8.0 ASSESSMENT OF POTENTIAL EFFECTS ON MARINE FISH AND FISH HABITAT

Marine fish and fish habitat has been selected as a valued component (VC) in consideration of ecological (e.g., ecosystem functioning, food web linkages) and socio-economic importance (e.g., commercial, recreational and Indigenous fisheries), potential interactions with Project activities and components, regulatory considerations, and requirements in the Environmental Impact Statement (EIS) Guidelines.

Marine fish and fish habitats are primarily subject to conservation and protection under the *Fisheries Act* and associated regulations. “Fish” as defined under the *Fisheries Act* includes any parts of and life history stages of fish, shellfish, crustaceans and marine animals (Government of Canada 2019a). “Fish habitat” includes water frequented by fish and other areas (e.g., spawning, nursery, rearing, food supply, and migration areas) that fish depend upon directly or indirectly to carry out life processes (Government of Canada 2019a). “Marine plants” are also protected under the *Fisheries Act* and include algae, marine flowering plants, and phytoplankton (Government of Canada 2019a). The Project Area depths are generally beyond the range for marine flowering plants and macroalgae; however, phytoplankton is the base for many marine food webs and is an important biotic component of marine fish and fish habitat. There are also protections for aquatic species under the List of Wildlife Species at Risk in Schedule 1, under the *Species at Risk Act* (SARA) (Government of Canada 2019b), including designating critical habitat for species that are Threatened or Endangered. The *Oceans Act* (Government of Canada 2019c) provides protections and regulates activities related to marine protected areas. Further information on special areas including marine protected areas are discussed in Section 6.4 and Chapter 11.

Project activities and components occurring in the marine environment may influence the biological and physical components of the marine ecosystem. This includes the marine fish, marine plants, and the associated habitats upon which they depend. The Project Area and surrounding areas include shelf, slope, and abyssal marine habitats that support plankton and assemblages of fish and invertebrates. The existing physical and biological environments for the Project Area and surrounding areas are characterized in Chapters 5 and 6 and include overviews of environmental linkages, key species, species at risk (SAR), and species of Indigenous or socio-economic importance. The existing environment is inherently considered as part of the effects assessment of Project activities. The Marine Fish and Fish Habitat VC is linked to the Marine Mammals and Sea Turtles VC (Chapter 9) and Marine and Migratory Birds VC (Chapter 10) through food web interactions (e.g., prey species), and Special Areas VC (Chapter 11) as the components on which the areas were designated. This VC is also linked to Commercial Fisheries and Other Ocean Uses VC (Chapter 12), and Indigenous Peoples and Communities VC (Chapter 13) as the target species for fishery resources.

BHP

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, Local Assessment Area (LAA), and Regional Assessment Area (RAA). The Government of Canada manages fish stocks within the 200 nautical mile Exclusive Economic Zone (EEZ) from the Canadian coastline. Within these areas, the Canadian federal *Fisheries Act* provides protection to fisheries by managing the fish resources and habitats that support these activities. The Northwest Atlantic Fisheries Organization (NAFO) is an intergovernmental fisheries science and management body for fisheries resources in the Northwest Atlantic, including outside the Canadian EEZ.

Sections 34 and 35 of the *Fisheries Act* focus on protecting fish and fish habitat. This includes prohibition against the serious harm to fish, death of fish, or harmful alteration, disruption, or destruction of fish habitat unless authorized by the Minister of Fisheries and Oceans. Section 36 of the *Fisheries Act* also prohibits the deposition of a deleterious substance in waters frequented by fish.

Marine fish SAR are protected under the federal 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 provincial Newfoundland and Labrador *Endangered Species Act* (NL ESA). A list of marine fish SAR that may occur in the Orphan Basin is provided in Section 6.1.8.

8.1.2 The Influence of Consultation and Engagement on the Assessment

During BHP's Project-related engagement with government departments and agencies, stakeholder organizations and Indigenous groups questions and comments about marine fish and fish habitat were documented (see Chapter 3 for further details). Concerns raised were primarily related to adverse effects from both routine operations and accidental events on migratory species and the inclusion of Indigenous traditional and ecological knowledge in the environmental assessment. Atlantic salmon and other culturally important species (including American eel, swordfish, tuna, ground fish, lobster, crab) were noted of particular concern by the Indigenous communities regarding loss or harm to species of importance.

8.1.3 Potential Effects, Pathways and Measurable Parameters

Potential interactions between planned offshore oil and gas exploration 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 mobile offshore drilling units (MODUs) and Project support vessels (PSVs), with increased potential for injury, mortality, contamination, and other interactions
- Temporary avoidance of areas by marine fish due to exposure to underwater sound or other disturbances, that 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 vertical seismic profiling (VSP) survey activity

These interactions also reflect consultations with government departments and agencies, stakeholder organizations, and Indigenous groups associated with the marine fish and fish habitat (Section 8.1.2). 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 availability, quality, and use

These effects reflect *Fisheries Act* prohibitions against causing serious harm to fish or habitat alteration, disruption and destruction 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 15.6.1.

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 direct interactions with individuals (e.g., smothering as a result of deposition of cuttings/drill muds) or indirectly through a change in habitat quality (degradation of habitat quality affecting fish health)	• Mortality (may be either direct measurement or qualitative) focused on population level changes

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 habitat availability, quality and use	• Direct Project effects on habitat availability and quality through deposition of cuttings / drill muds, effects on water quality from biocides, wastewater, drill cuttings plume • Direct effects on prey availability from effects on lower trophic levels due to waste discharges, presence of infrastructure • Effects of Project components that may result in attraction or avoidance by fish species including lighting, food availability, foraging conditions, sound, and others	• Distribution of drill cuttings and area of seabed infrastructure • Amount and quality of habitat types • Areal extent of changes in water or sediment quality • Zone of influence for underwater noise and light emissions • Species abundance and presence • Spatial and temporal distribution patterns of various life history stages

8.1.4 Boundaries

The spatial and temporal boundaries associated with the assessment of the potential effects of routine Project activities on marine fish and fish habitat are described 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 Exploration Licences (ELs) in the Project Area. The Project Area includes EL 1157 and EL 1158 with a buffer of approximately 20 km.

Local Assessment Area (LAA): The LAA (Figure 8-1) is defined as the area within which potential residual environmental effects on marine fish and fish habitat due to routine Project activities can be predicted with reasonable levels of accuracy and confidence. The LAA includes the Project Area and areas adjacent to it within which residual environmental effects on the marine fish and fish habitat due to routine Project activities are expected to occur. The occurrence of these effects are based on available information, including effects thresholds, predictive modelling, and professional judgement. Note that the LAA also includes vessel 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.

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. BHP is currently planning up to 20 wells proposed from 2021 to 2028. 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 35 to 115 days to drill. VSP surveys typically take approximately one to two days with sound source firing often limited to just a few hours. Drilling operations will not be continuous throughout the entire nine-year temporal scope of the Project and will depend partially on various factors including weather, MODU availability and results from previous wells. While drilling activities have the potential to be conducted at any time of the year, BHP's preference is to conduct drilling in ice-free months.

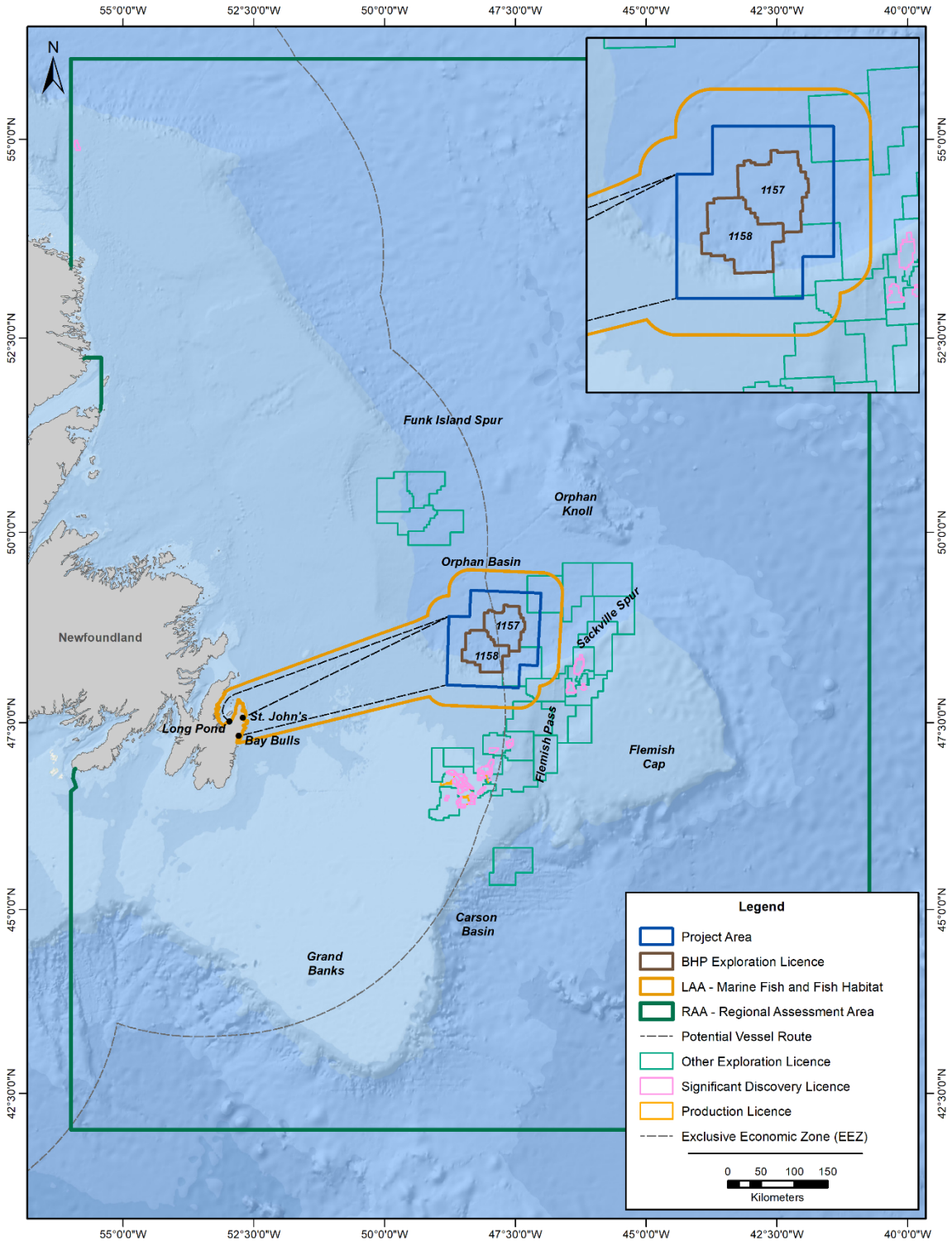

Figure 8-1 Marine Fish and Fish Habitat Spatial Boundaries

8.1.5 Residual Effects Characterization

Characterizations of the residual environmental effects used in this assessment on fish and fish habitat are defined in Table 8.2. These characterizations describe potential residual environmental effects on fish and fish habitat due to routine Project activities. These same characterizations are also used for the assessment of potential residual environmental effects on fish and fish habitat due to accidental events (see Section 15.6.1).

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 existing conditions	**Positive** – a residual environmental effect that moves measurable parameters in a direction beneficial to Marine Fish and Fish Habitat relative to existing conditions **Adverse** – a residual environmental effect that moves measurable parameters in a direction detrimental to Marine Fish and Fish Habitat relative to existing conditions **Neutral** – no net change in measurable parameters for Marine Fish and Fish Habitat relative to existing conditions
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	**Project Area** – 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 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 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 existing conditions unlikely

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

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
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 pre-Project 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 LAA, not adversely affected by human activity, or is likely able to assimilate the additional change **Disturbed** – The VC has been substantially previously disturbed by human development or human development is still present in the LAA, or the VC is likely not able to assimilate the additional change

8.1.6 Significance Definition

Based on the descriptors listed in Table 8.2, as well as requirements under SARA and associated regulation and recovery, the following criteria have been established to define a Project-related significant adverse residual environmental effect on marine fish and fish habitat:

- A residual environmental effect that causes a significant decline in either abundance or change in distribution of fish populations within the RAA, such that natural recruitment may not re-establish the population(s) to its original level within one generation
- A residual environmental effect that jeopardizes the achievement of self-sustaining population objectives or recovery goals for SAR
- A residual environmental effect that results in permanent and irreversible loss of critical habitat as defined in a recovery plan or an action strategy
- A residual environmental effect that results in serious harm to fish or fish habitat (as defined by the *Fisheries Act*) that is either unauthorized, unmitigated, or not compensated through offsetting measures in accordance with Fisheries and Oceans Canada's (DFO) Fisheries Protection Policy Statement (DFO 2019a)

8.2 PROJECT INTERACTIONS WITH MARINE FISH AND FISH HABITAT

Table 8.3 identifies, for each potential effect, the physical activities that might interact with marine fish and fish habitat and result in the identified environmental effect. These interactions are indicated by check mark 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 the table.

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

Physical Activities	Environmental Effects	
	Change in Risk of Mortality, Injury or Health	**Change in Habitat Availability, Quality and Use**
Presence and operation of a MODU (including drilling, associated safety zone, lights, and sound)	✓	✓
VSP	✓	✓
Discharges (e.g., drill muds / cuttings, liquid discharges)	✓	✓
Well Testing and Flaring (including air emissions)	-	-
Well Decommissioning and Abandonment or Suspension	-	✓
Supply and Servicing Operations (including helicopter transportation and PSV operations)	-	✓

Notes:
✓ = Potential interaction
– = No interaction

If substantial hydrocarbons are indicated during exploration drilling, well flow testing may be conducted to establish the viability and commercial potential of the geological formation. Well evaluation is an important component of exploration drilling to determine the viability of a prospect and the commercial potential of the reservoirs. 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). Produced water generated will be sent to the MODU's flare, treated for disposal in accordance with the Offshore Waste Treatment Guidelines (OWTG) (National Energy Board (NEB) et al. 2010), 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 habitat availability and quality. During well evaluation and testing activities, the atmospheric, lighting, and thermal 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 PSVs are addressed under the potential environmental effects from the presence and operation of a MODU.

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 fishes and invertebrates. Although the specific well abandonment program has not yet been defined (refer to Section 2.4.4), well abandonment is anticipated to have reduced interaction with habitat quality and use for marine fishes and invertebrates. The potential effects of well abandonment activities on habitat quality and use are discussed in Section 8.3.2.3.

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. 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 sounds produced by helicopters into the marine environment is related primarily to the aircraft altitude and sea surface conditions (Richardson et al. 1995). Underwater noise from helicopters is generally most intense just below the water surface and directly beneath the aircraft, with sounds attenuating over shorter distances than airborne sounds (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 (e.g., sharks and tunas) may elicit a similar, brief behavioural response. Therefore, helicopter operations will have limited interaction with the marine environment and associated marine fish species. Marine fish are not expected to be exposed to underwater sound levels from PSV traffic for sufficient durations that would result in injury or mortality (Popper et al. 2014). Fish species in the water column would temporarily avoid immediate areas nearby PSV traffic, further reducing the risk of fish injury or mortality because of vessel strikes or propeller blade contact. Supply and servicing operations could result in a change in habitat quality and use from waste discharges and is discussed in Section 8.3.2.3.

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 that may arise from potential interactions in Table 8.3. The EIS incorporates information from previous Environmental Assessment (EA) documents for similar exploration drilling projects and regional Strategic Environmental Assessments (SEAs) in the Northwest Atlantic, including comments received during Indigenous and stakeholder review processes.

8.3.1 Change in Risk of Mortality, Injury or Health

8.3.1.1 Project Pathways

A change in risk of mortality of physical injury for individual marine fishes and invertebrates 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 and invertebrate species, and VSP operations will also temporarily generate increased sound levels. If fishes and invertebrates near the VSP array do not move away from the airgun array before being exposed to high sound levels, these sound levels may result in mortality or physical injury from acute changes in sound pressure and/or particle motion. Artificial lighting emissions from the MODU may also increase predation and foraging opportunities for fish. Aquatic invasive species may be transported through ballast water or on the hulls of ships and the MODU. Introduction of invasive species may compete for food resources, potentially resulting in changes to fish health.

8.3.1.2 Mitigation

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 related to a change in risk of mortality, injury or health. The mitigation measures below are in consideration of the environmental effects pathway,

standard proven mitigation measures (e.g., AMEC 2014, BP 2018, Nexen 2018), and regulations and guidelines that govern offshore activities.

Presence and Operation of a MODU

- BHP will conduct a visual seabed survey in the vicinity of wells sites confirming the absence of shipwrecks, debris on the seafloor, unexploded ordnance and sensitive environmental features, such as habitat-forming corals or species at risk (SAR) to be used in conjunction with the geohazard assessment based on existing data. The survey will be developed in consultation with the C-NLOPB and DFO and will be carried out prior to drilling under a separate environmental approval by the C-NLOPB. If substantial environmental or anthropogenic sensitivities are identified during the survey, BHP will move the well site to avoid affecting them if it is feasible to do so. If it is not feasible, BHP will consult with the C-NLOPB and DFO to determine an appropriate course of action.

- Lighting will be limited to the extent that worker safety and safe operations is not compromised. Measures may include avoiding use of unnecessary lighting, shading, and directing lights towards the deck.

- Ballast water will be discharged according to the International Maritime Organization (IMO) *Ballast Water Management Regulations* and Transport Canada's *Ballast Water Control and Management Regulations*. The MODU will carry out ballast tank flushing prior to arriving in Canadian waters.

Vertical Seismic Profiling

- VSP activity 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* (DFO 2007). 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 VSP activity begins.

Discharges

- Selection of drilling chemicals will be in accordance with the Offshore Chemical Selection Guidelines (OCSG) for Drilling and Production Activities on Frontier Lands (NEB et al. 2009), which provides a framework for chemical selection to reduce potential for environmental effects. During planning of drilling activities, where feasible, lower toxicity drilling muds and biodegradable and environmentally friendly additives within muds and cements will be preferentially used. Where feasible the chemical components of the drilling fluids will be those that have been rated as being least hazardous under the Offshore Chemical Notification System (OCNS) scheme and Pose little or no risk to the environment (PLONOR) by the Convention for the Protection of the Marine Environment of the North-East Atlantic.

- Offshore waste discharges and emissions associated with the Project (i.e., operational discharges and emissions from the MODU and PSVs) will be managed in accordance with relevant regulations and municipal bylaws as applicable, including the Offshore Waste Treatment Guidelines [OWTG]) (NEB et al. 2010) and MARPOL, of which Canada has incorporated provisions under various sections of the *Canada Shipping Act*. Waste discharges not meeting legal requirements will not be discharged to the ocean and will be brought 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.

- Discharges of SBM and cuttings will be managed in accordance with the OWTG. SBM cuttings will only be discharged once the performance targets in OWTG of 6.9 g/100 g or less oil on wet solids can be satisfied. The concentration of synthetic oil on cuttings will be monitored on the MODU for compliance with the OWTG. In accordance with OWTG, no excess or spent SBM will be discharged to the sea. Spent or excess SBM that cannot be re-used during drilling operations will be brought back to shore for disposal (see Section 2.8.3.1).

- Putrescible solid waste, specifically food waste generated offshore on the MODU and PSVs, will be disposed of according to OWTG and MARPOL requirements. Food waste will be macerated so that particles are less than 6 mm in diameter and then discharged. There will be no discharge of macerated food waste within 3 nautical miles from land.

- Transfer of hazardous wastes will be conducted according to the *Transportation of Dangerous Goods Act.* Applicable approvals for the transportation, handling and temporary storage, of these hazardous wastes will be obtained as required.

Well Decommissioning and Abandonment or Suspension

- Once wells have been drilled to True Vertical Depth (TVD) and well evaluation programs completed (if applicable), the well will be plugged and abandoned in line with applicable BHP practices and C-NLOPB requirements. The final well abandonment program has not yet been finalized; however, these details will be confirmed to the C-NLOPB as planning for the Project continues.

- BHP plans to conduct a post-drilling visual survey of the seafloor using a remotely operated vehicle (ROV) after drilling activities to assess the visual extent of sediment dispersion and validate the modelling for the discharges of drill mud and cuttings.

8.3.1.3 Characterization of Residual Project-related Environmental Effects

Presence and Operation of a MODU

An operational MODU will generate continuous underwater sound, principally from the dynamic positioning system and drilling operations. The sound associated with an operational MODU will propagate through the water column and perhaps the seabed as well, potentially causing some behavioural disturbance to marine fishes and invertebrates occurring in the vicinity of the MODU. Based on sound modelling that included three MODU types (i.e., generic drill ship, Stena Forth, and semi-submersible drill rig), received sound pressure levels (SPLs) in the water column from the MODU sound sources will not exceed 150 dB re 1 µPa rms beyond 280 m from source. This received SPL is considered a conservative value for the minimum received level that could evoke behavioural responses from fishes that can detect sound pressure. The deepest that a 150 dB re 1 µPa rms received level is predicted to occur is 100 m. These modelling results include all scenarios (i.e., both sites and both time periods). Based on available scientific literature, it is unlikely that exposure to MODU sound would result in either physical injury or mortality to fishes and invertebrates.

It is generally recognized that the establishment of a single-sound exposure criterion for marine fishes to predict physical and behavioural changes is impossible given the variability of characteristics of the different types of anthropogenic sound, and inter- and intraspecific differences in how fishes detect sound and are affected by it (Popper et al. 2014). Given that direct evidence of mortality or potential injury to fishes due to exposure to sound from vessels is lacking, Popper et al. (2014) proposed qualitative risk guidelines based on distance between the fishes and the sound source. They concluded that for all three fish types (i.e., without swim bladder, with swim bladder not involved in hearing, and with swim bladder involved in hearing), the risk for mortality and potential injury for fishes is low, regardless of distance from the continuous sound source. Popper et al. (2014) also indicated that the risk of mortality, potential injury and recoverable injury effects on ichthyoplankton is low, regardless of distance from the sound source.

Popper et al. (2014) discussed scientific evidence for continuous underwater sound causing temporary thresholds shifts (TTS) and auditory tissue effects in goldfish (*Carassius auratus*) and catfish (*Pimelodus pictus*), both being highly pressure sensitive species that use their swim bladders in hearing. Smith et al. (2006) observed a maximum TTS of approximately 16 dB and recoverable loss of sensory hair cells in the ear of goldfish after 48 hours of exposure to white noise with a SPL of 170 dB re 1 µPa rms. Recovery of TTS required seven days while replacement of affected sensory cells required eight days. Another study by Amoser and Ladich (2003) observed a 26 dB TTS in goldfish and a 32 dB TTS in catfish following 12 hours of exposure to white noise with a SPL of 158 dB re 1 µPa rms. The hearing thresholds for the goldfish and catfish recovered within three days and 14 days, respectively. It is important to note that all fishes and invertebrates are able to detect the particle motion component of underwater sound while only some fishes and no invertebrates can detect the sound pressure component of sound (Hawkins et al. 2015; Nedelec et al. 2016; Hawkins and Popper 2016; Popper and Hawkins 2018, 2019).

The source SPLs associated with the three MODU types used in the acoustic modeling (Alavizadeh and Deveau 2019) for this Project ranged from 189.7 to 196.8 dB re 1 µPa rms. Using the 158 dB re 1 µPa rms received SPL reported in Amoser and Ladich (2003) as the reference point, modeling results indicate that received levels of 150-160 dB re 1 µPa rms from the three MODU types would occur approximately 100-300 m from the sound source (Alavizadeh and Deveau 2019). Therefore, the potential for recoverable injury and/or TTS would be localized. Mobile fishes would potentially respond to lower received levels and move away from the sound source, thereby limiting potential for temporary injury to individual fish and subsequently adverse effects on fish populations.

Chronic effects result from exposure to continuous sound over long time periods, not necessarily at high levels, and may result from increased shipping or other human activities. The sounds resulting in chronic effects are often continuously generated over large areas, where the overall level of sound in the area is higher than the natural background level (Hawkins et al. 2015). Other recommended scientific papers that review the interactions of underwater sound, including continuous sound, with fishes and invertebrates are Hawkins and Popper (2016) and Popper and Hawkins (2019). These reports use fish in laboratory conditions that are unable to move away from sound as would be possible under natural conditions. They conclude by stating the need for further research to determine longer-term effects of exposure to continuous sound on individual and population fitness.

Artificial lighting around the MODU may attract phototaxic plankton and may provide increased opportunities for predation by fish and other species (Keenan et al. 2007, Cordes et al. 2016). Depending

on the site and structures, light levels of studied platforms decreased to background levels within the sampling area (250 m from source) below 5 and 10 m water depth (Keenan et al. 2007). Potential effects of artificial lighting from the MODU are generally localized from hundreds of meters to less than 1.5 km from the light source (Keenan et al. 2007; Simonsen 2013; Foss 2016).

Introduced invasive species may compete with local species for resources (e.g., food) that may result in a change to fish health. Aquatic invasive species may be transmitted through attachment to the hulls of vessels or through discharge of ballast water. The MODU or PSVs may also provide 'stepping stone' habitat that increases the range of colonizing invasive invertebrates that do not typically spread across large expanses of open water (Cordes et al. 2016). With application of standard mitigation measures (e.g., *Ballast Water Regulations*) for prevention and mitigation of spread of invasive species, potential spread of invasive species is low.

Drilling could occur at any time of the year and the sound generated would be continuous during the drilling of each well (approximately 35 to 115 days per well). Based on available science in this field, the residual environmental effects resulting in increased risk of mortality and physical injury to marine fish and fish habitat exposed to light and sound emanating from an operational MODU is predicted to be adverse, low in magnitude, restricted to the Project Area, medium-term in duration, to occur more than once at irregular intervals, and reversible.

Vertical Seismic Profiling

VSP is expected to generate the highest levels of underwater sound associated with the Project. Based on sound modelling results, received SPLs in the water column from the VSP sound sources will exceed 150 dB re 1 µPa rms as far as 30.6 km from the sound source (specific to VSP at Site B in August) along the 90° azimuth. The distances from the VSP source to a received SPL of 150 dB re 1 µPa rms varies widely by site, month, azimuth and water depth. Generally, the greatest distances are predicted during August (maximum of 30.6 km) while the range of distances to received SPLs that exceed 150 dB re 1 µPa rms during February is 5.2 to 14.3 km. The depths where the maximum received SPLs occur range from 5 m to sea bottom, generally increasing with distance from the VSP source. While intense, the VSP sound source will be activated intermittently, with survey operations occurring over a relatively short period of time, approximately one to two days for each well. VSP surveys may be conducted as required throughout the life of the Project. Although Popper et al. (2014) propose threshold values in terms of both SPL and sound exposure level (SEL) for received sound from airgun 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). Sound modeling for VSP activities was based on a Dual Delta 1,200 in^3airgun array (Alavizadeh and Deveau 2019). Popper et al. (2014) proposed seismic airgun threshold guideline SPLs associated with mortality, potential injury and recoverable injury to fishes ranging from 207 to 213 dB re 1 µPa peak, depending on 'hearing class' of fish. Modeling results indicate that received levels of 207 to 213 dB re 1 µPa peak (approximately 201-207 dB re 1 µPa rms) from the VSP airgun array would occur within 60-70 m of the sound source (Alavizadeh and Deveau 2019).

It is unlikely that VSP sound levels received by mobile fishes would cause mortality or physical injury to them given their capability of moving away from the sound source once behaviour affecting levels are detected. A ramp-up period for the VSP source will be conducted during onset of the survey with the

intention of warning nearby biota and allowing them to move away from the sound source before SPLs high enough to potentially cause injury are received. In contrast to full 2D and 3D seismic surveys, the VSP source is stationary so mobile fishes and invertebrates would not likely be subjected to cumulative exposures. However, low-mobility fishes and sessile invertebrates occurring in the immediate area of a VSP source would be exposed numerous times to relatively consistent levels of sound during a VSP survey. A mitigating factor is the case that while all fishes and invertebrates are able to detect the particle motion component of underwater sound, only some fishes and no invertebrates can detect the sound pressure component of sound.

Marine plankton, including ichthyoplankton, could also be affected physically by sound emitted during VSP activities. But current science suggests that this might happen only if the biota occur immediately adjacent to the sound source (i.e., a few metres) (Kostyuchenko 1973, Booman et al. 1996, Østby et al. 2003, in Boertmann and Mosbech 2011). Popper et al. (2014) suggested that potential mortality or physical injury to ichthyoplankton exposed to seismic airgun sound might result from a cumulative SEL >210 dB re 1 µPa²s or peak SPLs >207 dB re 1 µPa. As noted, the seismic airgun received sound level guidelines presented by Popper et al. (2014) are based on experimentation using pile driving as the sound source. Although pile driving sound is also impulsive, some of its characteristics are different from those associated with seismic airgun sound. A relatively recent publication by McCauley et al. (2017) suggested that zooplankton exposed to the sound emitted by a single airgun (150 in^3) might be subject to physical injury and even mortality within 1.2 km of the airgun source. However, this study has been questioned by many scientists with expertise in this field so reported results are tenuous at best (e.g., Richardson et al. 2017, Fields et al. 2019). As a follow up to the McCauley et al. (2017) study, Richardson et al. (2017) modeled the impact of exposure to airgun sound on zooplankton over larger temporal and spatial scales. Results indicated that individual zooplankton could be impacted at a local scale (i.e., close to airgun source) but that it is unlikely that significant impact on zooplankton populations would occur. There is also evidence that suggests developing scallop larvae exposed to airgun sound could experience increased mortality risk due to body malformation (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).

Based on available science in this field, the residual environmental effects resulting in increased risk of mortality and physical injury to marine fish and fish habitat exposed to underwater sound emanating from a VSP airgun source is predicted to be adverse, low in magnitude, restricted to the Project Area, short-term in duration, to occur more than once at irregular intervals, and reversible.

Discharges

Potential discharges from an offshore exploration drilling program include drill mud and cuttings discharge from the MODU and liquid discharges from the MODU and PSVs. Drill mud and cuttings discharge is the primary potential adverse environmental effect to benthic environments associated with exploration drilling. Other potential liquid discharges from offshore PSVs 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 and associated standards and guidelines. Adherence to guidelines are not expected to result in significant effects to the environment (NEB et al. 2010).

Waste that cannot be discharged overboard will be stored and transported to shore for disposal in an approved facility (Section 2.7). If a biocide is used to treat seawater used for cooling purposes on the MODU, chemical selection will be in accordance with the OCSG. Produced water typically accounts for the largest volume of waste from offshore oil and gas production operations and is less of a concern for exploration drilling where small volumes of produced water may only be generated during a formation flow test (Lee and Neff 2011; DFO 2019b). Small amounts of produced water may be flared if BHP conducts a formation flow test.

Initial drilling will be conducted with WBM and then SBM once the riser is installed. SBM cuttings are returned to the MODU for treatment and eventual disposal overboard. Discharges to the seafloor are primarily WBM cuttings associated with riserless drilling and drilling of top hole sections. These discharges will result in turbidity and suspended sediment effects in the water column near the seafloor and a drill mud and cuttings deposition area on the seabed. Larger particles and flocculated material typically settle quickly after discharge, forming a deposition area that is generally localized to the well head (Ragnarsson et al. 2017). Sessile or low mobility benthic invertebrates have higher potential for effects from drill mud and cuttings relative to mobile fish and invertebrates that can avoid suspended sediments and deposition areas. The potential effects from toxicity and bioaccumulation effects from WBM and SBM cuttings are low. However, physical and indirect effects from drill cuttings may have effects on fish mortality, injury and health.

The potential effects on the water column are generally non-persistent and temporary with the rapid dilution and dispersal of drill mud and cuttings (Koh and Teh 2011; IOGP 2016). In a drill cuttings modelling study in the south China Sea, suspended solid levels returned to background levels hours after the discharge ceased (Koh and Teh 2011). Potential risk of injury is also reduced in pelagic or demersal fish and mobile invertebrates that usually avoid or move away from plumes of suspended drill cuttings (IOGP 2016). Although elevated turbidity levels from suspended solids may decrease light exposure to phytoplankton required for photosynthesis, such concentrations would be limited to within 25 m of the discharge source (IOGP 2016). Low mobility marine water column organisms (e.g., zooplankton, ichthyoplankton) that are unable to avoid exposure to turbidity and suspended solids can experience temporary physical effects (interference with respiration and feeding) (IOGP 2016). However, these effects are typically localized to the immediate area surrounding the discharge site (IOGP 2016). Therefore, near surface drill cuttings discharges are unlikely to have effects on the pelagic zone or the transfer of organic particulate matter from the pelagic zone to benthic areas. Suspension feeding benthic invertebrates (e.g., bivalves, corals, sponges) are considered more sensitive to direct exposure to suspended drill cuttings with their low capacity for avoidance. Benthic organisms associated with fine sediment environments generally have some ability for tolerance of suspended and settled sediments sediment (Smit et al. 2006, 2008, Bell et al. 2015, Kutti et al. 2015). Prolonged use of mechanisms for tolerating suspended sediments (e.g., reduced respiration, reduced feeding, sediment clearing) may also lead to sublethal and reduced growth effects (Smit et al. 2008; Larsson and Purser 2011; Bell et al. 2015; Ragnarsson et al. 2017). However, this would be species specific and depend on local oceanographic processes, exposure levels, and recovery times. *Geodia barretti*, a northwest Atlantic sponge species, reduces filter feeding when exposed to suspended sediments greater than 100 mg/L, thus decreasing their intake of sediment particles (Tjensvoll et al. 2013; Kutti et al. 2015). Exposure studies with this species showed evidence of adverse cellular effects at continuous and intermittent exposure to barite, a drill cuttings component, over 14 days (Edge et al. 2016). No effects were

observed on this sponge species when exposed continuously to 10 mg/L or short-term bentonite exposures up to 100 mg/L (Edge et al. 2016).

Modern WBM and SBM have a low toxicity to marine organisms based on laboratory toxicity studies (IOGP 2016). SBMs were developed specifically to have low toxicity and fast degradation (Neff et al. 2000, Jagwani et al. 2011, Paine et al. 2014, Tait et al. 2016) which are properties that reduce potential effects on marine fish (IOGP 2016). Laboratory exposure studies with SBM drilling fluids and juvenile pink snapper resulted in health effects that suggested potential for chronic toxicity (Gagnon and Bakhtyar 2013). However, exposure levels were not reflective of field conditions and chronic effects are unlikely with transient exposure to drilling fluids in the water column. Offshore eastern Newfoundland, the results of Environmental Effects Monitoring (EEM) at producing oilfields (Hibernia, Terra Nova, White Rose) provide regional information on sediment toxicity surrounding ongoing and historic cuttings discharge. Sediments surrounding the developments have limited to no evidence of project-related sediment toxicity. Hibernia EEM results indicate high survival (>90%) for amphipods and juvenile polychaetes in survival assays for sampling stations within 1 km of the platform (Hibernia Management Development Corporation [HMDC] 2019). This indicates sediments at these spatial scales were non-toxic (HMDC 2019). For the Terra Nova development, amphipod survival assays were rarely considered toxic nearby SBM depositional areas (Whiteway et al. 2014). Similarly, the White Rose EEM programs have shown >80% survival for amphipod survival assays for most sampling stations and indicate that sediments surrounding the development are predominantly non-toxic (Husky Energy 2019). Stations with amphipod toxicity responses were not associated with Project activities based on assessment of other physical and chemical parameters (Husky Energy 2019).

Drill mud components (e.g., barite, bentonite) and associated metals are also typically not readily bioaccumulated. 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). Some invertebrate species with low mobility have been shown to accumulate metals (Ruus et al. 2005; Neff 2010; Edge et al. 2016; IOGP 2016) and *Lophelia pertusa* corals have been shown to incorporate barite particles as far away as 600 m from the drill site (Ragnarsson et al. 2017). Several bioaccumulation bioassays using WBM cuttings found that metal concentration in the tissues of exposed animals were similar to those in the tissues of unexposed animals (IOGP 2016).

Although drill muds and cuttings have low toxicity and bioaccumulation effects, there are potential injury, mortality, and health effects on benthic communities from burial, sediment alteration, and degradation of organic components that lead to oxygen depletion (Kjeilen-Eilertsen et al. 2004; Smit et al. 2008; Neff 2010; Ellis et al. 2012; DeBlois et al. 2014; Tait et al. 2016; DFO 2019b). The effects of smothering can include mortality from the mass of discharges crushing them or inability to penetrate through the deposited layer from underneath (Kjeilen-Eilertsen et al. 2004). Species living on the drill cuttings may have lower growth rates as discharged particles have lower nutrient levels relative to native sediments (Kjeilen-Eilertsen et al. 2004). Also, sediment alterations may reduce suitability for larval settlement due to change in stability, and chemical and physical cues (Kjeilen-Eilertsen et al. 2004). The combination of these effects may result in a change in fauna community composition (Kjeilen-Eilertsen et al. 2004; Cordes et al. 2016; IOGP 2016). It has been calculated that an average burial depth of 6.5 mm or less is unlikely to cause net adverse effects to benthic organisms based on tolerances to burial, oxygen depletion, and change in sediment grain size (predicted no effect threshold (PNET)) (Kjeilen-Eilertsen et al. 2004; Smit et al. 2006, 2008; AMEC Foster

Wheeler 2017). Injury and polyp mortality were observed on the cold-water reef coral *L. pertusa* in laboratory experiments with deposition of WBM drill cuttings of 6.5 mm (Larsson and Purser 2011). This is an average value and some species may experience adverse effects at shallower or deeper burial depths. For example, sediment reworking by a brittle star and bivalve was reduced in a microcosm aquaria experiment with deposition of WBM drill cuttings of 2.5 mm (Trannum 2017). As the PNET threshold is based on average tolerances, the conservative approach as suggested by Kjeilen-Eilertsen et al. (2004) has been to set a lower threshold limit by subtracting 0.5 cm from the derived PNET value. Therefore, 1.5 mm is suggested as a more conservative predicted no-effect threshold (Kjeilen-Eilertsen et al. 2004; AMEC Foster Wheeler 2017). Drill mud and cuttings modelling for the Project considers deposition areas above 1.5 and 6.5 mm as further described below (Appendix D).

Field and monitoring studies of exploration and production drilling programs provides further indication of potential effects of drill mud and cuttings discharge and their overall spatial extents. Ellis et al. (2012) reviewed the results of sediment sampling from 72 production and exploration drilling platforms (water depths from 12 m to 565 m) to assess the zone of influence of sediment contamination and biological effects on benthic communities. The spatial extent based on barium concentration for WBM was determined to be 2-20 km from point of discharge, while spatial extent was smaller for SBM at 200-2,000 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). Gates et al. (2017) provided an overview of six exploration drilling projects in the Northeast Atlantic and off Venezuela (114-600 m water depths) associated with the Scientific and Environmental ROV Partnership using Existing Industrial Technology (SERPENT) project collaboration between industry and academia. Top hole drilling and associated drill cuttings discharge resulted in benthic effects (e.g., reduced faunal abundance) that were limited to scales up to hundreds of metres (Gates et al. 2017). Underwater visual surveys were conducted for the Shelburne Basin Venture Exploration Drilling Project off the Scotian Shelf in approximately 2,120 m of water to validate the modelling of drill cuttings discharge (Stantec 2017). Modelling results had indicated that much of the deposition area would be confined to within 100 m of the well site with 10 mm deposition thickness areas extending 122-155 m from the well site depending on seasonal scenario (Stantec 2017). Cumulative drill cuttings deposition areas were observed mainly within 50 m from the well site with intermittent observations of drill mud and cuttings up to 200 m from the well site (Stantec 2017). Although extents of deposition areas were slightly further than predicted, the area of high deposition was limited to areas immediately surrounding the well site and are similar to spatial extents of other drill cuttings discharge footprints. Overall, the zone of influence from drilling discharges may be limited to 100's of metres to a kilometre, depending on the volume of cuttings and types of drilling fluids discharged, discharge water depths, oceanographic processes, particle size distribution, and flocculant formation (Cordes et al. 2016; IOGP 2016; Gates et al. 2017). Project-specific modelling was conducted to provide the potential spatial distribution of drill cuttings based on local oceanographic processes (Appendix D) with the results summarized below.

Drill cuttings and fluids dispersion modelling was performed for the Project across summer and fall seasonal scenarios to assess the footprint, spatial extent, and thickness of discharged drill cuttings. WBM cuttings (60% total mass in larger size fraction) are released directly at the seafloor and SBM drill cuttings (40% of

total mass in smaller size fractions) are treated and discharged at the surface as described in Section 2.4.1.2 and 2.7.2. Model drill mud and cuttings and oceanographic process inputs are described in Appendix D. The water depths for the two sites modelled were similar with EL 1157 located in 2,338 m and EL 1158 in 2,047 m (further site details are provided in Section 2.2). At the modelled site for EL 1157 the discharged mud and cuttings (WBM and SBM) were deposited southwesterly in summer and southeasterly in fall. The drill cuttings deposition area was largely to the southeasterly for both the summer and fall scenarios for EL 1158. The differences between dispersion results for each EL were due to current patterns that are different at the modelled sites that are separated by a distance of 40 km. Modelled thicknesses above 6.5 mm were not predicted to occur at either site under either seasonal simulation, with the maximal depositional thickness of 5.45 and 4.75 mm predicted for EL 1157 and EL 1158, respectively. Dispersion sediment thicknesses of 1.5 mm or greater surrounding EL 1157 are predicted to reach a maximum extent up to 450 m from the discharge point and up to 580 m at EL 1158 and cover an area less than 0.12 km² at both sites. Variations in footprint shape and extent between seasonal simulations (summer and fall) can be attributed in part to the subsurface current regimes. Weaker subsurface currents in the summer simulations resulted in slightly more radial footprints, while fall simulations had more elongated footprints due to stronger subsurface current regimes. There is potential for the burial effects or disturbance to corals and sponges present in EL 1157 and EL 1158 in the immediate area of the well sites. Sensitive benthic organisms (e.g., corals and sponges) within the localized area of sediment thicknesses above 1.5 mm may be affected by the deposition of drilling waste. As modelled thickness above 6.5 mm were not predicted to occur at either site, effects on benthic organisms would likely be low.

Benthic mortality rates as a result of these discharges are not predicted to result in irreversible changes to local populations due to the low magnitude and spatial extent of potential effects. Although it is acknowledged that there are fewer data on effects of drilling waste on corals and sponges, recovery rates for these communities are expected to be longer (Henry and Hart 2005; Henry et al. 2017; Ragnarsson et al. 2017; Gates et al. 2017; Liefmann et al. 2018; DFO 2019b).

Lophelia pertusa is the most widely studied structure-forming, cold-water coral for potential effects of production platforms and exploration areas in Norwegian and Gulf of Mexico waters (e.g., Gass and Roberts 2006, Larsson and Purser 2011, Allers et al. 2013, Järnegren et al. 2017). While *Lophelia pertusa* reefs are not commonly observed in the Newfoundland and Labrador (NL) offshore region, studies on this species provide information on potential effects on branching and other cold-water corals. This coral species may be exposed to high sediment concentrations from higher bottom currents in its natural environment and has mechanisms for suspended particle removal (e.g., mucous production, ciliary movement; Zetsche et al. 2016). 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 (e.g., large gorgonians) would improve the ability to understand the effects of oil and gas activities on corals. Short-term (2.5 weeks) and long-term (12 weeks) laboratory drill cuttings exposure studies with adult *L. pertusa* showed no change in coral respiration, growth, or mucous production and changes to polyp activity returned to pre-exposure levels after cessation of drill cuttings (Baussant et al. 2018). However, areas of

the coral remained covered in drill cuttings even after a 4-week recovery period (Baussant et al. 2018). Up to 10 mg/L drill cuttings concentration have been suggested to be a threshold for which changes to coral condition in *L. pertusa* are reversible (Baussant et al. 2018). Physical injury from abrasive sediments may also reduce recovery from sedimentation and burial as demonstrated in soft corals (Slattery and Bockus 1997; Henry and Hart 2005; Liefmann et al. 2018). While corals have the ability to regenerate injured areas, it is energetically costly and may result in impairments to growth, reproduction, and predation defence (Henry and Hart 2005). Corals and sponges of lower morphological complexity have been suggested to regenerate less well relative to more morphological complex corals (Henry and Hart 2005). 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 with the ability of some species to withdraw partially or completely into the sediment to avoid disturbance (Greathead et al. 2007, Baker et al. 2012, Chimienti et al. 2018). Recruitment to experimentally cleared plots by sea pens has demonstrated recolonization to be highly clumped, spatially unpredictable and patchy with low successful recruitment rates of 10-15% of the area per year (Kenchington et al. 2011). 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). Long-term experiments where the *Geodia* sponges that are also found in the Newfoundland offshore region, were cyclically exposed to suspended crushed rock particles (50 mg/L) resulted in decreased oxygen consumption and metabolism (Kutti et al. 2015). However, this did not affect the energy content of the sponge, suggesting this species has coping mechanisms for turbidity and suspended sediments (Kutti et al. 2015).

The environmental changes associated with the discharge of drill muds and cuttings are detectable during the earlier phases of drilling within a localized area. However, these effects subside with time, generally between one to five years with recovery starting at the edges (Kjeilen-Eilertsen et al. 2004; Ellis et al. 2012; Gates and Jones 2012; Bakke et al. 2013). 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).

BHP will conduct an imagery-based seabed survey at the well site(s) to confirm the absence of sensitive environmental features, such as habitat-forming corals. The survey will be carried out before drilling and will consider the modelling spatial extent of the drill cuttings. If substantial environmental or anthropogenic sensitivities are identified during the survey, BHP will notify the C-NLOPB immediately to discuss an appropriate course of action. This may involve further investigation and/or moving the well site if it is feasible to do so. This survey will also provide existing conditions 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 and occur more than once at irregular intervals. Based on past evidence, this environmental effect will be reversible over a short-term to long-term duration.

8.3.2 Change in Habitat Availability, Quality and Use

8.3.2.1 Project Pathways

A change in habitat quality and use for marine fishes and invertebrates 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, and sound emissions into the seabed which result in substrate vibration. VSP surveys will temporarily generate high levels of underwater sound. Depending on the well abandonment program, which has yet to be defined (see Section 2.4.4), potential removal of the well head structure(s) could generate underwater sound, and potential abandonment of the well head(s) in place could cause a change in benthic habitat. During supply and servicing operations, underwater sound associated with vessel movement will be generated.

8.3.2.2 Mitigation

The mitigation measures and standard practices that will be employed to reduce the potential environmental effects of the Project on marine fish habitat are the same as those described in Section 8.3.1.2 to reduce the risk of mortality or physical injury to marine fish.

8.3.2.3 Characterization of Residual Project-related Environmental Effects

Presence and Operation of a MODU

The quality of the underwater acoustic environment for marine fishes and invertebrates could be affected by underwater sound emitted during MODU operations. The principal potential effects on mobile fishes and invertebrates would be behavioural in nature. If exposure to sound emitted by MODU operations causes mobile fishes and invertebrates to move away from the vicinity of the sound source, then a change in habitat quality and use would occur, albeit in a localized area.

As with physical effects on fishes, Popper et al. (2014) proposed qualitative risk guidelines related to the behavioural effects of exposure to continuous sound on fishes based on distance between the fishes and the sound source. They indicated that the lack of quantification of exposure sound levels that elicit behavioural responses to continuous sound makes it impossible to provide quantitative guidelines. They concluded that for fishes with swim bladders involved in hearing, the risk for behavioural effects is high when the receiver is near the sound source, whereas for the other two fish groups (i.e., no swim bladder, and with a swim bladder not involved in hearing), the risk is moderate for fishes near the sound source. Risk of behavioural effects on three fish groups when receivers are at intermediate and far distances from the sound source is moderate and low, respectively. Popper et al. (2014) also indicated that the risk of behavioural effects on ichthyoplankton occurring at near, intermediate and far distances from the continuous sound source is moderate, moderate and low, respectively.

General predictions of behavioural changes in fishes and invertebrates and their use of fish habitat in response to exposure to continuous sound are difficult given the variation in characteristics of sounds from different sources, inter- and intra-specific differences in how sound is detected and effects of exposure to it, and the relative lack of scientific information on this issue for fishes and invertebrates (Popper and

Hawkins 2018, 2019). Behavioural responses by individual fish, and likely individual invertebrates, can also vary by motivational state. For example, individual fish and invertebrates engaged in reproductive behaviour may not respond to underwater sound while those same individuals may respond to the same sound if in migratory mode.

Avoidance and startle responses may be exhibited by some marine fishes and invertebrates occurring near the continuous sound source during initiation of MODU operations/drilling (Müeller-Blenkle et al. 2008). It is anticipated that fishes will habituate to the continuous sound and avoidance and startle responses will decrease over time during the drilling. The source rms SPLs associated with the three MODU types (generic drill ship, Stena Forth, and semi-submersible drill rig) used in the acoustic modeling for this Project range from 189.7-196.7 dB re 1µPa @ 1m (Alavizadeh and Deveau 2019). Using 150 dB re 1 µPa rms received SPL as a conservative behavioural effect threshold level for fishes, modeling results indicate that received levels of 150 dB re 1 µPa rms from the three MODU types would occur as far as 280 m (i.e., maximum distance based on modelling) from the sound source (Alavizadeh and Deveau 2019). This distance was predicted for the generic drill ship and the semi-submersible drill rig. The horizontal distance to a received SPL of at least 150 dB re 1 µPa rms for the Stena Forth is predicted to be 120 m from the MODU sound source. 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 artificial lights of the MODU as marine fish may aggregate towards or avoid the light source. Marine fish behaviours (e.g., feeding, schooling, predator avoidance, and migration) may 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 200, Hanson et al. 2003 in BP 2018). Behavioural responses to light is variable across species and within species depending on competing priorities (e.g., foraging, predator avoidance, schooling) and light detection sensitivities (Marchesan et al. 2005; Stoner et al. 2008). Lighting around the MODU may attract phototaxic plankton and may provide increased opportunities for predation by fish and other species (Keenan et al. 2007; Cordes et al. 2016). In studies of the light field around active oil production platforms in the Gulf of Mexico, Keenan et al. (2007) observed that lighting was detected at greater than 100 m from the source and mainly near the surface (0.75 m water depth). Depending on the site and structures, light levels of studied platforms decreased to background levels within the sampling area (250 m from source) below 5 and 10 m water depths (Keenan et al. 2007). For species that undergo diel vertical migrations, there may be weak diel periodicity within 100 m of the platform and avoidance of the illuminated area at night (Simonsen 2013; Barker 2016). Potential effects of artificial lighting from the MODU are generally localized to hundreds of metres from the light source (Keenan et al. 2007; Simonsen 2013; Foss 2016).

Introduced invasive species may compete with local species for resources (e.g., colonizing habitat) that may result in a change to habitat availability. Aquatic invasive species may be transmitted through attachment to the hulls of vessels or through discharge of ballast water. The MODU or PSVs may also provide ‘stepping stone’ habitat that increases the range of colonizing invasive invertebrates that do not typically spread across large expanses of open water (Cordes et al. 2016). With application of standard mitigation measures (e.g., *Ballast Water Regulations*) for prevention and mitigation of spread of invasive species, potential spread of invasive species is low.

Drilling could occur at any time of the year and the sound and light generated would be continuous during the drilling of each well (approximately 35 to 115 days per well). Based on available science in this field, the residual environmental effects resulting in increased risk of behavioural effects on marine fish and fish habitat exposed to underwater sound and light emanating from a MODU is predicted to be adverse, low in magnitude, restricted to the Project Area and LAA, medium-term in duration, to occur more than once at irregular intervals, and reversible.

Vertical Seismic Profiling

Guidelines for received sound level thresholds that cause behavioural effects in fishes are limited. As with behavioural effects on fishes due to exposure to continuous sound, Popper et al. (2014) proposed qualitative risk guidelines related to the behavioural effects of exposure to seismic airgun sound on fishes based on distance between the fishes and the sound source. They indicated that despite the evidence that fish behavioural reactions can occur when exposed to seismic airgun sound, there are currently insufficient data to develop quantitative guidelines. They concluded that for fishes with swim bladders involved in hearing, the risk for behavioural effects is high when the receiver is near to and at intermediate distances from the sound source, and moderate for those fishes occurring far from the sound source. For the other two fish groups (e.g., no swim bladder, and with a swim bladder not involved in hearing), the risks for individuals occurring at all three qualitative distances from the seismic airgun source are high, moderate and low, respectively. Popper et al. (2014) also indicated that the risk of behavioural effects on ichthyoplankton occurring at near, intermediate and far distances from a seismic sound source is moderate, low, and low, respectively.

The United States National Marine Fisheries Service (NMFS) uses a threshold of 150 dB re 1 µPa for behavioural response (Stadler and Woodbury 2009), although Popper et al. (2014) indicate it is unclear if this is a peak or rms level. Sound modelling for VSP activities was based on a Dual Delta 1,200 in^3 airgun array (Alavizadeh and Deveau 2019). Using 150 dB re 1 µPa rms received SPL as a conservative behavioural effect threshold level for fishes, as was done for continuous sound above, modeling results indicate that received levels of 150 dB re 1 µPa rms from the VSP seismic airgun sound source could occur as far as 30.6 km from the sound source at Site B in August (Alavizadeh and Deveau 2019). As indicated in Section 8.3.1.3, the distances from the VSP source to a received SPL of 150 dB re 1 µPa rms varies widely by site, month, azimuth and water depth. Generally, the greatest distances are predicted during August (maximum of 30.6 km) while the range of distances to received SPLs that exceed 150 dB re 1 µPa rms during February is 5.2 to 14.3 km. The depths where the maximum received SPLs occur range from 5 m to sea bottom, generally increasing with distance from the VSP source. Given the scientific evidence for habituation by fishes to underwater sound, it is unlikely that exposure to VSP sound will result in long-term behavioural responses (e.g., all fishes leaving the area defined by a 17 km radius from the VSP location). For example, the sound modeling for the VSP sound source conducted for this Project indicates that received levels of 170 dB re 1 µPa rms could extend out to just under 2 km from the sound source (Alavizadeh and Deveau 2019). Given that fishes have habituated to similar received levels, far reaching behavioural effects on fishes are not anticipated. There are insufficient data to address the potential behavioural effects of exposure to seismic airgun sound on invertebrates. The effects of sound-generated particle motion is currently not well understood.

Received SPLs from VSP activities are expected to result in a short-term change in habitat quality and use for marine fish. While mobile fishes could exhibit a variety of behavioural responses when exposed to sound from the VSP, the sound source is stationary and hours in duration. The responses of marine fishes to seismic airgun sound can vary depending on species, life stage, history of exposure to similar sound sources, and various characteristics of the sound source.

Exposure of fishes to impulsive underwater sounds, such as those generated during VSP, has resulted in localized and temporary avoidance by a variety of fish species including salmonids, herring, and flatfish (Feist et al. 1996, McCauley et al. 2000a, 2000b in BP 2018). Other observed behavioural responses include a short duration “startle” response (flexion of body followed by a burst of faster swimming), and an “alarm” response with intense variable movements (Schwarz and Greer 1984, Feist et al. 1996, McCauley et al. 2000a, 2000b in BP 2018).

Based on available science in this field, the residual environmental effects resulting in increased risk of behavioural effects on marine fish and fish habitat exposed to underwater sound produced by a VSP airgun source is predicted to be adverse, low in magnitude, restricted to the Project Area or LAA, short-term in duration, to occur more than once at irregular intervals, and reversible.

Discharges

Drilling mud and cuttings are the primary discharges resulting in changes in habitat quality and availability from physical or chemical changes in the water column and/or sediment. As described in Section 8.3.1.3, drilling mud and cuttings discharges may result in a temporary increase in suspended particulate matter and turbidity in the water column. Water column exposure can range from minutes to several days, but generally returns within hours to background levels after cessation of discharges (Smit et al. 2006, Koh and Teh 2011, IOGP 2016). The potential effects in the water column are generally non-persistent and temporary with the rapid dilution and dispersal of drill cuttings.

Drilling mud and cuttings discharges that settle on the seafloor may change habitat quality and availability from sediment alteration, and degradation of organic components that lead to oxygen depletion (Kjeilen-Eilertsen et al. 2004; Smit et al. 2008; Neff 2010; Ellis et al. 2012; DeBlois et al. 2014; Tait et al. 2016; DFO 2019b). While macrofauna may be initially affected by these physical and indirect effects, recovery to the area may occur quickly after degradation of drill cuttings components (Tait et al. 2016). Sediment exposure to drill waste can persist for months or years; however, effects may subside between one to five years with recovery starting at the edges (Neff et al. 2000; Kjeilen-Eilertsen et al. 2004; Tait et al. 2016; Gates et al. 2017).

Biogenic habitat quality and availability may also change from potential injury, mortality, and health effects on coral and sponge communities drilling mud and cuttings discharges as described in in Section 8.3.1.3 (Allers et al. 2013; Cordes et al. 2016; DFO 2019b). As described in Section 6.1.6.1, structure-forming benthic invertebrate species (Baillon et al. 2012, 2014; Kenchington et al. 2013, 2016) occur in the Orphan Basin and in surrounding areas, including cold-water corals and sponges. Significant benthic areas (SiBAs) for sea pens and large gorgonian corals have been designated along the southern slopes of the Project Area and overlaps with EL 1158 (Figure 6-6). Drill cuttings dispersion modelling was performed for the Project to assess the footprint, spatial extent, and thickness of discharged drill cuttings as described in

Section 8.3.1.3. Dispersion sediment thicknesses of 1.5 mm or greater predicted to reach a maximum extent up to 450-580 m from the discharge point cover an area less than 0.12 km² at EL 1157 and EL 1158. Recovery rates for coral and sponge communities within the deposition area are expected to be longer (e.g., decades) than other benthic invertebrates (Henry and Hart 2005; Cordes et al. 2016; Henry et al. 2017; Ragnarsson et al. 2017; Liefmann et al. 2018). However, benthic mortality rates as a result of these discharges are not predicted to result in irreversible changes to local populations due to the low magnitude and spatial extent of potential effects. Therefore, predicted changes to biogenic habitat would be of similar low magnitude.

In consideration of proximity to SiBAs and lack of information on coral and sponge distributions in deeper areas of the Orphan Basin, BHP will conduct an imagery-based seabed survey near the well site(s) to confirm the absence of sensitive environmental features. The survey will be carried out before drilling and will consider the modelled spatial extent of the drill cuttings. If substantial environmental or anthropogenic sensitivities are identified during the survey, BHP will notify the C-NLOPB immediately to discuss an appropriate course of action. This may involve further investigation and/or moving the well site if it is feasible to do so. This survey will provide existing conditions 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.

Potential liquid discharges from an offshore exploration drilling program may have potential effects on water column habitat quality. These discharges will be managed in accordance with the OWTG and associated standards and guidelines. Discharges are expected to be temporary, non-bioaccumulating, nontoxic 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 Decommissioning and Abandonment or Suspension

Activities associated with well decommissioning and abandonment or suspension involve the presence of vessels at the drill site. As a result, the effects of these activities would be the same as those assessed for the presence and operations of the MODU, and therefore are not repeated here.

Well abandonment and decommissioning activities are predicted to result in a temporary, localized disturbance that may result in avoidance of the area and change in habitat availability for the duration of the activity. Well decommissioning and suspension or abandonment for this Project will be carried out as per BHP's Well Integrity Standard, as well as applicable industry practice and in compliance with relevant regulatory requirements. Well abandonment, with the well head left in place, will likely provide hard substrate that is suitable for colonization by benthic communities (Cordes et al. 2016, Lacey and Hayes 2019). However, these permanent effects would be of localized nature and potentially positive.

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 and occur more than once at irregular intervals and reversible. Depending on

decommissioning strategy designed in consultation with the regulatory authorities, potential effects may be short to long-term in duration. Residual environmental effects associated with removal of well head infrastructure (if applicable), including underwater sound and light 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 potential effects of continuous sounds on the marine environment is described in Section 8.3.1.3. 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 178 dB re 1 µPa m (Alavizadeh and Deveau 2019). 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 in BP 2018). Mobile fishes would potentially respond to lower received levels and move away from the vessel sound source, thereby limiting potential for temporary injury to individual fish and subsequently adverse effect on fish populations. Therefore, a change in habitat quality and availability from PSV traffic would represent a small increment (two to three vessels over the life of the Project completing an average of three return transits per week between shore base and the MODU; Section 2.4.5.1) 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.

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

There are 30 species of fish listed as SAR or otherwise of conservation concern with the potential to occur within the Project Area. This includes species listed under SARA, Committee on the Status of Endangered Wildlife in Canada (COSEWIC), the NL ESA, and the International Union for Conservation of Nature (IUCN) (Table 8.4). Four of these species are formally protected at the federal level on Schedule 1 under SARA and are further assessed: white shark, spotted wolffish, northern wolffish, and Atlantic wolffish. Details on the life history, spawning, feeding, and presence of these species in the RAA are provided in Sections 6.1.8.1 (all three wolffish) and 6.1.8.2. (white shark). American eel and Atlantic salmon, as both SAR and of Indigenous concern, are further described in Sections 6.1.9.1 and 6.1.9.2, respectively. Other SAR key species, such as American plaice and deepwater redfish, are described in Section 6.1.7.3. Table 8.4 gives a summary for SAR.

Northern, spotted, and Atlantic wolffish are demersal species that occur within the Project Area. 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). Critical habitat has been identified for northern and spotted wolffish and overlap based on area of occurrence approach. Critical habitat has been designated in this area due to the wolffishes preference for the associated depth and

temperatures (DFO 2018). This area overlaps with the Project Area along the northeast shelf and slope of the Grand Banks (DFO 2018). The LAA overlap represents 1.99% of the 118,232.1 km² of identified critical habitat area for northern wolffish and 5.65% of the 93,584.32 km² of identified critical habitat area for spotted wolffish (DFO 2018). The proposed wolffish recovery strategy indicates that oil and gas exploration and production may have potential environmental effects on wolffish associated with operational discharges; however, it notes that potential effects would be highly localized and minor at the population level (DFO 2018). Wolffish also do not have swim bladders and are therefore only potentially susceptible to the particle motion component of seismic airgun sound. Given the extreme depths in the Project Area, it is unlikely that wolffishes would be affected by MODU-associated sound or VSP activities. Wolffish eggs and adults are demersal and larvae are pelagic; therefore, different Project activities could potentially interact with wolffish 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, with the use of mitigation described above (Section 8.3.1.2), and the low spatial and temporal nature of effects, interactions with wolffish species in the Project Area would be localized and short-term.

White sharks are highly mobile pelagic species in the northwest Atlantic that may migrate through the Project Area. These species are apex predators that may be vulnerable to bioaccumulation of contaminants through their position in the food web (COSEWIC 2006, Marsili et al. 2016) and contaminants may be transferred to offspring through maternal offloading (Lyons et al. 2013). Marsili et al. (2016) found relatively high levels of polycyclic aromatic hydrocarbons (PAHs) in white sharks relative to other top marine predators off South Africa where there are frequent oil shipping routes. White shark muscle and liver tissue were also found to have higher levels of polychlorinated biphenyls (PCBs) and chlorinated hydrocarbon pesticides relative to other fishes in the Bay of Fundy-Gulf of Maine area (Zitko et al. 1972, COSEWIC 2006). Although health impacts of toxins has not been well studied in sharks, accumulation of contaminants may have hormone-disrupting effects (Marsili et al. 2016). As this species is highly mobile and given the low potential of prey contamination from this Project, and the absence of 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 8.3.1.2.

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 Species of Conservation Concern (SOCC) listed in Table 8.4 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 potential adverse interactions on SOCC. Additional details on swordfish, bluefin tuna, Atlantic salmon and American eel are provided in Section 13.3.3 (Indigenous Peoples and Communities).

Table 8.4 Marine Fish Species at Risk or of Conservation Concern with Potential to Occur in the Project Area

Species		Status / Designation[A, B]				Relevant Population (Where Applicable)	Summary of Presence and Potential Interactions
Common Name	Scientific Name	NL ESA	SARA	COSEWIC	IUCN		
Acadian redfish	*Sebastes fasciatus*			T	E	Atlantic (COSEWIC); Global (IUCN)	• Likely to be present year-round in Project Area • Inhabits continental slope and deep channels, and migrates vertically to feed • Fertilized eggs remain in brood pouch until hatched (typically spring and summer), larvae prefer surface waters where they feed on plankton • Potential interactions include larvae (pelagic) and juveniles / adults (demersal / pelagic) • Potential exists for Project effects, but reduced by Project mitigation measures and species mobility
Albacore tuna	*Thunnus alalunga*				NT	Global (IUCN)	• Migratory / transient in Project Area, may be present in summer and fall to feed • Predatory pelagic species, can form schools • Typically remain in the warmer Gulf Stream waters south of the Grand Banks • Potential interactions include juveniles / adults (pelagic) • Limited potential for Project interactions (mobile species, Project mitigation measures)
American eel	*Anguilla rostrata*	V		T	E	Global (IUCN)	• Migratory / transient in Project Area • Adults leave freshwater / estuarine habitats to migrate to the Sargasso Sea • Eggs and larvae drift / swim in the Gulf Stream to return to freshwater, larvae feed pelagically • Potential life stage interactions include larvae (pelagic) and juveniles / adults (pelagic) • Limited potential for Project interactions (mobile species, Project mitigation measures, no critical habitat)

Table 8.4 Marine Fish Species at Risk or of Conservation Concern with Potential to Occur in the Project Area

Species		Status / Designation[A, B]				Relevant Population (Where Applicable)	Summary of Presence and Potential Interactions
Common Name	Scientific Name	NL ESA	SARA	COSEWIC	IUCN		
American plaice	*Hippoglossoides platessoides*			T		NL (COSEWIC)	• Potentially present in the Project Area year-round • Demersal benthivore, prefer depths of 100 m to 300 m but can be as deep as 1,400 m • Spawn on Newfoundland Shelf in April or May, eggs and larvae are pelagic • Potential life stage interactions include eggs (pelagic), larvae (pelagic), and juveniles / adults (demersal) • Potential exists for Project effects, but reduced by Project mitigation measures and species mobility
Atlantic bluefin tuna	*Thunnus thynnus*			E	E	Global (IUCN)	• Migratory / transient in Project Area • Large pelagic predator, travels to Canadian waters to feed in the warm waters of the Gulf Stream • Spawn in tropical and sub-tropical waters to the south • Potential interactions include juveniles / adults (pelagic) • Limited potential for Project interactions (mobile species, Project mitigation measures)
Atlantic cod	*Gadus morhua*			E	V	NL (COSEWIC); Global (IUCN)	• Potentially present in the Project Area year-round • Demersal piscivore found in a wide variety of habitats, typically above 500 m depth • Broadcast spawner, pelagic eggs and larvae present in the water column from April to November • Potential life stage interactions include eggs (pelagic), larvae (pelagic), and juveniles / adults (demersal) • Potential exists for Project effects, but reduced by Project mitigation measures and species mobility

Table 8.4 Marine Fish Species at Risk or of Conservation Concern with Potential to Occur in the Project Area

Species		Status / Designation[A, B]				Relevant Population (Where Applicable)	Summary of Presence and Potential Interactions
Common Name	Scientific Name	NL ESA	SARA	COSEWIC	IUCN		
Atlantic halibut	*Hippoglossus hippoglossus*				E	Global (IUCN)	• Unlikely to be present in Project Area • Eggs and larvae are pelagic, eggs typically present from late fall to early spring • Juveniles and adults are found demersally from 20m to 1,000m deep, with older individuals living in deeper water • Potential life stage interactions include eggs (pelagic), larvae (pelagic), and juveniles / adults (demersal) • Limited potential for Project interactions (mobile species, Project mitigation measures, no critical habitat)
Atlantic salmon	*Salmo salar*			T		South Newfoundland	• Migratory / transient in Project Area • Adults from populations listed here may migrate through the Project Area while travelling to overwintering areas further north • Adult salmon have been found in two areas during their spring migration – slightly east of the 200 m isobath of the Grand Banks, and 480 km east of the Strait of Belle Isle • Potential interactions include juveniles / adults (demersal) • Limited potential for interaction (mobile species, Project mitigation measures, no critical habitat)
				SC		Quebec Eastern North Shore	
				SC		Quebec Western North Shore	
				E		Anticosti Island	
				SC		Inner St. Lawrence	
				SC		Gaspe-Southern Gulf of St. Lawrence	
				E		Eastern Cape Breton	
				E		Nova Scotia Southern Upland	
				E		Outer Bay of Fundy Population	
					LC	Global (IUCN)	

Table 8.4 Marine Fish Species at Risk or of Conservation Concern with Potential to Occur in the Project Area

Species		Status / Designation[A, B]				Relevant Population (Where Applicable)	Summary of Presence and Potential Interactions
Common Name	Scientific Name	NL ESA	SARA	COSEWIC	IUCN		
Atlantic wolffish	*Anarhichas lupus*		SC	SC			• Unlikely to be present in Project Area • Spawn in shallow waters near-shore, and larvae are pelagic • Adults typically inhabit demersal shelf and slope habitats • Potential interactions include juveniles / adults (demersal) • Limited potential for Project interactions (mobile species, Project mitigation measures, no critical habitat)
Barndoor skate	*Dipturus laevis*				E	Global (IUCN)	• Unlikely to be present in Project Area • Grand Banks represents northern edge of their range • Typically caught from 38 m to 351 m, but have been caught as deep as 1,174 m • Potential migrations and spawning not well understood • Potential interactions include juveniles / adults (demersal) • Limited potential for interaction (mobile species, Project mitigation measures, no critical habitat)
Basking shark	*Cetorhinus maximus*			SC	V	Atlantic (COSEWIC); Global (IUCN)	• Migratory / transient in Project Area • Feed pelagically on plankton, highly migratory, likely present in Canadian water in warm summer months • Potential interactions include juveniles / adults (pelagic) • Limited potential for interaction (mobile species, Project mitigation measures, no critical habitat)

Table 8.4 Marine Fish Species at Risk or of Conservation Concern with Potential to Occur in the Project Area

Species		Status / Designation[A, B]				Relevant Population (Where Applicable)	Summary of Presence and Potential Interactions
Common Name	Scientific Name	NL ESA	SARA	COSEWIC	IUCN		
Bigeye tuna	*Thunnus obesus*				V	Global (IUCN)	• Migratory / transient in Project Area • Large pelagic predator, travels to Canadian waters to feed in the warm waters of the Gulf Stream • Can dive below 500 m, typically found shallower • Potential interactions include juveniles / adults (pelagic) • Limited potential for Project interactions (mobile species, Project mitigation measures)
Blue shark	*Prionace glauca*				NT	Atlantic (COSEWIC); Global (IUCN)	• Migratory / transient in Project Area • Pelagic predator, can dive down to 600 m to feed • Prefers warmer waters of the Gulf Stream • Potential interactions include juveniles / adults (pelagic) • Limited potential for Project interactions (mobile species, Project mitigation measures)
Common Lumpfish	*Cyclopterus lumpus*			T		Atlantic (COSEWIC)	• Unlikely to be present in Project Area • Spawn in nearshore environments • Occur in waters ranging from 20 m to over 300 m • Potential interactions include juveniles / adults (demersal) • Limited potential for Project interactions (mobile species, Project mitigation measures)

Table 8.4 Marine Fish Species at Risk or of Conservation Concern with Potential to Occur in the Project Area

Species		Status / Designation[A, B]				Relevant Population (Where Applicable)	Summary of Presence and Potential Interactions
Common Name	Scientific Name	NL ESA	SARA	COSEWIC	IUCN		
Cusk	*Brosme brosme*			E			• Unlikely to be present in the Project Area • High aggregations are found on the Nova Scotian Shelf and Slope, Grand Banks is the northern edge of their range • Typically found between 150 m and 400 m, though have been recorded as deep as 1,185 m • Potential interactions include juveniles / adults (demersal) • Limited potential for Project interactions (mobile species, Project mitigation measures)
Deepwater redfish	*Sebastes mentella*			T	LC	Northern (COSEWIC); Global (IUCN)	• Likely to be present year-round in Project Area • Inhabits continental slope and deep channels, and migrates vertically to feed • Fertilized eggs remain in brood pouch until hatched (typically spring and summer), larvae prefer surface waters where they feed on plankton • Potential interactions include larvae (pelagic) and juveniles / adults (demersal / pelagic) • Potential exists for Project effects, but reduced by Project mitigation measures and species mobility
Greenland Shark	*Somniosus microcephalus*				NT	Global (IUCN)	• Likely to be present year-round in Project Area • Are found from surface waters to 1,200 m, but can be as deep as 2,200 m • Reproduction and spawning not well known • Potential interactions include juveniles / adults (demersal / pelagic) • Potential exists for Project effects, but reduced by Project mitigation measures and species mobility

Table 8.4 Marine Fish Species at Risk or of Conservation Concern with Potential to Occur in the Project Area

Species		Status / Designation[A, B]				Relevant Population (Where Applicable)	Summary of Presence and Potential Interactions
Common Name	Scientific Name	NL ESA	SARA	COSEWIC	IUCN		
Haddock	*Melanogrammus aeglefinus*				V	Global (IUCN)	• Unlikely to be present in Project Area • Typically observed from 80 m to 200 m • Eggs and larvae are pelagic • Potential interactions include juveniles / adults (demersal) • Limited potential for Project interactions (mobile species, Project mitigation measures)
Little skate	*Leucoraja erinacea*				NT	Global (IUCN)	• Occurs within the RAA; does not occur within the Project Area • Typically ranges from shallow shoal waters to 90 m depth • Eggs are laid on sandy bottoms, in water depths no greater than 27 m • Make no extensive migrations • Limited potential for Project interactions (mobile species, Project mitigation measures)
Northern wolffish	*Anarhichas denticulatus*		T	T			• Likely present within Project Area year-round • Identified critical habitat intersects Project Area • Has been found between 38 m and 1,504 m, and are capable of long migrations • Spawns from September through November, with pelagic larvae • Potential life stage interactions include eggs (demersal), larvae (pelagic), and juveniles / adults (demersal) • Potential exists for Project effects, but reduced by Project mitigation measures and species mobility

Table 8.4 Marine Fish Species at Risk or of Conservation Concern with Potential to Occur in the Project Area

Species		Status / Designation[A, B]				Relevant Population (Where Applicable)	Summary of Presence and Potential Interactions
Common Name	Scientific Name	NL ESA	SARA	COSEWIC	IUCN		
Porbeagle	*Lamna nasus*			E	V	Global (IUCN)	• Migratory / transient species • Typically inhabit coastal and shelf habitats • Mating occurs in Canadian waters, but females travel to pupping grounds further south to give birth • May be present during warmer months • Potential interactions include juveniles / adults (pelagic) • Limited potential for Project interactions (mobile species, Project mitigation measures)
Roundnose grenadier	*Coryphaenoides rupestris*			E	CE	Atlantic and Arctic (COSEWIC); Global (IUCN)	• Likely present in Project Area year-round • Demersal benthivore found from 200 m to 2,600 m deep • Prefers slope habitats along the edge of the continental shelf • Spawning not well known, may occur along Mid-Atlantic Ridge, with eggs and larvae transported by currents • Potential life stage interactions include eggs (pelagic), larvae (pelagic), and juveniles / adults (demersal) • Potential exists for Project effects, but reduced by Project mitigation measures and species mobility

Table 8.4 Marine Fish Species at Risk or of Conservation Concern with Potential to Occur in the Project Area

Species		Status / Designation[A, B]				Relevant Population (Where Applicable)	Summary of Presence and Potential Interactions
Common Name	Scientific Name	NL ESA	SARA	COSEWIC	IUCN		
Shortfin mako	*Isurus oxyrinchus*			E	V	Atlantic (COSEWIC); Global (IUCN)	• Migratory / transient species • Prefer warm waters of the Gulf Stream, migrate to Canadian waters to feed • Pupping appears to take place between 20° and 30° N • Potential interactions include juveniles / adults (pelagic) • Limited potential for Project interactions (mobile species, Project mitigation measures)
Smooth skate	*Malacoraja senta*			E	E	Funk Island Deep (COSEWIC); Global (IUCN)	• Unlikely to be present in Project Area • Typically encountered above 500 m depth • Lays egg capsules, all live stages are demersal • Potential life stage interactions include eggs (demersal), larvae (demersal), and juveniles / adults (demersal) • Limited potential for Project interactions (mobile species, Project mitigation measures, no critical habitat)
Spiny dogfish	*Squalus acanthias*			SC	V	Atlantic (COSEWIC); Global (IUCN)	• Unlikely to be present in Project Area • Highest abundances in Canadian waters are off Nova Scotia • Range from the intertidal to 730 m depth • Internal fertilization • Potential interactions include juveniles / adults (demersal) • Limited potential for Project interactions (mobile species, Project mitigation measures)

Table 8.4 Marine Fish Species at Risk or of Conservation Concern with Potential to Occur in the Project Area

Species		Status / Designation[A, B]				Relevant Population (Where Applicable)	Summary of Presence and Potential Interactions
Common Name	Scientific Name	NL ESA	SARA	COSEWIC	IUCN		
Spinytail skate	*Bathyraja spinicauda*				NT	Global (IUCN)	• Likely present in Project Area year-round • Typically found in cold, deep waters from 140 m to below 1,650 m depth • Observed spawning off Greenland in summer, but little is known of their reproduction otherwise • Potential interactions include juveniles / adults (demersal) • Potential exists for Project effects, but reduced by Project mitigation measures and species mobility
Spotted wolffish	*Anarhichas minor*		T	T			• Likely to be present in Project Area year-round • Identified critical habitat intersects with Project Area • Typically found between 200 m and 750 m • Fertilization in internal, with demersal eggs and pelagic larvae • Potential life stage interactions include eggs (demersal), larvae (pelagic), and juveniles / adults (demersal) • Potential exists for Project effects, but reduced by Project mitigation measures and species mobility
Thorny skate	*Amblyraja radiata*			SC	V	Canada (COSEWIC); Global (IUCN)	• Likely present in Project Area year-round • Typically found from 18 m to 1,400 m on a wide variety of substrates • Eggs are attached to the seafloor, and juveniles and adults are demersal benthivores • Potential life stage interactions include eggs (demersal), larvae (demersal), and juveniles / adults (demersal) • Potential exists for Project effects, but reduced by Project mitigation measures and species mobility

Table 8.4 Marine Fish Species at Risk or of Conservation Concern with Potential to Occur in the Project Area

Species		Status / Designation[A, B]				Relevant Population (Where Applicable)	Summary of Presence and Potential Interactions
Common Name	Scientific Name	NL ESA	SARA	COSEWIC	IUCN		
White hake	*Urophycis tenuis*			T		Atlantic and Northern Gulf of St. Lawrence (COSEWIC)	• Unlikely to be present in Project Area • Benthic species typically found on mud or sandy bottoms • Juveniles inhabit shallower waters, with older individuals living deeper • Eggs are buoyant and larvae are pelagic, spawning is typically in spring summer • Potential life stage interactions include eggs (pelagic), larvae (pelagic), and juveniles / adults (demersal) • Limited potential for Project interactions (mobile species, Project mitigation measures)
White shark	*Carcharodon carcharias*		E	E	V	Atlantic (COSEWIC/SARA); Global (IUCN)	• Migratory / transient species • Large predatory pelagic shark, migrates to Canadian waters to feed • Occupy surface waters and can dive down to 1,200 m • Typically remain in warmer Gulf Stream waters, spawning and breeding occurs in the south • Potential life stage interactions include juveniles / adults (pelagic) • Limited potential for Project interactions (mobile species, Project mitigation measures)

Table 8.4 Marine Fish Species at Risk or of Conservation Concern with Potential to Occur in the Project Area

Species		Status / Designation[A, B]				Relevant Population (Where Applicable)	Summary of Presence and Potential Interactions
Common Name	Scientific Name	NL ESA	SARA	COSEWIC	IUCN		
Winter Skate	*Leucoraja ocellata*			E	E	Eastern Scotian Shelf – Newfoundland (COSEWIC); Global (IUCN)	• Unlikely to be present in Project Area • Typically found above 150 m depth, though have been caught as deep as 400 m • Eggs are deposited on the sea floor, with young skates feeding demersally • Potential life stage interactions include eggs (demersal), larvae (demersal), and juveniles / adults (demersal) • Limited potential for Project interactions (mobile species, Project mitigation measures)

Notes:

[A] Least Concern (LC), Vulnerable (V), Near Threatened (NT), Special Concern (SC), Threatened (T), Endangered (E), Critically Endangered (CE)

[B] Multiple designations refer to multiple populations or sub-populations.

Data Sources: Species at Risk Public Registry 2019, IUCN Red List of Threatened Species 2019, NL Fisheries and Land Resources 2019

8.3.4 Summary of Project Residual Environmental Effects

The environmental effects assessment and associated residual effects for Project and marine fish and fish habitat interactions is summarized in Table 8.5 in consideration of the implementation of applicable mitigation measures, and adherence to industry standards. Interactions between Project activities are predicted to result in changes to fish mortality, injury, and health that are adverse, but low in magnitude and occurring within the Project Area. Predicted duration of effects range among Project activities and may be short-term as with VSP activities and medium-term as with sound emissions from drilling activities. As recovery times for sensitive benthic species (e.g., corals and sponges) affected by drilling discharges may take years to decades, the duration of discharge effects is considered long-term. However, the geographic extent is localized to the well site within the Project Area, reducing overall potential effects on these species and associated biogenic habitat.

Project activities are also predicted to result in changes to fish habitat availability, quality, and use that are mainly adverse, low in magnitude and occurring in the Project Area. Drill cuttings discharge is anticipated to be of moderate magnitude considering the burial and sediment alteration effects of the deposition area. Effects from this activity are localized to the Project Area. Due to the zone of influence of VSP activities and transient nature of PSVs, potential effects are predicted to be occurring within the LAA. Effects on fish habitat are largely medium-term as various sound and light emissions and discharges occur irregularly over the life of the Project. It is predicted that recovery to existing conditions would be long-term for drill cuttings discharge and well abandonment, but with effects localized to the well site.

Overall, effects are reversible with eventual recovery to existing conditions after Project completion. 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, Injury or Health							
Presence and Operation of a MODU	A	L	PA	MT	IR	R	D
VSP	A	L	PA	ST	IR	R	D
Discharges	A	L	PA	ST-LT	IR	R	D
Well Testing and Flaring	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Well Decommissioning and Abandonment or Suspension	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Supply and Servicing Operations	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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 Habitat Availability, Quality and Use							
Presence and Operation of a MODU	A	L	PA-LAA	MT	IR	R	D
VSP	A	L	PA-LAA	ST	IR	R	D
Discharges	A	L	PA	MT-LT	IR	R	D
Well Testing and Flaring	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Well Decommissioning and Abandonment or Suspension	N-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
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

8.4 DETERMINATION OF SIGNIFICANCE

With mitigation and environmental protection measures, the residual environmental effects on marine fish and fish habitat are predicted to be not significant. Project activities are predicted to result in adverse environmental effects to marine fish and fish habitat from sound and lighting emissions and discharges to the marine environment. The low magnitude and localized or short-term nature of predicted effects will result in interactions with marine fish and fish habitat that are spatially and temporally limited. Corals and sponges may provide biogenic habitat and estimated recovery rates from injury and health effects are generally slow. However, overall effects would be low considering pre-drilling seabed surveys for determination of sensitive environmental features and limited spatial extent of drill cuttings discharge. As effects to the water column are low, the food web linkage of transfer of organic matter to deep water areas from the pelagic zone is also unlikely to be affected.

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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. Furthermore, 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 through adherence to mitigation and environmental protection measures as used for fish species that are not of conservation concern. Although there is overlap between the LAA and critical habitat for northern and spotted wolffish (8.3.3), the area of overlap is small and potential interactions between these species and Project activities is limited. Project activities are not predicted to have implications on the overall abundance, distribution, or health of marine fish SAR or their eventual recovery.

As predicted effects are not likely to have population-level effects on marine fish and invertebrates and changes to fish habitat are spatially limited, effects through ecosystem linkages would be low. Associated changes to prey availability or quality for marine and migratory birds, marine mammals, and sea turtles would be low. Similarly, the low effects on commercially important species are not predicted to have implications for commercial fisheries and other ocean uses or Indigenous groups.

Residual environmental effects on marine fish and fish habitat from Project activities are predicted to be not significant. This determination has been made with consideration of available scientific knowledge regarding predicted effects from exploration drilling activities, effectiveness of mitigation measures, and the existing environment within the spatial boundaries.

8.5 PREDICTION CONFIDENCE

The effects of oil and gas exploration and production projects have been studied within the NL offshore region and worldwide with regards to the effects of discharges, seismic exploration, PSVs, and decommissioning. These studies have been used to inform government regulations and guidelines, mitigation measures, and industry standards. Available scientific information from field and laboratory studies was used to inform the effects analysis of potential effects of exploration drilling activities on marine fish and fish habitat. However, there is some uncertainty from the lack of information on specific species responses to Project activities within this region.

Marine fish and invertebrates within the Project Area, LAA and RAA are a diverse group with species-specific sensitivities and behavioural responses to Project emissions and discharges There is a general lack of information on behavioural effects from continuous and impulsive sounds and effects of particle displacement on marine fish and invertebrates. There is also uncertainty regarding thresholds for effects and estimated recovery of cold-water corals and sponges as they are a morphologically and ecologically diverse group. For example, research on effects of oil and gas activities on corals are largely based on the reef building coral *L. pertusa* that may not be prevalent within the study areas.

Therefore, the determination of predicted effects is made with a moderate level of confidence. BHP conducted Project-specific modeling for sound and drilling mud and cuttings discharges to address uncertainty in the effects from Project activities. While there are areas of uncertainty, the level of available information is sufficient for assessment of effects of the Project.

8.6 ENVIRONMENTAL FOLLOW-UP MONITORING

BHP proposes to implement an imagery-based monitoring program to address the predicted residual effects of drilling mud and cuttings discharges on marine benthic environments in consideration of proximity to coral SiBAs. BHP will conduct a pre-drilling seabed survey near proposed drilling locations to confirm the presence/absence of sensitive biological communities (e.g., corals and sponges). The visual surveys will also be used to confirm the absence of shipwrecks, debris on the seafloor, and unexploded ordnance. Survey results will be shared with C-NLOPB and DFO to inform discussions around well planning and mitigation for future exploration drilling. BHP plans to conduct a post-drilling survey of the seafloor to assess the visual extent of sediment dispersion and validate the modelling for the discharges of drill mud and cuttings. The specific details of the follow-up program will be determined in consultation with the C-NLOPB and DFO and in consideration of pre-drill seabed survey results.

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9.0 ASSESSMENT OF POTENTIAL EFFECTS ON MARINE AND MIGRATORY BIRDS

Marine and migratory birds were chosen as a Valued Component (VC) because of the group's role in pelagic and coastal ecosystems, the cultural and economic importance of subsistence and recreational hunts, predisposition to attraction to artificial lighting at night, the adverse effects of oil, regulatory considerations, and requirements in the Environmental Impact Statement (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) auks, fulmars, shearwaters, storm-petrels, gannets, skuas, terns, gulls, phalaropes, waterfowl, loons, grebes, and shorebirds (plovers, sandpipers) that are protected under the *Migratory Birds Convention Act, 1994* (MBCA) and additional marine-associated birds not protected under the MBCA but protected by the *Newfoundland and Labrador Wild Life Act* (i.e., cormorants). The term "migratory" in this context means protected under the MBCA regardless of whether a listed species under consideration undertakes seasonal or moult migrations. This VC also includes all marine and migratory birds listed under Schedule 1 of *Species at Risk Act* (SARA), Committee on the Status of Endangered Wildlife in Canada (COSEWIC), the *Newfoundland and Labrador Endangered Species Act* (NL ESA), or the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species.

The Orphan Basin and the Local Assessment Area (LAA) are part of a large marine ecosystem that is characterized by high biomass production due to the upwelling of nutrients by the Labrador Current along the continental shelf slope. As a result, the LAA is populated by large numbers of marine birds in every season of the year (Lock et al. 1994; Fifield et al. 2009). These bird populations are linked to distant areas through foraging trips by birds nesting in colonies along the Newfoundland coast, and through migratory connectivity to birds nesting at and fledging from nesting colonies in Newfoundland, northern Canada, Greenland, Iceland, northern Europe, and the south Atlantic. Nesting Leach's storm-petrels commute between the LAA and their nests in Newfoundland colonies to forage on deep-water prey. Non-breeding seabirds present in the LAA during summer include large numbers of great shearwaters and sooty shearwater that arrive in the LAA after nesting in the South Atlantic during the austral summer. In autumn dovekies, thick-billed murres, black-legged kittiwakes and northern fulmars arrive to overwinter in the LAA from breeding grounds in the Arctic and sub-Arctic lands surrounding the north Atlantic. Immature birds hatched in the same Arctic colonies, largely northern fulmars and black-legged kittiwakes, remain in the LAA during the summer after the adults have returned to the Arctic in spring. In late summer and fall, various species of shorebirds (plovers and sandpipers) depart Arctic nesting grounds to embark on trans-oceanic migratory flights from eastern North America to South America (Williams et al. 1978; Richardson 1979), some of which may traverse the LAA. Species at risk (SAR) designated on provincial or federal lists that may occur in the LAA or the Project Area consist of: harlequin duck, Barrow's goldeneye, piping plover, red knot, buff-breasted sandpiper, red-necked phalarope, ivory gull, Ross's gull, and peregrine falcon. Six additional species are included on the IUCN Red List of Threatened Species: long-tailed duck, black-legged kittiwake, Leach's storm-petrel, Bermuda petrel, Zino's petrel, and Desertas petrel. The Project Area is on the periphery of some of these species' distributions or migratory routes. However, they have been documented in the Project Area on rare occasion. Other shorebird and landbird SAR in Newfoundland and Labrador (NL) are not likely to occur in the LAA 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 (IBAs) and Convention on Biodiversity Ecologically or Biologically Significant Areas (EBSAs) are included as special areas.

9.1 SCOPE OF ASSESSMENT

9.1.1 Regulatory and Policy Setting

Most migratory and some non-migratory birds are protected under the MBCA, which is within the jurisdiction of Environment and Climate Change Canada (ECCC). The MBCA and attendant regulations cover all bird species listed in the Canadian Wildlife Service (CWS) Occasional Paper No. 1, *Birds Protected in Canada under the MBCA*. Species protected by the MBCA include most marine-associated birds (except cormorants and pelicans), all waterfowl, all shorebirds, and most landbirds (birds with principally terrestrial life cycles). Bird species (and other wildlife) not protected federally (e.g., cormorants), are protected under the provincial *Wild Life Act*. The MBCA and its regulations prohibit persons from disturbing, destroying, or taking/having 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 comprises prohibitions against releasing substances that are 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 encourage conformity with the MBCA and reduce the risk of incidental take of migratory birds, nests and eggs, ECCC has published Avoidance Guidelines (ECCC 2017a). A permit is required under the MBCA and *Migratory Bird Regulations* to authorize the capture and handling of migratory birds. The Canada-Newfoundland and Labrador Offshore Petroleum Board’s (C-NLOPB) has developed a report titled Measures to Protect and Monitor Seabirds in Petroleum Related Activity in the Canada-Newfoundland and Labrador Offshore Area (C-NLOPB n.d.) that 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 that appear on Schedule 1 of the federal SARA as endangered, threatened, or of special concern; or listed under the NL ESA as endangered, threatened, or vulnerable. Species of conservation concern (SOCC) include those that are listed as endangered, threatened, or of special concern by COSEWIC or IUCN, but not yet listed in Schedule 1 of SARA. Both federal and provincial legislation protect SAR and SOCC, including migratory birds.

Species protected under SARA are listed in Schedule 1 of the Act. SARA seeks to prevent species from extirpation or extinction; 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 protects species listed as endangered, threatened, or vulnerable under the Act, and 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 The Influence of Consultation and Engagement on the Assessment

During BHP's Project-related engagement with government departments and agencies, stakeholder organizations and Indigenous groups questions and comments about marine and migratory birds were documented (see Chapter 3 for further details). These primarily include concerns regarding adverse effects from both routine operations and accidental events on migratory bird species. Potential adverse effects to migratory birds that are important to Indigenous groups as a food source and for cultural reason was noted by the Indigenous communities.

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 as a result of the attraction of nocturnally-active birds to artificial lighting on the mobile offshore drilling unit (MODU) and Project support vessels (PSVs), operational discharges during well drilling and testing operations, underwater sound emissions from vertical seismic profiling (VSP) operations, and interactions with PSVs and helicopter activities during supply and servicing.

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 or stranding resulting in mortality) due to 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

In consideration of these potential pathways, the assessment of Project-related effects on marine and migratory birds focuses 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 15.6.2.

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 on the health or condition of marine and migratory birds (i.e., collisions, strandings, incineration, or increased predation due to attraction of predators 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 for marine and migratory birds are described in the sections below.

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 Exploration Licences (ELs) in the Project Area. The Project Area includes EL 1157 and EL 1158 with a buffer of approximately 20 km.

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, including the two ELs and 20 km buffer. This includes a 15 km zone of influence where Project-related artificial lighting emissions 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 plus a 10 km buffer. 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.

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 commercial fisheries and other ocean uses encompass all Project phases, including well drilling, testing, and abandonment. BHP is currently planning up to 20 wells proposed from 2021 to 2028. 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 35 to 115 days to drill. VSP surveys typically take approximately one to two days with sound source firing often limited to just a few hours. Drilling operations will not be continuous throughout the entire nine-year temporal scope of the Project and will depend partially on various factors including weather, MODU availability and results from previous wells. While drilling activities have the potential to be conducted at any time of the year, BHP's preference is to conduct drilling in ice-free months.

Some species of migratory birds as a group can be found in and around the Project Area at any time of the year with various species engaged in different stages of their life cycles, (i.e., migration, breeding, wintering, or summering). Section 6.2 provides details of marine and migratory bird species known to be present within the Project and Assessment Areas and times of year they present. For specific marine and migratory bird SAR and SOCC known to occur in the RAA, including their sensitive periods and relation to the Project Area, see Section 6.2.4.

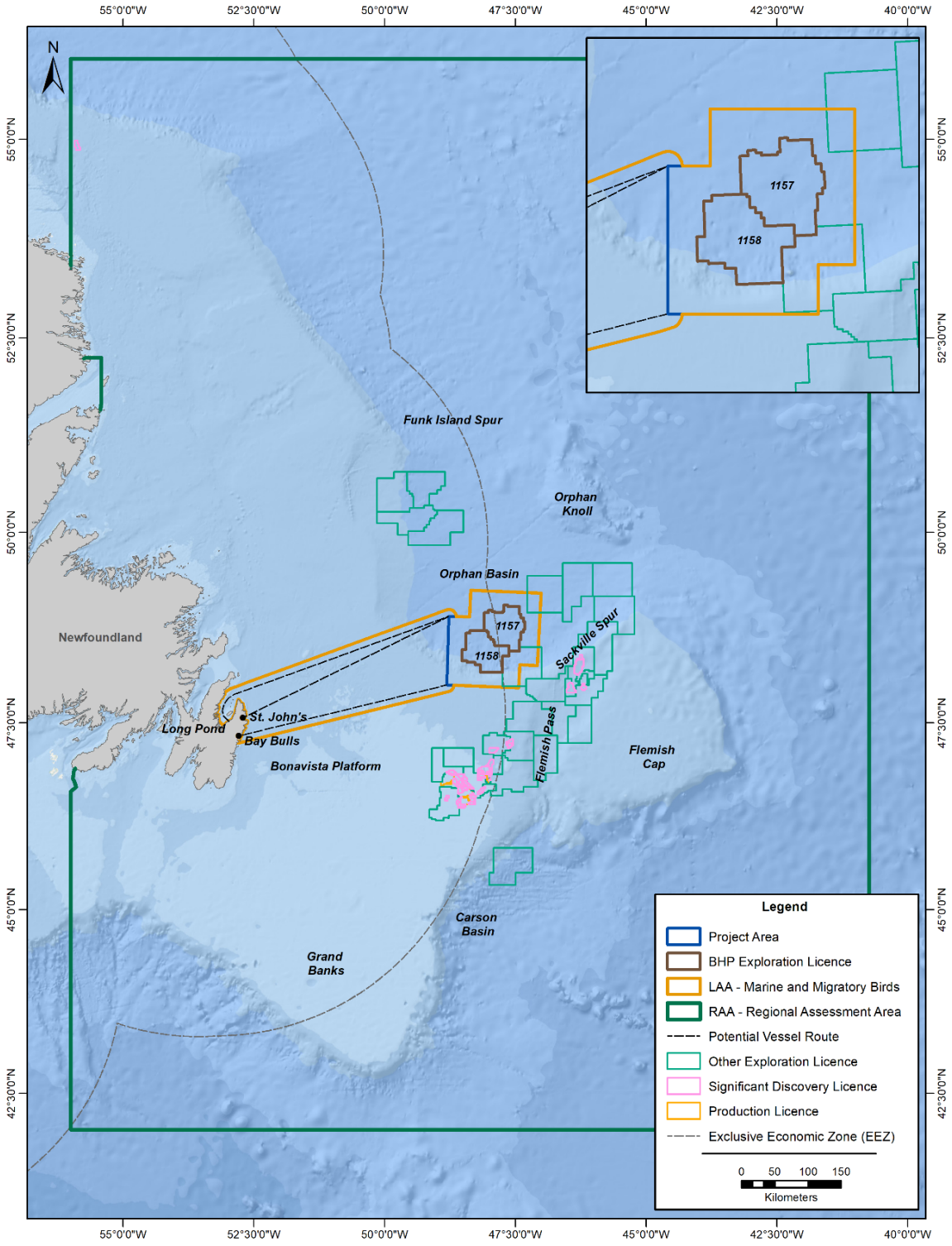

Figure 9-1 Marine and Migratory Birds Spatial Boundaries

9.1.5 Residual Effects Characterization

The definitions used to characterize environmental effects in this 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 15.6.2.

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 existing conditions	**Positive** – a residual environmental effect that moves measurable parameters in a direction beneficial to marine and migratory birds relative to existing conditions **Adverse** – a residual environmental effect that moves measurable parameters in a direction detrimental to marine and migratory birds relative to existing conditions **Neutral** – no net change in measurable parameters for marine and migratory birds relative to existing conditions
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	**Project Area** – 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 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 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 existing conditions unlikely

Table 9.2 Characterization of Residual Effects on Marine and Migratory Birds

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
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 pre-Project 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 LAA, not adversely affected by human activity, or is likely able to assimilate the additional change **Disturbed** – The VC has been substantially previously disturbed by human development or human development is still present in the LAA, or the VC is likely not able to assimilate the additional change

9.1.6 Significance Definition

In consideration of the descriptions in Table 9.2, 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 effect. These interactions are indicated by check mark and are discussed in detail in Section 9.3, in the context of effects pathways, standard and project-specific mitigation/enhancement, and residual effects.

Table 9.3 Project-Environment Interactions with Marine and Migratory Birds

Physical Activities	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, lights, and sound)	✓	✓
VSP	✓	✓
Discharges (e.g., drill muds / cuttings, liquid discharges)	✓	✓
Well Testing and Flaring (including air emissions)	✓	✓
Well decommissioning and abandonment or suspension	✓	✓
Supply and Servicing Operations (including helicopter transportation and Project support vessel operations)	✓	✓

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 with Project activities (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 information from recent Environmental Assessment (EA) documents for exploration drilling projects by ExxonMobil (2017), Statoil (2017), BP (2018), and Chevron (in preparation) in Flemish Pass and Orphan Basin, including comments received during Indigenous and stakeholder review processes, with updates incorporated as applicable.

9.3.1 Change in Risk of Mortality or Physical Injury

9.3.1.1 Project Pathways

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. These species are known to concentrate around drilling and production platforms as a result of artificial lighting at night, food, and other visual cues. This attraction to platforms potentially makes marine and migratory birds vulnerable to increased risk of mortality due to physical strikes with structures, stranding on the MODU or PSVs, predation by other marine bird species, and incineration from flares (Wiese et al. 2001; Ronconi et al. 2015). As well as direct (e.g., strikes) 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, 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 combined with the short duration of submersion by diving marine birds), and collisions with transiting helicopters.

9.3.1.2 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 limited to the extent that worker safety and safe operations is not compromised. Measures may include avoiding use of unnecessary lighting, shading, and directing lights towards the deck.

- BHP, in consultation with Environment and Climate Change Canada (ECCC) Canadian Wildlife Service (CWS), will develop a protocol for systematic, daily searches for seabirds stranded on the MODU and PSVs, which will include the documentation of search effort. Seabirds found will be recovered, rehabilitated, released and documented in accordance with the methods in Procedures for Handling and Documenting Stranded Birds Encountered on Infrastructure Offshore Atlantic Canada (ECCC 2017a). BHP will provide training in these protocols and procedures. A Seabird Handling Permit will be obtained from ECCC-CWS annually. In accordance with ECCC requirements, an annual report and all occurrence data that summarizes stranded and/or seabird handling occurrences will be submitted to ECCC.

- BHP will monitor daily for the presence of marine birds from the drilling installation using a trained observer following Environment and Climate Change Canada's *Eastern Canada Seabirds at Sea Standardized Protocol for Pelagic Seabird Surveys from Moving and Stationary Platforms* and monitor for the presence of stranded birds and follow Environment and Climate Change Canada's *Procedures for Handling and Documenting Stranded Birds Encountered on Infrastructure Offshore Atlantic Canada.*

Vertical Seismic Profiling

- 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). 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 and 10. 3) 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).

Well Testing and Flaring

- If flaring is required, BHP 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.
- If flaring is required, BHP will limit flaring to the length of time required to characterize the wells' hydrocarbon potential and as necessary for the safety of the operation.
- If flaring is required, flaring will be conducted as early as practicable during daylight hours to limit flaring that occurs during nighttime.
- C-NLOPB will be notified at least 30 days in advance of planned flaring to determine whether the flaring would occur during a period of migratory bird vulnerability and to determine how the Proponent plans to avoid adverse environmental effects on migratory birds.

Supply and Servicing Operations

- The regional CWS office will be contacted for separation distances and altitudes between helicopters transiting to and from the MODU and migratory bird nesting colonies, as per CWS guidelines (Government of Canada 2018) and routes will comply with provincial *Seabird Ecological Reserve Regulations, 2015* (no closer than 300 m). Specific details will be provided in the EPP.
- PSV routes transiting to and from the MODU will be planned to avoid passing within 100 m of migratory bird nesting colonies during the nesting period and will comply with provincial *Seabird Ecological Reserve Regulations, 2015* and federal guidelines to reduce disturbance to colonies (ECCC 2017b). Specific details will be provided in the EPP.
- Lighting on PSVs will be limited to the extent that worker safety and safe operations is not compromised. Measures may include avoiding use of unnecessary lighting, shading, and directing lights towards the deck.
- Searches for stranded birds and recovery, rehabilitation, release and documentation of birds will be conducted on PSVs as outlined above for the MODU.

9.3.1.3 Characterization of Residual Project-related Environmental Effects

Presence and Operation of a MODU

The most important potential interactions between marine and migratory birds and the presence and operation of a MODU result from the attraction of nocturnally-active birds to artificial lighting (including flaring where applicable) on platforms. This phenomenon can result in mortality in some species as a result of stranding, collisions, predation and exposure to other vessel-based threats.

Marine and migratory bird attraction to coastal and offshore lighting has been widely reported, but the underlying mechanisms are poorly known (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 regain flight and die from dehydration, starvation or hypothermia) (Baird 1990; Montevecchi et al. 1999; Wiese et al. 2000; LGL 2017). Bruinzeel and van Belle (2010) reported that most terrestrial bird mortality on offshore platforms was due to collision. Disoriented birds may also circle around lights for long periods of time, depleting energy resources, delaying foraging or migration, and potentially increasing their exposure to predation (Bourne 1979; Sage 1979; Wiese and Montevecchi 1999; Wiese et al. 2001; Jones and Francis 2003; Bruinzeel and van Belle 2010; Ronconi et al. 2015).

Attraction to artificial lighting and related stranding in marine birds has been documented in more than 40 species representing most families of procellariform birds (i.e., fulmarine and gadfly petrels, shearwaters, and prions [Procellariidae], storm-petrels [Hydrobatidae], and diving-petrels [Pelecanoididae]) (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). This suggests that some aspect of the orientation system common to procellariform birds may be disoriented by artificial light. Attraction to artificial lighting 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).

Marine bird attraction to artificial lighting has been recorded throughout the year but occurs most commonly at the end of the nesting season (Telfer et al. 1987; Le Corre et al. 2002; Miles et al. 2010). In the NL offshore area, most strandings of Leach's storm-petrels on drilling and production platforms and geophysical vessels occur from mid-September to mid-October when the young fledge and the adults abandon nesting colonies (LGL 2017). In other species, when the age of the grounded seabirds has been determined, most individuals are recently fledged juveniles, especially those stranding near seabird nesting colonies, suggesting that juvenile inexperience is a contributes to attraction to artificial lighting (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; therefore some authors suggest that artificial lights are being mistaken for celestial cues (Wiese et al. 2001; Gauthreaux and Belser 2006; Poot et al. 2008). Alternatively, nocturnally-foraging seabirds such as shearwaters and storm-petrels may mistake the reflection of lights on the sea surface for bioluminescent prey (Imber 1975; Wiese et al. 2001; Gauthreaux and Belser 2006; Poot et al. 2008).

Meteorological conditions and the phases of the moon are believed to influence the degree of bird attraction to artificial lighting. Reed et al. (1985) found that full moon conditions decrease attraction to lights, although the exact reason for this was not fully understood. Several studies reported that marine bird strandings 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; Syposz et al. 2018). Species prone to stranding may be more active on darker nights. The rate of nocturnal arrivals and departures of small procellariform species at active nests is lowest around the time of the full moon (Imber 1975; Bretagnolle 1990), which may reduce exposure to 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; LGL 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. 2008), investigated behaviour of birds in passage migration around offshore installations in the North Sea and observed milling behaviour of dense (and often mixed species) flocks only during overcast nights and concentrated primarily between midnight and dawn.

The wavelength and intensity of lighting have also been shown to influence the degree of attraction. In some studies, white and red-coloured lights are associated with the highest rates of attraction, while blue and green lights are associated with the lowest rates (Gauthreaux and Belser 2006; Poot et al. 2008; Marquenie et al. 2013). However, Poot et al. (2008) did not control for light intensity or weather, measured flight direction instead of bird number and had a low sample size (Ballasus et al. 2009 in Rebke et al. 2019). In a study of passerines (songbirds and suboscine birds) nocturnally migrating over the North Sea, continuous green, blue, or white light attracted substantially higher numbers of birds than continuous red light, but only when the sky was overcast (Rebke et a. 2019). Blinking lights attracted considerably fewer birds than continuous lights with all colours except red, which attracted the same number of birds as continuous light. Experimentation showed that high pressure sodium lights (colour temperature 2000 K, [i.e., warm]) attract 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 emit much less energy below 575 nautical miles than the other two types. Bird attraction is 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 is substantially reduced (Marquenie and van de Laar 2004; Marquenie et al. 2013). Shielding lights downward also correlates with reduce attraction (Reed et al. 1985).

In the NL offshore area marine birds often strand on fishing vessels, drilling and production platforms, and PSVs (Baillie et al. 2005; Ellis et al. 2013). Baillie et al. (2005) reported 469 stranded birds (mostly Leach's storm-petrels) at offshore installations and vessels off NL between 1998 and 2002, of which 16 (3%) were reported to have died and 344 (74%) were released; the fate of the remaining birds was not reported. The strandings were most common in September and October, and 97% of the birds were Leach's storm-petrels, which was also the most commonly seen species during seabird surveys conducted from the vessels. However, the authors did not report the dates that installations and vessels were on-site. Other species that were found included Atlantic puffin, common murre, ruddy turnstone and glaucous gull. In both Ellis et al. (2013) and Environment Canada (2015), Leach's storm-petrels were the most commonly found species stranded on vessels of various types, including fishing vessels as well as oil and gas-related vessels. LGL (2017) analyzed more recent stranding data. From 2003 to 2014, a total of 541 stranding events consisting of 2,048 birds of 31 species were recorded over the course of 14,136 days in the bird salvage logs of five MODUs and three offshore production facilities on Jeanne d'Arc and Orphan Basins, and Flemish Pass (LGL 2017). Of those birds recovered, 1,986 were marine species 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). Multi-individual 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. Sixty percent of all storm-petrels stranded between 2003 and 2014 were recorded during 2006.

Strandings were also seasonal. Most (95%) of the strandings occurred during the months of September and October, peaking from 10 September to 13 October (LGL 2017). The beginning of this peak period roughly coincides with the earliest published date of fledging at the nesting colony on Great Island in Witless Bay, Newfoundland (Pollet et al. 2019). After fledglings and adults abandon the colonies many begin their southward migration, which takes them across the RAA (Pollet et al. 2014).

Bird salvage logs from geophysical exploration vessels and PSVs from 2003 to 2014 have also been summarized (LGL 2017). Biologists were on board primarily to serve as Marine Mammal Observers (MMOs), but their duties also included systematic daily searches of the vessel at dawn for birds, and recovery, documentation and release of stranded birds. The vessels were engaged in the NL offshore area in exploration programs starting 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. 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. Most strandings occurred from 21 September to 10 October despite few vessels conducting programs after September. Almost all the storm-petrels stranded on the hydrophone streamer and air source array decks of geophysical seismic survey 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 even though storm-petrels are frequently seen approaching the lights on the open afterdecks of those vessels.

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). Nonetheless, even incidental information from industry-based monitoring is helpful to determine seasonal and weather-related patterns in strandings, and to determine which species are likely more susceptible to this phenomenon. 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 (LGL 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 plumage contamination from hydraulic fluid upon landing on the deck or in drip-trays under the numerous winches on streamer and air source array decks, then apparently succumbing to hypothermia as a result. However, since most birds that were uninjured and unoiled were unable to escape the vessels, it is surmised that they would also have died were they not retrieved and returned to the sea. Leach's storm-petrels attracted to the NL offshore area MODUs and production platforms are also exposed to potential 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; LGL 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 6.2.2.7, this species feeds primarily in the deep waters off the continental shelf. As a result, individuals nesting in Newfoundland colonies travel to the waters on the continental shelf slopes of the Grand Banks and beyond to forage, returning to the colonies to feed their nestlings. Large numbers nest at Baccalieu Island and Great Island, Witless Bay; the nearest deep waters to these colonies are found in Orphan Basin and Flemish Pass. Fledglings and adults travel to these deep waters during post-breeding dispersal (Pollet et al. 2014).

Data on the distance at which birds can be affected by light from a MODU or vessel are limited. The zone of influence varies with factors such as weather, intensity and position (height) of the light source, and ambient light conditions (Montevecchi 2006). 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 short-tailed shearwaters are attracted to artificial lighting from at least 15 km away (Rodríguez et al. 2014). The configuration of the LAA for marine and migratory birds (the Project Area plus an extension consisting of a buffer of 15 km) is based on this finding.

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. The data collected as a result of systematic searches by biologists on board geophysical exploration vessels and summarized above reveal that a high percentage of stranded Leach's storm-petrels survive the initial stranding and suggest that collisions, if any, rarely result in mortality in this species. In most cases mortality appeared to have been the result of hypothermia after contact with hydraulic fluids and water on the decks. This species flies at wave top height and must gain altitude to the reach the altitude of artificial lighting, thus losing airspeed and potential impact energy in the event of a collision and gaining maneuverability to avoid collisions. If this is representative of storm-petrel interactions with vessels and platforms in general, then few individuals may be colliding with vessel hulls, and fewer still may sustain fatal injuries and then fall into the sea. In addition, large stranding events appear to be episodic for reasons that are not clear. However, such large stranding events are rare, and can be largely mitigated by the implementation of a systematic search protocol and the release of recovered birds. There is some potential for the attraction of landbirds in passage migration, particularly during the fall. However, most landbird migration involving ocean crossings in Atlantic Canada is thought to take place south of and west of NL (Williams et al. 1978; Richardson 1979). Some fall shorebird migration departs from the south coast of Newfoundland (B. Mactavish, 2019, pers. comm.). These birds may head on a southeasterly course like those departing from Nova Scotia (Richardson 1979). It is therefore likely that most of this migration passes to the west of the LAA and that a small amount traverses the southwest corner of the RAA, so it is unlikely that large numbers of shorebirds and other landbirds will be affected.

The presence of the MODU and drilling installation would be a new source of night lighting in a region that is relatively free of nocturnal artificial lighting, as indicated in a world atlas computed of artificial night sky brightness (Falchi et al. 2016).

Based on the information and analysis summarized here, and with the implementation of appropriate mitigation measures as summarized in Section 9.3.1.2, 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 found alive and 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 adverse, low in magnitude, localized to the LAA, short-term in duration, irregular in frequency, and reversible.

VSP

As discussed in Section 2.4.2, VSP surveys will occur over one to two days per well with air source array pulses emitted for less than 24 hours.

Seabird hearing the effect of loud sounds on it is poorly known. Crowell (2016) measured in-air auditory brainstem response in long-tailed duck, lesser scaup, red-throated loon, and northern gannet and found sensitivity is greatest between 1.5 and 3 kHz. In the RAA these species have a primarily coastal distribution. Mooney et al. (2019) measured in-air auditory brainstem response in common murre and Atlantic puffin to sounds of frequencies from 0.125 to 6 kHz and found the greatest sensitivity to the frequencies from 1 to 2 kHz. Common murre is likely to occur in the LAA but Atlantic puffin is uncommon away from coastal waters. Underwater hearing thresholds in great cormorant are similar to seals and toothed whales in the 1 to 4 kHz frequency range (Anderson Hansen et al. 2016; Johansen et al. 2016). Great cormorants also respond to underwater sounds and may have special adaptations for hearing underwater (Johansen et al. 2016; Anderson Hansen et al. 2017).

Sound levels that cause injury to marine birds have not been tested. However, temporary hearing impairment can occur in terrestrial bird exposed to sound in air (Saunders and Dooling 1974; Ryals et al. 1999). Terrestrial bird species vary in their susceptibility to hearing damage resulting from sound exposure (Ryals et al. 1999), although they are generally thought to be more resistant to damage than mammals (Dooling and Popper 2007). Birds can regenerate sensory hair cells in the ear, unlike mammals (Ryals et al. 1999; Dooling and Popper 2007). Underwater hearing of birds is thought to be poorer than in air, because 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 evolved.

Permanent physiological damage, i.e., hearing loss (permanent acoustic threshold shift), is unlikely to result from a VSP survey. Temporary auditory impairment from exposure to loud impulse sound may last days (Hashino et al. 1988), which may impede a bird's ability to find their kin at nest sites, for example.

Deep-diving birds such as alcids (murres, razorbill, dovekie, Atlantic puffin) may be at somewhat higher risk of injury (or disturbance) due to exposure to underwater sound such as that generated by geophysical sound sources than shallow-diving species (northern fulmar, shearwaters). These species dive from a resting position on the sea surface to forage for small fish and invertebrates and can reach depths of 20 to 60 m and spending up to 40 s underwater at a time (Gaston and Jones 1998).

In air, sounds from a submerged air source array are reduced to a level below that which causes injury or mortality. However, they are audible to birds, as demonstrated by startle reactions to air source releases that are often visible in gulls and skuas flying near submerged air source arrays operated in shallow water (A. Lang, pers. obs.). Although the escape reactions seen in diving marine alcids on the surface in response to the approach of geophysical vessels cannot easily be classified into reactions to either air source pulses or to the movement of the source vessel, it is reasonable to conclude that they are as capable of hearing the air source pulses as gulls are. Therefore, ramp-ups could alert those diving marine birds that are resting on the surface during the initial part of the ramp-up. In addition, dive durations of common murres measured in various studies average 67 to 101 s and reach as high as 153 s (Gaston and Jones 1998). As a result, those birds that are not deterred by the first few pulses of a ramp-up before initiating a dive, would be submerged sufficiently long to hear one or more air source pulses.

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 source operations will incorporate a ramp-up in consideration of the 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 near the source. Above the water, atmospheric sound from the air source 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 to two days) 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 adverse, 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 Offshore Waste Treatment Guidelines (OWTG) and the International Convention for the Prevention of Pollution from Ships (MARPOL), as applicable. Discharges and emission are expected to be temporary, localized, non-toxic, and subject to dilution in the open ocean.

Cement, water-based mud (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 birds (or their habitats). Water depths in the Project Area range from approximately 1,175 m to 2,575 m. The deepest-diving seabirds

found in the Project Area, thick-billed murres, seldom reach depths of 200 m (Gaston and Hipfner 2000 in ExxonMobil Canada Ltd. 2017). Synthetic-based mud (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 encounter the chemical components of SBM. With appropriate screening and selection of chemicals 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 arise from the possible release of oily water and other substances through 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 2.7).

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 subsequent potential for 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 Fund (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 encountering a sheen with a thickness of 0.1 µm and picking up all 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 paucity of data on the occurrence of oiling of seabirds around platforms (Morandin and O'Hara 2016). Second, data on the frequency, likelihood, persistence, fate, and thickness of sheens resulting from discharges of produced water and drilling muds are also lacking. 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 in the RAA 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 9.3.1.2, 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 reduced 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 associated with 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 adverse, low in magnitude, irregular, localized to the Project Area, short term in duration, and reversible.

Well Testing and Flaring

Formation flow testing may occur during drilling of the well, or it may be carried out later upon re-entering a suspended well and 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. Estimates often rely on recovery of birds on platforms and vessels and, as discussed above for electrical lighting on offshore installations, recoveries are often conducted on an incidental basis (Ronconi et al. 2015). As a result, the number of birds killed but not recovered due to scavengers removing them or to landing in the ocean is not known (Bruinzeel et al. 2009; Ellis et al. 2013; Ronconi et al. 2015).

Some researchers contend that some portion of the of the birds attracted to drilling and production installations at night may be incinerated by gas flares (Russell 2005; Montevecchi 2006). Systematic visual monitoring of North Sea gas flares has detected no incineration (Hope Jones 1980; Wallis 1981). Monitoring of flares in the Gulf of Mexico has not been conducted, but two burned songbirds were found in a multi-year study of the use of several offshore oil platforms by landbird passage migrants (Russell 2005). Mortality at flares appears to be episodic, so discontinuous monitoring may miss such events. Bird mortality at an onshore flare stack in Alberta has been documented (Bjorge 1987). However, necropsies of 56 of the birds revealed injuries consistent with hydrogen sulfide poisoning rather than collisions or burning. 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. There have been fewer than five documented accounts of mass mortality events (>100 birds in a night) associated with oil and gas activities have been reported from Canada and United States (Bjorge 1987; CWHC 2009), but because these events are rarely documented, no comprehensive analysis has been published. At least one similar incident has been reported with offshore flares in the North Sea, where a large number ("hundreds to

thousands") of passerines were observed to have been killed in a night by flares (although not by incineration) (Sage 1979); however, research by Bourne (1979) and Hope Jones (1980) suggests a much lower mortality rate in the North Sea of approximately a few hundred birds per year per platform. While accurate assessment of mortality at offshore facilities may be difficult, no mass mortality events due to incineration in flares have ever been reported at offshore oil and gas operations in offshore NL.

As is the case with offshore lighting discussed above, a number of factors influence the potential severity of marine bird interactions with flares, including time of the year, location (i.e., whether concentrations of birds are present near the flare), height and weather conditions (Weir 1976; Wiese et al. 2001). Mortality can also increase during migration, especially if poor weather conditions force birds to down to low altitudes (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 altitude soon after takeoff and, shortly after midnight, undertake a gradual descent (Weir 1976).

The relative commonness of reports of nocturnal circulation of birds around flares and electric lighting in contrast with the rarity of reports of direct mortality from flares (Bourne 1979; Russell 2005) suggests that the magnitude of the effects of light attraction to a platform, i.e., energy consumption diverted from foraging and migration and of potential for mortality from stranding and collisions, is many times greater than the potential mortality from the heat of the flare. The zone of influence around the flare of temperatures high enough to cause injury or mortality is expected to be limited to several metres and would probably consist primarily of the backdraft drawing a bird to the flare, which would then have to use energy in powered flight to evade the flame or, on rare occasions, mortality from the flare's heat.

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 24 hrs during a one to three-month window at the end of drilling operations, if flaring occurs at all), and associated bird attraction will be limited to within 15 km of the MODU. Mitigation measures regarding flaring will be adhered to throughout the Project, including the use of high efficiency burners. If flaring is required, BHP 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, reducing flaring during periods of migratory bird vulnerability, and the use of a water curtain to deter birds from the general vicinity of the flare. The effects of formation flow testing with flaring on marine and migratory birds are therefore anticipated to be low.

Residual effects associated 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 adverse, low in magnitude, localized to a portion of the Project Area, short term in duration, irregular in frequency, and reversible.

Well Decommissioning and Abandonment or Suspension

Activities associated with well decommissioning and abandonment or suspension involve the presence of vessels at the drill site. As a result, the effects of these activities would be the same as those assessed for the presence and operations of the MODU, and therefore are not repeated here.

Underwater activities will occur at depths sufficient 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 (auks, murres, puffins and guillemots) are among the deepest divers and consequently would spend the most amount of time underwater. The maximum estimated diving depths 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 1,175 m to more than 2,500 m in the Project Area and drilling and well abandonment will take place beyond the depth of diving seabirds (i.e., 200 m or shallower) found in the area. These activities are therefore not predicted to interact with migratory birds, including diving seabirds.

Residual effects associated with well decommissioning and abandonment or suspension on risk of mortality and physical injury to marine and migratory birds are predicted to be adverse, low in magnitude, localized to the LAA, 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. 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, including that associated with existing oil production and exploratory drilling platforms in the RAA.

The potential effects due to nocturnal artificial lighting sources on the PSVs are anticipated to be similar but lower magnitude to those from lighting on the 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 9.3.1.2 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 reduced 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 9.3.1.2.

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 adverse, low in magnitude, localized in extent to the LAA, short-term, irregular in frequency, and reversible.

9.3.2 Change in Habitat Quality and Use

9.3.2.1 Project Pathways

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 artificial lighting, discharges and atmospheric and underwater sound associated with the MODU and PSVs. 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.

9.3.2.2 Mitigation

In consideration of the environmental effects pathways outlined above, the mitigation measures and standard practices described in Section 9.3.1.2 will be employed to reduce the potential for change in marine and migratory bird habitat quality and use as a result of routine Project activities.

9.3.2.3 Characterization of Residual Project-related Environmental Effects

Presence and Operation of a MODU

Changes in habitat quality and use related to the presence and operation of a MODU generally are due to artificial lighting and atmospheric and underwater sound emissions from the MODU that 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 platforms are often many times higher than before the installation of the platforms or some distance farther 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).

The presence of offshore platforms can also provide new habitats for birds (Russell 2005). Structures may be used as roosting and resting habitat by gulls (Burke et al. 2012), as stopover locations for migrating landbirds who may forage around the platforms (Russell 2005; Bruinzeel and van Belle 2010), or even potentially as hunting grounds for predatory species such as large gull species and peregrine falcons in passage migration that take advantage of concentrations of birds around the structures (Russell 2005). Foraging opportunities may also be enhanced around artificial reefs if hard substrate required by some invertebrate and fish assemblages is locally scarce (Wolfson et al. 1979; Fabi et al. 2002, 2004). Baird (1990) speculated that seabirds are attracted to these platforms because of this artificial reef effect. Great black-backed gulls congregate in large flocks at drilling and production platforms offshore NL in late summer post-breeding dispersal and fall migration (Brown 1986; Burke et al. 2012). These gulls are observed to

forage at night on fish such as Atlantic saury and northern sand lance, which are attracted to the surface by artificial light emissions from the platforms (Montevecchi et al. 1999; LGL 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.

Other species of marine birds are displaced by offshore platforms (AMEC 2011; Baird 1990; Bramford et al. 1990). Alcids, for example, are prone to disturbance from vessel traffic, which may be a cause of their rarity near platforms (Ronconi and St. Clair 2002; Bellefleur et al. 2009). Alcid distribution along supply routes between shore bases and platforms on the Grand Banks is more strongly correlated with ocean temperature than proximity to platforms (Burke et al. 2005). However, these attraction effects differ among species and seasons (Burke et al. 2012). The effect of habitat displacement on marine birds is likely to be minor, except where platforms occur in high concentrations, such as the North Sea, or on or near productive sites associated with oceanographic features such as continental shelf edges and slopes (Hedd et al. 2011; Ronconi et al. 2015). However, a high density of platforms is not the case in the RAA, where there are four production installations (with distances between the installations ranging from 10 to 75 km), and one to two drilling installations operating at any one time.

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 an extended 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 9.3.1.2, 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 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 (conservatively set at 15 km diameter based on Section 9.1.4.1) 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 adverse, low in magnitude, localized to the LAA, short--term in duration, irregular in frequency, and reversible.

VSP

Most field studies of the effects of underwater sound on bird behaviour have found no substantial effects (see LGL 1998; Minerals Management Service 2004). Moulting long-tailed ducks in the Beaufort Sea show no changes in movements or diving behaviour during geophysical surveys, although the authors noted that smaller-scale behavioural changes could not be ruled out (Flint et al. 2003; Lacroix et al. 2003). In the Davis Strait, Stemp (1985) found no evidence of effects of geophysical surveys on thick-billed murre, northern fulmar, or black-legged kittiwake mortality or distribution in the offshore. These species are found in the current LAA, although kittiwake and thick-billed murre are rare in summer. Stemp (1985), citing a personal communication with another researcher, also reported that shearwaters show no behavioural response close to a geophysical sound array even with their heads underwater. Evans et al. (1993) observed no evidence that marine birds are attracted to or repelled by offshore seismic survey activity in the Irish Sea. However, a five-year study (2009-2013) using Global Positioning System (GPS) tracking reported avoidance of a 2D seismic survey by African penguins when foraging close to breeding colonies that were located less than 100 km from the seismic survey (Pichegru et al. 2017). The air source array had a total volume of 4,230 in³ and nominally operated at 2,000 psi during an approximate one-month period in 2013. However, it could not be determined whether the penguins (flightless birds that dive to depths of 30 m on average) were responding directly to air source sound or to potential changes in the distribution of their prey. The birds reverted to normal behaviour when the seismic source array was shut down.

VSP surveys will be conducted for each well drilled and are expected to take approximately one to two days with sound source firing often limited to just a few hours. As discussed above, the foraging activity of at least one species of marine bird has been reported as being negatively affected by the underwater sound energy from marine seismic. Above the water, air source sound is reduced to that which is likely to have little or no effect on the behaviour of birds that have their heads above water or are in flight. Effects of sound disturbance on the 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 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 adverse, negligible in magnitude, localized within the Project Area, short-term, unlikely in

frequency, and reversible. Changes in habitat and food availability and quantity from VSP activities are likewise not anticipated because the activity will be localized and short-term, with negligible effects.

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. Burke et al. (2012) speculated that the biological growth (artificial reefs) on platforms is enhanced by fertilization of the waters around platforms by organic waste (sewage and food scraps) discharge from those platforms. Grey and black water (sewage) that is discharged into the environment may lead to organic enrichment of areas that have either positive or negative effects on local fish and invertebrates (Peterson et al. 1996) and affect local productivity (Chapter 8). However, this effect will only occur during the drilling program (35 to 115 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, shearwater species and storm-petrel species are attracted to sheens. The visual appearance of a hydrocarbon sheen would resemble a sheen of biological origin and may occasionally 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). Such species distinguish between sheen of oils derived from animals and sheen of petroleum oils by their odours (Hutchison and Wenzel 1980). As a result, these birds would be unlikely to encounter 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 are anticipated to be adverse, low in magnitude 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 Testing and Flaring

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 adverse, low in magnitude, short term in duration localized to portions of the Project Area, irregular in frequency, and reversible.

Well Decommissioning and Abandonment or Suspension

Activities associated with well decommissioning and abandonment or suspension involve the presence of vessels at the drill site. As a result, the effects of these activities would be the same as those assessed for the presence and operations of the MODU, and therefore are not repeated here.

Underwater activities will occur at depths sufficient 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 (auks, murres, puffins and guillemots) are among the deepest divers and consequently would spend the most amount of time underwater. The maximum estimated diving depths 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 1,175 m to more than 2,500 m in the Project Area and drilling and well abandonment will take place beyond the depth of diving seabirds (i.e., 200 m or shallower) found in the area. These activities are therefore not predicted to interact with migratory birds, including diving seabirds.

Residual effects associated with well decommissioning and abandonment or suspension to change habitat quality are primarily related to artificial light emissions. These may result in changes in habitat quality and use by marine and migratory birds. These changes are predicted to be adverse, low in magnitude, localized to the LAA, short-term in duration, 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 13 km southeast of the Cape St. Francis IBA and at least 39 km north of the Witless Bay Ecological Reserve IBA (the nearest IBA with seabird nesting colonies). PSV routes out of eastern Newfoundland may pass near IBAs (i.e., Cape St. Francis IBA, Witless Bay Islands Seabird Ecological Reserve) and will maintain required buffer distances (during daytime: 100 m from cliff nesting colony, *Seabird Ecological Reserve Regulations*; 200 m from a seabird concentration at-sea, e.g., Cape St. Francis; night-time: 15 km from Leach's storm-petrel concentration, e.g., Witless Bay Islands). This vessel traffic may interact with 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 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 are variable due to several factors including species, previous exposure levels, and the location, altitude, and number of flights (Hoang 2013). One of the most conspicuous 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). Eggs and nestlings may also be vulnerable to hypothermia. During flushing, adults may inadvertently knock eggs and nestlings from the nest, upon which they may fall from a cliff or be exposed to attacks by neighboring nesting pairs (Burger 1981; Carney and Sydeman 1999). Disturbance may disrupt rates of foraging and feeding of 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). The various bird species that occupy the Project Area and transit route will not likely be affected by helicopter activity due to its transitory nature and thus, its short-term presence at any one location, and because of mitigation measures in place (see below).

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 (Montevecchi et al. 1999; LGL 2017).

Discharge 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 reduced 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* and CWS guidelines discussed in Section 9.3.1.2. Routes from the eastern Newfoundland are well outside the daytime buffer for Seabird Ecological Reserves and the recommended buffer for concentrations at from the nearest seabird ecological reserve. The 15 km zone of influence of lighting on PSVs using the route from Bay Bulls overlaps one Leach's storm-petrel concentration, i.e., the Witless Bay Ecological Reserve, which is 1.8 km from the route. However, reducing lighting on board the PSVs and the speed at which they travel will prevent stranding on those vessels. For helicopter routes, the regional CWS office will be consulted for separation distances from nesting colonies, as per CWS guidelines. The nearest seabird nesting colony, a black-legged kittiwake nesting colony on Freshwater Bay, is over 5 km south of existing helicopter routes (Lock et al. 1994). The nearest seabird ecological reserve, Witless Bay Islands, is 40 km south of the St. John's International Airport.

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 (i.e., 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 adverse, low in magnitude, localized in extent to the LAA, short-term, irregular in frequency, and be reversible.

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

Table 9.4 presents marine and migratory bird SAR and SOCC that could potentially occur in the RAA, summarizing their likely occurrence 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 (with the exception of Leach's storm-petrel which is designated vulnerable on the IUCN Red List) 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 uncommon as far south and east as the Project Area or LAA (including PSV route) and limited to late winter. 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. As discussed in Section 6.2.2.6, the RAA is at the northern periphery of the ranges of Bermuda, Desertas and Zino's petrels where they occasionally occur in very low numbers, and, except for Bermuda petrel, do not venture out of the warm waters of the North Atlantic Drift (northern component of the Gulf Stream).

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

Species	NL ESA	Federal Status		IUCN Red List	Summary of Presence and Potential Interactions
		SARA Listing	COSEWIC Assessment		
Harlequin duck (eastern pop.)	Vulnerable	Special Concern (Schedule 1)	Special Concern	None	• Breeds inland but moves to coastal waters of RAA 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
Long-tailed duck	None	None	None	Vulnerable	• Present in coastal waters of RAA during fall, winter and spring • Unlikely in the Project Area
Barrow's goldeneye (eastern pop.)	Vulnerable	Special Concern (Schedule 1)	Special Concern	None	• 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

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

Species	NL ESA	Federal Status		IUCN Red List	Summary of Presence and Potential Interactions
		SARA Listing	COSEWIC Assessment		
Piping plover (*melodus* ssp.)	Endangered	Endangered (Schedule 1)	Endangered	Near threatened	• 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	Near threatened	• 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 • 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	Near threatened	• 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

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

Species	NL ESA	Federal Status		IUCN Red List	Summary of Presence and Potential Interactions
		SARA Listing	COSEWIC Assessment		
Red-necked phalarope	None	None	Special Concern	None	• 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
Black-legged Kittiwake	None	None	None	Vulnerable	• Present in large numbers in coastal RAA in the breeding season; large numbers in the Project Area in non-breeding season (October to February), present in small numbers during breeding season • Known to gather on sea surface downwind of offshore installations during daylight and periods of darkness • High potential for interaction with the Project given seasonality of presence in the RAA
Ivory gull	Endangered	Endangered (Schedule 1)	Endangered	Near threatened	• 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	None	• 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

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

Species	NL ESA	Federal Status		IUCN Red List	Summary of Presence and Potential Interactions
		SARA Listing	COSEWIC Assessment		
Peregrine falcon	Vulnerable	Special Concern (Schedule 1)	Special Concern	None	• Migrates along the coast of Newfoundland during fall • Observed in small numbers in the offshore RAA • If present, could potentially be attracted to the MODU and/or PSVs to rest or prey on landbirds seeking refuge in these areas, but likelihood is low
Leach's storm-petrel	None	None	None	Vulnerable	• Nests in large numbers in RAA • Adults commute between active nest and waters beyond continental shelf break to forage; fledglings disperse to the same waters in fall migration • Moderate potential for interactions with MODU and PSVs in summer and high potential in fall
Bermuda petrel	None	None	None	Endangered	• Grand Banks and waters to the south and east in RAA • Low potential to occur in the Project Area
Desertas petrel	None	None	None	Vulnerable	• Warm waters southeast of the continental shelf in RAA • Low potential to occur in the Project Area
Zino's petrel	None	None	None	Endangered	• Warm waters southeast of the continental shelf in RAA • Low potential to occur in the Project Area

Major threats identified in associated recovery strategies and action plans for these bird SAR are: predation at the nesting colony, competition for nesting habitat, erosion or fire at the nesting colony, flooding or pollution of coastal habitats, hunting, at-sea pollution, climate change (rising sea levels and food webs), competition with commercial fisheries, fisheries bycatch, and disease. Given the distance of most Project activities occurring offshore, Project effects with these bird SAR are expected to be negligible in magnitude, but low for Leach's storm-petrel, and are most likely to occur during species' post-breeding dispersal or 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 9.3.1.2) will help to protect bird SAR.

The residual effects of the Project on marine and migratory bird SAR are predicted to be adverse, negligible in magnitude (low for Leach's storm-petrel), extend to the LAA, an unlikely event, short term in duration, and reversible.

9.3.4 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 the development and implementation of protocols and training for systematic, daily searches, and for 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 2017b). 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	LAA	ST	IR	R	D
VSP	A	L	PA	ST	IR	R	D
Discharges	A	L	PA	ST	IR	R	D
Well Testing and Flaring	A	L	PA	ST	IR	R	D
Well Decommissioning and Abandonment or Suspension	A	L	LAA	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	LAA	ST	IR	R	D
VSP	A	N	PA	ST	UL	R	D
Discharges	A	L	PA	ST	IR	R	D
Well Testing and Flaring	A	L	PA	ST	IR	R	D
Well Decommissioning and Abandonment or Suspension	A	L	LAA	ST	IR	R	D
Supply and Servicing Operations	A	L	LAA	ST	IR	R	D

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
KEY: See Table 9.2 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			

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 effects 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 SAR 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 SAR. With mitigation and environmental protection measures, the residual environmental effects on marine and migratory birds (including SAR) are predicted to be not significant.

9.5 PREDICTION CONFIDENCE

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. This may also be true for some birds that strand on MODUs but are not found in time to permit 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. However, development and implementation of protocols for systematic, daily searching of the MODU and PSVs for stranded birds, and for documentation of search effort, will verify the effects assessment prediction and the effectiveness of the mitigation. In addition, there is a lack of data on the rate of oiling of marine birds around offshore oil installations.

9.6 ENVIRONMENTAL MONITORING AND MONITORING

For the duration of the drilling program for each well:

- Systematic searches for stranded birds will be carried out daily on the MODU and PSVs, and this effort documented, by trained personnel according to search protocols designed specifically for each facility
- Retrieval, rehabilitation, release and documentation of stranded birds will be conducted according to Procedures for Handling and Documenting Stranded Birds Encountered on Infrastructure Offshore Atlantic Canada (ECCC 2017b) 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 NL offshore area

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10.0 ASSESSMENT OF POTENTIAL EFFECTS ON MARINE MAMMALS AND SEA TURTLES

The marine mammals and sea turtles valued component (VC) includes baleen whales, large toothed whales, delphinids, porpoises, seals, and sea turtles, and includes those species that are listed under Schedule 1 of *Species at Risk Act* (SARA) and considered at risk by Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Marine mammals and sea turtles were selected as a VC because of their potential to interact with Project components and activities, as there is important habitat for these species in the offshore waters off Newfoundland, and because marine mammals are susceptible to effects from underwater sound. Marine mammals and sea turtles are also of cultural and recreational value to Indigenous groups and the general public.

As noted in Section 6.3, offshore waters of eastern Newfoundland are known to support many species of marine mammals and sea turtles, including species designated as Species at Risk (SAR) or Species of Conservation Concern (SOCC) (see Section 6.3.7). Thirty-two species of marine mammals could occur within or near the Project Area, including 26 species of cetaceans (whales, dolphins, and porpoises) and six species of seals. Most marine mammals occur in the area seasonally, but some use the area year-round. Four species of sea turtles could also occur within or near the Project Area, but only leatherback and loggerhead turtles occur regularly within the Regional Assessment Area (RAA). Due to similarities in habitat use and the nature of potential interactions with Project components and activities, sea turtles are assessed with marine mammals.

This VC is linked to the Marine Fish and Fish Habitat VC (Chapter 8) because marine mammals and sea turtles feed on fish and marine invertebrates. It is also linked to the Special Areas VC (Chapter 11), as some of these areas, such as Ecologically and Biologically Significant Areas (EBSAs), encompass important foraging habitat and migratory routes for marine mammals and sea turtles. No critical habitat has been designated for marine mammals and sea turtles in or near the Project Area.

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). Marine mammals and sea turtles as “marine animals” are considered “fish” for the purposes of the *Fisheries Act*. SARA includes provisions to protect species listed on Schedule 1 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 species listed under Schedule 1 of SARA as endangered, threatened, or special concern; and are federally protected under SARA. SOCC include those that are listed as endangered, threatened, or special concern by COSEWIC, but not yet listed in Schedule 1 of SARA. SARA aims to prevent species

from being extirpated or becoming extinct; provide for the recovery of species that are extirpated, endangered, or threatened as a result of human activity; and manage species of special concern to prevent them from becoming endangered or threatened. Sections 32, 33, and 58 of SARA contain provisions to protect SAR and their critical habitat. Under section 79 of SARA, ministerial notification is required if a project is likely to affect SAR or their critical habitat. This notification must identify the adverse effects of the project on SAR and their critical habitat and, if the project is conducted, measures that will be taken to avoid or reduce those effects, along with monitoring commitments.

SAR and SOCC are given special attention and emphasis in the analysis and evaluation of potential Project effects and necessary mitigation measures for this Environmental Impact Statement (EIS).

10.1.2 The Influence of Consultation and Engagement on the Assessment

During BHP's Project-related engagement with government departments and agencies, stakeholder organizations and Indigenous groups questions and comments about marine mammals and sea turtles were documented (see Chapter 3 for further details). Concerns were primarily related to adverse effects from both routine operations and accidental events on migratory species and the inclusion of Indigenous traditional and ecological knowledge in the environmental assessment. In particular, the North American right whale as well as other culturally important species (including sea turtles, sharks, and other marine mammals) were noted of concern by the Indigenous communities regarding loss or harm to species of importance.

10.1.3 Potential Effects, Pathways and Measurable Parameters

Routine Project activities and components have the potential to interact with marine mammal and sea turtle species due to underwater sound produced by operation of the mobile offshore drilling unit (MODU), vertical seismic profiling (VSP) survey, Project support vessels (PSVs), and helicopter overflights. These potential sources of disturbance, as well as operational discharges, could result in direct or indirect (e.g., changes in habitat quality) effects on marine mammals and sea turtles. There is also the risk of mortality or physical injury as a result of vessel collisions. The Project could also change the availability, distribution, or quality of prey (see Chapter 8 on assessment of effects on prey species). The assessment of Project-related effects on marine mammals and sea turtles focuses 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 indicated above, and the rationale for their selection, are shown in Table 10.1. Effects of accidental events are assessed in Section 15.6.3.

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 physical injury	• Project-related activities (e.g., installations at site, MODU, VSP surveys, vessel transits, well abandonment) will introduce underwater sound to the marine environment and result in changes to the acoustic environment • Exposure to underwater sound levels at or above established acoustic thresholds has the potential to result in hearing impairment and/or injury to marine mammals and sea turtles • Marine vessel traffic has the potential to result in ship strikes with marine mammals and sea turtles	• Degree and extent of underwater sound relative to established acoustic thresholds for marine mammals and sea turtles, based on available literature and acoustic modelling • Expected species occurrence and relative abundance (qualitative) in affected areas • Mortality or injury observed from a ship strike
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 would occur. Well locations have not been identified but will occur within the Project Area within Exploration Licence (EL) 1157 and 1158. The Project Area has been delineated to provide a 20 km buffer around the ELs.

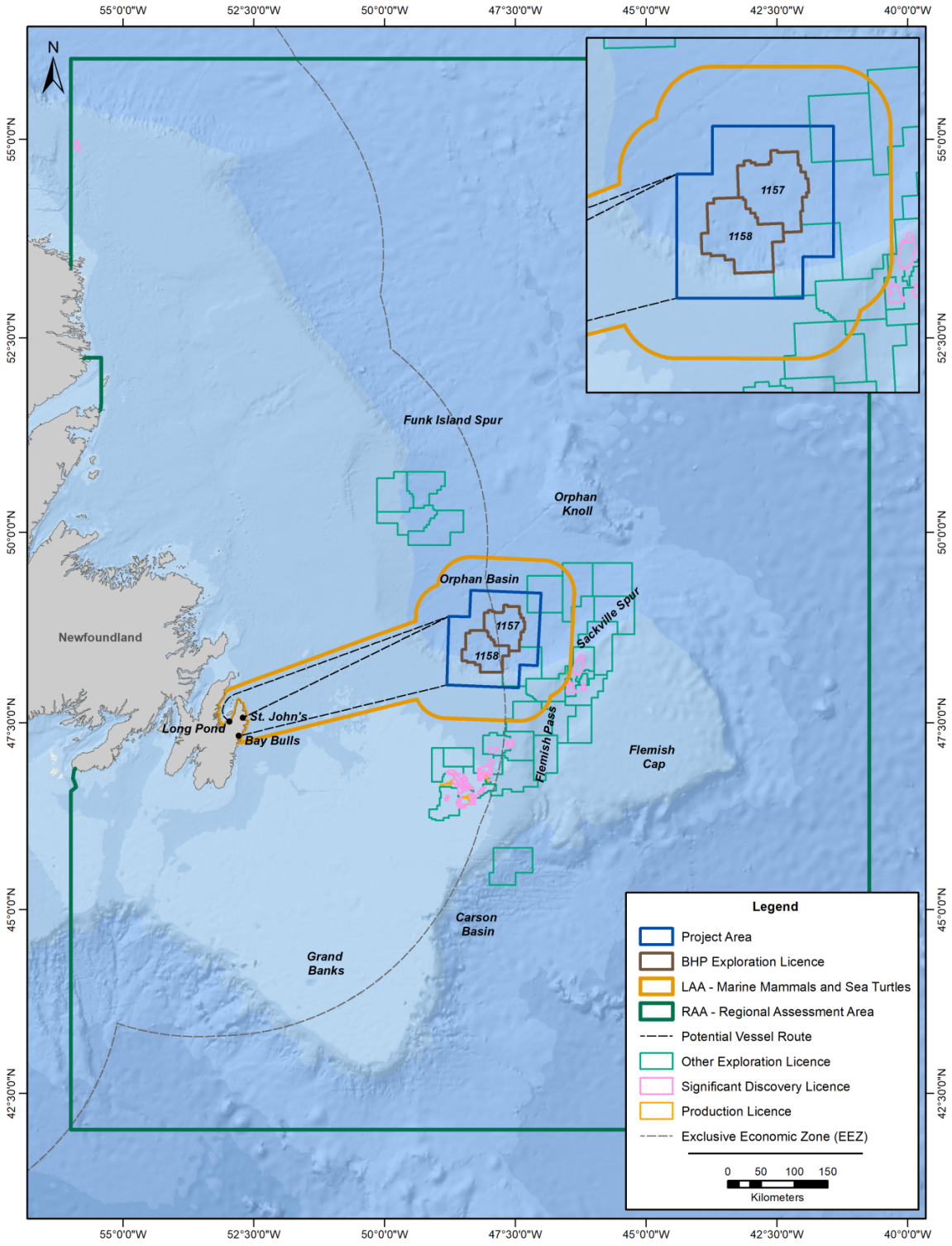

Figure 10-1 Marine Mammal and Sea Turtle Project Area, LAA, and RAA

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 (vessel and aircraft) 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 marine mammals and sea turtles is based on modeling results for distances to sound threshold criteria for behavioural change as well as scientific literature and is defined as a conservative 50-km radius buffer around the Project Area to encompass the maximum threshold distances for all activities. The LAA also includes a 10 km area around the associated vessel and aircraft traffic route 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. BHP is currently planning to drill up to 20 exploration or appraisal wells over the term of EL 1157 and 1158 (2019 to 2028). 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 35 to 115 days to drill. VSP surveys typically take approximately one to two days with the sound source airgun array activation often limited to just a few hours. Drilling operations will not be continuous throughout the entire nine-year temporal scope of the Project and will depend partially on various factors including weather, MODU availability and results from previous wells. While drilling activities have the potential to be conducted at any time of the year, BHP's preference is to conduct drilling between May and November.

Marine mammals and sea turtles occur in the RAA year-round. However, summer is an important season offshore Newfoundland when many migratory species come north to feed before returning to more southerly latitudes for the winter. Seals could be more common during the winter and spring. Section 6.3 provides seasonal information on the marine mammal and sea turtle species that could occur in the RAA.

10.1.5 Residual Effects Characterization

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 15.6.3.

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 existing conditions	**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 existing conditions **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 existing conditions **Neutral** – no net change in mortality, injury, health, or habitat quality for marine mammals and sea turtles relative to existing conditions
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	**Project Area** – 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 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 existing 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 pre-Project conditions before or after Project completion **Irreversible** – permanent

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

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 LAA, not adversely affected by human activity, or is likely able to assimilate the additional change **Disturbed** – The VC has been substantially previously disturbed by human development or human development is still present in the LAA, or the VC is likely not able to assimilate the additional change

10.1.6 Significance Definition

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 marine mammals and sea turtles is defined as a Project-related environmental effect that results in one or more of the following:

- 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 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, for each potential effect, the physical activities that might interact with marine mammals and sea turtles and result in the identified environmental effect. These interactions are indicated by a check mark and are discussed in detail in Section 10.3, in the context of effects pathways, standard and project-specific mitigation/enhancement, and residual effects. A justification for no effect is provided following the table.

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

Physical Activities	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, lights, and sound)	✓	✓
VSP	✓	✓
Discharges (e.g., drill muds / cuttings, liquid discharges)	–	✓
Well Testing and Flaring (including air emissions)	–	–
Well Decommissioning and Abandonment or Suspension	✓	✓
Supply and Servicing Operations (including helicopter transportation and PSV operations)	✓	✓
Notes: ✓ = Potential interaction; – = No interaction		

Discharge of drill muds and cuttings and routine discharges are not anticipated 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 Offshore Waste Treatment Guidelines (OWTG). Treated discharges may result in temporarily and localized reduction in water and sediment quality but this would 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 10.3.2, in the context of change in habitat quality and use.

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 (e.g., hydrocarbons extracted from produced water) that come to the surface for safe disposal. As these activities occur some distance above sea level, there is no potential for substantive interaction with marine mammals or sea turtles. If volumes of produced water are large, some produced water may be brought onto the MODU for treatment so that it can be discharged according to the OWTG. Potential effects of these discharges on marine mammal and sea turtle prey are discussed in Section 10.3.2, 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 sections assess the environmental effects on marine mammals and sea turtles from potential interactions as indicated in Table 10.3. Given the similarities in Project description, proximity of activities at Orphan Basin and Flemish Pass, the EIS incorporates recent information from previous EA documents for similar exploration drilling projects in Atlantic Canada, including comments received during stakeholder and Indigenous review processes, with updates incorporated as applicable due to Project and geographic differences and new scientific information.

10.3.1 Change in Risk of Mortality or Physical Injury

10.3.1.1 Project Pathways

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 Project activities. The PSVs transiting to and from the Project Area have the potential to collide with marine mammals or sea turtles, resulting in injury or mortality. The pathway of effect in the case of a ship strike is the physical contact with the vessel. Underwater sound generated by VSP operations and other Project activities has the potential to cause temporary hearing changes in marine mammals or sea turtles (temporary threshold shift or TTS) and there is the possibility of permanent hearing damage (permanent threshold shift or PTS). Auditory injury from MODU operations is deemed unlikely. There have been no reported cases of marine mammal or sea turtle mortalities that have been causally linked to sounds generated during oil and gas exploration activities.

10.3.1.2 Mitigation

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

Vertical Seismic Profiling

- As required in the Geophysical, Geological, Environmental and Geotechnical Program Guidelines (Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) 2019), 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) (Fisheries and Oceans Canada (DFO) 2007). The following are key mitigation measures that will be employed during VSP surveys:
  - Marine Mammal Observers (MMOs) will monitor and report on marine mammal and sea turtle sightings during VSP surveys to implement shutdown and ramp-up procedures.
  - A ramp-up procedure (i.e., gradual increase in seismic source level over a period of approximately 30 minutes until the operating level is achieved) will be implemented before 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 airgun array 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 a marine mammal or sea turtle is detected within 500 m of the airgun 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 mammals) expected to occur in the Project Area. This period is recommended by DFO (Moors-Murphy and Theriault 2017) in a review of the SOCP.

– Shut down procedures (i.e., shutdown of source array) will be implemented if a marine mammal or sea turtle listed as endangered or threatened on Schedule 1 of SARA, or a beaked whale species, is observed within 500 m of the airgun array.

Supply and Servicing Operations

- PSVs will follow established shipping routes where they exist (i.e., in proximity to shore).
- In order to reduce the potential for vessel collisions during transiting activities outside the Project Area, PSVs will reduce speed to a maximum of 13 km/hour (7 knots) when marine mammals or sea turtles are observed or reported within 400 m of a PSV, except if not feasible for safety reasons.
- If a vessel collision with a marine mammal or sea turtle occurs, BHP will contact the C-NLOPB, DFO's Canadian Coast Guard Regional Operations Centre, Indigenous groups, and other relevant authorities as soon as reasonably practicable but no later than 24 hours following the collision.

10.3.1.3 Characterization of Residual Project-related Environmental Effects

Sounds were modelled for each of the two Exploration Licenses (Site A, EL 1157 and Site B, EL 1158) during both February (winter) and August (summer). These months were selected because they best represent the range of conditions for sound propagation throughout the year (Alavizadeh and Deveau 2019).

Presence and Operation of a MODU

The MODU will produce continuous (i.e., non-impulsive) sound during operations (see Section 2.7.5.1). The type of MODU BHP will employ was undetermined when acoustic modelling was undertaken. Therefore, two types of drill ships (generic and the *Stena Forth*) and a semi-submersible drill rig (*Seadrill West Sirius*) were modelled (see Table 7 and Figure 25 in Alavizadeh and Deveau 2019, Appendix E); all MODUs were modelled assuming dynamic positioning (DP) thrusters were operational.

The types of MODUs modelled including source levels and source depths were:

- Generic Drillship with a broadband source level of 196.7 dB re 1 µPa @ 1 m SPL_{rms} with the source located at 12 m water depth
- Drillship *Stena Forth* with a broadband source level of 189.7 dB re 1 µPa @ 1 m SPL_{rms} with the source located at 12 m water depth
- Semi-submersible Drill Rig *Seadrill West Sirius* with a broadband source level of 196.7 dB re 1 µPa @ 1 m SPL_{rms} with the source located at 25 m water depth

A drillship source level of 196.7 dB re 1 µPa @ 1 m SPL_{rms}, was used for acoustic modelling for environmental assessments (EAs) of offshore exploration drilling programs in the Scotian Basin (Zykov 2016) and Flemish Pass (Quijano et al. 2017); it is considered conservative for effects assessment purposes as 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 or PTS for marine mammals (Table 10.4), it is highly unlikely that marine mammals would experience hearing impairment from sound exposure from a MODU. Given the assumed source levels of 189.7 and 196.7 dB

for the MODU, sound levels would not be expected to reach the SPL_{peak} auditory injury thresholds for any marine mammal groups. Acoustic modelling conducted for the Project Area in Orphan Basin showed that marine mammals (in particular, high-frequency cetaceans) would have to occur and remain within a distance of up to 283 m of the MODU (or less for other hearing groups) for a 24-hour period to experience sound levels above the sound exposure levels (SEL_{cum}) thresholds associated with PTS (Tables 14, 15 and 18 in Alavizadeh and Deveau 2019; Appendix E). Based on available information, cetaceans with high-frequency hearing, such as harbour porpoise, are at a slightly greater risk of incurring PTS within their hearing frequency range because of a lower SEL_{cum} threshold. It is anticipated that most marine mammals will avoid the immediate area around the MODU (see below, Change in Habitat Quality and Use), thereby further reducing the likelihood of incurring hearing impairment. Although little is known about the effects of underwater sound on sea turtle hearing and behaviour, it is assumed that sea turtles would also exhibit localized avoidance of the MODU. Based on published threshold values for auditory injury or PTS for sea turtles (Table 10.4), it is highly unlikely that sea turtles would experience hearing impairment from sound exposure from a MODU. Thus, 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 of a change in risk of mortality and physical injury to marine mammals and sea turtles are predicted to be adverse, but negligible in magnitude, localized to the Project Area, occur irregularly, short- to medium-term in duration, and reversible.

Vertical Seismic Profiling

As discussed in Section 2.4.2, VSP surveys use airguns in a source array which produce intermittent impulsive sound. However, the size and total volume of the source array used during a VSP survey are generally much smaller than those used in a traditional high-energy offshore seismic survey; thus, VSP operations tend to produce lower sound levels. VSP operations also 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 well site). The impulsive nature of sound is range-dependent, becoming less harmful over distance from the source (Hastie et al. 2019). While these factors greatly reduce the likelihood that marine mammals and sea turtles will incur hearing impairment from VSP operations, the potential does exist. During the Project, VSP will usually last one to two days with the airgun array firing often limited to just a few hours. 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 thresholds (see Appendix 4 of LGL 2015 for details). TTS has been studied and demonstrated in a limited number of captive odontocete and pinniped species exposed to sounds (reviewed in Southall et al. 2007; Finneran 2015). There is no specific evidence that exposure to sound pulses from an airgun array can cause PTS in any marine mammal, even when large arrays are in use. However, based on available information and given the likelihood that some mammals (e.g., harbour porpoise and seals) close to an airgun array might incur at least mild TTS, there has been speculation about the possibility that some individuals occurring very close to airguns might incur PTS (e.g., Richardson et al. 1995; Gedamke et al. 2011). Single or occasional occurrences of mild TTS are not typically 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). However, research has shown that sound exposure can cause cochlear neural degeneration, even when threshold shifts and hair

cell damage are reversible (Liberman et al. 2016). These findings have raised some doubts as to whether TTS should continue to be considered a non-injurious effect (Tougaard et al. 2016).

Based on current knowledge, it is assumed that any impact is directly related to total received energy, although there is some evidence that auditory effects in a given animal are not a simple function of received acoustic energy (Finneran 2015). Frequency, duration of exposure, and 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, 2018, 2019; Ketten 2012; Supin et al. 2016). For a beluga whale, TTS produced by exposure to a fatiguing noise was larger during the first session of an exposure (or naïve subject state) than TTS that resulted from the same sound in subsequent sessions (experienced subject state) (Popov et al. 2017). 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, 2016; Nachtigall et al. 2018).

It is not appropriate to assume that onset of TTS occurs at similar received levels in all cetaceans (cf. Southall et al. 2007), as TTS studies have involved a limited number of species (see Appendix 4 in LGL 2015). Finneran (2015) indicated that the potential for airgun arrays to cause auditory effects in dolphins could be lower than previously thought; based on behavioural studies, no measurable TTS was reported in three bottlenose dolphins after exposure to 10 impulses from an airgun source. However, auditory evoked potential measurements were more variable, with one dolphin showing a small threshold shift of 9 dB at 8 kHz. Received levels that elicit onset of TTS have been shown to be 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 suggests 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). However, harbour seals may be able to decrease their exposure to underwater sound by swimming just below the surface where sound levels are typically lower than at depth (Kastelein et al. 2018). When Reichmuth et al. (2016) exposed captive spotted and ringed seals to single airgun pulses with SELs of 165-181 dB re 1 μPa^2s and SPLs (peak to peak) of 190-207 dB re 1 µPa, no TTS was observed at low frequencies.

The frequencies emitted in airgun pulses overlap substantially with the frequencies that sea turtles are able to detect. Sounds from an airgun array might cause TTS in a sea turtle if it does not avoid the immediate area around the airguns. However, some sea turtles show localized movement away from approaching airguns (Appendix 5 in LGL 2015). At short distances from the source, received sound levels diminish rapidly with increasing distance; thus, even a small-scale avoidance response could result in a substantial reduction in sound exposure.

Nowacek et al. (2013) concluded that available data indicate that airguns have a low probability of directly harming marine life, except at close range. Several aspects of the planned monitoring and mitigation measures for seismic surveying are designed to detect marine mammals and sea turtles occurring near the airgun array and to avoid exposing them to sound pulses that might, at least in theory, cause hearing impairment. Many cetaceans and (to a lesser degree) pinnipeds and sea turtles show some avoidance of the area where received levels of airgun sound are strong enough to potentially cause hearing impairment. Thus, the avoidance responses of the animals themselves will reduce the possibility of hearing impairment.

Assessments of hearing impairment are generally 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; there is no single standard for assessing effects on these species. This assessment considers the most relevant and available scientific information, and the criteria used in this assessment and the rationale for the selection is provided below.

Guidelines from the United States National Marine Fisheries Service (NMFS) provide the most current guidance on threshold levels of underwater sound for the onset of TTS and PTS in marine mammals (NMFS 2016, 2018). These guidelines take into account some of the recommendations made by Southall et al. (2007) as well as those presented by Finneran (2016). Southall et al. (2019) provided updated scientific recommendations regarding noise exposure criteria which are similar to those presented by NMFS (2016, 2018), but include all marine mammals (including sirenians) and a re-classification of hearing groups. Acoustic threshold levels for the onset of PTS proposed by NMFS (2016, 2018) are summarized in Table 10.4. The exposure criteria use dual metrics for threshold values for impulsive sounds, consisting of peak sound pressure levels (SPL_{peak}) and cumulative (over 24 hours) SEL_{cum}; conclusions are based on whichever metric is first exceeded. 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 for Marine Mammals [A] and Sea Turtles [B]

Hearing Group	PTS Onset Threshold Levels			
	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
Sea Turtles	232	204	232	220

Notes:
dB (decibel) SPLpeak has a reference value of 1 µPa
dB SELcum has a reference value of 1 μPa^2s
[A] Guidelines released by NMFS in July 2016 (NMFS 2016) and amended in 2018 (NMFS 2018) 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 Fisheries 2019a).
[B] Guidelines from US Navy (2017).

Threshold criteria provided by NMFS (2016, 2018) were developed specifically for marine mammals. NMFS intends to establish similar acoustic thresholds for onset of PTS in other species, such as sea turtles and marine fish, when adequate data become available (NMFS 2018). 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 the approaches for marine mammals in Southall et al. (2007). As there is little information on the effects of underwater sound in sea turtles, the Animal Bioacoustics Working Group has so far only developed thresholds for potential sea turtle mortality in relation to explosions, airguns, and pile driving (Popper et al. 2014). However, given the high hearing thresholds measured for sea turtles, the United States (US) Navy (2017) recently proposed a PTS

threshold for sea turtles (Table 10.4) that matches the highest marine mammal threshold (for otariids). NMFS has also adopted the Navy's threshold criteria for TTS and PTS. However, there have been no new studies on TTS or PTS in sea turtles since the guidelines published by Popper et al. (2014).

Acoustic modelling of a 1,200 in³ airgun array with a source level of 220.4 dB re 1 µPa @ 1 m SPL_{rms} (broadside; 10-25,000 Hz) was undertaken (Alavizadeh and Deveau 2019; Appendix E). Estimated sound levels from the VSP airgun array were above SPL_{peak} injury thresholds (PTS onset) for impulsive sounds at distances from the array equal to or less than 40 m, < 20 m, and 120 m for low-, mid- and high-frequency cetaceans, respectively, and 40 m for seals (see Table 9 in Alavizadeh and Deveau 2019, Appendix E). Considering the SEL_{cum} metric for injury provided by NMFS (2016, 2018), marine mammals would have to occur and remain within close range of the airgun array (up to approximately 71 m for seals, but less for mid- and high-frequency cetaceans), to theoretically incur auditory injury (PTS) (Table 10 in Alavizadeh and Deveau 2019, Appendix E). This approach assumes that marine mammals occur within these distances of the VSP airgun array for a 24-hour period; this is considered highly unlikely. Low-frequency hearing specialists (i.e., baleen whales) are thought to be at greater risk of incurring auditory injury from VSP sounds because most of the acoustic energy in airguns is at lower frequencies. Based on the NMFS criteria, modelling results suggest that if a baleen whale occurs within 592 m (Table 10 in Alavizadeh and Deveau 2019) of the VSP airgun array for a 24-hour period there is risk of auditory injury (PTS). However, this is considered an unlikely scenario because baleen whales will likely exhibit localized avoidance behaviour of the VSP airgun array. The amount of acoustic energy received depends on where in the sound field an animal is when the sound source is active.

Popper et al. (2014) proposed guidelines for threshold levels where mortality may occur in sea turtles (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. The US Navy (2017) provided PTS thresholds of 204 dB SEL_{cum} and 232 dB_{peak}; these thresholds are similar to those for otariids (eared seals, such as sea lions) as presented by NMFS (2016, 2018). Sound levels from VSP activities are predicted to be below these levels at distances beyond 20 m of the airgun array (Alavizadeh and Deveau 2019, Appendix E). Popper et al. (2014) hypothesized that the rigid external anatomy of sea turtles may afford protection from the potential effects of impulsive sound, and categorized the relative risk of non-mortal injury for turtles as 'high' in the 'near' field (tens of metres from the source), and 'low' at both 'intermediate' (hundreds of metres) and 'far' (thousands of metres) distances.

Based on the information summarized here, and with the implementation of mitigation measures (Section 10.3.1.2), it is unlikely that VSP surveys will result in injuries (PTS) for marine mammals or sea turtles. To mitigate potential effects from VSP operations, a ramp-up procedure for the airgun array will be implemented in consideration of the SOCP (DFO 2007). Ramp-up will be delayed if a marine mammal or sea turtle is detected within 500 m of the airgun array. Airgun(s) will be shut down if a marine mammal or sea turtle listed as endangered or threatened on SARA Schedule 1 as well as a beaked whale is detected within the 500-m zone around the array. Overall, the risk for marine mammals and sea turtles incurring hearing impairment (injury) is considered low. This risk is even lower for SAR given the rare occurrence of these species, with the exception of fin whales (Schedule 1, special concern), which are common in the Project Area.

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

Well Decommissioning and Abandonment or Suspension

Activities associated with well decommissioning and abandonment or suspension involve the presence of vessels at the drill site. As a result, the effects of these activities would be the same as those assessed for the presence and operations of the MODU, and therefore are not repeated here.

Well suspension and abandonment typically involve setting a series of cement and mechanical plugs within the wellbore. Although wellhead removal is not specifically planned, if a wellhead is removed it will typically be done by using mechanical means. BHP does not plan to use explosives for wellhead removal. As such, well suspension and abandonment activities are not anticipated to produce sounds that pose a mortality or injury risk to marine mammals or sea turtles.

Residual effects associated with underwater sound from well decommissioning and abandonment or well suspension related to changes in the risk of mortality and injury are predicted to be adverse, negligible to low in magnitude, localized to the Project Area, occur irregularly, short-term in duration, and reversible.

Supply and Servicing Operations

The Project will involve the use of PSVs including supply and support traffic to, from, and within the Project Area throughout the year over the course of Project activities. Exposure to vessel sounds is not expected to result in mortality or PTS (i.e., Richardson et al. 1995). Furthermore, sound modelling for the PSV showed that marine mammals (in particular, high-frequency cetaceans) would have to occur and remain within a distance of up to 114 m of the PSV (or less for other hearing groups) for a 24-hour period to experience sound levels above the SEL_{cum} thresholds associated with PTS (Table 16 in Alavizadeh and Deveau 2019; Appendix E).

Mortality or injury of marine mammals and sea turtles can occur as a result of a vessel strike. Although there are no known marine mammal concentration areas along the PSV transit route, it is possible that groups of foraging marine mammals may be encountered, especially during summer months. Sea turtles are considered rare along the transit route as well as in the Project Area.

Baleen whales are known to be more vulnerable to collisions with vessels than odontocetes and pinnipeds (Laist et al. 2001; Jensen and Silber 2003; Vanderlaan and Taggart 2007). All species of mysticetes that may occur in the Project Area have been reported as being struck by ships (Jensen and Silber 2003). Fin whales are the most frequently struck baleen whale, followed by humpbacks and right whales (Laist et al. 2001; Jensen and Silber 2003; Panigada et al. 2006; Douglas et al. 2008). Although it is unclear why whales are unable to avoid vessel collisions, even when vessels are traveling slowly, strikes may be more likely in areas where large numbers of whales congregate to feed (Panigada et al. 2006). Vessel sounds are louder at the side and stern of the vessel than at the bow (Allen et al. 2012; McKenna et al. 2012), making it more difficult for a whale to detect an approaching vessel in front of the ship. The majority of lethal and severe injuries to large whales from ship strikes have occurred when vessels were travelling at ≥14 knots (25.9 kilometers per hour (km/h); Laist et al. 2001). A reduction in vessel speed is known to reduce the number

of marine mammal deaths and severe injuries due to collisions (Vanderlaan and Taggart 2007; Vanderlaan et al. 2008, 2009; van der Hoop et al. 2015; Wiley et al. 2016). Lethal strikes are considered infrequent if a vessel is traveling <14 knots and rare at <10 knots (18.5 km/h; Laist et al. 2001).

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

In their most recent five-year data set (2011-2015) baleen whale serious injury and mortality determinations for the east coast of North America, National Oceanic and Atmospheric Administration (NOAA) Fisheries reported an annual average of six large whale mortalities resulting from vessel strikes and another seven ship strikes in the region resulting in injury (either serious or nonserious) to the animal (Henry et al. 2017). The actual number of vessel strike mortalities is likely much greater due to underreporting, not being able to recover all carcasses, and the fact that the cause of death cannot be determined in many cases. For 2011-2015, NOAA Fisheries reported that, on average, 41 large whale mortalities annually had insufficient information to determine cause of death (Henry et al. 2017).

While nearly all large whale species have been involved in vessel collisions (Laist et al. 2001), of greatest concern is the small population of North Atlantic right whales. Ship strikes (and entanglements in commercial fishing gear) and decreasing calving rates are believed to be main contributors as to why the population of the North Atlantic right whale has not recovered (Kraus 1990; Caswell et al. 1999; IWC 2001; Elvin and Taggart 2008; Kraus et al. 2016). Right whales may be particularly prone to vessel strikes because of behaviours that may make them less aware of their surroundings (Knowlton et al. 1997), for example, the amount of time they spend just below the surface where they cannot be seen (Parks et al. 2012a; Baumgartner et al. 2017), and because they often fail to react to closely approaching vessels (Nowacek et al. 2004; Vanderlaan and Taggart 2007). Ship strikes were found to have caused the death of 21 (52.5%) of 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 due to elevated mortalities (NOAA Fisheries 2019b). In 2017, 17 dead right whales were found stranded (12 in Canada and 5 in the US), most in the Gulf of St. Lawrence region; another three mortalities occurred in 2018, and as of early July, six mortalities have been reported for 2019 in Canada (NOAA Fisheries 2019b). A report on seven of the whales that stranded in Canada found evidence of blunt force trauma, suggestive of a ship strike, for four whales and likely blunt force trauma in a fifth whale that was too decomposed to reliably determine cause of death (Daoust et al. 2017; DFO 2019). Themelis et al. (2016) reported a single non-fatal right whale ship strike for Atlantic Canada during 2008-2014. The recent mortality incidents, along with the changing distribution and habitat use of this species over the last several years require a change in the monitoring and management strategies for the right whale (Pettis et al. 2018). Although possible, it is unlikely that a right whale will occur in the Project Area and along the PSV routes.

Project vessels could strike sea turtles resulting in injury or mortality. Propeller and collision injuries from vessels are common for sea turtles in US waters (NMFS 2008). Hazel et al. (2007) suggested that turtles may not avoid faster moving vessels, as the proportion of green turtles moving to avoid a vessel decreased with increased vessel speed during a study in Australia.

Based on the information summarized here, and with the implementation of mitigation measures (Section 10.3.1.2), 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 use existing shipping lanes as practicable; where these do not exist, PSVs will follow a straight-line approach to and from the Project Area. PSVs will be required to reduce speed to a maximum of 7 knots when a marine mammal or sea turtle is observed or reported within 400 m of the PSV (except if not feasible for safety reasons). Vessels may also alter course if practicable to avoid collision with a marine mammal (or sea turtle). Overall, the risk of marine mammals and sea turtles incurring injury or mortality is considered quite low; the risk is lower for SAR given 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 adverse, negligible to low in magnitude, localized to the LAA, occur irregularly, short- to medium-term in duration, and reversible.

10.3.2 Change in Habitat Quality and Use

10.3.2.1 Project Pathways

A change in habitat quality and use for marine mammals and sea turtles may occur from Project activities, particularly due to the underwater sound generated by the MODU, VSP, PSVs, and well abandonment. Marine mammals detect and produce sounds both passively and actively to communicate, locate prey and predators, navigate, and obtain information about their surroundings (Richardson et al. 1995; Nowacek et al. 2007; Tyack 2008; Shannon et al. 2016). It is uncertain how important underwater sound is to sea turtles, but it is likely less important than for marine mammals. Anthropogenic sound from vessel traffic and other offshore exploration activities has the potential to cause adverse effects on marine mammals and sea turtles. This assessment focuses on disturbance or the potential changes in behaviour and distribution of animals that could be of sufficient magnitude to be “biologically important”. Communication masking of marine mammals is also considered, where a sound of interest is obscured by interfering sounds at a similar frequency.

10.3.2.2 Mitigation

Vertical Seismic Profiling Operations

- The same measures as outlined above for 10.3.1.2 apply. These measures will not only reduce the risk of injury, but also reduce the sound levels that marine mammals and sea turtles are exposed to.

Discharges

- Refer to the waste management mitigation measures identified in the Marine Fish and Fish Habitat VC (Section 8.3).

Supply and Servicing Operations

- The same measures as outlined in Section 10.3.1.2 apply, which will reduce the risk of injury and behavioural effects.

10.3.2.3 Characterization of Residual Project-related Environmental Effects

Presence and Operation of a MODU

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

Behavioural responses of marine mammals to sound are difficult to predict and depend on species, state of maturity, experience, current activity, reproductive state, time of day, and numerous other factors (Richardson et al. 1995; Wartzok et al. 2004; Southall et al. 2007; Weilgart 2007; Ellison et al. 2012, 2018). If a marine mammal changes its behaviour or moves a small distance in response to an underwater sound, the impacts 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 an extended period of time, 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; Farmer et al. 2018).

Drilling will be conducted by either a semi-submersible unit or a drillship. The MODU will maintain station via the use of DP; sounds from MODUs are non-impulsive in nature (i.e., they are continuous). Vessels using DP typically create more noise than transiting vessels due to increased cavitation (Delarue et al. 2018). Based on measurements acquired during drilling of Shell Canada's Monterey Jack exploration well in the Scotian Basin, the drillship Stena *IceMax* had a broadband source level of 187.7 dB re 1 µPa @ 1 m SPL_{rms} (MacDonnell 2017). Similarly, the drillship *Stena Forth* had broadband source levels of 184 dB re 1 µPa @ 1 m SPL_{rms} during drilling and 190 dB re 1 µPa @ 1 m SPL_{rms} during maintenance work (Kyhn et al. 2011). Sounds from the drillship *Stena IceMax* were also recorded at acoustic receivers located 13 km away during Shell's Cheshire drilling program off the Scotia Shelf during spring / summer 2016; when drilling operations were underway, broadband ambient sounds increased by 10 dB SEL or 3.8 dB SPL (Delarue et al. 2018). The presence of drilling platforms also increased the soundscape substantially in the areas monitored, with sound at the seabed extending at least 15 km in deep water and 35 km in shallow water (Delarue et al. 2018).

It is possible that marine mammals (and sea turtles) could change their behaviour in response to sounds produced by a MODU. There have been few studies of marine mammal behaviour in relation to drilling activity; however, available information suggests that effects are localized and temporary. Kapel (1979) reported several different species of baleen whales – mainly fin, minke, and humpback whales – within sight of active drillships off West Greenland. Offshore California, grey whales responded when closer than 1 km around a semi-submersible drilling unit (Malme et al. 1983, 1984). Humpbacks showed no overt response to drillship broadband sounds of 116 dB re 1 µPa (Malme et al. 1985). Marine mammals are frequently sighted around oil and gas installations in the North and Irish seas (Todd et al. 2016; Delefosse et al. 2018).

Bowhead whales exhibit variable responses to drilling sounds; some individuals have been seen less than a kilometre from drillships, whereas other have shown avoidance behaviour of up to 10 km (summarized in Richardson et al. 1995). Playback experiments of drilling sounds showed that bowhead whales typically did not respond to sound exposures in the 100 to 130 dB re 1 µPa rms range, although there were some minor behavioural changes (Richardson et al. 1990). Migrating bowheads in the Alaskan Beaufort Sea have been monitored during construction, drilling, and production activities at an artificial island (Northstar) just inshore of the migration corridor 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 (Richardson and Williams 2004). Localization methods were used to determine the locations of calling bowhead whales (Greene et al. 2004). Overall, the results showed slight offshore displacement of the proximal edge of the bowhead migration corridor at times when underwater sound levels were unusually high (Richardson 2008). The southern edge of the call distribution occurred 0.76 to 2.35 km farther offshore, indicating localized avoidance to industrial sound levels; however, the result was only apparent after intensive statistical analyses, and it is therefore unclear whether this represented a biologically effect.

When belugas were exposed to playback sounds from a semi-submersible drill rig in an Alaskan river, the whales swimming toward the sound source did not react overtly until they were within 50 to 75 m and 300 to 500 m (Stewart et al. 1982). Some individuals altered their course to swim around the source, some increased their swimming speed, and one reversed direction of travel (Stewart et al. 1982). Reactions to sound from the semi-submersible drill unit were less severe than those to motorboats with outboards (Stewart et al. 1982). Dolphins and other toothed whales have shown few behavioural responses to drill rigs and their support vessels (Richardson et al. 1995).

In the Arctic, ringed seals were often seen near drillships drilling during summer and fall (summarized by Richardson et al. 1995). Ringed and bearded seals approached and dove within 50 m of a projector transmitting drilling sound into the water at received levels of 130 dB re 1 µPa. Studies of seals near active seismic vessels appear to confirm that seals tolerate offshore industrial activities (Harris et al. 2001; Moulton and Lawson 2002). There are no available data on sea turtle responses to sound from MODUs.

Behavioural disturbance thresholds are commonly used in marine mammal effects assessments of offshore geophysical programs in Canada and the US (e.g., Stantec 2012, 2014a,b; LGL 2014, BP 2016). The NMFS have provided thresholds for behavioural disturbance to assess the effects of sound on marine mammals; these generic threshold levels are SPL_{rms} 120 dB re 1 µPa for non-impulsive sounds (e.g., shipping, drilling) and SPL_{rms} 160 dB re 1 µPa for impulsive sounds (e.g., airguns used in VSP) and apply to cetaceans and pinnipeds. These thresholds are considered as a guide for this 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 (e.g., Southall et al. 2007), this information is considered.

Depending on the type of MODU and the season, there was considerable variation in the modelled distances where sound levels were predicted to exceed the 120 dB re 1 µPa SPL_{rms} behavioural criterion (Table 10.5). Of the two drillships modelled (both were assumed to operate DP thrusters), the Generic Drillship was predicted to produce sound levels ≥120 dB (using R_{max}—most conservative estimate) that ranged from approximately 27 km in August to 65 km in February. In contrast, sound levels ≥120 dB (R_{max}) from the Representative Drillship (i.e., *Stena Forth*) ranged from approximately 10 km in August to 31 km

in February. The source level selected for modelling of the Generic Drillship was much higher than that of the *Stena Forth*. Sound levels from the semi-submersible drill rig, which was assumed to operate DP thrusters located at 25 m depth, were predicted to exceed the 120 dB behavioural criterion at distances ranging from 36 km in August to >100 km in February. Based on the information presented earlier, it is highly unlikely that marine mammals, particularly odontocetes and seals, would avoid the MODU at these distances; avoidance is expected to occur closer to the MODU. Marine mammals (i.e., humpback and minke whales) have been observed within hundreds of metres of the operating platforms on the Grand Banks (B. Mactavish, pers. comm.). Sound from the MODU is expected to result in localized avoidance by marine mammals. Sea turtles, considered rare in the Project Area, would be expected to exhibit localized avoidance.

Table 10.5 Distances (km) from Modelled MODUs Where Sound Levels are Predicted to Exceed the Generic Behavioural Acoustic Threshold Level (120 dB SPL_{rms}) for Marine Mammals.

MODU	Distance (km) from MODU (≥120 dB SPL_{rms})[A]			
	Site A (EL 1157)		Site B (EL 1158)	
	February	August	February	August
Representative Drillship (*Stena Forth*)	24.5 (23.9)	10.3 (9.9)	30.7 (30.1)	9.5 (9.0)
Generic Drillship	53.6 (47.7)	26.9 (17.5)	65.0 (60.9)	26.6 (17.4)
Semi-submersible Drilling Rig	>100 (97.4)	36.2 (35.7)	>100 (97.4)	36.2 (34.5)

Notes:
dB (decibel) SPL_{rms} has a reference value of 1 µPa
R_{max} is the maximum range at which the given sound level was encountered in the modelled maximum-over-depth sound field
$R_{95\%}$ is the maximum range at which the given sound level was encountered after excluding 5% of the farthest such points.
[A] R_{max} and $R_{95\%}$ values (in parentheses) are provided for each modelled Site (A, B) and Season (Winter, February and Summer, August)

Underwater sound, whether of anthropogenic or natural origin, may interfere with the abilities of marine mammals to communicate by masking sounds that are important to them. All marine mammal species produce sound which has been associated with important biological functions such as foraging, mating, rearing of young, social interaction, and group cohesion (Erbe et al. 2016). Masking could therefore potentially impact individual fitness. Introduced underwater sound at higher levels but at a similar frequency and with signal characteristics of relevant biological sounds will, through masking, reduce the effective communication space of a marine mammal species. Masking may occur if the frequency of the source is similar to that used by the marine mammal and if the anthropogenic sound is present for a substantial portion 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; Jones et al. 2017; Putland et al. 2017; Cholewiak et al. 2018; Dunlop 2018).

Baleen whale hearing systems 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 at higher frequencies than are the dominant components of MODU sounds, thereby limiting the potential for masking. The potential for masking of marine mammal calls and/or important environmental cues is considered low for the MODU given the relatively low source level and attenuation of sound

particularly towards the shallower shelf waters (Alavizadeh and Deveau 2019, Appendix E). Some cetaceans are known to continue calling in the presence of anthropogenic sounds, and some 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, 2017; Papale et al. 2015; Dahlheim and Castellote 2016; Gospić and Picciulin 2016; Heiler et al. 2016; Robertson et al. 2017; Fornet et al. 2018; Tsujii et al. 2018). The potential biological "costs" of these changes in vocalizations are unknown. Masking release mechanisms (e.g., spatial release, orientation towards the sound, and comodulation masking release) are also used by marine mammals to enhance signal detection and reduce masking (Erbe et al. 2016).

Based on the information 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 potentially being displaced from the immediate area around the MODU. The localized, transient, and short-term nature of these disturbances at one location and time during Project activities considerably reduces the potential for adverse effects on individual marine mammals and sea turtles and their populations. It is therefore unlikely that individuals will be displaced over extended areas or periods of time. Given that the zone of influence of the Project at one time or location will likely be a small proportion of the feeding, breeding, or migration area of species, marine mammals and sea turtles will not be displaced from important habitats or during important activities or be affected in a manner that causes 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 adverse, low in magnitude, generally localized to the Project Area but possibly extending into the LAA, short- to medium-term in duration, a multiple irregular event, and reversible.

Vertical Seismic Profiling

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

Baleen whales generally tend to avoid operating airguns, but avoidance radii are variable (Appendix 4 of LGL 2015 for details). Whales are often reported to show no overt reactions to pulses from large airgun arrays at distances beyond a few kilometers, although sound levels from the airgun source remain above ambient sound levels out to much greater distances. However, baleen whales often react to sound from an airgun array by deviating from their normal migration route and/or interrupting their feeding and moving away. However, in the cases of migrating grey and bowhead whales, the observed behavioural changes 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 500-in^3 airgun arrays or larger for minke and fin whales. This included lateral displacement and change in swimming or surfacing behaviour, indicating that the whales remained near the water surface.

During studies examining humpback whale behaviour in response to seismic surveys off Australia, Dunlop et al. (2017a) found that humpbacks were more likely to avoid active small airgun sources (20 and 140 in^3) within 3 km and received levels of at least 140 dB re 1 µPa^{2}s. Responses to ramp up and use of a large 3,130 in^3 array elicited greater behavioural changes when compared with small arrays (Dunlop et al. 2016). Humpbacks reduced their southbound migration, or deviated from their path thereby avoiding the active array, when they were within 4 km of the active large airgun source, where received levels were greater than 135 dB re 1 µPa^{2}s (Dunlop et al. 2017b). However, some individuals did not show avoidance behaviours even at levels as high as 160 to 170 dB re 1 µPa^{2}s (Dunlop et al. 2018).

Matos (2015) reported no change in sighting rates of minke whales in Vestfjorden, Norway, during seismic surveys outside of the fjord. Data collected on grey whales during a seismic program in 2015 showed some displacement of animals from the nearshore feeding area and responses to lower sound levels than expected (Muir et al. 2016; Gailey et al. 2016; Sychenko et al. 2017). Vilela et al. (2016) cautioned that environmental conditions should be considered when comparing sighting rates during seismic surveys, given 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 was attributed to environmental variables.

Little systematic information is available on reactions of odontocetes to 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 from monitoring studies (Appendix 4 of LGL 2015 for details). Seismic operators and MMOs on seismic vessels regularly see dolphins and other delphinids near operating airgun arrays, but in general there is a tendency for most individuals to show some avoidance of seismic vessels with an operating source array. 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 greater 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 aversive behaviours typically occurred only after exposure to high received levels of sound (e.g., Finneran et al. 2000, 2002, 2005).

Odontocete reactions to sound from large airgun arrays are variable and, at least for delphinids, seem to be confined to smaller distances 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 airgun arrays (500 in^3 or greater), with the exception of Risso's dolphin (Stone 2015). When investigating the auditory effects of multiple underwater pulses from an airgun source on bottlenose dolphins at the highest exposure condition ($SPL_{peak)}$ from 196–210 dB re 1 µPa), two of the three dolphins 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 (Finneran 2015). Bottlenose dolphins exposed to multiple airgun pulses exhibited some anticipatory behaviour (Schlundt et al. 2016). McGeady et al. (2016) analyzed stranding data and found that the number of long-finned pilot whale stranding along

Ireland's coast increased with seismic surveys operating offshore, although no causal link could be established.

Preliminary data from the Gulf of Mexico showed a correlation between reduced sperm whale acoustic activity and periods with airgun operations (Sidorovskaia et al. 2014). Thompson et al. (2013) reported reduced densities and acoustic detections of harbour porpoise in response to the presence of a seismic survey in Moray Firth, Scotland, at ranges of 5–10 km; however, animals returned to the area within a few hours (Thompson et al. 2013). Van Beest et al. (2018) exposed five harbour porpoises to a single 10 in^3 airgun for 1 min at 2–3 s intervals at ranges of 420–690 m and SELs of 135–147 dB μPa^2s; one porpoise moved away from the airgun array but returned to natural movement patters within 8 hours, and two porpoises had shorter and shallower dives but returned to natural behaviours within 24 hours.

Pinnipeds tend to be less responsive to airgun sounds than many cetaceans and are not likely to show a strong avoidance reaction to airgun arrays (Appendix 4 of LGL 2015 for details). Visual monitoring from seismic vessels typically has shown only slight (if any) avoidance of active airgun arrays by pinnipeds, and only slight (if any) changes in behaviour. Stone (2015) found that grey seals were displaced when large airgun source arrays of 500 in^3 or more in volume were active, 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 airgun array in New Zealand during 2009, but the results 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 airgun pulses, only limited behavioural responses were observed.

Available information, some of which was described above, indicates that marine mammal and sea turtles show variable behavioural responses to airgun sounds; avoidance responses are typically localized and temporary. Using the NMFS recommended behavioural response criteria of SPL_{rms} 160 dB re 1 µPa for impulsive sounds and based on the modelling study by Alavizadeh and Deveau (2019, Table 8 in Appendix E), marine mammals may exhibit avoidance behaviour of VSP airgun sound at distances of approximately 7 km (using R_{max} - most conservative estimate). Using the more representative estimate ($R_{95\%}$), the 160-dB threshold typically would be reached at approximately 4 to 6 km from the VSP airgun array. Avoidance by marine mammals is predicted to be temporary particularly given the short duration of VSP surveys (one to two days).

Because of the intermittent nature and low duty cycle of airgun pulses, marine mammals can emit and receive sounds during 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 masking of relevant biological sound. Situations with prolonged strong reverberation have been considered infrequent, but there are increased indications that this may be more of a concern for marine mammals than previously thought, particularly in consideration of multiple, concurrent seismic surveys. It is common for reverberation to cause some elevation of the background level between airgun pulses (e.g., Gedamke 2011; Guerra et al. 2011, 2016); this weaker reverberation presumably reduces the detection range of calls and other natural sounds to some degree.

Some cetaceans are known to continue calling in the presence of seismic sources, and their calls can be heard between source pulses. In addition, some cetaceans change their calling rates, shift their peak

frequencies, or otherwise modify their vocal behaviour in response to airgun sounds (e.g., Blackwell et al. 2015). Sills et al. (2017) reported that recorded airgun sounds at 1 km from the source may have masked the detection of low-frequency sounds by ringed and spotted seals completely at the onset of the airgun pulse when signal amplitude is variable (e.g., initial 200 ms). However, based on the reviewed information, 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 issue of concern for marine mammals exposed to the sounds from VSP surveys, particularly considering that each survey will typically be one to two days 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). The US Navy (2017) considers the behavioural response threshold for impulsive sounds for turtles to be an SPL_{rms} of 175 dB re 1 µPa based on information presented by McCauley et al. (2000); this sound level is likely to be limited to a range of less than 2 km (Table 8 in Zykov and Alavizadeh 2019). However, there are no specific data that demonstrate the consequences to sea turtles if surveys with large or small arrays of airguns occur in important areas at biologically important times of year. To the extent that there are adverse effects on sea turtles, operations involving airgun operations 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 when exposed to anthropogenic sound. However, sea turtles are considered rare in the Project Area; if they do occur there, responses are expected to be localized and temporary, particularly given the short duration of VSP surveys.

As described in Chapter 8, residual effects of VSP surveys on prey (fish, invertebrate) resources are predicted to be low magnitude and short term for both change in risk of mortality/physical injury and change in habitat quality and use. Given that VSP surveys typically occur over one to two days with intermittent activation of airguns (several hours), any indirect effects on marine mammals (and sea turtles) related to changes in prey availability would be quite temporary and localized.

Based on the information summarized here, the mitigation measures summarized in Section 10.3.1.2, 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 potentially being displaced from the immediate area around the VSP airgun array. The localized, transient, and short-term nature of behavioural responses at any one location and time during the Project considerably reduces the potential for adverse effects on individual marine mammals and sea turtles or their populations. It is therefore unlikely that individuals will be displaced over extended areas or periods of time. 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, low in magnitude, localized to the Project Area, short- to medium-term in duration, irregular in frequency, and reversible.

Discharges

Discharges from Project PSVs and the MODU will be in accordance with the OWTG and International Convention for the Prevention of Pollution from Ships (MARPOL), as applicable. Discharges are expected to be temporary, localized, low toxicity, and subject to dilution in the open ocean.

Drilling wastes such as cement, water-based mud (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 1,175 m to 2,575 m. Drilling activities are unlikely to produce concentrations of heavy metals in muds and cuttings that could be 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. Although the bearded seal, which is considered a benthic feeder, may occasionally occur in the Project Area, it typically does not feed at depths >200 m. These activities are expected to have minimal effects on marine mammals and sea turtles.

Synthetic-based mud (SBM) cuttings are treated prior to discharge, and although they have a synthetic base fluid as a component, they only have a small (and permitted) fraction of residual SBM when discharged. Discharging the SBM-related drill cuttings below the water's surface further reduces the potential for marine mammals and sea turtles to contact the chemical components of SBM. With screening and selection of chemicals (including use of low toxicity drilling fluids) in accordance with the Offshore Chemical Selection Guideline (OCSG), and proper disposal of drill muds and cuttings in accordance with the OWTG, potential 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 (Sections 2.7.3 and 2.7.4).

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 well sites within the Project Area. However, 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 potential 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. Effects (adverse or positive) are predicted to be negligible in magnitude, occur irregularly, restricted to the Project Area, short term in duration, and reversible.

Well Decommissioning and Abandonment or Suspension

Activities associated with well decommissioning and abandonment or suspension involve the presence of vessels at the drill site. As a result, the effects of these activities would be the same as those assessed for the presence and operations of the MODU, and therefore are not repeated here.

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 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, occur irregularly, 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 throughout the 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 the potential to cause 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 animal; slow approaches by a vessel tend to elicit fewer responses than fast, erratic approaches (Richardson et al. 1995). Seals often show limited or no response to vessels but have also shown signs of displacement in response to vessel traffic. Odontocetes sometimes show no avoidance reactions and occasionally approach vessels. However, some species such as the harbour porpoise are displaced by vessels or otherwise change their behaviour in response to vessel sounds (e.g., Wisniewska et al. 2018; Roberts et al. 2019). Baleen whales often change their normal behaviour and swim rapidly away from vessels that have strong or changing sound emission characteristics, in particular when a vessel heads towards a whale. Stationary vessels or slow-moving vessels generally elicit little response from baleen whales.

As noted above for drilling, sound from shipping, through masking, can also reduce the effective communication space of a marine mammal if sound levels are higher than relevant biological sounds, the frequency of the sound source is similar to that used by the animal, and the sound is present for a substantial period of time. In addition to the frequency and duration of the masking sound, the temporal pattern and location of the sound also play a role in the extent of the masking (e.g., Branstetter et al. 2013, 2016; Finneran and Branstetter 2013; Sills et al. 2017). 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 or important environmental cues is considered low from PSVs given the relatively low source level and attenuation of sound. Some baleen and toothed whales are known to continue calling in the presence of anthropogenic sounds, and some cetaceans

change their calling rates, shift their peak frequencies, or otherwise modify their vocal behaviour in response to anthropogenic sounds. For example, harbour seals were reported to increase the minimum frequency and amplitude of their calls in response to vessel noise (Matthews 2017); however, harp seals did not increase the frequencies of their calls in areas with increased low-frequency sounds (Terhune and Bosker 2016). Masking release mechanisms are also used by marine mammals to enhance signal detection and reduce 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 leading to localized avoidance of PSVs. Reactions of grey and humpback whales to vessels have been studied (see Richardson et al. 1995, Southall et al. 2007 for reviews). For example, Dunlop et al. (2015) reported that southward migrating humpbacks off Australia decreased their dive time and swim speed slightly in response to a source vessel which was not operating airguns. Williamson et al. (2016) suggested that close approaches by small vessels may cause small and temporary behavioural changes in humpbacks, although for female-calf groups, the behavioural change may be greater and last longer.

There is little information available on the reactions of right whales and rorquals (e.g., fin and blue whales) to vessels. North Atlantic right whales can often be approached by slow moving vessels, but they swim away from vessels that approach quickly (Watkins 1986). In addition, 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, calls from conspecifics, and a signal to alert the whales were monitored using acoustic recording tags (Nowacek et al. 2004). The whales responded overtly to the signal by swimming to the surface, thereby likely increasing rather than reducing the risk of a vessel strike. The whales reacted minimally to controlled exposure to calls of conspecifics, but showed no response to controlled sound exposure to recorded ship sounds as well as actual ships (Nowacek et al. 2004). Right whales are able to increase the source levels of their calls, shift their peak frequencies, or otherwise change their vocal behaviour in conditions with elevated ambient sound levels (e.g., Parks et al. 2007, 2011, 2012b, 2016; Gridley et al. 2016; Tenessen and Parks 2016). Rolland et al. (2012) suggested that ship noise causes increased stress in right whales; they showed that baseline levels of stress-related faecal hormone metabolites decreased in North Atlantic right whales with a 6-dB decrease in underwater noise from vessels.

Off New England, fin whales had shorter than usual dive and surfacing times when whale-watch and other vessels were nearby (Stone et al. 1992). Watkins (1981) and Watkins et al. (1981) reported that fin whales showed limited responses to slow moving vessels but avoided boats that altered course or speed quickly. During marine mammal monitoring from a high-speed, catamaran ferry transiting the Bay of Fundy during the summers of 1998-2002, most baleen whales (including fin, humpback, and minke whales) observed from the ferry appeared to show avoidance behaviour such as heading away, changing heading, or diving (Dufault and Davis 2003). Blair et al. (2016) reported that increased levels of ship noise affect foraging by humpbacks. In the western Mediterranean, fin whale sightings 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 vessels or remained near a vessel but changed direction or dove; the most overt responses occurred when vessels approached quickly or erratically (Edds and Macfarlane 1987). Fin and blue whales are able to increase the source levels of their calls, shift their peak frequencies, or otherwise change their vocal behaviour in the presence of increased sound levels such as from shipping (e.g., McKenna 2011;

Castellote et al. 2012; Melcón et al. 2012). In addition to ship sounds, the physical presence of vessels has been shown to disturb the foraging activity of blue whales (Lesage et al. 2017). McKenna et al. (2015) reported a dive response by blue whales when a vessel approached, but no lateral avoidance, which could lead to an increased risk for vessel strike.

Available information, some of which was described above, indicates that marine mammals show variable behavioural responses to vessel sounds; avoidance responses are typically localized and temporary. Using the NMFS recommended behavioural response criteria of SPL_{rms} 120 dB re 1 µPa for non-impulsive sounds and based on the modelling study by Alavizadeh and Deveau (2019, Table 13 in Appendix E), marine mammals may exhibit avoidance behaviour of PSV sound at distances ranging from approximately 3 to 6 km.

There are few systematic studies on sea turtle responses to vessels, but a response is likely to be minimal relative to reactions to sound from airguns. Hazel et al. (2007) examined behavioural responses of green sea turtles to a research vessel approaching at slow, moderate, or fast speeds (4, 11, and 19 km/h, respectively). Fewer sea turtles fled from an approaching vessel as speed increased; turtles that fled from moderate to fast approaches did so at significantly shorter distances from the vessel than those that fled from slow approaches. Hazel et al. (2007) concluded that sea turtles may not be able to avoid vessels with speeds greater than 4 km/h. However, the studies employed a 6-m aluminum boat powered by an outboard engine, which would likely be more difficult for a sea turtle to detect than a PSV. Tyson et al. (2017) reported that a juvenile green sea turtle dove during vessel passes and remained still near the sea floor. Lester et al. (2013) reported that behavioural responses of semi-aquatic turtles to boat sounds are variable.

Routine transportation activities associated with helicopter support have potential to cause changes in habitat quality or use for marine mammals and sea turtles due to disturbance. Sounds produced by helicopters are primarily related to rotor and propeller blade revolutions, with most frequencies below 500 Hz (Richardson et al. 1995). The transmission of sound produced by helicopters into the marine environment is correlated to the altitude of the aircraft and sea surface conditions (Richardson et al. 1995). Underwater sounds from helicopters are generally stronger just below the water surface and directly below the aircraft, but underwater sounds attenuate 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 cetaceans and pinnipeds (summarized in Richardson et al. 1995). The majority of behavioural responses elicited in beluga and bowhead whales by an overhead helicopter traveling over the Beaufort Sea occurred when the aircraft flew at altitudes and lateral distances less than 150 m and 250 m, respectively (Patenaude et al. 2002). As with other underwater sound sources, the degree of sensitivity of cetaceans to sounds produced by aircrafts depend on their activity state at the time of exposure; individuals in a resting state (as opposed to foraging, socializing, or travelling) appear to have the highest sensitivity to such disturbances (Würsig et al. 1998; Luksenburg and Parsons 2009). Cetaceans most commonly react to sounds from overhead aircrafts by diving (Luksenburg and Parsons 2009). Other reported behavioural responses include decreased surfacing periods, changes in activity state, 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 aircraft fly at lower altitudes and the turtles

are in relatively shallow waters. It is uncertain how sea turtles would respond, but single or occasional overflights by helicopters would likely elicit only brief behavioural responses.

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. Whenever possible, vessels will maintain a steady course and constant speed. PSVs will be required to reduce speed to a maximum of 7 knots when a marine mammal or sea turtle is observed or reported within 400 m of the PSV (except if not feasible for safety reasons). Vessels may also alter course if practicable to avoid collision with a marine mammal (or sea turtle).

Based on the information presented here, as well as the mitigation measures presented in Section 10.3.1.2, 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 possibly being displaced from the immediate area around a PSV or helicopter. 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 on individual marine mammals and sea turtles or their populations. It is 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 adverse, low in magnitude, localized to the LAA, short- to medium-term in duration, a multiple irregular event, and reversible.

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

Table 10.6 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 6.2.4 and summarized in Table 10.6, with the likely exception of fin and northern bottlenose whales, there is generally low potential for SAR or SOCC to interact with Project activities because these species are thought to occur infrequently in the Project Area, LAA, and (generally the) RAA, and because critical habitat has not been identified for marine mammals and sea turtles in the Project Area or LAA. Critical habitat has been proposed for leatherback sea turtles in the distant southwestern portion of the RAA (i.e., in Placentia Bay) but there is negligible potential for interaction with routine Project activities and sea turtles which occur in this area.

Relevant threats identified for marine mammals and sea turtles at risk in associated recovery strategies and action plans under SARA include acoustic disturbance, marine pollution, and vessel strikes. Mitigation measures are designed to reduce effects of underwater sound from VSP airgun source array. The management of discharges and reduction of PSV speeds (refer to Sections 10.3.1.2 and 10.3.2.2) will also help to protect marine mammal and sea turtle SAR. SAR marine mammal and turtle species are highly mobile, and many have large distributional ranges and undertake long migrations. Large seasonal and even

daily variations in abundance within the Project Area are therefore likely, and the potential for overlap and interaction with Project activities is likely to be temporary. The Project will not occur in identified concentration areas or critical habitat although it is acknowledged that detailed marine mammal (and sea turtle) baseline data are lacking. There is uncertainty as to whether the Project Area (or a portion of it) provides important habitat for northern bottlenose whales and fin whales (see Section 6.3.7.4) Delarue et al. 2018). While there is limited potential for Project activities to increase the risk of mortality or injury in these species, there is potential for sound from Project activities to result in a change in habitat use (i.e., avoidance response). Based on available information (including acoustic modelling), as well as the frequency and duration of Project activities, avoidance responses exhibited by SAR species are predicted to be short-term and localized.

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

Table 10.6 Marine Mammal and Sea Turtle Species at Risk and of Conservation Concern with Potential to Occur in the RAA and Potential to Interact with Project Activities

Species	Season	*SARA* Status[A]	COSEWIC Status[B]	Summary of Potential Interactions
Baleen Whales (Mysticetes)				
North Atlantic Right Whale	Summer	Schedule 1: Endangered	Endangered	• Low potential for interaction with Project activities given rare occurrence in the Project Area • Proposed mitigation (Sections 10.3.1.2 and 10.3.2.2) will reduce risk of effects from underwater sound (VSP), discharges, and supply and servicing (PSV transit)
Fin Whale (Atlantic population)	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 (Sections 10.3.1.2 and 10.3.2.2) will reduce risk of effects from underwater sound (VSP), discharges, and supply and servicing (PSV transit)
Blue Whale (Atlantic population)	Year-round	Schedule 1: Endangered	Endangered	• Low potential for interaction with Project activities given uncommon occurrence in the Project Area • Proposed mitigation (Sections 10.3.1.2 and 10.3.2.2) will reduce risk of effects from underwater sound (VSP), discharges, and supply and servicing (PSV transit)

Table 10.6 Marine Mammal and Sea Turtle Species at Risk and of Conservation Concern with Potential to Occur in the RAA and Potential to Interact with Project Activities

Species	Season	*SARA* Status[A]	COSEWIC Status[B]	Summary of Potential Interactions
Toothed Whales (Odontocetes)				
Northern Bottlenose Whale (Scotian Shelf population[C]; Davis Strait-Baffin Bay-Labrador Sea population[D])	Year-round	Schedule 1: Endangered [C] / No Status [D]	Endangered [C] / Special Concern [D]	• Moderate potential for interaction with Project activities given the possibly common occurrence but low numbers expected in the Project Area [E] • Proposed mitigation (Sections 10.3.1.2 and 10.3.2.2) will reduce risk of effects from underwater sound (VSP), discharges, and supply and servicing (PSV transit)
Sowerby's Beaked Whale	Year-round	Schedule 1: Special Concern	Special Concern	• Low potential for interaction with Project activities given rare occurrence in the Project Area • Proposed mitigation (Sections 10.3.1.2 and 10.3.2.2) will reduce risk of effects from underwater sound (VSP), discharges, and supply and servicing (PSV transit)
Killer Whale (Northwest Atlantic population)	Year-round	No Status	Special Concern	• Low potential for interaction with Project activities given uncommon occurrence in the Project Area • Proposed mitigation (Sections 10.3.1.2 and 10.3.2.2) will reduce risk of effects from underwater sound (VSP), discharges, and supply and servicing (PSV transit)
Harbour Porpoise (Northwest Atlantic subspecies)	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 (Sections 10.3.1.2 and 10.3.2.2) will reduce risk of effects from underwater sound (VSP), discharges, and supply and servicing (PSV transit)
Sea Turtles				
Leatherback Sea Turtle	April to December	Schedule 1: Endangered	Endangered	• Low potential for interaction with Project activities given rare occurrence in the Project Area • Proposed mitigation (Sections 10.3.1.2 and 10.3.2.2) will reduce risk of effects from underwater sound (VSP), discharges, and supply and servicing (PSV transit)
Loggerhead Sea Turtle	Summer and fall	Schedule 1: Endangered	Endangered	• Low potential for interaction with Project activities given rare occurrence in the Project Area • Proposed mitigation (Sections 10.3.1.2 and 10.3.2.2) will reduce risk of effects from underwater sound (VSP), discharges, and supply and servicing (PSV transit)

Table 10.6 Marine Mammal and Sea Turtle Species at Risk and of Conservation Concern with Potential to Occur in the RAA and Potential to Interact with Project Activities

Species	Season	*SARA* Status[A]	COSEWIC Status[B]	Summary of Potential Interactions
Notes: Extralimital SOCC (e.g., beluga and bowhead whales) are not included here. [A] Species designation under SARA (SARA website; Government of Canada 2019). [B] Species designation by COSEWIC (COSEWIC website 2019). [C] Scotian Shelf population. [D] Davis Strait-Baffin Bay-Labrador Sea population. [E] Recent genetic analyses of northern bottlenose whale tissues collected near the Project Area suggest that this region may be an area of mixing between the two known populations (i.e., Scotian Shelf and Davis Strait-Baffin Bay-Labrador Sea), and other unknown populations, or possibly represent a new population (Feyrer et al. 2019).				

10.3.4 Summary of Project Residual Environmental Effects

Table 10.7 summarizes the environmental effects assessment and prediction of residual environmental effects resulting from interactions between the Project and marine mammals and sea turtles. The highest potential for environmental effects on marine mammals and sea turtles related to underwater sound is from the MODU and PSVs and to a lesser extent from the short duration VSP surveys. It is possible that marine mammals may exhibit localized and temporary avoidance of the MODU, PSVs, and VSP surveys. 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 low. PSVs will maintain a constant course and speed whenever possible and reduce speed to a maximum of 7 knots when a marine mammal or sea turtle is observed or reported within 400 m of the PSV (except if not feasible for safety reasons). Similarly, the likelihood of a marine mammal and sea turtle incurring permanent hearing impairment (PTS) and physical injury from exposure to airgun pulses from VSP surveys is low, given the short duration of the activity and the implementation of mitigation measures. 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 SAR.

Table 10.7 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	L	PA	ST-MT	IR	R	D
VSP	A	N-L	PA	ST-MT	IR	R	D
Discharges	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 10.7 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
Well Testing and Flaring	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Well Decommissioning and Abandonment or Suspension	A	N	PA	ST	IR	R	D
Supply and Servicing Operations	A	N-L	LAA	ST-MT	IR	R	D
Change in Habitat Quality and Use							
Presence and Operation of a MODU	A	L	PA-LAA	ST-MT	IR	R	D
VSP	A	L	PA	ST-MT	IR	R	D
Discharges	A-P	N	PA	ST	IR	R	D
Well Testing and Flaring	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Well Decommissioning and Abandonment or Suspension	A	N	PA	ST	IR	R	D
Supply and Servicing Operations	A	L	LAA	ST-MT	IR	R	D

KEY:
See Table 10.2 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

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 Project Area 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 long-term changes in the spatial and temporal distributions of marine mammal and sea turtle populations. The potential for interactions between most SAR and the Project is limited, although there is higher potential

for Project interactions with fin and northern bottlenose whales. Nonetheless, effects are predicted to be temporary, generally low in magnitude given the planned mitigation measures, and there is no identified critical habitat in the Project Area or LAA. The Project is therefore not predicted to jeopardize the overall abundance, distribution, or health of SAR. With mitigation and environmental protection measures, the residual environmental effects on marine mammals and sea turtles (including SAR) are predicted to be not significant.

10.5 PREDICTION CONFIDENCE

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. For example, there is uncertainty as to whether the Project Area provides important habitat for the northern bottlenose whale (see Section 6.3.7.4) and which of the two known populations individuals which have been detected in the Project Area belong to, or whether they are a separate population. Another key data gap is the lack of information on marine mammal response to MODUs in Atlantic Canada; 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. Because 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 much variability of response to underwater sound from MODU / drillship, vessel, and airgun source activities.

10.6 ENVIRONMENTAL MONITORING AND FOLLOW-UP

BHP will develop a marine mammal and sea turtle monitoring plan to be implemented during VSP surveys as outlined in Section 10.3.1.2. The Plan will include MMO requirements, shutdown, and ramp-up procedures and reporting requirements. A report of the observational program will be submitted annually to the C-NLOPB and DFO, including documentation of marine mammal and sea turtle sightings.

In the unlikely event of a Project vessel collision with a marine mammal or sea turtle, BHP will contact DFO through their 24-hour emergency contact number (1-888-895-3003).

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11.0 ASSESSMENT OF POTENTIAL EFFECTS ON SPECIAL AREAS

The special areas valued component (VC) addresses areas of the marine environment that have been identified for their biological, ecological, historical or socio-cultural importance. Special areas may be protected under federal, provincial, international and/or other legislations or agreements due to their special characteristics or sensitivity. Special areas have been selected as a VC due to their presence within and near the Project Area, and concerns regarding Project activities affecting these areas. Special areas in the Regional Assessment Area (RAA) are described and illustrated in Section 6.4.

Chapter 11 presents the assessment of effects from routine Project activities on special areas and therefore focuses on special areas within the Local Assessment Area (LAA), which encompasses the zones of influence for potential effects on special areas. 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 potential accidental events, which are described in Section 15.2 The assessment of effects on special areas is closely linked to the assessment of Marine Fish and Fish Habitat VC (Chapter 8), Marine and Migratory Birds VC (Chapter 9), and Marine Mammals and Sea Turtles VC (Chapter 10). These VCs include species of conservation interest that may also be inherent to special areas. These sections are cross-referenced throughout the effects assessment of special areas.

11.1 SCOPE OF ASSESSMENT

Special areas overlap with Project exploration licences (ELs), the Project Area and LAA including the Project support vessel (PSV) route where marine vessels and aircraft are anticipated to transit. Detailed descriptions of these areas are included in Section 6.4. Summaries of the defining features of these special areas and the distance between Project components and those special areas in the LAA are included in Table 11.1.

The Project Area, and in some cases EL 1157 and EL 1158, overlaps with the Northeast Newfoundland Slope Closure marine refuge, significant benthic areas (SiBA) identified for corals and sea pens, the Northeast Slope ecologically and biologically significant areas (EBSA), the Slopes of the Flemish Cap and Grand Bank EBSA and proposed critical habitat for northern and spotted wolffish (Table 11.1). The LAA also overlaps with the latter EBSA, vulnerable marine ecosystems (VME), and Northwest Atlantic Fisheries Organization (NAFO) fisheries closure areas identified mainly for corals and sponges. Along the PSV route and in coastal areas, the LAA overlaps with special areas identified for marine fish and fish habitat, marine and migratory birds, and marine mammals and sea turtles. As shown in Figure 11-1, special areas (e.g., VMEs, a NAFO closure and a Convention on Biological Diversity (CBD) EBSA) may overlap with the LAA but not the PSV route. Likewise, certain special areas such as coastal EBSAs and important bird areas (IBAs) may overlap with the PSV route only.

Table 11.1 Special Areas in the LAA

Special Area	Defining Features	Nearest Distance to Special Area (km)			
		EL 1157 / 1158	Project Area	LAA	Potential PSV Routes
East Avalon/Grand Banks Candidate National Marine Conservation Area (NMCA)	Detailed description not available. Overlaps Eastern Avalon EBSA, Witless Bay Ecological Reserve and Witless Bay Islands IBA. Assumed an important area for seabirds.	278	248	Overlap	Overlap
Northeast Newfoundland Slope Closure Marine Refuge	High biodiversity. High density of corals and sponges. Bottom contact fishing activities prohibited to protect corals and sponges.	Overlap	Overlap	Overlap	Overlap
SiBA - Sea Pens	Fisheries and Oceans Canada (DFO) modelling shows high predicted presence probability of indicated species.	Overlap	Overlap	Overlap	Overlap
SiBA - Large Gorgonian Corals		Overlap	Overlap	Overlap	Overlap
Northeast Slope Canadian EBSA	Concentrations of corals. High aggregations of Greenland halibut and spotted wolffish (species at risk (SAR)) in spring. Aggregations of marine mammals (e.g., harp seals, hooded seals and pilot whales).	Overlap	Overlap	Overlap	Overlap
Eastern Avalon Canadian EBSA	Seabird feeding areas. Cetaceans, leatherback turtles and seals feed in the area from spring to fall.	281	250	Overlap	Overlap
Baccalieu Island Canadian EBSA	Capelin spawning area. Aggregations of killer whales, shrimp, piscivores, spotted wolffish. Foraging area for seabird species: Atlantic puffin, black-legged kittiwake and razorbill.	259	237	Overlap	Overlap
Critical Habitat Northern Wolffish	Critical habitat has been identified in areas containing features (e.g., depth and sea bottom temperatures) that allow for the recovery and survival of these species.	17	Overlap	Overlap	Overlap
Critical Habitat Spotted Wolffish		12	Overlap	Overlap	Overlap
6B Snow Crab Stewardship Exclusion Zone	Crab fishing closure area.	281	255	Overlap	Overlap
Near Shore Snow Crab Stewardship Exclusion Zone		277	248	Overlap	Overlap
Witless Bay Seabird Ecological Reserve	North America’s largest Atlantic puffin colony. World’s second largest Leach's storm-petrel colony.	337	306	Overlap	Overlap

Table 11.1 Special Areas in the LAA

Special Area	Defining Features	Nearest Distance to Special Area (km)			
		EL 1157 / 1158	Project Area	LAA	Potential PSV Routes
VMEs - Sponge	Concentrations of sponges and or corals.	62	35	Overlap	201
VMEs - Large Gorgonian Coral		63	35	Overlap	179
Sackville Spur (6) NAFO Fisheries Closure Area (FCA)	High sponge and coral concentration area where bottom fishing activities are prohibited.	59	32	Overlap	204
Slopes of the Flemish Cap and Grand Bank UN Convention on Biological Diversity EBSA	Aggregations of corals and sponges, high diversity of marine taxa including SAR . Greenland halibut fishery grounds.	Overlap	Overlap	Overlap	110
Quidi Vidi Lake IBA	Daytime resting site for gulls (e.g., herring, great black-backed, Iceland, glaucous, common black-headed) late fall to early spring; reported locally rare ring-billed gull, mew gull and lesser black-backed gull; waterfowl (e.g., American black ducks, mallards and northern pintails) common in winter.	320	292	Overlap	Overlap
Witless Bay Islands IBA	Globally significant numbers of breeding seabirds, including more than half of eastern North American Atlantic puffin population and almost 10% of global Leach's storm-petrel population. Large numbers of nesting common murre, black-legged kittiwake and herring gull. Smaller numbers of nesting great black-backed gull, northern fulmar, thick-billed murre, razorbill and black guillemot. Important area for sea ducks (e.g., white-winged scoter, surf scoter, long-tailed duck and common eider during fall migration.	307	337	Overlap	Overlap
Distances are calculated in NAD83 UTM Zone 23N Projection					

11.1.1 Regulatory and Policy Setting

The Guidelines for the Preparation of an Environmental Impact Statement (EIS) under the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) for the BHP Canada Exploration Drilling Project issued on June 28, 2019 (Sections 7.1.9.1, 7.3.8.3, and 7.6.3 of the EIS Guidelines, Appendix A) provide guidance on the assessment of environmental effects on special areas. Effects on species (including SAR, their critical habitat and Species of Conservation Concern (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).

Various legislation enacted by the governments of Canada and Newfoundland and Labrador (NL) enable protection of marine areas within Canadian jurisdiction. A summary of legislation applicable to this effects assessment of special areas is provided in Table 11.2. Additional details are provided throughout Section 6.4.

Table 11.2 Federal and Provincial Legislation to Establish Canadian Protected Areas

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

11.1.2 The Influence of Consultation and Engagement on the Assessment

During BHP's Project-related engagement with government departments and agencies, stakeholder organizations and Indigenous groups questions and comments about special areas were documented (see Chapter 3 for further details). These primarily include concerns regarding potential adverse effects associated with accidental events on special areas.

11.1.3 Potential Effects, Pathways and Measurable Parameters

Section 7.1.9.1 of the EIS Guidelines indicates that the EIS is to provide "the distances between the edge of the Project Area (i.e. drill sites and marine transportation routes) and special areas". Potential effects on a change to environmental features that define special areas (e.g., physical features, species assemblages and species abundance) including risk of mortality or physical injury and behavioural effects to marine species within special areas are addressed in Chapters 8, 9, and 10. Effects on special areas are to include: "use of dispersants", which is described in Chapter 15, Accidental Events.

Routine Project-related activities have the potential to affect the ability of special areas to provide and maintain important ecological and biological functions for related species. 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

The measurable parameters used for the assessment of the environmental effect presented above, and the rationale for their selection, are provided in Table 11.3. Effects of accidental events are assessed separately in Section 15.6.4.

Table 11.3 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 1157 and 1158 with a 20 km buffer around each EL.

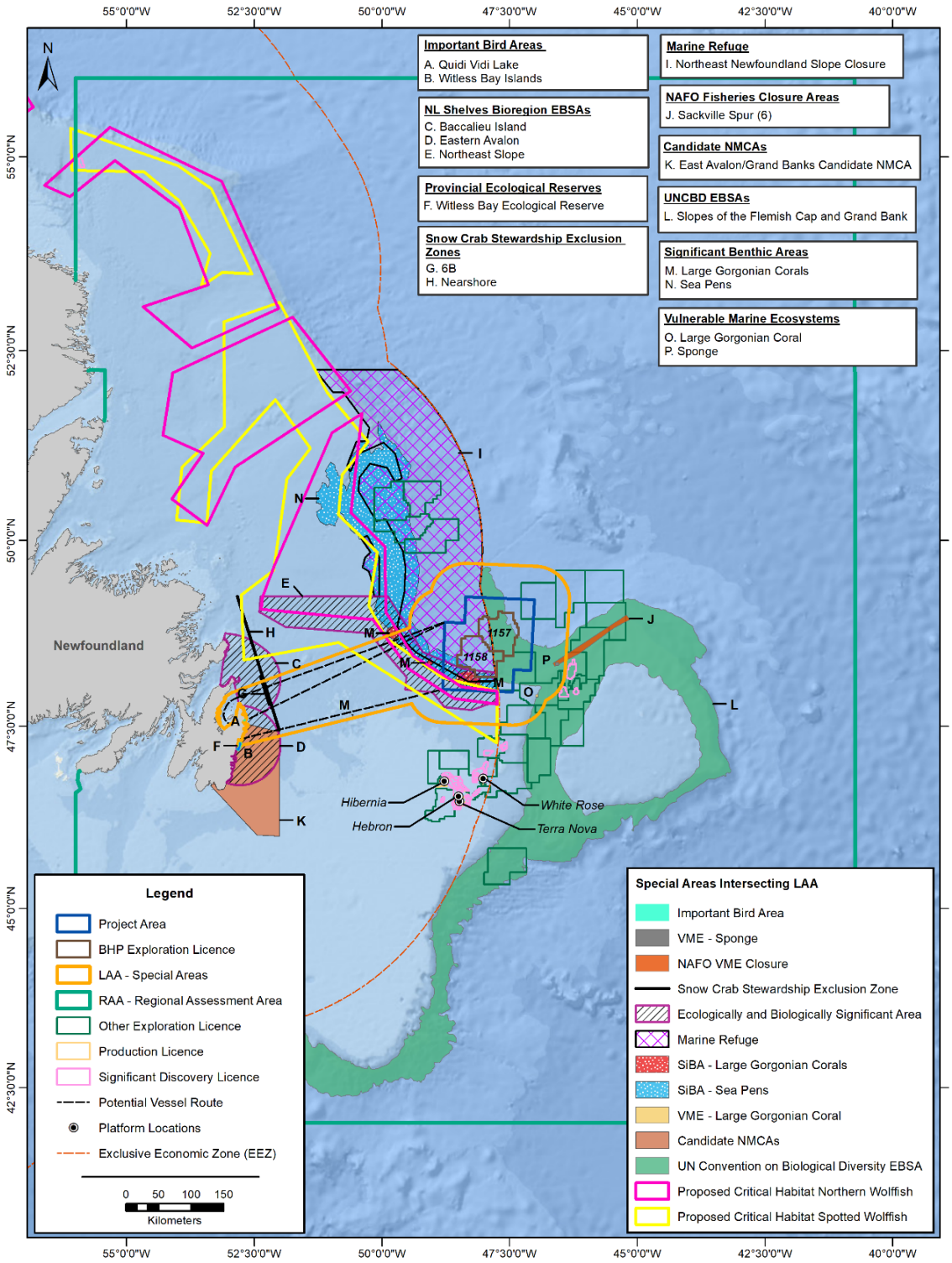

Figure 11-1 Special Areas in the LAA

Local Assessment Area (LAA): The LAA (Figure 11-1) encompasses the Project's zones of influence and includes 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 within a conservative 50 km buffer zone 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 with a 10-km zone of influence.

Regional Assessment Area (RAA): The 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. BHP is currently planning up to 20 wells proposed as early as 2021 to 2028. 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 35 to 115 days to drill. Vertical seismic profiling (VSP) surveys typically take approximately one to two days with sound source firing often limited to just a few hours. Drilling operations will not be continuous throughout the entire nine-year temporal scope of the Project and will depend partially on various factors including weather, MODU availability and results from previous wells. While drilling activities have the potential to be conducted at any time of the year, BHP's preference is to conduct drilling in ice-free months.

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.

11.1.5 Residual Effects Characterization

The definitions used to characterize environmental effects as part of this effects assessment for special areas are provided in Table 11.4. 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 15.6.4.

Table 11.4 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 existing conditions	**Positive** – a residual environmental effect that moves measurable parameters in a direction beneficial to special areas relative to existing conditions **Adverse** – a residual environmental effect that moves measurable parameters in a direction detrimental to special areas relative to existing conditions **Neutral** – no net change in measurable parameters for special areas relative to existing conditions
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 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 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 existing 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 pre-project conditions before or after Project completion **Irreversible –** permanent

Table 11.4 Characterization of Residual Effects on Special Areas

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 LAA, not adversely affected by human activity, or is likely able to assimilate the additional change **Disturbed** – The VC has been substantially previously disturbed by human development or human development is still present in the LAA, or the VC is likely not able to assimilate the additional change

11.1.6 Significance Definition

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 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
- 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 11-5 identifies the physical activities that might interact with special areas and result in the identified environmental effect. These interactions are indicated by check marks and a justification for no effect is provided in the text following the table. Potential residual effects are discussed in detail in Section 11.3, within the context of effects pathways as well as standard mitigation and Project-specific mitigation / enhancements. 3

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 (Table 11.1). Effects of well evaluation and testing on marine and migratory birds are discussed in Section 9.3. Well testing, if required, is conducted within a closed system, sending well samples back to the mobile offshore drilling unit (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 submerged special areas. Given the distance of the Project from the nearest coastline (at least 290 km from the island of Newfoundland), flaring or air emissions are not expected to interact with special areas onshore or along the coast of NL.

Table 11.5 Project-Environment Interactions with Special Areas

Physical Activities	Environmental Effects
	Change in Habitat Quality
Presence and operation of a MODU (including drilling, associated safety zone, lights, and sound)	✓
VSP	✓
Discharges (e.g., drill muds / cuttings, liquid discharges)	✓
Well Testing and Flaring (including air emissions)	–
Well Decommissioning and Abandonment or Suspension	✓
Supply and Servicing Operations (including helicopter transportation and Project supply vessel 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 (Table 11.1). Effects of well evaluation and testing on marine and migratory birds are discussed in Section 9.3. Well testing, if required, is conducted within a closed system, sending well samples back to the mobile offshore drilling unit (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 submerged special areas. Given the distance of the Project from the nearest coastline (at least 290 km from the island of Newfoundland), flaring or air emissions are not expected to interact with special areas onshore or along the coast of NL.

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 noted in Table 11.3. Given the similarities in Project description, proximity of activities in the Orphan Basin and Flemish Pass, and currency of data, the EIS incorporates learnings from previous Environmental Assessment (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.

11.3.1 Change in Habitat Quality

11.3.1.1 Project Pathways

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

11.3.1.2 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. As the value of special areas is linked to the marine species that use them, mitigation measures 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 on special areas important to these species.

Presence and Operation of a MODU

- BHP will conduct a visual seabed survey in the vicinity of wells sites confirming the absence of shipwrecks, debris on the seafloor, unexploded ordnance and sensitive environmental features, such as habitat-forming corals or species at risk (SAR) to be used in conjunction with the geohazard assessment based on existing data. The survey will be developed in consultation with the C-NLOPB and DFO and will be carried out prior to drilling under a separate environmental approval by the C-NLOPB. If substantial environmental or anthropogenic sensitivities are identified during the survey, BHP will move the well site to avoid affecting them if it is feasible to do so. If it is not feasible, BHP will consult with the C-NLOPB and DFO to determine an appropriate course of action.

- Lighting will be limited to the extent that worker safety and safe operations is not compromised. Measures may include avoiding use of unnecessary lighting, shading, and directing lights towards the deck.

Vertical Seismic Profiling

- VSP activity 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* (DFO 2007). 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 VSP activity begins.

Discharges

- Selection of drilling chemicals will be in accordance with the Offshore Chemical Selection Guidelines (OCSG) for Drilling and Production Activities on Frontier Lands (NEB et al. 2009), which provides a framework for chemical selection to reduce potential for environmental effects. During planning of drilling activities, where feasible, lower toxicity drilling muds and biodegradable and environmentally friendly additives within muds and cements will be preferentially used. Where feasible the chemical components of the drilling fluids will be those that have been rated as being least hazardous under the Offshore Chemical Notification System (OCNS) scheme and Pose little or no risk to the environment (PLONOR) by the Convention for the Protection of the Marine Environment of the North-East Atlantic.

- Offshore waste discharges and emissions associated with the Project (i.e., operational discharges and emissions from the MODU and PSVs) will be managed in accordance with relevant regulations and municipal bylaws as applicable, including the Offshore Waste Treatment Guidelines [OWTG]) (NEB et al. 2010) and MARPOL, of which Canada has incorporated provisions under various sections of the Canada Shipping Act. Waste discharges not meeting legal requirements will not be discharged to the ocean and will be brought 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.

- Discharges of synthetic-based mud (SBM) and cuttings will be managed in accordance with the OWTG. SBM cuttings will only be discharged once the performance targets in OWTG of 6.9 g/100 g retained “synthetic on cuttings” on wet solids can be satisfied. The concentration of SBM synthetic oil on cuttings will be monitored on the MODU for compliance with the OWTG. In accordance with OWTG, no excess or spent SBM will be discharged to the sea. Spent or excess SBM that cannot be re-used during drilling operations will be brought back to shore for disposal (refer to Section 2.8.3.1).

- Putrescible solid waste, specifically food waste generated offshore on the MODU and PSVs, will be disposed of according to OWTG and MARPOL requirements. Food waste will be macerated so that particles are less than 6 mm in diameter and then discharged. There will be no discharge of macerated food waste within 3 nautical miles from land.

- Transfer of hazardous wastes will be conducted according to the Transportation of Dangerous Goods Act. Applicable approvals for the transportation, handling and temporary storage, of these hazardous wastes will be obtained as required.

Well Decommissioning and Abandonment or Suspension

- Once wells have been drilled to True Vertical Depth (TVD) and well evaluation programs completed (if applicable), the well will be plugged and abandoned in line with applicable BHP practices and C-NLOPB requirements. The final well abandonment program has not yet been finalized; however, these details will be confirmed to the C-NLOPB as planning for the Project continues.

- BHP plans to conduct a post-drilling visual survey of the seafloor using a remotely operated vehicle (ROV) after drilling activities to assess the visual extent of sediment dispersion and validate the modelling for the discharges of drill mud and cuttings.

Supply and Servicing Operations

- The regional CWS office will be contacted for separation distances and altitudes between helicopters transiting to and from the MODU and migratory bird nesting colonies, as per CWS guidelines (Government of Canada 2018) and routes will comply with provincial *Seabird Ecological Reserve Regulations, 2015* (no closer than 300 m). Specific details will be provided in the EPP.
- PSV routes transiting to and from the MODU will be planned to avoid passing within 100 m of migratory bird nesting colonies during the nesting period and will comply with provincial *Seabird Ecological Reserve Regulations, 2015* and federal guidelines to reduce disturbance to colonies (ECCC 2017b). Specific details will be provided in the EPP.
- Lighting on PSVs will be limited to the extent that worker safety and safe operations is not compromised. Measures may include avoiding use of unnecessary lighting, shading, and directing lights towards the deck.
- Searches for stranded birds and recovery, rehabilitation, release and documentation of birds will be conducted on PSVs as outlined above for the MODU.

11.3.1.3 Characterization of Residual Project-related Environmental Effects

No special areas identified for the presence of marine and migratory birds or sea turtles, or their habitats overlap with the Project Area or LAA (other than the PSV route). Thus, this discussion is focused on marine fish and fish habitat and marine mammals in special areas that overlap with the Project Area and LAA as identified in Table 11.1. These include Northeast Newfoundland Slope Closure marine refuge (12.6% overlap with Project Area), SiBAs identified for sea pens and large gorgonian corals (5.9% and 4.0% overlap with Project Area, respectively), Northeast Slope EBSA (13.0% overlap with Project Area), Slopes of the Flemish Cap and Grand Bank EBSA (5.6% overlap), and proposed critical habitat for northern and spotted wolffish (1.5% and 0.9% overlap with the Project Area, respectively).

Presence and Operation of a MODU

Underwater sound would be generated by the MODU through drilling operations and use of dynamic positioning to hold the MODU. 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 mobile species avoiding an area, which may also affect species that prey upon them. Potential physical or behavioural effects on fish and marine mammals can indirectly affect the quality of special areas, if species avoid or no longer use these special areas 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 (Section 10.3), respectively. The effects of underwater sound on fish and marine mammals depends on a variety of factors, including sound frequency, ocean conditions, species, stage of life, and reproductive stage.

A change in habitat quality, primarily related to propagation of underwater sound from the MODU, could occur in special areas including the Northeast Newfoundland Slope Closure marine refuge, SiBAs, the Northeast Slope EBSA and the Slopes of the Flemish Cap and Grand Bank CBD EBSA, which are identified

for benthic species and habitats, and proposed critical habitat for spotted and northern wolffish. The Northeast Slope EBSA is also identified for the presence of marine mammals.

The potential effect of noise on marine fish and fish habitat are discussed in Section 8.3.2.3 and presented in this section as relevant to special areas. The quality of the underwater acoustic environment for marine fish and invertebrates could be affected by underwater sound emitted during MODU operations. The principal potential effects would be behavioural in nature. If exposure to sound emitted by MODU operations causes mobile fishes and invertebrates to move away from the vicinity of the sound source, then a change in habitat quality and use would occur, albeit in a localized area.

The lack of quantification of exposure sound levels that elicit behavioural responses to continuous sound makes it impossible to provide quantitative guidelines but some information is available (Popper et al. 2014). Researchers have concluded that for fishes with swim bladders involved in hearing, the risk for behavioural effects is high when the receiver is near the sound source, whereas for the other two fish groups (i.e., no swim bladder, and with a swim bladder not involved in hearing), the risk is moderate near the sound source. Risk of behavioural effects on the three fish groups when receivers are at intermediate and far distances from the sound source is moderate and low, respectively. Also, the risk of behavioural effects on ichthyoplankton occurring at near, intermediate and far distances from continuous sound sources is moderate, moderate and low, respectively (Popper et al. 2014).

General predictions of behavioural changes in fish and invertebrates and their use of fish habitat in response to exposure to continuous sound are difficult given the variation in characteristics of sounds from different sources, inter- and intra-specific differences in how sound is detected and effects of exposure to it, and the relative lack of scientific information on this issue for fish and invertebrates (Popper and Hawkins 2018, 2019). Behavioural responses by individual fish, and likely individual invertebrates, can also vary by motivational state. For example, individual fish and invertebrates engaged in reproductive behaviour may not respond to underwater sound while those same individuals may respond to the same sound if in migratory mode.

For this Project, underwater sound modelling was undertaken at two locations (one in EL 1157 and one in EL 1158) for the months of February and August, which best represent the range of sound propagations over the course of a year. The goal of this modelling was to estimate sound pressure levels of noise introduced to the environment by Project activities including VSP, which emits impulsive sound, and drill ships, semi-submersible drilling platforms and support vessels, which emit continuous sound. The sound modelling report is found in Appendix E.

Avoidance and startle responses may be exhibited by some marine fish and invertebrates occurring near continuous sound sources during initiation of MODU operations/drilling (Müeller-Blenkle et al. 2008). It is anticipated that fish will habituate to the continuous sound and avoidance and startle responses will decrease over time during drilling. The results of modelling for source sound pressure level (SPL) associated with the three MODU types used in the acoustic modeling results indicate that received levels would occur approximately 300 m from the sound source. Given the localized and temporary nature of the drilling activity, displacement of fish from habitats and population level disturbances are unlikely (Alavizadeh and Deveau 2019).

Special areas within the LAA contain sensitive benthic species (e.g., corals, sea pens, and sponges), which are also of ecological importance as they form biogenic habitat for other marine species and contribute to a productive marine environment. Marine fish are present in the area and several special areas are also identified for fish and shellfish habitat. The Northeast Slope EBSA is known to support aggregations of fish species, including SAR. However, a change in underwater sound in the area would be temporary, with the highest sound levels being close to the well site and not predicted to result in permanent or irreversible loss of habitat for fish or marine mammals. Underwater sound emissions would occur continuously while drilling is conducted, and therefore the presence of such sound would be reversible once drilling operations are completed 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.

The Northeast Slope EBSA has been identified for aggregations of marine mammals including harp seals, hooded seals and pilot whales. As discussed in Section 10.3.1.3 and demonstrated in detail in Appendix E, marine mammals are unlikely to be exposed to sound levels from the Project that would result in auditory injury. In the modelled scenarios, the maximum distance for onset of auditory injury was within 0.60 km of the source. Most of the threshold distances for vessel sources are much lower than those of VSP (Section 11.3.1.3: VSP), although the generic drillship yielded maximum onset distances, for auditory injury to high-frequency cetaceans, of 0.28 km at EL 1157 and 0.014 km for EL 1158 for the February scenarios.

Based information provided in Section 10.3.1.3, it is anticipated that most marine mammals will avoid the immediate area around the MODU, thereby further reducing the likelihood of incurring hearing impairment. Although little is known about the effects of underwater sound on sea turtle hearing and behaviour, it is assumed that sea turtles would exhibit localized avoidance of the MODU. Based on published threshold values for auditory injury for sea turtles, it is highly unlikely that sea turtles would experience hearing impairment from sound exposure from a MODU. Thus, 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.

As discussed in Section 2.7.6, light emissions will be generated from lights on the MODU and supply vessels, which operate 24 hours per day. A typical offshore platform emits 30 kW of artificial lighting. Lighting sources include pilot warning and obstruction avoidance lighting, navigation lights, strobe lights, and lighting for worker safety. Light (and heat) is also generated during flaring. Lighting attraction effects on marine and migratory birds are anticipated to be confined to between approximately 5 km and 16 km from a source. However, as noted above, none of the special areas that overlap with the Project Area or LAA have been identified for the presence of marine and migratory birds except for in the PSV route which is addressed in Section 11.3.1.3: Supply and Servicing. The nearest special area identified for marine birds is more than 235 km from the Project Area.

The potential effects of light from the MODU, as discussed in detail in Section 8.3.2.3, are presented here as relevant to special areas. Habitat quality and use may be affected by artificial lights on the MODU as marine fish may aggregate towards or avoid a light source. Marine fish behaviours (e.g., feeding, schooling, predator avoidance, and migration) may 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 in BP 2018). Behavioural responses to light is variable among and within species depending on competing priorities (e.g., foraging, predator avoidance, schooling) and light detection sensitivities

(Nightingale and Simenstad 2002, Hanson et al. 2003 in BP 2018). Lighting around the MODU may attract phototaxic plankton and may provide increased opportunities for predation by fish and other species (Keenan et al. 2007, Cordes et al. 2016). In studies of light fields around active oil production platforms in the Gulf of Mexico, researchers observed that lighting was detected at greater than 100 m from the source and mainly near the surface (0.75 m water depth) (Keenan et al. 2007). Depending on the site and structures, light levels of these platforms decreased to background levels within the sampling area (250 m from source) below 5 and 10 m water depths (Keenan et al. 2007). For species that undergo diel vertical migrations, there may be weak diel periodicity within 100 m of the platform and avoidance of the illuminated area at night (Simonsen 2013, Barker 2016). Potential effects of artificial lighting from the MODU are generally localized to hundreds of metres to less than 1.5 km from the light source (Keenan et al. 2007, Simonsen 2013, Foss 2016).

Drilling could occur at any time of the year and the sound and light generated would be continuous during the drilling of each well (approximately 35 to 115 days per well). Based on available literature, the residual environmental effects on a change in habitat quality in special areas exposed to underwater sound and light emanating from a MODU is predicted to be adverse, low to moderate in magnitude, restricted to the Project Area (for with fish species) or LAA (for special areas with marine mammals and sea turtle species), short-term (for special areas with marine mammals and sea turtles) to medium-term (for special areas with fish species) in duration, to occur irregularly, and reversible.

Vertical Seismic Profiling

The potential effects of Project-related VSP surveys on special areas within the Project Area and LAA include effects of underwater sound on fish and marine mammals that may inhabit these special areas during the time of a survey. An increase in underwater sound levels from a VSP survey, and the potential for behavioural effects such as avoidance or masking, for marine species 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.

VSP surveys could potentially occur within special areas identified for marine fish and fish habitat (e.g., the Northeast Newfoundland Slope Closure marine refuge, Northeast Slope EBSA, SiBAs, proposed critical habitat for northern and spotted wolffish, and the Slopes of the Flemish Cap and Grand Bank EBSA), which overlap with the Project Area and LAA. The potential effects of VSP on marine fish and fish habitat are discussed in detail in Section 8.3.2.3 and presented below as relevant to special areas.

It is unlikely that VSP sound levels received by mobile fish would cause mortality or physical injury given their capability of moving away from the sound source once behaviour affecting levels are detected. A ramp-up period for the VSP source will be conducted during onset of the survey with the intention of warning nearby biota and allowing them to move away from the sound source before SPLs high enough to potentially cause injury are received. In contrast to full 2D and 3D seismic surveys, the VSP source is stationary so mobile fishes and invertebrates would not likely be subjected to cumulative exposures. However, low-mobility fishes and sessile invertebrates occurring in the immediate area of a VSP source would be exposed numerous times to relatively consistent levels of sound during a VSP survey. While all fish and invertebrates

can detect the particle motion component of underwater sound, only some fishes and no invertebrates can detect the sound pressure component of sound.

Marine plankton, including ichthyoplankton, could be affected physically by sound emitted during VSP activities. Current science suggests that this might happen only if the biota occur immediately adjacent to the sound source (i.e., a few metres) (Kostyuchenko 1973, Booman et al. 1996, Østby et al. 2003). Studies on the potential mortality or physical injury to ichthyoplankton and zooplankton exposed to the sound emitted by airgun sound sources have shown variable results (Popper et al. 2014; McCauley et al. 2017). Some research studies suggest that individual zooplankton could be impacted at a local scale (i.e., close to airgun source) but that it sound from airguns is unlikely to result in substantial impact on populations (Richardson et al. 2017). Also, developing scallop larvae exposed to airgun sound have shown increased mortality risk due to body malformation (Richardson et al. 2017).

Modelling conducted for this Project indicated that most marine mammal groups would have to occur and remain near a VSP source array for the full duration of the survey to possibly incur auditory injury. This is considered unlikely as marine mammals are likely to avoid underwater sound from Project activities (see Section 10.3). The effects assessment for both the marine fish and fish habitat and marine mammals and sea turtles VCs found that there would be no significant residual adverse environmental effects from VSP surveys. The sound modelling report is found in Appendix E.

VSP surveys could potentially occur within special areas identified for the presence of marine mammals (i.e., the Northeast Slope EBSA) that overlap with the Project Area and LAA. VSP surveys could temporarily affect the habitat quality of the area and its ability to provide a suitable environment for mammal species. Based on information provided in Section 10.3, it is unlikely that VSP surveys will result in auditory injuries to marine mammals or sea turtles. To mitigate potential effects, a ramp-up procedure for the airgun array will be implemented. Ramp-up will be delayed if a marine mammal or sea turtle is detected within 500 m of the array. Airgun(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 array.

This residual effects of VSP surveys on a change in habitat quality in special areas is anticipated to be adverse, low in magnitude, short-term (i.e., approximately one day per well), restricted to the Project Area (for special areas with marine mammals and sea turtles) and Project Area to LAA (for special areas with marine fish species), short-term (for special areas with marine fish species) and short-term to medium-term (for special areas with marine mammals and sea turtles), occurring irregularly , and reversible once the survey activity ends. VSP survey activities will adhere to the Statement of Canadian Practice (SOCP) on Mitigation of Seismic Noise in the Marine Environment, as appended to the Geophysical, Geological, Environmental and Geotechnical Program Guidelines (C-NLOPB 2019).

Discharges

Discharges, including drill muds and cuttings, that result from offshore exploration drilling operations have the potential to adversely alter sediment concentration and water quality in special areas that overlap with the Project Area. These special areas include a marine refuge identified for corals and sponges, SiBAs, proposed critical habitat for wolffish, and EBSAs identified for the presence of sensitive benthic species (i.e., corals, sponges and sea pens), biogenic habitats, and fish SAR (refer to Table 11.1). The effects of

Project-related discharges on marine fish and fish habitat have been discussed in detail in the marine fish and fish habitat VC (Section 8.3).

Potential liquid discharges from an offshore exploration drilling program may have potential effects on water column habitat quality. These discharges will be managed in accordance with the OWTG and associated standards and guidelines. Discharges are expected to be temporary, non-bioaccumulating, nontoxic 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.

Drilling mud and cuttings are the primary discharges resulting in changes in habitat quality and availability from physical or chemical changes in the water column and/or sediment. Drilling mud and cuttings discharges may result in a temporary increase in suspended particulate matter and turbidity in the water column. Water column exposure can range from minutes to several days, but generally returns within hours to background levels after cessation of discharges (Smit et al. 2006; Koh and Teh 2011; International Association of Oil & Gas Producers (IOGP) 2016). The potential effects in the water column are generally non-persistent and temporary with the rapid dilution and dispersal of drill cuttings.

Drilling mud and cuttings discharges that settle on the seafloor may change habitat quality and availability from sediment alteration, and degradation of organic components that lead to oxygen depletion (Smit et al. 2008a; Neff 2010; Ellis et al. 2012; DeBlois et al. 2014; Tait et al. 2016; DFO 2019b). While macrofauna may be initially affected by these physical and indirect effects, recovery to the area may occur quickly after degradation of drill cuttings components (Tait et al. 2016). Sediment exposure to drill waste can persist for months or years; however, effects may subside between one to five years with recovery starting at the edges (Neff et al. 2000, Tait et al. 2016, Gates et al. 2017).

Biogenic habitat quality and availability may also change from potential injury, mortality, and health effects on coral and sponge communities drilling mud and cuttings discharges (Allers et al. 2013, Cordes et al. 2016, DFO 2019b). Structure-forming benthic invertebrate species (Baillon et al. 2012, 2014, Kenchington et al. 2013, 2016) occur in the Orphan Basin and in surrounding areas, including cold-water corals and sponges. SiBAs for sea pens and large gorgonian corals have been designated along the southern slopes of the Project Area. Drill cuttings dispersion modelling was performed for the Project to assess the footprint, spatial extent, and thickness of discharged drill cuttings (Section 8.3.1.3). Modelled thicknesses above the 6.5 mm threshold were not predicted to occur at either site, with the maximal depositional thickness of 5.45 and 4.75 mm predicted for EL 1157 and EL 1158, respectively. For EL 1157, dispersion sediment thicknesses of 1.5 mm or greater are predicted to reach a maximum extent up to 450 m from the discharge point and up to 580 m at EL 1158, and to cover an area less than 0.12 km² at either EL. There is potential for changes in habitat quality in special areas identified (i.e., SiBAs and an EBSA) and / or protected (i.e., a marine refuge) for corals and sponges in EL 1157 and EL 1158 if well sites were drilled in close proximity to these special areas, and sediment thicknesses above 1.5 mm were deposited. Modelling has predicted that thickness above 6.5 mm would not occur at either site, and effects on benthic organisms would likely be low.

Recovery rates for coral and sponge communities within the deposition area are expected to be longer (e.g., decades) than other benthic invertebrates (Henry and Hart 2005, Cordes et al. 2016, Henry et al. 2017, Ragnarsson et al. 2017, Liefmann et al. 2018). However, benthic mortality rates as a result of these

discharges are not predicted to result in irreversible changes to local populations due to the low magnitude and spatial extent of potential effects. Therefore, predicted changes to biogenic habitat would be of similar low magnitude.

In consideration of proximity to special areas identified for benthic habitat and lack of information of coral and sponge distributions in deeper areas of the Orphan Basin, BHP will conduct an imagery-based seabed survey at the well site(s) to confirm the absence of sensitive environmental features. The survey will be carried out before drilling and will consider the modelling spatial extent of the drill cuttings. If substantial environmental or anthropogenic sensitivities are identified during the survey, BHP will notify the C-NLOPB immediately to discuss an appropriate course of action. This may involve further investigation and/or moving the well site if it is feasible to do so. This survey will provide existing conditions 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 environmental effects on a change in habitat quality in special areas is predicted to be adverse, low to moderate in magnitude, restricted to the Project Area, medium-to long-term in duration, irregular, and reversible.

Well Decommissioning and Abandonment or Suspension

Activities associated with well decommissioning and abandonment or suspension involve the presence of vessels at the drill site. As a result, the effects of these activities would be the same as those assessed for the presence and operations of the MODU, and therefore are not repeated here.

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 in line with BHP's practices and C-NLOPB requirements. As discussed in Section 2.4.4., BHP will seek permission from the C-NLOPB to leave the wellhead in place after well plugging and abandonment. Where wellheads are left in place, they may provide additional hard substrate on the seafloor, which could be used for colonization by benthic fauna that prefer hard surfaces for attachment. Again, the Project Area and LAA overlap with various types of special areas identified for the presence of sensitive benthic species and biogenic habitats (refer to Table 11.1).

Residual environmental effects associated with well abandonment on a change in habitat quality for special areas identified are predicted to be neutral to adverse, low in magnitude, restricted to the Project Area, irregular, and reversible. Depending on decommissioning strategy, potential effects will be short-term in duration.

Supply and Servicing Operations

The potential effects of supply and servicing operations on special areas within the Project Area and LAA 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 to and from the Project Area to the shore base, and potential for behavioural effects from marine species, may also affect the overall quality and use of special areas by these species.

Vessel routes will potentially transit through special areas (i.e., Northeast Slope EBSA, Eastern Avalon EBSA and Baccalieu Island EBSA) identified for the presence of marine fish and mammals and related habitats (Section 6.4.1). The potential for effects related to underwater sound levels would be the same as discussed above for MODU presence and operation in the Project Area (Section 11.3.1.3: Presence and Operation of a MODU). The potential effects of underwater sound on marine fish and fish habitat, and marine mammals and sea turtles from supply and servicing operations are also discussed in Sections 8.3 and 10.3, respectively and presented below as relevant to special areas.

Supply and servicing operations will increase vessel traffic within the Project Area and LAA and may therefore locally affect fish habitat quality 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 178 dB re 1 µPa m (Alavizadeh and Deveau 2019). 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 species, and environmental conditions and physiological state of the fish at the time of the interaction (de Robertis and Handegard 2013 in BP 2018). Mobile fishes would potentially respond to lower received levels and move away from the vessel sound source, thereby limiting potential for temporary injury to individual fish and subsequently adverse effect on fish populations. Therefore, a change in habitat quality from PSV traffic would represent a small increment over similar effects from existing levels of marine traffic in the RAA.

The PSV route for this Project overlaps with special areas identified for the presence of sensitive habitats of marine and migratory birds and their habitats. These areas include: Eastern Avalon EBSA, Baccalieu Island EBSA, Witless Bay Ecological Reserve, Quidi Vidi IBA and Witless Bay Island IBA, which are on the coastline of eastern Newfoundland. The transitions of PSVs and aircraft from the Project Area to the shore base may increase the potential for interactions with marine and coastal bird species. The effects from supply and servicing on marine birds is discussed in Section 9.3 and presented below as relevant to special areas in the PSV route.

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. Vessel traffic may interact with seabirds through lighting, atmospheric and underwater sound, and other associated environmental emissions and discharges. The various bird species that occupy special areas in the LAA will not likely be affected by PSV activity 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 are variable due to several factors including species, previous exposure levels, and the location, altitude, and number of flights (Hoang 2013). One of the most conspicuous 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). Eggs and nestlings may also be vulnerable to hypothermia. During flushing, adults may inadvertently knock eggs and nestlings from the nest, upon which they may fall from a cliff or be exposed to attacks by neighboring nesting pairs (Burger 1981). Disturbance may disrupt rates of foraging and feeding of nestlings or fledglings (Belanger and Bedard 1990; Goudie 2006). Unfamiliar atmospheric sound may deter birds from using preferred habitats and may alter migration routes, causing affected birds to expend greater energy (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). The various bird species that occupy the LAA will not likely be affected by helicopter activity due to its transitory nature and thus, its short-term presence at any one location, and because of mitigation measures in place (see below).

When PSVs are on location (e.g., loading or unloading 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 (Montevecchi et al. 1999; LGL 2017).

Discharge 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 reduced 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* and CWS guidelines discussed in Section 9.3.1.2. Adherence to established PSV routes and compliance with regulations and guidelines will avoid or reduce disturbance to nesting colonies. 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 leading to increased food availability, fish attraction to PSV lighting at slow vessel speeds (i.e., 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 in special areas.

The PSV route overlaps with three EBSAs (i.e., Northeast Slope EBSA, Eastern Avalon EBSA and Baccalieu Island EBSA) that have been identified in part due to the presence of marine mammals and sea turtles including various seal, whale and turtle species. Based on available information presented in Section 10.3.1.3, with the implementation of mitigation measures, 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 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 and from the Project Area, PSVs will reduce speed to a maximum of 13 km/hour (7 knots) when marine mammals or sea turtles are observed or reported within 400 m of a PSV, except if not feasible for safety reasons. Vessel crew will keep watch for marine mammals

and sea turtles and reduce speed and/or alter course if practicable to avoid a collision. Overall, the risk of marine mammals and sea turtles incurring injury or mortality is considered quite low. The effects assessments of the biological VCs determined it is unlikely that there would be no significant residual adverse environmental effects resulting from supply and servicing activities. Residual environmental effects associated with supply and servicing operations on a change in habitat quality for special areas are predicted to be adverse, low in magnitude, within the LAA, short-term duration for special areas with marine and migratory birds, medium-term duration for special areas with fish species, short-term to medium-term duration for special areas with marine mammals and sea turtles, occurring on an irregular basis, and reversible once supply and servicing operations have finished.

11.3.2 Summary of Project Residual Environmental Effects

Table 11.6 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 Northeast Newfoundland Slope Closure marine refuge, SiBAs, VMEs, Northeast Shelf and Slope EBSA, and the Slopes of the Flemish Cap and Grand Bank EBSA as well as Eastern Avalon and Baccalieu Island EBSAs, Witless Bay Ecological Reserve, and Quidi Vidi Lake and Witless Bay Islands IBA. With the implementation of applicable mitigation measures described in Section 11.3.1.2 (e.g., imagery-based seabed surveys), and adherence to industry standards for offshore oil and gas activities in NL, the residual adverse environmental effects are considered to be low in magnitude for most Project components and activities, primarily within the Project Area and sometimes also the LAA, short to long-term in duration, occurring irregularly, and reversible. Project activities will occur within undisturbed and disturbed ecological and socio-economic settings. Various special areas that overlap with the Project Area (e.g., Northeast Newfoundland Slope Closure and SiBAs) have been protected or identified due to damage from activities such as bottom contact fishing. In addition, other activities such as research trawling and general marine traffic contribute to disturbances in special areas in offshore and coastal areas.

The residual environmental effects of a change in habitat quality within special areas are considered reversible because although the recovery rate of corals is slow, the benthic ecosystems are expected to recover. Drill cuttings sedimentation for this Project is estimated to be relatively low (up to a maximum of 580 m and to cover an area less than 0.12 km² at either EL). This low sedimentation, combined with mitigation to reduce potential effects on corals/sponges, indicates that effects will not likely result in permanent habitat loss. This is supported by the environmental effects monitoring (EEM) programs conducted in the Newfoundland offshore area (Hibernia Management Development Corporation (HMDC) 2017; Husky Energy 2019). Biological recovery (biodegradation by the microbial community) is typically complete in a matter of a few years.

Table 11.6 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-LAA	ST-MT	IR	R	D
VSP	A	L	PA-LAA	ST-MT	IR	R	D
Discharges	A	L-M	PA	MT-LT	IR	R	D
Well Testing and Flaring	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Well Decommissioning and Abandonment or Suspension	N-A	L	PA	ST	IR	R	D
Supply and Servicing Operations	A	L	LAA	ST-MT	IR	R	D

KEY:
See Table 11.4 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

11.4 DETERMINATION OF SIGNIFICANCE

With mitigation and environmental protection measures in place and implemented, residual environmental effects on special areas are predicted to be not significant.

11.5 PREDICTION CONFIDENCE

The prediction of significance has been determined with a moderate level of confidence based on analysis of scientific literature and the results of EEM programs for existing offshore oil and gas activities in offshore NL within the RAA (although generally in shallower water that that of the Project Area), and Project-specific modelling. Some uncertainty exists 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 species and habitat, within the RAA. The use of a pre-drill imagery-based seabed survey will help to identify

coral and sponge colonies (in special areas) that may exist within a 600 m radius of the proposed site for each well.

11.6 ENVIRONMENTAL MONITORING AND FOLLOW-UP

As noted in Section 11.3.2, BHP will conduct an imagery-based seabed survey at the proposed well site(s) to confirm the presence or absence of sensitive environmental features, such as habitat-forming benthic species, or SAR, prior to drilling. If environmental sensitivities are identified during the survey, BHP will notify the C-NLOPB immediately to discuss an appropriate course of action. This may involve further investigation and/or moving the well site if it is feasible to do so. This survey will also serve to provide existing conditions data for coral and sensitive benthic habitat that may be present and be used to inform discussions on a post-drilling visual survey of the seafloor to assess the visual extent of sediment and drill cuttings dispersion. BHP plans to conduct a post-drilling visual survey of the seafloor using a remotely operated vehicle (ROV) after drilling activities to assess the visual extent of sediment dispersion and validate the modelling for the discharges of drill mud and cuttings. Beyond the predrill and post-drill well site surveys to be conducted, EEM for recovery rates of infaunal organisms is typically not required for exploration drilling programs. 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.

11.7 REFERENCES

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12.0 ASSESSMENT OF POTENTIAL EFFECTS ON COMMERCIAL FISHERIES AND OTHER OCEAN USES

As the principal domestic economic activity within the Regional Assessment Area (RAA) (other than petroleum production), commercial fisheries are considered as a Valued Component (VC) for this assessment. They are also important socially and culturally to residents of the region. Fisheries in the RAA beyond the Canadian Exclusive Economic Zone (EEZ) are also important for harvesters from other nations. Other ocean uses in the RAA – such as biological, geophysical and oceanographic research, commercial and recreational shipping, other petroleum exploration and production activities, subsea communications, and military operations – are also valued for commercial, cultural, and strategic reasons.

As described in Section 7.2, many commercial fish species are harvested from RAA waters throughout the year, primarily by Canadian vessels within Canada's EEZ, and by both Canadian and non-Canadian vessels outside of the EEZ. Canadian fisheries include fishing pursued under communal commercial licences issued by Fisheries and Oceans Canada (DFO) to Indigenous groups in Atlantic Canada. Fisheries under such licences are conducted with the other commercial fisheries; thus, potential effects on communal commercial harvesting are assessed in this chapter. Potential effects on other Indigenous fisheries and Indigenous marine uses are assessed in Chapter 13.

The RAA fisheries include a variety of groundfish species such as redfish, Greenland halibut and Atlantic cod in directed and/or by-catch fisheries. They are harvested with fixed gear (e.g., gillnets) and mobile gear (e.g., otter trawls). Other important fisheries include shellfish, particularly snow crab (fixed gear pots) over much of the Grand Banks, and shrimp (mobile trawls) in northerly parts of the RAA. Harvesting large pelagic species, such as sharks and swordfish, and small pelagics, such as capelin and mackerel also occurs in some parts of the RAA.

Within the Local Assessment Area (LAA) and the Project Area, the geographic extent and type of fisheries are more limited, partially because of water depths and partly because of the presence of the Northeast Newfoundland Slope Closure (Section 6.1.7.1 and Section 7.2.3.2), which overlaps much of the Project Area and all parts of Exploration Licences (ELs) 1157 and EL 1158 that fall within the Canadian EEZ. The terms of this closure prohibit the use of bottom-contact gear, the principal type historically employed within LAA and Project Area waters. Consequently, very little harvesting is expected to occur within either the Project Area or LAA, except for a band of activity (primarily for groundfish) in the southernmost parts (Figures 7-8 and 7-18). Both domestic and foreign fishing patterns, combined with the closure restrictions, indicate that little harvesting is likely to occur within the BHP ELs during the temporal scope of this Environmental Impact Statement (EIS).

Fisheries are typically more active along the potential Project support vessel (PSV) routes between the Avalon Peninsula and the Project Area (Section 7.2.3.1). Vessels may transit through areas where domestic groundfish, snow crab and small pelagic fisheries take place, including both mobile and fixed gear harvesting. Lobster is harvest in some areas near shore, including within Conception Bay.

In areas where Project activities overlap with commercial harvesting, there is a potential for interactions because of temporary displacement, interference and/or reduced efficiency, or physical interactions. Effects on harvesting success may also result indirectly from behavioural or biological effects on commercial species or their habitat, including effects on prey species. These types of effects on fish and fish habitat are considered and assessed in Chapter 8 so are not repeated in detail in this VC assessment.

Other ocean uses and infrastructure are also common through much of the RAA, though less activity has been known to occur in the LAA, Project Area or ELs (Section 7.3). Potential effects pathways for other uses are similar to those for commercial fisheries (physical interactions, interference and/or displacement from marine areas within their preferred or "baseline" operating environment).

12.1 SCOPE OF ASSESSMENT

12.1.1 Regulatory and Policy Setting

As described in Section 7.2.1, commercial fisheries within the RAA are managed by two principal authorities. Canada's DFO has management and regulatory responsibility for stocks and fishing activity within much of the country's EEZ, and for sedentary species on the larger Canadian continental shelf. The Northwest Atlantic Fisheries Organization (NAFO) manages several species (straddling stocks) within Canada's EEZ and other stocks in the NAFO Regulatory Area (NRA). The International Commission for the Conservation of Atlantic Tunas (ICCAT) manages some large pelagic species fisheries that overlap the RAA.

Both DFO (through the *Oceans Act* 1996) and NAFO (through international Convention, NAFO 2017) have authority to designate and manage parts of their marine areas for conservation purposes, including prohibiting or limiting certain fishing activities. As described above and in Section 7.2, the Northeast Newfoundland Slope Closure overlaps an extensive portion of the LAA and the Project Area, and much of the BHP ELs. This area is closed to bottom fishing activity under DFO's authority. Within the RAA, some other areas have similar fisheries restrictions, established under Canadian authority (within the EEZ) or through NAFO (outside the EEZ); see Section 6.4 (Special Areas) for details.

Canada's *Fisheries Act* (1985) is managed through DFO and is concerned with protecting fish and fish habitat from harm, preserving biodiversity and ensuring sustainable exploitation, among other matters. The *Newfoundland and Labrador Fishery Regulations* (1978) and the *Atlantic Fishery Regulations* (1985), focus on the management and allocation of domestic fishery resources of the region. These regulations provide for commercial fish harvester licencing, who may hold licences, vessel registration, gear requirements, open and closed seasons, restricted areas, and other conservation and management measures (see Section 7.2). For fisheries under NAFO management, NAFO has authority under its Convention to set Canadian and foreign Total Allowable Catches (TACs) and allocate quotas for species to help manage and conserve commercial species. DFO and NAFO also manage fisheries research in the RAA through their respective authorities.

Other Canadian legislation, regulations, and guidance documents related specifically to petroleum exploration and development are also relevant to commercial fisheries and have been considered for this assessment of routine Project activities. These include, among others, the Geophysical, Geological,

Environmental and Geotechnical Programs Guidelines (C-NLOPB 2019), the *Newfoundland Offshore Petroleum Drilling and Production Regulations* (2009), the Offshore Waste Treatment Guidelines (OWTG) (NEB et al. 2010), and guidance documents prepared through One Ocean (e.g., One Ocean n.d.).

Relevant legislation and guidance for other ocean uses include both Canadian and international instruments, such as the Canada Shipping Act (2001) and associated regulations, the International Maritime Organization's International Convention for the Prevention of Pollution from Ships (MARPOL) (IMO 1973), the International Convention for the Safety of Life at Sea (SOLAS) (IMO 1974), and the United Nations Convention on the Law of the Sea (UNCLOS; UNCLOS 1982). For other marine petroleum-related operations within the RAA, many of the same authorities apply as for the current Project. Department of National Defence (DND) provides guidance for the identification of and response to unexploded ordinance (UXO).

12.1.2 The Influence of Consultation and Engagement on the Assessment

During BHP's Project-related engagement with government departments and agencies, stakeholder organizations and Indigenous groups questions and comments about commercial fisheries and other ocean users were documented (see Chapter 3 for further details). Concerns noted were primarily related to the importance of communication with the fishers and other ocean users and the potential affects from an accidental event. Fishers noted that communication was important, including information regarding Project schedule and area of Project-related activities. Concerns were raised regarding potential effects from spills and tainted products.

12.1.3 Potential Effects, Pathways and Measurable Parameters

Planned activities associated with the Project have a potential to interact with commercial fisheries either directly through effects on fishing activity itself (e.g., through temporary displacement from preferred fishing grounds, interference and reduced efficiency, or physical interactions, such as fishing gear damage), and/or indirectly from physical or behavioural effects on fish species (e.g., changes in commercial fish or prey health or quality, fish avoiding areas because of underwater sound, or changes in water quality). These effects have potential to result in reduced harvesting success and/or increased operating expenses, resulting in economic loss. These interactions might also affect fisheries research, most of which involves fishing with commercial or modified gear. Project activities and installations have a potential to restrict access to marine areas, and/or require route or timing modifications by other marine operators, including freighters, military operations, cruise liners, or other petroleum exploration ships.

As a result of these considerations, the assessment of Project-related effects on commercial fisheries and other ocean uses is focused on the following potential effect: a change in the availability of resources or in access to preferred or usual operating environments.

Biological and behavioural effects on fish species, including those of commercial importance, are described and assessed for fish and fish habitat in the VC assessment for marine fish and fish habitat (Chapter 8). These are not repeated in the following sections, but relevant interactions for commercial fisheries are cross-referenced to that Chapter.

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 and cumulative effects are assessed separately in Section 15.6.6 and Section 14.6.

Table 12.1 Potential Effects, Effects Pathways and Measurable Parameters for Commercial Fisheries and Other Ocean Uses

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Availability of Resources or Operating Environment	• Interactions between the extent, duration, or timing of Project activities that result in direct or indirect loss or reduction in the availability of resources • Location of Project activities that prevents access to or through marine areas, or that interact with existing artifacts or infrastructure in those areas	• Change in access to area used for commercial fisheries and other ocean activities (km²) • Change in catch rates (t) • Change in quality of research (e.g., the validity of study results) (confidence levels; extraneous variables) • Damage to or loss of gear and/or equipment ($) • Delays in schedule for commercial fishing and other ocean activities / increased expenses owing to diverting around Project activities, or travelling farther to alternative fishing grounds (time / distance / $) • Physical damage to marine artifacts/infrastructure, or rendering inaccessible

12.1.4 Boundaries

Spatial and temporal boundaries for the assessment of commercial fisheries and other ocean uses are discussed in the following sections. Figure 12-1 illustrates these spatial boundaries.

12.1.4.1 Spatial Boundaries

Project Area: The Project Area encompasses the immediate area in which Project drilling and related activities may occur. Well locations have not been identified but will be within ELs 1157 and 1158 (Figure 12-1). The Project Area includes these two ELs and an additional minimum 20 km buffer around both, for a total area of 15,775 km².

LAA: The LAA 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. As described in Section 7.2.1.3, NAFO Unit Area 3Le (25,700 km²) is used to define the LAA for the Commercial Fisheries and Other Ocean Uses VC. Potential PSV routes between the Island of Newfoundland and the Project Area (Figure 12-1) are also considered with the LAA for this assessment.

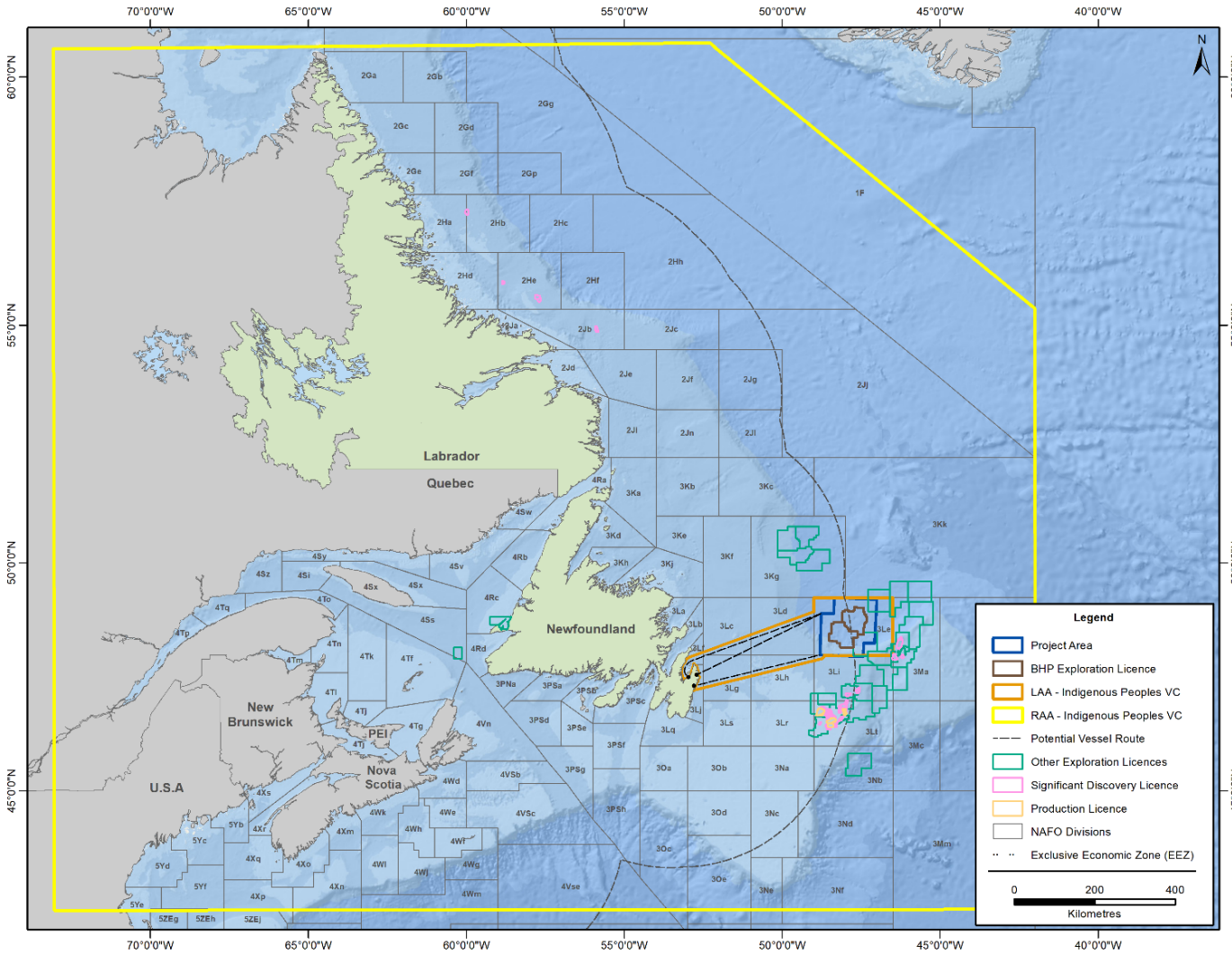

Figure 12-1 RAA, Project Area and Commercial Fisheries and Other Ocean Uses LAA

RAA: The RAA is an area (1,672,180 km²) within which residual environmental effects from operational activities and from accidental events may interact with commercial fishing and other human uses (including artifacts and infrastructure) of the marine environment. The RAA also accounts for residual environmental effects that could interact cumulatively with the residual environmental effects of other past, present, and reasonably foreseeable future physical activities, The RAA encompasses NAFO Divisions 3K and 3L, parts of Divisions 1F, 2H, 2J, 3M, 3N, 3O, and parts of Sub-Divisions 3PS and 4VS. Table 7.1 provides the composition of the RAA at the Unit Area level and explains how the DFO and NAFO commercial fisheries datasets are used for RAA fisheries description and analysis in this EIS.

12.1.4.2 Temporal Boundaries

The temporal boundaries for the assessment of potential Project-related environmental effects on commercial fisheries and other ocean uses encompass all Project phases, including well drilling, testing, and abandonment. BHP is currently planning up to 20 wells proposed from 2021 to 2028. 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 35 to 115 days to drill. Vertical Seismic Profiling (VSP) surveys typically take approximately one to two days with sound source firing often limited to just a few hours. Drilling operations will not be continuous throughout the entire nine-year temporal scope of the Project and will depend partially on various factors including weather, MODU availability and results from previous wells. While drilling activities have the potential to be conducted at any time of the year, BHP's preference is to conduct drilling in ice-free months.

12.1.5 Residual Effects Characterization

Table 12.2 defines the terms used to characterize the potential residual environmental effects resulting from routine Project activities on the Commercial Fisheries and Other Ocean Uses VC. These characterizations are also applicable for accidental events, discussed in Section 15.6.6.

Table 12.2 Characterization of Residual Effects on Commercial Fisheries and Other Ocean Uses

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual environmental effect relative to existing conditions	**Positive** – a residual environmental effect that moves measurable parameters in a direction beneficial to Commercial Fisheries and Other Ocean Uses relative to the existing environment **Adverse** – a residual environmental effect that moves measurable parameters in a direction detrimental to Commercial Fisheries and Other Ocean Uses relative to the existing environment **Neutral** – no net change in measurable parameters for Commercial Fisheries and Other Ocean Uses relative to the existing environment

Table 12.2 Characterization of Residual Effects on Commercial Fisheries and Other Ocean Uses

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions	**Negligible** – no measurable change **Low** – a detectable change that is within the range of natural variability, with no associated adverse effect on the overall nature, intensity, quality or value of the affected component or activity **Moderate** - a detectable change that is beyond the range of natural variability, but with no associated adverse effect on the overall nature, intensity, quality or value of the affected component or activity **High** - a detectable change that is beyond the range of natural variability, with an adverse effect on the overall nature, intensity, quality or value of the affected component or activity
Geographic Extent	The geographic area in which a residual environmental effect occurs	**Project Area –** 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 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 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 the duration of the activity, or for duration of accidental event **Medium term** - beyond the 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 the activity, or beyond the duration of threshold exceedance for accidental events – i.e., for years **Permanent** - recovery to existing 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 pre-Project 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 LAA, not adversely affected by human activity, or is likely able to assimilate the additional change **Disturbed** – The VC has been substantially previously disturbed by human development or human development is still present in the LAA, or the VC is likely not able to assimilate the additional change

12.1.6 Significance Definition

For this Project assessment, a significant adverse residual effect on commercial fisheries and other ocean uses 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 harvesting and/or in the net economic returns from commercial fishing because of a reduction in the quantity or quality of fish landings or increased operating expenses, for one or more fishing seasons
- An adverse change in other ocean uses such as marine research, shipping, military exercises, other petroleum exploration or production, or in-sea infrastructure or artifacts, including changes in the location and timing of these activities resulting in a measurable reduction in their quality, value or integrity over more than a year

12.2 PROJECT INTERACTIONS WITH COMMERCIAL FISHERIES AND OTHER OCEAN USES

Table 12.3 identifies, for each potential effect, the physical Project activities and or components that might interact with commercial fisheries and other ocean uses (indicated by a check mark) and that might result in the indicated effect. These interactions are discussed in detail in Section 12.3, in the context of effects pathways, planned mitigation measures, and residual effects. A justification for no effect (indicated by a dash) is provided following the table.

Table 12.3 Project-Environment Interactions with Commercial Fisheries and Other Ocean Uses

Physical Activities	Environmental Effects
	Change in Availability of Resources or Operating Environment
Presence and operation of a MODU (including drilling, associated safety zone, lights, and sound)	✓
VSP	✓
Discharges (e.g., drill muds / cuttings, liquid discharges)	✓
Well Testing and Flaring (including air emissions)	–
Well Decommissioning and Abandonment or Suspension	✓
Supply and Servicing Operations (including helicopter transportation and PSV operations)	✓
Notes: ✓ = Potential interaction – = No interaction	

Well evaluation and testing has not been included as having a potential interaction with commercial fishing activities or other ocean uses since flaring and air emissions take place above the Mobile Offshore Drilling Unit (MODU) and not in the marine environment. Effects of flaring and air emissions on fish species is

considered in Section 8.2, which concludes that this activity is not predicted to interact with marine fish or fish habitat and cause mortality or injury, or a change in habitat quality. As a result, there is no interaction predicted that could result in an effect on this VC.

12.3 ASSESSMENT OF RESIDUAL ENVIRONMENTAL EFFECTS ON COMMERCIAL FISHERIES AND OTHER OCEAN USES

This section assesses the potential environmental effects on commercial fisheries and other ocean uses resulting from planned Project activities, based on the possible interactions identified in Table 12.3. The assessment has benefited from comments received during the consultations and engagement processes for this EIS, relevant learnings from previous EIS, and Environmental Assessment (EA) documents for petroleum projects in Atlantic Canada, including comments and advice received during their review processes.

12.3.1 Change in Availability of Resources or Operating Environment

Potential effect on components of the Commercial Fisheries and Other Ocean Uses VC might result from temporary displacement from preferred fishing grounds or PSV traffic routes, interference and reduced efficiency of operations or transits, physical interactions (e.g., damage to fishing gear), or interactions with in-situ submarine infrastructure or artifacts.

12.3.1.1 Project Pathways

Commercial fishing activities (domestic and foreign) include travel to and from fishing grounds, deploying, baiting (in some cases), retrieving / hauling fixed or mobile gear, and locating targeted species on fishing grounds in economical quantities. Timely transits may also be essential for preserving the quality of the catch and/or reducing operating expenses. Fisheries research typically involves similar fishing methods and components. Other marine shipping (e.g., cargo and passenger) may route through areas of planned Project activities; other petroleum industry exploration activities (e.g., seismic surveys) may occur in or near the Project Area and potential PSV traffic routes; and military exercises may overlap work areas. Artifacts and infrastructure (documented and undocumented) may be in areas of planned Project activity.

Project interactions that might interfere with or prevent the normal operations of commercial fishing or other ocean activities include the closure of areas to fishing or to harvester and other vessel transit routes; damage to fishing gear or other equipment; reduced catch; and skewed fisheries science results. Physical contact with existing marine infrastructure or artifacts might damage them.

The following Project-related activities might result in a change in the availability of VC resources or preferred operating areas. Adverse effects on marine fish, including commercial species, are discussed in Chapter 8 (Marine Fish and Fish Habitat VC).

- Presence and operation of a MODU – The establishment of a safety (exclusion) zone around each MODU will prevent fish harvesting and vessel transits within the zone during operations and while Project equipment is in place (although, as described above and in Section 7.2.3.2 and discussed below, all but a very small part of the two ELs are currently closed to bottom fishing gear). Existing subsea artifacts or infrastructure might be damaged by drilling or other physical activities. Sound might scare fish from the area
- VSP operations – The activities will occur within or near the safety zones but underwater sound might alter fish distribution
- Project-related discharges – Potential change in fish distribution or quality / marketability
- Well decommissioning and abandonment or suspension – Continued exclusion of other activities while abandonment activities take place within the safety zone; sound changing fish distribution; permanent risk to bottom fishing gear if protruding infrastructure is left on the seabed and if in an area where bottom fishing might occur
- Supply and servicing operations – Increased vessel traffic and sound interacting with other marine operations; potential for damage to fixed fishing gear

12.3.1.2 Mitigation

Section 2.9.4 (Table 2.28) lists the general mitigation measures that will be implemented for the Project to reduce or eliminate adverse environmental effects. The following indicates those measures that will be applied to mitigate potential effects on commercial fisheries and other ocean uses more specifically. These measures, working collectively, should reduce the potential negative effects from the Project on the availability of commercial fisheries and other marine use resources and areas to levels that do not result in significant effects. Mitigation measures identified in the assessment on marine fish and fish habitat (Section 8.3.1.2) will also be implemented to reduce the potential for interaction with fish and their habitat.

- In accordance with the *Newfoundland Offshore Petroleum Drilling and Production Regulations*, a safety (exclusion) zone (estimated to be a 500-m radius) will be established around the MODU within which non-Project related vessels are prohibited.

- BHP will require the Drilling Contractor to provide details of the safety zone to the Marine Communication and Traffic Services for broadcasting and publishing in the Navigational Warning (NAVWARN) and Notices to Mariners (NOTMAR) systems.

- BHP will continue to engage commercial fisheries groups and relevant enterprises to share Project details and fisheries information, and to determine the need for a fisheries liaison officer (FLO) during mobilization and demobilization of the MODU, with reference to the One Ocean Risk Management Matrix Guidelines (One Ocean n.d.). A Fisheries Communication Plan will be used to facilitate coordinated communication with fishers, including details about planned activities and the safety (exclusion) zone.

- BHP will maintain ongoing communications with the Northwest Atlantic Fisheries Organization (NAFO) Secretariat, through DFO as the Canadian representative, regarding planned Project activities, including timely communication of drilling locations, safety zone, and decommissioned well sites.
- BHP will contact DFO about timing and locations of planned DFO research surveys.
- BHP will contact and inform the Department of National Defence (DND) of planned marine Project Activities and identify a specific individual or office to serve as a Point of Contact for Maritime Forces Atlantic (MARLANT) queries and concerns.
- Project-related damage to fishing gear will be compensated in accordance with industry best practices in the NL offshore and relevant industry guidance material such as the Geophysical, Geological, Environmental, and Geotechnical Program Guidelines (C-NLOPB 2019), the Canadian East Coast Offshore Operators Non-attributable Fisheries Damage Compensation Program (CAPP 2007), and the Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activities (C-NLOPB and CNSOPB 2017) which apply when gear loss or damage occurs because of a spill or authorized discharge, emission or escape of petroleum.
- PSVs will follow established shipping routes where they exist (i.e., in proximity to shore).
- To maintain navigational safety 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.
- If other petroleum exploration activities (e.g., another operator's seismic survey) are planned within the Project Area, or associated vessels are required to pass through the Project Area, communication protocols will be maintained with operators.
- A PSV will remain on standby at the MODU at all times in the event that operational assistance or emergency response support is required. PSVs performing standby duties will have a Canadian Standby Certificate.
- Prior to drilling activity, BHP will conduct a comprehensive well-site specific geohazard review using high-quality reprocessed 3D seismic data for the geohazards assessment.
- BHP will conduct a visual seabed survey in the vicinity of wells sites confirming the absence of shipwrecks, debris on the seafloor, unexploded ordnance and sensitive environmental features, such as habitat-forming corals or species at risk (SAR) to be used in conjunction with the geohazard assessment based on existing data. The survey will be developed in consultation with the C-NLOPB and DFO and will be carried out prior to drilling under a separate environmental approval by the C-NLOPB. If substantial environmental or anthropogenic sensitivities are identified during the survey, BHP will move the well site to avoid affecting them if it is feasible to do so. If it is not feasible, BHP will consult with the C-NLOPB and DFO to determine an appropriate course of action.
- BHP plans to conduct a post-drilling visual survey of the seafloor using a remotely operated vehicle (ROV) after drilling activities to assess the visual extent of sediment dispersion and validate the modelling for the discharges of drill mud and cuttings.

- Once wells have been drilled to True Vertical Depth (TVD) and well evaluation programs completed (if applicable), the well will be plugged and abandoned in line with applicable BHP practices and C-NLOPB requirements. The final well abandonment program has not yet been finalized; however, these details will be confirmed to the C-NLOPB as planning for the Project continues.

12.3.1.3 Characterization of Residual Project-related Environmental Effects

Presence and Operation of a MODU

During the nine years of the Project's temporal scope, up to 20 exploration or appraisal wells may be drilled at various locations within the two BHP ELs (up to ten per EL). At times, up to two MODUs may be working simultaneously at different locations. It is estimated that each well could take 35 to 115 days to complete, potentially at any time of the year, but more likely during spring to autumn. Within the timeframe, drilling will occur that involves physical interactions with the benthic environment and the production of sound in the water from the drilling equipment and the dynamic positioning system of the MODU. The MODU will have sufficient lighting above the water to provide for the safety of personnel and alert other marine traffic. Other activities associated with the operation of the drilling units and well site decommissioning and abandonment or suspension are considered below.

From the time a MODU arrives on location at a well site, a minimum 500-m radius safety zone will be established from the outer perimeter of the MODU before drilling starts and throughout the operation of the MODU. While a safety zone is in place (approximately 1 km² per drill site), entry to the zone by non-Project vessels will not be permitted, and no fishing gear may be used there for the safety of all parties, though at present only a very small part of either EL allows bottom gear due to water depth, as described in Section 7.2.3.2 and discussed below. This could result in an overall simultaneous exclusion area of approximately 2 km² if two drill sites are active at the same time. This would represent approximately 0.013% of the Project Area and 0.008% of the LAA. As described in Section 12.3.1.2, details of the locations and extent of safety zones will be communicated to the fishing industry and other maritime users via NAVWARNs, NOTMARs, the Fisheries Communication Plan and other means.

As detailed in Section 7.2.3.2 and illustrated in Figure 7-8, the domestic fishing grounds that might be affected by safety exclusion zones would be small, based on the available record of past harvesting within the ELs. Also, the Northeast Newfoundland Slope fisheries closure area includes the majority of the joint EL area. The depths of the EL waters east of the closure, beyond the EEZ (most greater than 2,000 m), also limit the potential for harvesting in those areas. For international fisheries, as described in Section 7.2.4, the NAFO fisheries Footprint overlaps approximately 34 km² of EL 1158, which is approximately 0.028% of that full bottom fishing area. If two wells were drilled within that 34 km² area at the same time, approximately 0.00017% of the Footprint would be excluded during the period of operations.

Harvesting that might occur within the closure area or most of the deep waters beyond the EEZ would be limited to non-bottom-contact gear, such as mid-water trawls, pelagic longlines or seines, but there is very little history of such fisheries in or near either EL. Given the availability of other upper-water grounds nearby, this would not be expected to affect the fishing success of any enterprise during the period of operations.

As described in Section 7.3.1, fisheries science studies are not expected to be planned within the ELs, and therefore should not be affected by the presence of safety exclusion zones, though plans for and locations

of drilling operations will be communicated to DFO, NAFO, and other relevant involved parties. No active communications cables transit potential drilling locations (Section 7.3.7), and there are no other known artifacts or infrastructure within the ELs. In all cases, potential drilling locations will be investigated through the GBR and other site surveys before drilling occurs. Other shipping (include non-Project petroleum exploration) that might have intended to traverse an active safety zone would require a minor course deviation, and would not impeded overall operations, particularly with a communications plan in place.

Although the establishment of safety zones will restrict other marine operations to the extent described, it will also function to eliminate the potential for fishing gear conflict in the area of drilling activity, as well as protecting the mutual safety of the MODU and other shipping. Consequently, the potential for such at-sea interactions would be confined to VSP surveys if they extended beyond a safety zone (Section 12.3.1.3), supply and servicing movements between a safety zone and port (Section 12.3.1.3) or during transits of the MODU to and from a drill site.

Planned movements of the MODU(s) will be communicated through the Fisheries Communications Plan and NAVWARNs, and a PSV will attend the MODU during transits. Fisheries gear damage compensation will be available should an interaction occur. As described in Section 12.3.1.2, BHP will also consider the need for a FLO during movements with reference to the One Ocean Risk Management Matrix Guidelines.

As discussed in Section 8.3.2.3, lighting from the MODU might attract some fish species, but such an effect would be minor, localized and temporary and not to an extent that would detract from the success of commercial harvesting in other areas. The sound produced by the operating of drilling equipment and a dynamic positioning system has a potential to scare fish from the area during operations (Section 8.3.2.3), though not to cause mortality (Section 8.3.2.3). However, the extent of fish displacement caused by noise (at much lower levels than seismic survey arrays, for instance, and producing primarily continuous rather than impulsive sounds) would be low in magnitude and short term (Section 8.3.4). JASCO's study of sound that might be generated under the three drilling scenarios modeled predicted Sound Pressure Levels (SPLs) of less than 150 dB re 1 µPa within 350 m or less of the source (i.e., well within a 500-m safety zone, Alavizadeh and Deveau 2019, Tables 8, 9 and 10).

Given these operational considerations, and with the noted mitigation measures in place, it is unlikely that marine resources or access to marine areas will be changed in a manner that would then result in effects on the overall availability, quality or accessibility of a marine resource for commercial fishers or other ocean uses as a result of the presence and operation of a MODU.

Residual effects associated with the presence and operation of a MODU are therefore predicted to be adverse, low in magnitude, to occur within the Project Area, to be short-term in duration, to occur irregularly, and to be reversible once drilling operations cease.

Vertical Seismic Profiling

VSP surveys are typically conducted after drilling operations to verify borehole data. They are conducted using the types of sound sources (compressed air arrays) used in 2D or 3D seismic surveys, except that the VSP arrays are usually smaller (450 in^3 to 2,400 in^3) and there is no towed streamer since the geophone receivers are placed in the borehole. The surveys usually last one to two days with sound source firing often limited to just a few hours. For some surveys, the sound source is placed above the borehole and all

activation occurs within the safety zone. Others ("walk-away" VSPs) tow the sound source a short distance from the drill site, potentially extending outside the safety zone. No other seismic surveys are planned as part of this Project.

As discussed in Section 8.3.2.3, underwater sound from a VSP array is not expected to cause physical injury to commercial species but could cause some fish species to avoid the area of disturbance within and near the safety zone (Section 8.3.2.3). The actual distance that this effect could occur depends on the sound energy produced, the duration of the sound and how it spreads, and the sensitivity of the fish species in the area. Given the very low levels of commercial harvesting within most of the Project Area, the localized nature of VSP surveys, the short duration of the surveys, and the relatively low sound levels expected at distance for the representative array and modeled sites and scenarios for this Project (predicted SPL less than 180 dB re 1 µPa near the outer perimeter of a safety zone, Alavizadeh and Deveau 2019, Appendix E), VSP surveys are not expected to have a measurable effect on catch rates and therefore on commercial fishing success

Similarly, VSP surveys would not be expected to affect fisheries science research results considering known study locations (i.e., outside the BHP ELs). Plans for and locations of VSP surveys will be communicated to DFO and NAFO to allow for coordination if required, and to other stakeholders through BHP's Fisheries Communication Plan and NAVWARNs as a caution to other marine operators. SIMOPS plans will be instituted if needed for an overlapping geophysical survey by another operator.

Since VSP surveys do not tow hydrophone streamers (the main potential for interaction with fishing gear or with other marine activities), the likelihood of conflict or gear damage is low. However, a PSV will be available for walk-away surveys and fisheries gear damage compensation will be available if an interaction were to occur. BHP will also consider the need for a FLO during walk-away surveys with reference to the One Ocean Risk Management Matrix Guidelines.

Residual effects associated with the VSP surveys are therefore predicted to be adverse, low in magnitude, to occur within the Project Area, to be short-term in duration, to occur as multiple irregular events, and to be reversible once the survey operations cease.

Discharges

Discharge during operations may include drill muds and cuttings, organic matter such as grey or black water, bilge water, deck drainage, blowout preventer fluid, and cement. As discussed in Section 8.3.2.3, certain discharges have a potential to affect fish health and habitat in the surrounding area, and while they will not interact directly with fishing activities or other ocean operators, they could potentially affect the quality of commercial fish species.

The mitigation measures for discharges and related discussion in Section 8.3.2.3 describe how chemicals and fluids will be selected in accordance with relevant environmental guidelines (e.g., NEB et al 2009; see also Section 2.8.4), and how substances used or produced during MODU operations will be treated in accordance with MARPOL (IMO 1973) and the OWTG (NEB et al. 2010), as applicable. A study of operational discharges of muds and cuttings prepared for the Project by RPS indicates for all scenarios modelled that depositional thicknesses at or above 1.5 mm (a conservative predicted no-effect threshold

for benthic invertebrates) were predicted to be confined within 580 m or less of the drill sites, with a maximum affected area at that thickness of 0.12 km² (RPS 2019).

Marine discharges from PSVs will also be in accordance with MARPOL. Based on these measures, Section 8.3.2.3 concludes that routine discharges from MODUs and other vessels are not expected to result in significant adverse environmental effects on fish or fish habitat, and that effects are expected to be low in magnitude and localized within the Project Area.

This is supported by results from several environmental effects monitoring (EEM) programs conducted for previous offshore drilling and production programs which have concluded that effects on commercial species such as American plaice and snow crab were negligible (Buchanan et al. 2003; Hurley and Ellis 2004; DeBlois et al. 2014). Results from a 2014 White Rose EEM program concluded similarly that there was no significant chemical body burden differences in American plaice or crab tissue collected within the White Rose field study areas and from reference areas, and the results of taste panels demonstrated that the two species were not tainted (Husky Energy 2017).

With mitigation measures in place, the discharges occurring during the Project will not result in measurable changes in the availability commercial fish harvesting resources or affect fishing success, or prevent other ocean operators from access to additional parts of the Project Area or LAA. Residual effects are therefore predicted to be neutral to adverse, low in magnitude, to occur within the Project Area, to be short-term in duration, to occur irregularly, and to be reversible after Project completion.

Well Decommissioning and Abandonment or Suspension

After the completion of drilling operations, each well (up to 20 during the life of the Project) will be decommissioned, and either abandoned or suspended (if future re-entry of the borehole is anticipated). Decommissioning and abandonment includes placing multiple, permanent cement barriers in the well thus re-instating the cap rock. Well suspension activities include placing multiple barriers in the well. Suspended wells will eventually be permanently abandoned as described above.

Well decommissioning and suspension or abandonment for this Project will be carried out as per BHP's Well Integrity Standard, as well as applicable industry practice and in compliance with relevant regulatory requirements. During the decommissioning process, the safety exclusion zone will remain in place and the potential for interactions with fish harvesting and other marine uses (e.g., fishing gear) will be reduced in the areas where abandonment activities will occur. Noise produced during the work will be no greater than that during drilling and operation of the MODU, so effects from sound would be similar.

Although unlikely to occur due to the small area where bottom fishing is permitted within the Project Area, if a part of the wellhead is left in place above the profile of the surrounding seabed, it would have a potential to interact with bottom gear fishing and/or research equipment, possibly causing damage. The locations of remaining infrastructure (including wells while suspended) will be publicized through NAVWARNs and NOTMARs and charted through the Canadian Hydrographic Service as appropriate, so that the locations can be avoided by bottom fishing gear (if otherwise permitted in the area) and by other ocean uses that impinge on the seabed (e.g., placement of new subsea cables). The information will also be communicated through the Fisheries Communication Plan.

Given the low level of fishing activity within and near potential drill sites, unless circumstances change (such as rescinding the Closure area, or enlarging the NAFO Footprint bottom fishing area), it is unlikely that subsea infrastructure that might remain would conflict with harvesting, based on regulatory restrictions and past harvesting data. As indicated in Figures 7-8 and 7-18 and discussed above (Section 12.3.1.3: Presence and Operation of a MODU), the potential overlap of any part of an EL where drilling might occur with bottom-gear harvesting areas is limited to a 34 km² zone in NRA, in the southeasternmost portion of EL 1158. Pelagic / mid-water gear commercial harvesting, other shipping and other sea-surface activities would not be affected by remaining seabed components. As documented in Section 7.3.1, no fisheries science studies are typically planned within the ELs and therefore the ability to conduct research should not be affected by the presence of remaining subsea infrastructure. Consequently, it is unlikely that wellhead abandonment will result in an interaction with commercial fishing, or other marine activities in a way that would result in a substantial change to availability of or access to a resource.

Residual effects of well decommissioning and abandonment or suspension on the availability of commercial fishing resources or on other ocean uses are predicted to be adverse, low in magnitude, localized to well site locations within the Project Area, short term to permanent (if wellhead is left in place) in duration, irregular (once per well conclusion if removed) / continuous (if the wellhead cap remains above the bottom profile in an area of bottom gear fishing), reversible (if removed) / irreversible (if above the bottom profile in an area of bottom gear fishing).

Supply and Servicing Operations

Throughout the Project, from initial drill site preparation to the completion of decommissioning, a variety of supply, servicing and other PSVs will be used to carry personnel, equipment and materials to and from active parts of the Project Area. These activities will occur primarily at or near a MODU, inside its safety zone, and along the vessel traffic route that will be taken between port facilities and the work area. A dedicated stand-by vessel will also be stationed at each MODU location. It is estimated that during operation of a MODU there will be approximately two to three round-trip transits per week, with timing based on work schedules, crew rotations and other factors. If two simultaneous drilling operations occurred, there would likely be total of five round trips per week. The addition of this Project vessel traffic will represent a small increment over existing levels for periods of approximately two to three months per year when drilling activities occur.

Helicopters may also be used to transport personnel. Helicopter use will not interact with harvesting activities or other surface or submarine uses of the ocean.

Expected fisheries and fishing gear along and near the potential PSV traffic routes are described in Sections 7.2.3 and 7.2.6. PSVs have a potential to interact with commercial fishing activity and other ocean use in overlapping areas through direct interference with fishing gear or at sea interactions with other shipping or marine activities. Since Project vessels will have no deployed in-sea equipment, the risk of such conflicts is the same as for other vessels of similar size currently navigating offshore waters. The types and levels of noise, discharges, and emissions will also be similar to other shipping which is common throughout the region (Section 7.3.5).

Relevant mitigation measures for these activities include adherence to the pre-established vessel traffic routes to and from the Project Area and Els,PSVs will use of proper lighting, Automatic Identification System, radar and other navigation and safety resources as needed. Radio communication systems will be in place and in working order for real-time contacts with other ships. Applicable Canadian and international laws, regulations and conventions will be followed for safe navigation and to protect the environment, including the Canadian *Shipping Act* and *Collision Regulations*, SOLAS and MARPOL. If a Project ship causes damage to fishing gear, harvesters will be compensated through BHP's gear and vessel damage program.

Residual effects associated with supply and servicing on the availability of commercial fishing resources or on other marine activities are therefore predicted to be adverse, low in magnitude, to occur within the LAA, to be short-term in duration, and to occur irregularly. The effects will be reversible following Project completion.

12.3.2 Summary of Project Residual Environmental Effects

The environmental effects assessment and prediction of residual environmental effects resulting from interactions between the Project and commercial fisheries and other ocean uses are summarized in Table 12.4. Based on the interactions identified between Project activities and commercial fisheries and other ocean uses, the Project has a potential to result in adverse residual effects through a change in access to marine resources or areas, including submarine areas used for other activities. This includes potential effects on harvesting, marine research, other vessel traffic, military operations, and submarine infrastructure and artifacts. With the implementation of applicable mitigation measures described in Section 12.3.1.2 and discussed in Section 12.3.1.3, those described in Section 8.3.2.3 to mitigate effects on fish and fish habitat, and adherence to other industry standards and best practices for marine oil and gas activities in the NL offshore, the residual adverse environmental effects are considered to be low in magnitude, confined within the Project Area and/or LAA, short-term in duration (with the possible exception of well abandonment), occurring at regular or irregular intervals, reversible (with the possible exception of well abandonment), and occurring within a disturbed ecological and socio-economic setting (presence of some commercial fishing activity, marine research, other vessel operations and subsea infrastructure within the Project Area and LAA).

Table 12.4 Summary of Residual Environmental Effects on Commercial Fisheries and Other Ocean Uses

Residual Effect	Residual Environmental Effects Characterization						
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in Availability of Resources or Operating Environment							
Presence and Operation of a MODU	A	L	PA	ST	IR	R	D
VSP	A	L	PA	ST	IR	R	D
Discharges	N-A	L	PA	ST	IR	R	D
Well Testing and Flaring	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Well Decommissioning and Abandonment or Suspension	A	L	PA	ST-P	IR-C	R-I	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

Given the type and location of planned Project activities, the anticipated level of domestic and foreign commercial fishing and other marine operations within areas where Project activities may take place, and after the implementation of the mitigation measures described, residual effects from routine Project activities are not predicted to result in an adverse change in fishing activity, including overall timing and intensity. Project activities will not result in a measurable reduction in overall levels of commercial harvesting, and/or a loss of net economic returns because of a reduction in the quantity or quality of landings or increased operating expenses, for one or more fishing seasons. Similarly, residual effects are not predicted to result in an adverse change in other ocean uses, such as marine research, shipping, military exercises, other petroleum exploration or production, and in-sea infrastructure or artifacts, including changes in the location and timing of these activities resulting in a measurable reduction in their quality, value or integrity over more than a year. Residual environmental effects on the Commercial Fisheries and Other Ocean Uses VC are predicted to be not significant.

12.5 PREDICTION CONFIDENCE

This prediction of significance has been determined with a high level of confidence based on current knowledge and understanding of the existing environment, of interactions between VC components and similar marine projects, and analysis of the relevant literature, including previous EEM results for petroleum projects in the RAA.

12.6 ENVIRONMENTAL MONITORING AND FOLLOW-UP

The implementation of the Project's Fisheries Communication Plan will allow for ongoing feedback from fishing interests about the implementation and effectiveness of related mitigation measures, and about changes in fishing activities or science research relevant to the Project Area. Instances of suspected gear damage will be communicated to BHP and will be followed up through the operator gear compensation program as initiated by a claimant. Other follow-up communications described in the mitigation measures (e.g., contact with DFO, NAFO, DND) will be undertaken regularly, as will the issuance of NAVWARNs and NOTMARs. Depending on on-going Project activity, updates and reports on past activities, as required, will provide additional opportunities for consultation and evaluation of effects predictions.

Given the high level of confidence for the prediction of no significant adverse environmental effects on commercial fisheries and other ocean uses with the implementation of mitigation measures, no other follow-up or monitoring are proposed for routine Project activities.

12.7 REFERENCES

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13.0 ASSESSMENT OF POTENTIAL EFFECTS ON INDIGENOUS PEOPLES AND COMMUNITIES

As required by the Environmental Impact Statement (EIS) Guidelines, Indigenous peoples and communities is included as a Valued Component (VC) in recognition of the cultural, social, and economic importance of marine life and fishing to Indigenous peoples, and in consideration of potential impacts of project activities on asserted or established Aboriginal and treaty rights. This VC specifically considers how changes to the environment caused by the Project could affect: health and socio-economic conditions: physical and cultural heritage, including any structure, site or thing of historical, archaeological or paleontological importance; and current use of lands and resources for traditional purposes. This scope is consistent with the EIS Guidelines and section 5(1)(c) of the *Canadian Environmental Assessment Act*, *2012* (CEAA 2012).

The EIS Guidelines identified 41 Indigenous groups with the potential to be affected by Project activities and therefore to be included within the scope of the environmental assessment: five groups in Newfoundland and Labrador (NL), 13 groups in Nova Scotia (NS), 16 groups in New Brunswick (NB), two groups in Prince Edward Island (PEI), and five groups in Quebec (QC). Further information on these groups is provided in Section 7.4.

It is BHP's understanding that the lands and waters of eastern offshore NL where the Project components and activities will be located, are not within an area that the listed Indigenous groups have asserted or established Aboriginal or treaty rights protected by section 35 of the *Constitution Act, 1982* (section 35 rights). The Project is located approximately 450 km from the nearest Indigenous community, and there is no predicted Project interaction with any structure, site or thing of historical, archaeological or paleontological importance to Indigenous peoples. Therefore, this VC focuses on the potential effects of planned Project activities on health and socio-economic conditions, and, current use of lands and resources for traditional purposes. This includes direct effects on access to and availability of resources for commercial communal and food, social and ceremonial (FSC) harvesting activities and potential indirect effects on socio-economic conditions that may subsequently occur.

Of the 41 identified Indigenous groups, several hold commercial communal licenses for species in areas that overlap with the Project Area and/or Regional Assessment Area (RAA), although it is not known if fishing under these licences currently takes place within the Project Area. There are no documented FSC licences within the Project Area, however some species targeted in FSC fisheries in other parts of the RAA are anadromous and can potentially migrate through the Project Area. This includes American eel and Atlantic salmon, two migratory fish species harvested in proximity to Indigenous communities and highlighted during Indigenous engagement as being of specific concern due to potential interaction with Project activities.

This VC is closely linked to the commercial fisheries and other ocean uses VC (Chapter 12), 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).

13.1 SCOPE OF ASSESSMENT

13.1.1 Regulatory and Policy Setting

The Project Area is both within and beyond the 200 nautical mile Exclusive Economic Zone (EEZ) and therefore has two jurisdictions with regulatory authority related to marine fisheries. Within the EEZ, the Government of Canada (Fisheries and Oceans Canada [DFO]) has jurisdiction over commercial fishing activities, including sedentary species up to the extent of the defined continental shelf. This gives the Government of Canada the authority to set total allowable catches, quota, and licenses to fishing enterprises, including allocation of commercial communal licenses to Indigenous communities and enterprises. The Northwest Atlantic Fisheries Organization (NAFO) has primary jurisdiction over commercial fisheries for non-sedentary species beyond the EEZ and has the authority to designate protected areas. Within NAFO Subdivisions 3KLM, 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 Exploration Licences (ELs) 1157 and 1158. This area is closed to bottom fishing activity and is regulated under the *Fisheries Act.*

Indigenous fishing is managed by DFO, with the productivity of commercial, recreational, or Aboriginal (CRA) fisheries protected under the federal *Fisheries Act.* Section 35 of the *Constitution Act*, 1982 recognizes and affirms Aboriginal and Treaty rights, and the right to harvest for FSC purposes or to earn a moderate livelihood have been affirmed in various Supreme Court of Canada decisions. Various Indigenous groups identified in the EIS Guidelines have asserted or established section 35 rights. In 1992, the Aboriginal Fishing Strategy was introduced by DFO to provide a regulatory framework for fisheries management, recognizing Aboriginal and Treaty rights and placing priority on Aboriginal rights to fish for FSC purposes. In 2000, DFO implemented the Marshall Response Initiative (MRI) to provide increased Indigenous access to the commercial fishery through commercial communal licenses. The Atlantic Integrated Commercial Fisheries Initiative (AICFI) replaced the MRI in 2007 and provided the 34 Mi'kmaq and Wolastoqiyik First Nations affected by the Marshall decision with capacity building support for increased commercial communal fisheries and participation in fisheries co-management (DFO 2012a, 2012b, 2012c).

The following technical guidance documents have influenced the scoping and assessment of this VC:

- Technical Guidance for Assessing Physical and Cultural Heritage or any Structure, Site or Thing that is of Historical, Archeological, Paleontological or Architectural Significance (CEA Agency 2015a)
- Technical Guidance for Assessing the Current Use of Lands and Resources for Traditional Purposes (CEA Agency 2015b)
- Aboriginal Consultation and Accommodation – Updated Guidelines for Federal Officials to Fulfill the Duty to Consult (AANDC 2011)
- Draft Consultation and Accommodation Guidelines for Proponents (2015)
- Government of Newfoundland and Labrador's Aboriginal Consultation Policy on Land and Resource Development Decisions (Government of NL 2013)
- The Terms of Reference for a Mi'kmaq-Nova Scotia-Canada Consultation Process
- The Mi'kmaq-Prince Edward Island-Canada Consultation Agreement
- Interim Tripartite Agreement on Mi'gmaq Consultation and Accommodation (Gaspe)
- Mi'gmag Wolastoqiyik, New Brunswick: Canada Interim Consultation Protocol

13.1.2 Influence of Consultation and Engagement on the Assessment

BHP is aware of the potential for the Project to affect Indigenous interests and is committed to engaging with Indigenous organizations to inform them about the Project; to discuss potential issues and concerns; and any potential mitigation and other preventative measures, where appropriate. During BHP's Project-related engagement to date, questions, issues, and concerns related to Indigenous peoples and communities have been considered (see Chapter 3 for further details), as well as the concerns raised through recent past assessments of NL offshore oil and gas activities.

A key message expressed by Indigenous groups is 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) and that the footprint of fishing activities need not overlap with the Project for Indigenous communities to be affected. This extends to the potential direct and indirect effects on the health and well-being of Indigenous communities that may result from effects on commercial communal and/or FSC fishing activities, as well as aquatic species.

Concerns raised include the 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, American eel, Atlantic bluefin tuna, swordfish, as well as blue whale, North Atlantic right whale, and cold-water corals. Concerns have been expressed regarding potential impacts on migratory birds and their eggs, which are traditionally and currently harvested. There were also inquiries about compensation for both economic and cultural loss in instances where fishing activity is adversely affected as a direct result of the Project. Indigenous groups have also expressed concerns with respect to the cumulative effects of the oil and gas industry on the marine environment.

Additional details on issues and concerns raised during Indigenous engagement is provided in Chapter 3.

13.1.3 Potential Effects, Pathways and Measurable Parameters

The nearest Indigenous community is located on the Island of Newfoundland, approximately 450 km from the Project Area. Distances are even further for communities in Labrador, the Maritime provinces, and Quebec. Given these distances and the localized extent of routine Project activities, there are no pathways for effects from routine Project activities to changes in structures, sites or things of historical, archaeological, paleontological, or architectural significance. Note that none of these structures or sites have been identified within the Project Area or Local Assessment Area (LAA).

Given the distance from the Project to Indigenous communities and the limited geographic extent of routine Project emissions and discharges, planned Project activities are also not predicted to directly affect the physical or social health and wellbeing of Indigenous communities. It is acknowledged that indirect effects on health and socio-economic conditions may result from Project-related effects on migratory species of interest to Indigenous peoples, as well as commercial communal or FSC fishing, hunting, or other harvesting activities.

Similar to commercial fisheries (Chapter 12), potential pathways of effects as a result of the Project on commercial communal fisheries include direct or indirect effects on fished species and/or effects on fishing activity from displacement from fishing areas, gear loss or damage, and/or availability of fisheries resources.

To date, no Indigenous community has indicated that they actively fish in the Project Area or LAA, although this does not preclude future activities. The location of the Project Area lowers the likelihood / extent of future activities, as little commercial fishing occurs within either the Project Area or LAA, except for an area of activity (primarily for groundfish) in the southernmost parts.

FSC fishing and/or harvesting activities do not occur in the Project Area or LAA; however, routine Project activities could interact with fish, bird or mammal species that migrate through the Project area and are subsequently harvested or have the potential to be harvested by Indigenous groups from onshore / nearshore harvesting sites.

Based on these considerations, the following potential effects are the focus of the assessment of Project-related effects on Indigenous peoples and communities:

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

Adverse effects on commercial communal harvesting activities could 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. Table 13.1 outlines the measurable parameters used for the assessment of the environmental effects presented above, and the rationale for their selection. Effects of accidental events are assessed separately in Section 15.6.6.

Table 13.1 Potential Effects, Effects Pathways and Measurable Parameters for Indigenous Peoples and Communities

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 resources arising from Project activities	• Change in availability of harvested species (i.e., through mortality or change in migration patterns of culturally significant species) (qualitative) • Change in fishing, hunting, gathering and/or trapping activities (qualitative) • Loss or change in cultural or spiritual practices (qualitative)

13.1.4 Boundaries

Spatial and temporal boundaries for the assessment for Indigenous peoples and communities are described in the sections below.

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 Exploration Licences (ELs) in the Project Area. The Project Area includes EL 1157 and EL 1158 with a buffer of approximately 20 km.

Local Assessment Area (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.

Regional Assessment Area (RAA): The RAA (Figure 13-1) 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 spatial distribution and overall geographic extent of the Indigenous groups under consideration, including their communities, activities, and distribution and movements of the various marine-associated resources that are used for traditional purposes, are also considered within the environmental effects assessment for this VC. The RAA for this VC is therefore much larger than other VC RAAs and includes the overall Atlantic Canada region. This encompasses the Indigenous communities and activities throughout relevant parts of NL, the Maritime Provinces and QC.

13.1.4.2 Temporal Boundaries

The temporal boundaries for the assessment of potential Project-related environmental effects on Indigenous peoples and communities encompass all Project phases, including well drilling, testing, and abandonment. BHP is currently planning up to 20 wells proposed from 2021 to 2028. 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 35 to 115 days to drill. Vertical seismic profiling (VSP) surveys typically take approximately one to two days with airgun array firing often limited to just a few hours. Drilling operations will not be continuous throughout the entire nine-year temporal 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, BHP's preference is to conduct drilling in ice-free months.

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

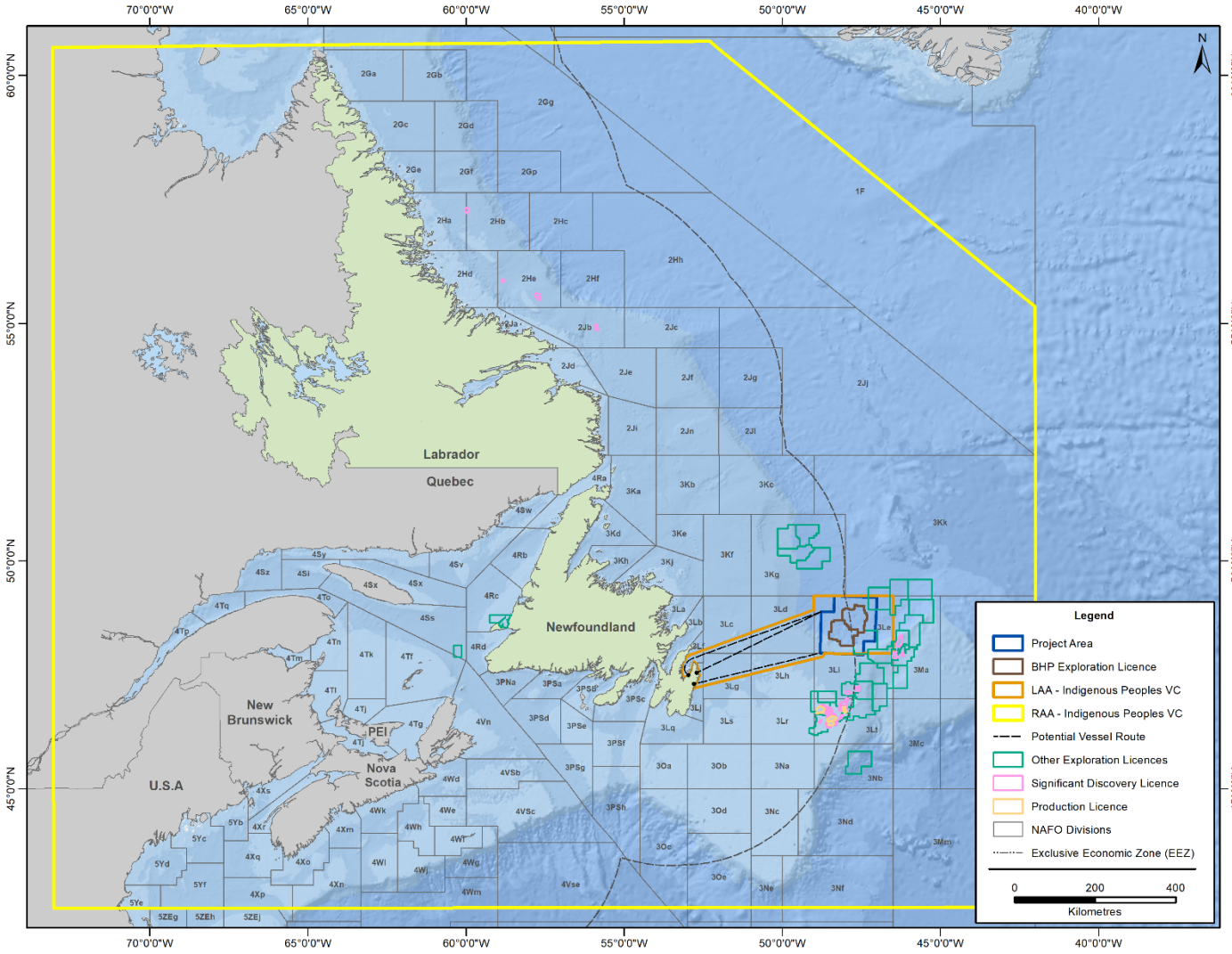

Figure 13-1 Indigenous Peoples and Communities Spatial Boundaries

13.1.5 Residual Effects Characterization

The definitions used to characterize environmental effects in this assessment for Indigenous peoples and communities are provided in Table 13.2. These characterizations will be used throughout the chapter when describing potential residual environmental effects on Indigenous peoples and communities from routine Project activities. These characterizations are also applicable for accidental events, as discussed in Section 15.6.6.

Table 13.2 Characterization of Residual Effects on Indigenous Peoples and Communities

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual environmental effect relative to existing conditions	**Positive** – a residual environmental effect that moves measurable parameters in a direction beneficial to Indigenous peoples and communities relative to existing conditions **Adverse** – a residual environmental effect that moves measurable parameters in a direction detrimental to Indigenous peoples and communities relative to existing conditions **Neutral** – no net change in measurable parameters for Indigenous peoples and communities and activities relative to existing conditions
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions	**Negligible** – no measurable change **Low** – a detectable change that is within the range of natural variability, with no associated adverse effect on the overall nature, intensity, quality / health or value of the affected component or activity. **Moderate** - a detectable change that is beyond the range of natural variability, but with no associated adverse effect on the overall nature, intensity, quality / health or value of the affected component or activity. **High** - a detectable change that is beyond the range of natural variability, with an adverse effect on the overall nature, intensity, quality / heath or value of the affected component or activity.
Geographic Extent	The geographic area in which a residual effect occurs	**Project Area** – 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 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

Table 13.2 Characterization of Residual Effects on Indigenous Peoples and Communities

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Duration	The 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 existing 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 pre-Project 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

13.1.6 Significance Definition

The descriptors listed above (Table 13.2) have been used to characterize residual environmental effects on Indigenous peoples and communities. For the purposes of this effects assessment, a significant adverse residual environmental effect on Indigenous peoples and communities is defined as a Project-related environmental effect that involves:

- Loss of access to areas or resources relied on for traditional use practices or the 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 groups, 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
- Unmitigated damage to fishing gear

13.2 PROJECT INTERACTIONS WITH INDIGENOUS PEOPLES AND COMMUNITIES

Table 13.3 identifies, for each potential effect, the physical activities that might interact with Indigenous peoples and communities and result in the identified environmental effect. These interactions are indicated by check mark and are discussed in detail in Section 13.3, in the context of effects pathways, standard and project-specific mitigation/enhancement, and residual effects.

Table 13.3 Project-Environment Interactions with Indigenous Peoples and Communities

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
Presence and operation of a mobile offshore drilling unit (MODU) (including drilling, associated safety zone, lights, and sound)	✓	✓
VSP	✓	✓
Discharges (e.g., drill muds / cuttings, liquid discharges)	✓	✓
Well Testing and Flaring (including air emissions)	–	✓
Well Decommissioning and Abandonment or Suspension	✓	✓
Supply and Servicing Operations (including helicopter transportation and Project support vessel operations)	✓	✓
Notes: ✓= Potential interaction – = No interaction		

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

13.3 ASSESSMENT OF RESIDUAL ENVIRONMENTAL EFFECTS ON INDIGENOUS PEOPLES AND COMMUNITIES

The environmental effects on Indigenous peoples and communities identified as arising from potential interactions in Table 13.3 are assessed in the following section. Given the similarities in other offshore exploration project environmental assessments, this EIS incorporates information from previous Environmental Assessment (EA) documents for similar exploration drilling projects in Atlantic Canada. This includes 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 Change in Commercial Communal Fisheries

13.3.1.1 Project Pathways

Some of the activities included in commercial communal fishing are travel to and from harvesting areas and deploying, setting, retrieving / hauling, and/or accessing gear in designated fishing grounds. The focus of this assessment is on Project interactions that might interrupt or prevent that process. Examples include having grounds closed to fishing, impediments to or from fishing grounds, lost or damaged fishing gear, or lost or reduced catch. Project activities that have potential to adversely affect marine fish, including targeted fishery species, is discussed in Chapter 8 (Marine Fish and Fish Habitat). Many Indigenous communities rely on revenue generated from commercial communal fishing to fund community ventures, social programs and benefits, and therefore, indirect socio-economic effects are also qualitatively considered in this assessment.

The commercial communal fishing licenses held by Indigenous groups that are relevant to this assessment are described in Section 7.4. Species harvested for commercial communal purposes within the RAA include capelin, groundfish, herring, mackerel, seal, shrimp, snow crab, tuna, and whelk. Within the LAA and the Project Area, the geographic extent and type of commercial fisheries in general is limited, partially because of water depths and partly because of the presence of the Northeast Newfoundland Slope Closure (Section 6.4.1.4 and Section 7.2.3.2), which overlaps much of the Project Area and all parts of EL1157 and EL1158 that fall within the Canadian EEZ. The terms of this closure prohibit the use of bottom-contact gear, the principal type historically employed within the LAA and Project Area waters. Consequently, little harvesting is expected to occur within either the Project Area or LAA, except for an area of activity (primarily for groundfish) in the southernmost parts (Figures 7-8 and 7-18).

However, this assessment also considers the potential residual effects on migratory species (e.g., bluefin tuna, swordfish) identified above that may move through the Project Area or LAA and be targeted by commercial communal fishing activities elsewhere in the RAA.

The following is a list of Project activities and resulting effect in the marine environment that could cause changes in commercial communal fisheries:

- The presence and operation of a MODU (fisheries exclusions and underwater sound effects on commercial fish species)
- VSP operations (underwater sound)
- Discharge of drill muds and cuttings (effects on water and sediment quality on commercial fish 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 (PSV operations resulting in underwater sound associated with vessel movement causing commercial fish species to avoid an area)

13.3.1.2 Mitigation

Based on the environmental effects pathways outlined above, the following mitigation measures and standard practices will be employed to reduce potential effects on Indigenous peoples and communities. The following mitigation measures are consistent with measures proposed to reduce potential adverse effects on commercial fisheries and other ocean uses (refer to Section 12.3.1.2). Mitigation measures identified in the assessment on marine fish and fish habitat (Section 8.3.1.2), marine and migratory birds (Section 9.3.1.2) and marine mammals and sea turtles (Section 10.3.1.2) will also be incorporated.

- BHP 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 Indigenous fishers.
- In accordance with the *Newfoundland Offshore Petroleum Drilling and Production Regulations*, a safety (exclusion) zone (estimated to be a 500-m radius) will be established around the MODU within which non-Project related vessels are prohibited.
- BHP will require the Drilling Contractor to provide details of the safety zone to the Marine Communication and Traffic Services for broadcasting and publishing in the Navigational Warning (NAVWARN) and Notices to Mariners (NOTMAR) systems.
- Project-related damage to fishing gear will be compensated in accordance with industry best practices in the NL offshore and relevant industry guidance material such as the Geophysical, Geological, Environmental, and Geotechnical Program Guidelines (C-NLOPB 2019), the Canadian East Coast Offshore Operators Non-attributable Fisheries Damage Compensation Program (CAPP 2007), and the Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activities (C-NLOPB and CNSOPB 2017) which apply when gear loss or damage occurs because of a spill or authorized discharge, emission or escape of petroleum.
- PSVs will follow established shipping routes where they exist (i.e., in proximity to shore).
- Lighting on PSVs and MODU will be limited to the extent that worker safety and safe operations is not compromised. Measures may include avoiding use of unnecessary lighting, shading, and directing lights towards the deck.

13.3.1.3 Characterization of Residual Project-related Environmental Effects

Presence and Operation of a MODU

Drilling activities will require a 500-m radius safety zone around the MODU (when it is present and operational), within which commercial communal fishing activities could be displaced. During the drilling period for each well, there is therefore potential for commercial communal fishing activities to be excluded from an area of approximately 0.8 km² (80 ha) for up to approximately 115 days. 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 most relevant to pelagic fisheries. Due to the localized and temporary nature of the fishing exclusion and the limited amount of commercial fishing currently occurring within the Project Area and LAA, the residual effect on commercial communal fishing activities and fisheries

resources is anticipated to be low in magnitude. BHP will require the Drilling Contractor to provide details of the safety zone to the Marine Communication and Traffic Services for broadcasting and publishing in the NAVWARN and NOTMAR systems. This information will also be communicated with Indigenous and non-Indigenous fishers during ongoing engagement, and through the implementation of the Indigenous Fisheries Communications Plan.

MODU underwater sound emissions can affect fish species, which may cause commercial fish species to avoid the area around the MODU, particularly during the start-up of drilling. Biophysical and behavioural effects are discussed in Chapter 8 (Marine Fish and Fish Habitat). Startle responses typically come to an end as fish become accustomed to the continuous sound levels from the MODU, and avoidance behaviour is therefore anticipated to be temporary (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 predicted to affect commercial communal fisheries to the extent that would result in a change in revenue for Indigenous communities or have adverse socio-economic effects.

Swordfish and tuna are noted through Indigenous engagement activities as being of primary commercial communal importance and are known to occur in the RAA. These two species migrate across larger geographic areas and could potentially be targeted for fishing outside the Project Area. These species are therefore further considered below.

Many Indigenous groups hold commercial communal fishing licences for swordfish, a large, highly migratory pelagic species, distributed widely throughout the Atlantic Ocean and known to forage in Canadian waters from June to October (DFO 2015). Commercial communal licences are held in NAFO Areas that overlap with the Project Area and the RAA. Commercial landing locations for swordfish, including those landings fished under a commercial communal licence, between 2011 and 2017, have been located primarily in NAFO subdivisions 3O and 3N, outside of the Project Area (Section 7.4.8). While commercial landings can be a proxy for swordfish distribution, the species has a wide range and can be found along the edge of the continental shelf and most of the North Atlantic Basin (Dewar et al. 2011; Trenkel et al. 2014). Consequently, there is some potential for swordfish to move throughout the Project Area during certain times of the year, but this species is likely to spend a large portion of time spawning and in nursery habitats, distant from the Project Area (e.g., Gulf of Mexico, eastern continental shelf of the United States) (Arocha 2007).

Like swordfish, tuna are a highly migratory species and have been found in the offshore waters of NL. Commercial landings for tuna species in offshore NL have generally been concentrated in NAFO area 3O, which is outside of the Project Area, and in the southwest portion of the RAA (Section 7.4.8). There is potential for tuna to migrate through the Project Area in search of prey species, however there are no known spawning or rearing habitats for larval and juvenile stages in Canadian waters (COSEWIC 2011).

Tuna are hearing generalists, capable of detecting low frequency sounds in the range of 200 to 700 Hz with higher sensitivity to sounds between 200 to 400 Hz (Southwood et al. 2008). Adult bluefin tuna are highly mobile (Hazen et al. 2016) and expected to avoid potential injury by avoiding high intensity sound levels. Swordfish are highly visual predators (DFO 2015). Swordfish, like many other pelagic fish, may be attracted to the MODU, due in part to increased foraging opportunities (aggregation of prey species) and increased light emissions. Attraction to Project infrastructure may expose individual swordfish to the emissions (sound, light) and discharges associated with drilling activities. Lights from the MODU or PSV are not projected into

the water column far beyond the physical footprint of the MODU / PSV (i.e., within 100 m), limiting the area affected. Based on hearing sensitivities of other large pelagic fish, swordfish are also expected to avoid high intensity sound levels.

Given this avoidance behavior and 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. Effects on prey species from routine Project activities are not predicted to occur such that it would affect foraging success of bluefin tuna or swordfish. Therefore, routine Project activities are not predicted to decrease the availability of swordfish or tuna as a resource for commercial communal fishing or result in associated adverse socio-economic impacts to the Indigenous communities.

Residual effects associated with the presence and operation of a MODU on commercial communal fisheries, including potential indirect socio-economic effects, on Indigenous peoples and communities are predicted to be adverse, low in magnitude, and within the Project Area. Effects are predicted to occur irregularly throughout the life of the Project, be short-term in duration, and reversible. General mitigation measures already implemented to protect marine fish and fish habitat (e.g., waste management) will also help reduce potential for adverse effects. Communication with Indigenous communities and fisheries stakeholders and compensation for damaged fishing gear, as required (see 13.3.2), will reduce potential effects on fishing.

VSP Operations

As with the operation and presence of a MODU, VSP surveys create underwater sound that can interact with commercial communally-fished species. Avoidance behavior exhibited by fish species, including commercial communal species, resulting from underwater sound could reduce catchability. Potential startle and alarm responses of marine fish resulting from VSP surveys is discussed in Section 8.3.

VSP surveys are like seismic operations in that they use similar equipment such as an airgun source array; however, unlike seismic operations, the size and volume of the array is much smaller and focused around a wellbore. The underwater sound effects are therefore localized around the drill site. VSP operations are typically of short duration, taking approximately one to two days to complete per well, over a one to three-week period (sounding just a few hours), which is much shorter than a typical seismic exploration program. As discussed in Section 8.3, physical and behavioural changes in commercial communal fish species and associated socio-economic effects resulting from VSP surveys are anticipated to be low.

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

Discharges

Potential localized effects on water quality and/or sediment quality resulting from discharge of drilling waste and other discharges and emissions may occur and therefore could affect commercial communal fish species. The extent of various thicknesses of the deposition of drill cuttings on the seafloor in a radius from the discharge site was estimated in the drill waste modelling conducted for this Project. As presented in Appendix D and discussed in Section 8.3, RPS indicates for all scenarios modelled that depositional

thicknesses at or above 1.5 mm (a conservative predicted no-effect threshold for benthic invertebrates) were predicted to be confined within 580 m or less of the drill sites, with a maximum affected area at that thickness of 0.12 km² (RPS 2019). The Project will adhere to the Offshore Chemical Selection Guidelines (OCSG) and the Offshore Waste Treatment Guidelines (OWTG), which have been developed to protect the marine environment and will limit adverse effects on commercial fish 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 from marine discharges are negligible. The availability of commercial communal fisheries resources is not expected to be affected by discharges.

Residual effects associated with discharges on commercial communal fisheries, including potential indirect socio-economic effects, are predicted to be adverse, 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 or Suspension

Activities associated with well decommissioning and abandonment or suspension involve the presence of vessels at the drill site. As a result, the effects of these activities would be the same as those assessed for the presence and operations of the MODU, and therefore are not repeated here.

BHP's abandonment program has not yet been defined (Section 2.4.4). Offshore exploration and appraisal wells are typically decommissioned and abandoned when drilling and associated well evaluation is completed and as approved by the C-NLOPB. In addition to regulatory requirements, well decommissioning and suspension or abandonment for this Project will be carried out as per BHP's Well Integrity Standard. Well decommissioning and abandonment activities involve isolation of the well bore by placing cement plugs, potentially in combination with mechanical devices, at various depths. Consideration will be given to removing wellheads from the seafloor if appropriate (given water depth and fishing activity), mechanical cutters would be used in this instance. In some circumstances, a well may not be abandoned but suspended and re-entered for additional data acquisition and evaluation before final abandonment.

Should wellheads be kept in place, BHP will communicate the locations of abandoned wellheads to fishers and the Canadian Hydrographic Services for publishing on future nautical charts. This will allow fishers, using mobile or fixed gear, to avoid locations around abandonment wellheads. A wellhead could interact with commercial communal fishing activity in the Project Area through a change in fish habitat (i.e., small structure above the seabed); however, 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 most relevant to pelagic fisheries. Due to the localized effects around the well site, 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 commercial communal fishing, including potential indirect socio-economic effects, are predicted to be adverse, negligible to low in magnitude, restricted to the Project Area, occur more than once at irregular intervals, be short to permanent in duration, and reversible.

Supply and Servicing Operations

PSVs operating within the Project Area and LAA will increase vessel traffic and may therefore affect commercial communally-fished species and fishing activity in the vicinity of the vessels. Two to three PSVs will likely be required, with an average of three round trips per week between the MODU and the shorebase, and one vessel on permanent stand-by at the MODU. Seasonally, ice management vessels may also be required. The increase in vessel traffic has the potential to interfere with fishing gear and may restrict fishing vessel navigation. To reduce potential conflicts with commercial communal fisheries, PSVs will follow the most direct vessel traffic routes between the shorebase and the Project Area and adhere to standard navigation procedures. It is predicted that effects of helicopter transportation on fisheries will be negligible, given the lack of interaction with marine fish or fishing activities.

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

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

13.3.2.1 Project Pathways

Harvesting activities that collect resources to provide nourishment, or for use in traditional ceremonies, cultural practices, and social events are considered current use of lands and resources for traditional purposes. Although there are no known FSC fisheries in the Project Area, species such as marine fish, marine mammals, and migratory birds, that are traditionally harvested elsewhere have the potential to migrate through the Project Area. The focus of this assessment is, therefore, on routine Project activities that might interact with these migratory species, thereby potentially affecting the quality or availability of these resources upon which Indigenous communities may depend.

Project activities that could affect marine species harvested by Indigenous communities thereby resulting in a change in current use of lands and resources for traditional purposes include:

- The presence and operation of a MODU (underwater sound effects on FSC fish species)
- VSP operations (underwater sound)
- Discharge of drill muds and cuttings (effects on water and sediment quality for FSC fish species)
- Other discharges and emissions (effects on water quality)
- Well evaluation and testing (including flaring) (effects on migratory birds)
- 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 (underwater sound associated with vessel movement causing FSC fish species to avoid the area or causing injury / mortality to marine mammals)

13.3.2.2 Mitigation

In consideration of the environmental effects pathways outlined above, the mitigation measures and standard practices described in Section 13.3.1.2 will be employed to reduce the potential for change in current use of lands and resources for traditional purposes as a result of routine Project activities.

13.3.2.3 Characterization of Residual Project-related Environmental Effects

Presence and Operation of a MODU

Underwater sound emissions from the MODU, particularly during the start-up phase of drilling, can affect fish by causing migratory species to avoid areas near the MODU (Section 8.3). Given that startle responses typically cease when fish become habituated to the continuous sound levels from the MODU, this avoidance behaviour is expected to be temporary (Chapman and Hawkins 1969; McCauley et al. 2000a, 2000b; Fewtrel and McCauley 2012). This localized, temporary effect is therefore not expected to affect migratory fish species to the extent that FSC fishers would experience change in availability of fisheries resources (through species mortality or dispersion of stocks) and would not indirectly result in associated social and cultural impacts to the Indigenous communities.

Indigenous groups hold FSC licenses for several species (Section 7.4). Due to the cultural and spiritual importance of Atlantic salmon (*Salmo salar*) and American eel (*Anguilla rostrate*), as noted during Indigenous engagement activities, the following assessment focusses on these two species, both of which are known to occur in the RAA and could occur in the Project Area.

Atlantic salmon populations 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 description of the general ocean distribution and migration for the various populations of Atlantic salmon is provided in Section 6.1.9. Research vessel surveys from 1965-1985 have caught salmon within the Project Area in the spring (Reddin and Shearer 1987; Section 6.1.9.2), however, catch data indicate low abundances, likely during migration. There is no information with regards to salmon overwintering in relation to the LAA. Some of the existing data gaps with respect to distribution of Atlantic salmon in areas of offshore oil and gas activity and potential effects of these activities on this species are currently being addressed by various collaborative efforts, including research support from oil and gas operators.

Based on the survey data from 1965-1985 and to maintain a precautionary approach, as with many EIS reports for other proposed exploration drilling projects (e.g., ExxonMobil 2017; Statoil 2017; BP 2018; Husky 2018; Nexen 2018), this assessment assumes that salmon may migrate through the Project Area. If Atlantic salmon were to migrate through the Project Area, they would only experience temporary exposure to underwater sound emissions and discharges in the Project Area. Underwater sound emissions from the presence and operation of a MODU, have the potential to affect salmon. However, salmon are generally expected to avoid underwater sound at lower levels than those at which injury may occur. Light from the MODU is not expected to penetrate the water column more than 50 m radius from the source (Davies et al. 2014) and is not predicted to affect salmon, including during spawning migration to natal rivers. Similarly, effects on prey species from routine Project activities are not predicted to occur such that they would affect foraging success of Atlantic salmon. Given the migratory nature of the salmon and the short-term nature of the activities (i.e., approximately 35-115 days), behavioural effects would be of limited duration. Therefore, potential effects on salmon population from the presence and operation of a MODU are unlikely.

The American eel lives primarily in freshwater and estuarine environments and has a broad distribution throughout the northwest Atlantic Ocean, stretching from Venezuela to Greenland and Iceland (Section 6.1.9) (COSEWIC 2012). American eel was not identified in the survey sets during DFO research vessel surveys for 2007 to 2018. Therefore, the potential for occurrence within the Project Area is considered low.

Specific migration patterns of American eel are not well known due to large data gaps, but if American eel were to occur within the Project Area, it is likely that they would be transported by currents on their way either to Greenland, Iceland, or to NL. A study of the recovery potential for America eel in Eastern Canada concluded that oil and gas exploration (with a focus on seismic exploration), as well as boat and ship traffic, represented a negligible threat based on evidence of populations of American eel in the NL region (Chaput et al. 2013). Additionally, if present in the Project Area, it is not expected that a localized potential area of avoidance would substantially affect migration behaviour through a relatively wide corridor (e.g., kilometres). It is possible that eels migrating to northern waters would attempt to avoid the MODU, although given the relatively small area of Project activities, this is not expected to interfere with migration at a population level within the RAA. Therefore, potential effects on American eel population from the presence and operation of a MODU are unlikely.

Indigenous groups harvest seals for FSC purposes. Six seal species occur in the Project Area: harp, hooded, grey, ringed, harbour and bearded seals, three of which are considered candidate species by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (Section 6.3.5). Bearded and hooded seals are considered mid-priority candidate species, whereas the harp seal is a low-priority candidate species (COSEWIC 2019). The harp seal and hooded seal are expected to be common in the Project Area, while the bearded, ringed, harbour and grey seals are expected to be uncommon. Section 10.3 describes the potential effects from the presence and operations of the MODU on marine mammals (including seals). Residual effects on marine mammals were predicted to be low in magnitude; therefore, potential impacts to harvested seal species are similarly predicted to be low in magnitude.

Traditional bird harvesting activities may be affected by the presence and operation of a MODU which could interact via the nocturnal attraction of birds to artificial lighting. Species commonly harvested by Indigenous communities include goose, ducks, loons, seagulls, murres, mergansers, and scoters (Section 7.4.8). Murres, including thick-billed murre and common murre, are frequent in the Project Area. The residual effects from the presence and operation of a MODU on marine and migratory birds are discussed in Section 9.3. With implementation of mitigation, such as following the Best Practices for Stranded Birds Encountered in Offshore Atlantic Canada, the magnitude of the effect of the presence and operation of a drilling installation on marine and migratory birds is anticipated to be low.

Residual effects associated with the presence and operation of a MODU on current use of lands and resources for traditional purposes, including associated effects on social and cultural values, is predicted to be adverse, 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 fish species will not have a permanent, irreversible effect on FSC fisheries).

VSP Operations

Migratory fish could experience startle and alarm responses from underwater sound levels associated with VSP surveys. However, based on the expectation that whey would avoid underwater sound at lower levels than those at which injury or mortality may occur, received sound levels are unlikely to result in physical effects to most mobile fish species (Section 8.3) (BP 2016). Similarly, it is unlikely that VSP surveys will result in injuries (permanent threshold shift [PTS]) for marine mammals or sea turtles with the implementation of mitigation measures (Section 10.3). Therefore, behavioural changes to FSC fish species

resulting from VSP surveys and potential impacts to social and cultural values are also anticipated to be low.

Migratory birds, particularly diving birds, which are expected to hear a sound pulse if they are underwater at the time the pulse arrives, have the potential to be affected by sounds produced during VSP surveys. Murres are the only diving species found in the Project Area that are traditionally harvested. They regularly dive to a depth of 100 m, remaining underwater for up to 202 seconds (Gaston and Jones 1998). Common murres have been known to dive to a depth of 180 m or deeper (Piatt and Nettleship 1985). However, the ramp-up period for the seismic survey should deter birds from underwater feeding in these areas, reducing their potential for exposure to potentially harmful underwater sound waves. Therefore, residual effects from these surveys are anticipated to be negligible, as the activity will be localized and short-term (approximately one day per well) (Section 9.3).

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

Discharges

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

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, RPS indicates for all scenarios modelled that depositional thicknesses at or above 1.5 mm (a conservative predicted no-effect threshold for benthic invertebrates) were predicted to be confined within 580 m or less of the drill sites, with a maximum affected area at that thickness of 0.12 km² (RPS 2019). Results of environmental effects monitoring programs undertaken for various drilling programs in Atlantic Canada (Hurley and Ellis 2004) concluded that, given brief exposure due to the transitory nature of these species, effects on the health of migratory fish species including Atlantic salmon and eels have been negligible.

The potential production of surface sheens is the primary effect related to discharges and emissions on marine and migratory birds (Section 9.3). The structure and function of seabird feathers is affected by small amounts of oil from sheens (O'Hara and Morandin 2010). The presence of oil can potentially result in water penetrating plumage and displacing the layer of insulating air, which reduces buoyancy and can cause hypothermia. With the implementation of waste management, discharge treatment measures, and compliance with the OWTG, these effects will be prevented or reduced, and the overall magnitude of the effect of drilling and other marine discharges on marine and migratory birds is anticipated to be low.

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

Residual effects associated with discharges on current use of lands and resources for traditional purposes, including associated impacts to social and cultural values, are predicted to be adverse, 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

Well evaluation and testing activities do not interact with the marine environment, therefore there is negligible interaction with migratory fish and marine mammal species.

Flaring, during well testing can interact with migratory birds, as discussed in Section 9.3. Migratory birds can be attracted to artificial light, although the potential mortality resulting from such interactions is poorly understood. If flaring is required, it will be short in duration, totaling approximately 24 hours during a one to three-month window at the end of drilling operations, for a maximum of two wells. Associated bird attraction would be limited to within several kilometers of the MODU. Refer to Section 9.3.1.2 for a discussion on mitigation measures which will be implemented to reduce adverse effects on marine and migratory birds, should flaring be required. It is therefore anticipated that the effects of formation flow testing with flaring (if conducted) on marine associated birds, will be negligible.

Residual effects associated with well evaluation and testing on current use of lands and resources for traditional purposes, including associated effects on social and cultural values, are predicted to be adverse, 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 or Suspension

Activities associated with well decommissioning and abandonment or suspension involve the presence of vessels at the drill site. As a result, the effects of these activities would be the same as those assessed for the presence and operations of the MODU, and therefore are not repeated here.

As described in Section 13.3.3.1, wells will be plugged and abandoned in line with BHP's Well Integrity Standard and C-NLOPB requirements, once wells have been drilled to total depth and well evaluation programs completed (if applicable). Consideration will be given to removing wellheads from the seafloor if appropriate (given water depth and fishing activity), mechanical cutters would be used in this instance. In some circumstances, a well may not be abandoned but suspended and re-entered for additional data acquisition and evaluation before final abandonment.

Well abandonment will occur underwater at sufficient depths to prevent interaction with species that may be harvested for traditional purposes, including marine fish, marine and migratory birds, and marine mammals.

Residual effects associated with well abandonment on current use of lands and resources for traditional purposes, including associated effects on social and cultural values, are predicted to be adverse, 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

Due to the operation of PSVs, there will be increased vessel traffic in the Project Area and LAA, and therefore areas around the PSVs may experience localized affects for marine species habitat quality associated with underwater sound, lights and discharges. It is likely that two to three PSVs will be required during the drilling period, with an average of three round trips per week between the MODU and the shorebase and one vessel on stand-by at the MODU, at all times. Given the temporary and transitory nature of this vessel traffic, the requirement for PSVs to comply with applicable legislation and regulations including applicable environmental protection measures, and the small incremental increase to existing levels of marine traffic and shipping activity throughout the RAA (Section 8.3), the residual effects on species that may be harvested for traditional purposes are low.

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

13.3.3 Overview of Potential Effects on Indigenous Peoples and Communities

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)(c) of CEAA 2012, including:

1. health and socio-economic conditions
2. physical and cultural heritage
3. the current use of lands and resources for traditional purposes, or
4. any structure, site or thing that is of historical, archaeological, paleontological or architectural significance

Effects of accidental events are assessed separately in Chapter 15.

13.3.3.1 Health and Socio-Economic Conditions

It is unlikely that effects from routine Project-activities will directly affect the physical or social health and well-being of Indigenous peoples or communities because the Project is located in the marine environment and the nearest Indigenous community on the Island of Newfoundland is approximately 450 km away, and communities in Labrador, the Maritime provinces, and QC are even further. Additionally, due to its distance offshore, the Project is unlikely to affect receptors that would be sensitive to atmospheric air or sound emissions from routine Project activities. Activities will occur in a localized area, over a short period of time, and standard mitigation practices will be implemented to reduce adverse effects. The overall presence, distribution, and quality of marine fish, marine mammals and sea turtles or migratory birds are not predicted to experience significant adverse environmental effects from routine Project activities (see Chapters 8-10). Therefore, routine Project activities are 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 socio-economic conditions in the Indigenous communities or interact with on-land or near-shore Indigenous activities that contribute to the socio-economic conditions, including services and infrastructure within or used by Indigenous people and their communities. Residual effects on Indigenous fisheries resources would be comparable to effects on marine fish and fish habitat, including species harvested for commercial communal and FSC purposes, which are determined to likely be temporary and of low magnitude. Additionally, disruption in access to fishing grounds, in the unlikely event that it occurs, is anticipated to be localized and temporary in nature. Given the low likelihood of residual effects on Indigenous fisheries from routine activities, associated potential indirect effects to socio-economic conditions, such as employment and business activity and income, community revenue, and availability of culturally important species in Indigenous communities, are anticipated to be low.

13.3.3.2 Physical and Cultural Heritage

Heritage is associated with important aspects of human history and culture and can encompass social, economic, political, environmental, scientific, natural, and cultural dimensions (CEA Agency 2015a). Any geographical area that has been modified, influenced, or given special cultural meaning by people, is often described within a cultural landscape (CEA Agency 2015a). There are no known heritage sites in the Project Area or LAA (Section 7.4). Given the Project's location is approximately 450 km from the nearest Indigenous community on the Island of Newfoundland, and even further from such communities in Labrador, the Maritime provinces, and QC, routine Project activities are not anticipated to result in changes to the environment that would influence physical and cultural heritage.

13.3.3.3 Current Use of Lands and Resources for Traditional Purposes

Current use of lands and resources for traditional purposes, and the exercise of Aboriginal and treaty rights, is associated with 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 (CEA Agency 2015b). Current activities of Indigenous peoples, or those likely to be conducted in a reasonably foreseeable future, are included within the definition of "Current use", which 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 (CEA Agency 2015b). Section 13.3.3.2 discusses the potential impacts on current use of lands and resources for traditional purposes resulting from routine Project activities. Harvesting activities to collect resources that provide nourishment, or for use in traditional ceremonies and social events, is included as current use of lands and resources related to FSC fisheries. Effects on the marine environment resulting from Project activities could cause a change in current use of lands and resources for traditional purposes. However, with the implementation of mitigation, effects are predicted to be negligible to low in magnitude, localized (within the LAA), short-term in duration, and reversible. Therefore, routine Project activities are not predicted to significantly affect current use of lands and resources for traditional purposes by an Indigenous group or community.

13.3.3.4 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 (CEA Agency 2015a). Physical and cultural sites, including structures, sites, or things of historical, archaeological, paleontological, or architectural significance are not known to exist within the Project Area or LAA. Given the offshore location of the Project and localized extent of Project interactions, routine Project activities are unlikely to adversely affect any structure, site or thing that is of historical, archaeological, paleontological, or architectural significance.

13.3.4 Summary of Project Residual Environmental Effects

Predicted residual environmental effects of routine Project activities on Indigenous peoples and communities is summarized in Table 13.4. There is potential for interactions between Project activities and commercial communal fisheries and current use of lands and resources for traditional purposes, however, 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 13.4 Summary of Residual Environmental Effects on Indigenous Peoples and Communities

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 a MODU	A	L	PA	ST	IR	R	D
VSP	A	N-L	PA	ST	IR	R	D
Discharges	A	L	PA	MT	IR	R	D
Well Testing and Flaring	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Well Decommissioning and Abandonment or Suspension	A	N-L	PA	ST-P	IR	R	D
Supply and Servicing Operations	A	L	LAA	ST	IR	R	D

Table 13.4 Summary of Residual Environmental Effects on Indigenous Peoples and Communities

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 a MODU	A	L	PA	ST	IR	R	D
VSP	A	L	PA	ST	IR	R	D
Discharges	A	L	PA	MT	IR	R	D
Well Testing and Flaring	A	L	PA	ST	IR	R	D
Well Decommissioning and Abandonment or Suspension	A	N-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

With mitigation and environmental protection measures in place, the residual environmental effects on Indigenous peoples and communities are predicted to be not significant. Routine Project activities are not expected to result in a loss of access to areas or resources relied on for traditional use practices or the loss of traditional use areas within a large portion of the LAA and RAA for a season or adverse effects on socio-economic conditions of affected Indigenous groups, 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 to the extent that there is a detectable adverse effect upon the economy of the affected Indigenous community. With BHP's commitment to compensating Project-related damage to fishing gear, if any, will be compensated in accordance with industry best practices in the NL offshore and relevant industry guidance material such as the Geophysical, Geological, Environmental, and Geotechnical Program

Guidelines (C-NLOPB 2019), the Canadian East Coast Offshore Operators Non-attributable Fisheries Damage Compensation Program (CAPP 2007), and the Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activities (C-NLOPB and CNSOPB 2017), no unmitigated damage to fishing gear is predicted.

This prediction is determined with a high level of confidence based on a good understanding of the effects of exploration drilling on commercial and traditionally harvested species inhabiting the RAA and the effectiveness of mitigation measures, including those discussed in Sections 13.3.

13.5 FOLLOW-UP AND MONITORING

No follow-up and monitoring are proposed for routine Project activities due to the high level of confidence in the prediction of no significant adverse environmental effects on Indigenous peoples and communities. This recommendation is also given in consideration of the standard mitigation to be implemented, ongoing engagement with communities, and the implementation of an Indigenous Fisheries Communication Plan.

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14.0 CUMULATIVE ENVIRONMENTAL EFFECTS

As per section 19(1)(a) of *Canadian Environmental Assessment Act, 2012* (CEAA 2012), in addition to assessing Project-specific environmental effects, the assessment of a designated project is required to 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 considers residual environmental effects of the Project (as identified in Chapters 8 to 13) in the context of residual effects from past, present, and certain or reasonably foreseeable future physical activities (i.e., projects or activities) to determine the potential for cumulative environmental effects.

14.1 SCOPE AND METHODS

The scope and methods for the cumulative effects assessment is outlined in Section 7.6.3 of the Environment Impact Statement (EIS) Guidelines (CEA Agency 2019) which is consistent with the Canadian Environmental Assessment Agency (CEA Agency 2018) interim *Technical Guidance for Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012* (the Technical Guidance Document) and the CEA Agency's (2015) Operational Policy Statement *Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012* (the Operational Policy Statement). Based on the EIS Guidelines, the approach takes into consideration:

- The characteristics of the Project
- The risks associated with the potential cumulative environmental effects
- The state (health, status or condition) of valued components (VCs) that may be impacted by the cumulative environmental effects
- The potential for mitigation and the extent to which mitigation measures may address potential environmental effects
- The level of concern expressed by Indigenous groups or the public

This chapter builds on cumulative effect assessments recently conducted for other offshore exploration drilling projects within the Regional Assessment Area (RAA) (e.g., Statoil 2017; ExxonMobil 2017; Nexen 2018; Husky 2018; BP 2018), incorporating relevant available findings associated with technical reviews and information requests from those projects.

14.1.1 Identification of Valued Components

As described in Chapters 8 to 13 of this EIS, residual Project-related environmental effects were identified for the following VCs:

- Marine Fish and Fish Habitat (including species at risk [SAR])
- Marine and Migratory Birds (including SAR)
- Marine Mammals and Sea Turtles (including SAR)
- Special Areas
- Commercial Fisheries and Other Ocean Uses
- Indigenous Peoples and Communities

Given these VCs have residual environmental effects which could potentially contribute to cumulative effects, the cumulative effects assessment focuses on these VCs. The following VCs, identified in the EIS Guidelines, were excluded from the scope of the EIS: marine plants; air quality and greenhouse gases (GHGs); and human environment. Rationale for the exclusion of these VCs in the Project-based effects assessment is provided in Section 4.1.3 of the EIS and the same rationale applies to the cumulative effects assessment.

14.1.2 Spatial and Temporal Boundaries

The Operational Policy Statement (CEA Agency 2015) requires identification of spatial and temporal boundaries for the assessment of cumulative environmental effects, indicating 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" (CEA Agency 2015).

The Technical Guidance Document (CEA Agency 2018) suggests the following methods to determine spatial boundaries for the cumulative effects assessment:

- VC-centered spatial boundaries, which are focused on the VC's geographic range and the project's zone of influence
- Ecosystem-centered spatial boundaries, which promote an ecosystem approach to assessing effects
- Activity-centered spatial boundaries, which are determined based on the distribution of physical activities in the vicinity of the project
- Administrative, political, or other human-made spatial boundaries

Although a VC-centered approach is commonly recommended as it allows for more meaningful consideration of effects regardless of jurisdiction boundaries, this approach presents challenges in assessing cumulative effects on VCs with far-reaching migration patterns (including multi-national ranges). This is particularly true if a project's contribution to cumulative effects is relatively minor compared to pressures exerted on the VC in other jurisdictions. An ecosystem-centered approach requires an understanding of the ecological setting and is best suited when regional data, such as that found in a Regional Assessment, is available (CEA Agency 2018).The cumulative effects assessment for this Project adopts elements from each of these approaches, drawing on available information on VC geographic ranges and predicted zones of influence, acknowledging ecosystem linkages between VCs (e.g., predator-prey relationships), and incorporating available information presented in the Eastern Newfoundland Strategic Environmental Assessment (SEA) (AMEC 2014), where applicable.

The specific spatial and temporal boundaries presented for each VC in the respective VC chapter (Chapters 8 to 13) are applied to the assessment of cumulative environmental effects for each VC. Spatial boundaries include the Project Area, Local Assessment Area (LAA), and RAA. Where the geographic range of a VC extends beyond these boundaries, the assessment may be extended to recognize additional environmental effects acting on the VC outside the RAA. The definition of the RAA is particularly relevant with respect to the assessment of cumulative environmental effects.

The RAA is the area that establishes the context for determination of significance of Project residual environmental effects from Project activities and components. It is also the area within which potential cumulative effects – the residual effects from the proposed Project in combination with those of past, present and reasonably foreseeable projects – are assessed. 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., blowout) could extend beyond the RAA. The RAA is consistent for all VCs, except for the Indigenous peoples and communities VC, which has a larger RAA to encompass the various Indigenous communities which have the potential to be affected by Project-related activities.

The migratory range of some biological 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., North Atlantic right whales, migrating sea turtles). Although as recognized in the Technical Guidance Document (CEA Agency 2018), this does not mean the spatial boundary needs to extend to include a physical activity outside the spatial boundary, as long as the environmental effects themselves are considered. In many cases, these “external” stressors outside the RAA (e.g., along a 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 BHP 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.

Temporal boundaries for the cumulative effects assessment are generally informed by the timing of Project activities, such as well drilling, testing and abandonment as well as the duration of resulting effects. VC-centered temporal boundaries, which enable an examination of environmental effects on VCs and a VC’s natural variation over time, are also considered. The existing environment descriptions for each VC (refer to Chapters 6 and 7) provide historic context for variability of VC conditions over time (e.g., population trends, change in fishing patterns). Temporal boundaries also acknowledge that residual effects may lag or extend beyond the timeframe of physical activities from the Project.

14.1.3 Sources of Potential Cumulative Effects

In accordance with the Operational Policy Statement (CEA Agency 2015), the cumulative effects assessment for this Project 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, this cumulative effects assessment 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 authorizations to proceed)

Other (non-Project) past, present, and future physical activities are identified in Table 14.1 that are considered in this cumulative effects assessment given they may result in residual environmental effects that could interact cumulatively with (i.e., overlap spatially and temporally with) the residual environmental effects of the Project within the RAA. Figure 14-1 shows the location of the various current and proposed exploration drilling and production projects in the RAA. Table 14.2 lists known proposed and ongoing offshore petroleum exploration (geophysical and drilling) projects in the RAA. Figure 7-5 in Section 7.2.3 shows the location of domestic commercial fishing activity for all species from 2013 to 2017, which provides a general picture of fishing effort in recent years.

Table 14.1 Other Projects and Activities Considered in the Cumulative Effects Assessment

Project / Activity	Overview	General Spatial and Temporal Considerations of Potential Residual Effects
Hibernia Oilfield, including Hibernia South Extension	• Discovered in 1979; operated by Hibernia Management and Development Company Ltd. (HMDC); located approximately 315 km east-southeast of St. John's, NL. • Gravity-based structure (GBS) installed on-site in June 1997; production began November 1997. • The Hibernia platform consists of topsides (accommodations, drilling and production equipment), a gravity-based structure, and an offshore loading system. • The completed platform (which stands 224 m high) was towed to the Hibernia oil field and positioned on the ocean floor (in 80 m water depth) in June of 1997 and began producing oil in November 1997. • The project was expanded to include the Hibernia South Extension, which began production in 2011.	• This on-going project is located approximately 139 km from the closest edge of the Project Area and approximately 207 km from EL 1157 and 164 km from EL 1158. • Production activities at this oilfield are planned to extend throughout and beyond the temporal duration of the Project (at least 2040). • Safety (exclusion) zones required around project installations (approximately 17 km²) may result in spatial use conflicts with fisheries and other ocean uses.
Terra Nova Oilfield and Extension Project	• Discovered in 1984; currently operated by Suncor Energy Inc.; located approximately 350 km southeast of St. John's and 35 km southeast of Hibernia. • Production from a floating, production storage, and offloading vessel (FPSO) began in January 2002. • Oil production wells were pre-drilled by a semi-submersible mobile offshore drilling unit (MODU). The wellheads and production manifolds are placed in "glory holes", which are excavations in the seafloor, that protect the equipment from scouring icebergs. • A network of more than 40 km of flexible flow lines is used to convey hydrocarbons to and from the wells. Produced gases are separated from the oil and re-injected into the reservoir to support oil production and for possible future extraction. Crude oil is offloaded from the FPSO onto large shuttle tankers for shipment. • In May 2019, Suncor and the Terra Nova joint venture owners sanctioned plans to proceed with a project that will extend the life of the FPSO vessel to approximately 2031. The asset life extension project is expected to allow the facility to capture approximately 80 million additional barrels of oil for the Terra Nova partnership. The asset life extension project will take place in 2020 (Suncor 2019).	• This on-going project is located approximately 169 km from the closest edge of the Project Area and approximately 229 km from EL 1157 and 189 km from EL 1158. • Production activities at this oilfield are planned to extend throughout and beyond the temporal duration of this Project (at least 2031). • Safety (exclusion) zones required around project installations (approximately 269 km²) may result in spatial use conflicts with fisheries and other ocean uses.

Table 14.1 Other Projects and Activities Considered in the Cumulative Effects Assessment

Project / Activity	Overview	General Spatial and Temporal Considerations of Potential Residual Effects
White Rose Oilfield and Extension Project	• Discovered in 1984; operated by Husky Energy Inc; located approximately 350 km east-southeast of St. John's, and approximately 50 km from Hibernia and Terra Nova. • The White Rose oilfield and its satellite extensions are operated using an FPSO. Production began in November 2005; North Amethyst expansion began production in May 2010. • The West White Rose Project will be developed using a fixed wellhead platform, with first oil expected towards the end of 2022.	• This on-going project is located approximately 133 km from the closest edge of the Project Area and approximately 187 km from EL 1157 and 153 km from EL 1158. • White Rose has been producing oil year-round since 2005 and is expected to be in production until at least 2020, followed by several additional years of production from the West White Rose extension. • Safety (exclusion) zones required around project installations (approximately 93 km²) may result in spatial use conflicts with fisheries and other ocean uses.
Hebron Oilfield	• Discovered in 1980; operated by ExxonMobil; located approximately 350 km southeast of St. John's and 16 km southeast of Terra Nova. • First oil was achieved in November 2017. • The Hebron field is being developed using a stand-alone concrete GBS in approximately 93 m water depth.	• This project is located approximately 161 km from the closest edge of the Project Area and approximately 222 km from EL 1157 and 182 km from EL 1158. • Hebron has been producing oil year-round since 2017 and has an estimated production life of 25 years. • Safety (exclusion) zones required around project installations (approximately 6 km²) may result in spatial use conflicts with fisheries and other ocean uses.
Proposed Bay du Nord (BdN) Development Project	• The proposed BdN Development Project is located approximately 450 km east-northeast of St. John's, NL, with a well-defined Core Development Area (450 km²). • Water depths in the Core BdN Development Area range from approximately 1,000 m - 1,200 m. • A Significant Discovery Licence (SDL) was issued in November 2017, to be operated by Equinor Canada. • The proposed project is a subsea development of 10 to 30 wells in the Core Development Area tied back to an FPSO installation. • Although the project has not yet been sanctioned by Equinor, a Project Description was filed in June 2018 and the CEA Agency issued a Notice of Commencement of an Environmental Assessment in August 2018. The EIS has yet to be posted on the CEA Registry.	• This project is located approximately 49 km from the Project Area and approximately 81 km from EL 1157 and 91 km from EL 1158. • As currently proposed, the footprint on the sea floor of proposed facilities covers an area of approximately 7 km². A broader project area (approximately 4,900 km²) is associated with potential future development. • According to the Project Description filed with the CEA Agency, construction could begin as early as 2020, with development drilling commencing in 2023 and occurring over a three to five-year period. Production is scheduled to begin in 2025 and could extend for approximately 12 to 20 years (Equinor 2018).

Table 14.1 Other Projects and Activities Considered in the Cumulative Effects Assessment

Project / Activity	Overview	General Spatial and Temporal Considerations of Potential Residual Effects
Offshore Petroleum Exploration - Drilling	• The Eastern NL offshore area is subject to ongoing and planned offshore exploration drilling programs that are in progress or being subject to EA review or recently approved as of the time of writing (see Table 14.2). The type and amount of offshore exploration activity can vary considerably from year to year. • A total of 478 wells have been drilled in the Canada-NL Offshore Area as of September 30, 2019, including 172 exploration wells, 59 delineation wells, and 249 development wells (C-NLOPB 2019a).	• Table 14.2 lists proposed exploration drilling projects in the eastern NL offshore area; locations are shown on Figure 14-1. • During drilling operations, a safety (exclusion) zone of approximately 500 m radius is maintained around the drilling installation. • Project-specific EAs include modelling studies to predict the zone of influence of effects, but in general, effects from exploration drilling are localized and short-term. • Timeframes for exploration drilling projects generally coincide with the terms of the exploration licences (maximum nine years), although activity is not continuous during this time and operators may choose to drill only a single well during this time period.
Offshore Petroleum Exploration – Geophysical and Other Exploration Activities	• Includes two-dimensional (2D), three-dimensional (3D) and possibly four dimensional (4D) geophysical data acquisition, as well as associated geochemical, environmental, and geotechnical survey activities. • Programs are proposed and approved through the EA process as multi-year programs covering large offshore areas. The type / level of activity each year can vary and is usually a fraction of the overall scope. For general illustration, over the period 2014 to 2016, an average of approximately 390,000 km of geophysical data was collected annually in the eastern NL offshore region, with an average of approximately 35,000 undertaken annually in the Jeanne d'Arc Basin area. • There are several offshore geophysical programs in the Eastern NL offshore in progress, being subject to EA review, or recently approved as of the time of EIS writing (see Table 14.2).	• Table 14.2 lists proposed geophysical exploration projects in the eastern NL offshore area; general locations are shown on Figure 14-1. • Geophysical programs can be localized (confined to one or more ELs) or regional in nature and can occur over a span of weeks or years, depending on the survey scope. • Although safety (exclusion) zones are not implemented for geophysical surveys, these surveys may result in spatial use conflicts with fisheries and other ocean uses.
Fishing Activity	• Commercial fisheries within and around the Project are extensive and diverse, as described in detail (including associated mapping) in Sections 7.2 and 7.4 of this EIS.	• Spatial and temporal characteristics of fisheries in the RAA are described in Sections 7.2 and 7.4. of this EIS.

Table 14.1 Other Projects and Activities Considered in the Cumulative Effects Assessment

Project / Activity	Overview	General Spatial and Temporal Considerations of Potential Residual Effects
Other Ocean Uses (including Other Marine Vessel Traffic)	• Section 7.2 describes other marine-based activities which occur in the RAA including research surveys (Section 7.3.1), shipping (Section 7.3.5), military exercises (Section 7.3.4), and existing marine-based infrastructure (e.g., telecommunication cables) (Section 7.3.7) which have been and will likely continue to be present in the RAA and potentially result in residual environmental effects on VCs.	• Depending on the nature of these activities, the geographic extent, duration and frequency of effects can vary considerably. • Spatial and temporal characteristics of other ocean uses in the RAA are described in Section 7.3. of this EIS.
Hunting	• Wildlife (especially seabird) populations off the coast of NL are subject to hunting activity. Refer to Section 7.4 for more information on Indigenous hunting in the RAA.	• 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 region.

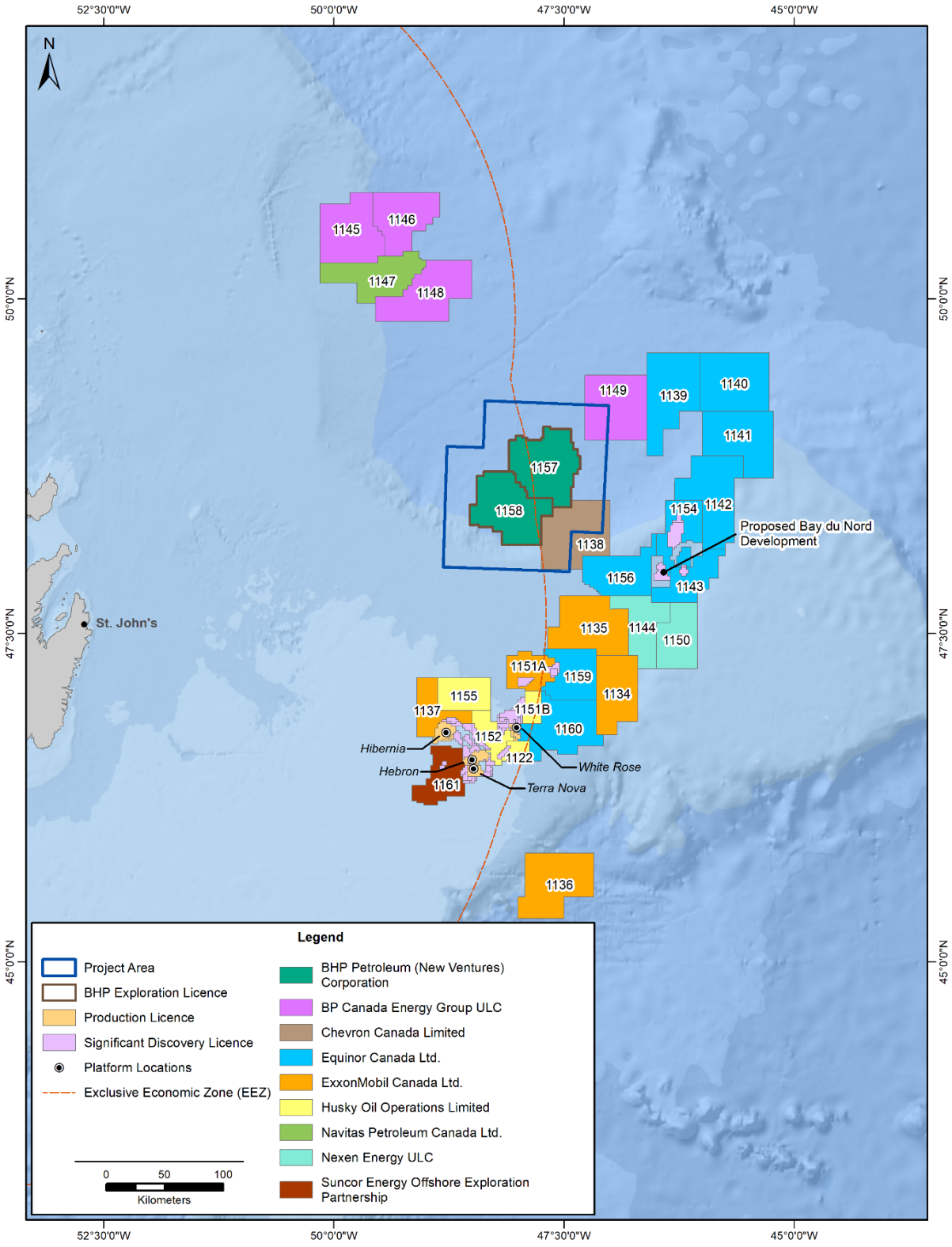

Figure 14-1 Ongoing and Proposed Oil and Gas Exploration Drilling and Production Projects Offshore Newfoundland and Labrador

Table 14.2 Ongoing and Proposed Offshore Petroleum Exploration Activities in the RAA

Proponent	Project Name	Temporal Boundaries
Geophysical and Seabed 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 Inc,	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 (Survey) UK Limited	Offshore Labrador Geochemical Data Acquisition and Seabed Sampling for Basin Modelling in Labrador Offshore	2015 to 2024
WesternGeco Canada	Eastern Newfoundland Offshore Seismic Program	2015 to 2024
WesternGeco Canada	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
Multiklient Invest AS	Newfoundland and Labrador Offshore Seismic Program	2018 to 2023
Fugro Geosurveys	Offshore Seafloor and Seep Sampling Program	2017 to 2027
Chevron Canada Limited	Capelin 3D Seismic Survey of EL 1138 Offshore Newfoundland and Labrador	2018 to 2021
CNOOC Petroleum North America ULC (formerly known as Nexen Energy ULC)	Offshore Seismic Program	2018 to 2023
BHP Petroleum (New Venture) Corp.	Exploration Drilling Project EL 1157 and 1158 Seabed Survey	2020 to 2025
BP Canada Energy Group ULC	BP Canada Energy Group ULC – Ephesus Prospect ROV Survey 2019-2024	2019 to 2024
Exploration Drilling Programs		
BHP Petroleum (New Venture) Corp.	BHP Canada Exploration Drilling Project 2019-2028	2019 to 2028
Chevron Canada Limited	West Flemish Pass Exploration Drilling Project	2021-2030
Suncor Energy Inc.	Tilt Cove Exploration Drilling Project	2019-2028
Equinor Canada Ltd.	Central Ridge Exploration Drilling Project	2020-2029
ExxonMobil Canada Ltd.	Southeastern Newfoundland Offshore Exploration Drilling Project	2020-2029
BP Canada Energy Group	Newfoundland Orphan Basin Exploration Drilling Program	2020-2026

Table 14.2 Ongoing and Proposed Offshore Petroleum Exploration Activities in the RAA

Proponent	Project Name	Temporal Boundaries
Husky Oil Operations Ltd.	Husky Energy Exploration Drilling Project	2018 to 2025
CNOOC Petroleum North America	Flemish Pass Exploration Drilling Project	2018 to 2028
Equinor Canada Ltd.	Flemish Pass Exploration Drilling Project	2018 to 2028
ExxonMobil Canada Ltd.	Eastern Newfoundland Offshore Exploration Drilling Program	2019 to 2030
Source: C-NLOPB 2019b		

14.1.4 Assessing Cumulative Effects on Each Valued Component

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

- Past and Ongoing Effects (existing environment): The context for cumulative environmental effects considers the current (existing) condition of the VC, including past natural or anthropogenic factors which may have affected the VC's current condition. 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 cumulative effects assessment 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

- Potential Project-related Contributions to Cumulative Effects: Considers how the existing 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)

- Future Projects and Their Effects: 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

- Potential Cumulative Environmental Effects: The assessment of residual effects from the Project combined with other projects and activities (including special consideration of potential cumulative environmental effects on SAR). 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 BHP will implement to avoid or reduce potential environmental (including cumulative) effects. 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

A cumulative effects summary is then provided for each VC. The significance of potential cumulative environmental effects is determined based on the same VC-specific thresholds used for the assessment of Project-related environmental effects in Chapters 8 to 13.

According to the Operational Policy Statement (CEA Agency 2015), the assessment of the environmental effects of accidents and malfunctions must be considered in the assessment of cumulative environmental effects if they are likely to result from the designated project in combination with other physical activities that have been or will be carried out. Potential environmental effects of Project-related accidental events and malfunctions are assessed in Chapter 15. Most of the accidental event scenarios, particularly larger-scale events with the greatest environmental consequences and opportunity to interact cumulatively with effects from other projects and activities, are considered unlikely to occur. Of the identified scenarios, the most likely accidental event which could occur are small operational spills from the MODU. Spill prevention and response procedures will be in place to reduce the risk of spills and associated environmental effects (refer to Section 15.4). Other offshore operators will also implement spill prevention and response measures. In the event that a small batch spill did occur from the Project, it would be unlikely to interact with the residual environmental effects of discharges from other exploration and/or production projects, fisheries, or other ocean uses in such a way that causes a cumulative environmental effect given the implementation of a 500-m radius safety (exclusion) zone surrounding the MODU and rapid dilution and/or evaporation of discharges. Therefore, cumulative effects from accidents and malfunctions are considered unlikely to happen and are not assessed further in the cumulative effects assessment. Cumulative effects of routine marine discharges are considered for each VC as applicable.

14.1.5 Mitigation and Follow-up

Mitigation, monitoring and follow-up requirements are discussed as appropriate, in order to reduce or eliminate adverse cumulative environmental effects. This includes mitigation to be implemented by BHP to reduce Project-related residual effects, as well as measures required by BHP and other parties to reduce or eliminate the contribution of effects from other projects and activities. 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 as well as relying on the professional experience of the EIS study team. The cumulative effects assessment 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.

14.1.6 Determination of Significance

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 (Chapters 8 to 13). 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 (INCLUDING SPECIES AT RISK)

14.2.1 Past and Ongoing Effects (Existing Environment)

The RAA is known to be inhabited by many fish and invertebrate species, including those fishery species of importance to Indigenous groups or for commercial and recreational purposes. “Fish”, under the *Fisheries Act*, includes all life stages of fish, shellfish, crustaceans, and marine animals, while “habitat” is the abiotic and biotic quality and areas that fish directly or indirectly use to live, including nursery, rearing, spawning, migration, and foraging areas.

The Project Area and surrounding areas include the shelf and slope areas of the Northeast Grand Bank and the abyssal areas of the Orphan Basin. The shelf slope is an important transition area, supporting regionally important areas of biodiversity and marine productivity, and are used by fish and invertebrate species. The abyssal plain supports unique assemblages of deep-sea fishes as well as coral and sponge communities and other invertebrates. Within and near the LAA are several biologically key areas for important species. The northeast shelf and slope is designated as an Ecologically and Biologically Significant Area (EBSA) due to the high abundance, biomass, and richness of finfish in the area (further discussed in Section 6.4). This area has diverse available habitats, strong primary production, and well-mixed nutrient-rich seawater due to the meeting of the Labrador Current and the Gulf Stream. This area is a known breeding area for witch flounder, and critical habitat has been proposed along the shelf for both spotted and northern wolffish.

Marine fish and fish habitat have been and continue to be affected by a variety of natural processes (e.g., water temperature changes, changes in prey species abundance and distribution) and human activities and policy decisions (e.g., shipping and vessel traffic, fishing activities, fishing restrictions, offshore petroleum exploration and production). These natural and human interactions have affected the presence, distribution, and abundance of fish species, and the overall size and health of fish populations. Warming sea surface temperatures in the Northwest Atlantic 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). This warming trend, along with restrictions on harvesting, may encourage the return of a groundfish-dominated system (Templeman 2010; Nogueira et al. 2017). Refer to Section 5.8 for additional details on climate change and evidence of human influence.

Human activities have interacted with marine fish and fish habitat mainly though the generation of underwater sound and through mortality of fish and/or changes in fish habitat caused by commercial fishing activities. Fish harvesting has taken place around the shores of NL for thousands of years, originally by Indigenous Peoples and later by Europeans who eventually settled on the Island and parts of the Labrador coasts, primarily to harvest fish. The fishery has remained an important component of the region’s economy and way of life since then. Through directed catch and by-catch of targeted fish species and/or prey species, fisheries have affected fish populations in the region. Use of some fishery techniques (e.g., bottom-trawling) have also resulted in long term changes to benthic habitat (e.g., destruction of corals and sponges). Fisheries management tools, including the use of moratoria or quotas, as well as the implementation of fishery closure areas, have been used to help manage the health of fish stocks and protect fish habitat.

Marine fish and fish habitat in the RAA are therefore already subject to natural and anthropogenic disturbance to varying degrees.

14.2.2 Potential Project-related Contributions to Cumulative Effects

As described in Chapter 8, routine Project activities have potential to interact with marine fish and fish habitat through discharge and deposition of drill cuttings and/or fluids. Discharges from the MODU and Project support vessels (PSVs) (e.g., ballast water, bilge and deck water, and grey / black water) may cause degradation, contamination or alteration of marine habitats and benthic organisms as well as contamination of fish / invertebrates. Underwater sound emissions within the water column from the MODU, PSV traffic, vertical seismic profiling (VSP) surveys can also interact with marine fish and fish habitat resulting in injury, larval mortality, or other disturbances such as temporary avoidance of areas by marine fish. This Project does not include 2D or 3D seismic surveys. The Project, therefore, has the potential to result in the following residual adverse environmental effects on marine fish and fish habitat:

- A change in risk of mortality of physical injury for individual marine fishes and invertebrates may result from the presence and operation of a MODU, VSP surveys, and Project-related discharges
- A 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 residual environmental effects in Section 8.3 and a determination of significance in Section 8.4. With the implementation of mitigation (Section 8.3.1.2 and 8.3.3), the residual environmental effects of routine Project activities on marine fish and fish habitat are predicted to be not significant.

14.2.3 Future Projects and Activities and Their Effects

Table 14.3 summarizes how present and future projects and activities in the RAA have potential to cause a residual change in risk of mortality or physical injury and/or a residual change in habitat quality and use, thereby affecting marine fish and fish habitat.

Table 14.3 Marine Fish and Fish Habitat: Residual Effects from Other Ongoing and Likely Future 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)
Existing Offshore Petroleum Production Projects (Production from Hibernia, Terra Nova, White Rose, and Hebron Oilfields)	• Change in risk of mortality or physical injury • Change in habitat quality and use	• Underwater sound, artificial light emissions, and operational discharges from project installations and associated vessels may affect habitat quality and use (e.g., avoidance, attraction) for marine fish species. • Acoustic monitoring along Canada's East Coast between 2015 and 2017 found that offshore oil and gas drilling facilities and marine vessels (including supply vessels) are key identifiable anthropogenic sources of underwater ambient sound that are dominant in the soundscape. Drilling platforms contributed significantly to the local soundscape of targeted areas (Delarue et al. 2018). • Active drilling is occurring at Hibernia, White Rose, Hebron, and Terra Nova. Underwater sound from drilling activities are assumed to be similar to those generated by the Project MODU (see Section 8.3.2.3), which may cause a change in habitat quality and use for marine fish. • Underwater sound levels generated by the supply vessels operating in support of these offshore petroleum production projects in the RAA are assumed to be similar to those generated by Project supply vessels. 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). • Underwater sound levels generated by site 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 close to the air-gun array). These effects would be short-term, localized, close to the sound source, and reversible, with no predicted lasting effects once surveys are complete. • Routine operational discharges from offshore petroleum production facilities and supply vessels (e.g., produced water, grey and black water, ballast water, bilge water, and deck drainage) are discharged in accordance with the Offshore Water Treatment Guidelines (OWTG) (National Energy Board [NEB] et al. 2010) and MARPOL and are therefore unlikely to cause a change in risk of mortality or physical injury for fish. • Subsea infrastructure and routine operational discharges (including deposition of drill mud and cuttings from development drilling) may affect habitat quality and use of the benthic environment although environmental effects monitoring programs have shown effects to be localized. • 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 [exclusion] zone), creating a localized change in habitat quality and use for fish.	**General Considerations** • 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 activities relatively longer-term in nature. • Acoustic monitoring in targeted areas on the East Coast of Canada found that underwater sound from drilling platforms were measurable for extended periods to ranges of at least 15 km at the seabed in deep water and 35 km in shallow water (Delarue et al. 2018). • 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 Environmental Effects Monitoring (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, the farthest amphipod survival tests indicative of toxicity occurred at 1 km, and 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 Hibernia Southern Extension. - Fuel range hydrocarbons were detected in sediments out to 1 km from the Hibernia platform and Hibernia Southern Extension. - 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 Hibernia Southern Extension 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 Hibernia Southern Extension 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, Hibernia Southern Extension 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

Table 14.3 Marine Fish and Fish Habitat: Residual Effects from Other Ongoing and Likely Future 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)
			>C_{10}-C_{21} 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 >C_{10}-C_{21} 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. **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).
Proposed Bay du Nord Development	• Change in risk of mortality or physical injury • Change in habitat quality and use	• Effects from the BdN Development Project are expected to be similar to those described above for existing development projects.	• The EIS and associated modelling studies are not yet publicly available for the BdN Development Project, although it is expected that the spatial extent of underwater sound and marine discharges (including produced water and drill mud and cuttings) would be similar to those described above from existing development projects. It is noted, however, that the core Bay du Nord Development Area is in considerably deeper water depths (1,000 m to 1,200 m) than the development projects in the Jeanne d'Arc Basin (approximately 80 m to 120 m).

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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 – Geophysical Survey Programs	• Change in risk of 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). • 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).	• Acoustic monitoring along Canada's East Coast detected seismic sound over wide areas, particularly north of the Flemish Pass (Delarue et al 2018). • 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.
Offshore Petroleum Exploration – Exploration and Delineation Drilling Programs	• Change in risk of mortality or physical injury • Change in habitat quality and use	• Underwater sound, artificial light emissions, and operational discharges from MODUs and vessels may affect habitat quality and use (e.g., avoidance, attraction) for marine fish. • 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. • Acoustic monitoring along Canada's East Coast between 2015 and 2017 found that offshore oil and gas drilling facilities and marine vessels (including supply vessels) are key identifiable anthropogenic sources of underwater ambient sound that are dominant in the soundscape. Drilling platforms contributed significantly to the local soundscape of targeted areas (Delarue et al. 2018). • Underwater sound generated by the supply vessels operating in support of these offshore petroleum exploration projects in the RAA are assumed to be similar to those generated by Project supply vessels. Operation of supply vessels 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 close to the air source array). These effects would be short-term (VSP typically takes approximately one day to a few days per well), localized close 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 following the completion of drilling operations and will eventually be recolonized by benthic communities.	• 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. • Acoustic monitoring in targeted areas on the East Coast of Canada found that underwater sound from drilling platforms were measurable for extended periods to ranges of at least 15 km at the seabed in deep water and 35 km in shallow water (Delarue et al. 2018). • 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.

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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)
		• 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.	
Fishing Activity	• Change in risk of mortality or physical injury • Change in habitat quality and use	• Fishing results in direct mortality of targeted fisheries species and can result in injury or mortality to other species as bycatch or entanglement in gear. • Bottom-contact fishing can cause changes to the seabed, impacts on epifauna, impacts on infauna, and changes in community characteristics (Clark et al. 2016). • 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. • 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.	• Commercial fisheries occur within and around the Project. 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 sound pressure levels.
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 cumulative effects assessment on marine fish and fish habitat.	• Not applicable
Other Ocean Uses	• Change in risk of mortality or physical injury • Change in habitat quality and use	• Underwater sound, artificial light emissions, and operational discharges from vessels may affect habitat quality and use (e.g., avoidance, attraction) for marine species. • 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, 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. • Seabed infrastructure (e.g., cables) potentially changes the quality of benthic habitat, although over time, some changes may be reversible as infrastructure becomes colonized by marine species.	• 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 sound pressure levels.
Source: Modified from BP 2018			

14.2.4 Potential Cumulative Environmental Effects

Residual environmental effects from the Project may potentially combine with residual effects from one or more other physical activities potentially resulting in cumulative environmental effects on fish and fish habitat. The potential cumulative environmental effects include a cumulative change in risk of mortality or physical injury to marine fish and/or a change in habitat quality and use.

14.2.4.1 Cumulative Change in Risk of Mortality or Physical Injury

A change in risk of mortality of physical injury for individual marine fishes and invertebrates may result from the presence and operation of a MODU, VSP surveys, and Project-related discharges. The presence and operation of a MODU and VSP operations will generate underwater sound that may affect the quality of the underwater acoustic environment for fish and invertebrate species. Aquatic invasive species may be transported through ballast water or on the hulls of ships and the MODU. Introduction of invasive species may compete for food resources, potentially resulting in changes to fish health. In general, offshore exploration drilling projects, production projects, geophysical surveys, commercial fishing and other ocean uses may result in physical injury or mortality to fish and the residual effects from these activities have the potential to combine with residual effects from the Project, resulting in cumulative adverse environmental effects. The underwater sources of sound emissions can generate sound pressure levels (SPLs) that may be harmful to fish at close ranges. It is expected that some species will be locally displaced by the presence of an approaching vessel or drilling activity, in the area surrounding VSP. Therefore, it is expected that most species will avoid underwater sound at levels lower than those at which injury or mortality might occur.

An acoustic monitoring program was conducted along Canada's east coast between 2016 and 2017 to provide an understanding of the existing underwater soundscape in the RAA. Several dominant sound sources were identified in the soundscape including fin whales, vessel traffic, oil and gas extraction and seismic surveys (Delarue et al. 2018). Vessel traffic, including supply vessels like those proposed to be used for the Project, which are generally transient sources, were detectable at any one of the monitoring locations. The sounds from vessels were continuously present at the monitoring locations closer to the exploration drilling sites and existing oil and gas extraction platforms in the Newfoundland offshore area (Delarue et al. 2018). Drilling platforms were measurable for extended periods at ranges of at least 15 km at the seabed in deep water and 35 km in shallow water (Delarue et al. 2018). Additionally, underwater sound from seismic source arrays was a dominant sound source in the soundscape.

Mobile species (particularly those whose ranges 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 physical activities throughout their life cycle. Mobile fishes would potentially respond to lower received sound levels and move away from the sound source, thereby limiting potential for temporary injury to individual fish and subsequently adverse effects on fish populations. Project emissions will contribute to an already disturbed soundscape in the marine environment, however, the underwater sound emissions from the Project will be relatively short-term and reversible. The cumulative change in risk of mortality or physical injury for marine fish, therefore, is not expected to affect population viability for marine fish species in the RAA.

Immobile species and species with very limited ranges 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 in a particular location. Given fish eggs / larvae are immobile they are more susceptible to harm when near seismic sound sources than other life stages of mobile fish. Underwater sound levels produced by Project-related and various seismic 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. However, these effects would be expected to be in the range of natural variability (not affecting population viability) and 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).

Due to the infrequent nature and short duration (i.e. approximately one day to a few days per well, over a one to three week period) of VSP operations, the possibility of a cumulative interaction between Project VSP activities and other seismic surveys in the RAA is uncertain and considered unlikely as modelling indicates that sound is limited to the Project Area (except the lowest maximum-over-depth SPL thresholds; see Appendix E). Implementation of ramp-up procedures for seismic source arrays in accordance with the Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment (SOCP) (DFO 2007) are anticipated to reduce the potential underwater sound effects on fish, marine mammals, sea turtles, and diving birds close to Project and non-Project seismic sources.

As is explained in Section 2.7.2, the deposition of Project-related drill muds and cuttings is not predicted to reach an effects threshold of 6.5 mm at any distance from the drilling sites, with the maximal depositional thickness of 5.45 and 4.75 mm predicted for EL 1157 and EL 1158, respectively. Dispersion sediment thicknesses of 1.5 mm or greater surrounding EL 1157 are predicted to reach a maximum extent up to 450 m from the discharge point and up to 580 m at EL 1158 and cover an area less than 0.12 km² at both sites. Sensitive benthic organisms (e.g., corals and sponges) within the localized area of sediment thicknesses above 1.5 mm may be affected by the deposition of drilling waste. As modelled thickness above 6.5 mm were not predicted to occur at either site, physical injury and mortality of benthic organisms due to Project-related drill muds and cuttings, and accordingly, its contribution to cumulative effects of injury and mortality of benthic organisms, is low. The extent of benthic disturbance would be localized per well site and, like BHP, other operators proposing exploration drilling activities in these areas have committed to conducting seabed surveys prior to drilling to confirm the absence of sensitive environmental features, such as habitat-forming corals or SAR and implementing an appropriate course of action in consultation with regulatory authorities to avoid or reduce adverse effects on these features. Furthermore, bottom-contact fishing is now restricted in certain areas (including the Northeast Newfoundland Slope Closure marine refuge) which will reduce cumulative adverse effects on sensitive benthic habitat. Effects would be low and limited to the Project Area, thereby reducing potential for overlapping effects from other projects or physical activities.

Given that the residual Project-related change in risk of mortality or physical injury associated with sediment (drill waste) deposition is anticipated to be very low, the risk of cumulative effects with 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), resulting in a change in the overall risk of mortality or physical injury for benthic and other fish species in the RAA in general is also very low. The residual effects of Project-related drill muds and cuttings discharged inside the safety (exclusion) zone are localized and unlikely to overlap spatially with the residual

effects of bottom-contact fishing outside of the safety (exclusion) zone at the individual or population level within the wider RAA.

The change in risk of mortality or physical injury predicted for the Project (albeit low) 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. Potential cumulative environmental interactions between the Project and bottom-contact fisheries will be limited by the low level of Project effects and presence of the 500-m radius safety (exclusion) zone excluding other third-party physical activities, as well as the localized nature of the deposition of drill muds and cuttings around the well site.

14.2.4.2 Cumulative Change in Habitat Quality and Use

A change in habitat quality and use for marine fishes and invertebrates may result from the operation and presence of the MODU, VSP surveys, project-related discharges, well abandonment, and supply and servicing operations. 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:

- Underwater sound emissions produced during Project drilling and other offshore petroleum exploration and production drilling projects in the RAA will be generated from a stationary source for the duration of drilling activities at each well, which are not likely to overlap (Appendix E). Fish are not expected to approach close enough to these offshore facilities to be exposed to sound levels capable of causing auditory injury, however, the sound emissions may cause behavioural responses such as temporary habitat avoidance or changes in activity state. 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

- Routine discharges from the Project and from other physical activities will comply with the requirements of Offshore Waste Treatment Guidelines (OWTG) (NEB et al. 2010) 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 to cause a substantial cumulative change in habitat quality and use

- Project-related discharge of drill muds and cuttings are predicted to result in a deposition of sedimentation maximal depositional thickness of 5.45 and 4.75 mm predicted for EL 1157 and EL 1158, respectively, with sediment deposition thickness of 1.5 mm or greater surrounding EL 1157 predicted to reach a maximum extent up to 450 m from the discharge point and up to 580 m at EL 1158 and cover an area less than 0.12 km² at both sites

- Potential cumulative changes 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 (exclusion) zone would likely be negligible based on the limited sedimentation from the Project and, as discussed in Section 12.3, only a very small part of either EL allows bottom gear due to water depth

- 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 (exclusion) zone would similarly be limited due to the low water column concentrations of Project-related discharges outside of the safety (exclusion) zone, the exclusion of non-Project activities within the safety (exclusion) zone, and the transient nature of underwater sound associated with vessel movements

- 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

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

14.2.5 Species at Risk

There are 30 species of marine fish with conservation designations occurring in the western North Atlantic with potential to overlap with the RAA. Four species are listed under the *Species at Risk Act* (SARA): the Atlantic wolffish (Special Concern), the northern wolffish (Threatened), the spotted wolffish (Threatened), and the white shark (Endangered). While the white shark is a rare migratory visitor to Atlantic Canadian waters, the three wolffish species have ranges that overlap with the LAA.

The key 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 are discussed in the Marine Fish and Fish Habitat VC (Chapter 8).

There are several biologically key areas for important species within and near the LAA. The Northeast Slope is designated as an EBSA due to the high abundance, biomass, and richness of finfish in the area (further discussed in Section 6.4 [Special Areas Existing Environment]). In this area, critical habitat has been proposed along the shelf for both spotted and northern wolffish. 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 given the geographic distribution of wolffish species is quite large, with high concentrations occurring outside the Project Area. The critical habitat for wolffish was designated due to of depth and temperature preference in the area. The Project will not measurably affect the water temperature of this habitat.

The adult marine fish SAR or species of conservation concern (SOCC) that may occur within the RAA are highly mobile and 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 measurably affect these species at risk. Identified critical habitat for Atlantic and spotted wolffish and the residences of other key habitats of individuals or populations are also not anticipated to be measurably adversely affected. Potential Project-related residual effects on these SAR / SOCC are expected to be negligible, particularly in comparison to residual effects on these SAR / SOCC resulting from commercial fisheries and other threats (DFO 2018). The Project is therefore not predicted to make a measurable contribution to potential cumulative effects on marine fish SAR.

14.2.6 Cumulative Effects Summary and Evaluation

Interactions from Project activities and other oil and gas exploration and production activities, shipping, and other ocean uses that are occurring in the RAA are predicted to cumulatively result in changes to fish mortality, injury, and health and changes in habitat quality and use that are adverse, but low in magnitude. Although the effects of the Project are predicted to be temporary and localized, mobile fish (particularly those whose ranges cover a large extent of the RAA), may be sequentially exposed to the residual effects of the Project and the residual effects of other activities throughout their life cycle. Immobile species and species with very limited ranges in areas that are subject to residual effects from the Project and other activities may be exposed to the residual effects of the Project and the residual effects of these other activities simultaneously. However, the geographic extent is localized to the well site within the Project Area, reducing overall potential effects on these species and associated biogenic habitat. With the implementation of a safety (exclusion) zone during drilling operations, direct overlap of effects from other activities is unlikely to occur.

With the application of proposed Project-related mitigation and environmental protection measures, as well as other measures being implemented by other proponents and through fisheries management to help protect fish populations and fish habitat (e.g., fisheries closures), the residual cumulative environmental effects on marine fish and fish habitat (including SAR) are predicted to be not significant. No additional mitigation measures are proposed to address potential cumulative effects.

14.3 MARINE AND MIGRATORY BIRDS (INCLUDING SPECIES AT RISK)

14.3.1 Past and Ongoing Effects (Existing Environment)

The marine waters off eastern Newfoundland provide a vast area of important breeding, migrating, and wintering habitat for marine-associated birds. Marine bird habitats in the RAA are comprised of coastal waters, continental shelf, slope, and deep waters. Concentrations of marine birds sometimes occur at the upwellings of oceanographic features. Millions of marine birds breed at nesting colonies in coastal northeastern Newfoundland, and forage for their young on the Grand Banks and other shelf areas during summer.

During summer large numbers of seabirds are concentrated in the vicinity of coastal nesting colonies (Fifield et al. 2009). This includes globally important numbers of Atlantic puffin, common murre, Leach's storm-petrel, and northern gannet, and continentally important numbers of black-legged kittiwake, and smaller numbers of other species (Bird Studies Canada 2016). Summer concentrations of non-breeding, sub-adult

northern fulmars are also found in deep waters off the shelf. During summer, the Grand Banks also host species that migrate from nesting areas in the South Atlantic, including globally important numbers of great shearwater, large numbers of sooty shearwater, smaller numbers of Wilson's storm-petrel, and south polar skua.

Thousands of non-breeding seabirds occur in the RAA during the summer months. For example, most of the world's population of great shearwater and large numbers of sooty shearwater migrate to Newfoundland waters to moult and feed upon completion of their breeding period in the Southern Hemisphere. Thousands of sub-adult seabirds of species that nest north of the RAA remain in the RAA during the summer, especially northern fulmar and black-legged kittiwake. In the fall, migration of marine birds that have bred in the Arctic and subarctic of eastern Canada and Greenland brings them to the RAA to spend the winter.

In total, nine species designated at risk provincially or federally, or of conservation concern as assessed by The Committee on the Status of Endangered Wildlife in Canada (COSEWIC), have the potential to occur in the RAA or the Project Area. These species include harlequin duck (eastern pop.), Barrow's goldeneye (eastern pop.), piping plover, red knot, buff-breasted sandpiper, red-necked phalarope, ivory gull, Ross's gull, and peregrine falcon. Other shorebird and landbird SAR in Newfoundland are not likely to occur in the RAA or Project Area. Several coastal areas have been designated as an Important Bird Area (IBA) because of seabirds that concentrate to nest, stage, or winter in these areas. There are 21 IBA sites in eastern Newfoundland and 10 of these include marine waters of the RAA (Figure 6-11).

Existing marine and migratory bird distribution, abundance, and health for secure species and SAR has been influenced by natural phenomena (e.g., weather, food availability, and oceanographic variation) and human activities. Human activities include vessel traffic (including residual hydrocarbons and other contaminants in routine operational discharges from vessels), hunting, fishing activity (including fisheries bycatch), offshore petroleum exploration and production activities, and associated effluents and emissions; pesticides; and other pollution.

In general, the populations of most marine-associated bird species occurring off Eastern Newfoundland are considered stable overall. An exception to this is the Leach's storm-petrel, which is the most numerous nesting seabird in Newfoundland. Potential cumulative influences of population declines include predation at colonies, high levels of contamination in eggs and other tissues, threats associated with light pollution, and ongoing climate and marine ecosystem changes (Hedd et al. 2018). The offshore foraging range of Leach's storm-petrel has been shown to be several hundred kilometres during the breeding season (Pollet et al. 2014; Hedd et al. 2018), thereby potentially increasing exposure of the species to various offshore projects and activities (and associated threats).

Given the density of marine traffic off Newfoundland associated with shipping activity between Europe and North America, the amount of persistent oil in the marine environment has been shown to be relatively high along Newfoundland coastlines (Wiese and Ryan 2003). Between 1984 and 1999, beached bird surveys indicated that chronic oil pollution along the southeast coast of Newfoundland was among the highest in the world, with murres and dovekies exhibiting the highest oiling rates (Wiese and Ryan 2003). More recent surveys between 2001 and 2013 have shown a decline in oiling rates, largely due to initiatives undertaken to reduce ship-based oil pollution in Canadian waters (e.g., increased surveillance and enforcement) (Wilhelm et al. 2016).

It is estimated that tens of thousands of murres and dovekies are oiled annually in the waters off Newfoundland (Wilhelm et al. 2016). Murres have also been subject to extensive hunting in Greenland and Newfoundland (Wiese and Robertson 2004) and are susceptible to bycatch and entanglement by commercial fishing (Ellis et al. 2013). Although the surveys showed that murres and other auks exhibited the highest oiling rates (Wiese and Ryan 2003), waterfowl, loons, and grebes are also relatively vulnerable to oil pollution due to the time spent 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 near the Project Area. Murre and waterfowl populations are also subject to pressure from hunting activity in the RAA.

The effects of previous activities and natural environmental influences are reflected in the existing 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 have potential to interact with migratory birds and their associated habitat as a result of the attraction of nocturnally-active birds to artificial lighting on the MODU and PSVs, operational discharges during well drilling and testing operations, underwater sound emissions from VSP operations, and interactions with PSVs and helicopter activities during supply and servicing. The Project, therefore, has the potential to result in the following residual adverse environmental effects on marine and migratory birds:

- A 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 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 and a determination of significance in Section 9.4. With the implementation of mitigation (Section 9.3.1.2 and 9.3.3), the residual environmental effects of routine Project activities on marine and migratory birds are predicted to be not significant.

14.3.3 Future Projects and Activities and Their Effects

Table 14.4 summarizes how 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 thereby affecting marine and migratory birds.

Table 14.4 Marine and Migratory Birds: Residual Effects from Other Ongoing and Likely Future 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)
Existing Offshore Petroleum Production Projects (Production from Hibernia, Terra Nova, White Rose, and Hebron Oilfields)	• Change in risk of mortality or physical injury • Change in habitat quality and use	• Offshore petroleum production projects can have adverse effects on marine and migratory birds, with the most frequently observed effects associated with attraction to artificial lighting (including flares). Additional effects may be associated with marine discharges (e.g., increased exposure to hydrocarbons and contaminants attraction to food and sewage wastes) and to a lesser extent, atmospheric and underwater sound emissions (Ellis et al. 2013; Ronconi et al. 2015). • Nocturnally migrating birds may be attracted and/or disoriented by artificial night lighting on production facilities and supply vessels, 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, well site survey operations (e.g., VSP) 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, localized close 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 supply vessels (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 supply vessels. • 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.	**General Considerations** • 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. • A typical, fully-lit offshore production platform emits approximately 30 kW of artificial lighting (Poot et al. 2008) and lighting attraction effects have been observed to occur within approximately 5 km (Poot et al. 2008) to 15 km (Rodriguez et al. 2015) from the source. Operational discharges and effects of vessel and aircraft traffic are more localized (Rojek et al. 2007; Hoang 2013). Some seabirds, such as Leach's storm-petrel, have foraging ranges of several hundreds of kilometres and therefore may be exposed to various artificial lighting sources within the RAA (Hedd et al. 2018). • 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 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 supply vessels (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.
Proposed Bay du Nord Development	• Change in risk of mortality or physical injury • Change in habitat quality and use	• Effects from the BdN Development Project are expected to be similar to those described above for existing development projects.	• The EIS and associated modelling studies are not yet publicly available for this project, although it is expected that the spatial extent of underwater sound and marine discharges (including produced water and drill mud and cuttings) would be similar to those described above from existing development projects. It is noted, however, that the Core BdN Development Area is in considerably deeper water depths (1,000 m to 1,200 m) than the development projects in the Jeanne d'Arc Basin (approximately 80 m to 120 m).
Offshore Petroleum Exploration – Geophysical Survey Programs	• Change in risk of 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 cumulative effects assessment that seismic sound from air source arrays will	• 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.

Table 14.4 Marine and Migratory Birds: Residual Effects from Other Ongoing and Likely Future 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)
		affect the quality of the underwater acoustic environment in such a way that has potential to disturb marine and migratory birds and cause temporary behavioral 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. However, a recent study showing avoidance of seismic survey activity by a marine bird species up to 100 km from the survey location suggests that the practice of ramping-up the air source array can effectively mitigate the likelihood of hearing injury in seabirds (Pichegru et al. 2017).	
Offshore Petroleum Exploration – Exploration and Delineation Drilling Programs	• Change in risk of 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 Offshore Chemical Selection Guidelines (OCSG) for Drilling and Production Activities on Frontier Lands (NEB et al. 2009). 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 close 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. • 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 close 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. • Supply vessel 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 supply vessel may alert birds and flush some species from the area. • Increased artificial lighting during transiting and operations of the supply vessels 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. • Lighting attraction effects have been observed to occur within approximately 5 km (Poot et al. 2008) to 15 km (Rodriguez et al. 2014, 2015) from the source. Operational discharges and effects of vessel and aircraft traffic are more localized (Rojek et al. 2007; Hoang 2013). Some seabirds, such as Leach's storm-petrel, have foraging ranges of several hundreds of kilometres and therefore may be exposed to various artificial lighting sources within the RAA (Hedd et al. 2018). • 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.

Table 14.4 Marine and Migratory Birds: Residual Effects from Other Ongoing and Likely Future 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)
Fishing Activity	• Change in risk of 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 NL (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. 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) are required to 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.
Other Ocean Uses	• Change in risk of 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. • Chronic ship-source oil pollution is the source of highest seabird mortality in Canada (Calvert et al. 2013). Wiese and Robertson (2004) estimated that, between 1998 and 2000, an average of 315,000 ± 65,000 murres and dovekies were killed annually in southeastern Newfoundland due to illegal discharges of oils from ships. Despite nationwide initiatives to reduce ship-based oil pollution in Canadian waters, it is estimated that tens of thousands of birds are oiled annually in Newfoundland waters (Wilhelm et al. 2016). Discharges may cause a change in risk of mortality or physical injury and/or change in habitat quality and use for marine and migratory birds within a localized area around the vessels of other ocean users.	• The transitory nature of vessel traffic 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 vessel traffic 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.
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 cumulative effects assessment.	• 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.

Source: Modified from BP 2018

14.3.4 Potential Cumulative Environmental Effects

As indicated in Section 14.3.1, marine and migratory birds are subject to numerous threats throughout their sometimes extensive ranges which can affect bird distribution, abundance, and health. These threats include hunting, fishing activity (including fisheries bycatch (entanglement in gear)), 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. Key cumulative effects pathways associated with the Project include discharges and emissions, artificial lighting, sound disturbances and helicopter strikes, which could potentially result in cumulative changes in risk of mortality or physical injury and/or habitat quality and use.

14.3.4.1 Cumulative Changes 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. This attraction to platforms potentially makes marine and migratory birds vulnerable to increased risk of mortality due to physical strikes with structures, stranding on the MODU or PSVs, predation by other marine bird species, and incineration from flares (Wiese et al. 2000; Ronconi et al. 2015).

The most important potential interactions between marine and migratory birds and the presence and operation of a MODU result from the attraction of nocturnally active birds to artificial lighting (including flaring where applicable). Using DMPSP-OLS satellite data, Cinzano et al. (2001) created an atlas showing the spatial distribution of artificial night sky brightness from anthropogenic sources. Offshore exploration drilling and production projects, as well as fishing fleets, were identified as sources of artificial night lighting in the offshore environment. In the NL offshore area, marine birds often strand on fishing vessels, drilling and production platforms, and PSVs (Baillie et al. 2005; Ellis et al. 2013). Baillie et al. (2005) reported 469 stranded birds (mostly Leach's storm-petrels) at offshore installations and vessels off NL between 1998 and 2002, of which 16 (3%) were reported to have died and 344 (74%) were released; the fate of the remaining birds was not reported. Artificial night lighting currently in the Project Area would be low and limited to fishing and shipping vessels transiting in proximity.

Nocturnally migrating species are generally attracted to artificial lighting on vessels, particularly when fog or rain sets in after the night's nocturnal migration has begun (Gauthreaux and Belser 2006). 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 regain flight and die from dehydration, starvation or hypothermia) (Baird 1990; Montevecchi et al. 1999; Wiese et al. 2000; LGL 2017). Leach's storm-petrel, a species that has been found to be particularly vulnerable to light attraction and stranding events, pass through existing producing oilfields between their nesting colonies and deep-water foraging areas. Most strandings of Leach's storm-petrels on drilling and production platforms and geophysical vessels occur from mid-September to mid-October when the young fledge and the adults abandon nesting colonies (LGL 2017). Given that the likely zone of influence of the Project (conservatively set at 15 km diameter based on Section 9.1.4.1), the presence of the MODU would be a new source of night lighting in a region that is relatively free of nocturnal artificial lighting, thereby increasing risk of mortality or physical injury and/or change in habitat quality and use for marine and migratory birds. Some localized and short-term behavioural effects (change in presence and abundance) are likely to occur,

however, 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 at the population level. It is therefore unlikely that individuals will be attracted or displaced over extended areas or timeframes and is not anticipated to contribute to those of other physical activities in such a way that would cause a substantial cumulative increase in mortality or injury affecting marine and migratory birds.

Adverse effects associated with light attraction and associated strandings will be mitigated through the development and implementation of protocols and training for systematic, daily searches, and for recovery, rehabilitation, and release of birds adhering to protocols detailed in *Procedures for Handling and Documenting Stranded Birds Encountered on Infrastructure Offshore Atlantic Canada* (Environment and Climate Change Canada 2017), Measures to Protect and Monitor Seabirds in Petroleum Related Activity in the Canada-Newfoundland and Labrador Offshore Area (C-NLOPB n.d.), and Offshore Seabird Monitoring Program (Fifield et al. 2009). Existing and proposed offshore petroleum exploration and development projects (including seismic surveys) are required to conduct surveys and adhere to proper bird handing and release procedures. This not only serves to mitigate potential cumulative environmental effects on marine and migratory birds, but also adds to the cumulative knowledge of bird use and strandings in the region, and the effectiveness of mitigation.

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, cuttings and other discharges. Although there are nationwide initiatives to reduce ship-based oil pollution in Canadian waters, it is estimated that tens of thousands of birds are oiled annually in Newfoundland waters (Wilhelm et al. 2016). Project discharges will be in accordance with the OWTG and the International Convention for the Prevention of Pollution from Ships (MARPOL), as applicable, which are standard mitigation measures for existing and proposed oil and gas exploration and production projects. Discharges and emissions from the Project are expected to be temporary, localized, non-toxic, and subject to dilution in the open ocean. The cumulative risk of changes to risk of mortality or physical injury or habitat quality and use due to hydrocarbon contamination through routine discharges from the Project is therefore low.

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. Exposure to underwater sound caused by VSP operations is anticipated to be limited by the short duration of VSP operations combined with the short duration of submersion by diving marine birds. 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. The change in risk of injury for diving marine birds is highly localized and diminishes with distance from the source.

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. 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 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.

14.3.4.2 Cumulative Changes in 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 through general avoidance responses. As discussed in Section 9.3.2, the foraging activity of at least one species of marine bird has been reported as being negatively affected by the underwater sound energy from marine seismic. 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.

Except for supply and servicing activities, routine Project activities will not interact with the nearshore environment. Project interactions (and therefore cumulative effects) with waterfowl, which are commonly found in coastal habitats, will therefore be limited. The use of PSVs and helicopters for supply and servicing could potentially result in a cumulative disturbance to marine and migratory birds, particularly for nesting colonies. However, due to the transitory nature of vessels and helicopters the presence of marine traffic at any one location will be short-term. Helicopter routes will lie at least 13 km southeast of the Cape St. Francis IBA and at least 39 km north of the Witless Bay Ecological Reserve IBA (the nearest IBA with seabird nesting colonies). PSV routes will lie about 26 and 35 km, respectively, from those IBAs. PSV and helicopter traffic will be generally consistent with the overall marine traffic that has occurred throughout the region for years and will observe recommended separation distances from migratory bird colonies. 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* and CWS guidelines discussed in Section 9.3.1.2. Cumulative interactions with the residual environmental effects of other vessel and helicopter traffic in the RAA are therefore expected to be low and not expected to result in a substantial change in habitat quality and use for marine and migratory birds.

14.3.5 Species at Risk

In total, nine species of marine and migratory birds designated at risk provincially or federally, or of conservation concern as assessed by COSEWIC, have the potential to occur in the RAA or the Project Area. These species include harlequin duck (eastern pop.), Barrow's goldeneye (eastern pop.), piping plover, red knot, buff-breasted sandpiper, red-necked phalarope, ivory gull, Ross's gull, and peregrine falcon. 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.

Major threats identified in associated recovery strategies and action plans for these bird species include:

- Predation at the nesting colony
- Competition for nesting habitat
- Erosion or fire at the nesting colony
- Flooding or pollution of coastal habitats
- Hunting; at-sea pollution
- Climate change (rising sea levels and food webs)
- Competition with commercial fisheries
- Fisheries bycatch
- Disease

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. Table 9.4 (Section 9.3.3) presents marine and migratory bird SAR and SOCC that could potentially occur in the RAA, summarizing their likely occurrence and potential interaction with Project activities. However, as discussed in Section 6.2.4, there is a low potential for SAR or SOCC to interact with the Project because of these species' low densities in the Project Area, LAA, and RAA (with the exception of Leach's storm-petrel which is designated vulnerable on the IUCN Red List) and because there are no critical habitats or nesting sites of SAR or SOCC in the RAA. Given the distance of most Project activities, Project interactions with these bird SAR are expected to be negligible, but low for Leach's storm-petrel, and are most likely to occur during species' post-breeding dispersal or migration activities. The Project is not predicted to result in direct or indirect effects, as well as cumulative effects, on the survival or recovery of federally listed species. 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 supply vessel and helicopter routes (refer to Section 9.3.1.2) will help reduce potential effects on bird SAR.

The Project is not anticipated to result in residual adverse effects on marine and migratory bird SAR, and therefore, not anticipated to contribute to cumulative effects on these species.

14.3.6 Cumulative Effects Summary and Evaluation

Interactions from Project activities and other oil and gas exploration and production activities, shipping, and other ocean uses that are occurring in the RAA are predicted to cumulatively result in adverse changes to marine and migratory bird mortality, injury, and health and changes in habitat quality and use. Cumulative

environmental effects on marine and migratory birds 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, monitoring, and environmental protection measures to reduce adverse effects associated with artificial lighting, underwater and atmospheric sound, routine discharges, and disturbance from supply vessels and helicopter traffic, the contribution of Project residual effects and associated cumulative environmental effects on marine and migratory birds (including SAR) are predicted to be not significant. No additional mitigation measures, beyond those in place to mitigate the Project's direct effects, are proposed to address potential cumulative effects.

14.4 MARINE MAMMALS AND SEA TURTLES (INCLUDING SPECIES AT RISK)

14.4.1 Past and Ongoing Effects (Existing Environment)

There are 32 marine mammal species that could potentially occur in the Project Area and RAA, including 26 cetacean species (whales, dolphins, and porpoises) and six seal species. Of the 26 cetacean species, seven are considered to be extralimital (i.e., outside their normal ranges), however, sightings / detections have been made within the RAA. Generally, most marine mammals use the area seasonally as the region likely offers important foraging habitat for many species. Four species of sea turtle could also occur within or near the Project Area.

Several EBSAs provide important ecological functions for marine mammals and sea turtles in the RAA, including important habitat for overwintering, refuge, and foraging. A portion of the Project Area overlaps with the Northeast Slope EBSA which is known to support aggregations of cetaceans and pinnipeds (refer to Section 6.4.2).

The potential influences 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 and behavioural effects (avoidance) from lower levels of underwater sound or other sources of sensory disturbance (e.g., discharges). These effects 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.

There are various ocean users which have been and continue to be, active throughout the RAA, such as 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). These activities, particularly shipping, oil and gas extraction, seismic surveys, and production facilities, have, and will continue to dominate the soundscape in the RAA as evident by acoustic monitoring that has occurred along the east coast of Canada (Delarue et al. 2018).

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 fishing activity (e.g., collisions with fishing vessels and entrapment or entanglement in fishing gear).

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The effects of previous activities and natural environmental influences are reflected in the existing environmental conditions for the Marine Mammals and Sea Turtles VC, as described in Section 6.3. This includes the consideration of 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.

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. 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). The Project, therefore, has the potential to result in the following residual adverse environmental effects on marine mammals and sea turtles:

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

The Project-specific environmental effects assessment for this VC includes a summary of Project residual environmental effects in Section 10.3 and a determination of significance in Section 10.4. With the implementation of mitigation (Section 10.3.1.2), the residual environmental effects of routine Project activities on marine mammals and sea turtles are predicted to be not significant.

14.4.3 Future Projects and Activities and Their Effects

Table 14.5 summarizes how 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 14.5 Marine Mammals and Sea Turtles: Residual Effects from Other Ongoing and Likely Future 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)
Current Offshore Petroleum Production Projects (Production from Hibernia, Terra Nova, White Rose, and Hebron Oilfields)	• Change in risk of mortality or physical injury • Change in habitat quality and use	• Underwater sound and operational discharges from project installations and associated vessels may affect habitat quality and use (e.g., avoidance, attraction) for marine mammals and sea turtles. • Acoustic monitoring along Canada's East Coast between 2015 and 2017 found that offshore oil and gas drilling facilities and marine vessels (including supply vessels) are key identifiable anthropogenic sources of underwater ambient sound that are dominant in the soundscape. Drilling platforms contributed significantly to the local soundscape of targeted areas (Delarue et al. 2018). • Active drilling is occurring at Hibernia, White Rose, Hebron, and Terra Nova. Underwater sound from drilling activities are assumed to be similar to those generated by the Project MODU, which may cause a change in habitat quality and use for marine mammals and sea turtles. • Underwater sounds associated with supply vessels could result in a change in habitat quality and use affecting marine mammals and sea turtles as the sound generated by supply vessels could potentially cause changes in swimming, foraging, or vocal behaviours. The transiting of supply vessels 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 well site survey 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, localized near the sound source, and reversible, with no predicted lasting effects once surveys are complete. • Discharges from the production facilities and supply vessels (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 mammals and sea turtles. • Operational discharges may cause a change in habitat quality and use for marine mammals and sea turtles (primarily related to potential effects on prey) within a localized area around supply vessels 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 relatively longer-term in nature.
Proposed Bay du Nord Development Project	• Change in risk of mortality or physical injury • Change in habitat quality and use	• Effects from the BdN Development Project are expected to be similar to those described above for existing development projects.	• The EIS and associated modelling studies are not yet publicly available for this project, although it is expected that the spatial extent of underwater sound and marine discharges (including produced water and drill mud and cuttings) would be similar to those described above from existing development projects. It is noted, however, that the core Bay du Nord Development Area is in considerably deeper water depths (1,000 m to 1,200 m) than the development projects in the Jeanne d'Arc Basin (approximately 80m to 120 m).
Offshore Petroleum Exploration – Geophysical Survey Programs	• Change in risk of 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. • Underwater sound from seismic sound sources and vessels 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. • 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., temporary threshold shift or PTS] at close range (Amec 2014)). Effects on prey species may also indirectly affect marine mammals and sea turtles health and behaviour.	• Acoustic monitoring along Canada's East Coast detected seismic sound over wide areas, particularly north of the Flemish Pass (Delarue et al 2018). • 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.

Table 14.5 Marine Mammals and Sea Turtles: Residual Effects from Other Ongoing and Likely Future 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 Exploration – Exploration and Delineation Drilling Programs	• Change in risk of mortality or physical injury • Change in habitat quality and use	• Underwater sound and operational discharges from MODUs and vessels may affect habitat quality and use (e.g., avoidance, attraction) for marine mammals and sea turtles • 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 for marine mammals and sea turtles, 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. • Acoustic monitoring along Canada's East Coast between 2015 and 2017 found that offshore oil and gas drilling facilities are key identifiable anthropogenic sources of underwater ambient sound that are dominant in the soundscape. Drilling platforms contributed significantly to the local soundscape of targeted areas (Delarue et al. 2018). • Underwater sounds associated with supply vessel traffic could result in a change in habitat quality and use affecting marine mammals and sea turtles as the sound generated by vessels could potentially cause changes in swimming, foraging, or vocal behaviours. The transiting of supply vessels 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 total suspended solids 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 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 close 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 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.
Fishing Activity	• Change in risk of 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 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) are required to 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.

Table 14.5 Marine Mammals and Sea Turtles: Residual Effects from Other Ongoing and Likely Future 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)
Other Ocean Uses	• Change in risk of 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. • Vessel transiting 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 vessels (e.g., grey and black water, ballast water, bilge water, and deck drainage) are required to comply with MARPOL, although illegal dumping of bilge waters can contribute to marine pollution, which, while is not likely to cause a change in risk of mortality or physical injury for marine species, may affect prey species and result in a change in habitat quality and use for marine mammals and sea turtles.	• The transitory nature of vessel traffic 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 vessel traffic 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.
Hunting Activity	• Change in risk of mortality or physical injury	• Hunting of 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 cumulative effects assessment.	• Although hunting is conducted in 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.

Source: Modified from BP 2018

14.4.4 Potential Cumulative Environmental Effects

Residual environmental effects from the Project may potentially combine with residual effects from one or more other physical activities (e.g., offshore exploration drilling projects, production projects, geophysical surveys, commercial fishing, hunting and other ocean uses) potentially resulting in cumulative environmental effects on marine mammals and sea turtles, including a cumulative change in risk of mortality or physical injury to marine mammals and sea turtles and/or a change in habitat quality.

Marine mammals and sea turtles 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. The widespread and often migratory nature of some species (including in many cases beyond the RAA) increases the potential for individuals and populations to be affected by multiple perturbations throughout their ranges.

14.4.4.1 Cumulative Changes in Risk of Mortality or Physical Injury

Underwater sound emissions from Project-related operations will contribute to the wider area soundscape, which includes underwater sound emissions of other physical activities and may, therefore, potentially result in a cumulative change in risk of mortality or physical injury. Except for 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. While some overlap and interaction between underwater sound from the Project and other anthropogenic sources can occur, these effects are likely to be transient and temporary in nature without substantial adverse cumulative effects on individuals or populations. PTS / TTS onset thresholds for the high-frequency cetaceans does not extend beyond the Project Area (largest estimated distance is 0.12 km to PTS threshold and 0.28 km to TTS threshold for both sites; see Appendix E).

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. Project activities, offshore petroleum exploration and production drilling projects, geophysical survey programs, and the activities of fisheries and other ocean users have potential to occur in different parts of the RAA, thereby cumulatively potentially increasing risk of mortality or physical injury.

14.4.4.2 Cumulative Changes in Change in Habitat Quality and Use

Similar to the discussion above for marine fish and fish habitat, cumulative effects to change in habitat quality and use may occur as a result of underwater sound and/or marine discharges from human activities. 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 generally applicable for marine mammals and sea turtles. The PTS / TTS thresholds for high-frequency cetaceans do not extend beyond the Project Area (see Appendix E).

The Project and other third party physical activities may temporarily reduce habitat availability within the RAA resulting from the potential for temporary avoidance of multiple areas at once.

14.4.5 Species at Risk

Five species/populations of marine mammals and two species of sea turtles that could occur in the Project Area are listed under Schedule 1 of SARA: (1) blue whale (Atlantic population); (2) fin whale; (3) North Atlantic right whale; (4) northern bottlenose whale (Scotian Shelf population); (5) Sowerby's beaked whale; (6) leatherback sea turtle; and (7) loggerhead sea turtle. Section 6.3.7 describes the marine mammal and sea turtle SAR found in the RAA, including key threats and recovery measures. The main potential cumulative interactions between the Project, other physical activities in the RAA, and marine mammal and sea turtle SAR are the same as for secure species.

Historically, many marine mammal species in the RAA, including the blue whale and North Atlantic right whale, were hunted to low population densities which remain relatively low today despite international protection from hunting. Key threats that remain today for marine mammal SAR include acoustic disturbances, vessel collisions, entanglement, and spills. Additional threats include contaminants in tissue and changes in food supply (COSEWIC 2011; DFO 2017).

The North Atlantic right whale is listed as endangered on Schedule 1 of SARA (Government of Canada 2019) and by COSEWIC (COSEWIC 2003, 2013). The objectives of the recovery strategy are to reduce mortality and injury from vessel collisions and entanglement and increase survey effort in offshore regions such as the Flemish Pass and Flemish Cap (DFO 2019). For the North Atlantic right whale population, 17 mortalities were reported in 2017 and three in 2018 (Pettis et al. 2018). Twelve of the reported 17 mortalities in 2017 occurred in the Gulf of St. Lawrence and five in the US; in 2018, the three mortalities were reported in the US (NMFS 2019). This prompted the US National Oceanic and Atmospheric Administration (NOAA) to declare an unusual mortality event for the species. Investigations are ongoing for some of the mortalities, but preliminary findings suggest rope entanglement and vessel strikes are the causes for most of these cases (NOAA 2019). Although these mortality events occurred outside the RAA and protection measures were prescribed for the Gulf of St. Lawrence (outside the RAA), the threats are applicable to North Atlantic right whales that could transit through the RAA (although possible, it is unlikely that a right whale will occur in the Project Area and along the potential PSV routes).

The primary threat facing sea turtles in Canadian waters is fisheries bycatch; globally, threats include ship strikes, marine debris, and oil and gas exploration (COSEWIC 2012). Hamelin et al. (2017) reported several incidental captures in fishing gear off Newfoundland, including the Grand Banks. The Canadian Atlantic pelagic longline fleet reported 701 incidental captures of loggerheads between 1999 and 2006 (Brazner and McMilan 2008). Although observer coverage of the area was extensive, no turtles were sighted northeast of the Grand Banks (Brazner and McMilan 2008). Encounters with loggerhead sea turtle in the longline fishery have occurred south of the Flemish Cap during 2002-2008 (Paul et al. 2010).

Mitigation measures proposed to reduce underwater sound disturbance associated with VSP airgun source arrays, manage discharges, and reduce supply vessel speeds (refer to Sections 10.3.1.2 and 10.3.2.2) will help to protect marine mammal and sea turtle SAR. These species are highly mobile, and many have large distributional ranges and undertake long migrations. Large seasonal and even daily variations in abundance

within the Project Area are therefore likely, and the potential for overlap and interaction with Project activities is likely to be temporary. Project activities will not occur in identified concentration areas or critical habitat.

14.4.6 Cumulative Effects Summary and Evaluation

Acknowledging that some marine mammal and sea turtle populations are currently critically endangered or threatened due to a variety of influences, including effects from anthropogenic activities, the Project contribution to these existing effects are expected to be very small. 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 therefore predicted to be not significant. No additional mitigation measures beyond those in place to mitigate the Project's direct effects are needed to address potential cumulative effects. It is assumed that other projects and activities in the RAA, including future projects and activities, will be required to comply with various mitigation measures and regulations, thus also reducing cumulative effects.

14.5 SPECIAL AREAS

14.5.1 Past and Ongoing Effects (Existing Environment)

A number of marine offshore and coastal areas in Newfoundland and Labrador are protected under federal, provincial, international and / or other legislations or agreements due to their ecological, historical or socio-cultural characteristics and importance. As described in Section 6.4, Special Areas within the RAA include EBSAs, Marine Protected Areas (MPAs), migratory bird sanctuaries, marine refuges, fisheries closures, National Parks, National Historic Sites, proposed critical habitat, significant benthic areas (SBAs), provincial ecological reserves, provincial parks, provincial historic sites, Municipal Stewardship Agreement Conservation Areas – Wetland Management Units, internationally designated EBSAs and vulnerable marine ecosystems (VMEs), IBAs, and a UNESCO World Heritage Site.

The following special areas have boundaries that overlap with the Project Area and/or LAA (supply vessel route) and therefore may potentially interact with the Project during routine Project activities:

- Northeast Newfoundland Slope and Closure Marine Refuge
- SiBA – Sea Pens
- SiBA – Large Gorgonian Corals
- Northeast Slope Canadian EBSA
- Eastern Avalon Canadian EBSA
- Baccalieu Island Canadian EBSA
- East Avalon/Grand Banks Candidate NMCA
- 6B Snow Crab Stewardship Exclusion Zone
- Witless Bay Seabird Ecological Reserve
- Slopes of the Flemish Cap and Grand Bank Un Convention on Biological Diversity EBSA
- VMEs – Sponge
- VMEs – Larges Gorgonian Coral

- Sackville Spur (6) Northwest Atlantic Fisheries Organization (NAFO) Fisheries Closure Area
- Quidi Vidi Lake IBA
- Witless Bay Island IBA

These special areas have various conservation objectives and varying levels of protection from human activities including no legal protection or restricted activity (e.g., EBSAs, SBAs), proposed legal protection (proposed critical habitat), specific regulatory protection (e.g., Witless Bay Ecological Reserve) and specific activity restrictions (e.g., no bottom fishing in marine refuge, no crab fishing in snow crab conservation exclusion zones). Special areas with defined benthic conservation objectives have primarily been designated in recognition of past adverse effects from bottom-contact fishing, an activity which is now restricted in many areas to help promote recovery and conservation of benthic habitats. Many of these special areas have been and will continue to be subjected to a high level of marine traffic from shipping, oil and gas production activities, and commercial fishing.

14.5.2 Potential Project-related Contributions to Cumulative Effects

As described in Chapter 11, routine Project-related activities have the potential to affect the ability of special areas to provide and maintain important ecological and biological functions for related species. The Project Area, EL 1157, and/or EL 1158 intersect the Northeast Newfoundland Slope Closure marine refuge, SBAs identified for corals and sea pens, the Northeast Slope EBSA, and the Slopes of the Flemish Cap and Grand Bank EBSAs. As a result of these considerations, the assessment of Project-related effects on special areas is focused on the following potential effect:

- A 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 and a determination of significance in Section 11.4. With the implementation of mitigation (Section 11.3.1.2), the residual environmental effects of routine Project activities on special areas are predicted to be not significant.

14.5.3 Future Projects and Activities and Their Effects

Table 14.6 summarizes how present and future projects and activities in the RAA have potential to cause a residual change in habitat quality affecting Special Areas.

Table 14.6 Special Areas: Residual Effects from Other Ongoing and Likely Future 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)
Current Offshore Petroleum Production Projects (Production from Hibernia, Terra Nova, White Rose, and Hebron Oilfields)	• Change in habitat quality	• Given their distances (refer to spatial and temporal considerations in next column), offshore production facilities are not expected to be visible or audible from 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 supply vessels 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 are the distances from the production projects to the closest special area, respectively. Routine Project activities are not predicted to affect these special areas; therefore there is not direct spatial overlap of effects in relation to these special areas. - The nearest special area to the Hibernia platform is the Virgin Rocks EBSA, approximately 103 km away. - The nearest special area to the Terra Nova FPSO is the Flemish Pass / Eastern Canyon NAFO VME, approximately 85 km away. - The nearest special area to the White Rose FPSO is the Flemish Cap CBD EBSA, approximately 60 km away. - The nearest special area to the Hebron platform is the Flemish Pass/Eastern Canyon NAFO VME closure, approximately 81 km away.
Proposed Bay du Nord Development Project	• Change in habitat quality	• Effects from the BdN Development Project are expected to be similar to those described above for existing development projects.	• The Bay du Nord Project Area overlaps with several internationally designated special areas, including: a CBD EBSA (Slopes of the Flemish Cap and Grand Bank), a VME (Sackville Spur) and one NAFO Fisheries Closure Area (Northwest Flemish Cap – 10), • The EIS and associated modelling studies are not yet publicly available for this project, although it is expected that the spatial extent of underwater sound and marine discharges (including produced water and drill mud and cuttings) would be similar to those described above from existing development projects. It is noted, however, that the core Bay du Nord Development Area is in considerably deeper water depths (1,000 m to 1,200 m) than the development projects in the Jeanne d'Arc Basin (approximately 80 m to 120 m).
Offshore Petroleum Exploration – Geophysical Survey Programs	• Change in habitat quality	• 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). • 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.	• Acoustic monitoring along Canada's East Coast detected seismic sound over wide areas, particularly north of the Flemish Pass, indicating that geophysical surveys are key source of underwater sound in the existing soundscape of the RAA (Delarue et al 2018). • 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. • Geophysical survey programs identified in Table 14.2 overlap spatially with one or more special areas in the RAA.
Offshore Petroleum Exploration – Exploration and Delineation Drilling Programs	• Change in habitat quality	• Several of the ELs in which proposed exploration drilling activities may be carried out in the RAA overlap with or are close to special areas. 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 well site surveys could potentially result in a change in habitat quality for marine species in special areas within several kilometres of the sound source. • MODUs operating more than approximately 40 km away from special areas are not expected to be visible or audible from 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 supply 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). • 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.	• 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). • Environmental assessments for other exploration drilling projects in the RAA have identified potential interactions with special areas through an overlap of Project Areas (e.g., BP's Newfoundland Orphan Basin Exploration Drilling Program Project Area overlaps with the Northeast Newfoundland Slope Closure marine refuge and a portion of proposed critical habitat for the northern and spotted wolffish; Nexen's Flemish Pass Exploration Drilling Project Area overlaps a portion of a VME coral and sponge closure area). Furthermore, most projects have identified the St. John's region as a proposed supply base location. Therefore, supply vessel routes to and from the offshore are very similar between projects and therefore overlap similar special areas, particularly in the nearshore. • 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.

Table 14.6 Special Areas: Residual Effects from Other Ongoing and Likely Future 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)
Fishing Activity	• Change in habitat quality	• 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 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, Northeast Flemish Cap, Northwest Flemish Cap, Sackville Spur, 3O Coral Closure, Fogo Seamounts 1, Newfoundland Seamounts, and Orphan Knoll).	• 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.
Other Ocean Uses	• Change in habitat quality	• Operational discharges, underwater sound, and artificial night-lighting from 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, vessels 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 transitory nature of vessel traffic 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 vessel traffic is expected to be short-term and transient at any given location (including in special areas).
Hunting Activity	• Change in habitat quality	• 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 cumulative effects assessment. • There is no known hunting activity within special areas offshore, nor targeting key species relevant to their designations. Hunting is prohibited within the Witless Bay Ecological Reserve.	• Hunting is limited to nearshore areas (and restricted within the Witless Bay Ecological Reserve) and is therefore not anticipated to interact with offshore special areas in and around the Project Area.

Source: Modified from BP 2018

14.5.4 Potential Cumulative Environmental Effects

14.5.4.1 Cumulative Change in Habitat Quality

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. Zones of influence related to underwater sound (PTS / TTS onset thresholds for the high-frequency cetaceans; see Appendix E), drill cuttings deposition (depositional thicknesses at or above 1.5 mm predicted to be confined within 580 m or less of the drill sites, with a maximum affected area at that thickness of 0.12 km²), and light (influence extends up to 15 km from the MODU [Rodriguez et al. 2014]) are expected to be limited to the Project Area. Therefore, much of the analysis of cumulative environmental effects provided for the corresponding VCs in Sections 14.2, 14.3, and 14.4 is also applicable for special areas.

As noted in Section 14.5.1, the Project Area or LAA overlaps with several special areas. 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, whose boundaries overlap with the Project Area. Many of these special areas also overlap with areas for proposed future exploration drilling programs which would be predicted to have similar environmental effects as the Project. The deposition of Project-related discharges of drill muds and cuttings from each well site could contribute to the residual environmental effects of fishing activity in the RAA, including the disturbance of benthic habitat. However, the extent of benthic disturbance would be localized per well site and, like BHP, other operators proposing exploration drilling activities in these areas have committed to conducting seabed surveys prior to drilling to confirm the absence of sensitive environmental features, such as habitat-forming corals or SAR and implementing an appropriate course of action in consultation with regulatory authorities to avoid or reduce adverse effects on these features. Furthermore, bottom-contact fishing is now restricted in certain areas (including the Northeast Newfoundland Slope Closure marine refuge) which will reduce cumulative adverse effects on sensitive benthic habitat.

Special areas, whose boundaries overlap with the LAA due to proposed supply vessel routes, may also experience effects on habitat quality associated with marine discharges, sound, and light emissions. The supply vessel and helicopter transport routes proposed for this Project would be similar to those used by existing oil and gas development projects on the Grand Banks (given commencement at an existing onshore port) and proposed future exploration drilling projects. Therefore, there is potential for cumulative environmental effects on these special areas due to increased marine traffic. These same areas may be simultaneously or sequentially exposed to habitat quality effects from underwater or atmospheric sound from marine vessels and helicopter traffic associated with oil and gas activities, as well as from existing and future fishing and shipping traffic. However, marine vessels and helicopter traffic of other ocean users are subject to the same special restrictions where necessary to protect sensitive marine species and habitats (e.g., adherence to *Seabird Ecological Reserve Regulations, 2015* and federal guidelines in order to reduce disturbance to colonies). Furthermore, the incremental changes to existing traffic volumes due to supply and servicing from the Project will be minor and temporary with effects being short-term and transitory in any one location.

14.5.5 Cumulative Effects Summary and Evaluation

Cumulative environmental effects on special areas are predicted to be adverse, low 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 (including those proposed for marine fish and fish habitat, marine and migratory birds, and marine mammals and sea turtles), the residual cumulative environmental effects on special areas are predicted to be not significant. 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 existing protection measures in place for special areas (e.g., fishing restrictions and closures).

14.6 COMMERCIAL FISHERIES AND OTHER OCEAN USES

14.6.1 Past and Ongoing Effects (Existing Environment)

Fish harvesting has taken place around the shores of NL for thousands of years, originally by Indigenous peoples and later by Europeans who eventually settled on the Island and parts of the Labrador coasts, primarily to harvest fish. Until the early 1990s, groundfish species accounted for most of the catch, with the majority taken by offshore stern otter trawlers harvesting such species as Atlantic cod, redfish species, American plaice, and other flounders. In 1992 a moratorium was instituted for directed fishing of many groundfish species because of severe stock declines. This closure is still in effect for some species in most areas. Since then, the composition of fisheries has changed within NL and other parts of Atlantic Canada, as groundfish harvesting numbers dropped and shellfish species were pursued much more actively, primarily snow crab and northern shrimp.

Recent harvesting within the RAA reflects the historical changes and trends described above, with shellfish (mainly snow crab and shrimp) making up the greatest part of the harvest by both value and quantity. Together, these two species accounted for 62% of the catch by quantity and nearly 92% by value, while groundfish species made up 10% and 5%, respectively.

The Project Area is contained almost entirely within Unit Area 3Le. Unit Area 3Le and the Project Area overlap with both the NAFO Regulatory Area and the Canadian Exclusive Economic Zone waters. A portion of the southeastern Project Area (approximately 950 km^2) is within an area designated by NAFO as the fisheries "Footprint", or Existing Bottom Fishing Areas - a 120,048 km² zone within the NAFO Regulatory Area where bottom fishing (e.g. otter trawling) has historically occurred.

Within the RAA, there are several areas that are currently closed to all or some commercial fishing activity. These include marine refuges, MPAs, VME closure areas, a snow crab conservation zone and a shrimp fishing area. Within the total area covered by the RAA, these fisheries closure areas represent 16% (25 km² excluding overlap) of the RAA. Safety (exclusion) zones designated for existing oil and gas production projects offshore eastern NL also represent areas that are closed to commercial fishing activity and these areas account for approximately 380 km² of area (0.02%) (refer to Figure 14-3 for locations of areas).

14.6.2 Potential Project-related Contributions to Cumulative Effects

As described in Chapter 12, planned activities associated with the Project have a potential to interact with commercial fisheries either directly through effects on fishing activity itself (e.g., through temporary displacement from preferred fishing grounds, interference and reduced efficiency, or physical interactions, such as fishing gear damage), and/or indirectly from physical or behavioural effects on fish species (e.g., changes in commercial fish or prey health or quality, fish avoiding areas because of underwater sound, or changes in water quality). These interactions might also affect fisheries research, most of which involves fishing with commercial or modified gear. Project activities and installations have a potential to restrict access to marine areas, and/or require route or timing modifications by other marine operators, including freighters, military operations, cruise liners, or other petroleum exploration ships. Submarine infrastructure or artifacts (e.g., communications cables, shipwrecks, UXO) may be affected if they are in areas where Project sub-sea installations occur.

The Project, therefore, has the potential to result in the following residual adverse environmental effects on commercial fisheries and other ocean uses:

- A change in the availability of resources or in access to preferred or usual operating environments 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 12.3 and a determination of significance in Section 12.4. With the implementation of mitigation (Section 12.3.1.2), the residual environmental effects of routine Project activities on commercial fisheries and other ocean uses are predicted to be not significant.

14.6.3 Future Projects and Activities and Their Effects

Table 14.7 summarizes how present and future projects and activities in the RAA have potential to cause a residual change in resource availability affecting commercial fisheries and other ocean uses.

Table 14.7 Commercial Fisheries and Other Ocean Uses: Residual Effects from Other Ongoing and Likely Future 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)
Current Offshore Petroleum Production Projects (Production from Hibernia, Terra Nova, White Rose, and Hebron Oilfields)	• Change in availability of resources and operating environment	• 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 (exclusion) 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 safety (exclusion) zones around production facilities and associated infrastructure for the duration of petroleum production from the Hibernia, Terra Nova, White Rose, and Hebron oilfields. The cumulative total of safety (exclusion) zones for these development projects is approximately 280 km² (refer to Table 14.1 for specific details). • Refer to Table 14.3 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.
Proposed Bay du Nord Development Project	• Change in availability of resources and operating environment	• Effects from the BdN Development Project are expected to be similar to those described above for existing development projects.	• The EIS for this project has not yet been published. The size of the safety (exclusion) zone that will be maintained around project facilities is not yet known. However, based on current design, the footprint of the Project facilities on the seabed will cover approximately 7 km².
Offshore Petroleum Exploration – Geophysical Survey Programs	• Change in availability of resources and operating environment	• 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.	• 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.
Offshore Petroleum Exploration – Exploration and Delineation Drilling Programs	• Change in availability of resources and operating environment	• Offshore petroleum exploration drilling projects exclude access to commercial fisheries and other ocean uses due to the establishment of 500-m radius safety (exclusion) 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 (exclusion) 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 (exclusion) 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 well sites. 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 uses (refer to Chapter 12). • 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.
Fishing Activity	• Change in availability of resources and operating environment	• 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.

Table 14.7 Commercial Fisheries and Other Ocean Uses: Residual Effects from Other Ongoing and Likely Future 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)
Other Ocean Uses	• Change in availability of resources and operating environment	• Other ocean users can occur throughout 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 transitory nature of vessel traffic 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 vessels is expected to be short-term and transient at any given location.
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 cumulative effects assessment.	• Not applicable

Source: Modified from BP 2018

14.6.4 Potential Cumulative Environmental Effects

14.6.4.1 Cumulative Change in Availability of Resources or Operating Environment

Similar to the cumulative effects assessed for Indigenous peoples and communities (see Chapter 13), the following cumulative environmental effect mechanisms are also applicable with respect to commercial fisheries and other ocean uses:

- Temporary displacement of commercial fishers from their customary fishing grounds due to establishment of a 500 m radius safety (exclusion) zone around the Project MODU, as well as the various safety (exclusion) zones associated with other exploration drilling projects and existing and proposed production projects (recognizing safety [exclusion] zones associated with exploration projects are short-term compared to longer term safety [exclusion] zones established for production projects)
- Restriction of fishing activities in fisheries closure areas (e.g., snow crab exclusion zones, marine refuges, NAFO VMEs)
- 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 (exclusion) zones, supply vessels, 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])

Within the RAA, there are several offshore petroleum exploration drilling programs proposed with a similar timeframe as the Project (refer to Table 14.3), as well as existing and proposed production projects. Drilling activities will require a 500-m radius safety (exclusion) zone around the MODU, within which commercial communal fishing activities could be displaced. During the drilling period for each well, there is therefore potential for fishing activities to be excluded from an area of approximately 0.8 km² (80 ha) for up to approximately 115 days. As described in Section 7.2.3.2, most of the two ELs (except a small portion) are currently closed to bottom fishing gear. The domestic fishing grounds that might be affected by safety exclusion zones would be small, based on the available record of past harvesting within the ELs. The Northeast Newfoundland Slope fisheries closure area includes the majority of the joint EL area and the depths of the EL waters east of the closure, beyond the EEZ (most greater than 2,000 m), also limit the potential for harvesting in those areas. For international fisheries, the NAFO fisheries footprint overlaps approximately 34 km² of EL 1158, which is approximately 0.028% of that full bottom fishing area. Harvesting that might occur within the closure area, or most of the deep waters beyond the EEZ, would be limited to non-bottom-contact gear, such as mid-water trawls, pelagic longlines or seines, but there is very little history of such fisheries in or near either EL. Given the availability of other upper-water grounds nearby, this would not be expected to affect the fishing success of any enterprise during the period of operations.

In the RAA there are some fishing restrictions within specific special areas in the RAA, including marine refuges, lobster area closures, NAFO VME closures, a shrimp fishing area (closed to fishing of northern shrimp) and snow crab exclusion zones (refer to Section 6.4). These also may contribute to potential space-use conflicts among fishers. Within the total area covered by the RAA, special areas that are closed to one or more types of fisheries (as represented by these fisheries closure areas) represent 16% (25 km²

excluding overlap of areas) of the RAA. Figure 14-3 shows the cumulative areas where fishing activity is restricted due to existing safety (exclusion) zones and fisheries closure areas; this figure does not show safety (exclusion) zones that would be associated with proposed exploration drilling projects as specific timing and location of wells is not known. Ongoing communication will be required to avoid adverse effects on fisheries that may occur in the RAA.

The presence of supply vessels, 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. These sources could cause a change in fisheries as a result of space-use conflicts. Project supply vessels are not expected to contribute to space-use conflicts with fishing vessels as Project-related vessel traffic will represent a minor component of total marine traffic in the RAA, occupy a negligible proportion of the total available fishing area in the RAA, and be short-term and transient in nature. PSVs will follow the most direct VTR between the shorebase and the Project Area.

Fishing effort within and surrounding the Project Area is relatively low and does not include unique fishing grounds or concentrated fishing effort that occurs exclusively within the Project Area. Underwater sound (see Appendix E), drill cuttings deposition (see Appendix D), and light emissions will not extend beyond the Project Area. The potential for temporary loss of access to preferred fishing areas as a result of the Project is therefore anticipated to be negligible and is unlikely to have a discernable effect on the overall distribution of fishing effort within the RAA.

Physical activities within the RAA may unintentionally result in damage to fishing gear which has the potential to cumulatively interact with the Project to result in a change in fisheries within the RAA. Project-related damage to fishing gear, if any, will be compensated in accordance with industry best practices in the NL offshore and relevant industry guidance material such as the Geophysical, Geological, Environmental, and Geotechnical Program Guidelines (C-NLOPB 2019), the Canadian East Coast Offshore Operators Non-attributable Fisheries Damage Compensation Program (CAPP 2007), and the Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activities (C-NLOPB and CNSOPB 2017). Similar compensation plans would be implemented in the event of gear loss or damage by other operators.

Standard practices for communication among marine users, including the communication of details of the safety (exclusion) zone to the Marine Communication and Traffic Services for broadcasting and publishing in the Navigational Warning and Notices to Mariners systems, is expected to mitigate potential conflicts with fisheries as well as other ocean users. During the drilling program, BHP will continue to engage commercial fisheries groups and relevant enterprises to share Project details and fisheries information, and to determine the need for a fisheries liaison officer during mobilization and demobilization of the MODU, with reference to the One Ocean Risk Management Matrix Guidelines (One Ocean n.d.). A Fisheries Communication Plan will be used to facilitate coordinated communication with fishers, including details about planned activities and the safety (exclusion) zone. It is assumed that other projects and activities in the RAA, including future projects and activities, will be required to comply with various mitigation measures and regulations. BHP 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.

As discussed in Section 14.2, cumulative effects on marine fish (including commercial species) are not expected to be of sufficient magnitude, duration, or extent and therefore are not anticipated to affect catch rates or otherwise cause a change in availability of fisheries resources for commercial fisheries. Section 14.7.4.1 provides the analysis of cumulative environmental effects relating to Indigenous commercial communal fisheries, which is also directly applicable for commercial fishers and other ocean uses. That section should be referred to for the assessment of potential cumulative effects related to a change in availability of resources.

BHP will conduct a visual seabed survey in the vicinity of wells sites confirming the absence of shipwrecks, debris on the seafloor, unexploded ordnance and sensitive environmental features, such as habitat-forming corals or species at risk (SAR) to be used in conjunction with the geohazard assessment based on existing data. The survey will be developed in consultation with the C-NLOPB and DFO and will be carried out prior to drilling under a separate environmental approval by the C-NLOPB. If substantial environmental or anthropogenic sensitivities are identified during the survey, BHP will move the well site to avoid affecting them if it is feasible to do so. If it is not feasible, BHP will consult with the C-NLOPB and DFO to determine an appropriate course of action.

14.6.5 Cumulative Effects Summary and Evaluation

Cumulative environmental effects on commercial fisheries and other ocean uses are predicted to be adverse, negligible to low in magnitude, occurring within the RAA, continuous in frequency, medium-term in duration, and reversible. With the application of proposed Project-related mitigation and environmental protection measures, plus the relative lack of fishing activity, the Project's contribution to cumulative effects is low and the residual cumulative environmental effects on commercial fisheries and other ocean uses are predicted to be not significant. With the application of standard practices for communication among marine users, including broadcasting and publishing in the Navigational Warning, 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 are needed to address potential cumulative effects.

14.7 INDIGENOUS PEOPLES AND COMMUNITIES

14.7.1 Past and Ongoing Effects (Existing Environment)

The Indigenous people and communities VC considers changes to the environment caused by the Project that could affect, with respect to Indigenous peoples, health and socio-economic conditions, physical and cultural heritage including any structure, site or thing of historical, archaeological or paleontological importance, and current use of lands and resources for traditional purposes.

In Eastern Canada there are several Indigenous organizations that hold commercial communal fishing licences for NAFO Divisions that overlap the Project Area, although it is currently not known if the Project Area is used for fishing under these licences. There are no documented food, social and ceremonial (FSC) licences within or near the Project Area. Interactions between Project activities (routine or unplanned) and species harvested for commercial or FSC purposes outside the Project Area may potentially occur during species migration to traditional fishing grounds. There is also the potential for the presence of SAR and/or

of cultural importance in the Project Area (e.g., Atlantic salmon). The EIS Guidelines identify 41 Indigenous groups in NL, NS, NB, PEI and QC that have the potential to be affected by Project activities.

Past and ongoing projects and activities in Eastern Canada have, to varying degrees, interacted with Indigenous peoples and communities, 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 provides an overview of current socio-economic characteristics and conditions of Indigenous communities in the RAA that reflects past and ongoing effects. However, 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. 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.

14.7.2 Potential Project-related Contributions to Cumulative Effects

The nearest Indigenous community to the Project Area is located on the Island of Newfoundland, approximately 450 km from the Project Area. Distances are even further for communities in Labrador, the Maritime provinces, and QC. Given these distances and the localized extent of routine Project activities, there are no pathways for effects from routine Project activities to changes in structures, sites or things of historical, archaeological, paleontological, or architectural significance. Additionally, given the distance from the Project to Indigenous communities and the limited geographic extent of routine Project emissions and discharges, planned Project activities are also not predicted to directly affect the physical or social health and wellbeing of Indigenous communities. It is acknowledged that indirect effects on health and socio-economic conditions may result from Project-related effects on commercial communal or FSC fishing, hunting, or other harvesting activities.

As described in Chapter 13, planned activities associated with the Project have a potential to interact with commercial communal fisheries either directly through effects on fishing activity itself (e.g., through temporary displacement from preferred fishing grounds, interference and reduced efficiency, or physical interactions, such as fishing gear damage), and/or indirectly from physical or behavioural effects on fish species (e.g., changes in commercial fish or prey health or quality, fish avoiding areas because of underwater sound, or changes in water quality). FSC fishing and/or harvesting activities do not occur in the Project Area or LAA; however, routine Project activities could interact with fish, bird or mammal species that migrate through the Project area and are subsequently harvested or have the potential to be harvested by Indigenous groups from onshore / nearshore harvesting sites.

Thus, the Project has potential to result in:

- A 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 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 13.3 and a determination of significance in Section 13.4. With the implementation of mitigation (Section 13.3.2), the residual environmental effects of routine Project activities on Indigenous peoples and communities are predicted to be not significant.

14.7.3 Future Projects and Activities and Their Effects

Table 14.8 summarizes how present and future projects and activities in the RAA have potential to cause a residual change in health and socio-economic conditions and/or a residual change in the current use of lands and resources for traditional purposes affecting Indigenous communities.

Table 14.8 Indigenous Peoples and Communities: Residual Effects from Other Ongoing and Likely Future 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)
Current 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 due to the establishment of safety (exclusion) 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 or FSC 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 geographic extent to affect catch rates or otherwise cause a change in commercial communal fisheries or FSC fisheries. • Marine and migratory birds may be attracted to artificial lighting on the production facilities, causing stranding and/or mortality. However, birds most vulnerable to these effects (e.g., storm-petrels) are not species which are commonly harvested by Indigenous communities. However, these environmental effects on marine and migratory birds are generally not expected to be of sufficient magnitude, duration, or geographic extent to affect harvesting activities. • The transiting of supply vessels has potential to cause mortality of marine mammals (including seals, which are a species of importance to Indigenous harvesters) due to vessel strikes. Similarly, these environmental effects on marine mammals are generally not expected to be of sufficient magnitude, duration, or geographic extent to affect harvesting activities.	• Commercial communal fishing activity has been, and will continue to be, excluded within the safety (exclusion) zones around production facilities and associated infrastructure for the duration of petroleum production from the Hibernia, Terra Nova, White Rose, and Hebron oilfields. The cumulative total of safety (exclusion) zones for these development projects is approximately 280 km² (refer to Table 14.1 for specific details). • Refer to Table 14.3 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.
Proposed Bay du Nord Development Project	• Change in commercial communal fisheries • Change in the current use of lands and resources for traditional purposes	• Effects from the BdN Development Project are expected to be similar to those described above for existing development projects.	• The EIS for this project has not yet been published. The size of the safety (exclusion) zone that will be maintained around project facilities is not yet known. However, based on current design, the footprint of the Project facilities on the seabed will cover approximately 7 km².
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 cumulative effects assessment 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) due to vessel strikes. • There is potential for entanglement of marine mammals (including seals) 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.

Table 14.8 Indigenous Peoples and Communities: Residual Effects from Other Ongoing and Likely Future 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 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 (exclusion) zones around their MODUs. • Marine and migratory birds may be attracted to artificial lighting on the production facilities, causing stranding and/or mortality. However, birds most vulnerable to these effects (e.g., storm-petrels) are not species which are commonly harvested by Indigenous communities. Environmental effects on marine and migratory birds are generally not expected to be of sufficient magnitude, duration, or geographic extent to affect harvesting activities. • 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. • Other discharges and emissions (including drilling and testing emissions) will result in temporary and localized effects on water quality around exploration well sites. 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 supply vessels has potential to cause mortality of marine mammals (including seals) due to vessel strikes. However, these environmental effects on marine mammals are generally not expected to be of sufficient magnitude, duration, or geographic extent to affect harvesting activities.	• 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 communities (refer to Chapter 13). • 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) due to vessel strikes. • There is potential for entanglement of marine mammals (including seals) or marine birds (e.g., murres) in fishing gear potentially causing mortality of entangled individuals.	• 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.
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 throughout 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 transitory nature of vessel traffic 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 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 for species of importance to Indigenous harvesters associated with underwater sound and vessel strikes.
Hunting Activity	• Change in commercial communal fisheries • 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 cumulative effects assessment.	• Although hunting is conducted within 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.

Source: Modified from BP 2018

14.7.4 Potential Cumulative Environmental Effects

14.7.4.1 Cumulative Change in Commercial Communal Fisheries

Potential cumulative environmental effects on Indigenous peoples and communities may result in changes to commercial communal fisheries, primarily related to resource use conflicts as per the following pathways:

- Temporary displacement of commercial fishers from customary fishing grounds due to a 500-m radius safety (exclusion) zone around the Project MODU, and the various safety (exclusion) zones associated with other exploration drilling projects and existing and proposed production projects (recognizing safety [exclusion] zones associated with exploration projects are short-term compared to longer term safety [exclusion] zones established for production projects)
- Restriction of fishing activities in fisheries closure areas (e.g., snow crab exclusion zones, marine refuges, NAFO VMEs) therefore resulting in increased competition with other displaced commercial fishers over remaining commercial fishing areas
- The cumulative 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 supply vessels, 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])

Within the RAA, there are several offshore petroleum exploration drilling programs proposed with a similar timeframe as the Project (refer to Table 14.3), as well as existing and proposed production projects. Drilling activities will require a 500-m radius safety (exclusion) zone around the MODU, within which commercial communal fishing activities could be displaced. During the drilling period for each well, there is therefore potential for Indigenous fishing activities to be excluded from an area of approximately 0.8 km² (80 ha) for up to approximately 115 days. 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 most relevant to pelagic fisheries. The safety (exclusion) 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. As indicated in Table 14.2, there are nine additional exploration drilling projects which could occur during the same timeframe of this Project. It is assumed, for the purpose of this assessment, that each of these exploration projects would institute a 500-m radius safety (exclusion) zone (approximately 0.8 km²) from which fisheries and other ocean uses would be temporarily excluded. It is unknown how many wells will actually be drilled and over what timeframe to be able to calculate an accurate estimate of fishing exclusion zones which could occur in the RAA at any given time. Although these safety (exclusion) zones would be in addition to the approximately 380 km² footprint of safety (exclusion) zones associated with existing production projects in the RAA.

In the RAA there are some fishing restrictions within specific special areas in the RAA, including marine refuges, lobster area closures, NAFO VME closures, a shrimp fishing area (closed to fishing of northern shrimp) and snow crab exclusion zones (refer to Section 6.4). These also may contribute to potential space-use conflicts among commercial communal fishers. Within the total area covered by the RAA, special areas that are closed to one or more types of fisheries (as represented by these fisheries closure areas) represent

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16% (25 km² excluding overlap of areas) of the RAA. Figure 14-3 shows the cumulative areas where fishing activity is restricted due to existing safety (exclusion) zones and fisheries closure areas; this figure does not show safety (exclusion) zones that would be associated with proposed exploration drilling projects as specific timing and location of wells is not known. Ongoing communication will be required to avoid adverse effects on commercial communal fisheries that may occur in the RAA and associated health and socio-economic conditions in Indigenous communities.

The presence of supply vessels, 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. These sources could cause a change in commercial communal fisheries as a result of space-use conflicts. Project supply vessels are not expected to contribute to space-use conflicts with fishing vessels as Project-related vessel 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. PSVs will follow the most direct vessel traffic routes between the shorebase and the Project Area.

Indigenous fishers that experience a change in access to their customary fishing areas as a result of the Project in combination with other physical activities in the RAA may be required to temporarily relocate their fishing effort. A temporary relocation could put additional pressure on nearby fishing areas, and therefore be adversely affected by the resultant competition for remaining fishing areas in the RAA. Fishing effort within and surrounding the Project Area is relatively low and does not include unique fishing grounds or concentrated fishing effort that occurs exclusively within the Project Area. Underwater sound (see Appendix E), drill cuttings deposition (see Appendix D), and light emissions will not extend beyond the Project Area. The potential for temporary loss of access to preferred fishing areas as a result of the Project is therefore anticipated to be negligible and is unlikely to have a discernable effect on the overall distribution of fishing effort within the RAA.

Physical activities within the RAA may unintentionally result in damage to fishing gear which has the potential to cumulatively interact with the Project to result in a change in commercial communal fisheries within the RAA. Project-related damage to fishing gear, if any, will be compensated in accordance with industry best practices in the NL offshore and relevant industry guidance material such as the Geophysical, Geological, Environmental, and Geotechnical Program Guidelines (C-NLOPB 2019), the Canadian East Coast Offshore Operators Non-attributable Fisheries Damage Compensation Program (CAPP 2007), and the Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activities (C-NLOPB and CNSOPB 2017). Similar compensation plans would be implemented in the event of gear loss or damage by other operators.

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. BHP (and several other operators conducting exploratory drilling) will also have an Indigenous Fisheries Communication Plan which will provide a framework for regular operational updates to Indigenous groups as well as emergency notifications if needed.

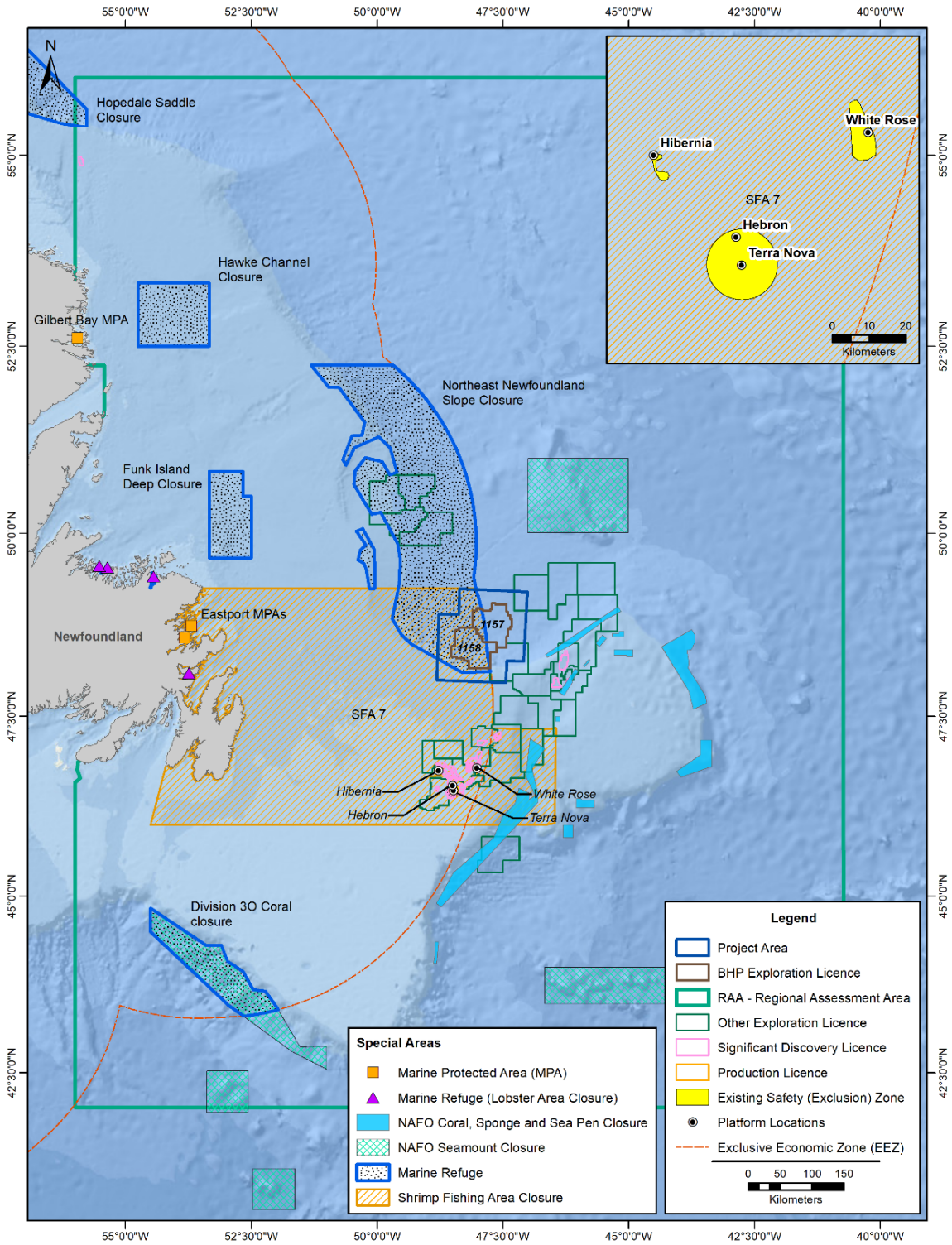

Figure 14-2 Established Safety Zones and Fisheries Closures Areas Offshore Newfoundland and Labrador

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. 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.

14.7.4.2 Cumulative Change in Current Use of Lands and Resources for Traditional Purposes

Although there are no known FSC fisheries in the Project Area, the assessment of cumulative effects on current use of lands and resources considers cumulative effects on migratory fish, bird and marine mammal species that have the potential to migrate through the Project Area. Potential cumulative environmental effects on Indigenous peoples and communities may result in changes to current use of lands and resources for traditional purposes through environmental effects on marine fish, marine and migratory birds and marine mammals and sea turtles due to the generation of underwater sound and water quality effects associated with discharges. The Atlantic salmon and American eel were noted as having cultural and spiritual importance to the Indigenous communities and are known to occur in the RAA; therefore, potentially affected by cumulative environmental effects. Similarly, Indigenous groups harvest seals for FSC purposes as well as marine birds (such as goose, ducks, loons, seagulls, murres, mergansers, and scoters). Cumulative effects on marine fish, marine and migratory birds, and marine mammals and sea turtles; however, were found to be not significant (refer to Sections 14.2, 14.3 and 14.4). Cumulative adverse effects on marine species that could be considered important from a food, social or ceremonial perspective, are not predicted to cause a change in quantity, quality or availability of these resources that could result in a change in health and socio-economic conditions or a change in current use of lands and resources for traditional purposes.

14.7.5 Cumulative Effects Summary and Evaluation

Residual adverse effect from Project activities may combine with other exploratory drilling projects, production projects, geophysical exploration surveys, commercial fishing, hunting, and other ocean users to result in cumulative environmental effects on Indigenous peoples and communities. Cumulative environmental effects on Indigenous peoples and communities are predicted to be adverse, negligible to low 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, standard practices for communication among marine users (including the development of an Indigenous Fisheries Communication Plan to facilitate coordinated communication with fishers), and ongoing Indigenous engagement efforts from other petroleum operators in the Newfoundland offshore area, the Project's contribution to cumulative effects is low and the residual cumulative effects on Indigenous peoples and communities are predicted to be not significant. No additional mitigation measures are proposed to address potential cumulative effects.

14.8 MITIGATION, MONITORING, AND FOLLOW-UP

VC-specific mitigation, monitoring and/or follow-up programs included as part of the Project-specific environmental effects assessment (Chapter 8 to 13) are applicable to the cumulative effects assessment. In recognition of existing pressures and threats caused by other projects and activities, various mitigation measures are being implemented to reduce adverse environmental effects, including use of regulations, guidelines, statements of practice and administrative restrictions. It is assumed that other projects and activities in the RAA, including future projects and activities, will be required to comply with various mitigation measures and regulations, thus also reducing cumulative effects. No additional or revised monitoring or follow-up is required or proposed specifically for potential cumulative environmental effects beyond standard measures that are implemented in the regular course of operations for other projects and activities.

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