West Flemish Pass Exploration Drilling Program

Chapters 8 to 14

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Table of Contents

LIST OF TABLES

LIST OF FIGURES

8.0 ASSESSMENT OF POTENTIAL EFFECTS ON MARINE FISH AND FISH HABITAT

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

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

The presence and abundance of marine fish species, and associated abiotic and biotic habitat characteristics, vary considerably across the eastern NL offshore area, which transitions from shelf areas to the continental slope and deeper waters. This VC considers relevant fish species (including SAR and SOCC), plankton, algae, benthos, and relative components of their habitat, such as water and sediment quality.

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

8.1 Scope of Assessment

8.1.1 Regulatory and Policy Setting

There are two regulatory regimes with authority over marine fish and fish habitat within the Project Area, LAA, and RAA. The Government of Canada manages fish stocks within the Exclusive Economic Zone (EEZ). Within these areas, the Canadian federal *Fisheries Act*, which was updated on June 21, 2019, provides protection of all fish and fish habitat and protection against the death of fish (other than by fishing) and the harmful alteration, disruption or destruction of fish habitat (HADD). This includes protection of fisheries by managing the fish resources and habitats that support these activities. Outside Canada's EEZ, groundfish, pelagic fish, and benthic invertebrates are managed by the NAFO, which is an intergovernmental fisheries science and management body.

The *Fisheries Act* and its associated regulations provide protection to fisheries by managing fish resources and the habitats that support them. The updated *Fisheries Act* contains provisions for the protection of all fish and fish habitats, restores the prohibition against HADD, prohibits activities that cause the "death of fish" (other than fishing activities), considers the cumulative effects of development activities, and provides

improved protection of highly productive, sensitive, rare or unique fish and/or fish habitats The potential effects of the Project on marine fish and fish habitat are relevant to the provisions of the *Fisheries Act* and are considered in this section. Some species and their habitats may also have legislative protection under the *Species at Risk Act* (SARA) or the Newfoundland and Labrador *Endangered Species Act* (NL ESA).

Fish SAR are protected under the federal SARA, which focuses on protecting species and associated habitat whose populations are not secure. For this assessment, sections 32, 33, and 58 of SARA are the most relevant, containing provisions to protect species listed on Schedule 1 of SARA and their critical habitat. Critical habitat is defined by SARA 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 the recovery strategy or in an action plan for the species”.

Under section 79 of SARA, Ministerial notification is required if a project is likely to affect a listed wildlife species or its critical habitat. The 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, must ensure that measures are taken to avoid or lessen those effects and to monitor them.

Marine fish SAR may also be formally protected under the NL ESA. A list of all marine fish SAR that may occur in the RAA is provided in Section 6.1.8.

8.1.2 The Influence of Consultation and Engagement on the Assessment

During Chevron’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). These primarily include concerns regarding 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

As described in AMEC (2014) and other recent EAs, potential interactions between planned offshore oil and gas activities and pathways of potential effects on marine fish and fish habitat include:

- 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 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 the mobile offshore drilling unit (MODU) and vessels may increase potential for injury, mortality, contamination, and other interactions.
- Temporary avoidance of areas by marine fish due to underwater sound or other disturbances, which may alter their presence and abundance as well as disturbing movements / migrations, feeding, or other activities.

- Changes in the availability, distribution, or quality of food sources and/or habitats for fish and invertebrates as a result of planned activities and their associated environmental emissions.
- Injury, mortality, or other disturbances to marine fish as a result of exposure to sound within the water column during vertical seismic profiling (VSP) survey activity.

In consideration of these potential interactions, and the policies in place to protect fish and fish habitat, the assessment of Project-related environmental effects on marine fish and fish habitat is focused on the following potential environmental effects:

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

These effects capture *Fisheries Act* prohibitions against HADD and allow for consideration of effects on fish SAR. The measurable parameters used for the assessment of the environmental effects presented above, and the rationale for their selection, are provided in Table 8.1. Effects of accidental events are assessed separately in Section 15.5.1.

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

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Risk of Mortality or Physical Injury	• Direct Project effects on fish mortality, injury, or health due to direct interactions with individuals or indirectly through a change in habitat quality (degradation of water/sediment quality affecting fish health)	• Mortality (may be either direct measurement or qualitative), focused on population level changes
Change in Habitat Quality and Use	• Change in fish habitat due to physical disturbance, destruction of benthic habitats, or deposition of cuttings / drill muds • Change in fish habitat quality due to a change in the chemical composition of water and sediment • Increased risk of exposure to underwater sound at levels capable of causing sensory disturbance	• Areal extent (ha) of alteration or destruction of fish habitat • Areal extent (ha) of fish habitat affected by changes in water quality and/or sediment quality that exceed applicable Canadian Council of Ministers of the Environment (CCME) guidelines • Area of habitat affected by underwater sound emissions at sound exposure levels which could result in potential behavioural effects on fish

8.1.4 Boundaries

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

8.1.4.1 Spatial Boundaries

Project Area: The Project Area (Figure 8-1) encompasses the immediate area in which Project activities would occur. Well locations have not been identified but will occur within the Project Area within EL 1138. The Project Area has been delineated to provide a 10 km buffer around the EL.

Local Assessment Area (LAA): The LAA (Figure 8-1) is the maximum area within which environmental effects from routine Project activities and components can be predicted or measured within a reasonable degree of accuracy and confidence. It consists of the Project Area and adjacent areas where Project-related environmental effects are reasonably expected to occur based on available information, including effects thresholds, predictive modelling, and professional judgement. The LAA also includes transit routes to and from the Project Area.

Regional Assessment Area (RAA): The RAA (Figure 8-1) is the area within which residual environmental effects from operational activities and accidental events may interact with marine fish and fish habitat that are outside of the Project Area. The RAA also accounts for residual environmental effects related to routine activities that could interact cumulatively with the residual environmental effects of other past, present, and future (certain or reasonably foreseeable) physical activities.

8.1.4.2 Temporal Boundaries

The temporal boundaries for the Project to be assessed encompass all Project phases, including well drilling, testing, and abandonment. Chevron is currently planning to drill up to eight exploration and delineation / appraisal wells over the term of EL 1138 (2016 to 2025). Project activities at each well could take approximately 180 days. Well testing 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. VSP surveys typically take approximately one to three days per well. Drilling operations would not be continuous throughout the Project and would depend on rig availability and results from previous wells. While drilling activities could be conducted year-round, Chevron's preference is to conduct drilling from May to September.

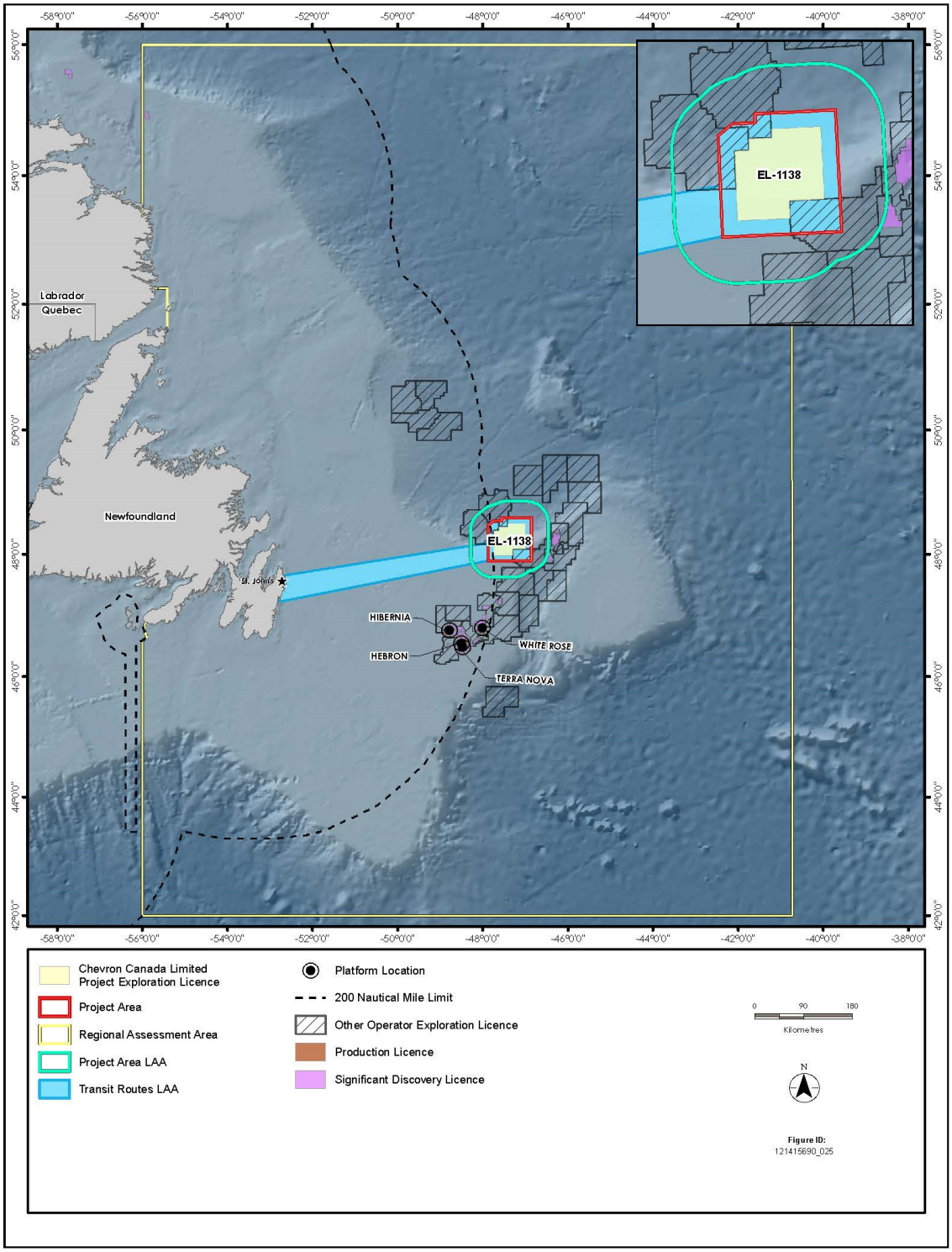

Figure 8-1 Marine Fish and Fish Habitat Assessment Areas

8.1.5 Residual Effects Characterization

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

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

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual environmental effect relative to baseline	**Positive** – a residual environmental effect that moves measurable parameters in a direction beneficial to marine fish and fish habitat relative to baseline **Adverse** – a residual environmental effect that moves measurable parameters in a direction detrimental to marine fish and fish habitat relative to baseline **Neutral** – no net change in measurable parameters for fish and fish habitat relative to baseline
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions	**Negligible** – no measurable change **Low** – a detectable change but within the range of natural variability **Moderate** – a detectable change beyond the range of natural variability, but with no associated adverse effect on the viability of the affected population **High** – a detectable change that is beyond the range of natural variability, with an adverse effect on the viability of the affected population
Geographic Extent	The geographic area in which a residual environmental effect occurs	**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 period of time required until the measurable parameter or the VC returns to its existing condition, or the residual effect can no longer be measured or otherwise perceived	**Short term** - for duration of the activity, or for duration of accidental event **Medium term** - beyond duration of activity up to end of Project, or for duration of threshold exceedance of accidental event – weeks or months **Long term** - beyond Project duration of activity, or beyond the duration of threshold exceedance for accidental events - years **Permanent** - recovery to baseline conditions unlikely

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 baseline conditions before or after Project completion **Irreversible –** permanent
Ecological and Socio-economic Context	Existing condition and trends in the area where residual effects occur	**Undisturbed** – The VC is relatively undisturbed in the 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

In consideration of the measurable parameters and residual effects descriptors listed above, the following threshold criteria has been established to define a significant adverse residual environmental effect on marine fish and fish habitat.

For the purpose of this effects assessment, a significant adverse residual effect on fish and fish habitat is defined as one that causes:

- A significant decline in 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.
- Jeopardizes the achievement of self-sustaining population objectives or recovery goals for listed SARA species.
- Results in permanent and irreversible loss of critical habitat as defined in a recovery plan or an action strategy.
- Results in the death of fish or HADD of fish habitat as defined by the *Fisheries Act* that is unauthorized, unmitigated, or not compensated through offsetting measures in accordance with DFO's Fisheries Protection Policy Statement.

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 the VC and result in the identified environmental effect. These interactions are indicated by a 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 assigning 'no interaction' is provided.

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

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 Abandonment	✓	✓
Supply and Servicing Operations (including helicopter transportation and Project supply vessel operations)	-	✓

Notes:
✓ = Potential interaction
– = No interaction

If during an exploration program there is sufficient indication of hydrocarbon presence, well testing (formation flow testing) will be undertaken to sample and identify formation fluids (which may contain hydrocarbons and/or water) and to measure flow rates. Formation flow testing may or may not include flaring; if flaring is required, produced hydrocarbons will be separated from produced water on the MODU. Compared to production drilling operations, the amount of produced water generated during exploration drilling is typically very small (Statoil Canada Ltd. 2017). Any water generated will be sent to the MODU's flare, treated for disposal in accordance with the Offshore Waste Treatment Guidelines (OWTG), or shipped to shore. Well evaluation and testing 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 or a change in habitat quality and use. During well evaluation and testing activities, the atmospheric and light emissions from these activities will occur above the water and will not interact with marine fish or their habitat. The potential effects of lights from vessels are addressed under the potential environmental effects from the presence and operation of a MODU.

The well abandonment program has not yet been defined for the Project. The wellhead removal strategy will consider water depth and the likelihood of potential interactions with fishing activities. Given the water depths in the Project Area, approval from the C-NLOPB may be sought in order to leave the wellheads in place in water depths greater than 900 m. If approved, the infrastructure that will be left on the seafloor will be a wellhead of approximately 1.5 to 3.7 m in height which will take up a permanent footprint of less than 1 m². All other subsea infrastructure will be removed; the blow-out preventer (BOP) will only be removed once the cement plugs are in place. If wellheads are to be removed, a mechanical casing / wellhead cutting device from the MODU will be used. The seafloor will then be inspected by a ROV or other equipment to verify that no obstructions to fishing gear or equipment remain in place. As Project planning continues, final details about the well abandonment program will be confirmed with the C-NLOPB. Well decommissioning will be carried out as per Chevron's internal procedures and with the *Newfoundland Offshore Petroleum Drilling and Production Regulations*.

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. Potential effects of sound produced by helicopters on the marine environment are related primarily to the aircraft altitude and sea surface conditions. Underwater sound levels from helicopters are generally higher just below the water surface and directly beneath the aircraft. It has been found that single or occasional overhead flights would cause no more than a brief behavioural response in marine mammals (Richardson et al. 1995), and it can be inferred that there would be less of an effect on marine fish, in general, though pelagic species that may occur near the surface (i.e., sharks and tunas) may elicit a similar, brief behavioural response. Helicopter operations will have very limited interaction with the marine environment and associated marine fish species. The underwater sound levels associated with supply vessel traffic is not expected to be at levels that would cause injury or mortality to marine fish species. Fish are expected to temporarily avoid the immediate areas subject to supply vessel traffic, thereby reducing the risk of fish mortality due to vessel strikes or contact with propeller blades. Supply and servicing operations could result in a change in habitat quality and use, which is discussed in Section 8.3.

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

The following section assesses the environmental effects on marine fish and fish habitat identified as arising from potential interactions in Table 8.3. Given the similarities in project description, proximity of activities in the Flemish Pass, and use of current data, this EIS incorporates relevant information from previous EA documents for similar exploration drilling projects in Atlantic Canada, including comments received during Indigenous and stakeholder review processes.

8.3.1 Change in Risk of Mortality or Physical Injury

8.3.1.1 Project Pathways

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

8.3.1.2 Mitigation

In consideration of the effects pathways for change in risk of mortality or physical injury noted above, the following mitigation measures will be employed to reduce the potential effects of the Project on marine fish and fish habitat.

Vertical Seismic Profiling Operations

- As required in the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2019), mitigation measures applied during geophysical surveys (VSP) will be consistent with those outlined in the SOCP (DFO 2007). While this procedure is primarily used to prevent injury to marine mammals (see Section 10.3), it will also have benefits in mitigating potential harm from underwater sound for other marine life, including fish. The following are key mitigation measures that will be employed during VSP surveys:
  - A ramp-up procedure (i.e., gradually increasing seismic source elements over a period of approximately 30 minutes until the operating level is achieved) will be implemented before any VSP activity begins. This measure will provide an opportunity for fish to move out of the area prior to initiation of the survey.

Discharges

- To mitigate potential environmental effects on fish and fish habitat from discharges in the Project Area during the Project activities, the following mitigation will be implemented based on applicable regulations and guidelines:
  - Selection of drilling chemicals will be in accordance with the Offshore Chemical Selection Guidelines for Drilling and Production Activities on Frontier Lands (OCSG; 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 scheme and pose little or no risk to the environment.
  - Offshore waste discharges and emissions associated with the Project (i.e., operational discharges and emissions from the MODU and supply vessels) will be managed in accordance with relevant regulations and municipal bylaws as applicable, including the Offshore Waste Treatment Guidelines (NEB et al. 2010) and MARPOL, of which Canada has incorporated provisions under various sections of the *Canada Shipping Act, 2001*. Waste discharges not meeting legal requirements will not be discharged to the ocean and will be brought to shore for disposal.
  - Sewage will be macerated to a particle size of < 6 mm and discharged as per the OWTG.
  - Waste discharges not meeting OWTG requirements and domestic garbage will be transported to shore for disposal or recycled. Garbage is segregated as required and in compliance with waste disposal requirement and Chevron's Waste Management Plan (WMP).

- Discharges of SBM mud and cuttings will be managed in accordance with the Offshore Waste Treated Guidelines (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 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.
- Foreign vessels operating in Canadian jurisdiction must comply with the Ballast Water Control and Management Regulations of the *Canada Shipping Act, 2001* during ballasting and de-ballasting activities.
- Cooling water will be discharged according to the OWTG which states that any biocides used in cooling water are selected in line with a chemical management system developed in line with the OCSG.
- Small amounts of produced water may be flared. If volumes of produced water are large, some produced water may be brought onto the MODU for treatment so that it can be discharged in line with the OWTG.
- Biomedical waste will be collected onboard by the medical professional and stored in special containers before being sent to land for incineration.

8.3.1.3 Characterization of Residual Project-related Environmental Effects

8.3.1.3.1 Presence and Operation of a MODU

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

It is generally recognized that the establishment of a single-sound exposure criterion for marine fish to predict physical or behavioural changes is impossible given the variation of sound characteristics from different types of sound sources and interspecific differences in how sound affects fish (Popper et al. 2014). As there is no direct evidence of mortality or potential mortal injury to fish due to exposure to sound from vessels, Popper et al. (2014) propose qualitative guidelines (Table 8.4) based on distance from the sound source to describe the relative risk to marine fish of potentially experiencing mortality, impairment, and behavioural effects from exposure to continuous sources of underwater sound.

Table 8.4 Guidelines for Shipping and Continuous Sounds

Type of Animal	Mortality and potential mortal injury	Impairment			Behavior
		Recoverable injury	TTS (temporary thresholds shifts)	Masking	
Fish: no swim bladder (particle motion detection)	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Fish: swim bladder is not involved in hearing (particle motion detection)	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Fish: swim bladder involved in hearing (primarily pressure detection)	(N) Low (I) Low (F) Low	170 dB rms for 48 h	158 dB rms for 12 h	(N) High (I) High (F) High	(N) High (I) Moderate (F) Low
Eggs and larvae	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) Low	(N) Moderate (I) Moderate (F) Low

Source: Reproduced from: Popper et al. 2014
Notes: rms sound pressure levels dB re 1 µPa. All criteria are presented as sound pressure even for fish without swim bladders since no data for particle motion exist. Relative risk (high, moderate, low) is given for animals at three distances from the source defined in relative terms as near (N), intermediate (I), and far (F).

The operation of the MODU will include continuous sound generated by DP and drilling activities. Considering the qualitative guidelines recommended by Popper et al. (2014) and the acoustic modelling conducted for similar exploration drilling projects in the eastern NL offshore area (e.g., Husky Energy 2012), potential physical injury effects on fish associated with MODU operations would likely be very localized. Aggregations of fish surrounding the thrusters are unlikely due to turbulence generated by the thruster propellers. Exposure to sound at such levels would be transient, as it is expected that mobile fish would respond behaviourally at lower thresholds and move away before injury could occur. There has been no direct evidence of fish mortality as a result of exposure to continuous underwater sound (Popper and Hastings 2009; Popper et al. 2014). A review of data by Popper et al. (2014) provided evidence of continuous underwater sound causing TTS and auditory tissue effects in goldfish (*Carassius auratus*) and/or catfish (*Pimelodus pictus*). One study observed a maximum TTS of approximately 16 decibel (dB) in combination with recoverable loss of sensory hair cells in the ear of goldfish after 48 hours of exposure to continuous underwater sound with a sound pressure level (SPL) of 170 dB re 1 µPa rms (Smit et al. 2006, in Popper et al. 2014). Another study observed a 26 dB TTS in goldfish and a 32 dB TTS in catfish following 12 hours of exposure to continuous underwater sound at 158 dB re 1 µPa rms SPL (Amoser and Ladich 2003, in Popper et al. 2014). The source SPL associated with the operation of a MODU is estimated to be 196.7 dB re 1 µPa @ 1 m rms (Matthews et al. 2018), therefore, effects from sound at this level are only expected if fish are in the immediate area at the time the sound is produced and remain there for some duration.

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

Residual effects associated with the presence and operation of a MODU on a change in risk of mortality and physical injury to marine fish and fish habitat is predicted to be:

- Adverse
- Low in magnitude
- Restricted to the Project Area
- Short-term in duration
- Occur more than once at irregular intervals
- Reversible

8.3.1.3.2 Vertical Seismic Profiling

VSP surveys are expected to generate the highest levels of underwater sound associated with the Project. While intense, the VSP sound source will be activated intermittently. Survey operations will occur over a relatively short period of time of approximately one to three days for each well. VSP surveys will be conducted as required throughout the life of the Project. Sound source parameters representative of the Project were compared to those of the Nexen Energy ULC Flemish Pass Exploration Drilling Project (Matthews et al. 2018). The source SPL associated with VSP operations is estimated to be 247.8 dB re 1 µPa peak @ 1 m (broadside) (Matthews et al. 2018). The received SPL to which fish are exposed due to an operational VSP with a source SPL of 247.8 dB re 1 µPa peak @ 1 m will depend on various factors, including the distance between the source and receiver, extent of sound propagation underwater, frequency and duration. For those fish species with swim bladders (i.e., the most sensitive), Popper et al. (2014) propose a 207 dB re 1 µPa peak SPL threshold for recoverable injury (although Popper et al.'s proposed received sound during seismic surveys, are derived from data primarily involving pile driving (Halvorsen et al. 2011, 2012a, 2012b, in Popper et al. 2014).

A recent review of 70 laboratory and field studies found only a few reports describing physical damage to adult fish (e.g. mortality, barotrauma; Carroll et al. 2017), all of which occurred when the fish were in extreme proximity to the air source (i.e., fish at distances <1 m from the source [McCauley et al. 2000a; Popper et al. 2005]). Other studies indicate that a TTS may occur when anthropogenic sounds exceeding normal ambient sound; however, it is expected the animal will recover over time (Popper et al. 2005, 2014; Popper and Hastings 2009). Communication, predator or prey detection, and/or assessing their environment may decrease in fish experiencing a TSS (Popper et al. 2014).

Early life stages of fish may be more susceptible to underwater sound than older life stages. Kostyuchenko (1973) studied the effects of energy released from a single large air source discharge on the survival and injury to the eggs of several commercial fish species. Survival in the fish eggs was over 75% at 0.5 m from the air source, over 87% at 5 m and over 90% when placed 10 m from the sound source.

The larvae of some groups (e.g., flounders / soles / flatfishes, gobies) have swim-bladders that are lost during development prior to settlement on the seafloor as juveniles, these swim-bladders are thought to increase the susceptibility to larvae from underwater sound. For fish, there is some indication of possible mortality immediately adjacent to a seismic sound source, but results are conflicting. Most of the damage that has been reported in fish larvae occurred when they were 1.5 m or closer to air sources and little or no effect has been observed at distances of >5 m (Fields et al. 2019). An exception was noted in McCauley et al. (2017) where experimental seismic sound exposure caused a 50% reduction in copepods and cladocerans out to a distance of 658 m from the source, where the received SEL was 186 dB re 1 µPa peak-to-peak.

Experimental exposure of common sole (*Solea solea*) larvae to pile driving sound levels (up to 210 dB re 1 μPa^2) did not result in increased larval mortality (Bolle et al. 2012). Similarly, there was no substantial change in the survival of cod eggs following close-range exposure (1-10 m) to air sources by Dalen and Knutsen (1987). Payne et al. (2009) also found no statistical differences in mortality (24-72 h post exposure) of exposed monkfish (*Lophius americanus*) larvae or capelin eggs in relation to survival. However, Survival of anchovy (*Engraulis encrasicolus ponticus*) and Mediterranean horse mackerel eggs (*Trachurus mediterraneus ponticus*) were reduced after exposure to air source blasts (Kostyuchenko 1973)

Received sound levels are unlikely to result in physical effects to most mobile fish species due to the expectation that they would avoid underwater sound at lower levels than those at which injury or mortality may occur. Prior to the survey and as mitigation, a ramp-up period for the VSP source will be initiated to deter mobile fish from the area, reducing the risk of individuals being exposed to harmful levels of sound above threshold levels associated with potential injury effects. While sound levels are anticipated to extend potentially 40 km beyond the Project Area into the LAA, the risk of injury and mortality will be negligible on fish.

For invertebrates, crustaceans and bivalves are the most studied groups, aspects investigated include catch rates and physical, behavioural, and physiological effects (Edmonds et al. 2016). Day et al. (2016) conducted a study to emulate seismic surveys in terms of exposure levels, exposing caged spiny lobster (*Jasus edwardsii*) and scallops (*Pecten fumatus*) to levels equivalent to those of a full scale seismic array passing within a few hundred meters. In lobster, exposure to air source signals did not result in any mortality in any of the four scenarios comprising this study, which included SPLs of 223 to 227 dB re 1 µPa peak-to-peak at the lobster pots containing the experimental lobsters. Following seismic sound exposure two reflexes, tail extension and righting, showed a response. Tail extension, a simple reflex, was reduced in lobsters in one of the four experiments conducted; and righting, a complex reflex was reduced in three of four studies. Damage to the sensory hairs of the statocyst, the primary mechanosensory and balance organ of the lobster, was observed following exposure in three of four experiments, which is thought to have affected the righting reflex. In contrast, no differences in righting time were detected in the American lobster 9, 65, or 142 days after exposure to air source sound of SPLs of 202 to 227 dB re 1 µPa peak-to-peak, indicating no immediate or long-term effects on predator avoidance behaviour of this species (Payne et al., 2007).

In scallop repeated exposure to seismic sound has shown to increase mortality. Day et al. (2016) indicated the risk of mortality substantially increased over a 120 seismic survey period, with the majority of mortality

occurring on day 120. Day et al. (2016) also noted electrolytes, minerals and metabolites in scallop haemolymph showed disrupted levels through day 120. Haemolymph pH in two of the three experiments, which showed a slight but persistent alkalosis corresponding to exposure level to day 14 post-exposure in those two experiments. Scallops demonstrated a reduction of classic behaviours during exposure eliciting a novel velar flinch behavior to seismic sound (Day et al. 2016).

Plankton, including ichthyoplankton, could also be affected by sound during VSP activities, as research has indicated that exposure to underwater sound associated with seismic air gun source arrays may result in a change in risk of mortality for plankton in the immediate vicinity of the seismic activity. Sound exposure guidelines for eggs and larvae determined by Popper et al. (2014) suggest that potential mortality or physical injury to eggs and larvae from seismic sources may result from a cumulative SEL greater than 210 dB re 1 µPa²s or peak SPLs greater than 207 dB re 1 µPa. Underwater sound generated by the seismic source arrays used in VSP may cause mortality of fish eggs, larvae, or fry in very close proximity (<5 m) to the sound source (Kostyuchenko 1973; Booman et al. 1996). Increased mortality to zooplankton and ichthyoplankton increases within two metres from the source and sub-lethal injuries can occur within five metres of the sound source (Østby et al. 2003, in Boertmann and Mosbech 2011). Similarly, intense and lengthy periods of exposure to low-frequency sound such as those in Booman et al. (1996) (220-242 dB re 1 µPa SPL, 0.75-6 m from sound source in caged experiments) can increase abnormality and mortality rates, indicating that fish larvae exposed to near-field air source may be vulnerable.

There is also evidence that sound exposure during larval development could increase mortality risk by producing body malformation in marine invertebrates (de Soto et al. 2013). Scallop larvae that were exposed to playbacks of seismic pulses showed developmental delays and 46% showed body abnormalities (de Soto et al. 2013). The potential mortality associated with the VSP sound source is not considered to affect recruitment in marine fish populations (Dalen et al. 1996).

Residual environmental effects associated with VSP activity on a change in risk of mortality or physical injury to marine fish and fish habitat is predicted to be:

- Adverse
- Low in magnitude
- Occur within the Project Area
- Short-term in duration
- Occur more than once at irregular intervals
- Reversible

8.3.1.1.3.3 Discharges

Potential adverse environmental effects on the marine environment from exploration drilling are primarily related to the effects of physical disturbance of the water column and benthic environment from discharge of drill cuttings and muds. Other potential liquid discharges from offshore vessels and equipment relate to the possible release of oily water and other substances through produced water (if applicable), deck drainage, bilge water, ballast water, and liquid wastes. These discharges will be managed in accordance with the OWTG. Waste that cannot be discharged overboard will be stored and transported to shore for disposal in an approved facility (Section 2.8). If a biocide is used to treat seawater used for cooling purposes

on the MODU, chemical selection will be in accordance with the OCSG for Drilling and Production Activities on Frontier Lands (NEB et al.2009).

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

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

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

Accumulation of drill solids on the seafloor can cause stress and disturbance to benthic fauna through direct toxicity from drilling muds and cuttings, burial (smothering), changes due to sediment grain size, nutrient enrichment, and oxygen depletion (Neff et al. 2004; Smit et al. 2006; Neff 2010). The effects of smothering can include mortality, reduced growth rates, reduced larval settlement, and a change in fauna composition (Neff et al. 2004). It is possible that some species may die from the mass of the discharges crushing them, while others may die because they cannot penetrate through the deposited layer that is burying them.

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

In the eastern NL offshore region, the results of EEM at three production oilfields (Hibernia, Terra Nova, White Rose) have shown that sediments have been largely non-toxic to Microtox, amphipods, and juvenile polychaetes (Suncor Energy 2011; HMDC 2012; Husky Energy 2013). EEM results at the Hibernia and Terra Nova oilfields have shown no clear association between Microtox toxicity and indices of oil and gas activities, and evidence suggests that any observed Microtox responses were related to natural factors such a sediment grain size (Suncor Energy 2011; HMDC 2012).

Ellis et al. (2012) reviewed the results of sediment sampling from 72 production and exploration drilling platforms to assess the zone of influence of sediment contamination and biological effects on benthic communities. The zone of influence for WBM was determined to be 2 to 20 km from point of discharge, while zone of influence was smaller for SBM at 200 to 2,000 m (Ellis et al. 2012). The zone of biological effects on benthic community diversity and abundance ranged from 100 to 1,000 m for both WBM and SBM; these effects included changes in benthic species diversity, abundance, and alterations to community structure. Functional changes to benthic community structure included a loss of suspension-feeding species and increases in deposit feeders and polychaetes (Ellis et al. 2012).

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

It has been calculated that an average burial depth of 9.6 mm or less is unlikely to cause net adverse effects to benthic organisms attributable to sedimentation (Neff et al. 2004). This is an average value and some species may experience adverse effects at shallower depths (e.g., Smit et al. 2006 references a threshold of 6.5 mm). Drill waste dispersion modelling conducted for the Project considered the extent of various thicknesses of the deposition of drill cuttings on the seafloor in a radius from the discharge site. The locations of representative drill sites within EL 1138 used for modelling are shown in Figure 1-1 of the modelling report. Modelling was conducted for two depths representative of the various depths within the Project Area; 500 m and 1,500 m. It is predicted that sediment thicknesses greater than 6.5 mm is not predicted to occur for either depth scenario.

In the southern half of EL 1138, corals (large and small gorgonian corals), sea pens, and sponges are present as observed in Figures 6-5 to 6-8 (Section 6.1.6.4). The discharge of drill wastes is not expected to have the potential to smoother organisms in the immediate well areas as the threshold of 6.5 mm deposition is not anticipated to occur (see Section 2.8.2.2 for a summary of the deposition modelling results). Furthermore, the zone of influence is expected to occur within 1 km of the well(s). In the event Project activities result in mortality of benthic organisms, the results are not predicted to cause irreversible changes to local populations, although it is acknowledged that there are fewer data on effects of drilling waste on corals and sponges, and recovery rates for these communities are expected to be longer (Gates and Jones 2012; Cordes et al. 2016; Henry et al. 2017). 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).

Chevron will conduct an imagery-based seabed survey at the proposed well sites to confirm the absence of sensitive environmental features, such as habitat-forming corals or species at risk. The survey will be

carried out prior to drilling and will encompass an area within a 500 m radius from each well site. If any environmental or anthropogenic sensitivities are identified during the survey, Chevron 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. These surveys will also provide baseline data for coral and sensitive benthic habitat that may be present and be used to inform discussions on potential follow-up and monitoring with respect to drill waste discharges.

Residual effects associated with discharges of produced water and drill cuttings and muds on a change in risk of mortality or physical injury to marine fish and fish habitat is predicted to be:

- Adverse
- Low in magnitude
- Restricted to the Project Area
- Medium-term to long-term in duration
- Occur more than once at irregular intervals
- Reversible

8.3.1.3.4 Well Abandonment

The exploratory wells will be decommissioned and abandoned according to C-NLOPB requirements and in accordance with Newfoundland Offshore Petroleum Production and Conservation Regulations, as well as any other applicable laws and industry standards at the time.

Well abandonment is likely only to give rise to a localized disturbance, and therefore it is expected that fish would avoid the immediate area where the mechanical separation activities are taking place. Wellheads mechanically removed by the drill rig or by ROV will have a negligible effect on risk of mortality or physical injury. However, circumstances can arise when mechanical cutting cannot effectively perform the task of wellhead severance. In such instances, shaped charges must be used, which will create localized effects. Chevron will employ the smallest effective explosive force and will only conduct the work after the Drilling Superintendent, the C-NLOPB, and any of its relevant advisory agencies review the application with approval granted on a case-by-case basis. To reduce the risk of mortality, explosive charges can be lowered into the well and detonated nearly simultaneously or applied to the outside of the casing.

Residual environmental effects associated with well abandonment on a change in risk of mortality or physical injury is predicted to be:

- Adverse
- Low in magnitude
- Localized to the Project Area
- Short-term in duration
- Irregular in frequency
- Reversible once the abandonment program is complete

8.3.2 Change in Habitat Quality and Use

8.3.2.1 Project Pathways

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

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

Baillon et al. (2012) found direct evidence that some commercially-harvested fish species were using sea pens and sea pen meadows (aggregations of sea pens) as nursery grounds. Forty-three percent of fish harvesters interviewed in Colpron (2016) reported areas containing sea pens to be good fishing grounds for a variety of commercially-harvested species (i.e., Atlantic cod, Atlantic halibut, and Northern shrimp) in the Northern Gulf of St. Lawrence.

8.3.2.2 Mitigation

In consideration of the environmental effects pathways noted above, the following mitigation measures will be employed to reduce the potential environmental effects of the Project on a change in habitat quality and use.

Presence and Operation of a MODU

- Lighting will be reduced to the extent that worker safety and safe operations is not compromised. Reduction of light may include avoiding use of unnecessary lighting, shading, and directing lights towards the deck.
- The loss of fish habitat will be mitigated through compliance with the *Fisheries Act*.

Vertical Seismic Profiling Operations

- VSP activities will be planned and conducted in consideration of the *Statement of Canadian Practice with Respect to the Mitigation of Seismic Sound in the Marine Environment* (SOCP; DFO 2007; refer to Section 10.3).

Discharges

- To mitigate potential environmental effects on fish and fish habitat from discharges in the Project Area during the Project activities, the following mitigation will be implemented based on applicable regulations and guidelines:
  - Chemicals used will be screened as per the OCSG.
  - Routine discharge limits (i.e., deck drainage, bilge water, cooling water) will be in accordance with the OWTG, Regulations for the Prevention of Pollution from Ships and for Dangerous Chemicals under the *Canada Shipping Act*, 2001 and the MARPOL.
  - Sewage will be macerated to a particle size of < 6 mm and discharged as per the OWTG.
  - Waste discharges not meeting OWTG requirements and domestic garbage will be transported to shore for disposal or recycled. Garbage is segregated as required and in compliance with waste disposal requirement and Chevron's WMP.
  - Concentration of SBM on cuttings will be monitored on the MODU for compliance with the OWTG.
  - Foreign vessels operating in Canadian jurisdiction must comply with the Ballast Water Control and Management Regulations of the *Canada Shipping Act*, 2001 during ballasting and de-ballasting activities.

Supply and Servicing

- Adhere to *Canada Shipping Act* and industry best practices and follow marine traffic rules and regulations.

8.3.2.3 Characterization of Residual Project-related Environmental Effects

8.3.2.3.1 Presence and Operation of a MODU

The quality of the underwater acoustic environment for marine fish may be affected by drilling operations and the DP activity of the MODU. Drilling could occur at any time of the year and the sound generated would be continuous during the drilling of each well (approximately 180 days per well).

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

sound levels also have the potential to affect local distribution and larger-scale changes in migration routes (Popper and Hastings 2009).

Avoidance and short duration startle responses by some marine fish species may occur close to the sound source during the start-up of the initial period of drilling (Müeller-Blenkle et al. 2008; Fewtrell and McCauley 2012). McCauley et al. (2000a) noted a general response to received SPLs of 156 to 161 dB re µPa @ 1 m rms. It is anticipated that fish will become accustomed to the sound source and that avoidance and startle responses will decline over the course of the drilling (Chapman and Hawkins 1969; McCauley et al. 2000a, 2000b; Fewtrell and McCauley 2012). The source SPL associated with the operation of a MODU for the Project is estimated to be 196.7 dB re 1 µPa at 1 m rms (Matthews et al. 2018). Based on qualitative guidelines recommended by Popper et al. (2014) (see Table 8.4, Section 8.3.1.3.1), potential behavioural effects on marine fish from exposure to continuous underwater sound are not predicted to extend beyond the Project Area. Given the localized and temporary nature of the drilling activity, displacement of fish from habitats and population level disturbances are unlikely.

Habitat quality and use may also be affected from the lights of the MODU as marine fish may experience physiological stress from the artificial lighting introduced into the water column. Groups of fish often react to the presence of artificial lighting by schooling and moving towards the light source. Feeding, schooling, predator avoidance, and migratory behaviours of marine fish can be altered by sharp light contrasts created by over-water structures due to shading during the day and artificial lighting at night (Nightingale and Simenstad 2002; Hanson et al. 2003).

Lighting may also increase the risk of mortality and physical injury. Marine fish, and especially juveniles and larvae, rely on visual cues for feeding. Shadows can create a light-dark interface that may increase predation and increase starvation by reducing feeding opportunities (NOAA 2008). The migratory behaviour of some fish species may prefer deeper water away from shaded areas during the day, and lighted areas could affect migratory movements at night, which could contribute to increased risk of predation. Light from the MODU, which would be quickly attenuated through refraction and absorption, is not expected to penetrate the water column any more than 50 m radius from the source (Davies et al. 2014).

Residual environmental effects associated with the presence and operation of a MODU on a change in habitat quality or use to marine fish and fish habitat is predicted to be:

- Adverse
- Low in magnitude
- Occur within the Project Area or LAA
- Medium-term in duration
- Occur more than once at irregular intervals
- Reversible

8.3.2.3.2 Vertical Seismic Profiling

As discussed in the assessment of a change in risk of mortality or injury, received sound levels are unlikely to result in physical effects to the majority of mobile fish species due to the expectation that they would avoid underwater sound at lower levels than those at which injury or mortality may occur. However, surveys

may cause a temporary change in habitat quality and use for marine fish near VSP operations. SPLs from VSP activities are expected to result in a short-term change in habitat quality and use for marine fish (particularly fish eggs and larvae near the air gun array used for VSP). This temporary change in habitat quality and use may result in sensory disturbance that triggers behavioural responses in marine fish and invertebrates. Mobile fish species may exhibit a variety of responses when exposed to sound from seismic source arrays, including VSP, though VSP operates at levels lower than the sound sources typically used in marine seismic exploration. The responses of marine fish to underwater sound vary with species, life stage, history of exposure to similar sound sources, and the duration, intensity, frequency, and geographic extent of the underwater sound exposure, and as a result, there are currently no established sound thresholds for behavioural disturbance of fish (Popper et al. 2014; Carroll et al. 2017). Guidelines for received sound levels that cause behavioural effects in fish are very limited. The United States National Marine Fisheries Service (NMFS) uses a criterion for behavioural response of 150 dB re 1 µPa (Stadler and Woodbury 2009). Although as pointed out by Popper et al. (2014), it is unclear if this is a peak or rms level and the criterion does not specify a particular behaviour; it simply assumes there is potential to experience a behavioural response.

High levels of sound can elicit various types of behavioural responses in marine fish and invertebrates, some of which may negatively affect a population (e.g., reduced rate of foraging or predator avoidance), and others which may pose no overall risk other than an energetic loss (e.g., startle response). Thresholds at which airgun sounds elicit behavioural responses in captive marine fish have been shown to vary among species. Pearson et al. (1992) established thresholds for startle responses of caged rockfish and noticed interspecies differences. Olive and black rockfish (*Sebastes serranoides* and *S. melanops)* responded to SPLs between 200 and 205 dB re 1 µPa, whereas no response was observed vermilion (*S. miniatus*) or brown (*S. auriculatus*) rockfish up to the maximum exposure of 207 re 1 µPa dB. Startle and alarm responses have been observed in captive fish several kilometres from the sound source, with European sea bass and the lesser sandeel responding at distances up to 2.5 and 5 km from a seismic source, respectively (Santulli et al. 1999; Hassel et al. 2004) and scallops have shown a distinctive flinching response at distances within 350 of the seismic array although no energetically costly responses such as swimming (Day et al. 2016).

Behavioural responses in commercial fish have been shown to vary by species. Commercial trawl and longline catch rates of Atlantic cod and haddock in the Barents Sea have been shown to fall by 45% and 70%, respectively, five days after seismic surveys (Engås et al., 1996). This reduction in catch rates was most likely the result of fish moving away from the seismic area due to an avoidance behavior, based on the local decline in fish density in the study area, (Engås et al. 1996). In contrast, following exposure to airgun sound in a Norwegian fishing ground, gillnet catches increased by 86% for redfish (*Sebastes norvegicus*) and by 132% for Greenland halibut, while longline catches of Greenland halibut and haddock decreased (by 16% and 25%, respectively, compared to pre-seismic levels) (Løkkeborg et al. 2012), the reduction in longline catches was thought to result from a decrease in feeding activity due to a change in behavior from seismic activity. Peña et al. (2013) used sonar to investigate the real-time behaviour of herring schools exposed to a 3-D seismic survey and found no changes could be attributed to the transmitting seismic vessel. School sizes, swimming speed and direction remained similar as the seismic array approached from a distance of 27 to 2 km. The lack of a response to the seismic survey was interpreted by the authors as a combination of a strong motivation for feeding, a lack of suddenness of the

airgun stimulus (the study was conducted over a 6-hour period), and an increased level of tolerance to the seismic sound (Peña et al. 2013).

Many benthic invertebrates have a free-swimming larval stage which means that the magnitude of seismic sound exposure cannot be reduced by active movement. Repeated exposure to short-term near-field seismic sound caused slower developmental rates and higher mortality or abnormality rates in larvae of snow crabs exposed to peak sound levels of 216 dB re 1 µPa every 10 s for 33 min (Christian et al. 2003), and scallops exposed to sound exposure levels of 161-165 dB RMS re 1 µPa every 3 s for 90 h (de Soto et al. 2013). Field-based studies using far-field sound exposures revealed no evidence of delayed development, increased mortality, or reduced abundance in scallop (*Pecten fumatus*) or Dungeness crab (*Cancer magister*) larvae (Pearson et al. 1994; Parry et al. 2002).

The source SPL associated with VSP operations for the Project is estimated to be 247.8 dB re 1 µPa peak @ 1 m (broadside) (Matthews et al. 2018). Popper et al. (2014) recommend qualitative guidelines for received levels of impulsive underwater sound from seismic air gun sources causing behavioural effects on fish. Based on these guidelines, the risk of behavioural effects would be high within tens of metres of the air gun source array for most fish species. For fish with swim bladders involved in hearing, this high risk of behavioural change could extend to hundreds of metres from the sound source. It is unlikely that behavioural effects on fish as a result of exposure to sound from VSP source arrays would extend beyond the Project Area.

Residual environmental effects associated with VSP activity on a change in habitat quality and use to marine fish and fish habitat is predicted to be:

- Adverse
- Low in magnitude
- Occur within the Project Area
- Short-term in duration
- Occur more than once at irregular intervals
- Reversible

8.3.2.3.3 Discharges

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

There is a low abundance of structure-forming benthic invertebrate species (e.g., corals) that occur in the Project Area. Within the Project Area, large and small gorgonians, sponges, and sea pens are present in

the southern half of EL 1138. Chevron will conduct an imagery-based seabed survey at the proposed well sites to confirm the absence of sensitive environmental features, such as habitat-forming corals or species at risk. The survey will be carried out prior to drilling and will encompass an area within a 500-m radius from the well site. If any environmental or anthropogenic sensitivities are identified during the survey, Chevron 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.

Chevron's EPP and WMP will include requirements for managing marine discharges and emissions in accordance with the OWTG and MARPOL, as applicable. Discharges are expected to be temporary, non-bioaccumulating, non-toxic and highly diluted. If residual hydrocarbons are present in discharges, such as deck drainage and bilge water, they will be in low volumes and concentrations, and not exceed limits stated in the OWTG and MARPOL.

Residual environmental effects associated with discharges on a change in habitat quality and use to marine fish and fish habitat is predicted to be:

- Adverse
- Low in magnitude
- Restricted to the Project Area
- Medium- to long-term in duration
- Occur more than once at irregular intervals
- Reversible

8.3.2.3.4 Well Abandonment

It is expected that well abandonment activities could cause a temporary, localized disturbance, although the abandonment program has not yet been defined. An abandonment program will be executed using a likely configuration of cement and permanent mechanical bridge plugs. As a minimum, the C-NLOPB drilling and production guidelines related to abandonment will be adhered to. Once the well is abandoned, the last stage in the process is to remove the wellhead from the seabed, depending on regulatory requirements. If determined that the wellhead needs to be removed, a mechanical cutter will be used, which can cut the wellhead below the seabed and it can be retrieved to the surface. Following well abandonment, it is anticipated that the wellhead, if left in place, will provide hard substrate that is suitable for colonization by benthic communities.

Residual environmental effects associated with well abandonment on a change in habitat quality and use to marine fish and fish habitat is predicted to be:

- Neutral to adverse
- Low in magnitude
- Restricted to the Project Area
- Long-term in duration
- Occur more than once at irregular intervals
- Reversible

8.3.2.3.5 Supply and Servicing

Supply and servicing operations will increase vessel traffic within the Project Area and LAA and may affect fish habitat quality and use locally around supply vessels resulting from increased vessel sound. The sound source generated by supply vessels will be irregular throughout the life of the Project, and the source levels associated with supply vessel operation for the Project are estimated to be 188.6 dB re 1 µPa²s (Matthews et al. 2018). This equates to approximately 0.1 kHz; moderate waves / surf generate sound at a frequency of 1 Hz to 100 kHz (National Research Council 2003). Although underwater sound generated by supply vessel traffic will introduce additional sound to the area, 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, environmental conditions, and physiological state of the fish at the time of the interaction (De Robertis and Handegard 2013). The likely reaction to vessel sound is either temporary displacement or avoidance of the area in which the disturbing sound level is occurring. Any change in habitat quality and use from supply vessel traffic would represent a small increment over similar effects from existing levels of marine traffic in the RAA.

Residual environmental effects associated with supply and servicing operations on a change in habitat quality and use to marine fish and fish habitat is predicted to be:

- Adverse
- Low in magnitude
- Occur within the LAA (including transit route)
- Medium-term in duration
- Occur more than once at irregular intervals
- Reversible

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

There are 31 marine fish SAR and/or SOCC that may be present in the Project Area and/or RAA, including species listed under SARA, the NL ESA, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and the International Union for the Conservation of Nature (IUCN) Red List (Table 8.5). Four of these are listed under Schedule 1 of SARA and formally protected at the federal level: northern, spotted, and Atlantic wolffish; and white shark.

The distributions of northern, spotted, and Atlantic wolffish overlap through much of their range, including the RAA. Wolffish are found on a variety of bottom types with associations with hard substrates during spawning. They are long lived and slow growing, and primarily a demersal species (Kulka et al. 2004; COSEWIC 2012). In Newfoundland and Labrador northern wolffish have been mainly observed to occur at depths of 500 to 1,000 m, spotted wolffish at 200 to 750 m, and Atlantic wolffish at 150 to 350 m (DFO 2018a). After hatching, wolffish larvae become pelagic and are commonly found on continental slopes. The life history of wolffish is poorly understood (Kulka et al. 2004). A proposed recovery strategy (DFO 2018a) and a proposed action plan (DFO 2018b) for northern and spotted wolffish has been prepared to promote wolffish population growth and recovery. A management plan for Atlantic wolffish has also been proposed (DFO 2018a).

Table 8.5 Marine Fish Species at Risk and/or Conservation Concern with Potential to Occur in the Project Area and/or RAA

Common Name [A]	Scientific Name	SARA Schedule 1 Status	COSEWIC Designation	NL ESA Designation	IUCN Red List Designation	Summary of Presence and Potential Interactions
Atlantic plaice (Newfoundland and Labrador population)	*Hippoglossoides platessoides*	NS	T	NL	NA	• Potentially present in the Project Area year-round • Adults typically prefer depths of 100-300 m, but have been found as deep as 1,400 m • Spawning occurs on the Newfoundland Shelf in April or May • Potential life stage interactions include eggs (pelagic), larvae (pelagic), and juveniles / adults (demersal) • Limited potential for Project interaction (mobile species, Project mitigation measures, no critical habitat)
Atlantic cod (Newfoundland and Labrador population); (Global - IUCN)	*Gadus morhua*	NS	E	NL	V	• Potentially present in the Project Area year-round • Adult cod occupy a diverse range of habitats with no particular depth or bottom substrate preferences. Mainly observed at depths <500 m offshore • Broadcast spawner. Eggs in the water column from April to November. • Potential life stage interactions include eggs (pelagic), larvae (pelagic), and juveniles / adults (demersal) • Limited potential for Project interaction (mobile species, Project mitigation measures, no critical habitat)
Northern wolffish	*Anarhichas denticulatus*	T	T	NL	NA	• Likely present within Project Area year-round • Long-lived and slow-growing species that mainly inhabit bottom habitats. Common between >500-1,000 m depths • Average migrations <8 to 800 km • Spawns September through November • Potential life stage interactions include eggs (demersal), larvae (pelagic), and juveniles / adults (demersal) • Proposed critical habitat has been established for this species • Limited potential for Project interaction (mobile species, Project mitigation measures, no critical habitat) • Project Area overlaps with recently proposed designated critical habitat (refer to Section 6.1.8 and Figure 6-36)

Table 8.5 Marine Fish Species at Risk and/or Conservation Concern with Potential to Occur in the Project Area and/or RAA

Common Name [A]	Scientific Name	SARA Schedule 1 Status	COSEWIC Designation	NL ESA Designation	IUCN Red List Designation	Summary of Presence and Potential Interactions
Roundnose grenadier (Atlantic and Arctic populations); (Global - IUCN)	*Coryphaenoides rupestris*	NS	E	NL	E	• Likely present in Project Area year-round • Captured at depths between 180 and 2,200 m and mainly observed at 400-1,200 m depths • In Canadian waters, it is most abundant in the northern part of the range (Labrador and Northeast Newfoundland shelves, Davis Strait) • Potential life stage interactions include eggs (pelagic), larvae (pelagic), and juveniles / adults (demersal) • Project interaction (mobile species, no critical habitat, Project mitigation measures)
Smooth skate (Funk Island Deep); (Global - IUCN)	*Malacoraja senta*	NS	SC	NL	E	• Unlikely to be present in Project Area • Captured in Canadian RV surveys of the Project Area were restricted to depths less than 500 m • Resident species but not numerically dominant in Canadian or NAFO waters in Project Area • Lays 40-100 large egg capsules per year • Not commercially important in the region • Limited potential for Project interactions (mobile species, Project mitigation measures, no critical habitat)
Spinytail skate (Global - IUCN)	*Bathyraja spinicauda*	NS	NS	NL	NT	• 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

Table 8.5 Marine Fish Species at Risk and/or Conservation Concern with Potential to Occur in the Project Area and/or RAA

Common Name [A]	Scientific Name	SARA Schedule 1 Status	COSEWIC Designation	NL ESA Designation	IUCN Red List Designation	Summary of Presence and Potential Interactions
Thorny skate (Canada); (Global - IUCN)	*Amblyraja radiata*	NS	SC	NL	V	• Likely present in Project Area year-round Slow-growing species that occupies depths of 18-1,400 m and inhabits a broad range of substrates including sand, shell, gravel and mud • Distributed continuously from Baffin Bay, Davis Strait, Labrador Shelf, Grand Banks, Gulf of St. Lawrence, Scotian Shelf and Bay of Fundy to Georges Bank, over a wide range of depths • Skates lay egg capsules on the seafloor year-round and all life stages occupy demersal habitats • Potential life stage interactions include eggs (demersal), larvae (demersal), and juveniles / adults • Limited potential for interaction (project mitigation measures, no critical habitat)
Winter skate (Eastern Scotian Shelf – Newfoundland population); (Global - IUCN)	*Leucoraja ocellata*	NS	E	NL	E	• Unlikely to be present in Project Area • Globally restricted to the Northwest Atlantic • Found from southern Newfoundland to the Canada / US border • Eggs deposited throughout the year in its southern range, eggs deposited in late summer to fall off Newfoundland • Limited potential for interaction (mobile species, Project mitigation measures)
Acadian redfish (Atlantic Population); Global - IUCN)	*Sebastes fasciatus*	NS	T	NL	E	• Likely to be present year-round in Project Area • Prefers the shelf slopes and deep channel areas, but undergoes large vertical diurnal migrations • Internal fertilization. Larval release between spring and summer and are primarily found in surface waters • Potential life stage interactions include larvae (pelagic), and juveniles / adults (pelagic) • Limited potential for Project interaction (mobile species, Project mitigation measures)

Table 8.5 Marine Fish Species at Risk and/or Conservation Concern with Potential to Occur in the Project Area and/or RAA

Common Name [A]	Scientific Name	SARA Schedule 1 Status	COSEWIC Designation	NL ESA Designation	IUCN Red List Designation	Summary of Presence and Potential Interactions
Albacore tuna (Global - IUCN)	*Thunnus alalunga*	NS	NS	NL	NT	• 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 (Global - IUCN)	*Anguilla rostrata*	NS	T	V	E	• Migratory / transient in Project Area • Adults leave freshwater / estuarine habitats to migrate to the Sargasso Sea • Larvae drift along the Gulf Stream to coastal areas before migrating into freshwater. Larvae and juveniles are concentrated in the water column in the upper 140 m at night and 350 m during the day • Potential life stage interactions include larvae (pelagic) and juveniles / adults (pelagic) • Limited potential for Project interaction (mobile species, Project mitigation measures, no critical habitat)
Atlantic bluefin tuna (Global - IUCN)	*Thunnus thynnus*	NS	E	NL	E	• Migratory / transient in Project Area • Individuals captured in continental shelf waters of the Gulf of St. Lawrence, Scotian Shelf and the Grand Bank • No known spawning or rearing habitats for early life stages in Canadian waters • Potential life stage interactions include juveniles / adults (pelagic) • Limited potential for Project interaction (mobile species, project mitigation measures)

Table 8.5 Marine Fish Species at Risk and/or Conservation Concern with Potential to Occur in the Project Area and/or RAA

Common Name [A]	Scientific Name	SARA Schedule 1 Status	COSEWIC Designation	NL ESA Designation	IUCN Red List Designation	Summary of Presence and Potential Interactions
Atlantic halibut (Global - IUCN)	*Hippoglossus hippoglossus*	NS	NS	NL	E	• Unlikely to be present in Project Area • Distribution of pelagic Atlantic halibut larvae is mostly between 5 and 50 m • Juveniles and adults are closely associated with the seabed. Typically found at depths of 100 to 700 m, though may be present at depths up to 1,000 m • Limited potential for Project interaction (mobile species, Project mitigation measures, no critical habitat)
Atlantic salmon (Global - IUCN)	*Salmo salar*	NS		NL	LC	• Migratory / transient in Project Area • Post-smolt from rivers in Maine, Bay of Fundy, Atlantic coast of Nova Scotia, and some rivers in Newfoundland migrate near the coast of eastern Newfoundland, arriving near the Funk Islands in the southern Labrador Sea in early August • Adult salmon have been found in abundance in two general locations during their spring spawning migration; approximately 480 km east of the Strait of Belle Isle and slightly east of the 200 m isobath (depth contour) along the eastern edge of the Grand Bank • Potential life stage interactions include juveniles / adults (demersal) • Limited potential for interaction (mobile species, Project mitigation measures, no critical habitat)
(South Newfoundland Population)		NS	T	NL		
(Quebec Eastern Shore Population)		NS	SC	NL		
(Quebec Western Shore Population)		NS	SC	NL		

Table 8.5 Marine Fish Species at Risk and/or Conservation Concern with Potential to Occur in the Project Area and/or RAA

Common Name [A]	Scientific Name	SARA Schedule 1 Status	COSEWIC Designation	NL ESA Designation	IUCN Red List Designation	Summary of Presence and Potential Interactions
(Anticosti Island Population)	*Salmo salar*	NS	E	NL		• Migratory / transient in Project Area • Post-smolt from rivers in Maine, Bay of Fundy, Atlantic coast of Nova Scotia, and some rivers in Newfoundland migrate near the coast of eastern Newfoundland, arriving near the Funk Islands in the southern Labrador Sea in early August • Adult salmon have been found in abundance in two general locations during their spring spawning migration; approximately 480 km east of the Strait of Belle Isle and slightly east of the 200 m isobath (depth contour) along the eastern edge of the Grand Bank • Potential life stage interactions include juveniles / adults (demersal) • Limited potential for interaction (mobile species, Project mitigation measures, no critical habitat)
(Inner St. Lawrence Population)		NS	SC	NL		
(Gaspé-Southern Gulf of St. Lawrence Population)		NS	SC	NL		
(Eastern Cape Breton Population)		NS	E	NL		
(Nova Scotia Southern Upland Population)		NS	E	NL		

Table 8.5 Marine Fish Species at Risk and/or Conservation Concern with Potential to Occur in the Project Area and/or RAA

Common Name [A]	Scientific Name	SARA Schedule 1 Status	COSEWIC Designation	NL ESA Designation	IUCN Red List Designation	Summary of Presence and Potential Interactions
(Outer Bay of Fundy Population)	*Salmo salar*	NS	E	NL		• Migratory / transient in Project Area • Post-smolt from rivers in Maine, Bay of Fundy, Atlantic coast of Nova Scotia, and some rivers in Newfoundland migrate near the coast of eastern Newfoundland, arriving near the Funk Islands in the southern Labrador Sea in early August • Adult salmon have been found in abundance in two general locations during their spring spawning migration; approximately 480 km east of the Strait of Belle Isle and slightly east of the 200 m isobath (depth contour) along the eastern edge of the Grand Bank • Potential life stage interactions include juveniles / adults (demersal) • Limited potential for interaction (mobile species, Project mitigation measures, no critical habitat)
Atlantic wolffish	*Anarhichas lupus*	SC	SC	NL	NA	• 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 • Long lived and limited potential for interaction (mobile species, Project mitigation measures, no critical habitat)
Barndoor skate (Global - IUCN)	*Dipturus laevis*	NS	NS	NL	E	• 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)

Table 8.5 Marine Fish Species at Risk and/or Conservation Concern with Potential to Occur in the Project Area and/or RAA

Common Name [A]	Scientific Name	SARA Schedule 1 Status	COSEWIC Designation	NL ESA Designation	IUCN Red List Designation	Summary of Presence and Potential Interactions
Basking shark (Atlantic Population); Global - IUCN)	*Cetorhinus maximus*	NS	SC	NL	V	• Migratory / transient in Project Area • Circumglobal, temperate, migratory pelagic species • Have been observed throughout Atlantic waters including the Gulf of St. Lawrence, Bay of Fundy, Scotian Shelf and Grand Banks, generally during the summer months • Observed at the surface during summer months in the Project Area • Limited potential for interaction (mobile species, Project mitigation measures, no critical habitat)
Bigeye tuna (Global - IUCN)	*Thunnus obesus*	NS	NS	NL	V	• Migratory / transient in Project Area • Migratory, pelagic oceanic species that is found in 13ºC to 29ºC water • Mostly found in depths shallower than 500 m but can dive deeper • Would occur in the Project Area generally during warm water seasons • Limited potential for interaction (mobile species, Project mitigation measures, no critical habitat)
Blue shark (Atlantic Population); Global - IUCN)	*Prionace glauca*	NS	NS	NL	NT	• Migratory / transient in Project Area • Distributed worldwide in temperate and tropical oceans, primarily in surface waters and offshore • Range in Canada includes Gulf Stream-associated waters off Nova Scotia and Newfoundland • Found at depths from surface to at least 600 m depth • Limited potential for interaction (mobile species, Project mitigation measures, no critical habitat)

Table 8.5 Marine Fish Species at Risk and/or Conservation Concern with Potential to Occur in the Project Area and/or RAA

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

Table 8.5 Marine Fish Species at Risk and/or Conservation Concern with Potential to Occur in the Project Area and/or RAA

Common Name [A]	Scientific Name	SARA Schedule 1 Status	COSEWIC Designation	NL ESA Designation	IUCN Red List Designation	Summary of Presence and Potential Interactions
Greenland Shark (Global - IUCN)	*Somniosus microcephalus*	NS	NS	NL	NT	• 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
Haddock (Global - IUCN)	*Melanogrammus aeglefinus*	NS	NS	NL	V	• 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 (Global - IUCN)	*Leucoraja erinacea*	NS	NS	NL	NT	• 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)
Porbeagle (Global - IUCN)	*Lamna nasus*	NS	E	NL	V	• Migratory / transient species • Abundant on the continental shelf of the Grand Bank. Rarely captured at surface or depths >200 m • Mating occurs during the summer and early fall and sharks migrate to pupping grounds in the Sargasso Sea • Potential life stage interactions include juveniles / adults (pelagic) • Limited potential for interaction (mobile species, project mitigation measures)

Table 8.5 Marine Fish Species at Risk and/or Conservation Concern with Potential to Occur in the Project Area and/or RAA

Common Name [A]	Scientific Name	SARA Schedule 1 Status	COSEWIC Designation	NL ESA Designation	IUCN Red List Designation	Summary of Presence and Potential Interactions
Shortfin mako (Atlantic Population); (Global - IUCN)	*Isurus oxyrinchus*	NS	E	NL	V	• Migratory / transient species • Associated with warm waters (17 ºC -22 ºC) in and around the Gulf Stream including the continental shelf of Nova Scotia, Grand Banks and the Gulf of St. Lawrence • Sharks in Canadian waters are at the northern extent of the population and considered a small portion of the total population • Potential life stage interactions include juveniles / adults (pelagic) • Limited potential for Project interactions (mobile species, Project mitigation measures)
Spiny dogfish (Atlantic Population); (Global - IUCN)	*Squalus acanthias*	NS	SC	NL	V	• 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)
Spotted wolffish	*Anarhichas minor*	T	T	NL	NA	• Likely to be present in Project Area year-round • Long lived and slow growing species that mainly inhabit soft bottom habitats. Common between 200-750 m depths • Spawning aggregations on the Northeast Shelf and Slope EBSA in the spring. Spawns from June, July, and August • Potential life stage interactions include eggs (demersal), larvae (pelagic), and juveniles / adults (demersal) • Limited potential for interaction (mobile species, Project mitigation measures, no critical habitat) • DFO recently proposed designated critical habitat for spotted wolffish, which is located within the RAA (see Figure 6-36)

Table 8.5 Marine Fish Species at Risk and/or Conservation Concern with Potential to Occur in the Project Area and/or RAA

Common Name [A]	Scientific Name	SARA Schedule 1 Status	COSEWIC Designation	NL ESA Designation	IUCN Red List Designation	Summary of Presence and Potential Interactions
White hake (Atlantic and Northern Gulf of St. Lawrence Population)	*Urophycis tenuis*	NS	T	NL	NA	• 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 (Atlantic Population); (Global - IUCN)	*Carcharodon carcharias*	E	E	NL	V	• Migratory / transient species • Occurs in inshore to offshore waters • Recorded in Newfoundland waters from the Northeast Newfoundland Shelf and the St. Pierre Bank • Potential life stage interactions include juveniles / adults (pelagic) • Limited potential for interaction (mobile species, Project mitigation measures)

Data Sources: SARA/COSEWIC (www.sararegistry.gc.ca), IUCN (https://www.iucnredlist.org/), NL ESA (https://www.flr.gov.nl.ca/wildlife/endangeredspecies/index.html).

E = Endangered; T = Threatened; SC = Special Concern; NS = No Status; V = Vulnerable; NT = Near Threatened; LC = Least Concern; NL = Not Listed; NA = Not Assessed

A = Relevant population as determined by COSEWIC, unless identified as determined by IUCN

As noted in the proposed recovery strategy and management plan (DFO 2018a), a combination of natural and human-induced mortality have caused the wolffish populations to decline. The leading cause of human-induced mortality is the incidental capture of wolffish in many fisheries. Starting in 2003/2004, it became a requirement to release wolffish caught as incidental bycatch in Canadian waters; however, a substantial portion of fishing mortality for wolffish occurs outside Canada's EEZ, where there is no requirement to release wolffish and bycatch is thought to be unreported (DFO 2018a). Other threats to wolffish in eastern Canadian waters, listed in DFO (2018a), include:

- Release of petrochemicals, dissolved metals, and other solids during accidents associated with oil and gas activities
- Underwater sound emissions from seismic exploration
- Ocean dumping (anticipated minimal effect given typically localized depositional area)

Wolffish eggs and adults are associated with bottom habitats and larvae are pelagic; therefore, 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, the geographic distribution of wolffish species is quite large and they remain close to the substrate; with the use of mitigation described above (see Sections 8.3.2.1 and 8.3.2.2), interactions with wolffish species in the Project Area would be localized and short-term. Distribution of northern wolffish is in the Northwest Atlantic as well as in the eastern Atlantic, including Greenland, Iceland, the Faroes, Finnmarken, Murman Coast, and Novaya Zemlya (DFO 2018a).

There is proposed critical habitat for both the northern wolffish and the spotted wolffish within the transit route, LAA, and a small portion of the Project Area. These areas are outlined in Figure 6-36 and discussed further in Section 6.4.2.9.

White shark occur inshore and offshore, from the intertidal area to the upper continental slope, ranging from the surface to 1,280 m deep (COSEWIC 2006). While most white sharks (Atlantic population) occur in US east coast waters, they can occur in Canadian waters during the summer months. They are a highly mobile pelagic species that have been recorded in the RAA and may migrate through the Project Area. White sharks have been recorded in Newfoundland and Labrador from the Northeast Newfoundland Shelf and Slope and the St. Pierre Bank (COSEWIC 2006), and on the Flemish Cap (COSEWIC 2009; Ocearch 2017). Fishing (either as bycatch or as an unmonitored sport fish) is the primary threat to white shark COSEWIC 2006). White shark live for a long time (23 to 60 years) and as apex predators, may bioaccumulate pollutants in their tissues (Zitko et al. 1972, in COSEWIC 2006; Marsili et al. 2016) which may be transferred to offspring (Lyons et al. 2013).

White shark are highly mobile and prey are widely available. No critical habitat has been identified within the RAA. White shark are unlikely to be adversely affected by the Project with the implementation of mitigation measures identified in Sections 8.3.1.2 and 8.3.2.2.

Additional details on SOCC and special areas that may occur in the RAA, have been previously described in Section 6.1.8 and Section 6.4, respectively. As with secure fish species and the SAR species described above, SOCC (Table 6.6) may also interact with Project activities based on occupation of various habitats

at different life history stages. The same planned mitigation measures proposed for secure fish species will also avoid or reduce such adverse interactions on SOCC.

8.3.4 Summary of Project Residual Environmental Effects

Table 8.6 summarizes the environmental effects assessment and prediction of residual environmental effects resulting from interactions between applicable Project activities and marine fish and fish habitat. Based on the characterization of the potential interactions between Project activities and marine fish and fish habitat, the Project may result in adverse environmental effects that could cause a change in risk of mortality and physical injury, and a change in habitat quality and use for marine fish.

Table 8.6 Summary of Residual Environmental Effects on Marine Fish and Fish Habitat, Including Species at Risk

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

In consideration of the implementation of applicable mitigation measures and adherence to industry standards, the residual effect of a change in risk of mortality or physical injury as a result of Project activities is predicted to be low in magnitude. The residual environmental effects of a change in risk of mortality or physical injury will be restricted primarily to the Project Area but could extend into the LAA during supply vessel operations. Any potential mortality would be limited to benthic invertebrates within a localized footprint from burial and within a short distance from high levels of underwater sound. The duration of effects may vary from short-term events such as VSP surveys, to medium-term, irregular events such as the operation of the MODU.

Residual environmental effects of a change in habitat quality and use are predicted to be low in magnitude, occur within the Project Area, short to long-term in duration, and reversible after the completion of the Project. No permanent alteration or destruction of fish habitat is predicted to occur as a result of Project activities.

8.4 Determination of Significance

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

The potential for interactions between marine fish SAR and Project activities is considered low. Therefore, the Project is not predicted to have implications on the overall abundance, distribution, or health of marine fish SAR or their eventual recovery.

With mitigation and environmental protection measures, the residual environmental effects on marine fish and fish habitat are predicted to be not significant.

8.5 Prediction Confidence

Prediction confidence is generally considered to be moderate in recognition of a good understanding of the general effects of exploration drilling and VSP operations on marine fish and fish habitat, the effectiveness of mitigation measures, and knowledge of the existing environment within the Project Area, LAA, and RAA. There is some uncertainty regarding effects associated with drilling discharges on deep-water corals, sponges, and sea pens and a relative lack of information on behavioural effects from continuous sound on marine fish.

8.6 Environmental Monitoring and Follow-up

Chevron is proposing to implement a follow-up program to measure the concentration of synthetic-based drilling fluids retained on discharged drill cuttings as described in the OWTG to verify that the discharge meets, at a minimum, the performance targets set out in the Guidelines. Chevron will conduct an imagery-based seabed survey at the proposed well sites to confirm the absence of sensitive environmental features, such as habitat-forming corals or SAR prior to drilling. If any environmental sensitivities are identified during the survey, Chevron 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 baseline data for coral and sensitive benthic habitat that may be present and be used to inform discussions on potential follow-up with respect to drill waste discharges. Chevron will conduct a visual survey of the seafloor using an ROV after drilling activities to assess the visual extent of sediment dispersion and validate drill waste modelling predictions. The specific details of the follow-up program will be determined in consultation with the C-NLOPB and DFO in consideration of the pre-drill survey results. While drilling activities are taking place for the first well in the exploration licence, surveys will be implemented to verify the accuracy of the environmental assessment as it pertains to underwater sound levels. The program will be developed in consultation with DFO and the C-NLOPB.

8.7 Summary of Commitments

- If during an exploration program there is sufficient indication of hydrocarbon presence, formation flow testing will be undertaken to sample and identify formation fluids (which may contain hydrocarbons and/or water) and to measure flow rates. Formation flow testing may or may not include flaring; if flaring is required, produced hydrocarbons will be separated from produced water on the MODU.
- Any water generated will be sent to the MODU's flare, treated for disposal in accordance with the OWTG, or shipped to shore.
- Given the water depths in the Project Area, approval from the C-NLOPB may be sought in order to leave the wellheads in place. If approved, the infrastructure that will be left on the seafloor will be a wellhead of approximately 1.5 to 3.7 m in height which will take up a permanent footprint of less than 1 m². All other subsea infrastructure will be removed; the BOP will only be removed once the cement plugs are in place.
- If wellheads are to be removed, a mechanical casing / wellhead cutting device from the MODU will be used. The seafloor will then be inspected by a ROV or other equipment to verify that no obstructions or equipment remain in place.
- Well decommissioning will be carried out as per Chevron's internal procedures and with the *Newfoundland Offshore Petroleum Drilling and Production Regulations*.
- Mitigation measures for geophysical surveys will be consistent with the SOCP (DFO 2007).
- Waste that cannot be discharged overboard will be stored and transported to shore for disposal in an approved facility.
- If a biocide is used to treat seawater used for cooling purposes on the MODU, chemical selection will be in accordance with the OCSG.

- If large volumes of produced water are created, some produced water may be treated on the MODU so it can be discharged at sea in accordance with the OWTG or shipped to shore for appropriate disposal.
- An imagery-based seabed survey will be conducted at the proposed well site(s) to confirm the absence of sensitive environmental features, such as habitat-forming corals or species at risk (as well as shipwrecks, debris on the seafloor, and unexploded ordnance). The survey will be carried out prior to drilling. If environmental or anthropogenic sensitivities are identified during the survey, Chevron will move the well site to avoid affecting them if it is feasible to do so. If it is not feasible, Chevron will consult with the Canadian-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) to determine an appropriate course of action. This survey will also provide baseline data for coral and sensitive benthic habitat that may be present and be used to inform discussions on potential follow-up and monitoring with respect to drill waste discharges.
- Lighting will be reduced to the extent that worker safety and safe operations is not compromised. Reduction of light may include avoiding use of unnecessary lighting, shading, and directing lights towards the deck.
- To mitigate potential environmental effects on fish and fish habitat from discharges in the Project Area during the Project activities, the following mitigation will be implemented based on applicable regulations and guidelines:
  - Chemicals used will be screened as per the OCSG.
  - Routine discharge limits (i.e., deck drainage, bilge water, cooling water) will be in accordance with the OWTG, *Regulations for the Prevention of Pollution from Ships and for Dangerous Chemicals* under the *Canada Shipping Act*, 2001 and MARPOL.
  - Sewage will be macerated to a particle size of < 6 mm and discharged as per the OWTG.
  - Waste discharges not meeting OWTG requirements and domestic garbage will be transported to shore for disposal or recycled. Garbage is segregated as required and in compliance with waste disposal requirement and Chevron's WMP.
  - Concentration of SBM on cuttings will be monitored on the MODU for compliance with the OWTG.
  - All foreign vessels operating in Canadian jurisdiction must comply with the *Ballast Water Control and Management Regulations* of the *Canada Shipping Act*, 2001 during ballasting and de-ballasting activities.
- Adhere to *Canada Shipping Act* and industry best practices and follow marine traffic rules and regulations.
- As required in the Geophysical, Geological, Environmental and Geotechnical Program Guidelines (C-NLOPB 2019), mitigation measures applied during geophysical surveys (VSP) will be consistent with those outlined in the SOCP. The following are key mitigation measures that will be employed during VSP surveys:
- A ramp-up procedure (i.e., gradually increasing seismic source elements over a period of approximately 30 minutes until the operating level is achieved) will be implemented before any VSP activity begins. This measure will provide an opportunity for fish to move out of the area prior to initiation of the survey.

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9.0 ASSESSMENT OF POTENTIAL EFFECTS ON MARINE AND MIGRATORY BIRDS

Marine and migratory birds were chosen as a VC due to the group's importance in marine and coastal ecosystems, the economic and cultural importance of recreational and subsistence hunts, susceptibility to attraction to artificial lighting, vulnerability to oil on water, regulatory considerations, and requirements in the EIS Guidelines. The Marine and Migratory Birds VC includes oceanic (i.e., beyond the continental shelf), neritic (continental shelf), and littoral zone (intertidal, splash, and spray zones) seabirds, waterfowl, loons, grebes, and shorebirds (plovers, sandpipers) that are protected under the *Migratory Birds Convention Act, 1994* (MBCA) and additional marine-associated birds not protected under the MBCA (i.e., cormorants). The term "migratory" 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 marine and migratory birds listed under Schedule 1 of the *Species at Risk Act* (SARA), Committee on the Status of Endangered Wildlife in Canada (COSEWIC), the *Newfoundland and Labrador Endangered Species Act* (NL ESA), the *Newfoundland and Labrador Wild Life Act,* or the International Union for Conservation of Nature (IUCN) Red List of Threatened Species.

The biologically productive Grand Banks and adjacent waters are inhabited by large numbers of seabirds in each of the four seasons (Lock et al. 1994; Fifield et al. 2009). Several million seabirds nest along the eastern and northeastern coasts of Newfoundland, and forage on the Grand Banks and adjacent waters during the nesting season and post-breeding dispersal. There are also many non-breeding seabirds in the Regional Assessment Area (RAA) during the summer months. Most of the world's population of great shearwater and large numbers of sooty shearwater migrate from nesting colonies in the South Atlantic to Newfoundland waters to spend the non-breeding season. During winter, seabirds that have nested in Canada's eastern Arctic and sub-Arctic and from both eastern and western Greenland gather in the RAA. Non-breeding sub-adults fledged from those nesting colonies, mostly of northern fulmar and black-legged kittiwake, remain in the RAA year-round. During fall Arctic-nesting shorebirds (plovers and sandpipers) of various species undergo trans-oceanic migration from eastern North America to South America (Williams and Williams 1978; Richardson 1979), some of which may pass through the RAA. Species designated at risk provincially or federally and have the potential to occur in the RAA or the Project Area are: harlequin duck, Barrow's goldeneye, piping plover, red knot, buff-breasted sandpiper, red-necked phalarope, ivory gull, Ross's gull, and peregrine falcon. An additional three species are listed on the IUCN Red List of Threatened Species: Bermuda petrel, Zino's petrel and Desertas Petrel. The Project Area is at the edge of distributions or migratory routes of some of these species, but they have been recorded in the Project Area on rare occasion. Other shorebird and landbird species at risk in Newfoundland and Labrador are not likely to occur in the RAA or Project Area.

This VC is linked to the Marine Fish and Fish Habitat VC (Chapter 8) in recognition of prey species on which marine and migratory birds may rely. This VC is also linked to the Special Areas VC (Chapter 11), as Important Bird Areas and Convention on Biodiversity Ecologically or Biologically Significant Areas are included as special areas and linked to the Indigenous Communities and Activities VC (Chapter 12) as marine and migratory birds are harvested by the Indigenous groups.

9.1 Scope of Assessment

9.1.1 Regulatory and Policy Setting

Migratory birds are protected under the federal MBCA, which is administered by Environment and Climate Change Canada (ECCC). The MBCA and associated regulations provide protection to all birds listed in the Canadian Wildlife Service (CWS) Occasional Paper No. 1, Birds Protected in Canada under the MBCA. Migratory and non-migratory birds protected by the MBCA include most seabirds (except cormorants and pelicans), all waterfowl, all shorebirds, and most landbirds (birds with principally terrestrial life cycles). 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 promote compliance with the MBCA and reduce the risk of incidental take of migratory birds, nests and eggs, ECCC has developed Avoidance Guidelines (ECCC 2017a). A permit under the MBCA and *Migratory Bird Regulations* is necessary to authorize the capture and handling of migratory birds. The Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) has developed Measures to Protect and Monitor Seabirds in Petroleum Related Activity in the Canada-Newfoundland and Labrador Offshore Area (C-NLOPB n.d.) 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.

Species at risk (SAR) include species listed under Schedule 1 of the federal SARA as endangered, threatened, or of special concern; or listed under the NL ESA as endangered, threatened, or vulnerable. 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.

Wildlife species that are 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 Chevron'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. Concern has been noted regarding noise disturbance to migratory species from VSP equipment including direct physiological effects and indirect effects to foraging behavior of prey species. Physical displacement of migratory bird species as a result of supply vessels was noted as a concern, as well as the attraction of, and increase in, predator species affecting migratory birds from waste disposal practices. 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 due to attraction of birds to artificial lighting on the mobile offshore drilling unit (MODU) and supply vessels, operational discharges during well drilling and testing operations, underwater sound emissions from vertical seismic profiling (VSP) operations, and interactions with supply vessel and helicopter activities during supply and servicing.

Guidelines for this EIS issued by the Canadian Environmental Assessment Agency in December 2018 identify and specify issues and potential effects on this VC to be considered in the EIS (see Section 7.3.5 of the EIS Guidelines [Appendix A]).

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

- Physical displacement because of vessel presence (e.g., disruption of foraging activities)
- Nocturnal disturbance (e.g., increased opportunities for predators, attraction to the MODU or supply vessels 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 supply vessels
- Collision risk with Project infrastructure (e.g., the MODU or supply vessels)
- 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 15.5.2.

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

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Risk of Mortality or Physical Injury	Interactions between the extent, duration, or timing of Project activities and the environment that result in direct effects 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 would occur. Well locations have not been identified but will occur within the Project Area within EL 1138. The Project Area has been delineated to provide a 10 km buffer around the EL.

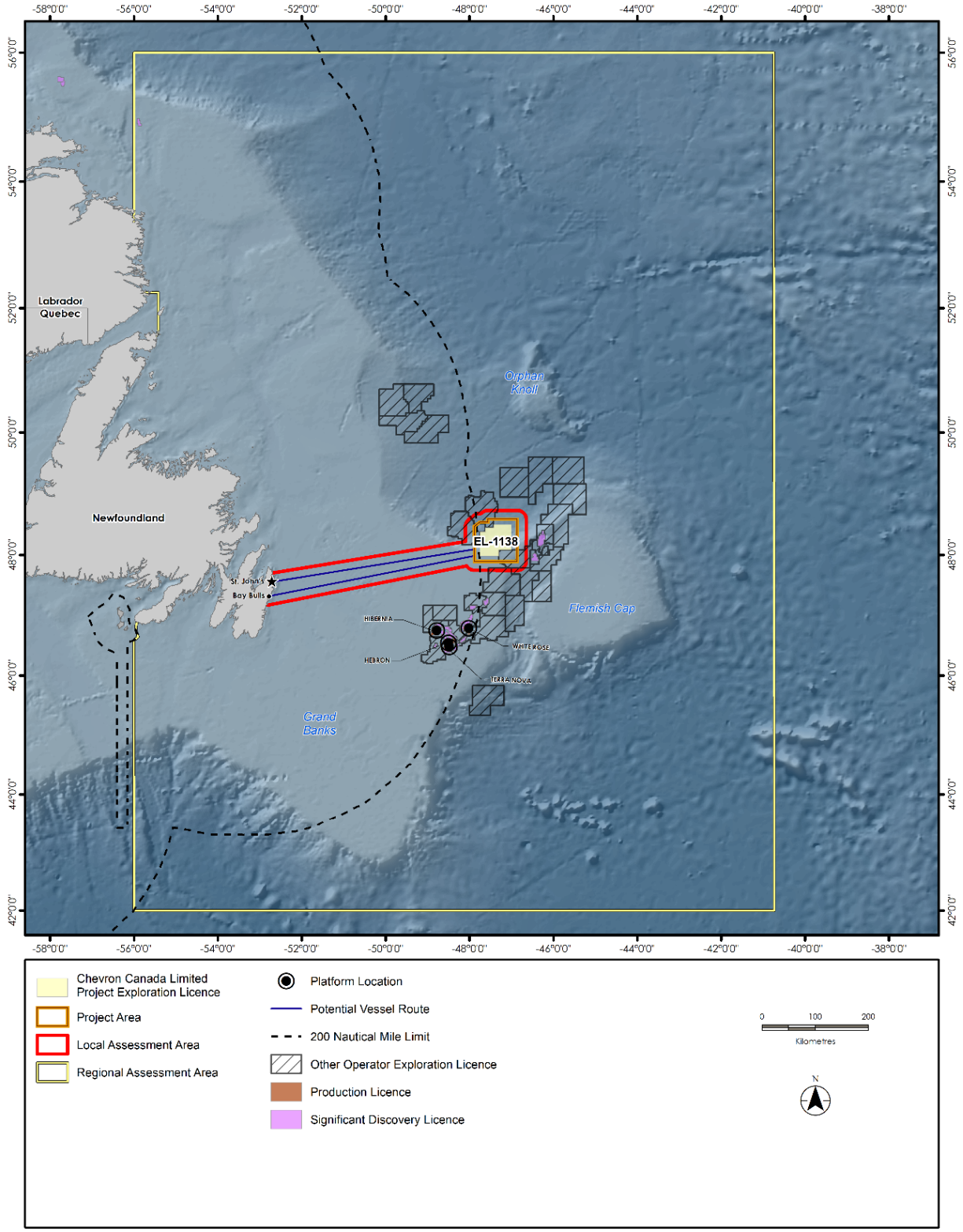

Figure 9-1 Marine and Migratory Birds Spatial Boundaries

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, its 10 km buffer and an additional 16 km buffer 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. 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 supply vessels.

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 Project to be assessed encompass all Project phases, including well drilling, testing, and abandonment. Chevron is currently planning to drill up to eight exploration and delineation/appraisal wells over the term of EL 1138 (2016 to 2025). Project activities at each well could take approximately 180 days to drill. 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. VSP surveys typically take one to three days per well. Drilling operations will not be continuous throughout the term of the EL 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, Chevron's preference is to conduct drilling between May and September.

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.

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 15.5.2.

Table 9.2 Characterization of Residual Effects on Marine and Migratory Birds

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual environmental effect relative to baseline	**Positive** – a residual environmental effect that moves measurable parameters in a direction beneficial to marine and migratory birds relative to baseline **Adverse** – a residual environmental effect that moves measurable parameters in a direction detrimental to marine and migratory birds relative to baseline **Neutral** – no net change in measurable parameters for marine and migratory birds relative to baseline
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions	**Negligible** – no measurable change **Low** – a detectable change but within the range of natural variability **Moderate** – a detectable change beyond the range of natural variability, but with no associated adverse effect on the viability of the affected population. **High** – A detectable change that is beyond the range of natural variability, with an adverse effect on the viability of the affected population.
Geographic Extent	The geographic area in which a residual environmental effect occurs	**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 baseline conditions unlikely
Reversibility	Pertains to whether a measurable parameter or the VC can return to its existing condition after the project activity ceases	**Reversible –** will recover to baseline conditions before or after Project completion **Irreversible –** permanent

Table 9.2 Characterization of Residual Effects on Marine and Migratory Birds

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

9.1.6 Significance Definition

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

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

- Causes a detectable decline in abundance or change in the spatial and temporal distribution of marine and migratory birds within the overall RAA, such that natural recruitment may not re-establish the population(s) to its original level within one generation
- Jeopardizes the achievement of self-sustaining population objectives or recovery goals for listed (SAR) species such that the overall abundance, distribution and health of that species and its eventual recovery within the RAA is adversely affected resulting 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 the VC 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. A justification for no effect is provided following the table.

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)	✓	✓
Vertical Seismic Profiling (VSP)	✓	✓
Discharges (e.g., drill muds / cuttings, liquid discharges)	✓	✓
Well Testing and Flaring (including air emissions)	✓	✓
Well Abandonment	–	–
Supply and Servicing Operations (including helicopter transportation and supply vessel operations)	✓	✓
Notes: ✓ = Potential interaction – = No interaction		

Well abandonment will occur underwater at sufficient depths to prevent interaction with marine and migratory birds, including diving species. Of the marine and migratory birds which are likely to occur in the vicinity of the Project regularly, alcids (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 400 m to more than 2,200 m in the Project Area but drilling and well abandonment will take place beyond the depth of diving seabirds (e.g., 200 m or shallower) found in the area and is therefore not predicted to interact with migratory birds, including diving seabirds. As Project planning continues, final details about the well abandonment program will be confirmed with the C-NLOPB. Well decommissioning will be carried out as per Chevron's internal procedures and with the *Newfoundland Offshore Petroleum Drilling and Production Regulations*.

9.3 Assessment of Residual Environmental Effects on Marine and Migratory Birds

The following section assesses the environmental effects on marine and migratory birds identified as arising from potential interactions in Table 9.3. Given the similarities in Project description, proximity of activities on Orphan Basin and Flemish Pass, and currency of data, the EIS incorporates information from previous EA documents (e.g., BP 2018, Husky 2018) for similar exploration drilling projects in Atlantic Canada, 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 supply vessels has the greatest potential to result in changes to risk of mortality or physical injury for marine and migratory birds because they are known to congregate around drilling and production platforms as a result of artificial lighting at night, food, and other visual cues, potentially making them vulnerable to increased risk of mortality due to physical strikes with structures, stranding on the MODU or supply vessels and subsequent dehydration or starvation, 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 supply vessels, the Project has potential to result in a change in risk of mortality or physical injury for marine and migratory birds through exposure to residual hydrocarbons associated with drill muds and cuttings and other discharges, exposure to underwater sound caused by VSP operations (although the likelihood of such an exposure is limited by the short duration of VSP operations 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 reduced to the extent that worker safety and safe operations are not compromised. Reduction of light may include avoiding use of unnecessary lighting, shading, and directing lights towards the deck.
- Chevron, in consultation with ECCC-CWS, will develop a protocol for systematic, daily searches for seabirds stranded on the MODU and supply vessels, 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 2017b). Chevron 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 occurrence data that summarizes stranded and/or seabird handling occurrences will be submitted to ECCC.

Vertical Seismic Profiling Operations

- VSP activities will be planned and conducted in consideration of the Statement of Canadian Practice with Respect to the Mitigation of Seismic Sound in the Marine Environment (SOCP; DFO 2007; refer to Section 10.3). 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 Evaluation and Testing

- If flaring is required, Chevron 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.

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 S*eabird Ecological Reserve Regulations, 2015*. Specific details will be provided in the environmental protection plan (EPP).
- Supply vessel routes transiting to and from the MODU will be planned to avoid passing within 300 m of migratory bird nesting colonies during the nesting period and will comply with provincial Seabird Ecological Reserve Regulations, 2015 and federal guidelines in order to reduce disturbance to colonies (ECCC 2017c). Specific details will be provided in the EPP.
- Lighting on supply vessels will be reduced to the extent that safety of operations is not compromised. Reduction of light may include avoiding use of unnecessary lighting, shading, and directing lights towards the deck.
- Searches for stranded birds and recovery, rehabilitation, release and documentation of birds will be conducted on supply vessels as outlined above for the MODU

9.3.1.3 Characterization of Residual Project-related Environmental Effects

9.3.1.3.1 Presence and Operation of a MODU

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

Marine and migratory bird attraction to coastal and offshore lighting is well documented, but the causes are poorly understood (Imber 1975; Wiese et al. 2001; Gauthreaux and Belser 2006; Montevecchi 2006; Montevecchi et al. 2009; Bruinzeel and van Belle 2010; Rodríguez et al. 2015; Ronconi et al. 2015). Attraction of nocturnally-active birds may result in direct mortality or injury through collisions with facility infrastructure, predation, or through stranding on the platform (i.e., birds are unable to return to the sea 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 landbird mortality on offshore platforms was

due to collision. In addition, disoriented birds may circle around lights for long periods of time, depleting energy resources, delaying foraging or migration, and potentially increasing their susceptibility to predation (Bourne 1979; Sage 1979; Wiese and Montevecchi 1999; Wiese et al. 2001; Jones and Francis 2003; Bruinzeel and van Belle 2010, 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 at all times of the year but occurs most frequently at the end of the nesting season (Telfer et al. 1987; Le Corre et al. 2002; Miles et al. 2010). In the Newfoundland and Labrador offshore area, 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 adults abandon nesting colonies (LGL 2017). In other species, when the age of the grounded seabirds is known, the majority of individuals are recently fledged juveniles, especially near seabird nesting colonies, suggesting that juvenile inexperience is a factor contributing 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 decreases 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 passage

migrant bird behaviour 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. 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). 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 nm 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 Newfoundland and Labrador offshore area marine birds often strand on fishing vessels, drilling and production platforms, and supply vessels (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 floating production storage and offloading unit. In addition, 60% of 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 supply vessels 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, thorough searches of the vessel for birds, and recovery and documentation of stranded birds. The vessels were engaged in the Newfoundland and Labrador offshore area in exploration programs initiated as early as 7 May and terminated as late as 26 November; however, most were conducted during some portion of the months of June through September. In total, seabird stranding monitoring spanned 2,197 days over 38 voyages. 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 included northern fulmar, great shearwater, sooty shearwater, Wilson's storm-petrel, Leach's storm-petrel, dovekie, and black-legged kittiwake. Of the marine birds, 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 streamer and airgun array decks of seismic vessels, which are open only at the stern, or in similar partially-enclosed spaces. Very few stranded on open decks of geophysical vessels or on supply vessels 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 supply vessels, 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 airgun 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 clear that they would also have died were they not retrieved and returned to the sea. Leach's storm-petrels attracted to the Newfoundland and Labrador offshore area drilling and production platforms also suffer predation in late summer and fall from great black-backed gulls attracted by the fish drawn to the surface at night by the artificial lighting (Montevecchi et al. 1999; 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, this species feeds primarily in the deep waters off the continental shelf. As a result, individuals nesting in Newfoundland colonies travel to the waters beyond the Grand Banks to forage, then return to the colonies to provision their nestlings. Large

numbers nest at Baccalieu Island and Great Island, Witless Bay, and 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).

Information is limited regarding the distance at which birds can be affected by light from a MODU or vessel. 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). Large numbers of fledgling short-tailed shearwaters have been attracted to artificial lighting from at least 15 km away (Rodríguez et al. 2014).

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 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 suffer mortality and fall into the sea as a result. However, large stranding events appear to be episodic for reasons that are not clear, introducing uncertainty about the effect of the Project MODU on the Leach's storm-petrel population in Newfoundland. It should be noted that large stranding events are rare in data from production installations, MODUs and seismic ships. There is some potential for the attraction of landbirds in passage migration, particularly during the fall. However, most landbird migration involving water crossings in Atlantic Canada is thought to take place south and west of NL (Williams and Williams 1978; Richardson 1979). Some fall shorebird migration departs from the south coast of Newfoundland (B. Mactavish, 2019, pers. comm.). They 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 Project Area and that a small amount traverses the southwest corner of the RSA, 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
- Reversible

9.3.1.3.2 Vertical Seismic Profiling

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

Hearing in marine birds and the effect of sound on them 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 frequencies from 1 to 2 kHz. Common murre is likely to occur in the LAA but Atlantic puffin is uncommon so far offshore. 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 more resistant to damage than mammals (Dooling and Popper 2007). In addition, 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 geophysical arrays, because although low-frequency sound waves propagate further than higher frequencies, they are less damaging. 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 seconds underwater at a time (Gaston and Jones 1998).

In air, sounds from a submerged airgun array are reduced to a level not causing injury or mortality. However, they are audible to birds, as demonstrated by startle reactions to airgun releases that are often visible in gulls and skuas flying near submerged airgun arrays (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 airgun pulses or to the movement of the source vessel, it is reasonable to conclude that they are as capable of hearing the airgun 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 seconds and reach as high as 153 seconds (Gaston and Jones 1998). As a result, those birds that are not deterred by the first few shots of a ramp-up before initiating a dive, would be submerged sufficiently long to hear one or more airgun 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, airgun operations will incorporate a ramp-up in consideration of the Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment (SOCP, DFO 2007). The gradual increase in emitted underwater sound levels will provide an opportunity for diving marine birds to move away from the sound source before associated underwater sound reaches levels that are potentially physically damaging to marine birds diving near the source. Above the water, atmospheric sound from the airgun 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 three days) and will occur in a small area. VSP surveys will typically be conducted opportunistically from supply vessels 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 a change in risk of mortality and physical injury to marine and migratory birds is predicted to be:

- Adverse
- Negligible to low in magnitude
- Localized within portions of the Project Area
- Short-term in duration
- Irregular in frequency
- Reversible

9.3.1.3.3 Discharges

All emissions from Project supply vessels and the MODU will be in accordance with the Offshore waste Treatment Guidelines (OWTG) and International Convention for the Prevention of Pollution from Ships (MARPOL), as applicable. As well, discharges and emission are expected to be temporary, localized, non-toxic, and subject to dilution in the open ocean.

Cement, water-based drilling 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 400 m to over 2,200 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 drilling 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 (including use of non-toxic drilling fluids) in accordance with the Offshore Chemical Selection Guidelines, and proper disposal of drill muds and cuttings in accordance with the OWTG, effects on birds due to disposal of drill muds and cuttings and associated waste materials are considered unlikely.

Other potential liquid discharges from offshore vessels and equipment relate to the possible release of oily water and other substances through produced water (if applicable), deck drainage, bilge water, ballast water and liquid wastes. These discharges will be managed in accordance with the OWTG. Waste that cannot be discharged overboard will be stored and transported to shore for disposal in an approved facility (Section 2.8).

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

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

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

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

Atmospheric emissions associated with the Project include exhaust from power and heat generation from the drilling installation(s), and from supply vessels and aircraft traffic. It is unlikely that such emissions will have a 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 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 Project Area
- Short-term in duration
- Irregular in frequency
- Reversible

9.3.1.3.4 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 scavenging or landing in the ocean is not known (Bruinzeel et al. 2009; Ellis et al. 2013; Ronconi et al. 2015).

Some researchers contend that a portion 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 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 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 height soon after takeoff and then undertake a gradual descent shortly after midnight (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 of the flare's heat is expected to be limited to a few metres of the flare 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 five days per well, if flaring occurs at all), and associated bird attraction will be limited to within several kilometres of the MODU. Mitigation measures regarding flaring will be adhered to throughout the Project, including the use of high efficiency burners. Also, Chevron will notify the C-NLOPB in advance of plans to flare associated with well testing for exploration drilling. Flaring will be avoided during atmospheric conditions when birds are more vulnerable (i.e., at night, fog, low cloud ceiling). When flaring, Chevron may use a water curtain to protect personnel and equipment on the MODU by limiting the transfer of radiated heat from the flare, thereby mitigating risk of fire. A secondary benefit of a water curtain may be potential deterrence of birds from the general vicinity of the flare based on the positioning of the water curtain. The effects of formation flow testing with flaring on marine and migratory birds are therefore anticipated to be low.

Residual effects associated with flaring on changes to risk of mortality or physical injury to marine and migratory birds are predicted to be:

- Adverse
- Low in magnitude
- Localized to a portion of the Project Area
- Short-term in duration
- Irregular in frequency
- Reversible

9.3.1.3.5 Supply and Servicing

The Project will involve supply vessel and aircraft use (presence and movements), including supply and support traffic to, from and within the Project Area potentially at all times of year over the course of the Project (although Chevron's preference is to conduct drilling between May and September). 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 supply vessel 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 supply vessels are anticipated to be similar to those resulting from lighting on MODU, which were discussed above. For the most part, supply vessels are not stationary, except for occurrences when supply vessels must maintain station (stand-by vessel and VSP activities), meaning that disturbances will be highly transient in nature but will extend across a wider area along the identified supply vessel 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

supply vessels. 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 supply vessels 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.

Supply vessel traffic for the MODU represents a negligible contribution to the overall vessel traffic off Eastern Newfoundland, and Project-related supply vessel 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 on a change to risk of mortality or 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
- 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 atmospheric and underwater sound, artificial lighting, and discharges associated with the MODU and supply vessels. 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 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

Mitigation measures are as described above in Section 9.3.1.2.

Vertical Seismic Profiling Operations

Mitigation measures are as described above in Section 9.3.1.2.

Discharges

Mitigation measures are as described above in Section 9.3.1.2.

Well Evaluation and Testing

Mitigation measures are as described above in Section 9.3.1.2.

Supply and Servicing Operations

Mitigation measures are as described above in Section 9.3.1.2.

9.3.2.3 Characterization of Residual Project-related Environmental Effects

9.3.2.3.1 Presence and Operation of a MODU

Changes in habitat quality and use due to the presence and operation of a MODU generally 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 platforms because they themselves may become artificial reefs on soft sediments upon which new invertebrate and fish assemblages are established (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, this 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 supply vessel routes through general avoidance responses. However, the effect of habitat displacement on marine-associated birds is likely to be minor due to its small footprint (Hedd et al. 2011; Ronconi et al. 2015). Because the MODU will not be situated in one location for extended periods of time, disturbance will be short-term and transient in nature.

Based on the information and analysis summarized here, and with the implementation of appropriate mitigation measures as summarized in Section 9.3.2.2, the overall magnitude of the effect of the presence and operation of a drilling installation on marine and migratory birds is anticipated to be low. Some localized and short-term behavioural effects (change in presence and abundance) are also likely to occur, with some species displaced from the Project Area / LAA and others attracted by lighting which will reduce the degree to which foraging opportunities are enhanced by the presence and operation of a drilling installation. The localized, transient, and short-term nature of these disturbances at one location and time during the Project considerably reduces the potential for adverse effects upon marine and migratory birds (individuals or populations). It is therefore unlikely that individuals will be attracted or displaced over extended areas or timeframes. Given that the likely zone of influence of the Project (conservatively set at 16 km diameter where Project-related artificial lighting emissions are reasonably expected to occur based on Section 9.3.2.3.1) 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 on change in habitat quality and use to marine and migratory birds are predicted to be:

- Adverse
- Low in magnitude
- Localized to the LAA
- Short-term in duration
- Irregular in frequency
- Reversible

9.3.2.3.2 Vertical Seismic Profiling

Most field studies of the effects of underwater sound on bird behaviour have found no substantial effects (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 kittiwakes are rare in summer. Turnpenny and Nedwell (1994) also observed no response to seismic testing in guillemots, fulmars, or kittiwakes. Stemp (1985) 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 GPS tracking reported avoidance of a 2-D seismic survey by African Penguins (*Spheniscus demersus*) when foraging close to breeding colonies that were located less than 100 km from the seismic survey (Pichegru et al. 2017). The airgun 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 airgun 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 three days per well. As discussed above, 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, airgun source array sound is reduced to that which is likely to have little or no effect on birds that have their heads above water or are in flight. Effects of sound disturbance on the foraging behaviour of surface-feeding marine birds are also unlikely, given that the above-water sound levels of geophysical source arrays are negligible. As described in Chapter 8, significant effects to fish resources are not expected to occur because of the Project, and so changes in the availability, location, or quality of food sources for marine birds are not likely.

These activities will have a short duration (approximately one to three days) 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.

Residual effects associated with VSP on change in habitat quality and use to marine and migratory birds are predicted to be:

- Adverse
- Negligible in magnitude
- Localized within the Project Area
- Short-term in duration
- Irregular in frequency
- Reversible

9.3.2.3.3 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 may result in little localized organic enrichment supporting local productivity (Chapter 8). However, this effect will only occur during the drilling program (up to 180 days per well) and be localized in nature.

The production of sheens from routine discharges will be unusual given adherence to the OWTG and MARPOL requirements for waste management. However, if they do occur, this could result in avoidance and/or attraction of marine birds. Northern fulmar, shearwaters and storm-petrels are attracted to sheens. The visual appearance of a hydrocarbon sheen would resemble a sheen of biological origin and may 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 contact a sheen during foraging. Other birds may not be attracted 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 predicted to be:

- Adverse
- Low in magnitude
- Localized to the Project Area
- Short-term in duration
- Irregular in frequency
- Reversible

9.3.2.3.4 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.

Residual effects associated with well testing and flaring on change to habitat quality and use by marine and migratory birds are predicted to be:

- Adverse
- Low in magnitude
- Localized to portions of the Project Area
- Short-term in duration
- Irregular in frequency
- Reversible

9.3.2.3.5 Supply and Servicing

The Project will involve supply vessel and helicopter transit to and from the MODU in the Project Area, potentially any time of year over the life of the Project. Helicopter routes will lie at least 14 km southeast of the Cape St. Francis Important Bird Area (IBA) and at least 38 km north of the Witless Bay Ecological Reserve IBA (the nearest IBA with seabird nesting colonies). Supply vessel routes out of the Port of St. John's will lie approximately 26 and 35 km, respectively, from those IBAs. This traffic may affect seabirds through lighting, atmospheric and underwater sound, and other associated environmental emissions and discharges. The various bird species that occupy the Project Area will not likely be affected by supply vessel activity or associated aircraft use, due to its transitory nature and thus, its short-term presence at any one location, and because it is generally consistent with the overall marine traffic that has occurred throughout the region for years.

Helicopters may interact with the marine and migratory birds through aircraft overflights and potential disturbance of normal nesting, foraging or resting activities. Possible disturbance effects include increased energy expenditure of birds due to escape reactions, increased heart rate, decreased food intake due to interruptions, and temporary loss of suitable habitat (Ellis et al. 1991; Trimper et al. 2003; Komenda-Zehnder et al. 2003). For example, helicopter atmospheric sound emissions can disturb seabirds at nesting colonies. However, seabird reactions to helicopters and other aircraft are variable due to a number of 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).

Similar to presence of the MODU, when supply vessels 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 supply vessels 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 supply vessel traffic represents a negligible contribution to the overall vessel traffic off Eastern Newfoundland. Supply vessels will use established shipping lanes wherever possible, and, along with Project-related helicopters, will avoid coastal seabird colonies during the nesting season as per the Seabird Ecological Reserve Regulations, 2015 discussed and CWS guidelines in Section 9.3.1.2. Routes from St. the Port of John's are at least 27 km from the nearest seabird ecological reserve and routes from Bay Bulls are at least 1.8 km from those reserves. Adherence to established supply vessel routes will avoid passing within 300 m of kittiwake nesting colonies lying outside that reserve. For helicopter routes, the regional CWS office will be consulted for separation distances from nesting colonies, as per CWS guidelines. The nearest seabird nesting colony, a black-legged kittiwake 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 on change in habitat quality and use to marine and migratory birds are predicted to be:

- Adverse
- Low in magnitude
- Localized in extent to the LAA
- Short-term in duration
- Irregular in frequency
- Reversible

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

Table 9.4 lists marine and migratory bird SAR and SOCC that could potentially occur in the RAA, indicating their likely presence and potential interaction with Project activities. As discussed in Section 6.2.4 (and summarized in Table 9.4), there is low potential for SAR or SOCC to interact with the Project because of these species' low densities in the Project Area, LAA, and RAA (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 supply vessels 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 supply vessel 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 supply vessels. 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. 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.

Major threats identified in associated recovery strategies and action plans for these bird species at risk 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 interactions with these bird species at risk 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 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 to protect bird species at risk.

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

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

Species	NL ESA	Federal Status		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 supply vessels 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

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		
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 supply vessels in nearshore waters; could potentially be affected in the unlikely event of a spill reaching coastal waters
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
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-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

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		
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
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, present in small numbers during breeding season • Gathers on sea surface downwind of offshore installations
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 supply vessels to rest or prey on landbirds seeking refuge in these areas
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 supply vessels 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

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). 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	N-L	PA	ST	IR	R	D
Discharge	A	L	PA	ST	IR	R	D
Well Testing and Flaring	A	L	PA	ST	IR	R	D
Supply and Servicing	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
Discharge	A	L	PA	ST	UL	R	D
Well Testing and Flaring	A	L	PA	ST	IR	R	D
Supply and Servicing	A	L	LAA	ST	IR	R	D

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 interactions with marine and migratory birds in parts of the Project Area and LAA primarily as a result of bird attraction to offshore lighting and other components, the Project is not predicted to result in a detectable decline in overall bird abundance or changes in the spatial and temporal distributions of bird populations within this area. The potential for interactions between individuals of species at risk and the Project is limited, and no identified critical habitat is present in the Project Area, LAA, or

RAA. The Project is therefore not predicted to jeopardize the overall abundance, distribution, or health of species at risk. With mitigation and environmental protection measures, the residual environmental effects on marine and migratory birds (including species at risk) are predicted to be not significant.

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, as may be the proportion of birds that strand on MODUs but are not found in time to prevent rehabilitation and release, or not found. 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 supply vessels 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 Follow-up

For the duration of the drilling program for each well:

- Daily, systematic searches will be conducted for stranded birds on the MODU and supply vessels, and this effort documented, by trained personnel in accordance with facility-specific search protocols;
- Recovery, 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 Newfoundland and Labrador offshore area.

9.7 Summary of Commitments

- Lighting will be reduced to the extent that worker safety and safe operations are not compromised. Reduction of light may include avoiding use of unnecessary lighting, shading, and directing lights towards the deck.
- Chevron, in consultation with ECCC-CWS, will develop a protocol for systematic, daily searches for seabirds stranded on the MODU and supply vessels, 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 2017b). Chevron 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 occurrence data that summarizes stranded and/or seabird handling occurrences will be submitted to ECCC.

- 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.
- Refer to the waste management mitigation measures identified in the Marine Fish and Fish Habitat VC (Section 8.3).
- If flaring is required, Chevron 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 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. Specific details will be provided in the environmental protection plan (EPP). Specific details will be provided in the EPP.
- Supply vessel routes transiting to and from the MODU will be planned to avoid passing within 300 m of migratory bird nesting colonies during the nesting period and will comply with provincial Seabird Ecological Reserve Regulations, 2015 and federal guidelines in order to reduce disturbance to colonies (ECCC 2017c). Specific details will be provided in the EPP.
- Lighting on supply vessels will be reduced to the extent that safety of operations is not compromised. Reduction of light may include avoiding use of unnecessary lighting, shading, and directing lights towards the deck.
- Searches for stranded birds and recovery, rehabilitation, release and documentation of birds will be conducted on supply vessels as outlined above for the MODU

9.8 References

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10.0 ASSESSMENT OF POTENTIAL EFFECTS ON MARINE MAMMALS AND SEA TURTLES

The Marine Mammals and Sea Turtles VC includes baleen whales, large toothed whales, delphinids, porpoises, seals, and sea turtles, focusing on those species that are listed under Schedule 1 of SARA and considered at risk by COSEWIC. This VC was selected because of the potential for these marine mammals and sea turtles to interact with Project components and activities, as there is important habitat for these species in the offshore waters off NL, and because marine mammals are susceptible to effects from underwater sound. This VC is also of cultural and recreational value to Indigenous groups and the general public. The EIS Guidelines require the assessment of potential Project effects on marine mammals and sea turtles.

As noted in Section 6.3 of the EIS, offshore waters of eastern NL 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 sea turtle species 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 or 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 all species listed under Schedule 1 of SARA as endangered, threatened, or special concern. SOCC include those that are listed as endangered, threatened, or special concern by COSEWIC, but not yet listed in Schedule 1 of SARA. Species that are federally protected under SARA are listed in Schedule

1 of the Act. 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 species listed under Schedule 1 of SARA and their critical habitat. Under section 79 of SARA, ministerial notification is required if a project is likely to affect listed species or its critical habitat. This notification must identify the adverse effects of the project on listed wildlife species and its critical habitat and, if the project is conducted, measures that will be taken to avoid or reduce those effects, along with monitoring commitments.

Populations of marine mammals and sea turtles that are stable and those listed under Schedule 1 of SARA or identified by COSEWIC as at risk are considered here. However, SAR and SOCC are given special attention and emphasis in the analysis and evaluation of potential Project effects and necessary mitigation measures.

10.1.2 The Influence of Consultation and Engagement on the Assessment

During Chevron'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). These primarily include concerns regarding 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. The North American right whale and other culturally important species (including sea turtles, sharks, and other marine mammals) were noted of particular 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 MODU, VSP survey, supply vessels, 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 results 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 15.5.3.

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

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in risk of mortality or 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 due to ship strikes
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 EL 1138. The Project Area has been delineated to provide a 10 km buffer around the EL.

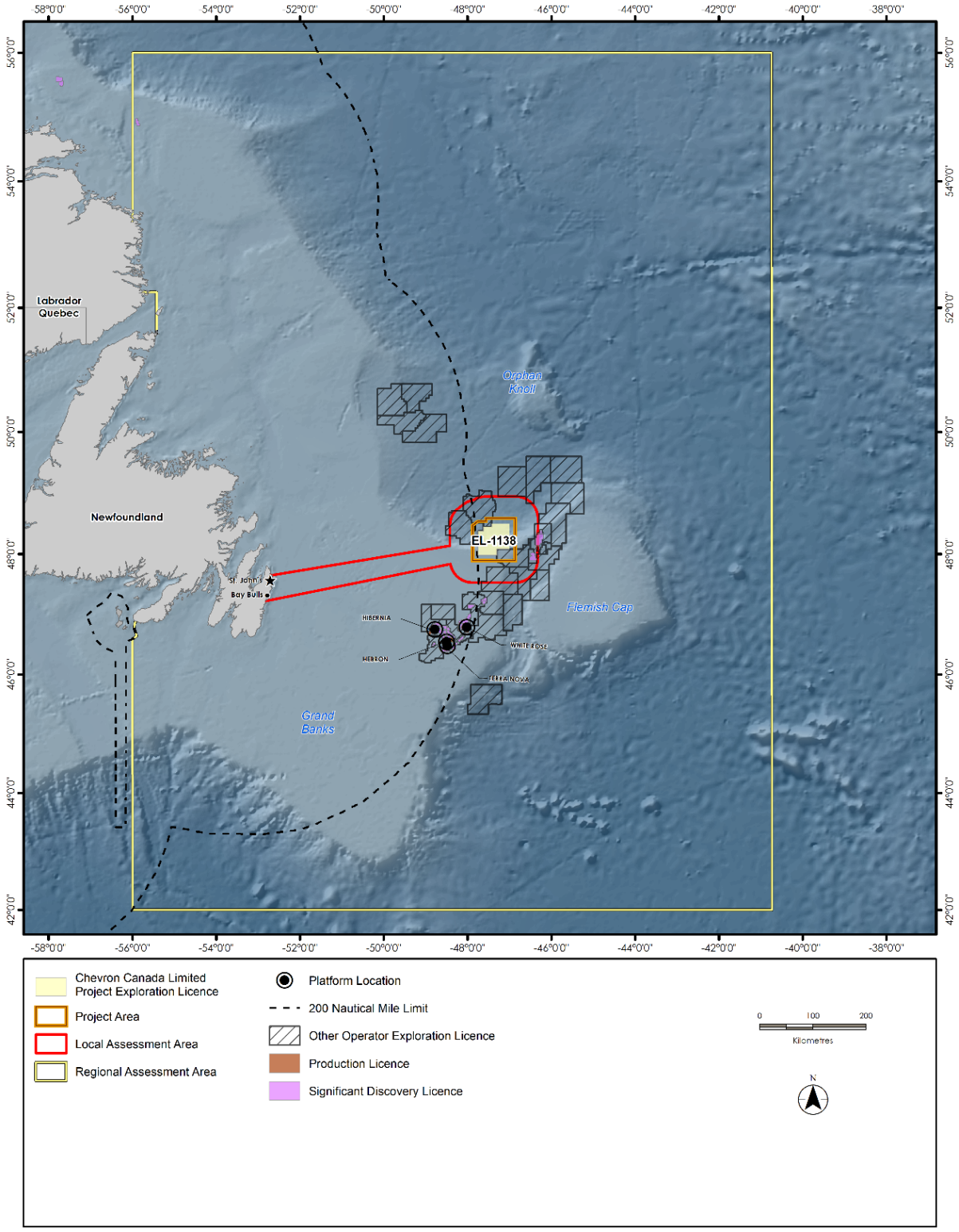

Figure 10-1 Marine Mammals and Sea Turtles Project Area, LAA, and RAA

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, including a 10-km buffer. 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, supply vessels, and VSP surveys. The LAA for marine mammals and sea turtles is based on modelling results for distances to sound threshold criteria for behavioural change and is defined as a conservative 40-km radius buffer around the Project Area to encompass the maximum threshold distances for activities.

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. Chevron is currently planning to drill up to eight exploration and delineation/appraisal wells over the term of EL 1138 (2016 to 2025). Project activities at each well could take approximately 180 days. Well testing 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. VSP surveys typically take approximately one to three days per well. Drilling operations would not be continuous throughout the Project and would depend on rig availability and results from previous wells. While drilling activities could be conducted year-round, Chevron's preference is to conduct drilling from May to September.

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 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 15.5.3.

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

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

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 RAA, 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 RAA, 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 the VC 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 Abandonment	–	✓
Supply and Servicing Operations (including helicopter transportation and Project supply vessel 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 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 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.

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

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

The following section assesses the environmental effects on marine mammals and sea turtles 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, new scientific information, and refined EA methods.

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 supply vessels 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 Operations

- As required in the Geophysical, Geological, Environmental and Geotechnical Program Guidelines (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) (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 any VSP activity begins. This measure is aimed at reducing the potential for auditory impairment to marine animals near the source at the onset of activity. This approach assumes that a gradual increase in emitted sound levels provides an opportunity for marine animals to move away from the sound source before potentially injurious sound levels are achieved close to the source. This procedure will include a pre-ramp up observation period. Ramp-up will be delayed if any marine mammal or sea turtle is detected within 500 m of the air gun array.
  - MMOs will implement a pre-ramp up watch of 60 minutes prior to ramp-up. The longer 60-minute pre-ramp up watch versus the minimum 30-minute period required in the SOCP will be used to account for the longer dive times of beaked whales (and other deep-diving marine mammals) expected to occur in the Project Area. This period is recommended by DFO (Moors-Murphy and Theriault 2017) in a recent review of the SOCP.
  - Shut down procedures (i.e., shutdown of source array) will be implemented if a marine mammal or sea turtle listed as endangered or threatened on Schedule 1 of SARA, as well as any beaked whale species, is observed within 500 m of the air gun array.

Supply and Servicing Operations

- Supply vessels will use existing shipping lanes as practicable; where these do not exist, supply vessels will follow a straight-line approach to and from the Project Area.
- During transit to and from the Project Area, supply vessels will travel at vessel speeds not exceeding 22 km/hour (12 knots), except as needed in the case of an emergency.
- Vessel crew will keep a watch for marine mammals or sea turtles and reduce speed and/or alter course if practicable to avoid a collision.

10.3.1.3 Characterization of Residual Project-related Environmental Effects

10.3.1.3.1 Presence and Operation of a MODU

The MODU will produce continuous (i.e., non-impulsive) sound during operations (see Section 2.8.5). The broadband sound source level for the MODU is assumed to be 196.7 dB re 1 µPa @ 1 m sound pressure level (SPL_{rms}). This source level has also been used for acoustic modelling for previous 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 expected SPL_{rms} of 196.7 dB for the MODU, sound levels would not reach the peak sound pressure level (SPL_{peak}) auditory injury thresholds for any marine mammal groups. Acoustic modeling conducted for the Project Area in Flemish Pass showed that marine mammals (in particular, high-frequency cetaceans) would have to occur and remain within a distance of up to 250 m of the MODU (or less for other hearing groups) for a 24-hour period to experience sound levels above the cumulative (over 24 hours) sound pressure level (SEL_{cum}) thresholds associated with PTS (Table 11 in Zykov and Alavizadeh 2019; Appendix D). 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
- Negligible in magnitude
- Restricted to the Project Area
- Short- to medium-term in duration
- Occur more than once at irregular intervals
- Reversible.

10.3.1.3.2 Vertical Seismic Profiling

As discussed in Section 2.8.5, VSP surveys use air guns 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 take one to three days per well. 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 air gun 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 air gun array might incur at least mild TTS, there has been speculation about the possibility that some individuals occurring very close to air guns might incur PTS (e.g., Richardson et al. 1995; Gedamke et al. 2011). Single or occasional occurrences of mild TTS are not 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 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 (Southall et al. 2007), as TTS studies have involved a limited number of species (see Appendix 4 in LGL 2015). Finneran et al. (2015) indicated that the potential for air gun 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 air gun 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 air gun pulses with SELs of 165-181 dB re 1 μPa^2s and SPLs (peak to peak) of 190-207 dB re 1 µPa, no TTS was observed at low frequencies.

The frequencies emitted in air gun pulses overlap substantially with the frequencies that sea turtles can detect. Sounds from an air gun array might cause TTS in a sea turtle if it does not avoid the immediate area around the air guns. However, some sea turtles show localized movement away from approaching air guns (Appendix 5 in LGL 2015). At short distances from the source, received sound levels diminish rapidly with increasing distance; 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 air guns have a low probability of directly harming marine life, except at close range. Several aspects of the planned monitoring and mitigation measures for seismic surveying are designed to detect marine mammals and sea turtles occurring near the air gun array and to avoid exposing them to sound pulses that might, at least in theory, cause hearing impairment. Many cetaceans and (to a lesser degree) pinnipeds and sea turtles show some avoidance of the area where received levels of air gun 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 consider 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 SPL_{peak} and 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 and Sea Turtles

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[1]	219	183	219	199
Mid-frequency Cetaceans[1]	230	185	230	198
High-frequency Cetaceans[1]	202	155	202	173
Phocids (in water)[1]	218	185	218	201
Sea Turtles[2]	232	204	232	220

Notes:
dB (decibel) SPL_{peak} has a reference value of 1 µPa
dB SEL_{cum} has a reference value of 1 μPa^2s
1 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).
2 Guidelines from U.S. 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, air guns, and pile driving (Popper et al. 2014). However, given the high hearing thresholds measured for sea turtles, the U.S. 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 2,400 in^3 air gun array with a sound pressure source level (broadside; 10-25,000 Hz) of 248.2 dB re 1 µPa at 1 m SPL_{peak} was undertaken (Zykov and Alavizadeh 2019; Appendix D). The sound speed profile for the water column for the month of May was used, as it represents the most favourable conditions for sound propagation and thus yields the most precautionary results. Estimated sound levels from the VSP air gun array were above SPL_{peak} injury thresholds (PTS onset) for impulsive sounds for low- and high-frequency cetaceans 20 m and 200 m from the array, respectively, and 30 m for seals; the PTS thresholds for mid-frequency cetaceans were not reached (see Table 7 in Zykov and Alavizadeh 2019; Appendix D). 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 air gun array (up to approximately 300 m for seals, but less for mid- and high-frequency cetaceans), to theoretically incur auditory injury (PTS) (Table 7 in Zykov and Alavizadeh 2019; Appendix D). This approach assumes that marine mammals occur within these distances of the VSP air gun 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 air guns

is at lower frequencies. Based on the NMFS criteria, modelling results suggest that if a baleen whale occurs within less than 5 km (up to 4.52 km; Table 9 in Zykov and Alavizadeh 2019) of the VSP air gun 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 air gun array. The amount of acoustic energy received depends on where in the sound field an animal is when the sound source is on.

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 U.S. 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 any of these levels at distances less than 40 m (Zykov and Alavizadeh 2019; Appendix D). 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 air gun 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 air gun array. Air gun(s) will be shut down if a marine mammal or sea turtle listed as endangered or threatened on SARA Schedule 1 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 to marine mammals and sea turtles are predicted to be:

- Adverse
- Negligible to low in magnitude
- Occur within the Project Area
- Short-to medium-term in duration
- Occur more than once at irregular intervals
- Reversible.

10.3.1.3.3 Supply and Servicing

The Project will involve the use of supply vessels 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); however, 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 supply vessel 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. Most lethal and severe injuries to large whales from ship strikes have occurred when vessels were travelling at ≥14 knots (25.9 km/hour; 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 (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), 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 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 U.S.), 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 reliable 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 supply vessel routes.

Project vessels could strike sea turtles resulting in injury or mortality. Propeller and collision injuries from vessels are common for sea turtles in U.S. 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 supply vessels transiting to and from the Project Area and within the Project Area will strike a marine mammal or a sea turtle. Supply vessels will use existing shipping lanes as practicable; where these do not exist, supply vessels will follow a straight-line approach to and from the Project Area. During transit to and from the Project Area, supply vessels will travel at lower speeds (not exceeding 22 km/hour or 12 knots) than those generally associated with lethal ship strikes to marine mammals, except as needed in the case of an emergency. In addition, vessel crew will keep a watch for marine mammals and sea turtles and reduce speed and/or alter course if practicable to avoid collision. 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, except for fin whales (Schedule 1, special concern).

Residual effects associated with the presence of supply vessels related to changes in the risk of mortality and injury to marine mammals and sea turtles are predicted to be:

- Adverse
- Negligible to low in magnitude
- Restricted to the LAA
- Short- to medium-term in duration
- Occur more than once at irregular intervals
- 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, supply vessels, and well abandonment and removal. 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 (e.g., affecting breeding or displacement from feeding area) to the individual or the population. 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. apply. These measures will not only minimize 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 above for 10.3.1. apply, which will minimize the risk of injury and behavioural effects.

10.3.2.3 Characterization of Residual Project-related Environmental Effects

10.3.2.3.1 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, 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 dynamic positioning (DP); sounds from MODUs are non-impulsive or continuous in nature. 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 rms SPL 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. Matthews et al. (2018) showed that DP thrusters from the semi-submersible drilling platform West Hercules located 209 km from an acoustic recorder were faintly detectable but did not increase the overall broadband sound levels.

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; Delefoss 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 important 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, respectively (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 U.S. 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., air guns used in VSP) and apply to cetaceans and pinnipeds. Here, these thresholds are considered as a guide for the assessment of potential effects of sound on behavioural responses of marine mammals, rather than an absolute indicator of such effects occurring. Where species-specific information on received sound levels is available (e.g., Southall et al. 2007), this information is considered.

The SPL_{rms} 120 dB re 1 µPa sound level (using R_{max} - most conservative estimate) was estimated to be 32 km from the MODU (Table 11 in Zykov and Alavizadeh 2019; Appendix D). Using the more representative $R_{95\%}$ distance estimate, the 120-dB threshold would occur at 27 km from the MODU. Based on the information presented earlier, it is unlikely that marine mammals, particularly odontocetes and seals, would avoid the MODU at these distances; any avoidance is expected to occur closer to the MODU. 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.

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). As such, masking could 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. 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 environmental effects associated with presence and operation of a MODU (primarily related to underwater sound) on a change in habitat quality and use to marine mammals and sea turtles are predicted to be:

- Adverse
- Low in magnitude
- Occur within the Project Area or LAA
- Short- to medium-term in duration
- Occur more than once at irregular intervals
- Reversible

10.3.2.3.2 Vertical Seismic Profiling

Most information on marine mammal behavioural response to air gun sounds comes from studies of 2D and 3D seismic surveys compared with the more localized, shorter duration, and smaller air gun 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 air guns, 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 air gun arrays at distances beyond a few kilometers, although sound levels from the air gun source remain above ambient sound levels out to much greater distances. However, baleen whales often react to sound from an air gun 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 substantial responses to 500-in^3 air gun arrays or larger for minkes 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 air gun sources (20 and 140 in^3) within 3 km and received levels of at least 140 dB re 1 μPa^2s. Responses to ramp up and use of a large 3130 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 air gun source, where received levels were greater than 135 dB re 1 μPa^2s (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^2s (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 air gun 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 air gun 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 substantial response (e.g., lateral displacement, localized avoidance, or change in behaviour) to sound from large air gun 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 air gun source on bottlenose dolphins at the highest exposure condition (peak SPLs 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 et al. 2015). Bottlenose dolphins exposed to multiple air gun 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 air gun 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 air gun 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 sound source but returned to natural movement patters within 8 h, and two porpoises had shorter and shallower dives but returned to natural behaviours within 24 h.

Pinnipeds tend to be less responsive to air gun sounds than many cetaceans and are not likely to show a strong avoidance reaction to air gun arrays (Appendix 4 of LGL 2015 for details). Visual monitoring from seismic vessels typically has shown only slight (if any) avoidance of active air gun arrays by pinnipeds, and only slight (if any) changes in behaviour. Stone (2015) found that grey seals were displaced when large air gun 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 air gun 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 air gun 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 air gun 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 and comparative analysis undertaken by Zykov and Alavizadeh (2019), marine mammals may avoid an area of approximately 6.2 km (using R_{max} - most conservative estimate) from the VSP air gun array (Table 2.15 in Section 2.8.5). Using the more representative estimate ($R_{95\%}$), the 160-dB threshold typically would be reached at 4.8 km from the VSP air gun array. Any avoidance by marine mammals is predicted to be temporary particularly given the short duration of VSP surveys (one to three days).

Because of the intermittent nature and low duty cycle of air gun 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 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 air gun 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 air gun sounds (e.g., Blackwell et al. 2015). Sills et al. (2017) reported that recorded air gun 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 air gun 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 three 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 U.S. 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 6 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 air guns occur in important areas at biologically important times of year. To the extent that there are any adverse effects on sea turtles, operations involving air gun 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, significant effects to prey (fish, invertebrate) resources are not expected to occur because of the Project, and changes in the availability, location, or quality of prey for marine mammals and sea turtles related to VSP surveys are unlikely.

Based on the information summarized here, the mitigation measures summarized in Section 10.3.2.2, 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 air gun array. The localized, transient, and short-term nature of any behavioural responses at one location and time during the Project considerably reduces the potential for

adverse effects 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 environmental effects associated with VSP (primarily related to underwater sound) on changes in habitat quality and use to marine mammals and sea turtles are predicted to be:

- Adverse
- Low in magnitude
- Restricted to the Project Area
- Short- to medium-term in duration
- Occur more than once at irregular intervals
- Reversible

10.3.2.3.3 Discharges

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

Drilling wastes such as cement, WBM, and cuttings released at the seafloor are unlikely to affect marine mammals and sea turtles. Water depths in the EL where exploration drilling would occur range from approximately 400 m to 2,200 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.

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 non-toxic drilling fluids) in accordance with the *Offshore Chemical Selection Guidelines*, and proper disposal of drill muds and cuttings in accordance with the OWTG, 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 (Section 2.8.4).

There is limited potential for interactions and effects of organic wastes disposed of from the MODU on marine mammals and sea turtles. Some prey species may be exposed to drill cuttings and discharges in the water column and in localized areas around the 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 a change in habitat quality and use to marine mammals and sea turtles is predicted to be:

- Adverse
- Negligible in magnitude
- Restricted to the Project Area
- Short term in duration
- Occur more than once at irregular intervals
- Reversible

10.3.2.3.4 Well Abandonment

There is little potential for marine mammals and sea turtles to interact with well abandonment activities. Nonetheless, 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. Residual environmental effects associated with well abandonment on a change in habitat quality and use to marine mammals and sea turtles is predicted to be:

- Adverse
- Negligible in magnitude
- Restricted to the Project Area
- Short-term in duration
- Occur more than once at irregular intervals
- Reversible

10.3.2.3.5 Supply and Servicing

The Project will involve supply vessel use including supply and support traffic to, from, and within the Project Area throughout the year during the Project life. In addition to supply vessel 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 supply vessels 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, 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 supply vessels given the relatively low source level and attenuation of sound (Statoil 2017). As noted earlier, 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 supply vessels. 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 air guns. 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.

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 air guns. 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 substantially 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 supply vessel. 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 supply vessel traffic represents a negligible contribution to the overall vessel traffic off eastern NL. supply vessels will use existing shipping lanes as practicable; where these do not exist, supply vessels will follow a straight-line approach to and from the Project Area. Whenever possible, vessels will maintain a steady course and constant speed. Additionally, during transit to/from the Project Area, supply vessels will travel at vessel speeds not exceeding 22 km/hour (12 knots), except as needed in the case of an emergency. In the event that a marine mammal or sea turtle is detected near the vessel, vessel speed will be reduced.

Based on the information presented here, as well as the mitigation measures presented in Section 10.3.2.2, the overall magnitude of the effect of the supply vessels 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 supply vessel 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 environmental effects associated with supply and servicing activities (primarily related to underwater sound) on a change in habitat quality and use to marine mammals and sea turtles are predicted to be:

- Adverse
- Low in magnitude
- Occur within the LAA (including transit route)

- Short- to medium-term in duration
- Occur more than once at irregular intervals
- Reversible

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

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

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

Species	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 (supply vessel 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 (supply vessel 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 (supply vessel transit)
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 • 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 (supply vessel transit)

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

Species	Season	*SARA* Status[a]	COSEWIC Status[b]	Summary of Potential Interactions
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 (supply vessel 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 (supply vessel 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 (supply vessel 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 (supply vessel 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 (supply vessel transit)

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.

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 proposed to reduce underwater sound disturbance associated with VSP air gun 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. 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 any identified concentration areas or critical habitat. However, there is some uncertainty as to whether the Project Area provides important habitat for marine mammals, such as the northern bottlenose whale (see Section 6.3.7.4) (Delarue et al. 2018; Maxner et al. 2019).

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.

10.3.4 Summary of Project Residual Environmental Effects

Table 10.6 summarizes the environmental effects assessment and prediction of residual environmental effects resulting from interactions between the Project and marine mammals and sea turtles. The greatest potential for environmental effects on marine mammals and sea turtles related to underwater sound is from the MODU and supply vessels 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, supply vessels, and the VSP survey. Similarly, in the unlikely event that a sea turtle occurred in the Project Area, there could be localized avoidance of Project activities. The risk of injury and mortality from ship strikes is considered very low, particularly since supply vessels will travel at 12 knots and will maintain a constant course and speed whenever possible. Similarly, the likelihood of a marine mammal and sea turtle incurring permanent hearing impairment (PTS) and physical injury from exposure to air gun 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 10.6 Summary of Residual Environmental Effects on Marine Mammals and Sea Turtles, Including Species at Risk

Residual Effect	Residual Environmental Effects Characterization						
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in Risk of Mortality or Injury							
Presence and Operation of a MODU	A	N	PA	ST-MT	UL	R	D
VSP	A	N-L	PA	ST-MT	UL	R	D

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

Residual Effect	Residual Environmental Effects Characterization						
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Well Abandonment	A	N-L	PA	ST	UL	R	D
Supply and Servicing	A	N-L	LAA	ST-MT	UL	R	D
Change in Habitat Quality and Use							
Presence and Operation of a MODU	A	L	PA-LAA	ST-MT	IR	R	D
VSP	A	L	PA	ST-MT	IR	R	D
Discharge	A	N	PA	ST	UL	R	D
Well Abandonment	A	N	PA	ST	UL	R	D
Supply and Servicing	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 possibly extending to the LAA, the number of individuals that may be affected, and the temporary and reversible nature of these effects, indicates that the Project will not result in a detectable decline in overall marine mammal and sea turtle abundance or 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 greater potential for Project interactions with fin and northern bottlenose whales. Nonetheless, any effects would be temporary, generally low in magnitude given the planned mitigation measures, and there is no identified critical habitat 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 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 (Delarue et al. 2018; Maxner et al. 2019) and which of the two known populations individuals 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, supply vessels, and VSP surveys on marine mammals and sea turtles. Numerous studies referenced in this EIS show high levels of variability of response to underwater sound from MODU / drillship, vessel, and air gun source activities.

10.6 Environmental Monitoring and Follow-up

Chevron will develop a marine mammal and sea turtle monitoring plan to be implemented during VSP surveys as outlined in Section 10.3.1.2 and 10.3.2.2. 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, Chevron will contact DFO through their 24-hour emergency contact number (1-888-895-3003).

10.7 Summary of Commitments

The Project is committed to the implementation of the following monitoring and mitigation measures:

- 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 will be implemented before any VSP activity begins.
- MMOs will implement a pre-ramp up watch of 60 minutes prior to ramp-up. Ramp-up will be delayed if any marine mammal or sea turtle is detected within 500 m of the air gun array.
- Shut down procedures will be implemented if a marine mammal or sea turtle listed as endangered or threatened on Schedule 1 of SARA, as well as any beaked whale species, is observed within 500 m of the air gun array.

- Supply vessels will use existing shipping lanes as practicable; where these do not exist, supply vessels will follow a straight-line approach to and from the Project Area.
- During transit to and from the Project Area, supply vessels will travel at vessel speeds not exceeding 22 km/hour (12 knots), except as needed in the case of an emergency.
- Vessel crew will keep a watch for marine mammals or sea turtles and reduce speed and/or alter course if practicable to avoid a collision.

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11.0 ASSESSMENT OF POTENTIAL EFFECTS ON SPECIAL AREAS

The Special Areas VC includes areas that have been established by federal or provincial governments, municipalities, or international organizations to identify and, depending on designation type, legally protect their ecological, historical and/or socio-economic importance. Special areas were selected as a VC due to their presence within/near the Project Area and/or Local Assessment Areas (LAAs) and their potential to be affected by Project activities. Of particular interest are the potential for effects from the Project on organisms and their habitat that rely on a special area and which resulted in a special area's designation.

Special areas are deemed important for all stakeholders, including for the identification and/or protection of unique, productive, or sensitive ecosystems or species, cultural heritage, and habitat or species important for fisheries. Special areas are linked to the Marine Fish and Fish Habitat (see Chapter 8), Marine and Migratory Birds (see Chapter 9), Marine Mammals and Sea Turtles (see Chapter 10), Indigenous Communities and Activities (see Chapter 12), and Commercial Fisheries and Other Ocean Users VCs (see Chapter 13), because special areas receive designation based on the presence and importance of these VCs.

Special areas that overlap the Project Area and/or LAA established for this VC are provided in Table 11.1 and Figure 11-1. The maximum zone of influence for underwater sound (marine mammal behavioural response), light (bird attraction), and dispersion of drill cuttings (fish and fish habitat) is approximately 40 km, 16 km, and 1 km, respectively. Conservatively, the zone of influence of 40 km for underwater sound (marine mammals) has been applied as a buffer around the Project Area and a 10 km buffer has been applied around the vessel transit route as shown in Figure 11-1.

Additional special areas identified within the Regional Assessment Area (RAA) (Section 6.4) are not expected to interact with routine Project activities but could potentially be affected in the unlikely event of an accidental event (Section 15.5.4) and could be subject to cumulative effects from the proposed Project in combination with those of past, present and reasonably foreseeable projects (Section 14.5); Chapter 11 presents the assessment of effects from routine Project activities and therefore focuses on special areas within and near the Project Area.

Table 11.1 Special Areas that Overlap the Project and/or Local Assessment Area

Special Area	Within Project Area		Within LAA for	
Federal	**Yes / No**	**% Overlap or CPA**	**Project Area**	**Transit Route**
EBSA				
Northeast Slope	Yes	2.04 %	Yes	Yes
Eastern Avalon	No	315 km	No	Yes
Baccalieu Island	No	306 km	No	Yes
Marine Refuge Closure				
Northeast Newfoundland Slope Closure	Yes	0.47 %	Yes	Yes
SBA				
Sea Pens	Yes	0.69 %	Yes	Yes
Large Gorgonian Corals	No	14.4 km	Yes	Yes
SARA Critical Habitat (Proposed)				
Spotted Wolffish	Yes	0.12 %	Yes	Yes
Northern Wolffish	Yes	0.08 %	Yes	Yes
Provincial				
Witless Bay Ecological Reserve	No	372.9 km	No	Yes
International				
Convention on Biological Diversity EBSA				
Slopes of the Flemish Cap and Grand Bank	Yes	4.48 %	Yes	Yes
NAFO Corals and Sponges Closures				
No. 6: Sackville Spur	No	15.6 km	Yes	No
No. 10: Northwest Flemish Cap	No	37.0 km	Yes	No
Other				
IBA				
Witless Bay Islands	No	371.9 km	No	Yes

Notes: EBSA = Ecologically or Biologically Significant Area; SARA = *Species at Risk Act*; VME = Vulnerable Marine Area; IBA = Important Bird Area; SBA = Significant Benthic Area; CPA = closest point of approach; LAA = Local Assessment Area

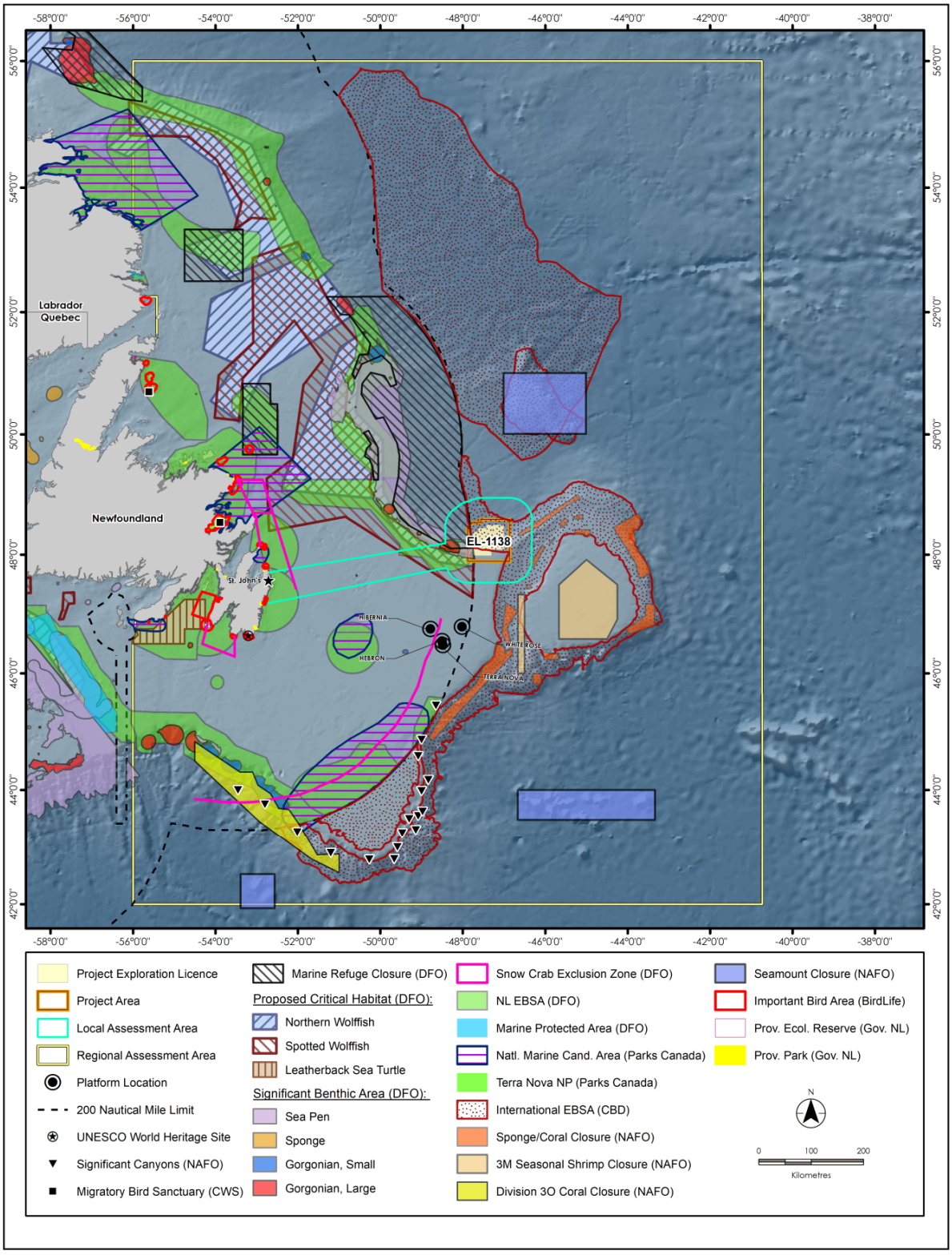

Figure 11-1 Special Areas that Overlap the Project Area and/or LAA

11.1 Scope of Assessment

11.1.1 Regulatory and Policy Setting

There are multiple regulatory instruments from the federal government of Canada and the provincial government of NL that enable protection of Canada's lands and waters. A summary of applicable legislation is provided in Table 11.2, with more details in Sections 6.4.2 (federal) and Section 6.4.3 (provincial).

Table 11.2 Relevant Legislation and Regulations for Special Areas within the Project Area and LAA

Special Area Type	Governing Body	Legislation / Regulation	Summary
EBSA	DFO	N/A	• EBSAs do not receive legal protection; they are identified to assist the delineation of MPAs, which are protected
	CBD	N/A	
Marine Refuge	DFO	*Oceans Act*, 1996, c.31 *Fisheries Act*, 1985, c.43	• Provide long-term protection for biodiversity, including species and their habitats[1] • Contribute to Canada's marine conservation targets[1] • Permissible / prohibited activities established for each Marine Refuge • Prohibited activities within Northeast Newfoundland Slope Closure: – Bottom-contact fisheries – Human activities that would negatively impact conservation objectives
VME: Coral and Sponge Closures	NAFO	Conservation and Enforcement Measures	• NAFO regulates bottom-contact fisheries that may adversely impact VMEs within its identified fishing footprint
Critical Habitat (proposed)	DFO, PC, and ECCC	SARA, 2002, c.29	• Necessary for species' survival or recovery and essential for life cycle completion of aquatic species, or areas of historical occupation with potential for reintroduction[2] • Identified and provided in Recovery Strategies for *Endangered / Threatened* species under Schedule 1 of SARA • Must be legally protected from destruction within 180 days of being finalized[3] • Proposed critical habitat does not receive legal protection
SBA	DFO	N/A	• SBAs do not receive legal protection; they may be used to identify the distribution of key marine species and act as indicators for areas requiring future conservation designation, such as VMEs

Table 11.2 Relevant Legislation and Regulations for Special Areas within the Project Area and LAA

Special Area Type	Governing Body	Legislation / Regulation	Summary
Ecological Reserve	GNL (Parks and Natural Areas Division)	*Wilderness and Ecological Reserves Act*, 1980	• Protect a Canadian province's representative ecosystems / ecoregions, unique or at-risk species, or other aspects important for natural heritage[4] • <1,000 km² area[4] • Only low-impact human activities are permitted (e.g., hiking, research) [4] • Access may require a permit[4]
IBA	Birdlife International, Bird Studies Canada, and Nature Canada	*Migratory Birds Convention Act*, 1917, 1994 Canada's Important Bird and Biodiversity Areas Program	• Designated to protect important areas where seabirds congregate to nest, stage, or overwinter, in order to support seabird biodiversity, density, reproduction, and survival
Notes: DFO = Fisheries and Oceans Canada; CBD = Convention on Biological Diversity; MPA = Marine Protected Area; PC = Parks Canada; ECCC = Environment and Climate Change Canada; VME = Vulnerable Marine Ecosystem; GNL = Government of Newfoundland and Labrador; NL = Newfoundland and Labrador Source: [1] DFO (2019); [2] DFO (2016); [3] DFO (2018); [4] FLR (2018);			

Two international organizations, the United Nations (Convention on Biological Diversity [CBD]) and Northwest Atlantic Fisheries Organization (NAFO), have designated a variety of special areas, such as CBD Ecologically or Biologically Significant Areas (EBSAs), Vulnerable Marine Ecosystems (VMEs), and shrimp closure areas. As reviewed in Section 6.4.4, NAFO-designated coral, sponge, sea pen, seamount, and shrimp closures are legally protected under NAFO's annual Conservation and Enforcement Measures (NAFO 2019).

11.1.2 The Influence of Consultation and Engagement on the Assessment

During Chevron'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. In particular, concern was raised regarding any potential impacts to Parks Canada managed lands.

11.1.3 Potential Effects, Pathways and Measurable Parameters

Routine Project-related activities have the potential to affect the features of special areas which provide important ecological and biological functions for the species that use these areas. As a result, the assessment of Project-related effects on special areas is focused on the potential effect of change in habitat quality.

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

The measurable parameters used for the assessment of change in habitat quality, and the rationale for their selection, are provided in Table 11.3. Effects of accidental events are assessed separately in Section 15.5.4.

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 • Smothering of sensitive, habitat-forming benthic fauna (corals, sponges) by cutting/drill mud deposition • Increase in underwater sound levels which may result in behavioural response (avoidance) for species that use special areas	• Area of habitat altered or lost (m^2) • Change in chemical composition of sediment and water (unit depends on the contaminant) • Change in species diversity or abundance (number of species and individuals) • 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 and depicted in Figure 11-1.

11.1.4.1 Spatial Boundaries

Project Area: The Project Area (Figure 11-1) encompasses the immediate area in which Project activities would occur. Well locations have not been identified but will occur within the Project Area within EL 1138. The Project Area has been delineated to provide a 10 km buffer around the EL.

LAA: The LAA (Figure 11-1) encompasses the overall geographic area over which all planned and routine Project-related environmental interactions may occur. It represents the predicted environmental zone of influence of the Project's planned components and activities, within which Project-related environmental changes to Special Areas may occur and can be assessed and evaluated. The LAA is conservatively defined as a 40 km wide area around the Project Area and 16 km around the associated transit route to encompass the zones of influence for the three preceding biological VCs (i.e. Marine Fish and Fish Habitat, Marine and Migratory Birds, and Marine Mammals and Sea Turtles).

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. Chevron is currently planning to drill up to eight exploration and delineation/appraisal wells over the term of EL 1138 (2016 to 2025). Project activities at each well could take approximately 180 days. Well testing 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. Vertical seismic profiling (VSP) surveys typically take approximately one to three days per well. Drilling operations would not be continuous throughout the Project and would depend on rig availability and results from previous wells. While drilling activities could be conducted year-round, Chevron's preference is to conduct drilling from May to September.

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 definitions will be used throughout the chapter when describing potential residual environmental effects on special areas from routine Project activities. These definitions are also applicable for accidental events, as discussed in Section 15.5.4.

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 baseline	**Positive** – a residual environmental effect that moves measurable parameters in a direction beneficial to special areas relative to baseline **Adverse** – a residual environmental effect that moves measurable parameters in a direction detrimental to special areas relative to baseline **Neutral** – no net change in measurable parameters for special areas relative to baseline
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions	**Negligible** – no measurable change **Low** – a detectable change but within the range of natural variability **Moderate** – a detectable change beyond the range of natural variability, but with no associated adverse effect on the viability of the affected population. **High** – A detectable change that is beyond the range of natural variability, with an adverse effect on the viability of the affected population.
Geographic Extent	The geographic area in which a residual environmental effect occurs	**Project Area – r**esidual environmental effects are restricted to the Project Area **LAA –** residual environmental effects extend into the LAA **RAA –** residual environmental effects extend into the RAA

Table 11.4 Characterization of Residual Effects on Special Areas

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Frequency	Identifies how often the residual effect occurs and how often during the Project	**Unlikely event** – effect is unlikely to occur **Single event** – effect occurs once **Multiple irregular event** – effect occurs at no set schedule **Multiple regular event** – effect occurs at regular intervals **Continuous** – effect occurs continuously
Duration	The period of time required until the measurable parameter or the VC returns to its existing condition, or the residual effect can no longer be measured or otherwise perceived	**Short term** - for duration of the activity, or for duration of accidental event **Medium term** - beyond duration of activity up to end of Project, or for duration of threshold exceedance of accidental event – weeks or months **Long term** - beyond Project duration of activity, or beyond the duration of threshold exceedance for accidental events - years **Permanent** - recovery to baseline conditions unlikely
Reversibility	Pertains to whether a measurable parameter or the VC can return to its existing condition after the project activity ceases	**Reversible –** will recover to baseline conditions before or after Project completion **Irreversible –** permanent
Ecological and Socio-economic Context	Existing condition and trends in the area where residual effects occur	**Undisturbed** – The VC is relatively undisturbed in the 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, 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 special areas.

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

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

11.2 Project Interactions with Special Areas

Table 11.5 identifies, for each potential effect, the physical activities that might interact with the VC and result in the identified environmental effect. These interactions are indicated by check marks and are discussed in detail in Section 11.3, in the context of effects pathways, standard and Project-specific mitigation / enhancement, and residual effects. A justification for no effect is provided following the table.

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 Abandonment	✓
Supply and Servicing Operations (including helicopter transportation and Project supply vessel operations)	✓
Notes: ✓ = Potential interaction – = No interaction	

Well testing and flaring 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 testing and flaring would occur, are not identified as being important aggregation points for marine and migratory birds. Effects of well testing and flaring on marine and migratory birds are discussed in Section 9.3.1.3.4. 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 facilitate an interaction with special areas. Given the distance of the Project from the coastline (approximately 375 km from St. John's), flaring or air emissions are not expected to interact with special areas that exist 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 potentially occurring from the interactions in Table 11.5. Given the similarities in Project description, proximity of activities on Orphan Basin and Flemish Pass, and currency of data, the EIS incorporates information from previous EA documents for similar exploration drilling projects in Atlantic Canada, including comments received during Indigenous and stakeholder review processes, with updates incorporated as applicable. Effects on species (including species at risk and species of conservation concern) 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) and detailed information on those effects are not repeated here.

11.3.1 Change in Habitat Quality

11.3.1.1 Project Pathways

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

Presence and Operation of a MODU

- An imagery-based seabed survey will be conducted at the proposed well site(s) to confirm the absence of sensitive environmental features, such as habitat-forming corals or species at risk (as well as shipwrecks, debris on the seafloor, and unexploded ordnance). The survey will be carried out prior to drilling. If environmental or anthropogenic sensitivities are identified during the survey, Chevron will move the well site to avoid affecting them if it is feasible to do so. If it is not feasible, Chevron will consult with the Canadian-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) to determine an appropriate course of action. This survey will also provide baseline data for coral and sensitive benthic habitat that may be present and be used to inform discussions on potential follow-up and monitoring with respect to drill waste discharges.

Vertical Seismic Profiling Operations

- VSP activities will be planned and conducted in consideration of the *Statement of Canadian Practice with Respect to the Mitigation of Seismic Sound in the Marine Environment* (SOCP; Fisheries and Oceans Canada [DFO] 2007; refer to Section 10.3.1.2).

Discharges

- Refer to the waste management mitigation measures identified in the Marine Fish and Fish Habitat VC (Section 8.3.1.2).

Well Abandonment and Decommissioning

- Once wells have been drilled and evaluation programs completed (if applicable), the wells will be plugged and abandoned as per applicable Chevron practices and C-NLOPB requirements.
- Mechanical means of wellhead severance will be used.

Supply and Servicing Operations

- Supply vessels will use existing shipping lanes as practicable; where these do not exist, supply vessels will follow a straight-line approach to and from the Project Area.
- During transit to and from the Project Area, supply vessels will travel at vessel speeds not exceeding 22 km/hour (12 knots), except as needed in the case of an emergency.
- Supply vessel routes transiting to and from the MODU will be planned to avoid passing within 300 m of migratory bird nesting colonies during the nesting period and will comply with provincial *Seabird Ecological Reserve Regulations*, *2015* and federal guidelines in order to minimize disturbance to colonies (Environment and Climate Change Canada [ECCC] 2017). Specific details will be provided in the environmental protection plan (EPP).
- Routes of helicopters transiting to and from the MODU will avoid transiting near migratory bird nesting colonies and will comply with provincial *Seabird Ecological Reserve Regulations, 2015*, and, ECCC's *Avoidance Guidelines* for seabird and waterbird colonies. Appropriate flight altitudes and horizontal buffer zones will be established to minimize disturbance to colonies in accordance with the Seabird *Ecological Reserve Regulations, 2015* and the ECCC's *Avoidance Guidelines*. Specific details will be provided in the EPP.
- Chevron, in consultation with ECCC-CWS, will develop a protocol for systematic, daily searches for seabirds stranded on the MODU and supply vessels. 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 2017).

As the value of special areas is linked to the marine species that use them, other mitigation measures that are specific to marine fish and fish habitat (Section 8.3), marine and migratory birds (Section 9.3), and marine mammals and sea turtles (Section 10.3) will also reduce potential adverse effects to special areas important to these species.

11.3.1.3 Characterization of Residual Project-related Environmental Effects

11.3.1.3.1 Presence and Operation of a MODU

The presence and operation of the MODU within Chevron's EL has the potential to affect habitat quality of special areas via underwater sound and light emissions (discharges are assessed in Section 11.3.1.3.3), Underwater sound would primarily be generated by the MODU through drilling operations and the use of dynamic positioning to keep the MODU on station. The continuous (i.e., non-impulsive) underwater sound emitted from the MODU 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. Potential behavioural effects on fish, marine mammal, and sea turtle species, can indirectly affect the quality of special areas, if species avoid or no longer use them due to increased underwater sound levels. Therefore, the effects of underwater sound on special areas are linked to those effects on marine fish and fish habitat (Section 8.3), and marine mammals and sea turtles (Section 10.3), respectively. Physical injury or harm to fish, marine mammals, and sea turtles from MODU sound are not anticipated. The behavioural effects of underwater sound on fish, marine mammals, and sea turtles depend on several factors, including but not limited to species, frequency of the sound source, environmental parameters, and the activity an animal is engaged in (e.g., Davis et al. 1998;

Southall et al. 2007; Weilgart 2007). The presence and operation of a MODU itself may not have a direct interaction on the physical area, but the increase of underwater sound levels may affect the overall quality of the area, and the species within it.

A change in habitat quality of special areas could therefore occur in the federally designated Northeast Newfoundland Slope Closure marine refuge and the Northeast Slope EBSA primarily related to the propagation of underwater sound from the MODU activity. These special areas also overlap in part with the internationally designated CBD Slopes of the Flemish Cap and Grand Bank. Likewise, there is some limited (<1%) overlap with proposed critical habitat for spotted and northern wolffish (Table 11.1). The Northeast Newfoundland Slope Closure marine refuge contains cold water corals and sponges, which provide ecological important benthic habitat for marine species, and a productive marine environment. The Northeast Slope EBSA contains feeding aggregations of spotted wolffish and Greenland halibut as well as feeding aggregations of seals and cetaceans like long-finned pilot whales. As described in Section 6.4.4, the CBD Slopes of the Flemish Cap and Grand Bank is recognized for its high biodiversity, aggregations of corals and sponges, high abundances of numerous fish species, including commercial fishes and invertebrates, such as Greenland halibut, and provision of habitat for at risk species including northern and spotted wolffish, northern bottlenose whale (CBD 2017).

Changes in underwater sound levels in any of these special areas would be temporary, with the highest sound levels localized close to the MODU and sound from the MODU is not predicted to result in permanent or irreversible loss of habitat for fish (see Section 8.3), marine mammals or sea turtles (see Section 10.3). In the case of marine mammals, including those species which, in part, contributed to the designation of special areas, it is predicted that behavioural responses would be limited to a maximum distance of 32 km from the MODU (see Section 10.5 for further details including prediction limitations). Based on available information and acoustic modelling results it was predicted that potential behavioural responses by fish, including those species which in part contributed to the designation of special areas, would be limited to within the Project Area (see Section 8.3.1.3.1). The relatively short-term nature of drilling activity (i.e., approximately 180 days per well), and the irregular occurrence of drilling activity would result in a short duration interaction with special areas. Any declines in abundance of key species (for which the special area was designated) or change in community structure would be short-term and reversible. There will be no permanent and irreversible loss of proposed critical habitat.

There are no Migratory Bird Sanctuaries (MBS) or Important Bird Areas (IBAs) within or near the Project Area. The nearest MBS is the Terra Nova MBS, which is 448 km away from the Project Area within which the MODU would be located. The nearest IBA is Cape St. Francis, 362 km away from the Project Area (Section 6.2). The potential effects from light emitted from the MODU on special areas is expected to be low in magnitude, irregular in nature and restricted to within the Project Area and will not interact with special areas designated specifically for marine and migratory birds (see Section 9.3 for details). There is some limited potential that the birds (i.e., dovekie and great skua) which in part contributed to the designation of CBD Slopes of the Flemish Cap and Grand Bank, may be affected by the lights of the MODU; however, residual effects are considered low in magnitude and short-term.

Residual environmental effects associated with the presence and operation of a MODU on a change in habitat quality to special areas is predicted to be:

- Adverse
- Low to moderate in magnitude
- Occur within the LAA
- Short-term in duration
- Occur more than once as irregular events
- Reversible

11.3.1.3.2 Vertical Seismic Profiling

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

There is potential for VSP surveys to occur within the special areas that overlap with the Project Area and/or LAA, primarily the Northeast Newfoundland Slope Closure marine refuge and the Northeast Slope EBSA, which could temporarily affect the habitat quality of that area to support fish and marine mammal species using it. These special areas also overlap in part with the internationally designated CBD Slopes of the Flemish Cap and Grand Bank as well as proposed critical habitat for spotted and northern wolffish.

Residual effects associated with VSP survey activities on a change in habitat quality is predicted to be:

- Adverse
- Low in magnitude
- Occur within the Project Area
- Short-term in duration
- Occur more than once at irregular intervals
- Reversible

VSP survey activities will adhere to the *Statement of Canadian Practice on Mitigation of Seismic Noise in the Marine Environment*, as appended to the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2019).

11.3.1.3.3 Discharges

Discharges that result from offshore exploration drilling operations, including drill muds and cuttings, have the potential to adversely alter sediment and water quality in special areas that overlap with Chevron's EL as well as affect benthic fauna and prey species for marine mammals. The effects of Project-related

discharges on marine fish and fish habitat, and marine mammals and sea turtles have been assessed in detail in Sections 8.3 and 10.3.

Slow moving or sessile organisms, such as benthic fauna, have a higher potential for interaction with drill mud and cuttings discharges compared to mobile species. Corals and sponges have the potential to be smothered by drilling wastes if they are located close to the well site. Sediment quality also has the potential to be altered in terms of oxygen depletion and nutrient enrichment, which may reduce species diversity and abundance (Neff et al. 2000, 2004). Measurable changes to benthic macrofauna are most often confined to a 250 m radius and seldom detected beyond 500 m of the drill site (Olsgård and Gray 1995; Bakke et al. 2013).

Smit et al. (2006) determined a threshold level of approximately 6.5 mm of sediment burial is required to cause mortality to benthic macrofauna. Drill waste dispersion modelling conducted for the Project considered the extent of various thicknesses of the deposition of drill cuttings on the seafloor in radii from the discharge site. The modelling predicted that sediment thicknesses greater than 6.5 mm would not occur for either the 500 m or 1,500 m water depth scenarios. In the event Project activities result in mortality of benthic organisms, the results are not predicted to cause irreversible changes to local populations within special areas, although it is acknowledged that there are fewer data on effects of drilling waste on corals and sponges, and recovery rates for these communities are expected to be longer (Gates and Jones 2012; Cordes et al. 2016; Henry et al. 2017). 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).

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

Other discharges associated with routine Project activities, such as organic matter, deck drainage, bilge water, produced water, etc., are also regulated by the C-NLOPB under the Offshore Waste Treatment Guidelines (OWTG) (National Energy Board [NEB] et al. 2010), to reduce the potential effects of discharged wastes on the marine environment. Discharges of materials at sea will comply with the standards set out in the OWTG to reduce potential effects on the marine environment including special areas. Waste not highlighted in the OWTG as being disposable will not be discharged to the ocean and will be brought to shore for treatment and disposal. Discharges into the marine environment may result in a temporary and localized reduction in water or sediment quality within special areas that overlap with the Project Area. These special areas include the federally designated Northeast Newfoundland Slope Closure marine refuge, the Northeast Slope EBSA, and Significant Benthic Area (SBA) for sea pens as well as the internationally designated CBD Slopes of the Flemish Cap and Grand Bank (Table 11.1). With mitigation measures in place, changes in water and sediment quality are not anticipated to result in a substantial change of habitat quality for marine species that use these areas. There will be no permanent and

irreversible loss of proposed critical habitat for spotted and northern wolffish particularly since these areas do not overlap with Chevron's EL 1138.

Residual environmental effects associated with discharges on a change in habitat quality to special areas is predicted to be:

- Adverse
- Low to moderate in magnitude
- Restricted to the Project Area
- Short-to medium-term in duration
- Occur more than once at irregular intervals
- Reversible

11.3.1.3.4 Well Abandonment

All wells drilled during the life of the Project will be plugged and abandoned upon completion of well evaluation activities (if applicable). All abandonment activities will be conducted in line with Chevron's practices and C-NLOPB requirements. As discussed in Section 2.4.4, Chevron may seek permission from the C-NLOPB to leave the wellhead in place after well plugging and abandonment. If the wellhead is left in place, it would provide additional hard substrate on the seafloor, which could be used for colonization by benthic fauna that prefer hard surfaces to grow. If the wellhead is removed, mechanical means of wellhead severance will be used. Special areas which may be affected by well abandonment activities include the Northeast Newfoundland Slope Closure marine refuge, the Northeast Slope EBSA, and SBA for sea pens as well as the internationally designated CBD Slopes of the Flemish Cap and Grand Bank. With mitigation measures in place, well abandonment activities are not predicted to result in a substantial change of habitat quality for marine species that use these areas. There will be no permanent and irreversible loss of proposed critical habitat for spotted and northern wolffish particularly since these areas do not overlap with Chevron's EL 1138.

Residual environmental effects associated with well abandonment on a change in habitat quality tor special areas is predicted to be:

- Neutral to adverse
- Low in magnitude
- Restricted to the Project Area
- Short-term in duration (assuming the wellhead is removed)
- Occur more than once at irregular intervals (once per well with no set schedule)
- Reversible

Residual environmental effects associated with leaving the wellhead infrastructure in place (if applicable), would be long-term in duration and possibly positive in direction.

11.3.1.3.5 Supply and Servicing

The potential effects of supply and servicing operations on special areas within the Project Area primarily include those effects of underwater sound on fish, marine mammals, and sea turtles that use these special

areas. An increase in underwater sound levels as supply vessels (and to a lesser extent helicopters) transit back and forth from the Project Area to the shore base (St. John's and/or Bay Bulls), and the potential for behavioural effects on marine species, may also affect the overall quality and use of special areas by these species. The potential effects of underwater sound on marine fish and fish habitat, and marine mammals and sea turtles from supply and servicing operations are discussed in detail in Sections 8.3 and 10.3, respectively. The transit of supply vessels and aircraft from the Project Area to the shore base would also result in closer approach to special areas such as IBAs (overlap with Witless Bay Islands) and MBSs along the coast (for example, the LAA is within 124 km of the Terra Nova MBS), which may increase the potential for an interaction with marine and coastal bird species including attraction to vessel lights. Special areas which overlap the LAA for the transit route include are listed in Table 11.1. The residual effects from supply and servicing activities on marine birds are discussed in Section 9.3. The effects assessments for marine and migratory birds, fish, marine mammals and sea turtles predicted that there would not be significant residual adverse environmental effects resulting from supply and servicing activities. The transient nature of supply vessels and aircraft would result in a short-term interaction at any one location (including areas adjacent to and within special areas), not lasting for more than a few hours as supply vessels and aircraft travel along a transit routes between the MODU and the shore base.

The number of supply vessels and aircraft required for the Project will represent a small increase above existing vessel traffic in the area. Supply and servicing is expected to have a short-term and localized effect on special areas, and the species that use them. As a reminder, supply vessels will be regularly searched for stranded birds and trained crew will follow ECCC procedures for the recovery, rehabilitation, and release of any stranded birds (ECCC 2017).

Residual environmental effects associated with supply and servicing on a change in habitat quality tor special areas is predicted to be:

- Adverse
- Low in magnitude
- Occur within the LAA (including transit route)
- Short-term in duration
- Occur more than once at irregular intervals
- Reversible

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 (see Table 11.1). With the implementation of applicable mitigation measures described in Section 11.3.1.2 (e.g., pre-drill remotely operated vehicle (ROV) 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, short to medium-term in duration, reversible, and primarily occur within an undisturbed ecological and socio-economic setting.

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	LAA	ST	IR	R	D
VSP	A	L	PA	ST	IR	R	D
Discharge	A	L-M	PA	ST-MT	IR	R	D
Well Abandonment	A	L	PA	ST*	IR	R	D
Supply and Servicing	A	L	LAA	ST	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

Note: * Assumes wellhead is removed.

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

It is predicted that the Project will not result in significant adverse effects on special areas. This conclusion is based on the nature and scope of the Project, knowledge about the existing environment with the LAA and RSA, and current understanding of the effects of similar projects on the VC and planned mitigation measures.

The primary pathways for interaction that may have effects on this VC include the marine discharges, sound, and light emissions associated with the Project, including those that may result in direct interaction with and effects on the seabed and sensitive benthic organisms and habitat. Many of the offshore activities and associated disturbances will be localized, short-term and at a specific location. The implementation of mitigation measures will reduce direct or indirect potential effects on special areas identified for the presence of sensitive benthic habitats and marine species. Drilling sites will represent small areas of disturbance to benthic habitats within the extensive areas of marine environment of special areas in the offshore. Discharges, including drill cuttings, will be treated as per regulations and best practices prior to discharge. As such, the Project is not likely to result in significant adverse effects on the defining features of special areas that overlap with the Project Area.

Special areas within the LAA have also been identified based on the presence of sensitive benthic habitats and to a lesser extent on fish and fish habitat, birds, marine mammals and sea turtles, and commercial fisheries. Routine Project activities in the LAA (e.g., supply and servicing) will not result in direct contact with the seabed and will therefore not physically disturb benthic animals or their habitats. These activities will introduce light and sound that could result in temporary behavioural changes in marine species. Based on present knowledge of special areas, the results of modelling exercises, and planned mitigation measures, the predicted environmental effects from planned Project activities on special areas in the LAA are also likely to be not significant.

In summary, the Project is not likely to result in a detectable adverse change in the valued habitat of special areas, resulting in a decrease in abundance of key species or community structure. Likewise, the Project will not result in permanent and irreversible loss of critical habitat.

11.5 Prediction Confidence

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

11.6 Environmental Monitoring and Follow-up

As noted in Section 11.3.1.2, Chevron will conduct an imagery-based seabed survey at the proposed well site(s) to confirm the absence of sensitive environmental features, such as habitat-forming corals or species at risk prior to drilling. If environmental sensitivities are identified during the survey, Chevron 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 baseline data for coral and sensitive benthic habitat that may be present and be used to inform discussions on potential follow-up with respect to drill waste discharges. Chevron plans to conduct a visual survey of the seafloor using an ROV after drilling activities to assess the visual extent of sediment dispersion and validate drill waste modelling predictions. The specific details of the follow-up program will be determined in consultation with the C-NLOPB and DFO in consideration of the pre-drill survey results.

11.7 Summary of Commitments

There are no new commitments specific to Special Areas.

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12.0 ASSESSMENT OF POTENTIAL EFFECTS ON INDIGENOUS COMMUNITIES AND ACTIVITIES

Indigenous Communities and Activities is selected as a VC in recognition of the cultural, spiritual, health, social, and economic importance of the marine environment and its resources to Indigenous communities and in recognition of potential or established Aboriginal and treaty rights.

As required by the EIS Guidelines, and section 5(1)(c) of CEAA 2012, the scope of this VC includes 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; or current use of lands and resources for traditional purposes.

There is no predicted Project interaction with any structure, site, or thing of historical, archaeological or paleontological importance to Indigenous peoples. This VC therefore focuses on potential effects on health and socio-economic conditions and current use of lands and resources for traditional purposes, which are intrinsically linked to Indigenous use of marine-related resources.

The EIS Guidelines identify 41 Indigenous groups in Eastern Canada which may have an interest in the Project (refer to Section 3.2 and Section 7.4 for information on these groups). There are several Indigenous organizations in Eastern Canada that hold commercial communal fishing licences for the NAFO Divisions that overlap the Project Area, although it is currently not known if actual fishing under these licences takes place in the Project Area. There are no documented FSC licences within or near the Project Area. There is, however, the potential for species at risk and/or of cultural importance to be present in the Project Area (e.g., Atlantic salmon, American eel). Species harvested for commercial or FSC purposes outside the Project Area may potentially interact with Project activities (planned or unplanned) during migration to traditional fishing or hunting grounds.

Potential biological effects on marine fish, marine and migratory birds, and marine mammals could also affect the success of Indigenous fishing and hunting activities and therefore affect health and socio-economic conditions and/or current use of lands and resources for traditional purposes. This VC is therefore closely linked to the Marine Fish and Fish Habitat VC (Chapter 8), Marine and Migratory Birds VC (Chapter 9), and Marine Mammals and Sea Turtles VC (Chapter 10). Due to similarities in commercial communal fishing methods and target species, this VC is also closely linked to the Commercial Fisheries and Other Ocean Users VC (Chapter 13).

12.1 Scope of Assessment

12.1.1 Regulatory and Policy Setting

Treaty rights and Aboriginal rights are recognized and affirmed in section 35 of the *Constitution Act, 1982* and are also a key part of the United Nations Declaration on the Rights of Indigenous Peoples which the Government of Canada has committed to adopt. It is Chevron's understanding that none of the listed Indigenous groups has asserted or established Aboriginal or treaty rights protected by section 35 of the

Constitution Act, 1982 to the lands and waters of eastern offshore NL where the Project components and activities will be located. However, various Indigenous groups identified in the EIS Guidelines have asserted or established section 35 rights to harvest for FSC purposes or to earn a moderate livelihood in their traditional territories.

The Government of Canada (through DFO) has jurisdiction over commercial fishing within the 200 nm EEZ and for sedentary species up to the extent of the defined continental shelf. Beyond the EEZ (where EL 1138 is located), NAFO has primary jurisdiction over commercial fisheries for non-sedentary species. Within its jurisdiction, DFO has the authority to allocate FSC and commercial communal fishing licences to Indigenous communities and enterprises. In 1992, DFO introduced the Aboriginal Fisheries Strategy to provide a regulatory framework for FSC fishing. In Canada, following conservation measures, fishing for FSC purposes takes precedence over other fisheries, including commercial and recreational fisheries.

Section 35 rights to harvest for FSC purposes or to earn a moderate livelihood have been affirmed in various Supreme Court of Canada (SCC) decisions, such as the “Sparrow decision” (1990), and the “Marshall decision” (1999). DFO implemented the Marshall Response Initiative (MRI) in 2000 to provide increased Indigenous access to the commercial fishery through commercial-communal licenses. In 2007, the MRI was replaced by the Atlantic Integrated Commercial Fisheries Initiative (AICFI) to sustain the public investment in Indigenous commercial fisheries. The AICFI provided the 34 Mi’kmaq and Wolastoqiyik First Nations, affected by the Marshall decision, with capacity-building support for commercial-communal fisheries and Indigenous participation in fisheries co-management (DFO 2012a, 2012b, 2012c).

Various technical guidance has been established to address Indigenous consultation and engagement and the environmental assessment of effects on Indigenous organizations. These guidance documents have been taken into consideration in this effects assessment and include the following:

- Aboriginal Consultation and Accommodation - Updated Guidelines for Federal Officials to Fulfill the Duty to Consult (Aboriginal Affairs and Northern Development Canada 2011)
- Reference Guide: Considering Aboriginal Traditional Knowledge in Environmental Assessments Conducted Under the *Canadian Environmental Assessment Act, 2012* (Agency 2015a)
- The Government of Newfoundland and Labrador’s Aboriginal Consultation Policy on Land and Resource Development Decisions (Government of Newfoundland and Labrador 2013)
- The Agency’s Technical Guidance for Assessing Physical and Cultural Heritage or any Structure, Site or Thing that is of Historical, Archaeological, Paleontological or Architectural Significance under the *Canadian Environmental Assessment Act, 2012* (Agency 2015b)
- The Agency’s Technical Guidance for Assessing the Current Use of Lands and Resources for Traditional Purposes under the *Canadian Environmental Assessment Act, 2012* (Agency 2016)

12.1.2 The Influence of Consultation and Engagement on the Assessment

During Chevron’s Project-related engagement with government departments and agencies, stakeholder organizations and Indigenous groups questions and comments were documented (see Chapter 3 for further details). One of the key messages communicated by Indigenous groups is that Indigenous interests and concerns extend beyond the potential interactions with effects on commercial communal and/or FSC fishing practices and that the footprint of fishing activities need not overlap with the Project for Indigenous

communities to be affected. While the Indigenous communities noted that there are currently no active fisheries being conducted by Indigenous groups in the immediate vicinity of the Project, concerns were expressed for the potential future ability to fish in areas currently designated as safety zones. Another key message is that potential effects on commercial communal and/or FSC fishing practices can have direct and indirect effects on the health and well-being of Indigenous communities (including sub-populations).

Several migratory species have been identified as being culturally or commercially significant, such as Atlantic salmon, American eel, swordfish, tuna, ground fish, lobster, crab, sea turtles, sharks, and marine mammals. Some Indigenous groups have also expressed concerns regarding potential effects on marine and migratory birds, which are harvested by Indigenous peoples.

12.1.3 Potential Effects, Pathways and Measurable Parameters

The Project Area is located approximately 609 km from the nearest Indigenous community on the Island of Newfoundland (Miawpukek First Nation). There are no known physical and cultural sites, including structures, sites, or things of historical, archaeological, paleontological, or architectural significance within the Project Area or the LAA. Therefore, there are no pathways of effects from routine Project activities to changes in structures, sites or things of historical, archaeological, paleontological, or architectural significance due to the offshore location of the Project and localized extent of routine Project interactions.

Given the distance of the Project offshore and the limited geographic extent of predicted atmospheric and marine discharges arising from routine Project activities, effects from routine activities are unlikely to affect the physical or social health and wellbeing of Indigenous communities, except potentially indirectly as a result of effects on commercial communal or FSC fishing, hunting, or other harvesting activities. The Project could affect commercial communal fisheries resources by direct or indirect effects on fished species or through effects on fishing activity (e.g., displacement from fishing areas, gear loss or damage, 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 necessarily mean they will not do so in the future. Although there is no known FSC fishing or harvesting taking place in the Project Area, routine Project activities could interact with migratory fish, bird or mammal species that may be harvested by Indigenous communities from onshore / nearshore harvesting sites. Adverse effects on fishing or harvesting activities could indirectly lead to changes in health and socio-economic conditions or cultural heritage of affected Indigenous communities.

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

- Change in health and socio-economic conditions
- Change in current use of lands and resources for traditional purposes

The measurable parameters used for the assessment of these environmental effects and rationale for their selection are provided in Table 12.1. Effects of accidental events are assessed separately in Section 15.5.6, although the same effects, pathways and measurable parameters apply.

Table 12.1 Potential Effects, Effects Pathways and Measurable Parameters for Indigenous Communities and Activities

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Health and Socio-economic Conditions	• Project activities causing a change in revenue for a community (e.g., through reduced access to fishing grounds, effects on targeted species, increased operating costs) • Discharges from the Project resulting in water quality changes, which could affect the health of Indigenous communities through indirect exposure (e.g., ingestion of contaminated food) to contaminants	• Change in access to area used for commercial communal or FSC fisheries (ha) • Change in catch rates (qualitative) • Area of fish habitat permanently affected (m^2) • Mortality of commercially or culturally important species (qualitative) • Damage or loss to gear and/or equipment • Change in commercial hunting or trapping activities (qualitative) • Change in community revenues (qualitative) • Change in water quality • Types and incidences of physical health issues in a community / population • Perceived quality of life and well-being (qualitative) • Contamination and/or loss of food sources (qualitative)
Change in Current Use of Lands and Resources for Traditional Purposes	Project activities causing a change in quantity, quality or availability of traditional lands and resources	• Change in quantity, quality or availability of resources and habitat (e.g. mortality or change in migration pattern of culturally significant species) (qualitative) • Change in access to navigable waters (qualitative) • Change in fishing, hunting or trapping activities (qualitative) • Loss of cultural or spiritual practice (qualitative)

12.1.4 Boundaries

Spatial and temporal boundaries for the assessment of Indigenous communities and activities are discussed in the following sections.

12.1.4.1 Spatial Boundaries

Project Area: The Project Area (Figure 12-1) encompasses the immediate area in which Project activities would occur. Well locations have not been identified but will occur within the Project Area within EL 1138. The Project Area has been delineated to provide a 10 km buffer around the EL.

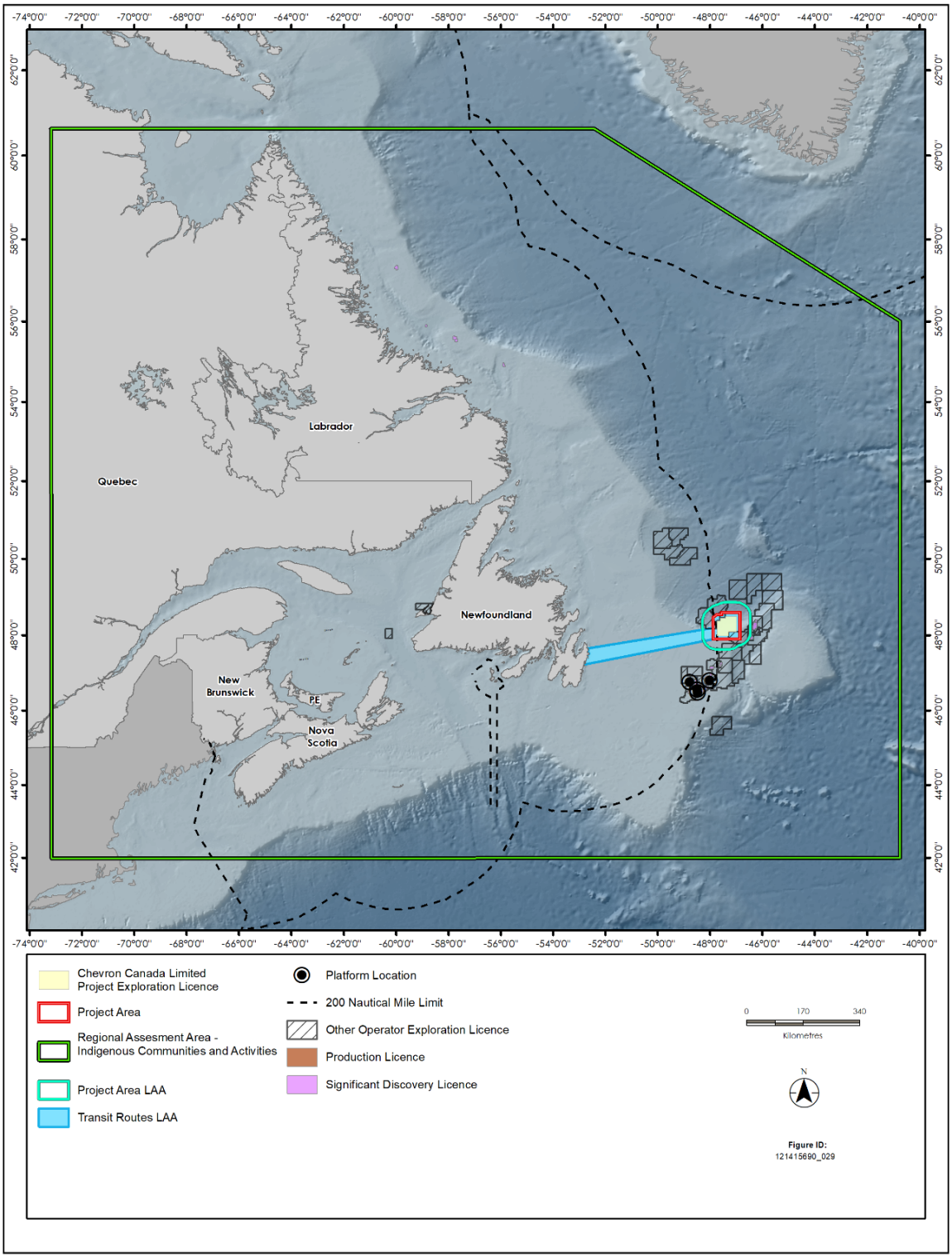

Figure 12-1 Indigenous Communities and Activities Spatial Boundaries

Local Assessment Area (LAA): The LAA (Figure 12-1) is the 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 has also been defined to include transit routes to and from the Project Area.

Regional Assessment Area (RAA): The RAA (Figure 12-1) 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 for the Indigenous Communities and Activities VC is larger than the RAA for other VCs in order to encompass the various Indigenous communities which have the potential to be affected by Project-related activities.

12.1.4.2 Temporal Boundaries

The temporal boundaries for the Project to be assessed encompass all Project phases, including well drilling, testing, and abandonment. Chevron is currently planning to drill up to eight exploration and delineation/appraisal wells over the term of EL 1138 (2016 to 2025). Project activities at each well could take approximately 180 days to drill. Well testing 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. VSP surveys typically take approximately one to three days per well. Drilling operations would not be continuous throughout the Project and would depend on rig availability and results from previous wells. While drilling activities could be conducted year-round, Chevron's preference is to conduct drilling from May to September.

The assessment of Project effects on Indigenous communities and activities also considers the timing of various Indigenous activities, and sensitive periods for species that may be targeted for Indigenous hunting and fishing, and how these may overlap with Project activities.

12.1.5 Residual Effects Characterization

The definitions used to characterize environmental effects on Indigenous communities and activities are provided in Table 12.2. These characterizations will be used throughout the chapter when describing potential residual environmental effects on Indigenous communities and activities from routine Project activities. These characterizations are also applicable for accidental events, discussed in Section 15.5.6.

Table 12.2 Characterization of Residual Effects on Indigenous Communities and Activities

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual environmental effect relative to baseline	**Positive** – a residual environmental effect that moves measurable parameters in a direction beneficial to Indigenous communities and activities relative to baseline **Adverse** – a residual environmental effect that moves measurable parameters in a direction detrimental to Indigenous communities and activities relative to baseline **Neutral** – no net change in measurable parameters for Indigenous communities and activities relative to baseline
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions	**Negligible** – no measurable change **Low** – a detectable change 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 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 period of time required until the measurable parameter or the VC returns to its existing condition, or the residual effect can no longer be measured or otherwise perceived	**Short term** – for duration of the activity, or for duration of accidental event **Medium term** – beyond duration of activity up to end of Project, or for duration of threshold exceedance of accidental event – weeks or months **Long term** – beyond Project duration of activity, or beyond the duration of threshold exceedance for accidental events - years **Permanent** – recovery to baseline conditions unlikely
Reversibility	Pertains to whether a measurable parameter or the VC can return to its existing condition after the project activity ceases	**Reversible** – will recover to baseline conditions before or after Project completion **Irreversible** – permanent

Table 12.2 Characterization of Residual Effects on Indigenous Communities and Activities

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** – VC is relatively undisturbed in the LAA, not adversely affected by human activity, or is likely able to assimilate the additional change **Disturbed** – 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

In consideration of the measurable parameters and residual effects descriptors listed above, the following threshold criteria has been established to define a significant adverse residual environmental effect on Indigenous communities and activities.

For the purpose of this effects assessment, a significant adverse residual environmental effect on Indigenous communities and activities is defined as a Project-related environmental effect that involves:

- Loss of access to areas relied upon 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 communities, such that there are associated detectable and sustained decreases in the quality of life of a community, including for subpopulations within a community, as applicable
- A reduction in the quality of ambient air, water, fish, wildlife, or other resources at concentrations predicted to result in unacceptable human health risks, with an associated detectable increase in the incidence of health issues
- Unmitigated damage to fishing gear.

12.2 Project Interactions with Indigenous Communities and Activities

Table 12.3 identifies, for each potential effect, the physical activities that might interact with the VC and result in the identified environmental effect. These interactions are indicated by check mark and are discussed in detail in Section 12.3, 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 12.3 Project-Environment Interactions with Indigenous Communities and Activities

Physical Activities	Environmental Effects	
	Change in Health and Socio-economic Conditions	Change in Current Use of Lands and Resources for Traditional Purposes
Presence and operation of a MODU (including drilling, associated safety zone, lights, and sound)	✓	✓
Vertical Seismic Profiling (VSP)	✓	✓
Discharges (e.g., drill muds / cuttings, liquid discharges)	✓	✓
Well Testing and Flaring (including air emissions)	✓	✓
Well Abandonment	✓	-
Supply and Servicing Operations (including helicopter transportation and supply vessel operations)	✓	✓
Notes: ✓ = Potential interaction – = No interaction		

Well abandonment activities will occur in the Project Area where FSC fishing and harvesting activities do not occur. Effects on marine fish, marine and migratory birds, and marine mammals from well abandonment activities are predicted to be negligible to low in magnitude (whether the wellhead remains in place or is removed) and are not predicted to affect the quality or availability of resources which Indigenous communities may fish or harvest for traditional purposes. No interaction is therefore predicted for a change in current use of lands and resources for traditional purposes due to well abandonment.

12.3 Assessment of Residual Environmental Effects on Indigenous Communities and Activities

The following section assesses the environmental effects on Indigenous communities and activities that may arise from potential interactions identified in Table 12.3. Given similarities with other offshore exploration drilling projects recently undergoing environmental assessment, this EIS incorporates recent information, including comments, received during Indigenous and stakeholder review processes for these other assessments. As discussed in Section 12.1.3, the main pathways for potential Project effects on Indigenous communities and activities are related to direct or indirect effects on commercial communal fisheries resources / activities or interactions with migratory fish, bird or mammal species that may be harvested by Indigenous communities from onshore / nearshore harvesting sites. Section 12.3.1 provides an overview of the species harvested as context for these potential effects.

12.3.1 Overview of Species Harvested

Commercial communal and FSC fishing activities are described in Section 7.4.8. Species harvested for commercial communal purposes within the RAA (as defined for this VC) include lobster, groundfish (e.g., Atlantic and Greenland halibut, hake), eel, smelt, herring, mackerel, seal, shrimp, snow crab, toad crab, arctic char, tuna, swordfish, skate capelin, quahaug, clam, and whelk. Commercial fisheries are described in Section 7.1, and Figures 7-10 to 7-13 show landing locations for primary commercial fisheries. These

figures demonstrate that commercial fishing activities, including those that are carried out under a commercial communal licence by Indigenous groups, are occurring within the Project Area or RAA. Note that commercial fishing activity within the Project Area (from 2013 to 2017) is limited to groundfish within the southwest corner.

Shrimp, snow crab and groundfish are key species harvested within the RAA by Indigenous groups based in NL for commercial purposes. Species, such as capelin, herring, and mackerel, are generally harvested in coastal areas. Several Indigenous groups from the Maritime provinces also have commercial communal licences to fish for swordfish and tuna in the RAA. As shown in Figure 7-65 to 7-68, these fisheries occur distant from the Project Area.

As described in Sections7.4.8.2, various species are harvested by Indigenous groups in the RAA for FSC purposes, including but not limited to gaspereau, trout, Atlantic salmon, bass, mackerel, eel, shad, groundfish, Arctic char, smelt, blue shark, cod, herring, redfish, capelin, mussel, clams, periwinkle, soft-shell clams, squid, tomcod, quahaug, razor clams, lobster, crab and scallops. Most of these FSC species would be harvested in the nearshore and/or freshwater systems and would not interact with Project activities. However, American eel and Atlantic salmon are migratory species which could potentially migrate through the Project Area at some point in their life cycle and could be harvested in areas far removed from the Project Area. Life histories of these species and their importance to Indigenous peoples are discussed in Section 6.1.9.

Over the course of environmental assessments for recently proposed offshore exploration drilling projects, various Indigenous communities and organizations have raised specific concerns about potential effects on swordfish, bluefin tuna, Atlantic salmon and American eel. Potential effects of routine Project activities on these species are discussed in further detail in Section 12.3.4.

Harp, grey, hooded and ringed seals are harvested by Indigenous groups in NL, with sealing activities generally occurring between late March and mid-May. Seals may be harvested as part of the commercial communal fishery or for FSC purposes (the latter of which could occur year-round).

Marine and migratory birds and eggs commonly harvested by Indigenous communities include geese (e.g., Canada goose), ducks (e.g., northern pintail, blue-winged teal, Harlequin duck, common eider), loons (e.g., common loon), gulls, murres (also referred to as turrs), mergansers and scoters. Game birds (e.g., ptarmigan, grouse) are also commonly harvested by Indigenous communities, but these birds do not use the marine environment nor are they migratory. There is no predicted Project-interaction with game birds, therefore they are not discussed further in this VC.

12.3.2 Change in Health and Socio-economic Conditions

12.3.2.1 Project Pathways

Given the distance of the Project offshore and the localized extent of predicted atmospheric and marine discharges arising from routine Project activities, any change in health and socio-economic conditions would most likely occur indirectly as a result of effects on commercial communal or FSC fishing or other harvesting (e.g., hunting) activities. For many Indigenous communities, commercial communal fishing

activities represents an important revenue source. As described in Section 7.4, community ventures, social programs, and benefits are often funded from revenue generated by commercial-communal fisheries. Therefore, potential effects on commercial-communal fisheries may be broader than direct and indirect economic effects upon communities (DFO 2012a, 2012b, 2012c).

Project interactions which could potentially interrupt or prevent commercial communal fishing through restricted access to fishing areas, lost or damaged gear, and/or lost or reduced catch, could result in reduced revenue for a community and affect community spending and investment in infrastructure, services and/or programs.

Chevron is not aware of any FSC fishing occurring in the Project Area. However, targeted fish, mammal and/or bird species or species linked to these harvested species (e.g., prey species) may migrate through the Project Area and interact with the Project, thereby potentially affecting the quality or availability of these resources upon which Indigenous communities may depend for FSC purposes. This, in turn, could result in adverse cultural effects and/or reduced food security for communities.

12.3.2.2 Mitigation

In consideration of the environmental effects pathways presented above, the following mitigation measures will be implemented to reduce potential effects on heath and socio-economic conditions for Indigenous communities:

- Chevron will continue to engage with Indigenous communities to share Project details and facilitate information sharing. This will be accomplished through the development and implementation of an Indigenous Fisheries Communication Plan
- Chevron 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. Details of the safety (exclusion) zone will also be communicated by Chevron during ongoing consultations with commercial and Indigenous fishers
- Supply vessels will follow established shipping lanes where they exist (i.e., in proximity to shore). During transit to/from the Project Area, supply vessels will travel at vessel speeds not exceeding 22 km/hour (12 knots) except as needed in the case of an emergency
- Chevron will communicate the locations of abandoned wellheads (if applicable) to Indigenous and non-Indigenous fishers and the Canadian Hydrographic Services for future nautical charts
- Chevron will develop and implement a compensation program for damages resulting from Project activities. This compensation program will be developed in consideration of C-NLOPB guidelines, including the Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activities (C-NLOPB and CNSOPB 2017)

Mitigation measures identified in the assessment for marine fish and fish habitat (Section 9.3), marine and migratory birds (Section 10.3), and marine mammals and sea turtles (Section 11.3), will also help reduce the potential for adverse environmental effects on health and socio-economic conditions for Indigenous communities.

12.3.2.3 Characterization of Residual Project-related Environmental Effects

12.3.2.3.1 Presence and Operation of a MODU

A 500-m radius safety (exclusion) zone will be maintained around the MODU when it is present and operating, within which non-Project vessels will be excluded. Commercial communal fishing will therefore be excluded from an area of approximately 0.8 km^2 (80 ha) for up to approximately 180 days for each well drilled. Chevron will provide details of the safety zone to Marine Communication and Traffic Services for broadcasting and publishing in the NAVWARN and NOTMAR systems. Details of the safety (exclusion) zone will also be communicated by Chevron during ongoing consultations with commercial and Indigenous fishers. Details of the safety zone will also be communicated through operational updates as described in the Indigenous Fisheries Communication Plan. As shown in Figure 7-5, commercial fishing efforts within the Project Area are low, with activity from 2013 to 2017 only occurring within the southwestern corner. The temporary exclusion of fishing from the safety zone (for up to 180 days per well) is not predicted to affect commercial communal fisheries to the extent that it would substantively affect revenue for Indigenous communities and affect community health and socio-economic conditions.

Marine fish may experience biophysical and/or behavioural (e.g., avoidance) effects due to underwater sound from the presence and operation of the MODU (refer to Chapter 8). However, these effects are predicted to be localized and temporary, particularly as the fish may become habituated to the continuous underwater sound emissions (Chapman and Hawkins 1969; McCauley et al. 2000a, 2000b; Fewtrel and McCauley 2012). Given the temporary and localized nature of this effect, it is not expected that fisheries species (or prey upon which they may depend) would experience a measurable change in availability to the extent that commercial communal or FSC fisheries resources would be adversely affected. Refer to Section 12.3.4 for a discussion of effects on species of commercial and cultural importance.

The presence and operation of the MODU could potentially affect bird species harvested by Indigenous communities, through nocturnal attraction of birds to artificial lighting. Species commonly harvested by Indigenous communities include geese, ducks, loons, gulls, murres, mergansers and scoters (Section 7.4.8). Section 9.3 evaluates Project effects on marine and migratory birds. The magnitude of the effect of MODU operation on marine and migratory birds is expected to be low in consideration of the implementation of mitigation, including following the Best Practices for Stranded Birds Encountered Offshore Atlantic Canada (ECCC 2016).

Residual effects associated with the presence and operation of a MODU on a change in health and socio-economic conditions to Indigenous communities and activities are predicted to be:

- Adverse
- Negligible to low in magnitude
- Occur within the RAA (where affected Indigenous communities are located)
- Short-term in duration
- Occur more than once as irregular events
- Reversible

12.3.2.3.2 Vertical Seismic Profiling

Underwater sound generated by VSP may also potentially affect commercial communal or FSC fish species (or prey species upon which fishery species may depend). At close range to the seismic sound source, fish eggs and larvae may experience mortality or physical effects. Underwater sound could also startle fish within a localized area, thereby potentially causing them to avoid an area and affecting catchability. As discussed in Section 8.3, physical and behavioral changes in marine fish (including fisheries species) would be temporary (VSP surveys are expected to take one to three days per well) and reversible (e.g., baseline conditions resume after VSP surveys are completed). Furthermore, received sound levels are unlikely to result in physical effects to the majority of mobile fish species due to the expectation that they would avoid underwater sound at lower levels and be away from the drilling areas during times when levels are at those when injury or mortality may occur. Effects on fisheries species would not be likely to affect the availability of fisheries resources such that there would be a measurable change in catch rates or mortality of commercially or culturally important species.

Residual effects associated with VSP on a change in health and socio-economic conditions to Indigenous communities and activities are predicted to be:

- Adverse
- Negligible to low in magnitude
- Occur within the RAA (where affected Indigenous communities are located)
- Short-term in duration
- Occur more than once as irregular events
- Reversible

12.3.2.3.3 Discharges

Drilling waste and other drilling discharges and emissions may result in temporary and localized effects on water and sediment quality and therefore could potentially affect commercial communal or FSC fishery species. Section 8.3 assesses the effects of discharges on marine fish and concludes that effects will be low in magnitude and localized to the Project Area. Discharges from the MODU will be in accordance with Chevron's Environmental Protection Plan and the OWTG (NEB et al. 2010). The availability of fisheries resources is not expected to be affected by discharges.

Marine and migratory birds that may be harvested for commercial or FSC purposes may interact with discharges resulting in attraction to the MODU and/or oiling of feathers if there is a sheen present. However, a sheen is unlikely to occur as a result of routine discharges given compliance with regulatory requirements for waste discharges.

Temporary and localized effects on water and sediment quality will not result in direct effects on human health given the nature of the discharges, their location offshore, and the natural dispersion that will occur.

Residual effects associated with discharges on a change in health and socio-economic conditions to Indigenous communities and activities are predicted to be:

- Adverse
- Negligible to low in magnitude
- Occur within the RAA (where affected Indigenous communities are located)
- Medium-term in duration
- Occur more than once at irregular intervals
- Reversible

12.3.2.3.4 Well Testing and Flaring

In consideration of the lack of interaction between well testing activities (including flaring) with the marine environment, there are no predicted effects on marine fish and mammal species as a result of this Project activity. If well testing includes flaring, marine and migratory birds could potentially be attracted to the MODU, potentially resulting in stranding and/or mortality of individuals. As described in Section 9.3, effects would likely be temporary (flaring occurring one to two days per well test) and localized to within several kilometres of the MODU (up to approximately 16 km). Furthermore, species most vulnerable to artificial light attraction and strandings (e.g., storm-petrels) are not species targeted for harvesting by Indigenous communities. The magnitude of the effect of well testing with flaring on marine and migratory birds is expected to be low in consideration of the implementation of mitigation, including following the Best Practices for Stranded Birds Encountered Offshore Atlantic Canada (ECCC 2016).

Residual effects associated with well testing and flaring on a change in health and socio-economic conditions to Indigenous communities and activities are predicted to be:

- Adverse
- Negligible to low in magnitude
- Occur within the RAA (where affected Indigenous communities are located)
- Short-term in duration
- Occur more than once as irregular events
- Reversible

12.3.2.3.5 Well Abandonment

Chevron has not yet defined its well abandonment strategy. Upon completion of drilling (and testing if applicable), well abandonment may or may not involve removal of wellheads from the seafloor. If the wellhead is to be removed, the preferred method for removal will involve using a mechanical cutter to cut the wellhead below the seabed and retrieving the wellhead to surface. Effects on marine fish and marine mammals are predicted to be low in magnitude and are not predicted to affect the availability of fisheries resources for commercial communal or FSC fishing and harvesting.

If the wellhead is kept in place (with approval from the C-NLOPB), it could potentially interact with commercial communal fishing as the infrastructure protruding from the seafloor could present a snagging hazard in some circumstances. However, water depth and potential for interaction with fishing practices will

be considered in the development and regulatory approval of its well abandonment strategy. Chevron will also communicate the locations of abandoned wellheads to fishers and the Canadian Hydrographic Services for publishing on future nautical charts. This will allow mobile gear and fixed gear fishers to avoid these locations around abandonment wellheads. Effects on commercial communal fishing activities are expected to be low in magnitude.

Residual effects associated with well abandonment on a change in health and socio-economic conditions to Indigenous communities and activities are predicted to be:

- Adverse
- Negligible to low in magnitude
- Occur within the RAA (where affected Indigenous communities are located)
- Medium-term in duration
- Occur more than once as irregular events
- Reversible

12.3.2.3.6 Supply and Servicing

Supply vessels will increase vessel traffic in the Project Area and the LAA and therefore could potentially interact with commercial communal fishing activity (e.g., interfere with fishing gear or fishing vessel navigation) or disrupt fishery species due to underwater sound emissions. Common shipping routes will be used by supply vessels, as practicable, and will adhere to standard navigation procedures, to reduce incremental marine disturbance and potential conflict with fishing vessels.

Helicopter traffic is not predicted to interact with marine fish or fishing activities, however, it could potentially disturb marine and migratory bird colonies (including murre colonies, refer to Table 6.8), as could supply vessel traffic that could be operating in proximity to seabird colonies. 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*. Supply vessel routes transiting to and from the MODU will be planned to avoid passing within 300 m of migratory bird nesting colonies during the nesting period and will comply with provincial Seabird Ecological Reserve Regulations, 2015 and federal guidelines in order to reduce disturbance to colonies (ECCC 2017c).

Residual effects associated with supply and servicing on a change in health and socio-economic conditions to Indigenous communities and activities are predicted to be:

- Adverse
- Negligible to low in magnitude
- Occur within the RAA (where affected Indigenous communities are located)
- Short-term in duration
- Occur more than once as irregular events
- Reversible.

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

12.3.3.1 Project Pathways

Indigenous peoples have historically relied on harvesting a variety of species (e.g., fish, birds, marine mammals, wildlife, plants) for sustenance, medicine, spiritual and cultural practices, and for trade. Indigenous people continue to engage in traditional land and resource use practices though the location, species and methods of harvesting may have changed over time.

As indicated above, Chevron is not aware of any FSC fishing occurring in the Project Area and routine Project activities are not predicted to interact with onshore lands used for traditional purposes (e.g., hunting, gathering, inshore fishing). However, migratory fish, mammal and/or bird species that may be traditionally harvested by Indigenous communities (or species linked to these harvested species [e.g., prey or predator species]) in the nearshore or onshore lands and waters, may migrate through the Project Area and interact with the Project, thereby potentially affecting the quality or availability of these resources upon which Indigenous communities may depend. This could potentially result in a change in current use of resources for traditional purposes.

The pathway for a Project effect causing a change in the current use of lands and resources for traditional purposes is therefore tied to effects on migratory species which may occur in the Project Area or LAA.

A change in current use of lands and resources for traditional purposes could occur as a result of Project activities affecting the marine environment, including drilling (underwater sound effects on FSC fisheries species), VSP (underwater sound effects on FSC fisheries species), discharges (effects on water and sediment quality for FSC fisheries, effects on marine and migratory birds), and supply and servicing (helicopters and supply vessels disturbing marine and migratory birds, and supply vessels disturbing marine fish).

12.3.3.2 Mitigation

The mitigation measures outlined in Section 12.3.2.2 will also be applicable to reducing potential effects on current use of lands and resources for traditional purposes.

12.3.3.3 Characterization of Residual Project-related Environmental Effects

12.3.3.3.1 Presence and Operation of a MODU

As discussed above, drilling activities will result in underwater sound emissions associated with MODU engine sound and use of thrusters for station keeping, and from the drilling unit on the MODU. These emissions may cause fish to temporarily avoid the area around the MODU, particularly during start up, although these effects are expected to temporary as the fish become habituated to the continuous sound levels. Given the temporary nature of this effect, it is not expected that migratory fish would be affected to the extent that FSC fisheries would experience a change in availability of fisheries resources (through species mortality or dispersion of stocks).

The presence and operation of the MODU could interact with bird harvesting activities through nocturnal attraction of birds to artificial lighting. Species commonly harvested by Indigenous communities include geese, ducks, loons, gulls, murres, mergansers and scoters (Section 7.4.8). Section 9.3 evaluates Project effects on marine and migratory birds. The magnitude of the effect of MODU operation on marine and migratory birds is expected to be low in consideration of the implementation of mitigation including following the Best Practices for Stranded Birds Encountered Offshore Atlantic Canada (ECCC 2016).

Residual effects associated with the presence and operation of the MODU on a change in current use of lands and resources for traditional purposes to Indigenous communities and activities are predicted to be:

- Adverse
- Negligible to low in magnitude
- Occur within the RAA (where affected Indigenous communities are located)
- Short-term in duration
- Occur more than once as irregular events
- Reversible (e.g., effects on fisheries species and birds will not have a permanent irreversible effect on use of lands and resources for traditional purposes)

12.3.3.3.2 Vertical Seismic Profiling

Underwater sound associated with VSP could cause physiological or behavioral effects on migratory fish. As discussed in Section 8.3, mobile fish would be expected to avoid underwater sound at thresholds which could result in injury or mortality, particularly with the implementation of ramp-up procedures (implemented primarily for the protection of marine mammals and sea turtles). Residual effects from VSP on FSC fisheries species are not anticipated since the VSP operation would be localized and short term, with negligible environmental effects on FSC fisheries species that may be migrating through the area.

Sound levels produced by VSP surveys could also potentially interact with migratory birds, particularly diving birds, who may hear a sound pulse if they are underwater when the VSP sound source is activated. Murres are diving species which could be present in the Project Area and which are traditionally harvested by Indigenous communities in the RAA. Common murres may dive to a depth of 180 m or deeper (Piatt and Nettleship 1985); however, given the ramp-up period, it is likely that the gradual increase in underwater sound levels would deter these birds from feeding underwater in the affected area when the seismic source is activated. Residual effects from VSP are not anticipated since the VSP operation would be localized and short term, with negligible environmental interactions on marine and migratory birds.

Residual effects associated with VSP operations on a change in current use of lands and resources for traditional purposes to Indigenous communities and activities are predicted to be:

- Adverse
- Negligible to low in magnitude
- Occur within the RAA (where affected Indigenous communities are located)
- Short-term in duration
- Occur more than once as irregular events
- Reversible

12.3.3.3.3 Discharges

Discharges and emissions from routine Project activities could potentially result in localized adverse effects on water and sediment quality within the Project Area, and therefore could potentially affect FSC species within a localized area. Discharges and emissions will be in accordance with Chevron's EPP and the OWTG (NEB et al. 2010), thereby reducing the potential for adverse environmental effects on marine fish and marine and migratory birds (refer to Sections 8.3 and 9.3). Localized effects on the marine benthos from drill waste deposition is not predicted to affect FSC fisheries species or marine and migratory birds.

With the implementation of standard environmental protection measures for waste management, the overall magnitude of the effect of discharges and emissions is predicted to be low. It is therefore unlikely that discharges and emissions would reduce the availability of species to be harvested for FSC purposes.

Residual effects associated with discharges on a change in current use of lands and resources for traditional purposes to Indigenous communities and activities are predicted to be:

- Adverse
- Negligible to low in magnitude
- Occur within the RAA (where affected Indigenous communities are located)
- Short-term in duration
- Occur more than once as irregular events
- Reversible

12.3.3.3.4 Well Testing and Flaring

Given the lack of interaction between well testing (including flaring) and the marine environment, there is no predicted effect of this activity on marine fish. If well testing involves flaring, there is potential for marine and migratory birds to be attracted to the flare where they may become stranded on the MODU and/or experience physical injury or death. Flaring, if conducted, would be brief and bird attraction would be limited to several kilometres of the MODU. Mitigation measures would be implemented to reduce adverse effects on marine and migratory birds (refer to Section 9.3).

Residual effects associated with well testing and flaring on a change in current use of lands and resources for traditional purposes to Indigenous communities and activities are predicted to be:

- Adverse
- Negligible to low in magnitude
- Occur within the RAA (where affected Indigenous communities are located)
- Short-term in duration
- Occur more than once as irregular events
- Reversible

12.3.3.3.5 Supply and Servicing

The operation of supply vessels and helicopters, particularly in the nearshore area, may result in sensory disturbances to nesting marine and migratory birds, and supply vessels may interact with FSC fisheries species or nearshore FSC fishing.

Supply and servicing activities are not predicted to affect access to traditional fishing areas or interfere with fishing activities. As discussed in Section 2.4.5, supply vessels and helicopters would represent an incremental increase of existing high levels of traffic in the nearshore and would abide by standard navigation practices to reduce or avoid adverse interactions with fishing activities. With respect to migratory bird colonies, buffer zones would be observed to reduce potential for sensory disturbance of breeding birds (refer to Section 9.3).

Residual effects associated with supply and servicing on a change in current use of lands and resources for traditional purposes to Indigenous communities and activities are predicted to be:

- Adverse
- Negligible to low in magnitude
- Occur within the LAA
- Short-term in duration
- Occur more than once at irregular intervals
- Reversible

12.3.4 Species of Commercial and/or Cultural Importance: Potential Effects and Key Mitigation

As indicated above, various Indigenous communities and organizations (over the course of environmental assessments for recently proposed offshore exploration drilling projects) have raised specific concerns about potential effects on swordfish, bluefin tuna, Atlantic salmon and American eel. Potential effects of routine Project activities on these species are discussed in further detail below, with a full assessment of Project effects on marine fish and fish habitat found in Section 8.3.

12.3.4.1 Swordfish

Miawpukek First Nation, along with several Indigenous communities from the Maritime provinces, hold commercial communal licences to fish swordfish in the RAA. Swordfish are large, highly migratory pelagic species that forage in Canadian waters from June to October (DFO 2015). Spawning and nursery habitats are distant from the Project Area (e.g., Gulf of Mexico, eastern continental shelf of the United States (Arocha 2007). The longline fishery for swordfish in the RAA occurs primarily on the southern Grand Banks (refer to Figure 7-64), distant from the Project Area (approximately 465 km) or LAA.

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 supply vessel are not

projected into the water column far beyond the physical footprint of the MODU / vessels (i.e. within 100 m), limiting the area affected. Also, based on hearing sensitivities of other large pelagic fish, swordfish are likely capable of detecting low frequency sounds and are expected to avoid high intensity sound levels thereby avoiding potential injury.

Project interactions with swordfish are expected to be low due to the limited seasonal distribution of swordfish in and near the Project Area, their non-schooling behavior, and its capability to avoid adverse effects associated with underwater sound. General mitigation measures implemented to protect marine fish and fish habitat (e.g., waste management) will also help reduce potential for adverse effects on swordfish. Potential effects on swordfish fishing will be mitigated through communication with Indigenous communities and fisheries stakeholders with fishing gear damage compensated as required.

12.3.4.2 Bluefin Tuna

Miawpukek First Nation, along with several Indigenous communities from the Maritime provinces, hold commercial communal licences to fish for bluefin tuna and/or other tuna species in the RAA. Bluefin tuna are highly migratory species and seasonal migrants to Canadian waters where they are fished from July through December in the Scotian Shelf, Gulf of St. Lawrence, Bay of Fundy and NL waters. The occurrence and abundance of bluefin tuna in any one of these locations varies from one year to the next, and there are no known spawning or rearing habitats for larval and juvenile stages in Canadian Waters (COSEWIC 2011).

Tuna are hearing generalists and can detect 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 high intensity sound levels, thereby avoiding potential injury. Project interactions with bluefin tuna are expected to be low due to the limited seasonal distribution and broad range of habitat locations, and its capability to avoid injury. Effects on prey species from routine Project activities are not predicted to occur such that it would affect foraging success of bluefin tuna. General mitigation measures implemented to protect marine fish and fish habitat (e.g., waste management) will also help reduce potential for adverse effects on bluefin tuna. Potential effects on tuna fishing will be mitigated through communication with Indigenous communities and fisheries stakeholders with fishing gear damage compensated as required.

12.3.4.3 Atlantic Salmon

As discussed in Section 6.1.9, Atlantic salmon has traditionally been a staple food for Indigenous peoples, although today, due to a lack of abundance and concern for local populations, it is often reserved for special occasions (Denny and Fanning 2016). There are several populations of Atlantic salmon which could be found in the RAA. Salmon of various ages may be found in the ocean, and those ages influence migratory patterns so that at any given time, there are individuals in a population inhabiting ocean environments (COSEWIC 2010). Migration routes for Atlantic salmon can also vary considerably due to variations in environmental conditions, such as sea surface temperature. Research vessel surveys have not identified salmon within the Project Area. Therefore, the potential for occurrence within the Project Area is considered low.

Although there is uncertainty regarding the presence / absence of Atlantic salmon in areas of offshore oil and gas activity in the Flemish Pass and Jeanne d'Arc Basin, in consideration of questions and concerns raised by Indigenous communities, EIS reports for proposed exploration drilling projects (e.g., ExxonMobil 2017; Statoil 2017; BP 2018; Husky 2018; Nexen 2018) have conservatively assumed that salmon may migrate through the Project Area. Multiple collaborative efforts are now underway to address data gaps regarding the presence / absence of Atlantic salmon in areas of offshore oil and gas activity, and potential effects of this activity on the species. These efforts include tagging studies initiated by the Atlantic salmon (with support from some oil and gas operators), and a recent call for proposals from the Environmental Studies Research Fund. Results from tagging studies and other research initiatives may help provide additional data regarding the migration routes of salmon and assist in the determination of whether this assumption is valid.

If Atlantic salmon were to occur within the Project Area, it is likely that they would be migrating through and would only be temporarily exposed to underwater sound emissions and discharges in the Project Area or LAA. Light from the MODU, which would be quickly attenuated through refraction and absorption, is not expected to penetrate the water column any 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. Atlantic salmon do not have special adaptations for hearing; however, they are sensitive to acoustic particle motion, particularly at frequencies below 200 Hz (Bui et al. 2013) and have been shown to avoid infrasound frequencies in freshwater environments (5 to 10 Hz) in controlled experiments. The MODU will produce low frequency sounds underwater not unlike other vessels currently operating in the marine environment, including supertankers / container ships (7 to 70 Hz), medium-sized ships such as ferries (approximately 50 Hz), boats <30m in length (<300 Hz), and smaller ships such as support / supply vessels (20 to 1,000 Hz) (Peng et al. 2015). Underwater sound emissions from the MODU and supply vessels are 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 it would affect foraging success of Atlantic salmon. General mitigation measures implemented to protect marine fish and fish habitat (e.g., waste management) will also help reduce potential for adverse effects on Atlantic salmon.

12.3.4.4 American Eel

As described in Section 6.1.9, American eel is a catadromous fish (i.e., migrating down rivers to the sea to spawn) that lives primarily within freshwater and estuarine environments and has a broad distribution throughout the northwest Atlantic Ocean, stretching from Venezuela to Greenland and Iceland (COSEWIC 2012). The Canadian portion of this distribution includes coastlines, freshwater habitats, estuaries, and coastal marine waters connected to Canada, up to the mid-Labrador coast.

DFO research vessel surveys for 2007 to 2018 did not identify American eel in any of the survey sets. Therefore, the potential for occurrence within the Project Area is considered low. There is little information available on specific migration patterns of American eel, and 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.

Mi'kmaq eel fishers have observed declines in traditional fishing areas as having to fish longer to get the same amounts to feed their families and provide for cultural events (Denny et al. 2012; Wagner et al. 2004, in Denny and Kavanagh 2018).

An assessment of recovery potential for America eel in Eastern Canada concluded that oil and gas exploration (with a focus on seismic exploration) represented a negligible threat based on evidence of populations of American eel in the NL region (Chaput et al. 2013). Similarly, it was concluded that boat and ship traffic represented a negligible threat to American eel in the NL region (Chaput et al. 2013).

Sounds in the range of 200 to 205 dB have been shown to elicit a startle response at ranges of 100-300 m suggesting that fish could move away from the source. However, DFO (2004) concluded that the ecological significance of such effects is expected to be low, except when they may lead to a dispersion of spawning aggregations or deflection from migration paths. There are no indications that American eels occur at sea in densities where their encounter during seismic surveys could result in harm to a great number of individuals or result in changes to migration or orientation (Chaput et al. 2013). Underwater sound from drilling or VSP surveys are therefore not predicted to have a measurable effect on American eel populations.

Studies have shown juvenile and adult American eel to exhibit a strong avoidance to lights (Hadderingh et al. 1992; Cullen and McCarthy 2000; Bruijs et al. 2002). Spawning migration appears almost exclusively during the night and can be interrupted by artificial light (Franke et al. 2013). As described above however, light from the MODU would be quickly attenuated through refraction and absorption, is not expected to penetrate the water column any more than 50 m radius from the source (Davies et al. 2014). Artificial lighting from the MODU is therefore not expected to affect eel migration patterns. Given the low likelihood of high densities of American eel migrating through the Project Area and the localized nature of effects from routine Project activities, the Project is not likely to have adverse effects on American eel. General mitigation measures implemented to protect marine fish and fish habitat (e.g., waste management) will also help reduce potential for adverse effects on American eel.

12.3.4.5 Summary

Project-related effects on marine fish species are assessed in Section 8.3. No significant adverse effects are predicted to occur on marine fish as a result of routine Project activities. Potential effects, proposed mitigation, and predicted residual environmental effects for marine fish would also apply to swordfish, bluefin tuna, Atlantic salmon, and American eel. Key mitigation to avoid adverse environmental effects on fishery species is adherence to proper waste management procedures. Discharges and emissions will be in accordance with Chevron's EPP, and the Offshore Waste Treatment Guidelines (NEB et al. 2010). Refer to Sections 8.3.1.2 and 8.3.2.2 for a detailed account of mitigation measures on marine fish and fish habitat.

Project-related effects on marine and migratory birds and marine mammals are assessed in Sections 9.3 and 10.3, respectively. No significant adverse effects are predicted to occur on marine and migratory birds, or marine mammals as a result of routine Project activities. Potential effects, proposed mitigation and predicted residual environmental effects for marine and migratory birds and marine mammals and sea turtles would apply to waterfowl and seabird species and/or seal species harvested by Indigenous communities.

There are no predicted effects on marine biota that would lead to a decrease in the overall nature, distribution or quality of species of commercial and/or cultural importance, or to effects on traditional activities or resources for Indigenous communities.

12.3.5 Summary of Project Residual Environmental Effects

Table 12.4 summarizes the predicted residual environmental effects on Indigenous communities and activities due to interactions with routine Project activities.

Table 12.4 Summary of Residual Environmental Effects on Indigenous Communities and Activities

Residual Effect	Residual Environmental Effects Characterization						
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in Health and Socio-economic Conditions							
Presence and Operation of a MODU	A	N-L	RAA	ST	IR	R	D
VSP	A	N-L	RAA	ST	IR	R	D
Discharges	A	N-L	RAA	MT	IR	R	D
Well Testing and Flaring	A	N-L	RAA	ST	IR	R	D
Well Abandonment	A	N-L	RAA	MT-LT	IR	R	D
Supply and Servicing	A	N-L	RAA	ST	IR	R	D
Change in Current Use of Lands and Resources for Traditional Purposes							
Presence and Operation of a MODU	A	N-L	RAA	ST	IR	R	D
VSP	A	N-L	RAA	ST	IR	R	D
Discharges	A	N-L	RAA	ST	IR	R	D
Well Testing and Flaring	A	N-L	RAA	ST	IR	R	D
Supply and Servicing	A	N-L	RAA	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

The Project may potentially interact with commercial communal fishing (if fishing rights are exercised in the LAA) and/or targeted species, although these effects are not predicted to occur to the extent that there would be a measurable change in revenue that could result in a change in health or socio-economic conditions for an Indigenous community. Similarly, the Project could interact with marine biota that could be considered important from a food, social or ceremonial perspective, although Project activities are not predicted to cause a change in quantity, quality or availability of traditional lands and resources that could result in a change in current use of lands and resources for traditional purposes.

12.4 Determination of Significance

Residual effects from routine Project activities on Indigenous communities and activities are not predicted to result in a loss of access to or permanent loss of areas relied upon for traditional use practices. Adverse effects on socio-economic conditions of affected Indigenous communities are not predicted such that there would be an associated detectable and sustained decrease in the quality of life of a community, including for subpopulations within a community. There is no predicted reduction in the quality of ambient air, water, fish, wildlife, or other resources at concentrations predicted to result in unacceptable human health risks or associated detectable increase in the incidence of health issues in any Indigenous community. Routine Project activities are also not predicted to result in a decrease in established employment and business activity in commercial communal fisheries such that there is a detectable adverse effect upon the economy of the affected Indigenous community, and any damage to fishing gear would be mitigated.

With mitigation and environmental protection measures, residual environmental effects on Indigenous communities and activities are predicted to be not significant.

12.5 Prediction Confidence

This prediction of a not significant effect is made with a high level of confidence based on a good understanding of the general effects on fisheries activities, and commercial and traditionally harvested species inhabiting the LAA, and the effectiveness of mitigation measures, including those proposed for marine fish, marine and migratory birds, marine mammals and sea turtles, and commercial fisheries.

12.6 Monitoring and Follow-up

No follow-up and monitoring are proposed for routine Project activities. This is based on several factors, including the high level of confidence for a prediction of no significant adverse environmental effects on Indigenous communities and activities, the implementation of standard mitigation, and ongoing engagement with Indigenous communities, including the development and implementation of an Indigenous Fisheries Communication Plan.

As discussed in Section 12.3.3, independent of this Project, multiple collaborative efforts are now underway to address data gaps regarding the presence / absence of Atlantic salmon in areas of offshore oil and gas activity and potential effects of this activity on the species.

12.7 Summary of Commitments

- Chevron will continue to engage with Indigenous communities to share Project details and facilitate information sharing. This will be facilitated by the development and implementation of an Indigenous Fisheries Communication Plan
- Chevron will provide details on the safety zone to the Marine Communication and Traffic Services for broadcasting and publishing in the Notices to Shipping and Notices to Mariners. Details of the safety zone will also be communicated during ongoing engagement with Indigenous and non-Indigenous fishers
- Common shipping routes will be used by supply vessels, as practicable, to reduce incremental marine disturbance. See Figure 2-8 for planned routes
- Chevron will communicate the locations of abandoned wellheads (if applicable) to Indigenous and non-Indigenous fishers and the Canadian Hydrographic Services for future nautical charts
- Project-related damage to fishing gear, if any, will be compensated in accordance with the Compensation Guidelines with Respect to Damages Relating to Offshore Petroleum Activity (C-NLOPB and CNSOPB 2017)

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

Commercial Fisheries and Other Ocean Users are considered a combined VC due to the economic and cultural importance they carry for the province of NL. Activities related to the Project have potential to interact with commercial fishing and other ocean users. In the following assessment, commercial fishing refers to harvesting activities by domestic and foreign fleets for species of shellfish, groundfish, pelagic and molluscs. Other ocean users offshore NL include marine research, military exercises, shipping, other offshore oil and gas activities, and marine infrastructure (e.g., subsea cables, shipwrecks and legacy sites). Activities related to commercial fisheries and other ocean users are known to occur within the Project EL, Project Area, Local Assessment Area (LAA) and Regional Assessment Area (RAA), as defined in Section 13.1.4.1.

Portions of the commercial fisheries assessment are inherently related to three other VCs including Indigenous Peoples and Community Values (Chapter 12), Marine Fish and Fish Habitat (Chapter 8) and Special Areas (Chapter 11). Their relationships to the Commercial Fisheries and Other Ocean Users VC are outlined in Table 13.1, and more details on those components can be found within the respective chapters.

Table 13.1 Relationship of Other VC to Commercial Fish and Other Ocean Users

VC	Relationship	Chapter
Indigenous Peoples and Community Values	Landings from Indigenous commercial communal licences, as issued by DFO, are represented in the domestic commercial fishing datasets.	12
Marine Fish and Fish Habitat	Potential biological effects on fish and fish habitat from Project activities may influence commercial fishing success due to changes in fish health and quality.	8
Special Areas	Special areas overlap with the Project Area, LAA and RAA and some special areas act as nursery grounds for species that are commercially fished. Project activities may influence availability of suitable habitat, which may influence commercial fishing success.	11

The existing environment sections for commercial fish and other ocean users are presented in Sections 7.1 and 7.2, respectively. Section 7.1 provides information on historical and current trends for domestic and foreign commercial fishing activity, as well as quotas, stock assessments, and seasonality for species that are important to commercial fishing. NAFO Divisions that overlap with the RAA include 2J 3KLMNO and subdivisions 3Ps.and 4Vs.These divisions contain important fishing areas, including the coastal areas surrounding the Avalon Peninsula, the northeast Newfoundland slope, the outer shelf of the Grand Banks, and the Labrador Shelf. The NAFO fishing footprint, in which most of the international commercial fishing activity occurs, overlaps with NAFO Divisions 3LMNO and identifies further important fishing grounds, such and the Flemish Cap and the slopes of the Grand Banks.

Most domestic landings are attributed to snow crab and Northern shrimp (see Figure 7-2), while foreign fleets tend to focus on groundfish species (see Figure 7-36). Snow crab fishing occurs from April to August and groundfish fisheries are typically harvested year-round, with most fishing taking place in the summer months (Figure 13-1).

13.1 Scope of the Assessment

13.1.1 Regulatory and Policy Setting

There are two governing bodies that oversee commercial fisheries in the offshore region of NL: the Government of Canada (through DFO); and NAFO. The Government of Canada has jurisdiction over activities within the 200 nm EEZ, while NAFO manages activities outside the 200 nm limit out to 42° W longitude, in the region known as the NAFO Regulatory Area (Figure 7-1). Within the NAFO Regulatory Area there is a defined area known as the existing bottom fishing area, or NAFO Footprint. The NAFO Footprint is the portion of the NAFO Regulatory Area where most bottom fishing activity has historically occurred (NAFO 2019). Both governing bodies use the same administrative boundaries known as the NAFO Divisions, shown in Figure 7-1. The RAA is comprised of all NAFO Divisions 3KL, and portions of 2HJ, 3MNO and subdivisions 3Ps and 4Vn.

The *Fisheries Act* and its associated regulations provide protection to commercial, recreational or Indigenous fisheries by managing fish resources and the habitats that support them. Under the *Fisheries Act*, “fish” includes all life stages of fish, shellfish, crustaceans, and marine animals, while “habitat” includes the abiotic and biotic quality and areas that fish directly or indirectly use to live, including nursery, rearing, spawning, migration, and foraging areas. Section 35 of this Act prohibits activities by persons that may cause serious harm to aquatic species that are part of a commercial, recreational or Indigenous fishery, or to aquatic species that support such a fishery. The potential effects of the Project commercial fishing and other ocean users are relevant to the provisions of the *Fisheries Act* and are considered in this section. Some species and their habitats may also have legislative protection under SARA or the NL ESA. The new *Fisheries Act* became law on June 21, 2019.

Domestic fishery resources are protected from uncontrolled fishing activity though DFO in accordance with the *Fisheries Act* and *Oceans Act* using one or more of the following management methods:

- Area closures
- Setting TAC and fishing quotas
- Temporal restrictions (i.e., opening and closing dates for fisheries)
- Gear and/or vessel restrictions

Integrated Fisheries Management Plans are also developed by DFO to help monitor and direct the recovery and management of various species throughout the NL region. These plans use scientific knowledge and industry data on capacity and harvesting methods, to create management strategies for the fishery.

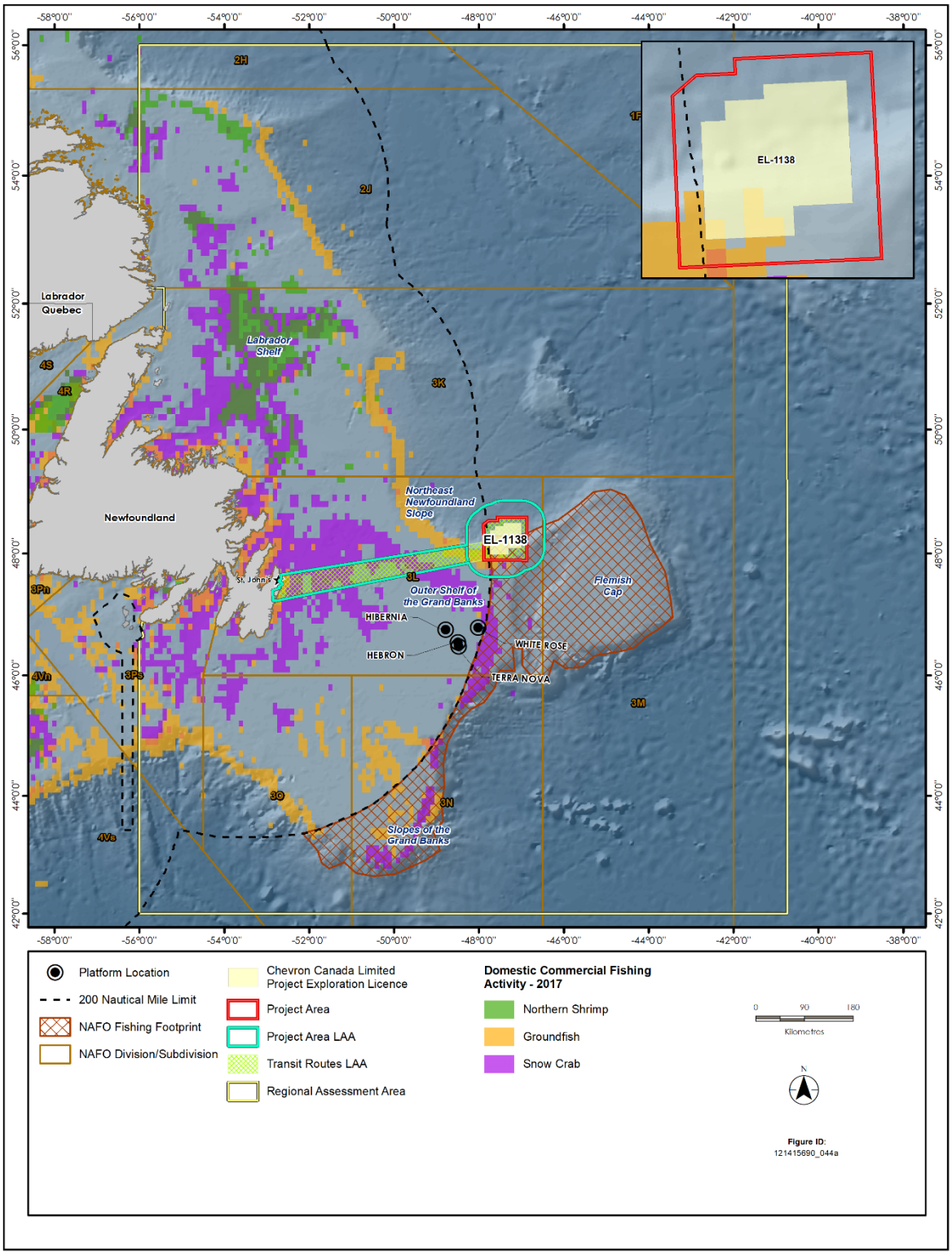

Figure 13-2 Known Commercial Fishing Areas for Key Species / Species Groups within the Project Area, LAA, and RAA in 2017

Regarding foreign fisheries (i.e., those occurring outside the Canadian EEZ by non-Canadian vessels), NAFO has the authority to set TACs and quotas for species to help manage and reduce the potential for overfishing. A constituent body of NAFO, known as the Scientific Council, published data on environmental and ecological factors related to fisheries, and at the request of NAFO, they also provide stock advice to guide the conservation and management of fisheries resources.

Until recently, two Snow Crab Conservation Exclusion Zones within the RAA, Eastern Avalon and Southern Avalon, created 0.5-nm wide corridors that followed the northern, eastern, and southern boundaries of CFAs 6C and 8A, respectively (DFO 2017). As of mid-May 2019, these Zones were removed in accordance with fleet recommendations and previously prohibited fishing activities have now been authorized (DFO 2019).

Both DFO and NAFO have identified areas where fishing restrictions are in place (Figure 13-2). These areas are intended to protect sensitive benthic environments and the ecological functions that are beneficial to the growth and sustainability of fish species (see Special Areas, Section 6.4 for more information).

13.1.2 Influence of Consultation and Engagement on the Assessment

During Chevron'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). These primarily include concerns regarding increased vessel traffic between the Project Area and shorebase that could interfere with inshore / nearshore fisheries. Standard communication on vessel movement will be required to reduce adverse effects to commercial fisheries and other ocean users.

13.1.3 Potential Effects, Pathways, and Measurable Parameters

Routine Project activities have the potential to interact directly and indirectly with commercial fisheries resources. Direct interactions can include displacement from fishing grounds and loss or damage to gear. Indirect interactions include those that may result in physical or behavioural effects on commercially fished species, such as changes in fish health or quality, fish avoiding popular fishing grounds due to underwater sound, or changes in water quality. These direct and/or indirect effects have the potential to result in economic loss to commercial fisheries. For other human components and activities, behavioural effects on fish could indirectly affect research activities, and oil and gas activities may also limit certain areas for research or military exercises, which may result in changes in schedules, or relocation of vessels to alternate areas.

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

- Change in availability of resources

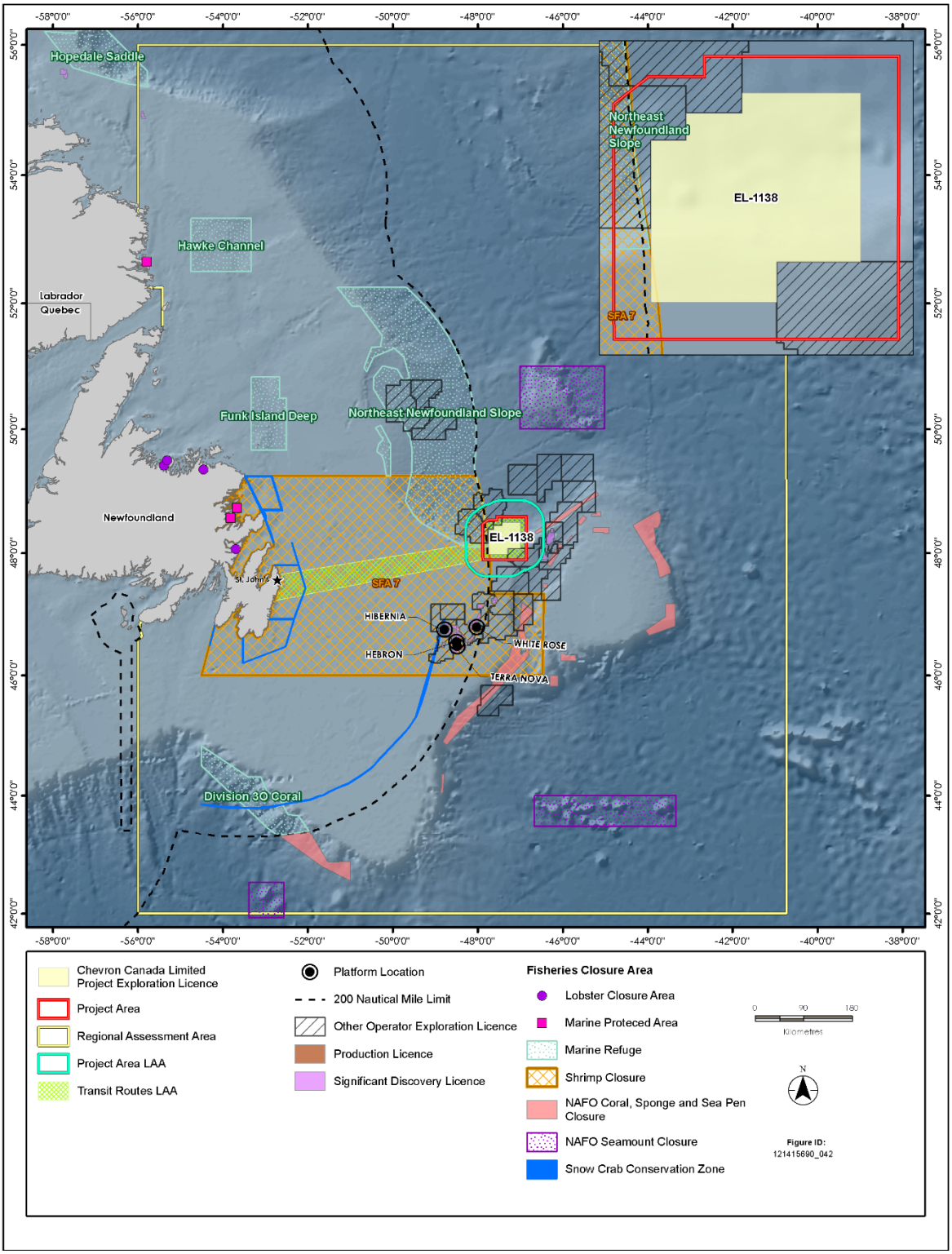

Figure 13-3 Fisheries Closures Areas in the Project Area, LAA, and RAA

Biological and behavioural effects on fish species, including those that are of commercial importance, are described in the VC assessment for marine fish and fish habitat (Section 8.3) and are noted below where applicable. The measurable parameters used for the assessment of the environmental effects presented above, and the rationale for their selection, are provided in Table 13.2. Effects of accidental events are assessed separately in Section 15.5.6, although the same effects, pathways and measurable parameters apply.

Table 13.2 Potential Effects, Effects Pathways, and Measurable Parameters for Commercial Fisheries and Other Ocean Users

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

13.1.4 Boundaries

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

13.1.4.1 Spatial Boundaries

Project Area: The Project Area (Figure 13-2) encompasses the immediate area in which Project activities would occur. Well locations have not been identified but will occur within the Project Area within EL 1138. The Project Area has been delineated to provide a 10 km buffer around the EL.

Local Assessment Area (LAA): The LAA (Figure 13-2) 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. The LAA consists of the Project Area and transit route corridor.

Regional Assessment Area (RAA): The RAA (Figure 13-2) is the area within which residual environmental effects from operational activities and accidental events may interact with commercial fishing and other human-based ocean activities that are outside the Project Area and the LAAs. The RAA also accounts for residual environmental effects that could interact cumulatively with the residual environmental effects of other past, present, and future (certain or reasonably foreseeable) physical activities. For the assessment of commercial fisheries and other ocean users, the RAA is comprised of all NAFO Divisions 3KL, and portions of 2HJ, 3MNO and subdivisions 3Ps and 4Vn.

13.1.4.2 Temporal Boundaries

The temporal boundaries for the Project to be assessed encompass all Project phases, including well drilling, testing, and abandonment. Chevron is currently planning to drill up to eight exploration and delineation/appraisal wells over the term of EL 1138 (2016 to 2025). Project activities at each well could take approximately 180 days to drill. Well testing 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. VSP surveys typically take approximately one to three days per well. Drilling operations would not be continuous throughout the Project and would depend on rig availability and results from previous wells. While drilling activities could be conducted year-round, Chevron's preference is to conduct drilling from May to September.

13.1.5 Residual Effects Characterization

The definitions used to characterize environmental effects on commercial fisheries and other ocean users are provided in Table 13.3. These characterizations will be used throughout the chapter when describing potential residual environmental effects on commercial fisheries and other ocean users from routine Project activities. These characterizations are also applicable for accidental events, discussed in Section 15.5.6.

Table 13.3 Characterization of Residual Effects on Commercial Fisheries and Other Ocean Users

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual environmental effect relative to baseline	**Positive** – a residual environmental effect that moves measurable parameters in a direction beneficial to special areas relative to baseline **Adverse** – a residual environmental effect that moves measurable parameters in a direction detrimental to special areas relative to baseline
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions	**Negligible** – no measurable change **Low** – a detectable change but within the range of natural variability **Moderate** – a detectable change beyond the range of natural variability, but with no associated adverse effect on the viability of the affected population or activity **High** – a detectable change that is beyond the range of natural variability, with an adverse effect on the viability of the affected population 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

Table 13.3 Characterization of Residual Effects on Commercial Fisheries and Other Ocean Users

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

13.1.6 Significance Definition

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

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

- Local fishers being displaced or unable to use substantial portions of the areas currently fished for all or most of a fishing season;
- Other ocean users being displaced or unable to use substantial portions of the areas currently used for one or more years;
- Local fishers experiencing a change in the availability of fisheries resources (e.g., fish mortality and/or dispersion of stocks) such that resources cannot continue to be used at current levels within the RAA for more than one fishing season, unmitigated damage to fishing gear or;

- Economic losses that cannot be mitigated by relocating marine research activities to another area or by other means

13.2 Project Interactions with Commercial Fisheries and Other Ocean Users

Table 13.4 identifies the physical activities that might interact with the VC and result in the identified environmental effect. These interactions are indicated by a 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. A justification for no effect is provided following the table.

Table 13.4 Project Environmental Interactions with Commercial Fisheries and Other Ocean Users

Physical Activity	Environmental Effects
	Change in Availability of Resources
Presence and operation of a MODU (including drilling, associated safety zone, lights, and sound)	✓
Vertical Seismic Profiling (VSP)	✓
Discharges (e.g., drill muds / cuttings, liquid discharges)	✓
Well Testing and Flaring (including air emissions)	-
Well Abandonment	✓
Supply and Servicing Operations (including helicopter transportation and supply vessel operations)	✓
Note: ✓ = Potential interaction – = No interaction	

Well testing and flaring has not been identified in this VC as having a potential interaction with commercial fishing activities or other ocean uses as flaring takes place in the airspace above the MODU, outside of the marine environment, and encompasses a small direct footprint within the 500-m radius safety zone of the MODU.

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

The following section assesses the environmental effects on commercial fisheries and other ocean users as identified though potential interactions noted in Table 13.2. 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.

13.3.1 Change in Availability of Resources

13.3.1.1 Project Pathways

Commercial fishing activity includes setting and retrieving gear in designated fishing grounds, as well as travel to and from those fishing grounds. Other ocean uses can include shipping and planned military activities, as well as ocean research activities, which include setting and retrieval of gear and/or equipment and travel to and from target sites. Project interactions that might interrupt or prevent these activities include obstacles that prevent access to and from fishing grounds or areas of other activities, closures applied in known fishing grounds, lost or damaged gear and equipment, or lost or reduced catch. Adverse effects to marine fish, including species that are commercially fished, are discussed in Chapter 8.

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

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

13.3.1.2 Mitigation

In consideration of the environmental effects pathways outlined above, the following mitigation measures and standard practices will be employed to manage and reduce potential effects on commercial fisheries and other ocean users. Mitigation measures identified in the assessment on marine fish and fish habitat (Section 8.3) will also be incorporated to help reduce the potential for interaction with fish that may be of commercial value; these are not repeated here.

- Chevron will continue to engage commercial fishers to share Project details, as applicable and determine the need for a fisheries liaison officer during mobilization and demobilization of the MODU. This engagement will be coordinated through One Ocean, Fish, Food and Allied Workers-Unifor, Ocean Choice International, Association of Seafood Producers, and Groundfish Enterprise Allocation Council. This will be accomplished through the development and implementation of a Fisheries Communication Plan
- Chevron will maintain ongoing communications with the NAFO Secretariat, through DFO as the Canadian representative, regarding planned Project activities, including timely communication of drilling locations, safety zone, and decommissioned well heads
- Chevron 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. Details of the safety (exclusion) zone will also be communicated by Chevron during ongoing consultations with commercial and Indigenous fishers

- Project-related damage to fishing gear, if it occurs, will be compensated in accordance with the *Compensation Guidelines with Respect to Damages Relating to Offshore Petroleum Activity* (C-NLOPB and CNSOPB 2017)
- An imagery-based seabed survey will be conducted at the proposed well site(s) to confirm the absence of subsea infrastructure (e.g., cables, UXOs, shipwrecks)
- Chevron will contact DFO regarding timing and locations of planned DFO research surveys
- Chevron will contact DND regarding timing of planned offshore military exercises
- Supply vessels will follow established shipping lanes where they exist (i.e., in proximity to shore). During transit to/from the Project Area, supply vessels will travel at vessel speeds not exceeding 22 km/hour (12 knots) except as needed in the case of an emergency
- To maintain navigational safety throughout the duration of the Project, obstruction lights, navigation lights and foghorns will be kept in working condition on board the MODU and supply vessels. Radio communication systems will be in place and in working order for contacting other marine vessels as necessary
- Chevron will communicate locations of abandoned wellheads (if applicable) to the appropriate authorities for inclusion on nautical charts for use by commercial fishers and other mariners

13.3.1.3 Characterization of Residual Project-related Environmental Effects

13.3.1.3.1 Presence and Operation of the MODU

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

When a MODU is set on location at the well site, a 500-m radius safety zone will be established prior to commencement of drilling and throughout the operation of the MODU. This will result in localized fisheries exclusion within an area of approximately 0.8 km² (less than 0.01% of the Project Area) for approximately 180 days for each well drilled. The safety zone excludes entry to vessels participating in activities related to fishing or other marine research. The safety zone can result in a change of availability of resources if commercial fishers are displaced from an area where they historically fish, particularly if in place during times of the year when commercial fishing activity is highest (e.g., the April to September), and for fisheries where the season is shorter (e.g., snow crab). This potential loss of access to fisheries resources could result in fishers having to delay a portion of their fishing season at a particular location or may cause vessels to re-route and move to a different area to fish. The outcomes of these interactions may include increased costs associated with moving equipment and vessels while waiting for the safety zone to be removed, resulting in lower economic returns for commercial fishers for the season. The MODU may also result in

damage to fishing equipment while it is in transit to a drill site. This interaction would likely apply to fixed fishing gear, such as crab pots, which are left in place for several days before they are retrieved.

The presence of the MODU, due to its safety zone, can have similar interactions and outcomes with other ocean users, including research programs and planned military exercises. The presence of a safety zone in a certain area may require other users to identify new areas for their program/exercises. or wait until the safety zone is removed before they can commence operations. This could result in delayed schedules, or part of a research program being compromised if it is time sensitive, both of which may cause an increase in associated costs.

The Project Area and Project EL overlap with known locations of domestic groundfish harvesting (Figure 13-1). Within these areas, in the Southwest quadrant of the Project Area and Project EL, there is potential for the safety zones to affect the availability of resource to commercial fishers and other ocean users. Commercial fishing by foreign vessels for groundfish species is also expected to occur within the southern portion off the project EL. Areas of the EL that are beyond the shelf edge and within the Flemish Pass that are deeper than approximately 1,000 m are not areas that are commonly fished as the habitat and ecosystem regimes are not favorable. Small amounts of domestic harvesting activity for snow crab have occurred within the Project Area (Figure 13-1). The Project Area and Project EL are in NAFO Division 3L within SFA 7, an area that is currently closed to fishing of Northern shrimp (Figure 13-2). More information on areas within the RAA that have restrictions on commercial fishing activity, their duration and applicable species can be found in Table 7.17.

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

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

reduce the access of these species to commercial harvesters, and potentially marine researchers, as they are prohibited from carrying out activities within the safety zone.

The effects of light and underwater sounds on fish are assessed in the Marine Fish and Fish Habitat VC (Section 8.3), which concluded that there would not be significant adverse environmental effects on marine fish species from interactions associated with the presence and operation of a MODU. Disturbances to fish species would be low in magnitude, localized, and temporary, returning to normal conditions once the MODU is removed. It is unlikely that marine resources will be affected or disturbed in a manner that would result in effects on the overall availability or quality of a marine resource for commercial fishers or other ocean users. Mitigation measures noted in Section 13.3.1.2, including timely and ongoing communication with other industry stakeholders, will further reduce potential interactions that could occur as a result of the presence and operation of a MODU.

Residual effects associated with the presence and operation of a MODU on a change in availability of resources to commercial fisheries and other ocean users are predicted to be:

- Adverse
- Low in magnitude
- Occur within the Project Area
- Short-term in duration
- Occur more than once as irregular events
- Reversible

13.3.1.3.2 Vertical Seismic Profiling

VSP surveys use equipment like those used in seismic operations (i.e., an air gun source sound array); however, the associated size and volume of the array are much smaller than a traditional seismic survey. The VSP is focused around a wellbore; sound effects are localized towards the drill site. VSP surveys will occur over a one to three-day period (per well) and are much more localized than large-scale 2D and 3D seismic surveys. More specific information on underwater sound emissions from VSP surveys can be found in Section 2.8.5 and Appendix C.

Underwater sound associated with a VSP survey could startle fish, causing them to periodically avoid the affected area, thus reducing landings for certain commercially fished species. As discussed in Section 8.3, received sound levels are unlikely to result in physical effects to the majority of mobile fish species due to the expectation that they would avoid underwater sound at lower levels and be away from the drilling areas during times when levels are at those when injury or mortality may occur.

Within the Project Area, most of the commercial fishing activity is associated with snow crab and groundfish species. Within the RAA, Northern shrimp is also important; however, the Project Area and LAA (including Transit Route) coincide with areas that are currently closed to commercial fishing activity for Northern shrimp.

Studies have been completed in the past on the effects of underwater sounds on species that are important to commercial fisheries. Engås et al. (1996) studied the effects of seismic exposure on cod catches off the coast of Norway and found that catch rates decrease by at least 50% within the seismic survey area, lasting for approximately 24 hours within a 10 km radius. Løkkeborg et al. (2010) conducted a similar study and found that fish species exhibit behavioural responses to source array exposure; while gillnet catches increased primarily from increased fish activity, longline catches decreased overall.

Unlike groundfish species, underwater sound does not have the same avoidance effect on invertebrate species. Christian et al. (2003) looked at pre- and post-exposure catchability of snow crab during commercial fishing season., concluding that catch-per-unit-effort did not decrease after snow crabs were exposed to seismic survey sound. Morris et al. (2018) undertook a similar study to measure the effects of 2D seismic exposure on the snow crab fishery off the coast of NL. The study involved a repeated Before-After-Control Impact study over two years to assess industry-scale seismic exposure to snow crab on catch rates on the Grand Banks. The results of the study did not support the hypothesis from snow crab harvesters that seismic activity had a negative effect on catch rates of snow crab, in both the short-term (i.e., days) and long-term (i.e., weeks) timeframes. The study suggests that the effects on commercial catch rates of snow crab resulting from seismic exposure are too small to detect and that that natural spatial and temporal influence are more important factors in determining the catch rate.

While source array activity could injure fish species if they are close to the sound source, it is likely that mobile fish will disperse from the source during array ramp-up or vessel approach and avoid harm (see Chapter 8). VSP activity could reduce catches if fish exhibit behavioural changes such as avoidance or a change in distribution.

Although there is a small amount of fishing that occurs within the EL 1138, it is unlikely that effects on commercial fish species from VSP surveys would affect distribution in a way that would create a substantial change in availability of resources for commercial fishers and or other ocean users. As most of the Project Area is outside the Canadian EEZ and more than 400 km from shore, research activities are limite (Section 7.2). Early and ongoing communication between other industries will also help reduce the potential for interaction with commercial fishers and other ocean users.

Residual effects associated with VSP operations on a change in availability of fisheries resources to commercial fisheries and other ocean users are predicted to be:

- Adverse
- Low in magnitude
- Occur within the Project Area
- Short-term in duration (approximately one to three days per well)
- Occur more than one at irregular intervals
- Reversible

13.3.1.3.3 Discharges

The discharge of drill muds and cuttings, and other discharges from the MODU and supply vessels, can result in a change in sediment and water quality of the surrounding area, up to 1 km from the location of the well (Appendix C). These changes have the potential to indirectly affect the quality or perceived quality of commercial fish species, and potential conditions for research activities. As discussed in the assessment of marine fish and fish habitat (Section 8.3), the effects from these discharges are expected to be low in magnitude and localized within the Project Area.

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

Other discharges and emissions have the potential to result in temporary and localized effects on water quality. This includes organic matter such as grey or black water, bilge water, deck drainage, BOP fluid, and cement. Marine discharges from the MODU will be in accordance with MARPOL and the OWTG. Marine discharges from the supply vessels will be in accordance with MARPOL. The effects assessment of discharges on marine fish and fish habitat is discussed in Section 8.3; these effects are expected to be low in magnitude.

Residual effects associated with discharges on a change in availability of fisheries resources to commercial fisheries and other ocean users are predicted to be:

- Adverse
- Low in magnitude
- Occur within the Project Area
- Short-term in duration
- Occurring irregularly
- Reversible

13.3.1.3.4 Well Abandonment

All wells drilled during the life of the Project will be plugged and abandoned upon completion of well evaluation activities, although the abandonment program has not yet been defined. Abandonment activities will be conducted according to Chevron's practices and requirements set by the C-NLOPB. Chevron's wellhead removal strategy considers water depth and the likelihood of potential interactions with fishing activities. As discussed in Section 2.4.4, Chevron may seek permission from the C-NLOPB to leave the wellhead in place after well plugging and abandonment for wells drilled in water depths of 900 m or deeper. If the wellhead is removed, mechanical means of wellhead severance will be used. If the wellhead is left in place, it would result in a permanent piece of infrastructure on the seafloor, which would have to potential

to interact with fishing and/or research equipment and may potentially cause damage. It is estimated that there would not be a large amount of interaction with commercial fishing activities in the LAA, as most harvesting takes place along the shelf edge at shallower depths. It is unlikely that wellhead abandonment will result in an interaction with commercial fishing and offshore research activity in a way that would result in a substantial change to availability of resource or unmitigated damages.

As part of its mitigation measures, Chevron will provide the locations for each decommissioned well to fishers and the Canadian Hydrographic Service and publish in the NAVWARN and NOTMAR systems. Details of the safety (exclusion) zone will also be communicated by Chevron during ongoing consultations with commercial and Indigenous fishers. This will allow mobile-gear and fixed-gear fishers to avoid these locations or plan activities around the abandoned wellhead.

Residual effects associated with well abandonment on a change in availability of resources to commercial fisheries and other ocean users are predicted to be:

- Adverse
- Low in magnitude
- Localized to the Project Area
- Short to long-term (if wellhead is left in place)
- Occur more than once as irregular events (once per well with no set schedule)
- Reversible

If the wellhead is left in place, the effects will be permanent and irreversible. There is a low level of interactions occurring between well abandonment and commercial fishing or other ocean users, as there are low levels of commercial fishing activity occurring in the deep-water areas of the Project Area, and Project EL.

13.3.1.3.5 Supply and Servicing

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

The Transit Route LAA interacts with nearshore areas in NAOF division 3L, where pelagic species such as capelin and herring are commercially fished in quantities that contribute to less than 2% of the total value of the fishery in NAOF Division 3L.

The addition of supply vessel traffic to and from the area will provide a small increase to existing marine traffic levels. Commercial fishers are aware of supply vessels moving throughout offshore NL and are accustomed to operating around supply vessels. The implementation of standard industry measures and operation of vessels will reduce the likelihood of an interaction. Supply vessels will follow established vessel traffic routes and communication protocols when transiting to and from the Project Area. Once near the Project Area, the supply vessel will select the route most appropriate for reaching the destination. Supply vessels will adhere to standard at-sea protocol and procedures, reducing potential conflicts with commercial fisheries and other ocean users. In the unlikely event of an interaction between a supply vessel and fishing

gear causing damage, compensation for damages will be managed in accordance with the Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activity (C-NLOPB and CNSOPB 2017).

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

Residual effects associated with supply and servicing on a change in availability of fisheries resources to commercial fisheries and other ocean users are predicted to be:

- Adverse
- Low in magnitude
- Occur within the LAA
- Short-term in duration
- Occur more than once as irregular events
- Reversible

13.3.2 Summary of Project Residual Environmental Effects

Table 13.5 summarizes the environmental effects assessment and prediction of residual environmental effects resulting from interactions between the Project and commercial fisheries and other ocean users. Based on the characterization of the potential interactions between Project activities and commercial fisheries and other ocean users, the Project can result in residual adverse effects through a change in availability (including a change in quality of marine resources) that exist within the LAA. This includes resources that may be used for commercial fishing activity, offshore marine research, and military training exercises. The designated safety zone while drilling is occurring will result in restricted access for less than 0.01% of the Project Area. With the implementation of applicable mitigation measures described in Section 13.3.2, and adherence to industry standards and best practices for offshore oil and gas activities in NL, the residual adverse environmental effects are considered to be low in magnitude, located within the Project Area and LAA, short-term in duration (with the exception of well abandonment), occurring at irregular intervals, reversible (with the exception of well abandonment), and primarily occurring within a disturbed ecological and socio-economic setting (presence of some commercial fishing activity and offshore research).

Table 13.5 Summary of Residual Environmental Effects on Commercial Fisheries and Other Ocean Users

Residual Effect	Residual Environmental Effects Characterization						
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in Availability of Resources							
Presence and Operation of a MODU	A	L	PA	ST	IR	R	D
VSP	A	L	PA	ST	IR	R	D
Discharge	A	L	PA	ST	IR	R	D
Well Abandonment	A	L	PA	ST-P	IR	R-I	D
Supply and Servicing	A	L	LAA	ST	IR	R	D

KEY:
See Table 13.3 for detailed definitions
N/A: Not Applicable

Direction:
P: Positive
A: Adverse
N: Neutral

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

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

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

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

Reversibility:
R: Reversible
I: Irreversible

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

13.4 Determination of Significance

Residual adverse effects from routine Project activities on commercial fisheries are not anticipated to result in local fishers being displaced or unable to use portions of the areas currently used for fishing for all or most of the season and it is not expected that local fishers will experience a change in availability of fishing resources such that they cannot be used at current levels within the RAA for more than one fishing season, or that local fishers will experience unmitigated damage to fishing gear. Likewise, for other ocean users, it is not expected they will be displaced or unable to use substantial portions of the areas currently used for one or more years or that economic losses due to relocation will be unmitigated.

Given the irregular schedule and short-term duration of drilling activities, the localized nature of Project interactions with commercial fishing activity, and the implementation of mitigation, such as communication with commercial fishers and other ocean users, and environmental protection measures, residual adverse environmental effects on commercial fisheries and other ocean users are predicted to be not significant.

13.5 Prediction Confidence

This prediction of significance has been determined with a high level of confidence based on the current knowledge of the offshore environment and interactions between oil and gas and other industries offshore, analysis of scientific literature and EEM results specific to offshore NL projects within the RAA, and analysis of current fishing activity within the Project Area.

13.6 Monitoring and Follow-up

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

13.7 Summary of Commitments

- Chevron will continue to engage with fishers to share Project details and facilitate information sharing. This will be facilitated by the development and implementation of a Fisheries Communication Plan
- Chevron will provide details on the safety zone to the Marine Communication and Traffic Services for broadcasting and publishing in the NAVWARN and NOTMAR systems. Details of the safety (exclusion) zone will also be communicated by Chevron during ongoing consultations with commercial and Indigenous fishers
- Details of the safety zone will also be communicated during ongoing engagement with Indigenous and non-Indigenous fishers
- Common shipping routes will be used by supply vessels, as practicable, to reduce incremental marine disturbance (see Figure 2-8 for planned routes)
- Chevron will communicate the locations of abandoned wellheads (if applicable) to fishers and the Canadian Hydrographic Services for future nautical charts
- Project-related damage to fishing gear, if any, will be compensated in accordance with the Compensation Guidelines with Respect to Damages Relating to Offshore Petroleum Activity (C-NLOPB and CNSOPB 2017)

13.8 References

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14.0 CUMULATIVE ENVIRONMENTAL EFFECTS

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

This chapter evaluates 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

Section 7.6.3 of the EIS Guidelines (Agency 2018a) outlines the scope and methods for the cumulative effects assessment (CEA) which is consistent with the Canadian Environmental Assessment Agency (Agency 2018b) interim *T*echnical Guidance for Assessing Cumulative Environmental Effects under the *Canadian Environmental Assessment Act, 2012* (Technical Guidance Document) and the CEA Agency's (2015) Operational Policy Statement Assessing Cumulative Environmental Effects under the *Canadian Environmental Assessment Act, 2012*.

As directed by the Operational Policy Statement, the approach and level of effort applied to assessing cumulative environmental effects takes into consideration:

- the characteristics of the Project
- the risks associated with the potential cumulative environmental effects
- the state (health, status or condition) of 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 analysis also builds on CEAs recently conducted for other offshore exploration drilling projects within the 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

Residual Project-related environmental effects were identified for the following VCs, as evaluated in Chapters 8 to 13 of this EIS:

- Marine Fish and Fish Habitat
- Marine and Migratory Birds
- Marine Mammals and Sea Turtles
- Special Areas

- Indigenous Communities and Activities
- Commercial Fisheries and Other Ocean Users

Since these VCs have residual environmental effects which could potentially contribute to cumulative effects, the CEA focuses on these VCs. The EIS Guidelines identified additional VCs for consideration in the CEA including: marine plants; air quality and greenhouse gases (GHGs); and human environment. Section 4.2 of the EIS provides rationale for the exclusion of these VCs in the Project-based effects assessment and the same rationale applies to the CEA. Marine plants are considered as applicable under the Fish and Fish Habitat VC. Relevant aspects of the human environment which may be affected by Project or cumulative environmental effects are addressed in Commercial Fisheries and Other Ocean Users. Project-related effects on air quality and GHGs are discussed in Section 2.8.1, and cumulative effects are considered in the context of Climate Change (refer to Section 5.8).

No other components of the biophysical or socio-economic environments have been identified as having the potential to be directly and adversely affected by the Project in such a way that would necessitate or justify their inclusion as VCs in the CEA.

14.1.2 Spatial and Temporal Boundaries

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

The Technical Guidance Document (Agency 2018b) suggests various methods to determine spatial boundaries for CEA, including:

- 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; or
- administrative, political, or other human-made spatial boundaries.

Although a VC-centered approach is generally recommended since it allows for more meaningful consideration of effects regardless of jurisdiction boundaries, this approach can present challenges in assessing cumulative effects on VCs with far-reaching migration patterns (including multi-national ranges), particularly 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 (Agency 2018b).This CEA 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 that are presented for each VC in the respective VC analysis chapter in Chapters 8 to 13 are generally applied to the assessment of cumulative environmental effects for each VC, including the Project Area, Local Assessment Area (LAA), and RAA, although 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 People and Community Values 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 Document (Agency 2018b), 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 Chevron 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 this CEA are generally informed by the timing of Project activities, although 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 baseline 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 CEA considers other physical activities that have been, are being, and are likely to be carried out. With respect to future physical activities that are likely to be carried out, the CEA considers:

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

Table 14.1 identifies other (non-Project) past, present, and future physical activities that are considered in the CEA because they have potential to result in residual environmental effects that may interact cumulatively with (i.e., overlap spatially and temporally with) the residual environmental effects of the Project within the RAA. Additional projects and activities or natural phenomena (e.g., climate change) that may serve as external stressors to a VC and may be relevant to the cumulative effects assessment are identified on a VC-specific basis, as applicable.

Table 14.2 lists known proposed and ongoing offshore petroleum exploration (geophysical and drilling) projects in the RAA. Figure 14.1 demonstrates the overlap of current and proposed geophysical survey programs in the RAA. Figure 14.2 shows the location of the various current and proposed exploration drilling and production projects. Figure 7-5 in Section 7.2.2 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 South Extension	• Discovered in 1979; operated by Hibernia Management and Development Company Ltd. (HMDC); located approximately 315 km ESE of St. John's, NL. • Gravity-based structure (GBS) installed on-site in June 1997; production began Nov 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 ongoing project is located approximately 144 km from the closest edge of the Project Area and approximately 160 km from EL 1138. • Production activities at this oilfield are planned to extend throughout and beyond the temporal duration of this 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 users.
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 ongoing project is located approximately 164 km from the closest edge of the Project Area and approximately 180 km from EL 1138. • 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 users.

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 ESE 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 Nov 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 ongoing project is located approximately 123 km from the closest edge of the Project Area and approximately 138 km from EL 1138. • 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 users.
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 ongoing project is located approximately 157 km from the closest edge of the Project Area and approximately 171 km from EL 1138. • 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 users.
Proposed Bay du Nord (BdN) Development Project	• The proposed 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 1,000-1,200 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 within the Project Area and approximately 40 km from EL 1138. • 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 477 wells have been drilled in the Canada-NL Offshore Area as of August 28, 2019, including 172 exploration wells, 59 delineation wells, and 248 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 fairly 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 a number of 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 fairly 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.

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
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.
Other Ocean Uses (including Other Marine Vessel Traffic)	• Section 7.3 describes other marine-based activities which occur in the RAA including research surveys (Section 7.3.1), shipping (Section 7.3.2), military exercises (Section 7.3.4), and existing marine-based infrastructure (e.g., telecommunication cables) (Section 7.3.5) 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 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.

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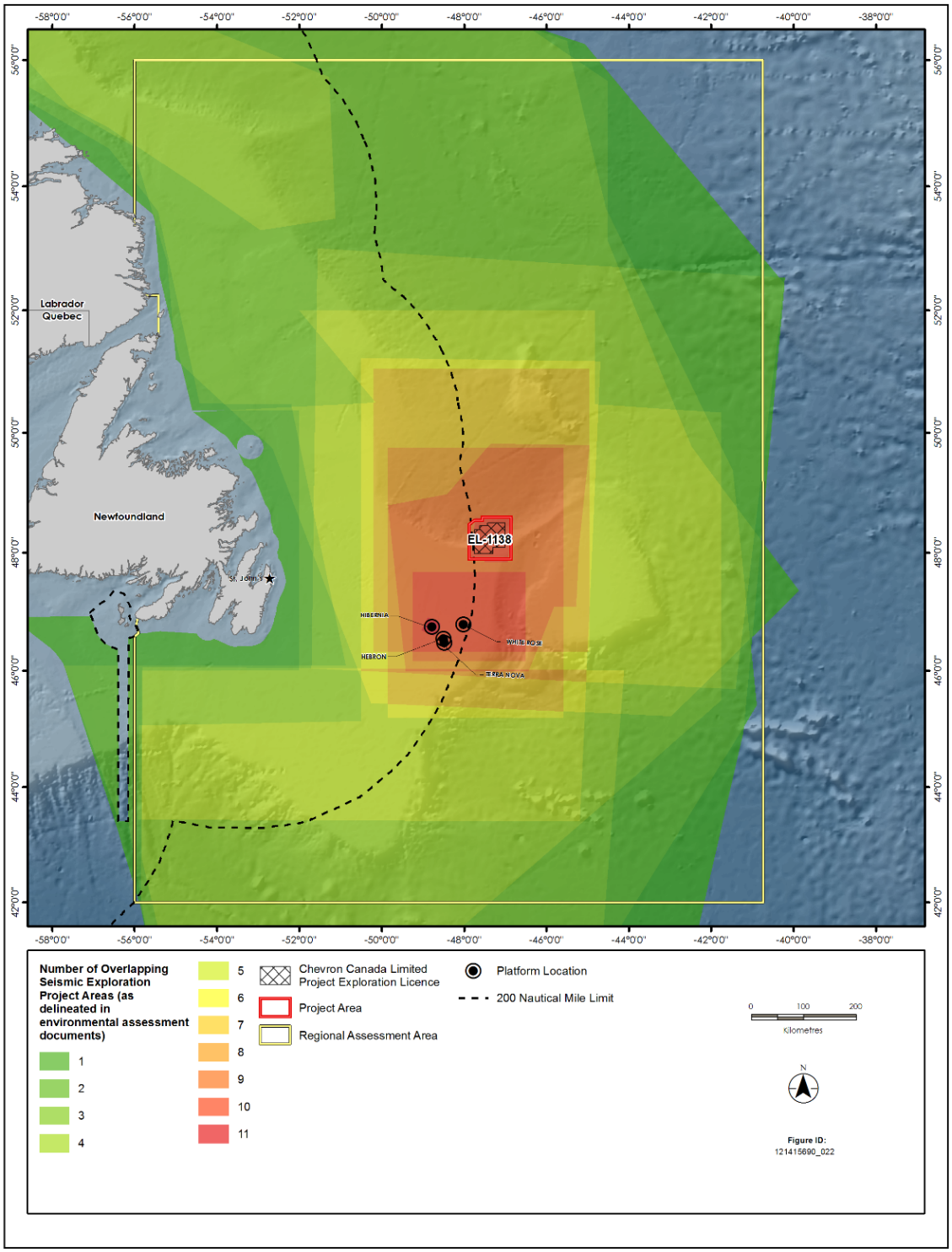
Table 14.2 Ongoing and Proposed Offshore Petroleum Exploration Activities in the RAA

Proponent	Project Name	Temporal Boundaries
Geophysical Survey Programs		
Husky Oil Operations Limited	Jeanne d'Arc Basin / Flemish Pass Regional Seismic Program	2012 to 2020
Hibernia Management and Development Company Ltd.	2D / 3D / 4D Seismic Projects for the Hibernia Oil and Gas Production Field	2013 to remaining life of field
Suncor Energy	Eastern Newfoundland Offshore Area 2D / 3D / 4D Seismic Program	2014 to 2024
ExxonMobil Canada Ltd.	Eastern Newfoundland Offshore Geophysical, Geochemical, Environmental and Geotechnical Program	2015 to 2024
MG3	Offshore Labrador Geochemical Data Acquisition and Seabed Sampling f	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 (Chevron)	Capelin 3D Seismic Survey of EL 1138 Offshore Newfoundland and Labrador	2018 to 2021
Nexen Energy ULC	Offshore Seismic Program	2018 to 2023
Exploration Drilling Programs		
Chevron Canada Limited	West Flemish Pass Exploration Drilling Project (the Project)	2016 to 2025
Suncor Energy	Tilt Cove Exploration Drilling Project	2019-2028
Equinor Canada Ltd. (Equinor)	Central Ridge Exploration Drilling Project	2020-2029
BHP Canada	Exploration Drilling Project	2019-2028
ExxonMobil Canada Ltd.	Southeastern Newfoundland Offshore Exploration Drilling Project	2020-2029
BP Canada Energy Group	Newfoundland Orphan Basin Exploration Drilling Program	2020-2026
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	Flemish Pass Exploration Drilling Project	2018 to 2028
ExxonMobil Canada Ltd. (ExxonMobil)	Eastern Newfoundland Offshore Exploration Drilling Program	2019 to 2030

Source: C-NLOPB 2019b



Note: Figure represents spatial overlap of ongoing and proposed seismic programs (between 2012 and 2027) and does not account for temporal boundaries for individual programs (i.e., may be spatial overlap without temporal overlap). Refer to Table 14.3 for more information on timeframes for seismic programs.

Figure 14-1 Ongoing and Proposed Geophysical (Seismic) Survey Programs in the RAA

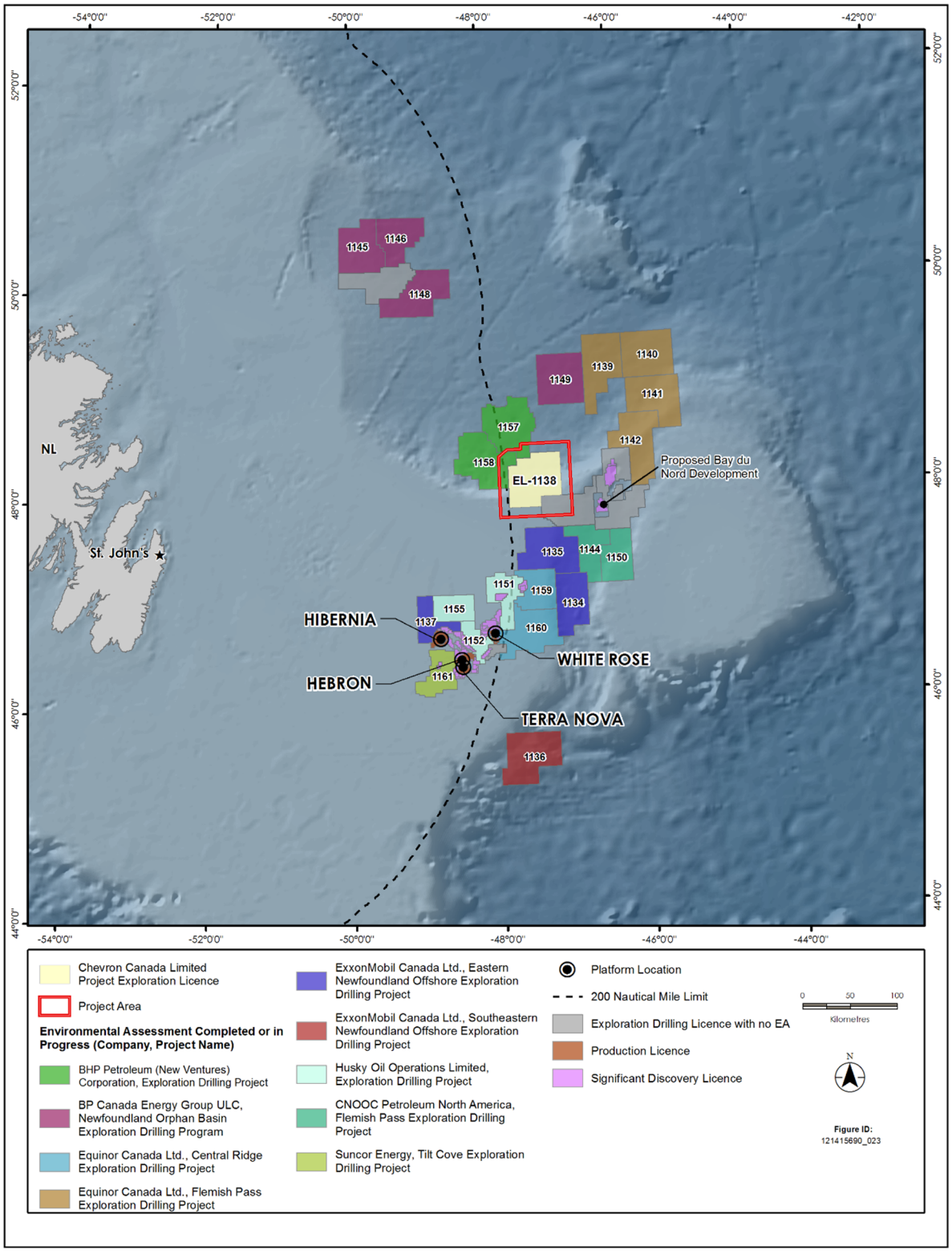


Figure 14-2 Ongoing and Proposed Oil and Gas Exploration Drilling and Production Projects

14.1.4 Assessing Cumulative Effects on Each Valued Component

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

- the context for cumulative environmental effects (e.g., current [baseline] condition of the VC including threats and vulnerability, in consideration of past natural or anthropogenic factors which may have affected the VC's current condition)
- potential Project-related contributions to cumulative effects (based on predicted residual effects presented in Chapters 8 to 13)
- residual effects from other projects and activities
- potential cumulative environmental effects combining residual effects from the Project and other projects and activities (including special consideration of potential cumulative environmental effects on species at risk).

A cumulative effects summary is then provided for each VC.

According to the CEA Agency's Operational Policy Statement, Assessing Cumulative Environmental Effects Under the *Canadian Environmental Assessment Act, 2012* (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 malfunctions and accidental events are assessed in Chapter 15. Most of these accidental 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 all 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 users in such a way that causes a cumulative environmental effect, particularly with the implementation of a 500-m radius safety (exclusion) zone surrounding the MODU and rapid dilution and/or evaporation of discharges. Cumulative effects of routine marine discharges are considered for each VC as applicable.

14.1.5 Mitigation and Follow-up

Following the VC-specific cumulative effects analysis, 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 Chevron to reduce Project-related residual effects, as well as measures required by Chevron 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. The CEA considers the nature, location, and timing of these other projects

and their environmental effects in relation to the Project, as well as environmental protection measures which are known and/or required to be implemented in relation to them, including those required under applicable legislation, regulations, and other requirements. The assessments of cumulative effects presented here are therefore not based on information or assumptions regarding mitigation measures by other proponents that would require discussions with, or confirmation by, other parties.

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. 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 (Baseline)

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

The presence and abundance of marine fish species, and associated abiotic and biotic habitat characteristics, vary considerably across the eastern Newfoundland offshore area, which transitions from shelf areas to the continental slope and deeper waters. The assessment of Project-related and cumulative effects on marine fish and fish habitat includes relevant fish species, plankton, algae, benthos, and relative components of their habitat, such as water and sediment quality.

The RAA contains several important areas for fish including marine refuges and lobster area closures, Ecologically or Biologically Significant Areas (EBSAs), significant benthic areas, and Northwest Atlantic Fisheries Organization (NAFO) Vulnerable Marine Ecosystems (VMEs). There is one fish species at risk (northern wolffish) and seven species of conservation concern (SOCC) likely to occur in the Project Area and/or RAA. Proposed critical habitat designated under the *Species at Risk Act* (SARA) for northern and spotted wolffish occurs in the RAA. There is a low abundance of structure-forming benthic invertebrate species (e.g., corals) that occur in the Project Area. Within the Project Area, large and small gorgonians, sponges, and sea pens are present in the southern half of EL 1138.

Marine fish and fish habitat in the RAA, and in the larger Northwest Atlantic 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., fishing activities, fishing restrictions, shipping and vessel traffic, offshore petroleum exploration and production). These natural and human influences have affected the presence, distribution, and abundance of fish species, as well as the overall size and health of fish populations, both collectively and individually to varying degrees. Warming

sea surface temperatures in this region have been linked to a northward shift in both fish species distribution and commercial fishing industry catch (Nye et al. 2009; Pinsky and Fogarty 2012; Pershing et al. 2015). This warming trend along with restrictions on harvesting may encourage the return of a groundfish-dominated system (Templeman 2010; Nogueira et al. 2017). See Section 5.10 for more details on climate change and evidence of human influence.

Human activities have influenced marine fish and fish habitat primarily though the generation of underwater sound and through mortality of fish and/or changes in fish habitat caused by commercial fishing activities. An acoustic monitoring program consisting of 20 acoustic recorders deployed in shallow and deep waters along Canada's east coast between 2015 and 2017 identified several existing dominant sound sources in the soundscape which are likely to continue through the lifetime of the Project, including fin whales, shipping, oil and gas extraction platforms, and seismic surveys (Delarue et al. 2018). Commercial fishing has played an important role in shaping the offshore marine environment and will continue to do so in the foreseeable future. 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 closures 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 Section 8.1.3, routine Project activities may result in:

- Alteration, contamination, or destruction 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 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
- Attraction of marine fish to MODUs and vessels, increasing potential for injury, mortality, contamination, and other interactions
- Temporary avoidance of areas by marine fish due to underwater sound or other disturbances, which may alter their presence and abundance as well as disturbing movements / migrations, feeding, or other activities
- Changes in the availability, distribution, or quality of food sources and/or habitats for fish and invertebrates as a result of planned activities and their associated environmental emissions
- Injury, mortality, or other disturbances to marine fish as a result of exposure to sound within the water column during VSP survey activity.

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. As shown in Appendix C and summarized in Sections 2.8.2 and 8.3.1, depositional thicknesses from drilling discharges are not expected to reach thicknesses of 6.5 mm (a conservative no-effect concentration threshold; Smit et al. 2006) in either deep or shallow water modelled scenarios within EL 1138.

Chevron will conduct an imagery-based seabed survey at proposed well sites to confirm the absence of sensitive environmental features, such as habitat-forming corals or species at risk. The survey will be carried out prior to drilling and will encompass an area within a 500-m radius from the well site. If environmental or anthropogenic sensitivities are identified during the survey, Chevron will notify the C-NLOPB 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. Additional mitigation to help prevent or reduce adverse environmental effects on fish and fish habitat include adherence to regulations and guidelines to manage chemical use and waste discharges and reduce effects from seismic sound sources (refer to Sections 8.3.1.2 and 8.3.2.2 for specific mitigation measures).

With the implementation of mitigation, 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 ongoing 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 affecting marine fish and fish habitat.

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, including a cumulative change in risk of mortality or physical injury to marine fish and/or a change in habitat quality.

Physical injury or mortality to fish and/or changes to habitat quality and use may occur as a result of underwater sound emissions, degradation of habitat quality (e.g., changes in water and/or sediment quality, direct benthic disturbance), and targeted fishing and bycatch in addition to environmental causes of mortality (e.g., predation, sea temperature changes). Offshore exploration drilling projects, production projects, geophysical surveys, commercial fishing and other ocean uses have the potential to result in physical injury or mortality and/or changes to habitat quality and use for fish, and residual effects from these activities may combine with residual effects from the Project to result in cumulative adverse environmental effects.

Table 14.3 Marine Fish and Fish Habitat: Residual Effects from Other Projects and Activities in the RAA

Physical Activity	Potential Residual Environmental Effect(s)	Explanation of Potential Residual Environmental Effect(s)	VC-specific Spatial and Temporal Considerations (Refer to Table 14.1 for General Consideration of Potential for Spatial and Temporal Overlap)
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, 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 zone), creating a localized change in habitat quality and use for fish.	• Potential residual effects from offshore petroleum production drilling projects are similar to those potentially associated with the Project. Unlike the Project, however, production facilities and their associated effects are confined to a fixed location and 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 (HSE), the farthest amphipod survival tests indicative of toxicity occurred at a distance of 1 km, and significant near-field effects on sediment parameters were also noted within 1 km. - Sediment toxicity testing has shown barium levels from drill cuttings not significantly different from total barium baseline (1994) concentrations up to 1 km from platform, with the highest levels of barium found approximately 250 m from the Hibernia platform and HSE. - Fuel range hydrocarbons were detected in sediments out to 1 km from the Hibernia platform and HSE. - The water sampling program confirmed the levels of many analytes are elevated in surface samples collected nearest to the discharge point. However, this effect was found to be very localized (<50 m) with fast decreasing contaminant concentrations away from the point of discharge. - Fuel range hydrocarbons and lube range hydrocarbons were present in all livers of American plaice collected from the Hibernia platform and HSE areas, as well as in almost all livers from fish collected in the reference areas located 16 km away from the Hibernia platform on the north and west radii. Overall the results indicate that the hydrocarbon levels in fish livers are similar for American plaice from the reference area when compared to fish livers from the Hibernia platform area. However, liver tissue from the HSE area had a significantly higher level of fuel range hydrocarbons compared to reference area samples in 2014. - The results of the fish health survey carried out in 2014 indicated that the overall health of American plaice is similar in the Hibernia platform area, HSE area, and the more distant reference areas. **Production from Terra Nova Oilfield** • The following is an overview of key results from the Terra Nova 2014 EEM program (Suncor 2017): - Concentrations of barium decreased to background levels within approximately 3 km from drill centres; concentrations of $>C_{10}$-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.

Table 14.3 Marine Fish and Fish Habitat: Residual Effects from Other Projects and Activities in the RAA

Physical Activity	Potential Residual Environmental Effect(s)	Explanation of Potential Residual Environmental Effect(s)	VC-specific Spatial and Temporal Considerations (Refer to Table 14.1 for General Consideration of Potential for Spatial and Temporal Overlap)
			- 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 this proposed 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 80 m to 120 m).
Offshore Petroleum Exploration – Geophysical Survey Programs	• Change in risk or mortality or physical injury • Change in habitat quality and use	• Discharges from survey and support vessels will be made in accordance with MARPOL and are therefore unlikely to cause a change in risk of mortality or physical injury for fish. Discharges may temporarily degrade water quality within a localized area around survey and support vessels, thereby potentially causing temporary behavioural effects (e.g., avoidance / displacement or attraction) for fish within the immediate area. • Vessel-related emissions of artificial light and underwater sound will affect habitat quality in such a way that has potential to disturb fish and cause temporary behavioural effects (e.g., localized avoidance / displacement or attraction) (AMEC 2014). • 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.

Table 14.3 Marine Fish and Fish Habitat: Residual Effects from Other Projects and Activities in the RAA

Physical Activity	Potential Residual Environmental Effect(s)	Explanation of Potential Residual Environmental Effect(s)	VC-specific Spatial and Temporal Considerations (Refer to Table 14.1 for General Consideration of Potential for Spatial and Temporal Overlap)
Offshore Petroleum Exploration – Exploration and Delineation Drilling Programs	• Change in risk or 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. • Well abandonment could potentially result in a change in habitat quality and use or a change in risk of mortality or physical injury for marine fish, depending on the method of abandonment. If the wellhead is mechanically separated from the seabed, it is expected that fish would avoid the immediate area where well abandonment activities are taking place. If the wellhead is kept in place, it is expected to be colonized by benthic epifauna.	• Residual effects from other exploration drilling programs are generally anticipated to be similar in nature and extent (including similar spatial and temporal scales) to predicted Project-related residual environmental effects on marine fish and fish habitat (refer to Chapter 8). • Exploration drilling activities are typically relatively short-term and localized. This can reduce the potential for individuals and populations to be affected simultaneously and repeatedly by multiple physical activities. • 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.

Table 14.3 Marine Fish and Fish Habitat: Residual Effects from Other Projects and Activities in the RAA

Physical Activity	Potential Residual Environmental Effect(s)	Explanation of Potential Residual Environmental Effect(s)	VC-specific Spatial and Temporal Considerations (Refer to Table 14.1 for General Consideration of Potential for Spatial and Temporal Overlap)
Fishing Activity	• Change in risk or 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 within and around the Project are extensive and diverse. 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.
Other Ocean Uses	• Change in risk or 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			

For immobile species and species with very limited ranges in areas that are affected by multiple physical activities at once, individuals may be exposed to the residual effects of the Project and the residual effects of one or more other physical activities either simultaneously or individually over an extended period. For mobile species (particularly those whose ranges cover a large extent of the RAA), individuals may be sequentially exposed to the residual effects of the Project and the residual effects of one or more other physical activities throughout their life cycle. However, this cumulative change in risk of mortality or physical injury for marine fish is not expected to affect population viability for marine fish species in the RAA. The relative contribution of the Project to the cumulative change in risk of mortality or physical injury for marine fish in the RAA is considered minor in comparison to the contribution of other activities, such as commercial fisheries.

An acoustic monitoring program along Canada's east coast between 2015 and 2017 has provided an understanding of the existing underwater soundscape in the RAA. Delarue et al. (2018) identified several dominant sound sources in the soundscape including fin whales, shipping, oil and gas extraction platforms and seismic surveys. Shipping, including supply vessels like those proposed to be used for the Project, are generally transient sources that were detectable at any one location over a period of several hours. Closer to the exploration drilling areas and existing oil and gas extraction platforms in the Newfoundland offshore area, the sounds from vessels and dynamically positioned vessels were continuously present (Delarue et al. 2018). Underwater sound from seismic source arrays was also a dominant sound source in the soundscape. Although the underwater sound emissions from the Project will be relatively short-term and reversible, Project emissions will contribute to an already disturbed soundscape in the marine environment.

Some of the underwater sound emissions generated by offshore petroleum exploration and production drilling, geophysical surveys, fisheries, and other ocean users during vessel transiting and other activities (e.g., depth sounding, bottom profiling, naval or side scan sonar, air source arrays) generate sound pressure levels (SPLs) that may be harmful to fish at close ranges. However, it is expected that the presence of an approaching vessel or drilling activity will locally displace some species from the area around operating VSP, seismic, sounding, profiling, or sonar sound sources before they are exposed to sound levels associated with mortality or injury effects in close proximity to those sound sources, and that most species will avoid underwater sound at lower levels than those at which injury or mortality might occur.

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, although such effects for each sound source would be expected to be in the range of natural variability (not affecting population viability). Fish eggs / larvae are immobile and are therefore more susceptible to harm in close proximity to these sound sources than other life stages of mobile fish; however, the sound sources themselves are far enough apart that, even if there was some temporal overlap of activities, there will be no spatial overlap (based on predicted propagation of underwater sound levels) of direct residual environmental effects on fish eggs / larvae.

The possibility of cumulative interaction between Project VSP activities and other seismic surveys in the RAA is uncertain and considered unlikely due to the infrequent nature and short duration (i.e., approximately one day to three days per well) of VSP operations, which may not be completed for each Project well or for

each well associated with other offshore drilling projects. Geophysical surveys may cover a much larger geographic area over a longer period, although underwater sound emissions at levels high enough to result in physical injury or mortality to fish eggs and larvae would be within metres of the source and would be transitory over the survey area. The 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) will mitigate 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 2.8.2, 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 site, and deposition of muds and cuttings exceeding 1 mm was predicted to remain confined within 1 km. 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 very low. Effects would be negligible to 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 zone are localized and unlikely to overlap spatially with the residual effects of bottom-contact fishing outside of the safety zone at the individual or population level within the wider RAA.

Routine discharges and underwater sound emissions from the Project are not likely to be detected outside the Project Area, however individuals of species whose ranges cover a large extent of the RAA may be exposed to discharges and/or emissions (including underwater sound) from one or more physical activities, as well as other direct habitat disturbances (e.g., from bottom-contacting commercial fishing activity), throughout their life cycle. The Project will introduce an additional source of sensory disturbance (e.g., emissions and discharges) that these individuals have potential to encounter. Mobile fish and other marine wildlife may temporarily avoid localized areas subject to degraded water quality and/or underwater sound.

The 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 presence of the 500-m radius safety 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.

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 operation of the Project MODU 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. Although fish are not expected to approach close enough to these offshore facilities to be exposed to sound levels capable of causing auditory injury, the sound emissions may cause behavioural responses such as temporary habitat avoidance or changes in activity state. However, the localized areas potentially affected by the Project, other offshore drilling projects, and other physical activities represent a relatively small proportion of the total amount of habitat available within the RAA.
- It is anticipated that routine discharges from the Project and from other physical activities will comply with the requirements of Offshore Waste Treatment Guidelines (OWTG) (National Energy Board [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 up to approximately 5.3 mm thick, with sediment deposition thickness of 1 mm potentially extending out to approximately 1 km from the well site.
- 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 zone would likely be negligible based on the limited sedimentation from the Project.
- Potential interactions between Project-related drill waste discharges and underwater sound from the vessels of fisheries and other ocean users operating outside of the 500-m radius safety zone would similarly be limited due to the low water column concentrations of Project-related discharges outside of the safety zone, the exclusion of non-Project activities within the safety zone, and the transient nature of underwater sound associated with vessel movements. Although Project-related discharges could also interact with physical activities generating higher SPLs outside of the safety zone (e.g., third party seismic, sounding, profiling, or sonar sound sources) to cause a cumulative change in habitat quality and use within the 1 km radius spatial extents for 1 mm sediment deposition thickness, these cumulative interactions will be transient and negligible in terms of overlapping effects on habitat quality.
- In general, the presence of Project and non-Project vessels in any particular area is anticipated to be medium-term and transient in nature, thus limiting water quality and sound effects (and associated cumulative changes in habitat quality and use) at any given location, including areas of importance for reproduction, feeding, and migration of fish.

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

14.2.5 Species at Risk

There are eight marine fish species at risk and/or SOCC that have been identified in the RAA. Of these, the northern wolffish and spotted wolffish are the only species at risk listed under Schedule 1 of SARA and formally protected at the federal level. There is proposed critical habitat for both the northern wolffish and the spotted wolffish within the transit route, LAA, and a small portion of the Project Area (none in EL 1138). These areas are outlined in Figure 6-36 and discussed further in Section 6.4.2.9.

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

The Northeast Slope EBSA is known to support high aggregations of spotted wolffish and overlaps with a portion of the Project Area. The establishment of a 500-m radius safety zone around the Project MODU will reduce the potential for direct spatial and temporal overlap of effects from different physical activities within these known wolffish aggregation areas. Only a small portion of the proposed critical habitat is within the Project Area and is unlikely to interact cumulatively with the residual effects of other physical activities on wolffish.

A combination of natural and human-induced mortality have caused the wolffish populations to decline, with the leading cause of human-induced mortality being the incidental capture of wolffish in many fisheries (DFO 2018a). Starting in 2003/2004, it became a requirement to release wolffish caught as incidental bycatch in Canadian waters; however, a significant portion of fishing mortality for wolffish occurs outside Canada's Exclusive Economic Zone (EEZ), where there is no requirement to release wolffish and bycatch is thought to be unreported. Other threats to wolffish in eastern Canadian waters include: the accidental release of petrochemicals, dissolved metals, and other solids during oil and gas activities; underwater sound emissions from seismic exploration; and ocean dumping (DFO 2018a).

Wolffish eggs and adults are associated with bottom habitats and larvae are pelagic; therefore, 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, the geographic distribution of wolffish species is quite large and they remain close to the substrate. As noted previously, drill waste dispersion modelling for the Project has predicted that the deposition of muds and cuttings exceeding 1 mm was predicted to remain confined within 1 km of a well site within EL 1138. Interactions with wolffish species in the Project Area would be localized and short-term.

The marine fish species at risk or SOCC with potential to occur within the RAA are highly mobile in their adult stages. Given the highly localized and short-term nature of planned Project activities and their likely environmental effects (along with the planned implementation of mitigation measures outlined previously), the Project is not anticipated to affect these species at risk substantially. 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 substantially adversely affected. Potential Project-related residual effects on these species at risk / SOCC are expected to be negligible in comparison to residual effects on these species at risk / SOCC resulting from commercial fisheries and other threats. Therefore, the Project is not predicted to make a measurable contribution to potential cumulative effects on marine fish species at risk.

14.2.6 Cumulative Effects Summary and Evaluation

Existing fish presence and abundance for secure species and species at risk has been and is being affected by directed fisheries and bycatch and various other human activities (including associated emissions and effluents).

The primary interactions that may have adverse environmental effects on marine fish and fish habitat include underwater sound and environmental discharges associated with the Project, including those that may interact with sensitive benthic organisms and habitats (e.g., cold-water corals and sponges). These interactions are also associated with other oil and gas exploration and production activities, shipping, and other ocean uses that are occurring in the RAA, along with commercial fishing, which can combine with adverse environmental effects from the Project to result in cumulative adverse environmental effects. 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, given the localized and short-term to medium term duration of predicted Project effects on marine fish and fish habitat, and the implementation of a safety (exclusion) zone during drilling operations, direct overlap of effects from other activities is unlikely to occur.

The Project may result in a residual adverse change in risk of mortality or physical injury and a residual adverse change in habitat quality and use for marine fish and fish habitat, including secure species and species at risk. These residual effects are predicted to be not significant and the Project is not expected to result in residual population-level effects on marine fish.

14.2.7 Conclusion

With the application of proposed Project-related mitigation and environmental protection measures, as well as other measures being implemented 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 species at risk) 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 (Baseline)

The Marine and Migratory Birds VC includes oceanic (i.e., beyond the continental shelf), neritic (continental shelf), and littoral zone (intertidal, splash, and spray zones) seabirds, waterfowl, loons, grebes, and shorebirds (plovers, sandpipers) that are protected under the *Migratory Birds Convention Act, 1994* (MBCA) and additional marine-associated birds not protected under the MBCA (i.e., cormorants).

The Grand Banks and adjacent waters are inhabited by large numbers of seabirds in each of the four seasons (Lock et al. 1994; Fifield et al. 2009). Several million seabirds nest along the eastern and

northeastern coasts of Newfoundland, and forage on the Grand Banks and adjacent waters during the nesting season and post-breeding dispersal. Globally important numbers of Atlantic puffin, common murre, Leach's storm-petrel, and northern gannet, and continentally important numbers of black-legged kittiwake (Fifield et al. 2009; Bird Studies Canada 2016) are concentrated at nesting colonies and in the coastal areas in the RAA in the summer. There are also many non-breeding seabirds in the RAA during the summer months. Most of the world's population of great shearwater and large numbers of sooty shearwater migrate from nesting colonies in the South Atlantic to Newfoundland waters to spend the non-breeding season. During winter, seabirds that have nested in Canada's eastern Arctic and sub-Arctic and from both eastern and western Greenland gather in the RAA. Non-breeding sub-adults fledged from those nesting colonies, mostly of northern fulmar and black-legged kittiwake, remain in the RAA year-round. During fall Arctic-nesting shorebirds (plovers and sandpipers) of various species undergo trans-oceanic migration from eastern North America to South America (Williams et al. 1978; Richardson 1979), some of which may pass through the RAA.

Species designated at risk provincially or federally and have the potential to occur in the RAA or the Project Area are: harlequin duck, Barrow's goldeneye, piping plover, red knot, buff-breasted sandpiper, red-necked phalarope, ivory gull, Ross's gull, and peregrine falcon. An additional three species are listed on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species: Bermuda petrel, Zino's petrel and Desertas Petrel. The Project Area is at the edge of distributions or migratory routes of some of these species, but they have been recorded in the Project Area on rare occasion. Other shorebird and landbird species at risk in NL are not likely to occur in the RAA or Project Area. In the northwest quarter of the RAA, the Northeast Newfoundland Shelf is part of a globally significant wintering area for ivory gull (Endangered, SARA Schedule 1). The RAA contains various designated special areas of importance to marine and migratory birds (e.g., marine and migratory bird sanctuaries, EBSAs, provincial ecological reserves, and International Bird Areas [IBAs]).

Existing marine and migratory bird distribution, abundance, and health for secure species and species at risk has been and is being affected by natural phenomena, as well as human activities and their associated disturbances, within the often-extensive ranges of marine and migratory bird species. These can include hunting; fishing activity, including fisheries bycatch; vessel traffic, including residual hydrocarbons and other contaminants in routine operational discharges from vessels; offshore petroleum exploration and production activities and associated effluents and emissions; pesticides; and other pollution.

The populations of most marine-associated bird species occurring off Eastern Newfoundland are generally considered stable overall. An exception to this is the Leach's storm-petrel. Leach's storm-petrel is the most numerous nesting seabird in Newfoundland (refer to Table 6.8 in Section 6.2.2). In excess of two million pairs of Leach's storm-petrel nested on the Avalon Peninsula in the recent past. Various breeding colonies of Leach's storm-petrel in Newfoundland have experienced significant declines, with the cause of the decline not yet confirmed. Potential cumulative drivers 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).

The amount of persistent oil in the marine environment has been shown to be relatively high along Newfoundland coastlines due to the density of marine traffic off Newfoundland associated with shipping activity between Europe and North America (Wiese and Ryan 2003).Beached bird surveys conducted between 1984 and 1999 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 conducted 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).

Despite improvements, it is estimated that tens of thousands of murres and dovekies remained 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 in or near the Project Area. In addition to being vulnerable to chronic oil pollution, murre and waterfowl populations are also subject to pressure from hunting activity in the RAA.

The effects of previous activities and natural environmental influences are reflected in the existing baseline environmental conditions for the marine and migratory bird VC, as described in Section 6.2. This includes considering the current condition (e.g., health or quality) of potentially affected bird populations and their habitats, as well as their potential resiliency or sensitivity to further environmental change resulting from the Project in combination with other ongoing and future projects and activities that may affect the same VC.

14.3.2 Potential Project-related Contributions to Cumulative Effects

Routine Project activities may result in a change in risk of mortality or physical injury and/or a change in habitat quality and use that affect marine and migratory birds through the following 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 supply vessels 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 supply vessels
- Collision risk with Project infrastructure (e.g., the MODU or vessels)
- Physical or behavioural effects due to increased underwater sound from VSP surveys

Given compliance with chemical management and waste management guidelines, and low likelihood of accidental spills (see Section 15.3), the greatest potential for environmental effects on marine and migratory birds from Project activities is related to artificial lighting which can result in nocturnal attraction and stranding of birds. 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 Environment and Climate Change Canada's *Procedures for Handling and Documenting Stranded Birds Encountered on Infrastructure Offshore Atlantic Canada* (ECCC 2017). If flaring is required, Chevron will discuss flaring plans with the C-NLOPB, including steps to reduce adverse effects on migratory birds (refer to Section 9.3 for details on mitigation measures).

The Project-specific environmental effects assessment for this VC includes a summary of residual environmental effects in Section 9.3 and a determination of significance in Section 9.4. Based on the nature of the interactions between the Project and marine and migratory birds, the planned implementation of mitigation, and residual changes to risk of mortality or physical injury, or to habitat quality and use, the Project is not likely to result in significant adverse effects on marine and migratory birds. Although Project-related components, activities and emissions may result in some localized, short-term interactions with marine and migratory birds in parts of the Project Area and LAA, primarily as a result of bird attraction to offshore lighting and other components, the Project is not predicted to result in a detectable decline in overall bird abundance or changes in the spatial and temporal distributions of bird populations within this area.

14.3.3 Future Projects and Activities and Their Effects

Table 14.4 summarizes how ongoing 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 and migratory birds.

14.3.4 Potential Cumulative Environmental Effects

Marine and migratory birds can have extensive migratory ranges and may be exposed to various human activities and associated disturbances which can affect bird distribution, abundance, and health. As indicated in Section 14.3.1, marine and migratory birds are subject to numerous threats throughout their sometimes extensive ranges, including: 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 pathways for cumulative effects associated with the Project include discharges and emissions and artificial lighting, both of which could potentially result in cumulative changes in risk of mortality or physical injury and/or a change in habitat quality and use.

Table 14.4 Marine and Migratory Birds: Residual Effects from Other Projects and Activities in the RAA

Physical Activity	Potential Residual Environmental Effect(s)	Explanation of Potential Residual Environmental Effect(s)	VC-specific Spatial and Temporal Considerations (Refer to Table 14.1 for General Consideration of Potential for Spatial and Temporal Overlap)
Existing Offshore Petroleum Production Projects (Production from Hibernia, Terra Nova, White Rose, and Hebron Oilfields)	• Change in risk or mortality or physical injury • Change in habitat quality and use	• 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.	• 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 16 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 this proposed 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 or mortality or physical injury • Change in habitat quality and use	• Discharges from survey and support vessels will be made in accordance with MARPOL and are therefore unlikely to cause a change in risk of mortality or physical injury for marine and migratory birds. Discharges may temporarily degrade water quality within a localized area around survey and support vessels, thereby potentially causing temporary behavioural effects (e.g., avoidance / displacement or attraction) for marine and migratory birds within the immediate area. • Although relatively little is known about the potential effects of seismic sound on marine and migratory birds, and the limited information that is available has not provided strong evidence of adverse effects (AMEC 2014), it is assumed for the purposes of the CEA that seismic sound from air source arrays will affect the quality of the underwater acoustic environment in such a way that has potential to disturb marine and migratory birds and cause temporary behavioural and/or physiological effects to individuals diving in proximity to the sound source (AMEC 2014).	• 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 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)
		• 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 or mortality or physical injury • Change in habitat quality and use	• The presence and operation of MODUs is predicted to result in a change in habitat quality and use for marine and migratory birds due to the generation of drilling sound (atmospheric and underwater), lights, and flares. • Atmospheric and underwater sound from MODUs may result in sensory disturbance of marine and migratory birds locally, potentially leading to behavioural responses, such as temporary habitat avoidance or changes in activity state. • Change in risk of mortality or physical injury may occur due to attraction of marine and migratory birds to MODUs. • The discharge of mud and cuttings will be in accordance with the OWTG and Offshore Chemical Selection Guidelines for Drilling and Production Activities on Frontier Lands (NEB et al. 2009) OCSG. However, discharges of mud and cuttings will result in localized increases in TSS in the water column, temporarily affecting water quality in a localized area around exploration drilling activities, potentially resulting in species avoidance. • The routine discharge of other wastes and emissions could possibly result in a change in habitat quality and use and a change in risk of mortality or physical injury for marine and migratory birds. Discharges from MODUs will be in accordance with OWTG and MARPOL requirements. • Discharges of sanitary and domestic waste may attract marine and migratory birds and/or prey to MODUs, but non-hazardous waste will be macerated to maximum particle size (6 mm) and treated on board prior to disposal, in accordance with the OWTG. • Gray water discharge may attract gulls and other species to the vicinity of MODUs, which may slightly increase the risk of mortality or physical injury of marine and migratory bird species, particularly if they interact with a flare or become stranded on MODUs. • Although marine and migratory birds diving 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. • In addition, 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. • 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 16 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 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 or mortality or physical injury • Change in habitat quality and use	• Marine and migratory birds, particularly seabirds, can become entangled in fishing gear (e.g., gillnets, longlines, and bottom trawls) as accidental bycatch, thereby resulting in a change in risk of mortality or physical injury. Murres and shearwaters are the most commonly captured in 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 or mortality or physical injury • Change in habitat quality and use	• Atmospheric and/or underwater sound associated with other ocean users' vessels have potential to cause a localized change in habitat quality and use that could result in sensory disturbance of marine and migratory birds. Vessels that employ artificial night lighting may also attract and/or disorient nocturnally migrating birds and cause an associated change in risk of mortality or physical injury. • Helicopter traffic may also cause a change in risk of mortality or physical injury for marine and migratory birds, due to potential bird strikes, as well as a change in habitat quality and use for marine and migratory birds due to atmospheric sound emissions. • 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 CEA.	• Although hunting is restricted to nearshore areas outside the Project Area, some birds are highly mobile and individuals that occur in the Project Area may also be at risk of mortality due to hunting.

Source: Modified from BP 2018

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). Project discharges will be managed through Chevron's EPP and comply with the *Offshore Waste Treatment Guidelines* and MARPOL requirements as applicable. These mitigation measures are standard for existing and proposed future oil and gas exploration and production projects. 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.

Using DMPSP-OLS satellite data, Cinzano et al. (2001) created an atlas showing the spatial distribution of artificial night sky brightness from anthropogenic sources. This atlas reveals detectable artificial brightness levels from the outward propagation of light pollution in many areas that were previously believed to be unpolluted because they appear completely dark in night-time satellite images (Cinzano et al. 2001). Offshore exploration drilling and production projects, as well as fishing fleets, were identified as sources of artificial night lighting in the offshore environment. Current artificial night lighting in the Project Area would be low and limited to fishing and shipping vessels transiting in proximity.

Nocturnally migrating species are often attracted to artificial lighting on vessels, especially when fog or rain sets in after the night's nocturnal migration has begun (Gauthreaux and Belser 2006). These species are most often seen during fall migration (July to November). 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. These artificial light footprints have the potential to cumulatively affect the nesting populations of Baccalieu and Gull Islands. The zone of influence for lighting attraction effects from a fully lit platform may extend up to 16 km (Rodriguez et al. 2014, 2015). Although artificial lighting associated with the Project will therefore not overlap with lighting footprints from existing producing oilfields or with other proposed exploration drilling projects in the RAA, and it will be at least 500 m from fishing vessels and vessels of other ocean users, it will still contribute to existing sources of artificial light in the offshore, thereby increasing risk of mortality or physical injury and/or change in habitat quality and use for marine and migratory birds. However, the Project's contribution to artificial lighting in the offshore will represent a fairly localized and temporary (up to 180 days to drill a well) increase 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 with systematic, daily searches for seabirds stranded on the MODU and supply vesels, and the recovery, rehabilitation and release of stranded birds in accordance with the *Procedures for Handling and Documenting Stranded Birds Encountered on Infrastructure Offshore Atlantic Canada* (ECCC 2017). 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.

With the exception of 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 be limited. The use of vessels and helicopters for supply and servicing on the Project 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 used for supply and servicing, the presence of marine traffic at any one location will be short-term. Furthermore, Project vessel 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. Cumulative interactions with the residual environmental effects of other vessel and helicopter traffic in the RAA are therefore expected to be minimal and not expected to result in a substantial change in habitat quality and use for marine and migratory birds.

The short-term and localized effects from the Project are not predicted to interact with other third-party activities in such a way that will causes a cumulative change in risk of mortality or physical injury, or a cumulative change in habitat quality and use.

14.3.5 Species at Risk

Nine marine and migratory bird 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 (i.e., harlequin duck, Barrow's goldeneye, piping plover, red knot, buff-breasted sandpiper, red-necked phalarope, ivory gull, Ross's gull, and peregrine falcon). Details regarding the marine and migratory bird species at risk that may occur in the Project Area and/or RAA, including general life history information, are provided in Section 6.2.4.

The main potential cumulative environmental interactions between the Project, other physical activities in the RAA, and marine and migratory bird species at risk are the same as for the secure species that comprise the Marine and Migratory Birds VC. However, as discussed in Section 6.2.4, there is a low potential for species at risk or SOCC to interact with the Project because of these species' low densities in the Project Area, LAA, and RAA and because there are no critical habitats or nesting sites of species at risk or SOCC in the RAA.

Major threats identified in associated recovery strategies and action plans for these bird species at risk 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; and disease. Given the distance of most Project activities occurring offshore, Project interactions with these bird species at risk 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 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) will help to protect bird species at risk.

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

14.3.6 Cumulative Effects Summary and Evaluation

The distribution, abundance and health of marine and migratory birds in the RAA have been and will continue to be affected by natural phenomena and human activities. Many marine and migratory birds have extensive ranges over their lifetimes, which further increases their risk of interaction with various disturbances. The Project is predicted to have residual adverse environmental effects on marine and migratory birds, although these effects are predicted to be of low magnitude and of short duration.

14.3.7 Conclusion

With the application of proposed Project-related mitigation 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 is predicted to be low and associated cumulative environmental effects on marine and migratory birds (including species at risk) 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 (Baseline)

The Marine Mammals and Sea Turtles VC includes baleen whales, large toothed whales, delphinids, porpoises, seals, and sea turtles, focusing in particular on those species that are listed under Schedule 1 of SARA and considered at risk by COSEWIC.

Thirty-two marine mammal species could potentially occur in the Project Area and RAA, including twenty-six cetaceans (whales, dolphins, and porpoises) and six phocids (true seals). The occurrence of seven of the cetacean species is atypical; however, sightings / detections have been or could be made within the RAA. Most marine mammal species use the area seasonally, and the region likely offers important foraging habitat for various marine mammals. Four sea turtle species could also occur within or near the Project Area, with loggerhead or leatherback sea turtle being the most likely to be present.

The RAA contains multiple EBSAs that provide important ecological functions for marine mammal and sea turtle species 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). No critical habitat for marine mammals and sea turtles has been designated in the RAA, although important foraging habitat has been identified as critical habitat for leatherbacks in the proposed recovery strategy, including the Placentia Bay Area within the RAA (DFO 2016).

The potential environmental effects of human activities on marine mammals and sea turtles include possible hearing impairment or permanent injury or mortality from exposure to high levels of underwater sound, as well as behavioural effects (avoidance) from exposure to lower levels of underwater sound or other sources of sensory disturbance (e.g., discharges), which may alter the presence, abundance and overall distribution

of these species and their health, movements, communications, feeding and other activities. Marine mammals and sea turtles may also be affected by other marine environmental discharges and disturbances, including through physical exposure, ingestion, effects on prey and habitats, and other changes.

Various ocean users have been, and continue to be, active throughout the RAA, including commercial fisheries, shipping and general marine traffic, scientific research, military activities, and offshore petroleum exploration and production activities (including geophysical surveys) (refer to Chapter 7). As evidenced by acoustic monitoring that has occurred along the east coast of Canada, these activities, particularly shipping, oil and gas extraction and production facilities and seismic surveys, have and will continue to dominant the soundscape in the RAA (Delarue et al. 2018).

In addition to interactions with underwater sound, marine mammals and sea turtles may also be affected by other human activities in the RAA, including potential interactions with vessel traffic (e.g., operational discharges and collisions) and fishing activity (e.g., collisions with fishing vessels and entrapment or entanglement in fishing gear).

The widespread and migratory nature of marine mammals and sea turtles and their overall sensitivity to certain types of disturbance increases the potential for individuals and populations to be affected by multiple environmental disturbances, and thus, for cumulative effects to occur. This is reflected in the fact that many species of marine mammals and sea turtles that may be found in the RAA have been designated as species at risk or species of conservation concern.

The effects of previous activities and natural environmental influences are reflected in the existing baseline environmental conditions for the Marine Mammals and Sea Turtles VC, as described in Section 6.3. This includes considering the current condition (e.g., health or quality) of potentially affected marine mammal and sea turtle populations and their habitats, as well as their potential resiliency or sensitivity to further environmental change resulting from the Project in combination with other ongoing and future projects and activities that may affect the same VC.

14.4.2 Potential Project-related Contributions to Cumulative Effects

As discussed in Chapter 10, 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 MODU, VSP survey, supply vessels, 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).

Acoustic modelling conducted for the Project predicted that sound levels from drilling would not reach the peak sound pressure level (SPL_{peak}) auditory injury thresholds for any marine mammal groups. Although estimated sound levels from the VSP air gun array were above SPL_{peak} injury thresholds (Permanent Threshold Shift [PTS] onset) for impulsive sounds for low- and high-frequency cetaceans 20 m and 200 m from the array, respectively, and 300 m for seals (see Table 7 in Zykov and Alavizadeh 2019; Appendix D), injury would be unlikely to occur since individuals would have to occur and remain within close range of the

air gun array to theoretically incur auditory injury. Sound pressure levels of 120 dB re 1 µPa (assumed generic behavioural disturbance threshold for non-impulsive sounds on marine mammals) could extend 27 to 32 km from the MODU (Table 11 in Zykov and Alavizadeh 2019; Appendix D). However, it is unlikely that marine mammals, particularly odontocetes and seals, would avoid the MODU at these distances; any avoidance is expected to occur closer to the MODU. Sea turtles, considered rare in the Project Area, would be expected to exhibit localized avoidance.

The Project-specific environmental effects assessment for this VC includes a summary of residual environmental effects in Section 10.3.4 and a determination of significance in Section 10.4. Key mitigation includes adherence to the SOCP (DFO 2007), management of chemical use and marine discharges, and supply vessel transit procedures to avoid risk of collisions (refer to Sections 10.3.1.2 and 10.3.2.2 for specific details on mitigation). With the implementation of mitigation, 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 ongoing 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.

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. Changes to habitat quality and use may occur as a result of underwater sound and/or marine discharges from human activities. These interactions, along with vessel collision and/or entanglement, can also potentially result in physical injury or mortality of marine mammals and sea turtles.

Marine mammal and sea turtle 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.

Table 14.5 Marine Mammals and Sea Turtles: Residual Effects from Other Projects and Activities in the RAA

Physical Activity	Potential Residual Environmental Effect(s)	Explanation of Potential Residual Environmental Effect(s)	VC-specific Spatial and Temporal Considerations (Refer to Table 14.1 for General Consideration of Potential for Spatial and Temporal Overlap)
Current Offshore Petroleum Production Projects (Production from Hibernia, Terra Nova, White Rose, and Hebron Oilfields)	• Change in risk or mortality or physical injury • Change in habitat quality and use	• 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 in close proximity to 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 focused on a smaller area than EL areas for exploration and are relatively longer-term in nature. Refer to Table 14.3 for a summary of EEM results of the various production projects.
Proposed Bay du Nord Development Project	• Change in risk or mortality or physical injury • Change in habitat quality and use	• Effects from this proposed 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 or mortality or physical injury • Change in habitat quality and use	• Discharges from survey and support vessels will be made in accordance with MARPOL and are therefore unlikely to cause a change in risk of mortality or physical injury for marine mammals and sea turtles. Discharges may temporarily degrade water quality within a localized area around survey and support vessels, thereby potentially causing temporary behavioural effects (e.g., avoidance / displacement or attraction) for marine mammals and sea turtles within the immediate area. • 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 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 or 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 mortality or physical injury for marine mammals and sea turtles. These effects would be short-term (VSP typically takes approximately one day to a few days per well), localized 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 or mortality or physical injury • Change in habitat quality and use	• Entanglement in fishing gear (especially fixed fishing gear) is one of the primary threats for marine mammals in Atlantic Canada waters, including species at risk, resulting in a change in risk of mortality or physical injury. • Fishing vessels may cause a localized change in habitat quality and use for marine mammals and sea turtles through the generation of underwater sound from engines and propellers during transiting, which may potentially cause changes in swimming, foraging, or vocal behaviours. • Although underwater sound levels produced during the transiting of fishing vessels are below the thresholds for physical injury to marine species, sound due to other third party physical activities that may be carried out by fishing vessels (e.g., depth sounding, bottom profiling, and side scan sonar) may cause injury or mortality to marine mammals at close ranges. • The transiting of fishing vessels may cause a change in risk of mortality or physical injury for marine mammals and sea turtles due to potential vessel strikes. • Discharges from fishing vessels (e.g., grey and black water, ballast water, bilge water, and deck drainage) 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 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 or mortality or physical injury • Change in habitat quality and use	• Other ocean users in the RAA can cause a change in risk of mortality or physical injury and a change in habitat quality and use for marine mammals and sea turtles through the generation of underwater sound, which may potentially cause changes in swimming, foraging, or vocal behaviours. • Although underwater sound levels produced by the types of vessels most commonly used by other ocean users are generally below the thresholds for physical injury to marine species, sound levels from other physical activities that may be carried out by these ocean users (e.g., naval sonar) are high enough to cause injury or mortality to marine mammals and sea turtles in certain circumstances. • 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 CEA.	• 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

As discussed above, the underwater soundscape is dominated by anthropogenic sources of sound emissions from shipping, oil and gas extraction and production facilities and seismic surveys in the RAA (Delarue et al. 2018). Underwater sound emissions from the Project will contribute to an already disturbed soundscape, although the sound emissions from the Project are expected to be temporary and relatively localized. 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. Due to the temporary nature of activities at any given location within the Project Area, the relatively small zone of influence of effects from underwater sound propagation from the Project, the separation distance of the Project Area from other oil and gas exploration and production projects, and the highly mobile nature of marine mammals and sea turtles, it is expected that less affected corridors between areas of influence would be available to marine mammals throughout the lifetime of the Project, particularly in the comparatively undisturbed portions of the Project Area. Project mitigation, including adherence to the SOCP during VSP surveys, will reduce risk or physical injury or mortality due to underwater sound emissions. Geophysical survey programs conducted by others would also comply with the SOCP to reduce adverse residual effects on marine mammals and sea turtles.

Marine vessel traffic, commercial fishing, and hunting (seals) can contribute to mortality or physical injury of marine mammals and sea turtles. Supply vessels for the Project represent a small increase over existing levels of marine traffic in the RAA, and therefore are expected to only cause a small increase in the cumulative change in risk of mortality or physical injury for marine mammals and sea turtles. During transit to and from the Project Area, supply vessels will travel at vessel speeds not exceeding 22 km/hour (12 knots) (except as needed in the case of an emergency) and vessel crew will keep a watch for marine mammals or sea turtles and reduce speed and/or alter course if practicable to avoid a collision. Additional measures are being taken for other ocean activities (e.g., shipping, fishing) to help reduce risk of mortality or physical injury of marine mammals and sea turtle (see Section 14.4.5).

14.4.5 Species at Risk

The main potential cumulative interactions between the Project, other physical activities in the RAA, and marine mammal and sea turtle species at risk are the same as for secure species. Section 6.3.7 describes the marine mammal and sea turtle species at risk found in the RAA, including key threats and recovery measures.

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

Between 2017 and July 11, 2019 there were 26 mortalities of North Atlantic right whales (18 in Canada; 8 in the United States) documented, prompting 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). Enhanced protection measures instituted by Transport Canada include ship

speed reductions (reduction to 10 knots within designated areas for vessels longer than 13 metres), aerial surveillance, and funding for initiatives to enhance marine mammal response (Transport Canada 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, which could transit through the RAA.

In Canadian waters, the primary threat facing sea turtles at risk is bycatch in fisheries; however, globally, leatherbacks and loggerheads are threatened by collisions with ships, marine debris, artificial lights at nesting beaches, as well as oil and gas exploration (COSEWIC 2012; DFO 2017b). Several incidental captures of leatherbacks have been reported in fishing gear off Newfoundland, including on the Grand Banks (Hamelin et al. 2017). Hundreds (n = 701) of incidental captures of loggerhead sea turtles were reported by the Canadian Atlantic pelagic longline fleet between 1999 and 2006; despite considerable observer coverage in the area, none of these sightings occurred northeast of the Grand Banks (Brazner and McMilan 2008). However, loggerhead encounters in the longline fishery were reported south of the Flemish Cap for 2002 to 2008 (Paul et al. 2010).

Mitigation measures proposed to reduce underwater sound disturbance associated with VSP air gun 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 species at risk. 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 any identified concentration areas or critical habitat. With the exception of fin and northern bottlenose whales, there is generally low potential for species at risk or SOCC to interact with the Project because these species occur at low densities in the RAA, Project Area, and LAA, and because there is no identified critical habitat in the RAA. Therefore, the Project is not predicted to make a perceptible contribution to potential cumulative effects on marine mammal or sea turtle species at risk.

14.4.6 Cumulative Effects Summary and Evaluation

Existing marine mammal and sea turtle presence and abundance for secure species and species at risk have been and are likely to continue to be affected by marine traffic, fisheries, geophysical survey programs, and various other human activities, including associated discharges, emissions, and the generation of underwater sound. The widespread and often migratory nature of many marine mammal and sea turtle species increases the potential for individuals and populations to be affected by multiple perturbations (including outside the RAA). Some marine mammal and sea turtle populations are currently critically endangered or threatened due to effects from anthropogenic activities.

Routine Project activities are predicted to have adverse environmental effects on marine mammals and sea turtles, but these effects are predicted to be negligible to low in magnitude and confined to the Project Area or LAA. The Project is therefore anticipated to have only a small contribution to existing cumulative effects on marine mammals and sea turtles. Species are not predicted to 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, including species at risk.

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.

14.4.7 Conclusion

With the application of proposed Project-related mitigation and environmental protection measures, the residual cumulative environmental effects on marine mammals and sea turtles (including species at risk) 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.

14.5 Special Areas

14.5.1 Past and Ongoing Effects (Baseline)

Special areas are established or delineated with the intent of protecting ecologically, historically and/or socio-economically important habitat, flora and fauna. Special Areas may be designated (and in some cases protected) by federal and/or provincial governments, international organizations, and/or special interest groups. 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 VMEs, IBAs, and a UNESCO World Heritage Site. Refer to Section 6.4 for a description of these Special Areas.

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:

- NL Shelves Bioregion Northeast Slope EBSA (overlaps with the southwestern portion of the Project Area and a portion of the supply vessel route)
- Northeast Newfoundland Slope Closure marine refuge (partially overlaps the northwestern portion of the Project Area)
- Proposed critical habitats for northern and spotted wolffish (overlap the southwestern-most portion of the Project Area)
- SBA for sea pens (overlaps the southwestern portion of the Project Area) and an SBA for large gorgonian corals (located immediately west of the Project Area's western boundary)
- Slopes of the Flemish Cap and Grand Bank, a Convention on Biological Diversity (CBD) EBSA (overlaps most of the Project Area)
- Eastern Avalon EBSA (overlaps a portion of the supply vessel route in the LAA)
- Snow crab conservation exclusion zones (overlaps a portion of the supply vessel route)
- Witless Bay Ecological Reserve and Witless Bay Islands IBA (overlaps the LAA)

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). Many of these special areas have been designated as part of larger integrative management efforts on a regional or even international scale to help ecological processes and features remain intact. Some designations have been established to help prevent further damage to sensitive areas that have already experienced adverse impacts.

Most 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. 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.

14.5.2 Potential Project-related Contributions to Cumulative Effects

Routine Project-related activities have the potential to affect the features of special areas which provide important ecological and biological functions for the species that use these areas. The primary pathways for effects on special areas include marine discharges, sound, and light emissions associated with the Project, including those that may result in direct interaction with and effects on the seabed and sensitive benthic organisms and habitat. Many of the offshore activities and associated disturbances will be localized, short-term and at a specific location. The implementation of mitigation measures will reduce direct or indirect effects on special areas identified for the presence of sensitive benthic habitats and marine species. Drilling sites will represent small areas of disturbance to benthic habitats within the extensive areas of marine environment of special areas in the offshore. Discharges, including drill cuttings, will be treated as per regulations and best practices prior to discharge. As such, the Project is not likely to result in significant adverse effects on the defining features of special areas that overlap with the Project Area.

Special areas within the LAA have also been identified based on the presence of sensitive benthic habitats and to a lesser extent on fish and fish habitat, birds, marine mammals and sea turtles, and commercial fisheries. Routine Project activities in the LAA (e.g., supply and servicing) will not result in direct contact with the seabed and will therefore not physically disturb benthic animals or their habitats. These activities will introduce light and sound that could result in temporary behavioural changes in marine species. However, the predicted environmental effects from planned Project activities on special areas in the LAA are also likely to be not significant.

The Project is not likely to result in a detectable adverse change in the valued habitat of special areas, resulting in a decrease in abundance of key species or community structure, nor will it result in the permanent and irreversible loss of critical habitat in the RAA.

The Project-specific environmental effects assessment for this VC includes a summary of residual environmental effects in Section 11.3 and a determination of significance in Section 11.4. Key mitigation proposed for biological VCs (e.g., Marine Fish and Fish Habitat, Marine and Migratory Birds, Marine Mammals and Sea Turtles) will also serve to help reduce adverse environmental effects on special areas.

14.5.3 Future Projects and Activities and Their Effects

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

14.5.4 Potential Cumulative Environmental Effects

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. 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. Special areas, whose boundaries overlap with the Project Area, may experience effects on habitat quality associated with marine discharges, sound, and light emissions, including those that may result in direct interaction with and effects on the seabed and sensitive benthic organisms and habitat. Many of these special areas also overlap with Project 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 Chevron, 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 species at risk and implementing an appropriate course of action in consultation with regulatory authorities to avoid or reduce adverse effects on these features. Collectively, these surveys will contribute to a better understanding of benthic features in the eastern NL offshore area. 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 in St. John’s) and proposed future exploration drilling projects. Therefore, there is potential for cumulative environmental effects on these special areas due to increased marine traffic.

Table 14.6 Special Areas: Residual Effects from Other Projects and Activities in the RAA

Physical Activity	Potential Residual Environmental Effect(s)	Explanation of Potential Residual Environmental Effect(s)	VC-specific Spatial and Temporal Considerations (Refer to Table 14.1 for General Consideration of Potential for Spatial and Temporal Overlap)
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 any of the special areas in the RAA and are therefore not expected to cause a change in habitat quality for special areas. • Operational discharges, underwater sound, and artificial night-lighting from 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 any of 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 this proposed 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. • All the 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 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 CEA. • 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

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

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 Indigenous Communities and Activities

14.6.1 Past and Ongoing Effects (Baseline)

The Indigenous Communities and Activities 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.

The EIS Guidelines identify 41 Indigenous groups in NL, Nova Scotia, New Brunswick, Prince Edward Island and Quebec that have the potential to be affected by Project activities. These communities hold commercial communal and/or food, social, and ceremonial (FSC) licenses in the RAA or for species that may migrate through the RAA. Species harvested for commercial communal purposes within the RAA (as defined for this VC) include lobster, groundfish (e.g., Atlantic and Greenland halibut, hake), eel, smelt, herring, mackerel, seal, shrimp, snow crab, toad crab, arctic char, tuna, swordfish, skate capelin, quahaug, clam, and whelk. Species harvested for FSC purposes in the RAA include gaspereau, trout, Atlantic salmon, bass, mackerel, eel, shad, groundfish, Arctic char, smelt, blue shark, cod, herring, redfish, capelin, mussel, clams, periwinkle, soft-shell clams, squid, tomcod, quahaug, razor clams, lobster, crab and scallops. Most of these FSC species would be harvested in the nearshore and/or freshwater systems although some species (e.g., Atlantic salmon, American eel) are anadromous and can potentially migrate through the Project Area. Several species of marine and migratory birds and eggs are also harvested by Indigenous communities including geese, ducks, loons, gulls, murres, mergansers and scoters. Species harvested for commercial or FSC purposes outside the Project Area may potentially interact with Project activities (planned or unplanned) during migration to traditional fishing or hunting grounds.

Other past and ongoing projects and activities in Eastern Canada have, to varying degrees, interacted with and affected Indigenous communities and activities, depending on their location, nature, and scale in

relation to the communities, activities, and other components and interests of individual Indigenous groups. Given the long and varied history of Indigenous peoples and different Indigenous communities in the region, it is not practical to attempt in this EIS to identify and describe how past and ongoing development projects and other processes and activities have influenced and otherwise affected Indigenous peoples. However, Section 7.4 presents an overview of current socio-economic characteristics and conditions of Indigenous communities that reflects past and ongoing effects. Where possible and applicable, Section 7.4 identifies how certain socio-economic components, such as traditional land use patterns, may have been influenced by previous and ongoing development activities and other factors.

14.6.2 Potential Project-related Contributions to Cumulative Effects

As described in Chapter 13, there are no pathways of effects from routine Project activities to changes in structures, sites or things or historical, archaeological, paleontological, or architectural significance due to the offshore location of the Project and localized extent of routine Project interactions. Given the distance of the Project offshore and the limited geographic extent of predicted atmospheric and marine discharges arising from routine Project activities, effects from routine activities are unlikely to affect the physical or social health and well-being of Indigenous communities except potentially indirectly as a result of effects on commercial communal or FSC fishing, hunting, or other harvesting activities. The Project could potentially affect commercial communal fisheries resources by direct or indirect effects on fished species or through effects on fishing activity (e.g., displacement from fishing areas, gear loss or damage, availability of fisheries resources). Although there is no known FSC fishing or harvesting taking place in the Project Area, routine Project activities could interact with migratory fish, bird or mammal species that may be harvested by Indigenous communities from onshore / nearshore harvesting sites. Adverse effects on fishing or harvesting activities could potentially affect Aboriginal and treaty rights and indirectly lead to changes in health and socio-economic conditions or cultural heritage of affected Indigenous communities.

The Project-specific environmental effects assessment for this VC includes a summary of Project residual environmental effects in Section 12.3.4 and a determination of significance in Section 12.4. Key mitigation focuses on effective communication with Indigenous communities throughout the life of the Project and implementation of a compensation program to compensate for damages resulting from Project activities. Routine Project activities are predicted to have a low to negligible adverse environmental effect on health and socio-economic conditions and a low to negligible adverse environmental effect on current use of lands and resources for traditional purposes. Project effects on Indigenous communities and activities are predicted to be not significant.

14.6.3 Future Projects and Activities and Their Effects

Table 14.7 summarizes how ongoing 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 14.7 Indigenous Communities and Activities: Residual Effects from Other Projects and Activities in the RAA

Physical Activity	Potential Residual Environmental Effect(s)	Explanation of Potential Residual Environmental Effect(s)	VC-specific Spatial and Temporal Considerations (Refer to Table 14.1 for General Consideration of Potential for Spatial and Temporal Overlap)
Current Offshore Petroleum Production Projects (Production from Hibernia, Terra Nova, White Rose, and Hebron Oilfields)	• Change in health and socio-economic conditions • 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 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 of 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. • 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.	• Commercial communal fishing activity has been, and will continue to be, excluded within the safety 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 health and socio-economic conditions • Change in the current use of lands and resources for traditional purposes	• Effects from this proposed 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 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 health and socio-economic conditions • Change in the current use of lands and resources for traditional purposes	• It may become necessary for communal commercial fishers to exert a higher level of effort to achieve the same catch during seismic operations, either due to the temporary displacement of target fish species because of underwater sound from the air source array, or due to the temporary displacement of fishing vessels to accommodate seismic vessels and streamers, either of which could affect catch rates or otherwise cause a change in availability of fisheries resources for commercial communal fisheries. • Although relatively little is known about the potential effects of seismic sound on marine and migratory birds, and the limited information that is available has not provided strong evidence of adverse effects (AMEC 2014), it is conservatively assumed for the purposes of the CEA that seismic sound from air source arrays will affect the quality of the underwater acoustic environment in such a way that has potential to disturb marine and migratory birds and cause temporary behavioural and/or physiological effects to individuals diving in proximity to the sound source (AMEC 2014), potentially including species harvested for traditional purposes. • Air source array operations during seismic surveys will affect the quality of the underwater acoustic environment in such a way that has potential to disturb seals and cause temporary behavioural effects and/or physiological effects (AMEC 2014), potentially including species harvested for commercial communal or traditional purposes. • The transiting of survey-related vessels has potential to cause mortality of marine mammals (including seals) 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 14.7 Indigenous Communities and Activities: Residual Effects from Other Projects and Activities in the RAA

Physical Activity	Potential Residual Environmental Effect(s)	Explanation of Potential Residual Environmental Effect(s)	VC-specific Spatial and Temporal Considerations (Refer to Table 14.1 for General Consideration of Potential for Spatial and Temporal Overlap)
Offshore Petroleum Exploration – Exploration and Delineation Drilling Programs	• Change in health and socio-economic conditions • Change in the current use of lands and resources for traditional purposes	• Offshore petroleum exploration drilling projects have localized effects on access to species of interest for Indigenous fishers and harvesters due to the establishment of 500 m radius safety zones around their MODUs. • 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. • 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.	• Residual effects from other exploration drilling programs are generally anticipated to be similar in nature and extent (including similar spatial and temporal scales) to predicted Project-related residual environmental effects on Indigenous peoples and community values (refer to Chapter 12). • Exploration drilling activities are typically relatively short-term and localized. This can reduce the potential for individuals and populations of species of importance to Indigenous fishers / harvesters to be affected simultaneously and repeatedly by multiple physical activities.
Commercial Fishing Activity	• Change in health and socio-economic conditions • 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 health and socio-economic conditions • 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 health and socio-economic conditions • Change in the current use of lands and resources for traditional purposes	• If the species of interest to Indigenous harvesters are not harvested sustainably, the residual environmental effects of present hunting activity in the RAA could cause a change in the use of lands and resources for traditional purposes for future Indigenous harvesters due to resource depletion. • Potential effects associated with the presence and transiting of hunting vessels, including associated emissions and discharges, are equivalent to the potential effects associated with the vessels of other ocean users in the RAA and are therefore not considered separately in the CEA.	• Although hunting is 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			

14.6.4 Potential Cumulative Environmental Effects

Potential cumulative environmental effects on Indigenous communities and activities may result in changes to health and socio-economic conditions and current use of lands and resources for traditional purposes, primarily related to resource use conflicts as per the following mechanisms:

- temporary displacement of commercial fishers from their customary fishing grounds due to establishment of a 500-m radius safety zone around the Project MODU, as well as the various safety zones associated with other exploration drilling projects and existing and proposed production projects (recognizing safety zones associated with exploration projects are short-term compared to longer term safety zones established for production projects)
- restriction of fishing activities in fisheries closure areas (e.g., snow crab exclusion zones, marine refuges, NAFO VMEs) resulting in 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 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])

Several offshore petroleum exploration drilling programs are proposed to be carried out in the RAA within a similar timeframe as the Project (refer to Table 14.3), in addition to existing and proposed production projects. A 500-m radius safety zone will be established around the Project MODU, within which Indigenous fisheries and harvesting activities will be excluded while the MODU is in operation. This will amount to the localized exclusion of fisheries within an area of approximately 0.8 km² for up to 180 days for each of the wells to be drilled in the Project Area. The safety zones associated with other offshore petroleum exploration and production drilling projects will increase the cumulative area that will be temporarily unavailable to Indigenous fishers and harvesters at any given time during Project activities. Table 14.2 shows nine additional exploration drilling projects which could occur during the timeframe of this Project. For the purpose of this assessment, it is assumed that each of these exploration projects would institute a 500-m radius safety 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 zones associated with existing production projects in the RAA.

Another factor that may contribute to potential space-use conflicts among Indigenous commercial communal fishers is the restriction of certain fishing activities within various special areas in the RAA, including 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). 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 17% (287,038 km² excluding overlap of areas) of the RAA. Figure 14-3 shows the cumulative areas where fishing activity is restricted due to existing safety zones and

fisheries closure areas; this figure does not show safety zones that would be associated with proposed exploration drilling projects as specific timing and location of wells is not known.

These cumulative fishing restrictions are not anticipated to affect current land and resource use for traditional purposes but will require planning and ongoing communication to avoid adverse effects on commercial communal fisheries that may occur in the RAA and associated health and socio-economic conditions in Indigenous communities.

In addition to the safety zones associated with offshore petroleum exploration and development, 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 that could cause a change in commercial communal fisheries or change in land and resource use for traditional purposes as a result of space-use conflicts.

Project supply vessels are not expected to contribute to space-use conflicts with fishing vessels, as existing shipping lanes will be used as practicable when travelling between the MODU and the supply base in St. John's, and 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.

Indigenous fishers / harvesters that experience a change in access to their customary fishing / harvesting areas as a result of the Project in combination with other physical activities in the RAA may be required to temporarily relocate their fishing / harvesting effort. This could put additional pressure on nearby fishing / harvesting areas, and fishers / harvesters may be adversely affected by the resultant competition for remaining fishing / harvesting areas in the RAA. This could result in a cumulative change in commercial communal fisheries or change in land and resource use for traditional purposes either of which could adversely affect health and socio-economic conditions in Indigenous communities.

The level of fishing / harvesting effort within and surrounding the Project Area is relatively low. The Project Area does not include any unique fishing / harvesting grounds or concentrated fishing / harvesting effort that occurs exclusively within the Project Area, nor is it likely to represent a substantial portion of a customary fishing / harvesting area for an Indigenous fisher / harvester. The potential for temporary loss of access to preferred fishing / harvesting grounds as a result of the Project is therefore anticipated to be negligible and is unlikely to have any discernable effect on the overall distribution of fishing / harvesting effort within the RAA.

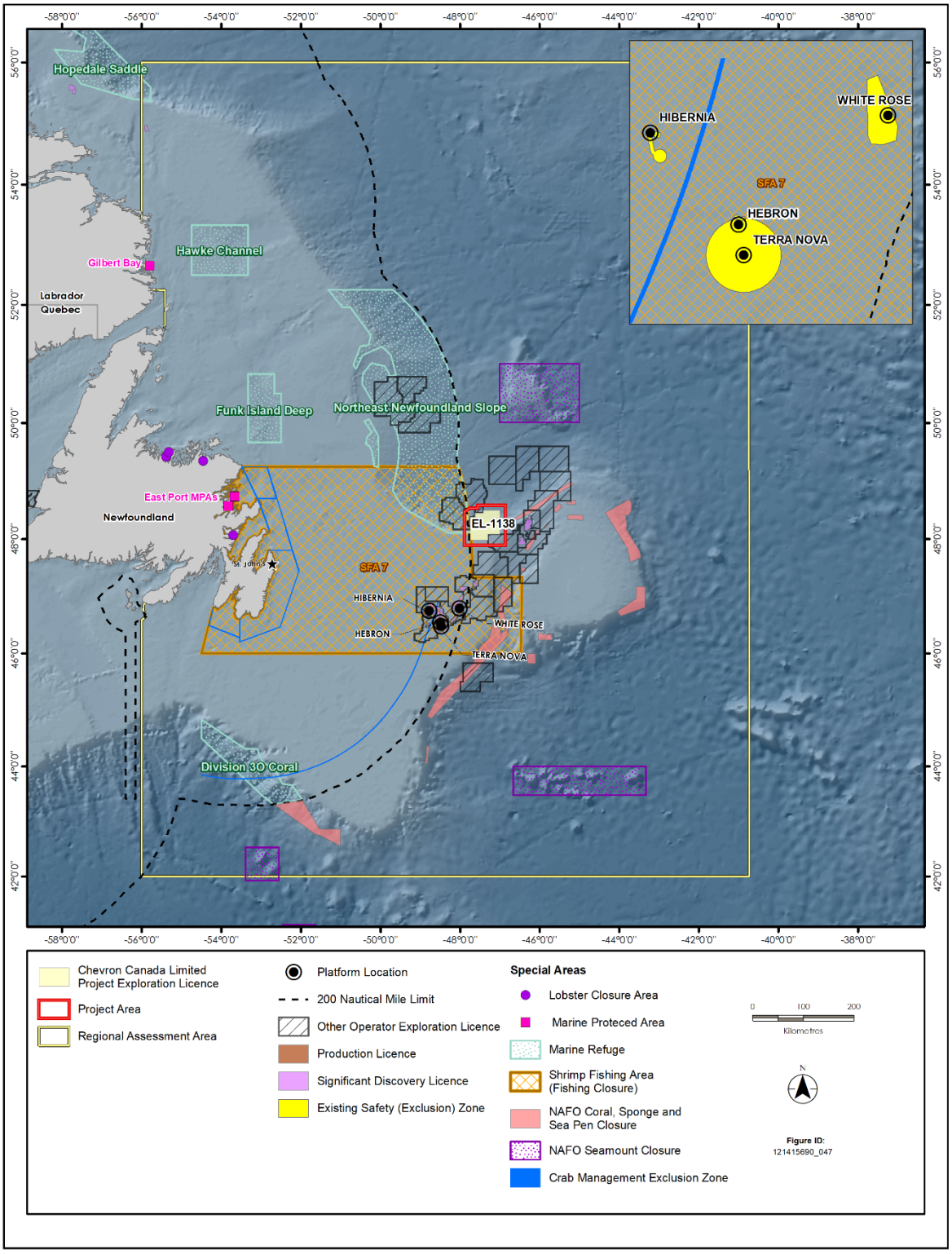


Figure 14-3 Established Safety Zones and Fisheries Closure Areas in the RAA

All physical activities within the RAA have some potential to inadvertently result in damage to fishing gear. The Project contributes to a potential cumulative change in commercial communal fisheries within the RAA due to potential incidents of gear loss or damage. Project-related damage to fishing gear, if any, will be compensated in accordance with the Compensation Guidelines with Respect to Damages Relating to Offshore Petroleum Activity (C-NLOPB and Canada-Nova Scotia Offshore Petroleum Board [CNSOPB] 2017). Other offshore operators would have similar compensation plans to be implemented in the event of gear loss or damage.

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. Chevron (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.

Cumulative effects on marine resources (e.g., fish, mammals, marine birds) harvested for commercial communal and/or FSC purposes have been evaluated in Sections 14.2, 14.3, and 14.4 and found to be not significant. Cumulative adverse effects on marine species that could be considered important from a commercial, 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.

14.6.5 Cumulative Effects Summary and Evaluation

The Project may result in a negligible to low residual adverse effect on health and socio-economic conditions (related primarily to effects on commercial communal and/or FSC fisheries) and change in current use of lands and resources for traditional purposes. These residual effects 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 communities and activities. Historically, commercial fishing has had a substantial influence on the fisheries resource availability for Indigenous fisheries, although this is managed through the use of various best practices and regulatory tools including quotas and closures.

14.6.6 Conclusion

With the application of proposed Project-related mitigation and environmental protection measures, standard practices for communication among marine users, 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 communities and activities are predicted to be not significant. No additional mitigation measures are proposed to address potential cumulative effects.

14.7 Commercial Fisheries and Other Ocean Users

14.7.1 Past and Ongoing Effects (Baseline)

Domestic commercial fishing occurs throughout the RAA, from the bays surrounding the Avalon Peninsula, along the Grand Banks, within the Flemish Pass and contouring along the slopes of the Grand Bank and the Newfoundland and Labrador Slopes. Historically most of the domestic fishing activity (77%) in the offshore region of NL was for groundfish species (e.g., Atlantic cod and American plaice). However, the collapse of several groundfish stocks subsequently led to a moratorium on cod, American plaice, and several other groundfish species. This resulted in an increase in shrimp and crab fishing to supplement losses. In recent years however, the viability of shrimp and crab stocks are being questioned (DFO 2018b; DFO 2018c), with declines in reported catch weight (see Figure 7-3 in Section 7.2.2).

Species that are important for current commercial fishing activity in the RAA and/or show trends indicating potential to be fished within the RAA during the lifetime of the Project include snow crab, Northern shrimp, Greenland halibut (turbot), Atlantic halibut, Atlantic cod, American plaice, redfish, and Arctic surf clams.

The Project Area intersects Unit Areas 3Le and 3Li within NAFO Division 3L. Only 10.2% of the Project Area overlaps the Canadian EEZ; approximately 89.8% of the Project Area is within the NAFO Regulatory Area and approximately 52% of the Project Area overlaps with the NAFO Footprint (portion of the NAFO Regulatory Area where most bottom fishing activity has historically occurred) (NAFO 2019). Dominant species harvested within 3Le and 3Li include Greenland halibut (turbot), northern shrimp, and snow crab. From 2013 to 2017, the total catch weight in Unit Areas 3Le and 3Li decreased 25% from 3,868 tonnes to 2, 885 t. During the same time period, the value increased from $15, 810,110 to $27, 511, 528. The decrease in weight was primarily due to a decrease in northern shrimp catch in 2013 and 2014, followed by an absence of commercial fishing of northern shrimp in 2015 and 2016. Starting in 2016, Shrimp Fishing Area 7, which overlaps with NAFO Division 3L, was closed to shrimp fishing. The lack of shrimp fishing saw an increase in the catch weight and value of snow crab. Within the Project Area itself, domestic commercial fishing activity is primarily dominated by groundfish harvesting in the southern portion of the Project Area.

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 17% (287,038 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).

The offshore area of NL also hosts a range of other human-related activities that may interact with Project-related activities within the RAA and Project Area. These are discussed in Section 7.3 and include marine research, shipping related activities, military operations, other offshore oil and gas projects, and marine infrastructure. There is potentially one active subsea cable that intersects with the Project Area and appears to intersect EL 1138.

14.7.2 Potential Project-related Contributions to Cumulative Effects

Routine Project activities have the potential to interact directly and indirectly with commercial fisheries resources. Direct interactions can include displacement from fishing grounds and loss or damage to gear. Indirect interactions include those that may result in physical or behavioural effects on commercially fished species, such as changes in fish health or quality, fish avoiding popular fishing grounds due to underwater sound, or changes in water quality. These direct and/or indirect effects have the potential to result in economic loss to commercial fisheries. For other human components and activities, behavioural effects on fish could indirectly affect research activities, and oil and gas activities may also limit certain areas for research or military exercises, which may result in changes in schedules, or relocation of vessels to alternate areas.

The Project-specific environmental effects assessment for this VC includes a summary of residual environmental effects in Section 13.3.4 and a determination of significance in Section 13.4. Key mitigation focuses on effective communication with commercial fisheries and other ocean users throughout the life of the Project and implementation of a compensation program to compensate for gear damage resulting from Project activities. With the implementation of proposed mitigation, Project effects on commercial fisheries and other ocean users are predicted to be not significant.

14.7.3 Future Projects and Activities and Their Effects

Table 14.8 summarizes how ongoing and future projects and activities in the RAA have potential to cause a residual change in resource availability affecting commercial fisheries and other ocean users.

14.7.4 Potential Cumulative Environmental Effects

Similar to the cumulative effects assessed for Indigenous communities and activities, the following cumulative environmental effect mechanisms are also applicable with respect to commercial fisheries and other ocean users:

- Temporary displacement of commercial fishers from their customary fishing grounds due to establishment of a 500-m radius safety zone around the Project MODU, as well as the various safety zones associated with other exploration drilling projects and existing and proposed production projects (recognizing safety zones associated with exploration projects are short-term compared to longer term safety 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 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])

Table 14.8 Commercial Fisheries and Other Ocean Users: Residual Effects from Other Projects and Activities in the RAA

Physical Activity	Potential Residual Environmental Effect(s)	Explanation of Potential Residual Environmental Effect(s)	VC-specific Spatial and Temporal Considerations (Refer to Table 14.1 for General Consideration of Potential for Spatial and Temporal Overlap)
Current Offshore Petroleum Production Projects (Production from Hibernia, Terra Nova, White Rose, and Hebron Oilfields)	• Change in availability of resources	• Offshore petroleum production projects have localized effects on access to commercial fisheries resources and exclude access to offshore areas by other ocean users due to the establishment of safety zones around their production facilities and associated infrastructure. • Offshore petroleum production projects also cause environmental effects on fish and fish habitat (including for commercial fisheries resources) due to the generation of underwater sound and water quality effects associated with discharges. However, these environmental effects on fish and fish habitat are generally not expected to be of sufficient magnitude, duration, or extent to affect catch rates or otherwise cause a change in availability of resources.	• Commercial fishing activity and the activities of other ocean users has been, and will continue to be, excluded within the safety 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	• Effects from this proposed 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 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	• 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	• Offshore petroleum exploration drilling projects exclude access to commercial fisheries and other ocean users due to the establishment of 500-m radius safety zones around their MODUs. • Underwater sound emissions will also be generated as a result of the presence and operation of MODUs during drilling, testing and abandonment, which may cause commercial fisheries resources to temporarily avoid areas around the safety zone of the MODUs, particularly during start-up of drilling or VSP underwater sounds. Underwater sound emissions from exploration drilling also have potential to interfere with scientific research and military activities, depending on the nature of these activities. • The discharge of drill muds and cuttings may interact with marine species within a localized area as a result of sedimentation and localized changes in water quality, thereby affecting availability of commercial fisheries resources. However, these effects would primarily be expected to occur within the safety zone of the MODU, which excludes commercial fishing and other activities anyway. • Other discharges and emissions (including drilling and testing emissions) will result in temporary and localized effects on water quality around exploration 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 users (refer to Chapter 13). • Exploration drilling activities are typically relatively short-term and localized. This can reduce the potential for individuals and populations of commercially important species to be affected simultaneously and repeatedly by multiple physical activities.

Table 14.8 Commercial Fisheries and Other Ocean Users: Residual Effects from Other Projects and Activities in the RAA

Physical Activity	Potential Residual Environmental Effect(s)	Explanation of Potential Residual Environmental Effect(s)	VC-specific Spatial and Temporal Considerations (Refer to Table 14.1 for General Consideration of Potential for Spatial and Temporal Overlap)
Fishing Activity	• Change in availability of resources	• Under a relevant licence, commercial fisheries can be carried out in any NAFO Division and Unit Area in the RAA and thus have potential to cause a change in availability of fisheries resources for competing commercial fisheries in the RAA (e.g., through displacement of competitors from their preferred fishing grounds). • If fisheries resources are not harvested sustainably, the residual environmental effects of present fishing activity in the RAA could cause a change in availability of fisheries resources for future commercial fishers due to decreased catch rates as well as resource depletion. • Fisheries also cause localized environmental effects on fish and fish habitat due to the generation of underwater sound and water quality effects associated with discharges. However, these environmental effects on fish and fish habitat are generally not expected to be of sufficient magnitude, duration, or extent to affect catch rates or otherwise cause a change in availability of fisheries resources for commercial fisheries.	• Various commercial fishing activities have potential to overlap spatially and temporally in the RAA and Project Area.
Other Ocean Uses	• Change in availability of resources	• 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 CEA.	• Not applicable
Source: Modified from BP 2018			

Cumulative effects on marine fish (including commercial species) are 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 (refer to Section 14.2). The analysis of cumulative environmental effects provided in Sections 14.6.4 relating to Indigenous commercial communal fisheries is also directly applicable for commercial fishers and other ocean users. That section should be referred to for the assessment of potential cumulative effects related to a change in availability of resources.

Standard practices for communication among marine users, including the issuance of Notices to Mariners and Notices to Shipping (as appropriate), is expected to mitigate potential conflicts with fisheries as well as other ocean users. During the drilling program, Chevron will implement a Fisheries Communication Plan which will provide a framework for regular operational updates to fisheries stakeholders as well as emergency notifications if needed. Ongoing implementation of the One Ocean Consultation Protocol (One Ocean 2013) by Chevron 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.

Chevron will also conduct an imagery-based seabed pre-drill survey at each well site to confirm the avoidance of subsea infrastructure (e.g., cables, UXOs, shipwrecks). This is standard practice for the industry that is expected to reduce the risk of potential damage to active subsea cables and other subsea infrastructure.

14.7.5 Cumulative Effects Summary and Evaluation

The Project is predicted to result in residual adverse environmental effects that are considered to be low in magnitude, located within the Project Area and LAA, short-term in duration (with the exception of well abandonment), occurring at irregular intervals, reversible (with the exception of well abandonment), and primarily occurring within a disturbed ecological and socio-economic setting (presence of some commercial fishing activity and offshore research).

14.7.6 Conclusion

With the application of proposed Project-related mitigation and environmental protection measures, the Project's contribution to cumulative effects is low and the residual cumulative environmental effects on commercial fisheries and other ocean users are predicted to be not significant. With the application of standard practices for communication among marine users, including Notices to Shipping, Notices to Mariners, and fisheries communication plans implemented by other offshore petroleum operators in the eastern Newfoundland offshore area, it is concluded that no additional mitigation measures are needed to address potential cumulative effects.

14.8 Mitigation, Monitoring and Follow-up

Mitigation, monitoring and/or follow-up programs that have been identified and described for VCs as part of the Project-specific environmental effects assessment (Chapters 8 to 13) would be relevant to cumulative environmental effects, in that they are relevant to the Project's potential contribution to cumulative environmental effects in the region. 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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