of physical injury for marine species. The analysis provided in Section 14.2.4 regarding underwater sound emissions from Project-related VSP operations in combination with the underwater sound emissions of other physical activities generating high levels of underwater sound in the RAA could be relevant for marine birds diving in proximity to these sound sources. However, based on current scientific knowledge regarding the effects of underwater sound on birds (Stemp 1985, Turnpenny and Nedwell 1994, Lacroix et al. 2003), diving marine and migratory birds appear to be less sensitive to underwater sound emissions than fish, marine mammals, or sea turtles. Marine and migratory birds are therefore assumed to be less susceptible to a potential cumulative change in risk of mortality or physical injury from underwater sound than fish or marine mammals and sea turtles. As noted in Table 14.7, although marine and migratory birds diving in close proximity to high levels of underwater sound have potential to be injured, VSP operations are not anticipated to have a measurable adverse effect on marine and migratory bird mortality risk, given the short duration marine birds spend underwater during foraging dives, and the short temporal scale of VSP operations. The change in risk of injury for diving marine birds is highly localized and diminishes with distance from the source.

Marine and migratory birds are vulnerable to potential injury or mortality when exposed to hydrocarbon contamination. Non-routine discharges from the Project and various other physical activities in the RAA could contribute to a cumulative change in risk of mortality or physical injury for marine and migratory birds. However, routine discharges are expected to comply with government standards and requirements, and residual hydrocarbons in discharges released in accordance with the OWTG and/or MARPOL (as applicable) are generally not associated with the formation of a slick (potentially affecting marine and migratory birds) and are therefore unlikely to cause a measurable cumulative change in risk of mortality or physical injury to marine and migratory birds.

Table 14.7 Marine and Migratory Birds: Residual Effects from Other Projects and Activities in the RAA

Physical Activity	Potential Residual Environmental Effect(s)	Explanation of Potential Residual Environmental Effect(s)	VC-specific Spatial and Temporal Considerations (Refer to Table 14.1 for General Consideration of Potential for Spatial and Temporal Overlap)
Offshore Petroleum Production Projects (Production from Hibernia, Terra Nova, White Rose, and Hebron Oilfields)	• Change in risk or mortality or physical injury • Change in habitat quality and use	• Nocturnally migrating birds may be attracted and/or disoriented by artificial night lighting on production facilities and PSVs, thereby increasing their risk of injury or mortality. • Although marine and migratory birds diving in close proximity to high levels of underwater sound have potential to be injured, VSP operations are not anticipated to have a measurable adverse effect on marine and migratory bird mortality risk, given the short duration marine and migratory birds spend underwater during foraging dives, and the short temporal scale of VSP operations. • VSP operations could potentially result in a change in habitat quality and use for marine and migratory birds. This change would be short-term (VSP typically takes approximately one day to a few days per well), localized in close proximity to the sound source, and reversible, with no predicted lasting effects once VSP surveys are complete. • Based on current scientific knowledge regarding the effects of underwater sound on birds (Stemp 1985, Turnpenny and Nedwell 1994, Lacroix et al. 2003), diving marine and migratory birds appear to be less sensitive to underwater sound emissions than fish, marine mammals, or sea turtles. Marine and migratory birds are therefore assumed to be less susceptible to a potential change in risk of mortality or physical injury from underwater sound than fish or marine mammals and sea turtles. • Discharges from production facilities and PSVs (e.g., produced water, grey and black water, ballast water, bilge water, and deck drainage deck drainage) are discharged in accordance with the OWTG and MARPOL and are therefore unlikely to cause a change in risk of mortality or physical injury for marine and migratory birds. • Discharges may cause a change in habitat quality and use for marine and migratory birds within a localized area around offshore production facilities and PSVs. • Helicopter traffic may cause a localized change in risk of mortality or physical injury for marine and migratory birds, due to potential bird strikes, as well as a change in habitat quality and use for marine and migratory birds in proximity to the helicopter due to atmospheric sound emissions.	• Potential residual effects from offshore petroleum production drilling projects are similar to those potentially associated with the Project. Unlike the Project, however, production facilities and their associated effects are confined to a fixed location and are relatively longer-term in nature. • Interactions with the VC are anticipated to be confined to within approximately 5 km of the source for lighting attraction effects (Poot et al. 2008). Operational discharges and effects of vessel and aircraft traffic are more localized (Rojek et al. 2007 and Hoang 2013). • The majority of strandings reported by offshore petroleum operators occur in September and October, corresponding with the departure of Leach's storm-petrel fledglings from the breeding colonies, and with fall landbird migration (Davis et al. 2015). Inclement weather conditions (fog, drizzle) are also associated with greater numbers of strandings. **Production from Hibernia Oilfield** • The 2014 EEM water sampling program confirmed the levels of many analytes are elevated in surface samples collected nearest to the discharge point. However, this effect was found to be very localized (<50 m) with fast decreasing contaminant concentrations away from the point of discharge (HMDC 2017). **Production from Terra Nova Oilfield** • Analyses of water samples collected during the 2014 EEM program indicated that seawater physical and chemical characteristics at EEM study area stations and reference area stations, located approximately 20 km southeast and southwest of the Terra Nova site, were similar (Suncor 2017). **Production from White Rose Oilfield** • The results of the 2014 EEM program did not provide evidence of project effects on water quality (Husky 2017). **Production from Hebron Oilfield** • Discharges from production facilities and PSVs (e.g., produced water, grey and black water, ballast water, bilge water, and deck drainage deck drainage) are discharged in accordance with the OWTG and MARPOL.
Offshore Petroleum Exploration – Geophysical Survey Programs	• Change in risk or mortality or physical injury • Change in habitat quality and use	• Discharges from survey and support vessels will be made in accordance with MARPOL and are therefore unlikely to cause a change in risk of mortality or physical injury for marine and migratory birds. Discharges may temporarily degrade water quality within a localized area around survey and support vessels, thereby potentially causing temporary behavioural effects (e.g., avoidance / displacement or attraction) for marine and migratory birds within the immediate area. • Although relatively little is known about the potential effects of seismic sound on marine and migratory birds, and the limited information that is available has not provided strong evidence of adverse effects (Amec 2014), it is assumed for the purposes of the CEA that seismic sound from air source arrays will affect the quality of the underwater acoustic environment in such a way that has potential to disturb marine and migratory birds and cause temporary behavioural and/or physiological effects to individuals diving in proximity to the sound source (Amec 2014). • Based on current scientific knowledge regarding the effects of underwater sound on birds (Stemp 1985, Turnpenny and Nedwell 1994, Lacroix et al. 2003), diving marine and migratory birds appear to be less sensitive to underwater sound emissions than fish, marine mammals, or sea turtles. Marine and migratory birds are therefore assumed to be less susceptible to a potential change in risk of mortality or physical injury from underwater sound than fish or marine mammals and sea turtles.	• Although the relatively large survey areas covered by some types of offshore geophysical surveys and the known propagation of underwater sound in the marine environment can increase the potential for spatial interactions between their effects and those of other projects and activities in the RAA, most survey activities operate for a short period of time in any one location, thus resulting in a transient and relatively short-term disturbance within localized portions of the survey area.

Physical Activity	Potential Residual Environmental Effect(s)	Explanation of Potential Residual Environmental Effect(s)	VC-specific Spatial and Temporal Considerations (Refer to Table 14.1 for General Consideration of Potential for Spatial and Temporal Overlap)
Offshore Petroleum Exploration – Exploration and Delineation Drilling Programs	• Change in risk or mortality or physical injury • Change in habitat quality and use	• The presence and operation of MODUs is predicted to result in a change in habitat quality and use for marine and migratory birds due to the generation of drilling sound (atmospheric and underwater), lights, and flares. • Atmospheric and underwater sound from MODUs may result in sensory disturbance of marine and migratory birds locally, potentially leading to behavioural responses such as temporary habitat avoidance or changes in activity state. • Change in risk of mortality or physical injury may occur due to attraction of marine and migratory birds to MODUs. • The discharge of mud and cuttings will be in accordance with the OWTG and OCSG. However, discharges of mud and cuttings will result in localized increases in TSS in the water column, temporarily affecting water quality in a localized area around exploration drilling activities, potentially resulting in species avoidance. • The routine discharge of other wastes and emissions could possibly result in a change in habitat quality and use and a change in risk of mortality or physical injury for marine and migratory birds. Discharges from MODUs will be in accordance with OWTG and MARPOL requirements. • Discharges of sanitary and domestic waste may attract marine and migratory birds and/or prey to MODUs, but non-hazardous waste will be macerated to maximum particle size (6 mm) and treated on board prior to disposal, in accordance with the OWTG. • Gray water discharge may attract gulls and other species to the vicinity of MODUs, which may slightly increase the Risk of Mortality or Physical Injury of marine and migratory bird species, particularly if they interact with a flare or become stranded on MODUs. • Although marine and migratory birds diving in close proximity to high levels of underwater sound have potential to be injured, VSP operations are not anticipated to have a measurable adverse effect on marine and migratory bird mortality risk, given the short duration marine and migratory birds spend underwater during foraging dives, and the short temporal scale of VSP operations. • Based on current scientific knowledge regarding the effects of underwater sound on birds (Stemp 1985, Turnpenny and Nedwell 1994, Lacroix et al. 2003), diving marine and migratory birds appear to be less sensitive to underwater sound emissions than fish, marine mammals, or sea turtles. Marine and migratory birds are therefore assumed to be less susceptible to a potential change in risk of mortality or physical injury from underwater sound than fish or marine mammals and sea turtles. • VSP operations could potentially result in a change in habitat quality and use for marine and migratory birds. This change would be short-term (VSP typically takes approximately one day to a few days per well), localized in close proximity to the sound source, and reversible, with no predicted lasting effects once VSP surveys are complete. • Helicopter traffic may cause a localized change in habitat quality and use and a change in risk of mortality or physical injury for marine and migratory birds, due to potential bird strikes, and atmospheric sound emissions. • PSV activities could potentially result in a change in habitat quality and use with regard to marine and migratory birds, as the presence of an approaching PSV may alert birds and flush some species from the area. However, PSVs will not come in close proximity to any critical habitat for marine and migratory birds (e.g., piping plover or roseate tern) or IBAs. • In addition, increased artificial lighting during transiting and operations of the PSVs may present a mortality risk to marine and migratory birds.	• Residual effects from other exploration drilling programs are generally anticipated to be similar in nature and extent (including similar spatial and temporal scales) to predicted Project-related residual environmental effects on marine and migratory birds (refer to Chapter 9). • Exploration drilling activities are typically relatively short-term and localized. This can reduce the potential for individuals and populations to be affected simultaneously and repeatedly by multiple physical activities. • Interactions with the VC are anticipated to be confined to within approximately 5 km of the source for lighting attraction effects (Poot et al. 2008). Operational discharges and effects of vessel and aircraft traffic are more localized (Rojek et al. 2007 and Hoang 2013). • The majority of strandings reported by offshore petroleum operators occur in September and October, corresponding with the departure of Leach's storm-petrel fledglings from the breeding colonies, and with fall landbird migration (Davis et al. 2015). Inclement weather conditions (fog, drizzle) are also associated with greater numbers of strandings.
Commercial Fishing Activity	• Change in risk or mortality or physical injury • Change in habitat quality and use	• Marine and migratory birds, particularly seabirds, can become entangled in fishing gear (e.g., gillnets, longlines, and bottom trawls) as accidental bycatch, thereby resulting in a change in risk of mortality or physical injury. Murres and shearwaters are the most commonly captured in Newfoundland and Labrador (Ellis et al. 2013). • Atmospheric or underwater sound associated with fisheries vessels has potential to cause a localized change in habitat quality and use that could result in sensory disturbance of marine and migratory birds. Any vessels that employ artificial night lighting may also attract and/or disorient nocturnally migrating birds and cause an associated change in risk of mortality or physical injury. • Discharges from fishing vessels (e.g., grey and black water, ballast water, bilge water, and deck drainage) will be discharged in accordance with MARPOL and are therefore unlikely to cause a change in risk of mortality or physical injury for marine and migratory birds. However, discharges may cause a change in habitat quality and use for marine and migratory birds within a localized area around fishing vessels. Bait and offal from fishing vessels cause change in food availability for marine and migratory birds, and this in turn may result in localized changes in presence and abundance of avifauna.	• The presence of mobile bottom-contact fishing gear is relatively more transient in nature than the presence of fixed fishing gear. Mobile fishing gear typically also occupies less space near the surface of the water, where marine and migratory birds may be present, and is therefore relatively less likely to result in accidental bycatch of marine and migratory birds. The residual environmental effects of mobile gear fishing activity on marine and migratory birds is therefore generally shorter term and more localized than the potential residual effects on marine and migratory birds associated with the use of fixed fishing gear. • The potential residual change in habitat quality and use associated with sensory disturbance and emissions / discharges from fishing vessels is expected to be short-term and transient at any given location, as is the potential residual change in risk of mortality or physical injury associated with artificial night-lighting.

Physical Activity	Potential Residual Environmental Effect(s)	Explanation of Potential Residual Environmental Effect(s)	VC-specific Spatial and Temporal Considerations (Refer to Table 14.1 for General Consideration of Potential for Spatial and Temporal Overlap)
Hunting Activity	• Change in risk of mortality or physical injury	• Hunting of some types of marine and migratory birds (i.e., murres and waterfowl) results in a change in risk of mortality or physical injury for the targeted species. • Potential effects associated with the presence and transiting of hunting vessels, including associated emissions and discharges, are equivalent to the potential effects associated with the vessels of other ocean users in the RAA and are therefore not considered separately in the CEA.	• Although hunting is restricted to nearshore areas outside the Project Area, some birds are highly mobile and individuals that occur in the Project Area may also be at risk of mortality due to hunting.
Other Ocean Uses	• Change in risk or mortality or physical injury • Change in habitat quality and use	• Atmospheric and/or underwater sound associated with other ocean users' vessels have potential to cause a localized change in habitat quality and use that could result in sensory disturbance of marine and migratory birds. Vessels that employ artificial night lighting may also attract and/or disorient nocturnally migrating birds and cause an associated change in risk of mortality or physical injury. • Helicopter traffic may also cause a change in risk of mortality or physical injury for marine and migratory birds, due to potential bird strikes, as well as a change in habitat quality and use for marine and migratory birds due to atmospheric sound emissions. • Discharges from the vessels of other ocean users (e.g., grey and black water, ballast water, bilge water, and deck drainage) will be discharged in accordance with MARPOL and are therefore unlikely to cause a change in risk of mortality or physical injury for marine and migratory birds. • Discharges may cause a change in habitat quality and use for marine and migratory birds within a localized area around the vessels of other ocean users.	• The highly transitory nature of the vessels of other ocean users reduces potential residual effects on marine and migratory birds in any particular location and at any particular time. • The potential residual change in habitat quality and use associated with sensory disturbance and emissions / discharges from the vessels of other ocean users is expected to be short-term and transient at any given location, as is the potential residual change in risk of mortality or physical injury associated with artificial night-lighting and high underwater sound levels.

Although rare, it is possible for helicopter traffic from the Project, offshore geophysical survey programs, other offshore petroleum exploration and production projects, and other ocean users (where applicable) to strike flying birds. Thus, the Project may contribute to a cumulative change in risk of mortality or physical injury due to potential collisions with marine and migratory birds. Cougar Helicopters logs 4,000 to 5,000 flying hours annually providing helicopter services to all offshore installations in the Jeanne d'Arc Basin and conducted 1,012 flights in and around the RAA in 2008 alone, reported a total of five bird strikes during the period from 2005 to 2011 (SMS 2012). In general, the residual environmental effects of helicopter traffic from the Project will be so spatially and temporally limited (i.e., localized to the helicopter, which will be almost continuously moving, and transient) that potential cumulative interactions with the residual environmental effects of other helicopter / aircraft traffic in the RAA will be minimal and are not expected to result in a substantial change in risk of mortality or physical injury or change in habitat quality and use for marine and migratory birds. Helicopter activities in support of the Project will only account for a small, incremental increase in overall helicopter / aircraft traffic within the RAA.

Artificial night lighting associated with the Project will contribute to the total amount of night lighting from various sources in the RAA, including lighting on the PSVs and MODUs / platforms for other offshore petroleum exploration and production projects, fishing vessels, and the vessels of other ocean users (where applicable). Each of these sources of artificial night lighting can attract and/or disorient marine and migratory birds, thereby resulting in a cumulative change in risk of mortality or physical injury due to potential stranding and increased opportunities for predation, collisions, exposure to vessel-based threats, and emissions. Limited flaring by the MODU during testing (if conducted) may similarly attract marine and migratory birds and result in increased mortality due to the lighting-related hazards identified above as well as the risk of incineration. Project-related flaring (if conducted) will contribute to the bird mortality risk already associated with gas flaring from offshore petroleum exploration and production drilling projects in the RAA.

Routine checks for stranded birds on the MODU and PSVs and appropriate procedures for release (i.e., the protocol outlined in ECCC's *Best Practices for Stranded Birds Encountered Offshore Atlantic Canada* [ECCC 2016]) will be implemented to mitigate the environmental effects of Project-related artificial night lighting and flaring on birds. Lighting on Project infrastructure will be reduced, to the extent possible without compromising worker safety. Flaring will only be undertaken during the Project as necessary to characterize the well potential and maintain safe operations and will be carried out in accordance with C-NLOPB *Drilling and Production Guidelines*. Project lighting and flaring will represent only a small increase over existing levels of lighting and flaring in the RAA, will be temporary and localized, and will occur at sufficient distance from other light sources (i.e., at least 500 m from fishing vessels and the vessels of other ocean users) and flaring sources (i.e., at least approximately 110 km from other offshore petroleum exploration and production drilling projects). Residual lighting and flaring effects of the Project are therefore not anticipated to contribute to those of other physical activities within the RAA in such a way that causes a substantive cumulative increase in mortality or injury affecting marine and migratory birds.

Hunting pressure on birds that frequent the Project Area also has potential to contribute to a cumulative change in risk of mortality or physical injury for marine and migratory birds, particularly in the case of murres, which are the only marine and migratory bird that can be legally hunted from a power boat (ECCC 2017). Waterfowl are more commonly found in coastal habitats and less likely to interact with the Project. The number of murres harvested has shown a significant overall decrease over time since bag limits and

geographic and seasonal hunting restrictions were first implemented by the Canadian Wildlife Service in the winter of 1993-1994 (Chardine et al. 1999, in Wiese and Ryan 2003). All murre hunters must purchase and be in possession of a Migratory Game Bird Hunting Permit and a Habitat Conservation Stamp, and the murre hunt is only open to residents of Newfoundland and Labrador (ECCC 2017). These resource management measures help to mitigate potential residual adverse effects on murres, thus also mitigating potential cumulative effects. The potential cumulative change in risk of mortality or physical injury is further reduced because murres are not nocturnally migrating and are therefore unlikely to be attracted to artificial night-lighting or flares from the Project or other physical activities in the RAA.

14.3.4.2 Cumulative Change in Habitat Quality and Use

For marine and migratory birds whose ranges cover a large extent of the RAA, individuals may be exposed to various sources of liquid emissions and atmospheric sound (i.e., geophysical survey programs, other offshore petroleum exploration and production drilling projects, fisheries, and other ocean users) throughout their life cycle, thereby potentially resulting in a cumulative change in habitat quality and use, when combined with discharges and atmospheric sound generated by the Project. Section 14.2.4 discusses potential cumulative interactions between marine discharges and marine fish and fish habitat that are anticipated to also be applicable for marine and migratory birds.

Atmospheric sound emissions generated from other physical activities in the RAA may locally displace marine and migratory birds for short durations. The cumulative environmental effects of the Project in combination with other physical activities will therefore include a temporary reduction in the amount of marine and migratory bird habitat available within the RAA (i.e., due to temporary avoidance of multiple areas at once). This cumulative change in habitat quality and use has potential to disrupt foraging and/or migratory behaviour; however, effects of in-air sound would be localized and temporary. Such a potential cumulative effect is considered unlikely given the lack of spatial overlap between the Project Area or LAA and designated special areas known to be of particular importance for foraging and/or migration of birds. The presence of Project and non-Project vessels in a particular area is generally anticipated to be short-term and transient in nature, thus limiting associated atmospheric sound effects at any given location.

Atmospheric sound emissions produced during operation of the Project MODU and from other offshore petroleum exploration and production facilities in the RAA will be generated from a stationary source (for approximately 60 to 120 days for offshore exploration drilling projects, and for up to several years for offshore production projects). Sound emissions may cause behavioural responses such as temporary habitat avoidance or changes in activity state (e.g., feeding, resting, or travelling). However, the areas to be affected by the Project represents a very small portion of the total amount of bird habitat available in the RAA and are not known to contain any uniquely important habitat for marine and migratory birds.

Helicopters transiting to and from the MODU will fly at altitudes greater than 300 m and at a lateral distance of 2 km over active colonies when possible, thereby reducing disturbance to marine and migratory birds. In general, the residual environmental effects of helicopter traffic from the Project will be so spatially and temporally limited that potential cumulative interactions with the residual environmental effects of other helicopter traffic in the RAA will be minimal and are not expected to result in a substantial change in habitat quality and use for marine and migratory birds.

In consideration of the above, cumulative atmospheric sound effects are considered unlikely to substantially disrupt the use of important habitat areas by marine and migratory birds. The localized areas potentially affected by the Project and other third party physical activities in such a way that causes a cumulative change in habitat quality and use for marine and migratory birds will represent a relatively small proportion of the total amount of habitat available within the RAA.

14.3.5 Species at Risk

As described in the existing environment description for marine and migratory birds (Section 6.2.4), nine marine and migratory bird SAR (i.e., harlequin duck, Barrow's goldeneye, piping plover, red knot, buff-breasted sandpiper, red-necked phalarope, ivory gull, Ross's gull, and peregrine falcon) have potential to occur in the Project Area and/or RAA. Details regarding the marine and migratory bird SAR that may occur in the Project Area and/or RAA, including general life history information, are provided in Section 6.2.4.

The main potential cumulative environmental interactions between the Project, other physical activities in the RAA, and marine and migratory bird SAR are the same as for the secure species that comprise the Marine and Migratory Birds VC.

The Project is not anticipated to result in residual adverse effects on marine and migratory bird SAR, and therefore, to contribute to cumulative effects on these species. There is no designated critical habitat for marine and migratory bird SAR within the Project Area or RAA, and ivory gull and red-necked phalarope are the only avian SAR that have the potential to be found in the Project Area on a regular basis. The ivory gull is generally associated with pack ice, and as such, it is more likely to occur in northern portions of the Project Area. The only special area in the RAA that is known to be important to ivory gulls is the Labrador Marginal Trough EBSA, which is located approximately 271 km outside of the Project Area. During fall migration, there is some potential for peregrine falcon and nocturnally migrating landbird SAR to pass through, but the risk of interactions with the Project and other physical activities in the RAA is considered low.

14.3.6 Cumulative Effects Summary and Evaluation

Cumulative environmental effects on marine and migratory birds are predicted to be adverse, low to moderate in magnitude, occurring within the LAA, sporadic (VSP operations) to continuous (artificial night-lighting) in frequency, medium-term in duration, and reversible. With the application of proposed Project-related mitigation and environmental protection measures, the residual cumulative environmental effects on marine and migratory birds (including SAR) are predicted to be not significant. Therefore, no additional mitigation measures beyond those in place to mitigate the Project's direct effects are needed to address potential cumulative effects.

Table 14.8 summarizes the results of the CEA for this VC.

Table 14.8 Marine and Migratory Birds: Summary of Potential Cumulative Environmental Effects

Summary of Potential Cumulative Environmental Effects	
Context for Cumulative Environmental Effects	• The existing biological environment for marine and migratory birds is described in Section 6.2. • Several major seabird colonies are found along the Newfoundland coastline, and species that do not breed in the area are drawn to the productive Grand Banks and adjacent areas for foraging throughout the year. The RAA also contains various designated special areas of importance to marine and migratory birds (e.g., marine and migratory bird sanctuaries, EBSAs, provincial ecological reserves, and IBAs). • Existing marine and migratory bird distribution, abundance, and health for secure species and SAR has been and is being affected by natural phenomena as well as human activities and their associated disturbances, including hunting, fisheries bycatch, and chronic oil pollution from shipping. • The populations of most marine-associated bird species occurring off Eastern Newfoundland are generally considered stable overall, although the Leach's storm-petrel population has declined in recent years.
Residual Environmental Effects of the Project	• The Project physical activity with the greatest potential for environmental effects on marine and migratory birds is artificial lighting associated with presence and operation of a MODU resulting in nocturnal attraction and stranding of Leach's storm-petrels on the MODU and PSVs. • The Project may result in a residual adverse change in risk of mortality or physical injury and a residual adverse change in habitat quality and use for marine and migratory birds, including secure species and SAR. These residual effects are predicted to be not significant and the Project is not expected to result in residual population-level effects on marine and migratory birds. • This significance determination has generally been made with a moderate to high level of confidence based on a good understanding of the available information on exploration drilling and VSP operation on marine and migratory birds, the effectiveness of mitigation measures discussed in Section 9.3, and knowledge of the existing environment within the Project Area, LAA, and RAA. The assessment does acknowledge there is limited information related to the effects of underwater sound on diving marine birds.
Other Projects / Activities	**Potential for Interaction with Effects of Project:**
Offshore Petroleum Production Projects (Production from Hibernia, Terra Nova, White Rose, and Hebron Oilfields)	Y – Offshore petroleum production operations are located at substantial distances outside of the Project Area and LAA, with highly localized environmental effects. For species whose ranges cover a large extent of the RAA, individuals may be sequentially exposed to the residual effects of the Project and the residual effects of one or more offshore petroleum production projects throughout their life cycle. For individuals that do not encounter residual effects from both the Project and offshore petroleum production projects, the residual effects of the Project will nonetheless overlap spatially and temporally with the residual effects of these other physical activities in such a way (refer to Table 14.1) that contributes to cumulative effects on marine and migratory birds in general within the RAA.

Summary of Potential Cumulative Environmental Effects	
Offshore Petroleum Exploration – Geophysical Survey Programs	Y – Some potential for interaction, although localized and short-term nature of these activities and their effects, along with planned and required separation measures and other mitigation measures, will reduce potential for interaction. For species whose ranges cover a large extent of the RAA, individuals may be sequentially exposed to the residual effects of the Project and the residual effects of geophysical survey programs throughout their life cycle. For species with very limited ranges in areas that are subject to residual effects from the Project and geophysical survey programs at once, individuals may be exposed to the residual effects of the Project and the residual effects of geophysical survey programs activities simultaneously.
Offshore Petroleum Exploration – Exploration and Delineation Drilling Programs	Y – Some potential for interaction, although localized and short-term nature of these activities and their effects, along with planned and required separation measures and other mitigation measures, will reduce potential for interaction. For species whose ranges cover a large extent of the RAA, individuals may be sequentially exposed to the residual effects of the Project and the residual effects of other exploration drilling projects throughout their life cycle. For species with very limited ranges in areas that are subject to residual effects from the Project and other exploration drilling projects at once, individuals may be exposed to the residual effects of the Project and the residual effects of other exploration drilling activities simultaneously.
Commercial Fishing Activity	Y – Some potential for interaction, although these activities are restricted within portions of the Project Area and occur mostly outside of the ELs. Safety zones around the MODU will limit the potential for overlapping and concurrent environmental effects. For species whose ranges cover a large extent of the RAA, individuals may be sequentially exposed to the residual effects of the Project and the residual effects of commercial fishing activity throughout their life cycle. For species with very limited ranges in areas that are subject to residual effects from the Project and commercial fishing activity at once, individuals may be exposed to the residual effects of the Project and the residual effects of commercial fishing activity simultaneously.
Hunting Activity	Y – Hunting pressure could potentially result in cumulative changes in mortality / injury to murres and, to a lesser extent, waterfowl. Hunting is restricted to nearshore areas located at substantial distances outside of the Project Area and LAA, with highly localized environmental effects. For species whose ranges cover a large extent of the RAA, individuals may be sequentially exposed to the residual effects of the Project and the residual effects of hunting activity throughout their life cycle. For individuals that do not encounter residual effects from both the Project and hunting activity, the residual effects of the Project will nonetheless overlap spatially and temporally with the residual effects of this other physical activity in such a way (refer to Table 14.1) that contributes to cumulative effects on marine and migratory birds in general within the RAA.
Other Ocean Uses	Y – Some potential for interaction, although these activities and their effects are highly localized and transient. Safety zones around Project activities measures will limit the potential for overlapping and concurrent environmental effects. For species whose ranges cover a large extent of the RAA, individuals may be sequentially exposed to the residual effects of the Project and the residual effects of the activities of other ocean users throughout their life cycle. For species with very limited ranges in areas that are subject to residual effects from the Project and the activities of other ocean users at once, individuals may be exposed to the residual effects of the Project and the residual effects of the activities of other ocean users simultaneously.
Cumulative Effects Summary	The residual cumulative environmental effects on marine and migratory birds that have potential to occur as a result of the residual effects of the Project on the VC in combination with the residual effects of other projects or activities on the VC are predicted to be not significant.

14.4 Marine Mammals and Sea Turtles

14.4.1 Context for Cumulative Environmental Effects

The Marine Mammals and Sea Turtles VC, as described in Chapter 10, includes baleen whales, large toothed whales, dolphins, porpoises, seals, and sea turtles. This VC also considers marine mammals and sea turtles listed under Schedule 1 of SARA and considered at risk by COSEWIC.

Although the RAA contains multiple EBSAs that represent important foraging habitat and migratory routes for marine mammals and sea turtles, the Project Area does not overlap with any designated special areas that are known to be of particular importance to marine mammals or sea turtles. However, potential vessel transit routes intersect additional special area, the Northeast Shelf and Slope EBSA, which is known to support aggregations of cetaceans and pinnipeds (refer to Section 6.4.1). No critical habitat for marine mammals or sea turtles has been designated in the Project Area or RAA.

The potential environmental effects of human activities on marine mammals and sea turtles include possible hearing impairment or permanent injury or mortality from exposure to high levels of underwater sound, as well as behavioural effects (avoidance) from exposure to lower levels of underwater sound or other sources of sensory disturbance (e.g., discharges), which may alter the presence, abundance and overall distribution of these species and their health, movements, communications, feeding and other activities. Marine mammals and sea turtles may also be affected by other marine environmental discharges and disturbances, including through physical exposure, ingestion, effects on prey and habitats, and other changes.

Various ocean users have been, and continue to be, active throughout the RAA, including commercial fisheries, shipping and general marine traffic, scientific research, military activities, and offshore petroleum exploration and production activities (including geophysical surveys) (refer to Chapter 7). The activities of these other offshore users generate varying levels and frequencies of underwater sound emissions (refer to Table 14.4 in Section 14.1.3). Thus, portions of the region's underwater environment have elevated sound levels at particular times, relative to naturally occurring oceanographic sounds. Naturally occurring oceanographic sound levels also vary spatially and temporally based on differences in abiotic and biotic conditions, including sea state (wind and waves), as indicated in Table 14.4. As described in Section 14.2.1, the underwater sound comparative assessment completed for the Project (Matthews et al. 2018; Appendix C) identified four key sources of underwater sound that dominate the soundscape and are expected to be present in the foreseeable future in the Project Area: fin whales; shipping and oil and gas extraction facilities; seismic surveys; and ambient noise.

In addition to interactions with underwater sound, marine mammals and sea turtles may also be affected by other human activities in the RAA, including potential interactions with vessel traffic (e.g., operational discharges and collisions) and commercial, Indigenous, and recreational fishing activity (e.g., collisions with fishing vessels and entrapment or entanglement in fishing gear).

The widespread and migratory nature of marine mammals and sea turtles and their overall sensitivity to certain types of disturbance increases the potential for individuals and populations to be affected by multiple environmental disturbances, and thus, for cumulative effects to occur. This is reflected in the fact that many

species of marine mammals and sea turtles that may be found offshore Eastern Newfoundland have been designated as species at risk or are otherwise of conservation concern.

The effects of previous activities and natural environmental influences are reflected in the existing baseline environmental conditions for the Marine Mammals and Sea Turtles VC, as described in Section 6.3. This includes considering the current condition (e.g., health or quality) of potentially affected marine mammal and sea turtle populations and their habitats, as well as their potential resiliency or sensitivity to further environmental change resulting from the Project in combination with other ongoing and future projects and activities that may affect the same VC. Specific information on physical characteristics of marine mammal and sea turtle habitat (e.g., marine geology, and geomorphology, sediment and marine water quality) are described in Chapter 5.

14.4.2 Potential Project-related Contributions to Cumulative Effects

As described in Chapter 10, routine Project activities and components have potential to interact with marine mammals and sea turtles primarily due to underwater sound associated with the presence and operation of the MODU, VSP survey, PSV operations, and to a lesser extent, helicopter overflights. These potential disturbance sources, as well as operational discharges, could result in direct and indirect (e.g., changes to habitat quality) effects on marine mammals and sea turtles. There is also risk of morality or physical injury as a result of collisions with PSVs. The Project could also result in changes in the availability, distribution, or quality of prey (refer to Section 8 for an assessment of effects on prey species).

The Project-specific environmental effects assessment for this VC includes a summary of Project residual environmental effects in Section 10.3.5 and a determination of significance in Section 10.4. With the implementation of mitigation (refer to Section 10.3.2), the residual environmental effects of routine Project activities on marine mammals and sea turtles are predicted to be not significant.

14.4.3 Other Projects and Activities and their Effects

Table 14.9 summarizes how past, present, and future projects and activities in the RAA have potential to cause a residual change in risk of mortality or physical injury and a residual change in habitat quality and use affecting marine mammals and sea turtles.

Table 14.9 Marine Mammals and Sea Turtles: Residual Effects from Other Projects and Activities in the RAA

Physical Activity	Potential Residual Environmental Effect(s)	Explanation of Potential Residual Environmental Effect(s)	VC-specific Spatial and Temporal Considerations (Refer to Table 14.1 for General Consideration of Potential for Spatial and Temporal Overlap)
Offshore Petroleum Production Projects (Production from Hibernia, Terra Nova, White Rose, and Hebron Oilfields)	• Change in risk or mortality or physical injury • Change in habitat quality and use	• ESRF data (reported in Matthews et al. 2018; Appendix C) indicate that offshore oil and gas drilling facilities and marine vessels (including PSVs) are two key identifiable anthropogenic sources of underwater ambient sound that dominate the soundscape and are expected to be present in the foreseeable future (refer to Section 5.3.10.3). • Active drilling is occurring at Hibernia, White Rose, and Hebron, and Terra Nova may resume oil production at any time. Given that the offshore petroleum production facilities for these projects do not use DP, the underwater sound levels generated by their drilling activities are generally assumed to be slightly lower than those generated by Project-related drilling activities. These levels nonetheless have potential to cause a change in habitat quality and use for marine mammals and sea turtles. • Underwater sounds associated with PSV traffic could result in a change in habitat quality and use affecting marine mammals and sea turtles as the sound generated by PSVs could potentially cause changes in swimming, foraging, or vocal behaviours. The transiting of PSVs may cause a change in risk of mortality or physical injury for marine mammals and sea turtles due to potential vessel strikes. • Underwater sound levels from VSP activities are expected to result in a change in habitat quality and use and a change in risk of mortality or physical injury for marine mammals and sea turtles. These effects would be short-term (VSP typically takes approximately one day to a few days per well), localized in close proximity to the sound source, and reversible, with no predicted lasting effects once VSP surveys are complete. • Discharges from the production facilities and PSVs (e.g., produced water, grey and black water, ballast water, bilge water, and deck drainage deck drainage) are discharged in accordance with the OWTG and MARPOL and are therefore unlikely to cause a change in risk of mortality or physical injury for marine species. • Operational discharges may cause a change in habitat quality and use for marine mammals and sea turtles within a localized area around PSVs and production facilities. • There is potential for helicopter traffic to elicit diving behaviour in marine mammals in response to physical presence or sound, although these behaviours would be temporary.	• Potential residual effects from offshore petroleum production projects are similar to those potentially associated with the Project. Unlike the Project, however, production facilities and their associated effects are focused on a smaller area than EL areas for exploration and are relatively longer-term in nature. **Production from Hibernia Oilfield** • The 2014 EEM water sampling program confirmed the levels of many analytes are elevated in surface samples collected nearest to the discharge point. However, this effect was found to be very localized (<50 m) with fast decreasing contaminant concentrations away from the point of discharge (HMDC 2017). **Production from Terra Nova Oilfield** • Analyses of water samples collected during the 2014 EEM program indicated that seawater physical and chemical characteristics at EEM study area stations and reference area stations, located approximately 20 km southeast and southwest of the Terra Nova site, were similar (Suncor 2017). **Production from White Rose Oilfield** • The results of the 2014 EEM program did not provide evidence of project effects on water quality (Husky 2017). **Production from Hebron Oilfield** • Discharges from production facilities and PSVs (e.g., produced water, grey and black water, ballast water, bilge water, and deck drainage deck drainage) are discharged in accordance with the OWTG and MARPOL.
Offshore Petroleum Exploration – Geophysical Survey Programs	• Change in risk or mortality or physical injury • Change in habitat quality and use	• Discharges from survey and support vessels will be made in accordance with MARPOL and are therefore unlikely to cause a change in risk of mortality or physical injury for marine mammals and sea turtles. Discharges may temporarily degrade water quality within a localized area around survey and support vessels, thereby potentially causing temporary behavioural effects (e.g., avoidance / displacement or attraction) for marine mammals and sea turtles within the immediate area. • Vessel-related sound will affect the quality of the underwater acoustic environment with potential to disturb marine mammals and sea turtles and cause temporary behavioural effects (e.g., localized avoidance / displacement or attraction; and interference with vocal communications and/or masking of other biologically important sounds) (Amec 2014). • The transit of survey and support vessels has potential to cause injury or mortality of marine mammals and sea turtles because of vessel strikes. • ESRF data (reported in Matthews et al. 2018; Appendix C) indicate that seismic surveys are a dominant anthropogenic source of underwater sound that affect the soundscape and is expected to be present in the foreseeable future (refer to Section 5.3.10.3). Air source array operations during seismic surveys increase sound levels in the underwater acoustic environment in such a way that has potential to disturb marine mammals and sea turtles and cause temporary behavioural effects (e.g., localized avoidance / displacement, attraction, or other changes in distribution or activities; and changes in vocalizations, respiration, swim speed, diving, and foraging behaviour) and/or physiological effects (e.g., stress immune depression, hearing deterioration [i.e., TTS or PTS] at close range (Amec 2014).	• Although the relatively large survey areas covered by some types of offshore geophysical surveys and the known propagation of sound in the marine environment can increase the potential for spatial interactions between their effects and those of other projects and activities in the RAA, most survey activities operate for a short period of time in any one location, thus resulting in a transient and relatively short-term disturbance within localized portions of the survey area.

Physical Activity	Potential Residual Environmental Effect(s)	Explanation of Potential Residual Environmental Effect(s)	VC-specific Spatial and Temporal Considerations (Refer to Table 14.1 for General Consideration of Potential for Spatial and Temporal Overlap)
Offshore Petroleum Exploration – Exploration and Delineation Drilling Programs	• Change in risk or mortality or physical injury • Change in habitat quality and use	• ESRF data (reported in Matthews et al. 2018; Appendix C) indicate that offshore oil and gas drilling facilities and marine vessels (including PSVs) are key identifiable anthropogenic sources of underwater ambient sound that have affected the soundscape and are expected to be present in the foreseeable future (refer to Section 5.3.10.3). • Underwater sound levels generated by MODUs have potential to result in a change in habitat quality and use for marine mammals and sea turtles through behavioural responses, including localized avoidance and displacement, and potential changes in swimming, foraging, or vocal behaviours. • Underwater sounds associated with PSV traffic could result in a change in habitat quality and use affecting marine mammals and sea turtles as the sound generated by PSVs could potentially cause changes in swimming, foraging, or vocal behaviours. The transiting of PSVs may cause a change in risk of mortality or physical injury for marine mammals and sea turtles due to potential vessel strikes. • The selection of drilling chemicals will be in accordance with the OCSG and discharge of drilling wastes (e.g., mud and cuttings) will be in accordance with the OWTG. However, discharges of mud and cuttings will result in localized increases in TSS in the water column, temporarily affecting water quality in a localized area around exploration drilling activities, potentially resulting in species avoidance. • Other routine discharges will also be in accordance with OWTG and MARPOL requirements and will be non-bio-accumulating and non-toxic, resulting in localized and temporary effects in water quality and an associated potential change in habitat quality and use for marine mammals and sea turtles. • Underwater sound levels from VSP activities are expected to result in a change in habitat quality and use and a change in risk of mortality or physical injury for marine mammals and sea turtles. These effects would be short-term (VSP typically takes approximately one day to a few days per well), localized in close proximity to the sound source, and reversible, with no predicted lasting effects once VSP surveys are complete. • Helicopter traffic may cause a change in habitat quality and use for marine mammals and sea turtles as it may elicit diving behaviour as a response mechanism to the physical presence or atmospheric and underwater sound created by helicopter traffic. However, these behaviours are predicted to be temporary in nature as any effects from the presence of helicopters will be brief in both space and time.	• Residual effects from other exploration drilling programs are generally anticipated to be similar in nature and extent (including similar spatial and temporal scales) to predicted Project-related residual environmental effects on marine mammals and sea turtles (refer to Chapter 10). • Exploration drilling activities are typically relatively short-term and localized. This can reduce the potential for individuals and populations to be affected simultaneously and repeatedly by multiple physical activities.
Commercial Fishing Activity	• Change in risk or mortality or physical injury • Change in habitat quality and use	• Entanglement in fishing gear (especially fixed fishing gear) is one of the primary threats for marine mammals in Atlantic Canada waters, including SAR, resulting in a change in risk of mortality or physical injury. • Fishing vessels may cause a localized change in habitat quality and use for marine mammals and sea turtles through the generation of underwater sound from engines and propellers during transiting, which may potentially cause changes in swimming, foraging, or vocal behaviours. • Although underwater sound levels produced during the transiting of fishing vessels are below the thresholds for physical injury to marine species, sound due to other third party physical activities that may be carried out by fishing vessels (e.g., depth sounding, bottom profiling, and side scan sonar) may cause injury or mortality to marine mammals at close ranges. • The transiting of fishing vessels may cause a change in risk of mortality or physical injury for marine mammals and sea turtles due to potential vessel strikes. • Discharges from fishing vessels (e.g., grey and black water, ballast water, bilge water, and deck drainage) will be discharged in accordance with MARPOL and are therefore unlikely to cause a change in risk of mortality or physical injury for marine species. • Discharges may cause a change in habitat quality and use for marine mammals and sea turtles within a localized area around fishing vessels.	• The presence of mobile bottom-contact fishing gear is relatively more transient in nature than the presence of fixed fishing gear. Mobile bottom-contact fishing gear typically also occupies less space at the depths of water that marine mammals and sea turtles are most likely to occur and is therefore relatively less likely to result in accidental bycatch of marine mammals or sea turtles. The residual environmental effects of mobile bottom-contact commercial fishing activity on marine mammals and sea turtles is therefore generally shorter term and more localized than the potential residual effects on marine mammals and sea turtles associated with the use of fixed fishing gear. • The potential residual change in habitat quality and use associated with sensory disturbance and emissions / discharges from fishing vessels is expected to be short-term and transient at any given location, as is the potential residual change in risk of mortality or physical injury associated with artificial night-lighting.
Hunting Activity	• Change in risk of mortality or physical injury	• Hunting of some types of marine mammals (i.e., seals) results in a change in risk of mortality or physical injury for the targeted species. • Potential effects associated with the presence and transiting of hunting vessels, including associated emissions, discharges, and collision risk, are equivalent to the potential effects associated with the vessels of other ocean users in the RAA and are therefore not considered separately in the CEA.	• Although hunting is restricted to nearshore areas outside the Project Area, some species are highly mobile and individuals that occur in the Project Area may also be at risk of mortality due to hunting.

Physical Activity	Potential Residual Environmental Effect(s)	Explanation of Potential Residual Environmental Effect(s)	VC-specific Spatial and Temporal Considerations (Refer to Table 14.1 for General Consideration of Potential for Spatial and Temporal Overlap)
Other Ocean Uses	• Change in risk or mortality or physical injury • Change in habitat quality and use	• Other ocean users in the RAA can cause a change in risk of mortality or physical injury and a change in habitat quality and use for marine mammals and sea turtles through the generation of underwater sound, which may potentially cause changes in swimming, foraging, or vocal behaviours. • Although underwater sound levels produced by the types of vessels most commonly used by other ocean users are generally below the thresholds for physical injury to marine species, sound levels from other physical activities that may be carried out by these ocean users (e.g., naval sonar) are high enough to cause injury or mortality to marine mammals and sea turtles in certain circumstances. • The transiting of vessels by other ocean users can cause a change in risk of mortality or physical injury for marine mammals and sea turtles due to potential vessel strikes. • There is potential for helicopter traffic to elicit diving behaviour in marine mammals in response to physical presence or atmospheric and underwater sound, although these behaviours will be temporary. Helicopter traffic associated with other ocean users (where applicable) may therefore result in a temporary change in habitat quality and use for marine mammals. • Discharges from the vessels of other ocean users (e.g., grey and black water, ballast water, bilge water, and deck drainage) will be discharged in accordance with MARPOL and are therefore unlikely to cause a change in risk of mortality or physical injury for marine species. • Discharges may cause a change in habitat quality and use for marine mammals and sea turtles within a localized area around the vessels of other ocean users.	• The highly transitory nature of the vessels of other ocean users reduces potential residual effects on marine mammals and sea turtles in any particular location and at any particular time. • The potential residual change in habitat quality and use associated with sensory disturbance and emissions / discharges from the vessels of other ocean users is expected to be short-term and transient at any given location, as is the potential residual change in risk of mortality or physical injury associated with underwater sound and vessel strikes.

14.4.4 Potential Cumulative Environmental Effects

14.4.4.1 Cumulative Change in Risk of Mortality or Physical Injury

Underwater sound emissions from Project-related VSP operations will contribute to the wider area soundscape, which includes underwater sound emissions of other physical activities. Sound levels associated with the Project VSP sound source may potentially result in a cumulative change in risk of mortality or physical injury.

There will also be a cumulative change in risk of mortality or physical injury for marine mammals and sea turtles due to increased potential for strikes with vessels conducting various physical activities within the RAA (including Project activities). Marine mammals and sea turtles are also at risk of mortality due to entanglement in fishing gear. As evidenced, for example, by the 2017 North Atlantic right whale mortalities in the Gulf of St. Lawrence, potential collisions with vessels and entanglement in fishing gear pose greater mortality and injury risks for marine mammals and sea turtles than underwater sound. Project activities, offshore petroleum exploration and production drilling projects, geophysical survey programs, and the activities of fisheries and other ocean users all have potential to occur in different parts of the RAA at both the same time and different times, thereby cumulatively potentially increasing risk of mortality or physical injury.

With the exception of the discussion of cumulative environmental effects on fish eggs / larvae and benthic organisms, the analysis of cumulative environmental effects from underwater sound and operational discharges provided in Section 14.2.4 is also applicable for marine mammals and sea turtles.

The operation of the Project MODU and PSVs will represent only a small incremental increase over existing levels of marine traffic in the RAA and will therefore only cause a small increase in the cumulative change in risk of mortality or physical injury for marine mammals and sea turtles. Project PSVs will reduce the risk of collision with marine mammals and sea turtles by limiting their maximum speed to 22 km/h (12 knots), avoiding known important areas for marine mammals except as needed in the case of an emergency. In general, the presence of Project and non-Project vessels in any given area is anticipated to be short-term and transient in nature, thereby limiting opportunities for vessel strikes.

Hunting pressure on marine mammals (i.e., seals) that frequent the Project Area also has potential to contribute to a cumulative change in risk of mortality or physical injury for marine mammals and sea turtles. All non-Indigenous seal harvesters require either a commercial or personal use licence to harvest seals and must adhere to rules set out in the Marine Mammal Regulations and conditions of the licence. As explained by DFO (2016), *"*The total allowable catch (TAC) is determined every year and sets the upper limit of what can be harvested commercially. TAC decisions are based on long-term conservation and sustainability principles and take into consideration the department's management plan, the latest science advice (including changes in reproductive rates, the effects of climate change, ice conditions, etc.) and consultation with industry*"*. These resource management measures help to mitigate potential residual adverse effects on seals, thus also mitigating potential cumulative effects.

14.4.4.2 Cumulative Change in Habitat Quality and Use

Similar to the cumulative interactions discussed above for marine fish and fish habitat, potential water quality and sound effects from the Project and other third-party physical activities may temporarily reduce habitat availability within the RAA (i.e., due to the potential for temporary avoidance of multiple areas at once). Although this cumulative change in habitat quality and use has potential to disrupt reproductive, foraging and feeding, and/or migratory behaviour of marine mammals and sea turtles if the availability of important habitat areas, including designated special areas, is affected, the likelihood of this cumulative interaction is considered low given the distances over which Project and non-Project activities are taking place, as well as the localized nature of potential residual Project effects.

Helicopter presence and associated atmospheric and underwater sound emissions also have potential to elicit temporary diving responses in marine mammals; thus, Project-related helicopter traffic may potentially trigger additional diving responses in individual marine mammals already exposed to the presence and sound of helicopter traffic from offshore petroleum exploration and production projects and other ocean users (where applicable).

Underwater sound generated by various Project activities will contribute to the underwater sound produced by other physical activities in the RAA. The resultant cumulative increase in ambient underwater sound levels may adversely affect marine mammals through the masking of biologically significant sounds as well as avoidance behaviours.

Much of the analysis of cumulative environmental effects from underwater sound and operational discharges provided in Section 14.2.4 for marine fish and fish habitat is also applicable for marine mammals and sea turtles.

It is quite possible that marine mammals (and sea turtles) may exhibit changes in behaviour in response to sounds produced by a MODU (refer to Section 10.3 and Appendix C). This continuous sound could interact cumulatively with transient and intermittent sound from Project and non-Project vessels (including other exploration drilling MODUs and vessels) potentially contributing to a cumulative change in habitat quality and use.

In general, the residual environmental effects of helicopter traffic from the Project will be so spatially and temporally limited that potential cumulative interactions with the residual environmental effects of other helicopter traffic in the RAA will be minimal and are not anticipated to result in a substantial cumulative change in habitat quality and use for marine mammals.

14.4.5 Species at Risk

As described in the existing environment description for marine mammals and sea turtles (Section 6.3.7), three marine mammal SAR (i.e., blue whale, North Atlantic right whale, and northern bottlenose whale) and two sea turtle SAR (i.e., leatherback sea turtle and loggerhead sea turtle) have potential to occur in the Project Area. Details regarding these SAR, including general life history information, are provided in Section 6.3.7.

The main potential cumulative environmental interactions between the Project, other physical activities in the RAA, and marine mammal and sea turtle SAR are the same as for the secure species that comprise the Marine Mammals and Sea Turtles VC.

In general, the RAA is a productive area for marine mammals and sea turtles. There are a number of EBSAs of importance for marine mammals and sea turtles that intersect the RAA, some of which represent important foraging habitat and migratory routes for these species. However, none of the designated special areas in proximity to the Project Area are known to be of particular importance to marine mammals or sea turtles, and no critical habitat for marine mammals or sea turtles has been designated in the Project Area or RAA. The nearest special area of known importance to marine mammals or sea turtles (more specifically cetaceans and pinnipeds) is the Northeast Shelf and Slope EBSA, which is located approximately 60 km outside of the Project Area.

Marine mammal and sea turtle SAR are highly mobile, and many have broad ranges and make large movements across annual migration routes. Large seasonal and even daily fluctuations in presence and abundance within the Project Area and RAA are therefore likely. Although the widespread and often migratory nature of some species increases the potential for individuals and populations to be affected by multiple perturbations, these mobile species likewise have capability for avoidance. While there is some potential for overlap and interaction between the Project and other projects and activities (particularly with respect to underwater sound), effects are likely to be transient and temporary in nature without significant adverse cumulative effects on individuals or populations.

14.4.6 Cumulative Effects Summary and Evaluation

Cumulative environmental effects on marine mammals and sea turtles are predicted to be adverse, low to moderate in magnitude, occurring within the RAA, sporadic to regular in frequency, medium-term in duration, and reversible. With the application of proposed Project-related mitigation and environmental protection measures, the residual cumulative environmental effects on marine mammals and sea turtles (including SAR) are predicted to be not significant. Therefore, no additional mitigation measures beyond those in place to mitigate the Project's direct effects are needed to address potential cumulative effects.

Table 14.10 summarizes the results of the CEA for this VC.

Table 14.10 Marine Mammals and Sea Turtles: Summary of Potential Cumulative Environmental Effects

Summary of Potential Cumulative Environmental Effects	
Context for Cumulative Environmental Effects	• The existing biological environment for marine mammals and sea turtles is described in Section 6.3. Physical characteristics of fish habitat are described in Chapter 5. • The RAA contains multiple EBSAs that represent important foraging habitat and migratory routes for marine mammals and sea turtles. • Existing marine mammal and sea turtle presence and abundance for secure species and SAR has been and is being affected by marine traffic, fisheries, geophysical survey programs, and various other human activities, including associated discharges, emissions, and the generation of underwater sound. The predominant identifiable sources of underwater sound recorded in the Project Area between 2015 and 2017 were: fin whales, shipping, oil and gas extraction facilities, seismic surveys, and ambient noise (Matthews et al. 2018; Appendix C).
Residual Environmental Effects of the Project	• The primary interactions that may have adverse environmental effects on marine mammals and sea turtles include underwater sound associated with VSP surveys and MODU operation. • The Project may result in a residual adverse change in risk of mortality or physical injury and a residual adverse change in habitat quality and use for marine mammals and sea turtles, including secure species and SAR. These residual effects are predicted to be not significant and the Project is not expected to result in residual population-level effects on marine mammals or sea turtles. • This significance determination has generally been made with a moderate level of confidence given there are several key uncertainties in predicting the effects of the Project on marine mammals and sea turtles (Section 10.4).
Other Projects / Activities	**Potential for Interaction with Effects of Project:**
Offshore Petroleum Production Projects (Production from Hibernia, Terra Nova, White Rose, and Hebron Oilfields)	Y – Offshore petroleum production operations are located at substantial distances outside of the Project Area and LAA, with highly localized environmental effects. For species whose ranges cover a large extent of the RAA, individuals may be sequentially exposed to the residual effects of the Project and the residual effects of one or more offshore petroleum production projects throughout their life cycle. For individuals that do not encounter residual effects from both the Project and offshore petroleum production projects, the residual effects of the Project will nonetheless overlap spatially and temporally with the residual effects of these other physical activities in such a way (refer to Table 14.1) that contributes to cumulative effects on marine mammals and sea turtles in general within the RAA.
Offshore Petroleum Exploration – Geophysical Survey Programs	Y – Some potential for interaction, although localized and short-term nature of these activities and their effects, along with planned and required separation measures and other mitigation measures, will reduce potential for interaction. For species whose ranges cover a large extent of the RAA, individuals may be sequentially exposed to the residual effects of the Project and the residual effects of geophysical survey programs throughout their life cycle. For species with very limited ranges in areas that are subject to residual effects from the Project and geophysical survey programs at once, individuals may be exposed to the residual effects of the Project and the residual effects of geophysical survey programs activities simultaneously.

Summary of Potential Cumulative Environmental Effects	
Offshore Petroleum Exploration – Exploration and Delineation Drilling Programs	Y – Some potential for interaction, although localized and short-term nature of these activities and their effects, along with planned and required separation measures and other mitigation measures, will reduce potential for interaction. For species whose ranges cover a large extent of the RAA, individuals may be sequentially exposed to the residual effects of the Project and the residual effects of other exploration drilling projects throughout their life cycle. For species with very limited ranges in areas that are subject to residual effects from the Project and other exploration drilling projects at once, individuals may be exposed to the residual effects of the Project and the residual effects of other exploration drilling activities simultaneously.
Commercial Fishing Activity	Y – Some potential for interaction, although these activities are restricted within portions of the Project Area and occur mostly outside of the ELs. Safety zones around the MODU will limit the potential for overlapping and concurrent environmental effects. For species whose ranges cover a large extent of the RAA, individuals may be sequentially exposed to the residual effects of the Project and the residual effects of commercial fishing activity throughout their life cycle. For species with very limited ranges in areas that are subject to residual effects from the Project and commercial fishing activity at once, individuals may be exposed to the residual effects of the Project and the residual effects of commercial fishing activity simultaneously.
Hunting Activity	Y – Hunting pressure could potentially result in cumulative changes in mortality / injury to seals. Hunting is restricted to nearshore areas located at substantial distances outside of the Project Area and LAA, with highly localized environmental effects. For species whose ranges cover a large extent of the RAA, individuals may be sequentially exposed to the residual effects of the Project and the residual effects of hunting activity throughout their life cycle. For individuals that do not encounter residual effects from both the Project and hunting activity, the residual effects of the Project will nonetheless overlap spatially and temporally with the residual effects of this other physical activity in such a way (refer to Table 14.1) that contributes to cumulative effects on marine mammals in general within the RAA.
Other Ocean Uses	Y – Some potential for interaction, although these activities and their effects are highly localized and transient. Safety zones around Project activities measures will limit the potential for overlapping and concurrent environmental effects. For species whose ranges cover a large extent of the RAA, individuals may be sequentially exposed to the residual effects of the Project and the residual effects of the activities of other ocean users throughout their life cycle. For species with very limited ranges in areas that are subject to residual effects from the Project and the activities of other ocean users at once, individuals may be exposed to the residual effects of the Project and the residual effects of the activities of other ocean users simultaneously.
Cumulative Effects Summary	The residual cumulative environmental effects on marine mammals and sea turtles that have potential to occur as a result of the residual effects of the Project on the VC in combination with the residual effects of other projects or activities on the VC are predicted to be not significant.

14.5 Special Areas

14.5.1 Context for Cumulative Environmental Effects

The Special Areas VC, as described in Chapter 11, includes areas that have been noted for their biological and ecological importance and have been designated, and in some cases protected, under international, federal, and/or other applicable legislation due to this importance (e.g., EBSAs, VMEs, NAFO coral and sponge closure areas, and marine refuge areas). Special areas may provide habitat for secure species as well as those listed as SAR.

The following special areas are overlapped spatially by the Project Area (refer to Section 6.4):

- the Northeast Newfoundland Slope Closure marine refuge, which is closed to bottom-contact fishing activities in consideration of its high density of corals and sponges and high biodiversity
- the Orphan Spur EBSA, which was designated in consideration of its high concentration of corals and its densities of sharks as well as SAR and SOCC (e.g., northern, spotted, and striped wolffish; skates; roundnose grenadier; American plaice; redfish)
- the Bonavista Cod Box, which is experimentally closed to all fishing activity (except snow crab trapping) in consideration of its importance as a spawning and migration area for Atlantic cod, American plaice, and redfish
- the Orphan Knoll Seamount Closure, which is closed to bottom-fishing to protect deep-water corals

Other than these special areas that are overlapped by the Project Area, the Sackville Spur NAFO VME is the next closest special area to any of the Project ELs; it is located approximately 52 km south of Project EL 1149. Potential vessel transit routes intersect one additional special area, the Northeast Shelf and Slope EBSA, which is known to support aggregations of groundfish, marine mammals, and corals.

Environmental interactions between human activities and special areas may be both direct and indirect in nature and cause (Amec 2014). For example, the presence and operation of anthropogenic sources of noise, other emissions and effluents, and/or physical disturbance (e.g., vessels, bottom-contact fishing gear, geophysical survey equipment, offshore structures, or installations) within or near special areas may directly affect the existing natural environment in special areas. This in turn may affect the key environmental characteristics and processes that define and distinguish these areas, thereby affecting their overall and underlying characteristics, integrity, and value. Biophysical effects resulting from human activities either within or outside of these areas may also indirectly affect them by affecting the marine fish, marine and migratory birds, marine mammals, sea turtles, or other environmental components and systems that are relevant to their identification and their key and relevant characteristics and importance.

The current environmental conditions within the existing, identified special areas off Eastern Newfoundland reflect the occurrence and environmental consequences of past and ongoing anthropogenic activities and natural processes within and beyond their boundaries, as well as those that may have affected the larger natural and socio-economic features and processes that characterize and influence them. Special areas are identified and designated in order to recognize their importance and/or protect particularly important or sensitive environmental components. In certain cases, this is based on the objective of conserving the

presently pristine nature of these areas, while in other cases their designation is intended to help prevent further damage to already affected and sensitive environmental features and components.

14.5.2 Potential Project-related Contributions to Cumulative Effects

As described in Chapter 11, routine Project activities and components have potential to affect the ability of special areas to provide and maintain important ecological and biological functions for the species that use these areas. Thus, the Project has potential to result in a residual change in habitat quality associated with the presence and operation of the MODU, VSP surveys, Project-related discharges, well abandonment, and supply and servicing operations.

The Project-specific environmental effects assessment for this VC includes a summary of Project residual environmental effects in Section 11.3.4 and a determination of significance in Section 11.4. With the implementation of mitigation (refer to Section 11.3.2), the residual environmental effects of routine Project activities on special areas are predicted to be not significant.

14.5.3 Other Projects and Activities and their Effects

Table 14.11 summarizes how past, present, and future projects and activities in the RAA have potential to cause a residual change in risk of mortality or physical injury and residual change in habitat quality and use within special areas.

14.5.4 Potential Cumulative Environmental Effects

The only special areas that are overlapped spatially by the Project Area are the Northeast Newfoundland Slope Closure marine refuge, Orphan Spur EBSA, Bonavista Cod Box, and Orphan Knoll Seamount Closure. Given the distance of the Project Area from other special areas (refer to Section 6.4), potential cumulative interactions associated with the presence and operation of the MODU, including discharge of drill muds and cuttings as well as other discharges and emissions, VSP surveys, and well abandonment activities, would be limited, for the most part, to localized portions of these special areas. A total of up to 20 Project exploration wells have potential to be drilled within the Northeast Newfoundland Slope Closure marine refuge (which is overlapped by Project ELs 1134, 1146, and 1148) and the Orphan Spur EBSA (which is overlapped by Project EL 1134); however, no Project ELs overlap with the Bonavista Cod Box or the Orphan Knoll Seamount Closure, so no Project wells will be drilled within those special areas. Cumulative environmental effects from Project drilling activities would not extend to distances that may interact with other special areas; however, PSV transiting has potential to cumulatively interact with other physical activities in several other special areas within the RAA. Potential vessel transit routes intersect one additional special area, the Northeast Shelf and Slope EBSA, which is known to support aggregations of groundfish marine mammals, and corals (refer to Section 6.1).

Table 14.11 Special Areas: Residual Effects from Other Projects and Activities in the RAA

Physical Activity	Potential Residual Environmental Effect(s)	Explanation of Potential Residual Environmental Effect(s)	VC-specific Spatial and Temporal Considerations (Refer to Table 14.1 for General Consideration of Potential for Spatial and Temporal Overlap)
Offshore Petroleum Production Projects (Production from Hibernia, Terra Nova, White Rose, and Hebron Oilfields)	• Change in habitat quality and use	• Given their distances (refer to spatial and temporal considerations in next column), offshore production facilities are not expected to be visible or audible from any of the special areas in the RAA and are therefore not expected to cause a change in habitat quality for special areas. • Operational discharges, underwater sound, and artificial night-lighting from PSVs transiting in or immediately adjacent to a special area have potential to cause localized water quality effects, sensory disturbance, and a resultant change in habitat quality for marine species within the affected special area(s). • Helicopter traffic has potential to affect habitat quality and use in special areas where marine mammals and/or marine and migratory birds are likely to occur. The following special areas within the RAA are known to support aggregations of marine and migratory birds and/or marine mammals: Baccalieu Island Ecological Reserve, Baccalieu Island IBA, Cape Freels Coastline and Cabot Island IBA, Cape St. Francis IBA, Cape St. Mary's Ecological Reserve, Cape St. Mary's IBA, Eastern Avalon EBSA, Fogo Shelf EBSA, Funk Island Deep marine refuge, Funk Island Ecological Reserve, Funk Island IBA, Grates Point IBA, Grey Islands EBSA, Labrador Marginal Trough EBSA, Lily Canyon–Carson Canyon EBSA, Mistaken Point IBA, Northeast Shelf and Slope EBSA, Notre Dame Channel EBSA, Placentia Bay Extension EBSA, Quidi Vidi Lake IBA, South East Shoal and Adjacent Shelf Edge / Canyons NAFO VME, Southeast Shoal and Tail of the Banks EBSA, Southwest Shelf Edge and Slope EBSA, Terra Nova Migratory Bird Sanctuary, Terra Nova National Park IBA, The Cape Pine and St. Shotts Barren IBA, Virgin Rocks EBSA, Wadham Islands and Adjacent Marine Area IBA, Witless Bay Ecological Reserve, and Witless Bay Islands IBA.	• The only offshore production facility within approximately 80 km of any of the special areas in the RAA is the White Rose platform, which is located approximately 42 km south of the Northeast Shelf and Slope EBSA. All the other production facilities are located at least approximately 85 km from any special areas: - The nearest special area to the Hibernia platform is the Virgin Rocks EBSA, approximately 93 km away. - The nearest special area to the Terra Nova platform is the Flemish Pass / Eastern Canyon NAFO VME, approximately 85 km away. - The nearest special area to the White Rose platform is the Northeast Shelf and Slope EBSA, approximately 42 km away. - The nearest special area to the Hebron platform is the Northeast Shelf and Slope EBSA, approximately 88 km away.
Offshore Petroleum Exploration – Geophysical Survey Programs	• Change in habitat quality and use	• Operational discharges, underwater sound, and artificial night-lighting from geophysical survey vessels transiting in or immediately adjacent to special areas have potential to cause localized water quality effects, sensory disturbance, and a resultant change in habitat quality and use for marine species within the affected special area(s). • ESRF data (reported in Matthews et al. 2018; Appendix C) indicate that seismic surveys are a dominant anthropogenic source of underwater sound that have affected the soundscape and is expected to be present in the foreseeable future (refer to Section 5.3.10.3). Underwater seismic sound from air source arrays and other geophysical survey activities have potential to cause a change in habitat quality and use in special areas within several kilometres of the sound source.	• Although the relatively large survey areas covered by some types of offshore geophysical surveys and the known propagation of noise in the marine environment can increase the potential for spatial interactions between their effects and those of other projects and activities in the RAA, most survey activities operate for a short period of time in any one location, thus resulting in a transient and relatively short-term disturbance within localized portions of the survey area. • All the geophysical survey programs identified in Table 14.3 overlap spatially with one or more special areas in the RAA.
Offshore Petroleum Exploration – Exploration and Delineation Drilling Programs	• Change in habitat quality and use	• Several of the ELs in which proposed exploration drilling activities may be carried out in the RAA overlap with special areas (refer to Figure 14.1). The potential presence and operation of one or more MODUs associated with these offshore exploration drilling projects could therefore affect habitat quality in the overlapped special areas through sensory disturbance caused by atmospheric underwater sound emissions, artificial night-lighting, and operational and drilling discharges. The discharge of mud and cuttings will be in accordance with the OWTG and OCSG. However, discharges of mud and cuttings will result in localized increases in TSS in the water column, temporarily affecting water quality in a localized area around exploration drilling activities, potentially resulting in species avoidance. • It is conservatively assumed that underwater sound emissions from VSP operations and wellsite surveys could potentially result in a change in habitat quality for marine species in special areas within several kilometers of the sound source. • MODUs operating within ELs more than approximately 40 km away from special areas are not expected to be visible or audible from any of the special areas in the RAA and are therefore not expected to cause a change in habitat quality for special areas. • Operational discharges, underwater sound, and artificial night-lighting from PSVs transiting in or immediately adjacent to special areas have potential to cause localized water quality effects and a resultant change in habitat quality and use for marine species within the affected special area(s). • Helicopter traffic has potential to affect habitat quality and use in special areas where marine mammals and/or marine and migratory birds are likely to occur. The following special areas within the RAA that are known to support aggregations of marine and migratory birds and/or marine mammals are listed above (refer to the first row of this table).	• Residual effects from other exploration drilling programs are generally anticipated to be similar in nature and extent (including similar spatial and temporal scales) to predicted Project-related residual environmental effects on special areas (refer to Chapter 11). • Exploration drilling activities are typically relatively short-term and localized. This can reduce the potential for individuals and populations to be affected simultaneously and repeatedly by multiple physical activities. • The following non-Project ELs are located approximately 40 km or less from the same special areas that are also in close enough proximity to Project ELs to be potentially affected by the Project-related drilling activities (i.e., Northeast Newfoundland Slope Closure marine refuge, Orphan Spur EBSA, Bonavista Cod Box, and Orphan Knoll Seamount Closure; refer to Sections 14.5.1 and 14.5.4): - Navitas' EL 1147, which overlaps the Northeast Newfoundland Slope Closure marine refuge and the Orphan Spur EBSA, and is approximately 13 km from the Bonavista Cod Box - Chevron's EL 1138, which is located approximately 0.5 km from the Northeast Newfoundland Slope Closure marine refuge - Statoil's EL1126, which is located approximately 34 km from the Northeast Newfoundland Slope Closure marine refuge - ExxonMobil's EL 1135, which is located approximately 40 km from the Northeast Newfoundland Slope Closure marine refuge.

Physical Activity	Potential Residual Environmental Effect(s)	Explanation of Potential Residual Environmental Effect(s)	VC-specific Spatial and Temporal Considerations (Refer to Table 14.1 for General Consideration of Potential for Spatial and Temporal Overlap)
Commercial Fishing Activity	• Change in habitat quality and use	• Operational discharges, underwater sound, and artificial night-lighting from fishing vessels transiting in or immediately adjacent to special areas have potential to cause localized water quality effects and a resultant change in habitat quality and use for marine species within the affected special area(s). • In addition to the localized generation of underwater sound from engines and propellers during transiting, fishing vessels may carry out physical activities that generate higher SPLs (e.g., bottom trawling, depth sounding, bottom profiling, and side-scan sonar) that have potential to affect habitat quality and use in special areas within several kilometres of the sound source. • Certain special areas in the RAA are subject to fishing closures or gear restrictions, including (refer to Section 6.4): the Bonavista Cod Box, the Eastport Peninsula Lobster Management Area, various marine refuges (i.e., Division 3O Coral, Northeast Newfoundland Slope, Funk Island Deep, and Hawke's Channel), Gander Bay and Gooseberry Island lobster closure areas, and several NAFO VMEs (i.e., Tail of the Bank, Flemish Pass / Eastern Canyon, Beothuk Knoll, Eastern Flemish Cap, Northern Flemish Cap, Northwest Flemish Cap, Sackville Spur, 3O Coral Closure, Corner Seamounts, Fogo Seamounts 1 and 2, Newfoundland Seamounts, and Orphan Knoll). • None of the other special areas in the RAA are currently subject to any fishing closures or gear restrictions. The use of mobile bottom-contact fishing gear therefore has potential to cause a change in habitat quality in the remaining special areas in the RAA.	• Although the presence of mobile bottom-contact fishing gear is relatively more transient, the residual environmental effects of this type of commercial fishing activity on habitat quality and use within special areas is generally more disruptive, longer term, and more spatially extensive than the temporary and localized residual effects to fish and fish habitat associated with the use of fixed fishing gear. • The potential residual change in habitat quality and use associated with sensory disturbance and emissions / discharges from fishing vessels is expected to be short-term and transient at any given location.
Hunting Activity	• Change in habitat quality and use	• The potential presence in special areas of vessels engaged in hunting of some types of marine and migratory birds and (specifically, murres and waterfowl) and mammals (seals) may result in a change in habitat quality and use for marine species within the affect special area(s). • Potential effects associated with the presence and transiting of hunting vessels, including associated emissions and discharges, are equivalent to the potential effects associated with the vessels of other ocean users in the RAA and are therefore not considered separately in the CEA. • There is no known hunting activity within special areas offshore, nor targeting key species relevant to their designations.	• Hunting is restricted to nearshore areas and is therefore not anticipated to interact with offshore special areas in and around the Project Area.
Other Ocean Uses	• Change in habitat quality and use	• Operational discharges, underwater sound, and artificial night-lighting from the vessels of other ocean users transiting in or immediately adjacent to special areas have potential to cause localized water quality effects and a resultant change in habitat quality and use for marine species within the affected special area(s). • In addition to the localized generation of underwater sound from engines and propellers during transiting, the vessels of other ocean users may carry out physical activities that generate higher SPLs (e.g., naval sonar) that have potential to affect habitat quality and use in special areas within several kilometres of the sound source. • Helicopter traffic has potential to affect habitat quality and use in special areas where marine mammals and/or marine and migratory birds are likely to occur. The following special areas within the RAA that are known to support aggregations of marine and migratory birds and/or marine mammals are listed above (refer to the first row of this table).	• The highly transitory nature of the vessels of other ocean users reduces potential residual effects on marine species in any particular location (including in special areas) and at any particular time. • The potential residual change in habitat quality and use associated with sensory disturbance and emissions / discharges from the vessels of other ocean users is expected to be short-term and transient at any given location (including in special areas).

Many of the mechanisms for cumulative environmental effects on fish and fish habitat, marine and migratory birds, and marine mammals and sea turtles are also applicable to special areas:

- Marine discharges from the Project as well as from other physical activities could result in localized areas of water quality reduction throughout the RAA. Fish, marine mammals, sea turtles, and marine and migratory birds may temporarily avoid or be attracted to these areas. This cumulative environmental effect has potential to occur in localized areas of the Northeast Newfoundland Slope Closure marine refuge (where drilling will occur) and, to a lesser extent, the Orphan Spur EBSA, Bonvavista Cod Box, and Orphan Knoll Seamount Closure (although no drilling will occur in these special areas), and in other special areas that could be crossed by PSV traffic. The same special areas may also be simultaneously or sequentially exposed to habitat quality and use effects from various sources of underwater sound, helicopter traffic, and direct disturbance of benthic habitat from bottom-contact commercial fishing activities. Other special areas in the wider RAA (outside of the zone of influence of the Project) may experience similar residual effects from one or more other physical activities, thus resulting in a cumulative change in habitat quality and use for special areas in general throughout the RAA.
- As is explained in Section 2.8.2, drill waste deposition modelling results indicate that a sediment deposition thickness of 1 mm (visual threshold) from Project-related discharge of drill muds and cuttings may extend:
  - up to a 625-m radius around the discharge point in ELs 1145, 1146, and 1148 in the West Orphan Basin and
  - up to 147-m radius around the discharge point in EL 1149 in the East Orphan Basin.

  The dispersion of Project-related discharges of drill muds and cuttings from each wellsite could contribute to the residual environmental effects of fishing activity in the RAA, including the resuspension of sediments during groundfishing with mobile bottom-contact fishing gear, in such a way that causes a cumulative change in habitat quality and use for benthic organisms and other marine fish within the aforementioned 625-m radius in the West Orphan Basin and 147-m radius in the East Orphan Basin. This cumulative environmental effect has potential to occur within localized areas of the Northeast Newfoundland Slope Closure marine refuge, in which Project ELs 1145, 1146, and 1148 are located. The next nearest special area to any of the Project ELs (the Orphan Spur EBSA) which is located approximately 1.5 km from EL 1148.
- Underwater sound generated by various Project activities and components will contribute to the underwater sound produced by other physical activities in the RAA. Fish, marine mammals, and sea turtles may temporarily avoid localized areas subject to underwater sound. This cumulative change in habitat quality has potential to disrupt reproductive, foraging and feeding, and/or migratory behaviour if the availability of important habitat areas, including designated special areas, is affected. For the purposes of the CEA, it is conservatively assumed that underwater sound emissions from VSP operations and wellsite surveys could potentially result in a change in habitat quality for marine species in special areas within 40 km of the sound source. This cumulative environmental effect therefore has potential to occur in the Northeast Newfoundland Slope Closure marine refuge, Orphan Spur EBSA, and Bonavista Cod Box.

- A cumulative increase in ambient underwater sound levels may adversely affect marine mammals causing temporary avoidance. This cumulative environmental effect has potential to occur in the Northeast Newfoundland Slope Closure marine refuge, Orphan Spur EBSA, Bonavista Cod Box, and Orphan Knoll Seamount Closure, where the Project Area is located, as well as in the Northeast Shelf and Slope EBSA, which is crossed by the PSV route portion of the RAA.
- Project-related helicopter traffic may cause additional sensory disturbance for marine and migratory birds and trigger additional diving responses in individual marine mammals already exposed to the presence and sound of helicopter traffic from other offshore petroleum exploration and production projects and other ocean users (where applicable). However, no special areas in the Project Area are known to support aggregations of marine and migratory birds or marine mammals.
- The same special areas that are exposed to habitat quality and use effects from underwater sound emissions and helicopter traffic may also be simultaneously or sequentially exposed to various sources of marine discharges as well as direct disturbance of benthic habitat from bottom-contact commercial fishing activities. Other special areas in the wider RAA (outside of the zone of influence of the Project) may experience similar residual effects from one or more other physical activities, thus resulting in a cumulative change in habitat quality and use for special areas in general throughout the RAA.

Given the importance of the Northeast Shelf and Slope Closure marine refuge, Orphan Spur EBSA, and Bonavista Cod Box for marine fish and fish habitat, as well as the importance of other special areas in the RAA for marine and migratory birds, marine mammals, and sea turtles, much of the analysis of cumulative environmental effects provided for the corresponding VCs in Sections 14.2.4, 14.2.5, and 14.2.6 is also applicable for special areas.

Although PSVs, geophysical survey and support vessels, fishing vessels, and the vessels of other ocean users may be present in designated special areas, they are subject to special restrictions where necessary to protect sensitive marine species and habitats.

14.5.5 Cumulative Effects Summary and Evaluation

Cumulative environmental effects on special areas are predicted to be adverse, low to moderate in magnitude, occurring within the VC-specific LAA, sporadic to regular in frequency, short to medium-term in duration, and reversible. With the application of proposed Project-related mitigation and environmental protection measures, the residual cumulative environmental effects on special areas are predicted to be not significant. Therefore, no additional mitigation measures beyond those in place to mitigate the Project's direct effects are needed to address potential cumulative effects, assuming other ocean users also respect industry standard protection measures in place for special areas (e.g., fishing restrictions and closures).

Table 14.12 summarizes the results of the CEA for this VC.

Table 14.12 Special Areas: Summary of Potential Cumulative Environmental Effects

Summary of Potential Cumulative Environmental Effects	
Context for Cumulative Environmental Effects	• Various types of special areas are located within the RAA, including coastal and marine areas protected through legislation or formally identified as being special or sensitive. • The following designated special areas overlap with the Project Area: Northeast Newfoundland Slope Closure marine refuge, Orphan Spur EBSA, Bonavista Cod Box, and Orphan Knoll Seamount Closure. Potential vessel transit routes intersect the Northeast Shelf and Slope EBSA.
Residual Environmental Effects of the Project	• The primary interactions that may have adverse environmental effects on marine fish and fish habitat, marine and migratory birds, and marine mammals and sea turtles (refer to Tables 14.6, 14.8, and 14.10, respectively) are also applicable to special areas. • The Project may result in a residual adverse change in habitat quality. This residual effect is predicted to be not significant. • This significance determination has generally been made with a moderate level of confidence based on analysis of scientific literature and EEM results that exist specific to offshore Newfoundland and Labrador projects within the RAA, and Project-specific modelling. There is some uncertainty regarding potential coral and sponge presence in the Project Area and a lack of available EEM information from drilling activities in deep-water environments with sensitive benthic habitat in the RAA.
Other Projects / Activities	**Potential for Interaction with Effects of Project:**
Offshore Petroleum Production Projects (Production from Hibernia, Terra Nova, White Rose, and Hebron Oilfields)	N – Offshore petroleum production operations are located at substantial distances outside of the Project Area and LAA, with highly localized environmental effects. There are no special areas that overlap with both the Project (i.e., Project Area or potential PSV transit routes) and the Hibernia, Terra Nova, White Rose, and/or Hebron project area(s).
Offshore Petroleum Exploration –Geophysical Survey Programs	Y – Some potential for interaction, although localized and short-term nature of these activities and their effects, along with planned and required separation measures and other mitigation measures, will reduce potential for interaction.
Offshore Petroleum Exploration – Exploration and Delineation Drilling Programs	Y – Some potential for interaction, although localized and short-term nature of these activities and their effects, along with planned and required separation measures and other mitigation measures, will reduce potential for interaction.
Commercial Fishing Activity	Y – Fishing activity occurs throughout the offshore area. Fishing activity and ELs that may contain exploration wells as part of this Project both overlap with portions of the Northeast Newfoundland Slope Closure marine refuge (which is closed to bottom-contact fishing but open to other gear types) and the Orphan Spur EBSA (which is not subject to any fishing restrictions).
Hunting Activity	N – There is no hunting activity within special areas offshore, nor targeting of key species relevant to their designations.

Summary of Potential Cumulative Environmental Effects	
Other Ocean Uses	Y – Some potential for interaction, although these activities and their effects are highly localized and transient. Safety zones around Project activities measures will limit the potential for overlapping and concurrent environmental effects, and thus, for cumulative effects on this VC.
Cumulative Effects Summary	The residual cumulative environmental effects on special areas that have potential to occur as a result of the residual effects of the Project on the VC in combination with the residual effects of other projects or activities on the VC are predicted to be not significant.

14.6 Indigenous Peoples and Community Values

14.6.1 Context for Cumulative Environmental Effects

The Indigenous Peoples and Community Values VC includes the following for factors with respect to Indigenous peoples, as applicable: health and socio-economic conditions; physical and cultural heritage; current use of lands and resources for traditional purposes; and any structure, site or thing that is of historical, archaeological, paleontological or architectural significance. The EIS Guidelines for the Project identify Indigenous groups in Newfoundland and Labrador, Nova Scotia, New Brunswick, Prince Edward Island and Quebec that have the potential to be affected by Project activities. These communities hold commercial communal and/or FSC licenses in the RAA or for species that may migrate through the RAA. Species harvested for commercial communal purposes in the RAA include capelin, groundfish, herring, mackerel, seal, shrimp, snow crab, swordfish, tuna, and whelk. There is no known FSC harvesting occurring in the RAA; however, some species are anadromous and can potentially migrate through the area. Two migratory fish species have been highlighted during Indigenous engagement as being of concern due to potential interaction with Project activities: American eel and Atlantic salmon.

Other past and ongoing projects and activities in Eastern Canada have, to varying degrees, interacted with and affected Indigenous communities and activities, depending on their location, nature, and scale in relation to the communities, activities, and other components and interests of individual Indigenous groups. Given the long and varied history of Indigenous peoples and different Indigenous communities in the region, it is not practical to attempt in this EIS to identify and describe how past and ongoing development projects and other processes and activities have influenced and otherwise affected Indigenous peoples. However, Section 7.4 presents an overview of current socio-economic characteristics and conditions of Indigenous communities that reflects past and ongoing effects. Where possible and applicable, Section 7.4 identifies how certain socio-economic components, such as traditional land use patterns, may have been influenced by previous and ongoing development activities and other factors.

14.6.2 Potential Project-related Contributions to Cumulative Effects

As described in Chapter 12, routine Project activities and components have potential to affect commercial communal fisheries resources by direct or indirect effects on fished species and/or effects on fishing activity from displacement from fishing areas, gear loss or damage, and availability of fisheries resources. Although there is no known FSC fishing occurring in the Project Area, routine Project activities may interact with migratory species, including marine fish, marine mammals, and marine and migratory birds, traditionally and currently harvested by Indigenous communities at their traditional harvesting sites. Thus, the Project has potential to result in:

- a residual change in commercial communal fisheries associated with the presence and operation of the MODU, VSP surveys, Project-related discharges, well abandonment, and supply and servicing operations
- a residual change in current use of lands and resources for traditional purposes associated with the presence and operation of the MODU, VSP surveys, Project-related discharges, well testing and flaring, well abandonment, and supply and servicing operations

The Project-specific environmental effects assessment for this VC includes a summary of Project residual environmental effects in Section 12.3.5 and a determination of significance in Section 12.4. With the implementation of mitigation (refer to Section 12.3.2), the residual environmental effects of routine Project activities on Indigenous peoples and community values are predicted to be not significant.

14.6.3 Other Projects and Activities and their Effects

Table 14.13 summarizes how past, present, and future projects and activities in the RAA have potential to cause a residual change in commercial communal fisheries and a residual change in the current use of lands and resources for traditional purposes affecting Indigenous peoples and community values.

14.6.4 Potential Cumulative Environmental Effects

In addition to the Project, several other offshore petroleum exploration drilling programs are proposed to be carried out in the RAA within a similar timeframe (refer to Table 14.3) and have potential to result in residual effects that interact cumulatively with the residual effects of the Project. In recognition of this, BP has sought opportunities to coordinate Indigenous engagement efforts for the Project with ExxonMobil, Equinor (formerly Statoil), Husky, and Nexen in an effort to reduce “consultation fatigue” and better understand potential issues and concerns (refer to Section 3.2).

A 500-m radius safety zone will be established around the Project MODU, within which Indigenous fisheries and harvesting activities will be excluded while the MODU is in operation. This will amount to the localized exclusion of fisheries within an area of approximately 0.8 km² for up to 60 days for each of the wells to be drilled in the Project Area. More specifically, the safety zone to be established for the Project will occupy approximately 0.0001% of the total available area in the NAFO Divisions in which the Project Area is located (i.e., Divisions 3KLM). The safety zones associated with other offshore petroleum exploration and production drilling projects will increase the cumulative area that will be temporarily unavailable to Indigenous fishers and harvesters at any given time during Project activities.

In addition to the safety zones associated with offshore petroleum exploration and development, the presence of PSVs, competing fishing vessels, seismic vessels and streamers associated with geophysical survey programs, and the marine traffic associated with other ocean users are other sources of potential conflict with fishing vessels within the RAA that could cause a change in commercial communal fisheries or change in land and resource use for traditional purposes as a result of space-use conflicts.

Table 14.13 Indigenous Peoples and Community Values: Residual Effects from Other Projects and Activities in the RAA

Physical Activity	Potential Residual Environmental Effect(s)	Explanation of Potential Residual Environmental Effect(s)	VC-specific Spatial and Temporal Considerations (Refer to Table 14.1 for General Consideration of Potential for Spatial and Temporal Overlap)
Offshore Petroleum Production Projects (Production from Hibernia, Terra Nova, White Rose, and Hebron Oilfields)	• Change in commercial communal fisheries • Change in the current use of lands and resources for traditional purposes	• Offshore petroleum production projects have localized effects on access to species of interest for Indigenous fishers and harvesters due to the establishment of safety zones around their production facilities and associated infrastructure. • Offshore petroleum production projects also cause environmental effects on fish and fish habitat (including for commercial communal fisheries resources) due to the generation of underwater sound and water quality effects associated with discharges. However, these environmental effects on fish and fish habitat are generally not expected to be of sufficient magnitude, duration, or extent to affect catch rates or otherwise cause a Change in commercial communal fisheries. • The transiting of PSVs has potential to cause mortality of marine mammals (including seals, which are a species of importance to Indigenous harvesters) due to vessel strikes.	• Commercial communal fishing activity has been, and will continue to be, excluded within the following safety zones around production facilities and associated infrastructure for the duration of petroleum production from the Hibernia, Terra Nova, White Rose, and Hebron oilfields (Statoil 2017): - there is a collective safety zone of 53 km² around the Hibernia GBS, offloading system, and Hibernia Southern Extension, with additional zones for each flowline; - the Terra Nova safety zone extends approximately 9.26 km (5 nautical mile) from FPSO and the Terra Nova Fisheries Exclusion Zone is approximately 14 km²; - the White Rose safety zone is approximately 105 km²; and - the safety zone around Hebron is approximately 6 km² around the GBS and offloading system (similar to Hibernia) and 500 m from the centre of the deep-water site. • Refer to Table 14.5 for an overview of results from the Hibernia, Terra Nova, and White Rose 2014 EEM programs regarding effects on marine water quality and fish health, contamination, and tainting.
Offshore Petroleum Exploration – Geophysical Survey Programs	• Change in commercial communal fisheries • Change in the current use of lands and resources for traditional purposes	• It may become necessary for communal commercial fishers to exert a higher level of effort to achieve the same catch during seismic operations, either due to the temporary displacement of target fish species because of underwater sound from the air source array, or due to the temporary displacement of fishing vessels to accommodate seismic vessels and streamers, either of which could affect catch rates or otherwise cause a change in availability of fisheries resources for commercial communal fisheries. • Although relatively little is known about the potential effects of seismic sound on marine and migratory birds, and the limited information that is available has not provided strong evidence of adverse effects (Amec 2014), it is conservatively assumed for the purposes of the CEA that seismic sound from air source arrays will affect the quality of the underwater acoustic environment in such a way that has potential to disturb marine and migratory birds and cause temporary behavioural and/or physiological effects to individuals diving in proximity to the sound source (Amec 2014), potentially including species harvested for traditional purposes. • Air source array operations during seismic surveys will affect the quality of the underwater acoustic environment in such a way that has potential to disturb seals and cause temporary behavioural effects and/or physiological effects (Amec 2014), potentially including species harvested for commercial communal or traditional purposes. • The transiting of survey-related vessels has potential to cause mortality of marine mammals (including seals, which are a species of importance to Indigenous harvesters) due to vessel strikes. • There is potential for entanglement of marine mammals (including seals, which are a species of importance to Indigenous harvesters) because of interaction with seismic streamers. • Discharges from survey and support vessels will be made in accordance with MARPOL and are therefore unlikely to cause a change in risk of mortality or physical injury for fish, marine and migratory birds, or seals that may be harvested by Indigenous peoples and migrating through the area. • Discharges may temporarily degrade water quality within a localized area around survey and support vessels, thereby potentially causing temporary behavioural effects (e.g., avoidance / displacement or attraction) for fish, marine and migratory birds, or seals within the immediate area.	• Although the relatively large survey areas covered by some types of offshore geophysical surveys and the known propagation of noise in the marine environment can increase the potential for spatial interactions between their effects and those of other projects and activities in the RAA, most survey activities operate for a short period of time in any one location, thus resulting in a transient and relatively short-term disturbance within localized portions of the survey area.

Physical Activity	**Potential Residual Environmental Effect(s)**	**Explanation of Potential Residual Environmental Effect(s)**	**VC-specific Spatial and Temporal Considerations (Refer to Table 14.1 for General Consideration of Potential for Spatial and Temporal Overlap)**
Offshore Petroleum Exploration – Exploration and Delineation Drilling Programs	• Change in commercial communal fisheries • Change in the current use of lands and resources for traditional purposes	• Offshore petroleum exploration drilling projects have localized effects on access to species of interest for Indigenous fishers and harvesters due to the establishment of 500-m radius safety zones around their MODUs. • Underwater sound emissions will also be generated as a result of the presence and operation of MODUs during drilling, testing and abandonment, which may cause species of interest for Indigenous fishers and harvesters to temporarily avoid the immediate area surrounding MODUs, particularly during start-up of drilling. • The discharge of drill muds and cuttings may interact with marine species within a localized area as a result of sedimentation and localized changes in water quality, thereby affecting availability of species of interest for Indigenous fishers and harvesters. • Other discharges and emissions (including drilling and testing emissions) will result in temporary and localized effects on water quality around exploration wellsites. Discharges will be in accordance with the OWTG and are predicted to not adversely affect species of interest for Indigenous fishers and harvesters. • It may become necessary for commercial communal fishers to exert a higher level of effort to achieve the same catch during VSP due to the temporary displacement of target fish species because of underwater sound, which could affect catch rates or otherwise cause a change in availability of fisheries resources for commercial communal fisheries. • The transiting of PSVs has potential to cause mortality of marine mammals (including seals, which are a species of importance to Indigenous harvesters) due to vessel strikes.	• Residual effects from other exploration drilling programs are generally anticipated to be similar in nature and extent (including similar spatial and temporal scales) to predicted Project-related residual environmental effects on Indigenous peoples and community values (refer to Chapter 12). • Exploration drilling activities are typically relatively short-term and localized. This can reduce the potential for individuals and populations of species of importance to Indigenous fishers / harvesters to be affected simultaneously and repeatedly by multiple physical activities.
Commercial Fishing Activity	• Change in commercial communal fisheries • Change in the current use of lands and resources for traditional purposes	• Under a relevant licence, commercial fisheries can be carried out in any NAFO Division and Unit Area in the RAA and thus have potential to cause a change in availability of fisheries resources for competing communal commercial fisheries in the RAA (e.g., through displacement of competitors from their preferred fishing grounds). • If fisheries resources are not harvested sustainably, the residual environmental effects of present fishing activity in the RAA could cause a change in availability of fisheries resources for future commercial communal and FSC fishers due to decreased catch rates as well as resource depletion. • Fisheries also cause localized environmental effects on fish and fish habitat due to the generation of underwater sound and water quality effects associated with discharges. However, these environmental effects on fish and fish habitat are generally not expected to be of sufficient magnitude, duration, or extent to affect catch rates or otherwise cause a change in availability of fisheries resources for commercial communal fisheries. • The transiting of commercial fishing vessels has potential to cause mortality of marine mammals (including seals, which are a species of importance to Indigenous harvesters) due to vessel strikes. • There is potential for entanglement of marine mammals (including seals, which are a species of importance to Indigenous harvesters) because of interaction with fishing gear.	• Various commercial fisheries and commercial communal fisheries have potential to overlap spatially and temporally in the RAA and Project Area. Various commercial fisheries and FSC fisheries have potential to overlap spatially and temporally in the RAA.
Hunting Activity	• Change in the current use of lands and resources for traditional purposes	• If the species of interest to Indigenous harvesters are not harvested sustainably, the residual environmental effects of present hunting activity in the RAA could cause a change in the use of lands and resources for traditional purposes for future Indigenous harvesters due to resource depletion. • Potential effects associated with the presence and transiting of hunting vessels, including associated emissions and discharges, are equivalent to the potential effects associated with the vessels of other ocean users in the RAA and are therefore not considered separately in the CEA.	• Although hunting is restricted to nearshore areas outside the Project Area, some species of interest to Indigenous harvesters are highly mobile and individuals that occur in the Project Area may also be at risk of mortality (and associated resource depletion) due to hunting.
Other Ocean Uses	• Change in commercial communal fisheries • Change in the current use of lands and resources for traditional purposes	• Other ocean users can occur in any NAFO Division and Unit Area in the RAA and have potential to cause a change in availability of fisheries resources for commercial fisheries through temporary displacement of commercial fishing activity (due to vessel presence) or damage to fishing gear. • Other ocean users also cause localized environmental effects on fish and fish habitat due to the generation of underwater sound and water quality effects associated with discharges. However, these environmental effects on fish and fish habitat are generally not expected to be of sufficient magnitude, duration, or extent to affect catch rates or otherwise cause a change in availability of fisheries resources for commercial fisheries. • The transiting of the vessels of other ocean users has potential to cause mortality of marine mammals (including seals, which are a species of importance to Indigenous harvesters) due to vessel strikes.	• The highly transitory nature of the vessels of other ocean users reduces potential residual effects on Indigenous fishers in any particular location and at any particular time. • The potential residual change in habitat quality and use for species of importance to Indigenous fishers / harvesters associated with sensory disturbance and emissions / discharges from the vessels of other ocean users is expected to be short-term and transient at any given location, as is the potential residual change in risk of mortality or physical injury for species of importance to Indigenous harvesters associated with underwater sound and vessel strikes.

Another factor that may contribute to potential space-use conflicts among Indigenous commercial communal fishers is the restriction of certain fishing activities within various special areas in the RAA, including *Fisheries Act* marine refuges, lobster area closures, NAFO VMEs, and an experimental closure (refer to Section 6.4). Special areas that are closed to one or more types of fisheries represent approximately 9% of the total RAA.

No substantial change in commercial communal fisheries or change in land and resource use for traditional purposes is anticipated to result from the cumulative interaction of the various safety zones associated with the Project, Hibernia, Terra Nova, White Rose, Hebron, or exploration drilling projects. Alternative fishing and harvesting locations are anticipated to be available nearby as these safety zones are relatively small and occupy a negligible amount of the total harvestable grounds in the RAA.

Project PSVs are not expected to contribute to space-use conflicts with fishing vessels, as existing shipping lanes will be used by Project PSVs as practicable when travelling between the MODU and the supply base in St. John's, and Project-related PSV traffic will represent a minor component of total marine traffic in the RAA, occupy a negligible proportion of the total available Indigenous fishing and harvesting area in the RAA, and be short-term and transient in nature.

Indigenous fishers and harvesters may adversely affect one another through direct competition over productive fishing and harvesting grounds in such a way that causes a change in commercial communal fisheries or change in land and resource use for traditional purposes. Any Indigenous fishers / harvesters that experience a change in access to their customary fishing / harvesting areas as a result of the Project in combination with other physical activities in the RAA may be required to temporarily relocate their fishing / harvesting effort. This could put additional pressure on nearby fishing / harvesting areas, and fishers / harvesters and may be adversely affected by the resultant competition for remaining fishing / harvesting areas in the RAA, thereby causing a cumulative change in commercial communal fisheries or change in land and resource use for traditional purposes.

The level of fishing / harvesting effort within and surrounding the Project Area is relatively low. The Project Area does not include any unique fishing / harvesting grounds or concentrated fishing / harvesting effort that occurs exclusively within the Project Area, nor is it likely to represent a substantial portion of a customary fishing / harvesting area for an Indigenous fisher / harvester. The potential for temporary loss of access to preferred fishing / harvesting grounds as a result of the Project is therefore anticipated to be negligible and is unlikely to have any discernable effect on the overall distribution of fishing / harvesting effort within the RAA.

All of the physical activities within the RAA have some potential to inadvertently result in damage to fishing gear. The Project contributes to a potential cumulative change in commercial communal fisheries within the RAA due to potential sequential incidents of gear loss or damage. Project-related damage to fishing gear, if any, will be compensated in accordance with the *Compensation Guidelines with Respect to Damages Relating to Offshore Petroleum Activity* (C-NLOPB and CNSOPB 2017).

Standard practices for communication among marine users, including the issuance of Notices to Mariners and Notices to Shipping (as appropriate), is expected to mitigate potential conflicts with Indigenous fisheries as well as other ocean users. During the drilling program, BP will also implement an Indigenous Fisheries Communication Plan which will provide a framework for regular operational updates to Indigenous groups as well as emergency notifications if needed.

14.6.5 Cumulative Effects Summary and Evaluation

Cumulative environmental effects on Indigenous peoples and community values are predicted to be adverse, negligible in magnitude, occurring within the VC-specific LAA, continuous in frequency, medium-term in duration, and reversible. With the application of proposed Project-related mitigation and environmental protection measures, the residual cumulative environmental effects on Indigenous peoples and community values are predicted to be not significant. With the application of standard practices for communication among marine users, and ongoing Indigenous engagement efforts from other petroleum operators in the Newfoundland offshore area, it is concluded that no additional mitigation measures beyond those in place to mitigate the Project's direct effects are needed to address potential cumulative effects.

Table 14.14 summarizes the results of the CEA for this VC.

Table 14.14 Indigenous Peoples and Community Values: Summary of Potential Cumulative Environmental Effects

Summary of Potential Cumulative Environmental Effects	
Context for Cumulative Environmental Effects	• The EIS Guidelines for the Project identify Indigenous groups in Newfoundland and Labrador, Nova Scotia, New Brunswick, Prince Edward Island and Quebec that have the potential to be affected by Project activities. • Other past and ongoing projects and activities in Eastern Canada have, to varying degrees, interacted with and affected Indigenous communities and activities, depending on their location, nature, and scale in relation to the communities, activities, and other components and interests of individual Indigenous groups. • Section 7.4 presents an overview of current socio-economic characteristics and conditions of Indigenous communities that reflects past and ongoing effects.
Residual Environmental Effects of the Project	• The Project may result in a residual adverse change in commercial communal fisheries and change in current use of lands and resources for traditional purposes. These residual effects are predicted to be not significant and the Project is not expected to result in measurable effects on socio-economic conditions for Indigenous communities or Aboriginal or treaty rights. • This significance determination has been made with a high level of confidence based on a good understanding of the general effects on commercial and traditionally harvested species inhabiting the LAA and the effectiveness of mitigation measures including those discussed in Section 12.3.
Other Projects / Activities	**Potential for Interaction with Effects of Project:**
Offshore Petroleum Production Projects (Production from Hibernia, Terra Nova, White Rose, and Hebron Oilfields)	Y – Some potential for interaction. Although operations are located at substantial distances outside of the Project Area and have localized environmental effects, the safety zones associated with other offshore petroleum production drilling projects will increase the cumulative area that will be temporarily unavailable to Indigenous fishers at any given time during Project activities. Indigenous fishers whose customary fishing grounds cover a large extent of the RAA may be sequentially exposed to the residual effects of the Project and the residual effects of one or more offshore petroleum production projects throughout the course of their fishing activities. For Indigenous fishers that do not encounter residual effects from both the Project and offshore petroleum production projects, the residual effects of the Project will nonetheless overlap spatially and temporally with the residual effects of these other physical activities in such a way (refer to Table 14.1) that contributes to cumulative effects on Indigenous peoples and community values in general within the RAA.
Offshore Petroleum Exploration – Geophysical Survey Programs	Y – Some potential for interaction, although localized and short-term nature of these activities and their effects, along with planned and required separation measures and other mitigation measures, will reduce potential for interaction. Indigenous fishers whose customary fishing grounds cover a large extent of the RAA may be sequentially exposed to the residual effects of the Project and the residual effects of one or more geophysical survey programs throughout the course of their fishing activities. For Indigenous fishers that do not encounter residual effects from both the Project and geophysical survey programs, the residual effects of the Project will nonetheless overlap spatially and temporally with the residual effects of these other physical activities in such a way (refer to Table 14.1) that contributes to cumulative effects on Indigenous peoples and community values in general within the RAA.

Summary of Potential Cumulative Environmental Effects	
Offshore Petroleum Exploration – Exploration and Delineation Drilling Programs	Y – Some potential for interaction, although localized and short-term nature of these activities and their effects, along with planned and required separation measures and other mitigation measures, will reduce potential for interaction. Indigenous fishers whose customary fishing grounds cover a large extent of the RAA may be sequentially exposed to the residual effects of the Project and the residual effects of one or more other exploration drilling projects throughout the course of their fishing activities. For Indigenous fishers that do not encounter residual effects from both the Project and other exploration drilling projects, the residual effects of the Project will nonetheless overlap spatially and temporally with the residual effects of these other physical activities in such a way (refer to Table 14.1) that contributes to cumulative effects on Indigenous peoples and community values in general within the RAA.
Commercial Fishing Activity	Y – Some potential for interaction, although these activities are restricted within portions of the Project Area and occur mostly outside of the ELs. Safety zones around Project activities will limit the potential for overlapping and concurrent environmental effects, and thus, for cumulative effects on this VC. Indigenous fishers whose customary fishing grounds cover a large extent of the RAA may be sequentially exposed to the residual effects of the Project and the residual effects of commercial fisheries throughout the course of their fishing activities. For Indigenous fishers that do not encounter residual effects from both the Project and commercial fisheries, the residual effects of the Project will nonetheless overlap spatially and temporally with the residual effects of these other physical activities in such a way (refer to Table 14.1) that contributes to cumulative effects on Indigenous peoples and community values in general within the RAA.
Hunting Activity	Y – Some potential for interaction, although these activities and their effects are highly localized and transient. Safety zones around Project activities measures will limit the potential for overlapping and concurrent environmental effects, and thus, for cumulative effects on this VC. Indigenous fishers whose customary fishing grounds cover a large extent of the RAA may be sequentially exposed to the residual effects of the Project and the residual effects of hunting throughout the course of their fishing activities. For Indigenous fishers that do not encounter residual effects from both the Project and hunting, the residual effects of the Project will nonetheless overlap spatially and temporally with the residual effects of this other physical activity in such a way (refer to Table 14.1) that contributes to cumulative effects on Indigenous peoples and community values in general within the RAA.
Other Ocean Uses	Y – Some potential for interaction, although these activities and their effects are highly localized and transient. Safety zones around Project activities measures will limit the potential for overlapping and concurrent environmental effects, and thus, for cumulative effects on this VC. Indigenous fishers whose customary fishing grounds cover a large extent of the RAA may be sequentially exposed to the residual effects of the Project and the residual effects of other ocean uses throughout the course of their fishing activities. For Indigenous fishers that do not encounter residual effects from both the Project and other ocean uses, the residual effects of the Project will nonetheless overlap spatially and temporally with the residual effects of this other physical activity in such a way (refer to Table 14.1) that contributes to cumulative effects on Indigenous peoples and community values in general within the RAA.
Cumulative Effects Summary	The residual cumulative environmental effects on Indigenous peoples and community values that have potential to occur as a result of the residual effects of the Project on the VC in combination with the residual effects of other projects or activities on the VC are predicted to be not significant.

14.7 Commercial Fisheries and Other Ocean Users

14.7.1 Context for Cumulative Environmental Effects

The Commercial Fisheries and Other Ocean Users VC, as described in Chapter 13, includes wild fisheries, with species being harvested by Canadian vessels within Canada's EEZ, and by both Canadian and non-Canadian vessels fishing outside of the EEZ, as well as other ocean activities such as offshore research, subsea communications, military training, and shipping activities that occur in offshore waters. The scope of the assessment of Project effects on commercial fisheries and other ocean users in Chapter 13 also includes Indigenous commercial communal fisheries to the extent that landings under commercial communal licences are included in aggregate commercial fishing data reported by DFO. However, for the purposes of the CEA, Indigenous commercial communal fisheries are assessed in the context of the Indigenous Peoples and Community Values VC (Section 14.6).

Commercial fisheries have potential to occur almost anywhere in the RAA, except within safety zones established by offshore petroleum operators, areas in which space-use conflicts may occur due to the presence and activities of other fishers and ocean users, and designated special areas that are subject to fisheries restrictions or closures (refer to Section 6.4). Such special areas include the Northeast Newfoundland Slope Closure marine refuge, Bonavista Cod Box, and Orphan Knoll Seamount Closure, all of which are partially overlapped by the Project Area and thus result in the closure of approximately 53% of the Project Area to bottom-contact fishing activities. Approximately 9% of the wider RAA is closed to one or more types of fisheries.

The Project Area is located within NAFO Divisions 3KLM, while the RAA overlaps portions of NAFO Divisions 2J and 3KLMNO. Fishing offshore Newfoundland and Labrador has been an important socio-economic activity for hundreds of years. Historically, the commercial fishing effort offshore was primarily concentrated on the use of large stern otter trawlers by local and international fishing fleets to harvest Atlantic cod and other groundfish, until several of the stocks collapsed and the Canadian government imposed a moratorium on the Northern cod fishery in 1992. In addition to cod, several other species of groundfish in NAFO Divisions 2+3KL are currently under moratoria, including haddock, redfish, American plaice, witch flounder, and grenadier. Considerable effort is placed on avoiding these bycatch species (DFO 2014).

As is explained in Section 7.2.8, although the latest stock assessment for Atlantic cod in NAFO Divisions 2J+3KL found that the stock has increased considerably over the last decade, the species still remains below pre-moratoria levels, and is still within the critical recovery zone (DFO 2018). Industry representatives are also cautious about the return of a commercial fishery for Atlantic cod, indicating that while the stock has increased, the species still needs further recovery before consideration can be given for a commercial fishery (CBC 2016). DFO announced that it will begin annual full stock assessments of Atlantic cod, beginning in 2018 (DFO 2017). These assessments will continue annually for five years, in an effort to more closely monitor the recovery and status of the species and determine whether a future commercial fishery for the species is viable.

Outside of applicable moratorium areas, groundfish species such as redfish, Greenland halibut (turbot), Atlantic halibut, roughhead grenadier, greysole / witch flounder, Atlantic cod, and American plaice remain key commercially harvested species in the RAA that are important for both domestic and international fleets. Other key commercially harvested species in the RAA include northern shrimp and snow crab. The stock health and stability of northern shrimp has become a growing concern for harvesters both domestically and internationally, as northern shrimp stocks have generally been in decline since 2010 and the female spawning stock has declined to within DFO's "critical zone" (refer to Section 7.2.7.1). Snow crab stocks have similarly undergone changes in recent years such that total exploitable biomass of snow crab has been in decline since 2013 and is now at its lowest observed levels (refer to Section 7.2.7.2).

The snow crab fishery uses fixed crab pots that are lowered to the sea floor and marked with a buoy to signal their presence. The northern shrimp fishery employs modified otter trawls specific to harvesting shrimp, while groundfish are fished via combination of stern trawls, gillnets (which can be fixed or mobile), and longlines. Pelagic fisheries use longline, seines, and nets, while dredges are used to harvest species such as deep-sea clams.

Potential effects of climate change on the marine environment (e.g., warming waters) may influence the species that may be harvested commercially in the future. Warming temperatures could result in more abundance and presence of larger migratory fish such as tuna and swordfish. Changes in temperatures could also cause fish species to change distribution, and some fisheries may decrease or increase as a result. This may create changes on what species are harvested, where they are harvested, and the seasonality of the harvest. These changes have the potential to take place during the temporal scope of the Project. Should a new fishery emerge, or the opening of a previously closed fishery take place, it will identified and assessed in the assessment of commercial fishing activity related to the Project (refer to Section 13).

In addition to commercial fishing activity, other ocean users also occur in the eastern Newfoundland offshore area. These include research activities undertaken by DFO annually, and by industries and other academic institutions. Military training exercises also occur offshore, along with marine shipping, subsea fibre optic cables and infrastructure, and other oil and gas activities related to exploration and development.

14.7.2 Potential Project-related Contributions to Cumulative Effects

As described in Chapter 13, routine Project activities and components have potential to interact with commercial fisheries resources either directly through effects on fishing activity itself (e.g., through displacement from fishing areas, gear loss or damage) and/or indirectly from physical or behavioural effects on species (e.g., changes in fish health or quality, fish avoiding popular areas due to noise or changes in water quality). These direct and/or indirect effects have potential to result in a demonstrated economic loss to commercial fishing interests. The same is true for other ocean users. Oil and gas activities may restrict certain areas to research or military exercises, which may result in changes in schedules, or moving to different areas. Likewise, a biological effect on fish and fish habitat (such as water quality), could indirectly affect research activities if the parameters of the research have been influenced by Project activities. In addition, the presence of the Project MODU and the establishment of Project safety zones have potential to preclude certain areas from use for the installation of new subsea infrastructure and/or the repair of existing subsea cables. Thus, the Project has potential to result in a residual change in availability of

resources for commercial fisheries and other ocean users associated with the presence and operation of the MODU, VSP surveys, Project-related discharges, well abandonment, and supply and servicing operations.

The Project-specific environmental effects assessment for this VC includes a summary of Project residual environmental effects in Section 13.3.4 and a determination of significance in Section 13.4. With the implementation of mitigation (refer to Section 13.3.2), the residual environmental effects of routine Project activities on commercial fisheries and other ocean users are predicted to be not significant.

14.7.3 Other Projects and Activities and their Effects

Table 14.15 summarizes how past, present, and future projects and activities in the RAA have potential to cause a residual change in availability of resources affecting commercial fisheries and other ocean users.

14.7.4 Potential Cumulative Environmental Effects

Similar to the cumulative effects assessed for Indigenous peoples and community values, the following cumulative environmental effect mechanisms are also applicable with respect to commercial fisheries and other ocean users:

- temporary displacement of commercial fishers from their customary fishing grounds due to establishment of a 500-m radius safety zone around the Project MODU, as well as the various safety zones associated with other exploration drilling projects, Hibernia, Terra Nova, White Rose, and Hebron
- increased competition with other displaced commercial fishers over remaining commercial fishing areas
- risk of incidents of gear loss or damage caused by the Project in combination with other physical activities in the RAA
- other general space-use conflicts (i.e., between safety zones, PSVs, geophysical survey and support vessels, commercial fishing vessels, and the vessels of other ocean users [e.g., scientific research vessels, vessels engaged in military exercises, and cable-laying or cable repair vessels])

The analysis of cumulative environmental effects provided in Sections 14.6.4 relating to Indigenous commercial communal fisheries is also directly applicable for commercial fishers and other ocean users. That section should be referred to for the assessment of potential cumulative effects related to a change in availability of resources.

Table 14.15 Commercial Fisheries and Other Ocean Users: Residual Effects from Other Projects and Activities in the RAA

Physical Activity	Potential Residual Environmental Effect(s)	Explanation of Potential Residual Environmental Effect(s)	VC-specific Spatial and Temporal Considerations (Refer to Table 14.1 for General Consideration of Potential for Spatial and Temporal Overlap)
Offshore Petroleum Production Projects (Production from Hibernia, Terra Nova, White Rose, and Hebron Oilfields)	• Change in availability of resources	• Offshore petroleum production projects have localized effects on access to commercial fisheries resources and exclude access to offshore areas by other ocean users due to the establishment of safety zones around their production facilities and associated infrastructure. • Offshore petroleum production projects also cause environmental effects on fish and fish habitat (including for commercial fisheries resources) due to the generation of underwater sound and water quality effects associated with discharges. However, these environmental effects on fish and fish habitat are generally not expected to be of sufficient magnitude, duration, or extent to affect catch rates or otherwise cause a change in availability of resources.	• Commercial fishing activity and the activities of other ocean users has been, and will continue to be, excluded within the following safety zones around production facilities and associated infrastructure for the duration of petroleum production from the Hibernia, Terra Nova, White Rose, and Hebron oilfields (Statoil 2017): - there is a collective safety zone of 53 km² around the Hibernia GBS, offloading system, and Hibernia Southern Extension, with additional zones for each flowline; - the Terra Nova safety zone extends approximately 9.26 km (5 nautical mile) from FPSO and the Terra Nova Fisheries Exclusion Zone is approximately 14 km²; - the White Rose safety zone is approximately 105 km²; and - the safety zone around Hebron is approximately 6 km² around the GBS and offloading system (similar to Hibernia) and 500 m from the centre of the deep-water site. • Refer to Table 14.5 for an overview of results from the Hibernia, Terra Nova, and White Rose 2014 EEM programs regarding effects on marine water quality and fish health, contamination, and tainting.
Offshore Petroleum Exploration – Geophysical Survey Programs	• Change in availability of resources	• It may become necessary for commercial fishers to exert a higher level of effort to achieve the same catch during seismic operations, either due to the temporary displacement of target fish species because of underwater sound from the air source array, or due to the temporary displacement of fishing vessels to accommodate seismic vessels and streamers, either of which could affect catch rates or otherwise cause a change in availability of resources for commercial fisheries. • The vessels of other ocean users may also be temporarily displaced to accommodate seismic vessels and streamers. • There is potential for fishing gear damage / entanglement because of interaction with seismic streamers. • Discharges from survey and support vessels will be made in accordance with MARPOL and are therefore unlikely to cause a change in risk of mortality or physical injury for commercial fisheries resources. Discharges may temporarily degrade water quality within a localized area around survey and support vessels, thereby potentially causing temporary behavioural effects (e.g., avoidance / displacement or attraction) for commercial fisheries resources within the immediate area.	• Although the relatively large survey areas covered by some types of offshore geophysical surveys and the known propagation of noise in the marine environment can increase the potential for spatial interactions between their effects and those of other projects and activities in the RAA, most survey activities operate for a short period of time in any one location, thus resulting in a transient and relatively short-term disturbance within localized portions of the survey area.
Offshore Petroleum Exploration – Exploration and Delineation Drilling Programs	• Change in availability of resources	• Offshore petroleum exploration drilling projects exclude access to commercial fisheries and other ocean users due to the establishment of 500-m radius safety zones around their MODUs. • Underwater sound emissions will also be generated as a result of the presence and operation of MODUs during drilling, testing and abandonment, which may cause commercial fisheries resources to temporarily avoid areas around the safety zone of the MODUs, particularly during start-up of drilling or VSP underwater sounds. Underwater sound emissions from exploration drilling also have potential to interfere with scientific research and military activities, depending on the nature of these activities. • The discharge of drill muds and cuttings may interact with marine species within a localized area as a result of sedimentation and localized changes in water quality, thereby affecting availability of commercial fisheries resources. However, these effects would primarily be expected to occur within the safety zone of the MODU, which excludes commercial fishing and other activities anyway. • Other discharges and emissions (including drilling and testing emissions) will result in temporary and localized effects on water quality around exploration wellsites. Discharges will be in accordance with the OWTG and are predicted to not adversely affect commercial fisheries resources. • It may become necessary for commercial fishers to exert a higher level of effort to achieve the same catch during VSP due to the temporary displacement of target fish species because of underwater sound, which could affect catch rates or otherwise cause a change in availability of fisheries resources for commercial fisheries.	• Residual effects from other exploration drilling programs are generally anticipated to be similar in nature and extent (including similar spatial and temporal scales) to predicted Project-related residual environmental effects on commercial fisheries and other ocean users (refer to Chapter 13). • Exploration drilling activities are typically relatively short-term and localized. This can reduce the potential for individuals and populations of commercially important species to be affected simultaneously and repeatedly by multiple physical activities. Potential interactions between exploration and delineation drilling programs and existing subsea infrastructure (e.g., cables) are expected to be negligible given the requirement for pre-drill surveys to confirm the absence of such hazards prior to drilling.

Physical Activity	Potential Residual Environmental Effect(s)	Explanation of Potential Residual Environmental Effect(s)	VC-specific Spatial and Temporal Considerations (Refer to Table 14.1 for General Consideration of Potential for Spatial and Temporal Overlap)
Commercial Fishing Activity	• Change in availability of resources	• Under a relevant licence, commercial fisheries can be carried out in any NAFO Division and Unit Area in the RAA and thus have potential to cause a change in availability of fisheries resources for competing commercial fisheries in the RAA (e.g., through displacement of competitors from their preferred fishing grounds). • If fisheries resources are not harvested sustainably, the residual environmental effects of present fishing activity in the RAA could cause a change in availability of fisheries resources for future commercial fishers due to decreased catch rates as well as resource depletion. • Fisheries also cause localized environmental effects on fish and fish habitat due to the generation of underwater sound and water quality effects associated with discharges. However, these environmental effects on fish and fish habitat are generally not expected to be of sufficient magnitude, duration, or extent to affect catch rates or otherwise cause a change in availability of fisheries resources for commercial fisheries.	• Various commercial fishing activities have potential to overlap spatially and temporally in the RAA and Project Area.
Hunting Activity	• Not applicable	• Potential effects associated with the presence and transiting of hunting vessels, including associated emissions and discharges, are equivalent to the potential effects associated with the vessels of other ocean users in the RAA and are therefore not considered separately in the CEA.	• Not applicable
Other Ocean Uses	• Change in availability of resources	• Other ocean users can occur in any NAFO Division and Unit Area in the RAA and have potential to cause a change in availability of fisheries resources for commercial fisheries through temporary displacement of commercial fishing activity (due to vessel presence) or damage to fishing gear. Other ocean users may also displace one another and create space-use conflicts (e.g., a military exercise involving multiple vessels in a concentrated area could temporarily preclude use of the area by other ocean users). • Other ocean users also cause localized environmental effects on fish and fish habitat due to the generation of underwater sound and water quality effects associated with discharges. However, these environmental effects on fish and fish habitat are generally not expected to be of sufficient magnitude, duration, or extent to affect catch rates or otherwise cause a change in availability of fisheries resources for commercial fisheries.	• The highly transitory nature of the vessels of other ocean users reduces potential residual effects on commercial fishers in any particular location and at any particular time. • The potential residual change in habitat quality and use for commercially important species associated with sensory disturbance and emissions / discharges from the vessels of other ocean users is expected to be short-term and transient at any given location.

Standard practices for communication among marine users, including the issuance of Notices to Mariners and Notices to Shipping (as appropriate), is expected to mitigate potential conflicts with fisheries as well as other ocean users. During the drilling program, BP will also implement a Fisheries Communication Plan which will provide a framework for regular operational updates to fisheries stakeholders as well as emergency notifications if needed. Ongoing implementation of the One Ocean Consultation Protocol (One Ocean 2013) by BP and other offshore petroleum operators in eastern Newfoundland's offshore area will promote effective communication between the petroleum and fishing industries and thus help mitigate potential cumulative effects on commercial fisheries.

BP will conduct a pre-drill survey at each wellsite to confirm the avoidance of subsea infrastructure (e.g., cables, UXOs, shipwrecks). This is standard practice for the industry that is expected to reduce the risk of potential damage to active subsea cables from the Project as well as other offshore petroleum exploration and production drilling projects in the RAA.

14.7.5 Cumulative Effects Summary and Evaluation

Cumulative environmental effects on commercial fisheries and other ocean users are predicted to be adverse, negligible in magnitude, occurring within the VC-specific LAA, continuous in frequency, medium-term in duration, and reversible. With the application of proposed Project-related mitigation and environmental protection measures, the residual cumulative environmental effects on commercial fisheries and other ocean users are predicted to be not significant. With the application of standard practices for communication among marine users, including Notices to Shipping, Notices to Mariners, and fisheries communication plans implemented by other offshore petroleum operators in the eastern Newfoundland offshore area, it is concluded that no additional mitigation measures beyond those in place to mitigate the Project's direct effects are needed to address potential cumulative effects.

Table 14.16 summarizes the results of the CEA for this VC.

Table 14.16 Commercial Fisheries and Other Ocean Users: Summary of Potential Cumulative Environmental Effects

Summary of Potential Cumulative Environmental Effects	
Context for Cumulative Environmental Effects	• The Project Area is located within NAFO Divisions 3K and 3L, while the RAA overlaps portions of NAFO Divisions 3KLMNO and 2J. • Historically, the commercial fishing effort offshore was primarily concentrated on the use of large stern otter trawlers by local and international fishing fleets to harvest Atlantic cod and other groundfish, until several of the stocks collapsed and the Canadian government imposed a moratorium on the northern cod fishery in 1992. In addition to cod, several other species of groundfish in NAFO Divisions 2+3KL are currently under moratorium, • Key commercially harvested species that are important for both domestic and international fleets include northern shrimp, and snow crab, and groundfish (for species and locations not under moratorium). • In addition to commercial fishing activity, other ocean users also occur in the eastern Newfoundland offshore area, including those involved in activities related to scientific research, military training, marine shipping, subsea fibre optic cables and infrastructure, and oil and gas exploration and development activities.
Residual Environmental Effects of the Project	• The Project may result in a residual adverse change in availability of resources. These residual effects are predicted to be not significant. • This significance determination has been made with a high level of confidence based on the current knowledge of the offshore environment and interactions between oil and gas and other industries offshore, analysis of scientific literature and EEM results that exist specific to offshore Newfoundland and Labrador projects within the RAA, and analysis of current fishing activity with the Project Area.
Other Projects / Activities	**Potential for Interaction with Effects of Project:**
Offshore Petroleum Production Projects (Production from Hibernia, Terra Nova, White Rose, and Hebron Oilfields)	Y – Some potential for interaction. Although operations are located well outside of the Project Area and have localized environmental effects, the safety zones associated with other offshore petroleum production drilling projects will increase the cumulative area that will be temporarily unavailable to commercial fishers at any given time during Project activities. Commercial fishers whose customary fishing grounds cover a large extent of the RAA and other ocean users that conduct activities over a large extent of the RAA may be sequentially exposed to the residual effects of the Project and the residual effects of one or more offshore petroleum production projects throughout the course of their activities. For commercial fishers and other ocean users that do not encounter residual effects from both the Project and offshore petroleum production projects, the residual effects of the Project will nonetheless overlap spatially and temporally with the residual effects of these other physical activities in such a way (refer to Table 14.1) that contributes to cumulative effects on commercial fisheries and other ocean users in general within the RAA.

Summary of Potential Cumulative Environmental Effects	
Offshore Petroleum Exploration – Geophysical Survey Programs	Y – Some potential for interaction, although localized and short-term nature of these activities and their effects, along with planned and required separation measures and other mitigation measures, will reduce potential for interaction. Commercial fishers whose customary fishing grounds cover a large extent of the RAA and other ocean users that conduct activities over a large extent of the RAA may be sequentially exposed to the residual effects of the Project and the residual effects of one or more geophysical survey programs throughout the course of their activities. For commercial fishers and other ocean users that do not encounter residual effects from both the Project and geophysical survey programs, the residual effects of the Project will nonetheless overlap spatially and temporally with the residual effects of these other physical activities in such a way (refer to Table 14.1) that contributes to cumulative effects on commercial fisheries and other ocean users in general within the RAA.
Offshore Petroleum Exploration – Exploration and Delineation Drilling Programs	Y – Some potential for interaction, although localized and short-term nature of these activities and their effects, along with planned and required separation measures and other mitigation measures, will reduce potential for interaction. Commercial fishers whose customary fishing grounds cover a large extent of the RAA and other ocean users that conduct activities over a large extent of the RAA may be sequentially exposed to the residual effects of the Project and the residual effects of one or more other exploration drilling projects throughout the course their activities. For commercial fishers and other ocean users that do not encounter residual effects from both the Project and other exploration drilling projects, the residual effects of the Project will nonetheless overlap spatially and temporally with the residual effects of these other physical activities in such a way (refer to Table 14.1) that contributes to cumulative effects on commercial fisheries and other ocean users in general within the RAA.
Commercial Fishing Activity	Y – Some potential for interaction, although these activities are restricted within portions of the Project Area and occur mostly outside of the ELs. Safety zones around Project activities will limit the potential for overlapping and concurrent environmental effects, and thus, for cumulative effects on this VC. Commercial fishers whose customary fishing grounds cover a large extent of the RAA and other ocean users that conduct activities over a large extent of the RAA may be sequentially exposed to the residual effects of the Project and the residual effects of commercial fisheries throughout the course of their activities. For commercial fishers and other ocean users that do not encounter residual effects from both the Project and commercial fisheries, the residual effects of the Project will nonetheless overlap spatially and temporally with the residual effects of these other physical activities in such a way (refer to Table 14.1) that contributes to cumulative effects on commercial fisheries and other ocean users in general within the RAA.
Hunting Activity	Y – Some potential for interaction, although these activities and their effects are highly localized and transient. Safety zones around Project activities measures will limit the potential for overlapping and concurrent environmental effects, and thus, for cumulative effects on this VC. Commercial fishers whose customary fishing grounds cover a large extent of the RAA and other ocean users that conduct activities over a large extent of the RAA may be sequentially exposed to the residual effects of the Project and the residual effects of hunting throughout the course of their activities. For commercial fishers and other ocean users that do not encounter residual effects from both the Project and hunting, the residual effects of the Project will nonetheless overlap spatially and temporally with the residual effects of this other physical activity in such a way (refer to Table 14.1) that contributes to cumulative effects on commercial fisheries and other ocean users in general within the RAA.

Summary of Potential Cumulative Environmental Effects	
Other Ocean Uses	Y – Some potential for interaction, although these activities and their effects are highly localized and transient. Safety zones around Project activities measures will limit the potential for overlapping and concurrent environmental effects, and thus, for cumulative effects on this VC. Commercial fishers whose customary fishing grounds cover a large extent of the RAA and other ocean users that conduct activities over a large extent of the RAA may be sequentially exposed to the residual effects of the Project and the residual effects of other ocean uses throughout the course of their activities. For commercial fishers and other ocean users that do not encounter residual effects from both the Project and other ocean uses, the residual effects of the Project will nonetheless overlap spatially and temporally with the residual effects of this other physical activity in such a way (refer to Table 14.1) that contributes to cumulative effects on commercial fisheries and other ocean users in general within the RAA.
Cumulative Effects Summary	The residual cumulative environmental effects on commercial fisheries and other ocean users that have potential to occur as a result of the residual effects of the Project on the VC in combination with the residual effects of other projects or activities on the VC are predicted to be not significant.

14.8 Monitoring and Follow-up

Monitoring or follow-up programs that have been identified and described for VCs as part of the Project-specific environmental effects assessment (Chapters 8 to 13) would be relevant to cumulative environmental effects, in that they are relevant to the Project's potential contribution to cumulative environmental effects in the region. No additional or revised monitoring or follow-up is required or proposed related specifically to potential cumulative environmental effects.

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