Tilt Cove Exploration Drilling Program

Chapter 10: Marine and Migratory Birds VC

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April 2023

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10.0 ASSESSMENT OF POTENTIAL EFFECTS ON MARINE AND MIGRATORY BIRDS

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

The Grand Banks and adjacent waters are characterized by high biomass production and are populated by large numbers of marine birds in every season of the year (Lock et al. 1994; Fifield et al. 2009). Several million marine birds breed in nesting colonies along the eastern and northeastern coasts of Newfoundland, and forage on the Grand Banks or adjacent waters during the nesting season and post-breeding dispersal. Non-breeding seabirds are also present in the RAA during summer. Most great shearwaters (*Puffinus gravis*) and large numbers of sooty shearwater (*Ardenna grisea*) arrive in the RAA after nesting in the South Atlantic. In autumn seabirds arrive from breeding grounds in Canada’s eastern Arctic and sub-Arctic and from both eastern and western Greenland to overwinter in the RAA. Immature birds, largely northern fulmar (*Fulmarus glacialis*) and black-legged kittiwake (*Rissa tridactyla*; also included on the IUCN Red List of Threatened Species), hatched in the same Arctic colonies remain in the RAA during the summer after the adults have returned to the Arctic in spring. In late summer and fall, various species of shorebirds (plovers and sandpipers) depart Arctic nesting grounds to embark on trans-oceanic migratory flights from eastern North America to South America (Williams and Williams 1978; Richardson 1979), some of which may traverse the RAA. SAR designated on provincial or federal lists that may occur in the RAA or the Project Area consist of harlequin duck (*Histrionicus histrionicus*), Barrow’s goldeneye (*Bucephala islandica*), piping plover (*Charadrius melodus*), red knot (*Calidris canutus*), buff-breasted sandpiper (*Tryngites subruficollis*), red-necked phalarope (*Phalaropus lobatus*), ivory gull (*Pagophila eburnea*), Ross’s gull (*Rhodostethia rosea*), and peregrine falcon (*Falco peregrinus*). Five additional species are included on the IUCN Red List of Threatened Species: long-tailed duck (*Clangula hyemalis*), black-legged kittiwake, Leach’s storm-petrel (*Hydrobates leucorhous* [*Oceanodroma leucorhoa*]), Bermuda petrel (*Pterodroma cahow*), Zino’s petrel (*Pterodroma madeira*), and Desertas petrel (*Pterodroma deserta*). The Project Area is on the periphery of some of these species’ distributions or migratory routes. However, they have been documented in the Project Area on rare occasion. Other shorebird and landbird SAR in NL 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 IBAs and Convention on Biodiversity EBSAs are included as special areas.

10.1 SCOPE OF ASSESSMENT

10.1.1 Regulatory and Policy Setting

Most migratory and some non-migratory birds are protected under the MBCA, which is within the jurisdiction of Environment and Climate Change Canada (ECCC). The MBCA and attendant regulations cover all bird species listed in the Canadian Wildlife Service (CWS) Occasional Paper No. 1, Birds Protected in Canada under the MBCA. Species protected by the MBCA include most marine-associated birds (except cormorants and pelicans), all waterfowl, all shorebirds, and most landbirds (birds with principally terrestrial life cycles). Bird species (and other wildlife) not protected federally (e.g., cormorants), are protected under the NL *Wildlife Act*. The MBCA and its regulations prohibit persons from disturbing, destroying, or taking/having in their possession a migratory bird (alive or dead) or part thereof, or its nest or eggs, except under authority of a permit. Section 5.1 of the MBCA comprises prohibitions against releasing substances that are harmful to migratory birds: "No person or vessel shall deposit a substance that is harmful to migratory birds, or permit such a substance to be deposited, in waters or an area frequented by migratory birds or in a place from which the substance may enter such waters or such an area".

To encourage conformity with the MBCA and reduce the risk of incidental take of migratory birds, nests and eggs, ECCC has published Avoidance Guidelines (ECCC 2017a). A permit is required under the MBCA and *Migratory Bird Regulations* to authorize the capture and handling of migratory birds. The 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.

SAR include all species that appear on Schedule 1 of the federal SARA as endangered, threatened, or of special concern; or listed under the NL ESA as endangered, threatened, or vulnerable. 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 migratory birds.

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

The NL ESA protects species listed as endangered, threatened, or vulnerable under the Act, and their core habitat. The conservation and recovery of species assessed and listed under the NL ESA is coordinated by the Wildlife Division of the Newfoundland and Labrador Department of Fisheries, Forestry and Agriculture.

10.1.2 The Influence of Consultation and Engagement on the Assessment

During Suncor's Project-related engagement with government departments and agencies, stakeholder organizations and Indigenous groups questions and comments about marine and migratory birds were documented (see Chapter 3 for further details). These primarily include concerns regarding adverse effects from both routine operations and accidental events on migratory bird species. Potential adverse effects to migratory birds were noted by the Indigenous communities. Indigenous groups wanted to see monitoring and follow-up programs, including research and data collection related to impacts on Indigenous groups, marine birds.

10.1.3 Potential Effects, Pathways and Measurable Parameters

Routine Project activities and components have potential to interact with migratory birds and their associated habitat as a result of the attraction by nocturnally-active birds to the artificial light emitted by the MODU and supply vessels, operational discharges during well drilling, underwater sound emissions from VSP operations, emissions during well testing operations, and interactions with supply vessels and helicopter activities during supply and servicing.

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

- 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 artificial light levels different weather conditions and seasons
- Physical displacement because of vessel presence (e.g., disruption of foraging activities)
- Exposure to 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)
- Well testing and flaring
- 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 10.1. Effects of accidental events are assessed separately in Section 16.5.2.

Table 10.1 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

10.1.4 Boundaries

Spatial and temporal boundaries for the assessment for marine and migratory birds are described in the sections below.

10.1.4.1 Spatial Boundaries

Project Area: The Project Area (Figure 10-1) encompasses the immediate area within which Project activities and components may occur. Specific well locations have not been identified but will occur within EL 1161. A 40 km buffer around the perimeter of EL 1161 defines the Project Area.

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 the transit route (with a 10 km buffer).

Regional Assessment Area (RAA): The RAA (Figure 10-1) is the area within which residual environmental effects from Project activities and components may interact cumulatively with the residual environmental effects of other past, present, and future (i.e., certain or reasonably foreseeable) physical activities. Although the RAA is intended to be much broader than the LAA, which focuses on the extent of potential effects associated with routine Project activities for marine and migratory birds, it is possible that effects from larger scale unplanned events (e.g., blowout) could extend beyond the RAA.

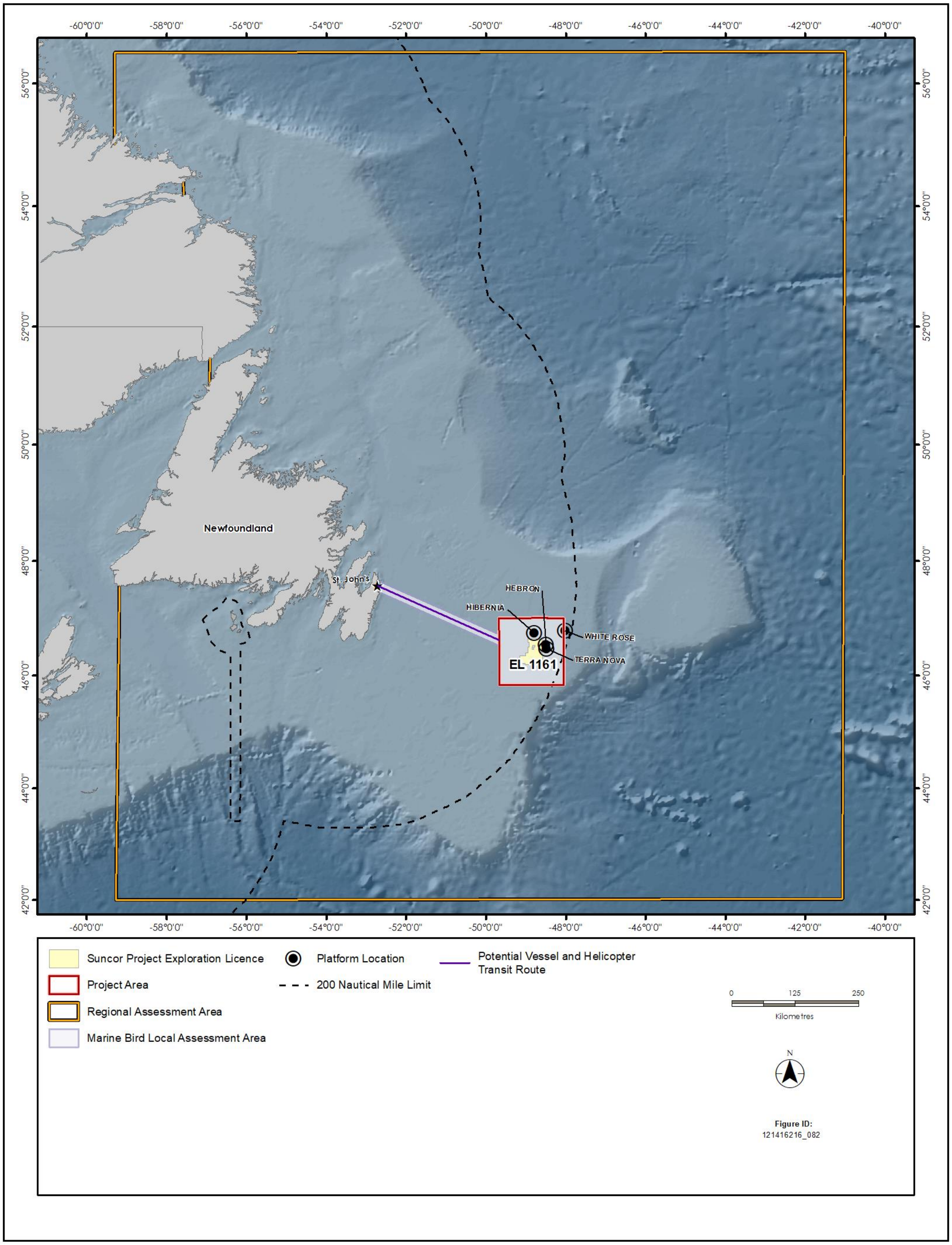

Figure 10-1 Marine and Migratory Birds LAA

10.1.4.2 Temporal Boundaries

Suncor is proposing to drill 12 to 16 wells exploration and delineation / appraisal wells on EL 1161 over the temporal scope of the Project, with an initial well proposed for as early as Q2 2024, pending regulatory approval (activities may occur any time over the lease period). The drilling of each well is expected to take 45 to 120 days and drilling activities may occur year-round. The temporal scope of the Project extends to end of 2029 to cover off activities that could carry over following the last year of the EL.

Some species of marine and 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.

10.1.5 Residual Effects Characterization

The definitions used to characterize environmental effects in this assessment for marine and migratory birds are provided in Table 10.2. 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 16.5.2.

Table 10.2 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 – 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 10.2 Characterization of Residual Effects on Marine and Migratory Birds

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 return 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

10.1.6 Significance Definition

In consideration of the descriptions in Table 10.2, as well as consideration of requirements under MBCA, SARA, NL ESA, and associated regulations and recovery plans, the following threshold has been established to define a significant adverse residual environmental effect on marine and migratory birds.

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

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

10.2 PROJECT INTERACTIONS WITH MARINE AND MIGRATORY BIRDS

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 check mark and are discussed in detail in Section 10.4, in the context of effects pathways, standard and project-specific mitigation/enhancement, and residual effects. A justification for no effect is provided following Table 10.3.

Table 10.3 Project-Environment Interactions with Marine and Migratory Birds

Physical Activities	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)	✓	✓
Geophysical (including VSP), Geological, Geotechnical, and Environmental Surveys	✓	✓
Discharges (e.g., drill muds / cuttings, liquid discharges)	✓	✓
Well Testing and Flaring (including air emissions)	✓	✓
Well Decommissioning, Suspension and Abandonment	✓	✓
Supply and Servicing Operations (including helicopter transportation and Project supply vessel operations)	✓	✓

10.3 ASSESSMENT OF RESIDUAL ENVIRONMENTAL EFFECTS ON MARINE AND MIGRATORY BIRDS

The following section assesses the environmental effects on marine and migratory birds identified as arising from potential interactions with Project activities (Table 10.3). Given the similarities in Project description, proximity of activities on Orphan Basin and Flemish Pass, and currency of data, the EIS incorporates information from recent EA documents for exploration drilling projects by ExxonMobil (2017), Statoil (2017), BP (2018), Chevron (2020), and BHP (2020) in Flemish Pass and Orphan Basin, including comments received during Indigenous and stakeholder review processes, with updates incorporated as applicable.

10.3.1 Change in Risk of Mortality or Physical Injury

10.3.1.1 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. Some of these species are known to concentrate around drilling and production platforms as a result of artificial lighting at night, food, and other visual cues. This attraction to platforms potentially makes marine and migratory birds vulnerable to increased risk of mortality due to physical strikes with structures, stranding on the MODU or supply vessels, predation by other marine bird species, and incineration from flares [if well testing and flaring is required for reservoir evaluation; see Section 10.3.1.2] (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, 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.

10.3.1.2 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.

- Lighting will be reduced on the MODU and supply vessels 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.
- Suncor, 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 (ECCC 2020; ECCC-CWS 2021). 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). Suncor will provide training in these protocols and procedures. A Seabird Handling Permit will be obtained from ECCC-CWS annually. In accordance with ECCC requirements, an annual report and all occurrence data that summarizes stranded and/or seabird handling occurrences will be submitted to ECCC.
- 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 11.3.1.2). Although these mitigation measures are primarily designed to reduce the risk of injury to marine mammals, implementation of a ramp-up procedure (as described in Section 11.3.1.2) 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 9.3.1.2).
- Suncor intends the primary means of formation evaluation to be via wireline methods, which do not require flaring. However, if well testing and flaring is required for reservoir evaluation, Suncor 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 well hydrocarbon potential and as necessary for the safety of the operation, minimizing flaring during periods of migratory bird vulnerability, and the use of a water curtain to deter birds from the general vicinity of the flare.
- 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 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 (Government of Canada 2018). Specific details will be provided in the EPP.

10.3.1.3 Characterization of Residual Project-related Environmental Effects

10.3.1.3.1 Presence and Operation of a MODU

The most important potential interactions between marine and migratory birds and the presence and operation of a MODU result from the attraction of nocturnally-active birds to artificial lighting at night on platforms. This phenomenon can result in mortality in some species as a result of stranding, collisions, predation and exposure to other vessel-based threats. Experts on North Atlantic seabirds rank light pollution as the human activity with the third highest risk of negative impacts on seabirds in Atlantic Canada waters, following fisheries by-catch and oiling (Lieske et al. 2019).

Marine and migratory bird attraction to coastal and offshore lighting at night has been widely reported, but the underlying mechanisms are poorly known (Imber 1975; Wiese et al. 2001; Gauthreaux and Belser 2006; Montevecchi 2006; Montevecchi et al. 2009; Bruinzeel and van Belle 2010; Rodríguez et al. 2015; Ronconi et al. 2015; Adams et al. 2019). Attraction of nocturnally-active birds may result in direct mortality or injury through collisions with facility infrastructure, predation, or through stranding on the platform (i.e., birds are unable to regain flight and die from dehydration, starvation or hypothermia) (Baird 1990; Montevecchi et al. 1999; Wiese et al. 2000; LGL 2017). Bruinzeel and van Belle (2010) reported that most terrestrial bird mortality on offshore platforms was due to collision. Disoriented birds may also circle around lights for long periods of time, depleting energy resources, delaying foraging or migration, and potentially increasing their exposure to predation (Bourne 1979; Sage 1979; Wiese and Montevecchi 1999; Wiese et al. 2001; Jones and Francis 2003; Bruinzeel and van Belle 2010; Rodríguez et al. 2014; 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). In contrast, when artificial light was introduced at an active nesting colony of manx shearwaters, a marine bird, fewer shearwaters were counted in flight above the colony, suggesting that breeding adults were repelled by the artificial light rather than attracted (Syposz et al. 2021). Fewer shearwaters were counted in flight when using a bright light than a dim one (Syposz et al. 2021). Longer duration illuminations resulted in fewer birds in flight above the colony than shorter durations, except when a dim light was used. These results were found both at a site with no human access and at a site with occasional human access.

Marine bird attraction to artificial lighting has been recorded throughout the year but occurs most commonly at the end of the nesting season (Telfer et al. 1987; Le Corre et al. 2002; Miles et al. 2010). In the NL offshore area, most strandings of Leach's storm-petrels on drilling and production platforms and geophysical vessels occur from mid-September to mid-October, when the young fledge and the adults abandon nesting colonies (LGL 2017). In other species, when the age of the grounded seabirds has been determined, most individuals are recently fledged juveniles, especially those stranding near seabird nesting colonies, suggesting that juvenile inexperience contributes to attraction to artificial lighting (Imber 1975; Telfer et al. 1987; Wiese et al. 2001; Gauthreaux and Belser 2006; Poot et al. 2008; Rodríguez and Rodríguez 2009; Miles et al. 2010; Rodríguez et al. 2015). Atchoi et al. (2020) proposed that the propensity for recently fledged young seabirds to strand as a result of artificial light may be due to their eyes not having achieved emmetropia. This is the ability of the eye to produce a well-focused image, which is attained after a period of visual stimulation. In burrow-nesting seabird species this visual stimulation does not occur until the young leave the dark burrow. Visual development has not been studied in seabirds, but in terrestrial species emmetropia is achieved after one to two weeks of visual exposure. The avoidance of artificial light by breeding Manx Shearwaters at an active nesting colony found by Syposz et al. (2021) (discussed above) is consistent with the avoidance of active colonies on moonlit nights by breeding adults of several species of shearwaters and petrels. This behaviour is thought to be an adaptation to the risk of higher predation on adults on moonlit nights.

Many nocturnally-active bird species navigate using visual cues; therefore, some authors suggest that artificial lights are being mistaken for celestial cues (Wiese et al. 2001; Gauthreaux and Belser 2006; Poot et al. 2008). Alternatively, nocturnally-foraging seabirds such as shearwaters and storm-petrels may mistake the reflection of lights on the sea surface for bioluminescent prey (Imber 1975; Wiese et al. 2001; Gauthreaux and Belser 2006; Poot et al. 2008).

Meteorological conditions and the phases of the moon are believed to influence the degree of bird attraction to artificial lighting. Reed et al. (1985) found that full moon conditions decrease attraction to lights, although the exact reason for this was not fully understood. Several studies reported that marine bird strandings peak when moonlight levels are lowest (i.e., around the time of the new moon) (Telfer et al. 1987; Rodríguez and Rodríguez 2009; Miles et al. 2010; Wilhelm et al. 2013; Syposz et al. 2018). Species prone to stranding may be more active on darker nights. The rate of nocturnal arrivals and departures of small procellariform species at active nests is lowest around the time of the full moon (Imber 1975; Bretagnolle 1990), which may reduce exposure to nocturnal predators (Watanuki 1986; Mougeot and Bretagnolle 2000; Oro et al. 2005).

Several studies report greater numbers of bird strandings around artificial lighting when there is a low cloud ceiling, particularly when accompanied by fog or rain (Telfer et al. 1987; Black 2005; Poot et al. 2008; Zhao et al. 2020). 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, in Poot et al. 2008), investigated behaviour of birds in passage migration around offshore installations in the North Sea and observed milling behaviour of dense (and often mixed species) flocks only during overcast nights and concentrated primarily between midnight and dawn.

The wavelength and intensity of lighting have also been shown to influence the degree of attraction. In some studies, white and red-coloured lights are associated with the highest rates of attraction, while blue and green lights are associated with the lowest rates (Gauthreaux and Belser 2006; Poot et al. 2008; Marquenie et al. 2013). However, Poot et al. (2008) did not control for light intensity or weather, measured flight direction instead of bird number and had a low sample size (Ballasus et al. 2009, in Rebke et al. 2019). In studies of passerines (songbirds and suboscine birds) nocturnally migrating, continuous green, blue, or white light attracted significantly higher numbers of birds than continuous red light, but only when the sky was overcast (Evans et al. 2007; Rebke et al. 2019). Blinking lights attracted significantly fewer birds than continuous lights with all colours except red, which attracted the same number of birds as continuous light. A field experiment by Zhao et al. (2020) on nocturnally migrating land birds showed similar results. Blue light attracted 7.8 times as many birds as red light, green light attracted 4.7 times as many birds as red, and yellow light attracted 3.5 times as many birds as red. Experimentation showed that high pressure sodium lights (colour temperature 2000 Kelvin, [i.e., warm, orange]) attract fewer short-tailed shearwaters than metal halide (4,500 K, cool, green) or light emitting diode lights (4,536 K, cool, green) (Rodríguez et al. 2017). High pressure sodium lights emit much less energy below a wavelength of 575 nanometres (green, blue) 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 significantly reduced (Marquenie and van de Laar 2004; Marquenie et al. 2013). Shielding lights downward also correlates with reduced attraction (Reed et al. 1985).

In the NL offshore area marine birds often strand on fishing vessels, drilling and production platforms, and, to a lesser extent, supply vessels (Baillie et al. 2005; Ellis et al. 2013). Leach's storm-petrel is considered the western North Atlantic seabird species most at risk of the negative effects of artificial lighting (Lieske et al. 2019). 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 in Jeanne d'Arc, Orphan and Flemish Pass basins (LGL 2017). Of those birds recovered, 1,986 were marine species consisting of 11 species and the remaining 62 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 (284 individuals) 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 storm-petrel stranding events appear to be episodic with the total number of strandings on the three production platforms (SeaRose, Hibernia, and Terra Nova) per day, ranging from 0 to 122 individuals. The latter occurred on 2 October 2006, with 83 on the Hibernia GBS, 32 on the *SeaRose FPSO*, and 7 on the Terra Nova FPSO.. Sixty percent of all storm-petrels stranded between 2003 and 2014 were recorded during 2006. Similarly, Leach's storm-petrels comprised 93% of birds attracted to artificial light sources at night in a study of bird stranding reports from offshore and coastal industrial facilities in Atlantic Canada (Gjerdrum et al. 2021). Leach's storm-petrels also strand more often in fog or rain than expected due to chance (LGL 2017). The frequency of large stranding events (10 or more individuals on a single day) was significantly associated with moon phase in the Gjerdrum et al. (2021) study. The moon was less than 20% illuminated in 46% of large stranding events and in nine out of ten of the largest stranding events.

Leach's storm-petrel strandings are also seasonal. Most (95%) of the strandings occurred during the months of September and October, peaking from 10 September to 13 October in the LGL (2017) study. In the Gjerdrum et al. (2021) study, 84% of the strandings also occurred during September and October. 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 and Labrador (Pollet et al. 2021). After fledglings and adults abandon the colonies many begin their southward migration, which takes them across the RAA (Pollet et al. 2014).

To study Leach's storm-petrel interactions with the oil production installations and drilling platforms in the existing oilfields in the NL offshore Collins et al. (2022) tracked adults nesting at the colony on Gull Island, NL, with GPS loggers. Many of these birds transit through the oilfields on their way to foraging areas off the continental shelf (Hedd et al. 2018). The Collins et al. (2022) study found that the birds were no more likely to fly within a light catch basin of one of those platforms during the night than during the day, despite this species' documented attraction to artificial light at night. However, this is not unanticipated given that these birds are experienced adults and that most strandings coincide with the time when naïve young fledglings depart their natal colonies.

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 daily searches of the vessel at dawn for birds, and recovery, documentation and release of stranded birds. The vessels were engaged in the NL offshore area in exploration programs starting as early as 7 May and terminated as late as 26 November; however, most were conducted during some portion of the months of June through September. In total, seabird stranding monitoring spanned 2,197 days over 38 voyages. Storm-petrel strandings on these vessels showed numbers and seasonality of strandings that are similar to those recorded on the drilling/production platforms. Over the 11-year period 1,029 birds were found stranded on these vessels, of which 1,012 were marine birds, and 994 individuals were Leach's storm-petrels. Of the Leach's storm-petrels, 84.3% were recovered and released. Most strandings occurred from 21 September to 10 October, despite few vessels conducting exploration programs after September. Almost all the storm-petrels stranded on the hydrophone streamer and air source array decks of geophysical seismic survey vessels, which are open only at the stern, in lifeboat stations that are recessed in the hull, 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, 87.3% were recovered and released, 11.7% were found dead or died in care, 0.6% were sent to shore for rehabilitation (ultimate fate unknown), and fate was not recorded for 0.4%. Most of that mortality was due to the plumage contamination from hydraulic fluid upon landing on the deck or in drip-trays under the numerous winches on streamer and air source array decks, then apparently succumbing to hypothermia as a result. However, since most birds that were uninjured and unoiled were unable to escape the vessels, it is surmised that they would also have died were they not retrieved and returned to the sea. Leach's storm-petrels attracted to the NL offshore area drilling and production platforms are also exposed to potential predation in late summer and fall from great black-backed gulls attracted by the fish drawn to the surface at night by the artificial lighting (Montevecchi et al. 1999; LGL 2017). However, the success rate of the gulls in capturing storm-petrels is unknown.

On-board lighting will be required for Project activities that occur at night and during periods of reduced visibility and must be in place to meet safety and regulatory requirements. The greatest potential for interaction between artificial light emissions from the MODU and marine and migratory birds is in the attraction of Leach's storm-petrels. As discussed in Section 6.2.2.7, this species feeds primarily in the deep waters off the continental shelf. As a result, individuals nesting in Newfoundland colonies travel to the deep waters on the continental shelf slopes of the Grand Banks and beyond to forage, returning to the colonies to feed their nestlings. Large numbers nest at Baccalieu Island and Great Island, Witless Bay. Fledglings and adults also travel to deep waters during post-breeding dispersal (Pollet et al. 2014). A tracking study suggests that this species is occasionally present in the RAA during winter (Pollet et al. 2019).

Data on the distance at which birds can be affected by light from a MODU or vessel are limited. The zone of influence varies with factors such as weather, intensity and position (height) of the light source, and ambient light conditions (Montevecchi 2006). Bruinzeel and van Belle (2010) found that the distance at which birds become disoriented ranges from 200 m in dense fog to 1,000 to 1,400 m in lighter fog to light rain, to up to 4.5 km in overcast skies with no celestial cues and otherwise good visibility. Poot et al. (2008) showed that 30 kW of electric lighting affects migrating landbirds out to at least 5 km, but greater distances cannot be ruled out (Poot et al. 2008; Hedd et al. 2011; Ronconi et al. 2015). Large numbers of fledgling short-tailed shearwaters were attracted to intense, temporary artificial lighting separated by 15 km of sea from the nearest nesting colony (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 undetected because they are killed or injured from collisions and fall into the water, fall prey to gulls, or are not encountered during customary personnel duties. The effectiveness of mitigation measures on offshore platforms is unknown because of the lack of systematic searches for stranded birds and the lack of complete documentation of dead and stranded individuals (Gjerdrum et al. 2021). However, the data collected as a result of systematic, thorough searches by biologists on board geophysical exploration vessels and summarized above reveal that a high percentage of stranded Leach's storm-petrels survive the initial stranding and suggest that collisions, if any, rarely result in mortality in this species. In most cases mortality appeared to have been the result of hypothermia after contact with hydraulic fluids and water on the decks. This species flies at wave top height and must gain altitude to the reach the altitude of artificial lighting, thus losing airspeed and potential impact energy in the event of a collision and gaining maneuverability to avoid collisions. If this is representative of storm-petrel interactions with vessels and platforms in general, then few individuals may be colliding with vessel hulls, and fewer still may sustain fatal injuries and then fall into the sea. In addition, large stranding events appear to be episodic for reasons that are not clear. However, such large stranding events are rare, and can be largely mitigated by the implementation of a systematic search protocol and the release of recovered birds. There is some potential for the attraction of landbirds in passage migration, particularly during the fall.

However, most landbird migration involving ocean crossings in Atlantic Canada is thought to take place south 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.). These birds may head on a southeasterly course like those departing from Nova Scotia (Richardson 1979). It is therefore likely that most of this migration passes to the west of the LAA and that a small amount traverses the southwest corner of the RAA, so it is unlikely that large numbers of shorebirds and other landbirds will be affected.

Based on the information and analysis summarized here, and with the implementation of appropriate mitigation measures as summarized in Section 10.3.1.2, the overall magnitude of the effect of the presence and operation of a MODU 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 low in magnitude, localized to the LAA, short- term in duration, irregular in frequency, and reversible.

10.3.1.3.2 Geophysical (including VSP), Geological, Geotechnical and Environmental Surveys

As discussed in Section 2.4.2.1, VSP surveys will take approximately one day per well.

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

Sound levels that cause injury to marine birds have not been tested. However, temporary hearing impairment can occur in terrestrial birds exposed to sound in air (Saunders and Dooling 1974; Ryals et al. 1999). Terrestrial bird species vary in their susceptibility to hearing damage resulting from sound exposure (Ryals et al. 1999), although they are generally thought to be more resistant to damage than mammals (Dooling and Popper 2007). Birds can regenerate sensory hair cells in the ear, unlike mammals (Ryals et al. 1999; Dooling and Popper 2007). Underwater hearing of birds is thought to be poorer than in air, because the middle ear constricts under the increased pressure associated with diving (Dooling and Therrien 2012). Unlike some other marine animals, seabirds are not known to communicate vocally underwater, and a heightened auditory sensitivity in water is thus unlikely to have evolved.

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

Deep-diving birds such as alcids (common and thick-billed murre, razorbill, dovekie, Atlantic puffin) may be at somewhat higher risk of injury (or disturbance) due to exposure to underwater sound from geophysical sound sources than shallow-diving species (northern fulmar, shearwaters). Alcids dive from a resting position on the sea surface to forage for small fish and invertebrates and can reach depths of 20 to 200 m and spending up to 153 seconds underwater at a time (Gaston and Jones 1998).

In air, sounds from a submerged air source array are reduced to a level below that which causes injury or mortality. However, they are audible to birds, as demonstrated by startle reactions to air source releases that are often visible in gulls and skuas flying near submerged air source arrays operated in shallow water (A. Lang, pers. obs.). Although the escape reactions seen in diving marine alcids on the surface in response to the approach of geophysical vessels cannot easily be classified into reactions to either air source pulses or to the movement of the source vessel, it is reasonable to conclude that they are as capable as gulls of hearing the air source pulses. 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 pulses of a ramp-up before initiating a dive, would be submerged sufficiently long to hear one or more air source pulses.

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

These activities will have a short duration (approximately one day) 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.

The Project will involve geological, geotechnical environmental surveys conducted from survey-specific vessels within the Project Area potentially at all times of year over the course of the Project. These vessels 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 geological, geotechnical and environmental surveys due to their transitory nature and thus, their 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. The effects are similar to those discussed in supply and servicing (Section 10.3.1.3.6). Mitigation measures outlined in Section 10.3.1.2 will be in place during Project operations to reduce the effects of bird attraction due to offshore lighting from survey vessels.

Residual effects associated with geophysical (including VSP), geological, geotechnical and environmental surveys on marine and migratory birds is predicted to be negligible to low in magnitude, localized within portions of the Project Area, short-term, irregular in frequency, and reversible.

10.3.1.3.3 Discharges

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

Cement, WBM and cuttings released at the seafloor will be at depths below the maximum diving range of most seabird species expected in the Project Area, except the razorbill and common and thick-billed murre. Water depths in EL 1161 range from approximately 61 to 87 m. The deepest-diving seabird species found in the Project Area, thick-billed murre, can reach depths up to 200 m (Gaston and Hipfner 2000, in ExxonMobil Canada Ltd. 2017). However, alcids such as the two murre species generally avoid platforms, which reduces the potential for murres interacting with mud and cuttings (Amec 2011; Baird 1990; Bramford et al. 1990). 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 arise from 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 2.8.3).

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; Matcott et al. 2019), which has the potential to result in water penetrating plumage and displacing the layer of insulating air, resulting in loss of buoyancy and subsequent potential for hypothermia. This can in turn cause a heightened metabolic rate (increased energy expenditure), as well as behavioural changes such as increased time spent preening at the expense of foraging and breeding, and potentially death, especially in the winter months when conditions are colder and thermoregulation is most difficult (Morandin and O'Hara 2016). Chicks and eggs are most susceptible to negative effects of exposure to oil (even at low levels) (Morandin and O'Hara 2016).

Controlled-dose studies, including a study commissioned by the ESRF on the effects of sheens on marine birds, show that 5 mL of oil can have negative external and internal effects on individual birds (O'Hara and Morandin 2010; Morandin and O'Hara 2016). As a result, an individual bird encountering a sheen with a thickness of 0.1 µm and picking up all the oil in an area of 50 m^2 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). However, the threshold sheen thickness above which oil significantly affects feathers is between 0.1 and 3 µm, depending on sheen exposure, environmental conditions and species (O'Hara and Morandin 2010; Matcott et al. 2019). The feathers of deep-diving seabird species such as alcids are more resistant to the effects of oil than those of shallow-diving species such as fulmars and shearwaters, which are in turn more resistant than those of surface-feeding species such as gulls (Matcott et al. 2019).

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 any measurable effect on marine and migratory birds, as the emissions will be within regulatory standards, transient in nature, and short-term at one location.

With the proper implementation of mitigation measures summarized in Section 10.3.1.2, the overall magnitude of the effect of drilling and other marine discharges on marine and migratory birds is anticipated to be low. These effects will be prevented or reduced through the waste management and discharge treatment measures in compliance with OWTG and adherence to associated MARPOL requirements.

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

10.3.1.3.4 Well Testing and Flaring

Suncor does not intend to employ formation flow testing during drilling of an exploration well, however it may be carried out in a later appraisal well, or upon re-entering a suspended well, in which case flaring may be required. In Atlantic Canada, nocturnal migrants, and nocturnally-active seabirds such as Leach's storm-petrel are the marine and migratory birds most at risk of attraction to flares, although the potential mortality resulting from such interactions is poorly understood. Estimates often rely on recovery of birds on platforms and vessels and, as discussed above for electrical lighting on offshore installations, recoveries are often conducted on an incidental basis (Ronconi et al. 2015). As a result, the number of birds killed but not recovered due to scavengers removing them or to landing in the ocean is not known (Bruinzeel et al. 2009; Ellis et al. 2013; Ronconi et al. 2015).

Some researchers contend that some portion of the 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. There have been fewer than five documented accounts of mass mortality events (>100 birds in a night) associated with oil and gas activities from Canada and United States (Bjorge 1987; Canadian Wildlife Health Cooperative 2009), but because these events are rarely documented, no comprehensive analysis has been published. While accurate assessment of mortality at offshore facilities may be difficult, no mass mortality events due to incineration in flares have ever been reported at 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 of the flare 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 altitude soon after takeoff and, shortly after midnight, undertake a gradual descent (Weir 1976).

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

As with light emissions from artificial lighting discussed above, the greatest potential for interactions is with Leach's storm-petrel. If required, flaring activities would be short in duration (approximately 36 hours per test, if flaring occurs at all), and associated bird attraction will be limited to within 15 km of the MODU. Mitigation measures regarding flaring will be adhered to throughout the Project, including the use of high efficiency burners. If flaring is required, Suncor will discuss flaring plans with the C-NLOPB including steps to reduce adverse effects on migratory birds. This may involve restricting flaring to the minimum required to characterize the wells' hydrocarbon potential and as necessary for the safety of the operation, minimizing flaring during periods of migratory bird vulnerability, and the use of a water curtain to deter birds from the general vicinity of the flare. The effects of formation flow testing with flaring on marine and migratory birds are therefore anticipated to be low.

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 Suncor 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; therefore, produced water is therefore not expected to be an issue for this exploration program.

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

10.3.1.3.5 Well Decommissioning, Suspension and Abandonment

Well decommissioning, suspension and abandonment will occur underwater at depths within the range of diving depths of some marine and migratory bird 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 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 61 to 87 m in EL 1161 and drilling; therefore, well decommissioning, suspension and abandonment will take place within the depths capable of being reached by the latter two species, as well as thick-billed murre. These activities therefore have the potential to interact with migratory birds, including diving seabirds.

If well decommissioning, suspension and abandonment includes removal of a wellhead, it will be done using mechanical cutting means rather than explosives. These mechanical means are not anticipated to produce sounds that pose a mortality or injury risk to deep-diving marine bird species capable of reaching those depths (i.e., razorbill and common and thick-billed murre). In addition, alcids (including murres) are readily disturbed by vessel traffic, so vessels used for well decommissioning, suspension and abandonment activities are likely to displace any murres (Ronconi and St. Clair 2002; Bellefleur et al. 2009). Displacement of marine birds by vessels is expected to be limited to a small area of habitat (within and few hundred meters of the well decommissioning, suspension and abandonment activities) and is assessed below for Supply and Servicing. Consequently, the residual effects of well decommissioning, suspension and abandonment related to changes in the risk of mortality and injury are predicted to be negligible in magnitude, localized to portions of the Project Area, irregular in frequency, short-term in duration, and reversible.

10.3.1.3.6 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. 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 but lower magnitude to those from lighting on the 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 any 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 10.3.1.2 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 minimized 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 10.3.1.2.

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

10.3.2 Change in Habitat Quality and Use

10.3.2.1 Project Pathways

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

10.3.2.2 Mitigation

In consideration of the environmental effects pathways outlined above, the mitigation measures and standard practices described in Section 10.3.1.2 will be employed to reduce the potential for change in marine and migratory bird habitat quality and use as a result of routine Project activities.

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 related to the presence and operation of a MODU generally are due to artificial lighting and atmospheric and underwater sound emissions from the MODU that can result in behavioural changes in marine and migratory birds. Effects of waste discharges from the MODU are discussed separately below.

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

The presence of offshore platforms can also provide new habitats for birds (Russell 2005). Structures may be used as roosting and resting habitat by gulls (Burke et al. 2012), as stopover locations for migrating landbirds who may forage around the platforms (Russell 2005; Bruinzeel and van Belle 2010), or even potentially as hunting grounds for predatory species such as large gull species and peregrine falcons in passage migration that take advantage of concentrations of birds around the structures (Russell 2005). Foraging opportunities may also be enhanced around artificial reefs if hard substrate required by some invertebrate and fish assemblages is locally scarce (Wolfson et al. 1979; Fabi et al. 2002, 2004). Baird (1990) speculated that seabirds are attracted to these platforms because of this artificial reef effect. Great black-backed gulls congregate in large flocks at drilling and production platforms offshore NL in late summer post-breeding dispersal and fall migration (Brown 1986; Burke et al. 2012). These gulls are observed to forage at night on fish that are attracted to the surface by artificial light emissions from the platforms, e.g., as Atlantic saury and northern sand lance (Montevecchi et al. 1999; LGL 2017). Diving thick-billed murres are attracted to underwater lights during the Arctic polar night, but dovekies are not, suggesting that some diving marine bird species could potentially be attracted to the MODU at night for foraging opportunities (Ostaszewska et al. 2017).

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

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

Some marine bird species, especially alcids, may be displaced from the area around the active MODU during drilling operations and along 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 an extended time, disturbance will be short-term and transient in nature.

Based on the information and analysis summarized here, and with the implementation of appropriate mitigation measures as summarized in Section 10.3.1.2, the overall magnitude of the effect of the presence and operation of a drilling installation on marine and migratory birds is anticipated to be low. Some localized and short-term behavioural effects (change in presence and abundance) are likely to occur, with some species displaced from the Project Area / LAA and others attracted by lighting which will reduce the degree to which foraging opportunities are enhanced by the presence and operation of a drilling installation. The localized, transient, and short-term nature of these disturbances at one location and time during the Project considerably reduces the potential for adverse effects upon marine and migratory birds (individuals or populations). It is therefore unlikely that individuals will be attracted or displaced over extended areas or timeframes. Given that the likely zone of influence of the Project (conservatively set at 16 km diameter based on Section 10.1.4.1) at one time or location will represent a small proportion of the feeding, breeding or migration area of species, birds will not be displaced from key habitats or during important activities or be otherwise affected in a manner that causes detectable adverse effects to overall populations in the region. Changes in habitat and food availability and quantity will also be on a localized scale and for a short-term duration.

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

10.3.2.3.2 Geophysical (including VSP), Geological, Geotechnical and Environmental Surveys

Most field studies of the effects of underwater sound on bird behaviour have found no substantial effects (see LGL 1998; Minerals Management Service 2004). Moulting long-tailed ducks in the Beaufort Sea show no changes in movements or diving behaviour during geophysical surveys, although the authors noted that smaller-scale behavioural changes could not be ruled out (Flint et al. 2003; Lacroix et al. 2003). In the Davis Strait, Stemp (1985) found no evidence of effects of geophysical surveys on thick-billed murre, northern fulmar, or black-legged kittiwake distribution or mortality in the offshore. These species are found in the current LAA, although kittiwake and thick-billed murre are rare in summer. Stemp (1985), citing a personal communication with another researcher, also reported that shearwaters show no behavioural response close to a geophysical sound array even with their heads underwater. Evans et al. (1993) observed no evidence that marine birds are attracted to or repelled by offshore seismic survey activity in the Irish Sea. However, a five-year study (2009-2013) using Global Positioning System (GPS) tracking reported avoidance of a 2-D seismic survey by African penguins when foraging close to breeding colonies that were located less than 100 km from the seismic survey (Pichegru et al. 2017). The air source array had a total volume of 4,230 in^3 and nominally operated at 2,000 psi during an approximate one-month period in 2013. It could not be determined whether the penguins (flightless birds that dive to depths of 30 m on average) were responding directly to air source sound or to potential changes in the distribution of their prey. The birds reverted to normal behaviour when the seismic source array was shut down.

VSP surveys will be conducted for each well drilled and are expected to take approximately one day per well. As discussed above, the foraging activity of at least one species of marine bird has been reported as being negatively affected by the underwater sound energy from marine seismic. Above the water, air source sound is reduced to that which is likely to have little or no effect on the behaviour of birds that have their heads above water or are in flight. Effects of sound disturbance on the foraging behaviour of surface-feeding marine birds are also unlikely, given that the above-water sound levels of geophysical source arrays are minimal. As described in Chapter 9, significant effects to fish resources are not expected to occur because of the Project, and so changes in the availability, location, or quality of food sources for marine birds are not likely.

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

The Project will involve geological, geotechnical and environmental surveys conducted from survey-specific vessels within the Project Area potentially at all times of year over the course of the Project. The effects are similar to those discussed in supply and servicing (Section 10.3.2.3.6). Mitigation measures outlined in

Section 10.3.1.2 will be in place during Project operations to reduce the effects of bird attraction due to offshore lighting from survey vessels.

Any changes in habitat quality and use as a result of sound exposure from geophysical (including VSP), geological, geotechnical and environmental surveys are predicted to be negligible in magnitude, localized within the Project Area, short-term, unlikely in frequency, and reversible. Changes in habitat and food availability and quantity from geophysical (including VSP), geological, geotechnical an environmental surveys are likewise not anticipated because the activity will be localized and short-term, with negligible effects.

10.3.2.3.3 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 affect local productivity (Chapter 8). However, this effect will only occur during the drilling program (approximately 120 days per well) and be localized in nature.

The production of sheens from routine discharges will be unusual given adherence to the OWTG and MARPOL requirements for waste management. However, if they do occur, this could result in avoidance and/or attraction of marine birds. Northern fulmar, shearwater species and storm-petrel species are attracted to sheens. The visual appearance of a hydrocarbon sheen would resemble a sheen of biological origin and may occasionally attract such species (Nevitt 1999). However, these species also search for food by olfaction, relying on the smell of chemicals found in their foods, such as dimethyl sulfide (e.g., Leach’s storm-petrel; Nevitt and Haberman 2003). Such species distinguish between sheen of oils derived from animals and sheen of petroleum oils by their odours (Hutchison and Wenzel 1980). As a result, these birds would be unlikely to encounter a sheen during foraging. Other birds may not be attracted at all and may temporarily avoid the localized affected area.

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

10.3.2.3.4 Well Testing and Flaring

Suncor does not plan to employ formation flow testing as its primary means of formation evaluation for exploration wells. However, it may be required during appraisal drilling of a discovery to determine the deliverability of a reservoir, in which case, flaring may be required. As discussed previously, nocturnal flaring introduces artificial lighting to the marine environment and has the potential to attract marine and migratory birds (particularly storm-petrels), diverting them from their movements between foraging areas and nesting colonies. Changes to habitat quality and use by marine and migratory birds are therefore predicted to be low in magnitude, short term in duration, localized to portions of the Project Area, irregular in frequency, and reversible.

10.3.2.3.5 Well Decommissioning, Suspension and Abandonment

The potential for marine and migratory birds to interact with well decommissioning, suspension and abandonment activities is low because the activities will take place at depths below the diving depths of all seabird species expected in the Project Area, except the razorbill and common and thick-billed murre, as discussed in Section 10.3.1.3.5. However, movement and presence of vessels supporting the well decommissioning, suspension and abandonment activities have the potential to displace murres and other alcids from the localized area due to alcids' avoidance of vessel traffic (Ronconi and St. Clair 2002; Bellefleur et al. 2009). Changes to habitat quality and use by marine and migratory birds are therefore predicted to be negligible in magnitude, short term in duration, localized to portions of the Project Area, irregular in frequency, and reversible.

10.3.2.3.6 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 13 km southeast of the Cape St. Francis IBA and at least 39 km north of the Witless Bay Ecological Reserve IBA (the nearest IBA with seabird nesting colonies). Supply vessel routes out of the Port of St. John's will lie about 26 and 35 km, respectively, from those IBAs. This vessel traffic may interact with seabirds through lighting, atmospheric and underwater sound, and other associated environmental emissions and discharges. The various bird species that occupy the Project Area will not likely be affected by supply vessel activity due to its transitory nature and thus, its short-term presence at any one location, and because it is generally consistent with the overall marine traffic that has occurred throughout the region for years.

Helicopters may interact with the marine and migratory birds through aircraft overflights and potential disturbance of normal nesting, foraging or resting activities. Possible disturbance effects include increased energy expenditure of birds due to escape reactions, increased heart rate, decreased food intake due to interruptions, and temporary loss of suitable habitat (Ellis et al. 1991; Trimper et al. 2003; Komenda-Zehnder et al. 2003). For example, helicopter atmospheric sound emissions can disturb seabirds at nesting colonies. However, seabird reactions to helicopters and other aircraft are variable due to several factors including species, previous exposure levels, and the location, altitude, and number of flights (Hoang 2013). One of the most conspicuous behavioural effects of helicopter atmospheric sound on birds is flushing of breeding birds from their nests, which can have immediate negative effects such as predation of eggs or nestlings, and reduced time spent incubating eggs or brooding nestlings (Burger 1981; Brown 1990; Bolduc and Guillemette 2003; Beale 2007; Burger et al. 2010). Eggs and nestlings may also be vulnerable to hypothermia. During flushing, adults may inadvertently knock eggs and nestlings from the nest, upon which they may fall from a cliff or be exposed to attacks by neighboring nesting pairs (Burger 1981; Carney and Sydeman 1999). Disturbance may disrupt rates of foraging and feeding of nestlings or fledglings (Davis and Wiseley 1974; Lynch and Speake 1978; Belanger and Bedard 1990; Delaney et al. 2002; Goudie 2006). Unfamiliar atmospheric sound may deter birds from using preferred habitats and may alter migration routes, causing affected birds to expend greater energy (Larkin 1996; Beale 2007). Visible behavioural responses to aircraft operations, such as flushing, may be prompted at a distance of 366 m for common murre (Rojek et al. 2007), although there is variability in between and within species (Blumstein et al. 2005; Hoang 2013). The various bird species that occupy the Project Area and transit route will not likely be affected by helicopter activity due to its transitory nature and thus, its short-term presence at any one location, and because of mitigation measures in place (see below).

Similar to presence of the MODU, when 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 minimized 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* and CWS guidelines discussed in Section 10.3.1.2. Routes from the Port of St. John's are at least 27 km from the nearest seabird ecological 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 nesting colony on Freshwater Bay, is over 5 km south of existing helicopter routes (Lock et al. 1994). The nearest seabird ecological reserve, Witless Bay Islands, is 40 km south of the St. John's International Airport.

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

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

Table 10.4 presents marine and migratory bird SAR and SOCC that could potentially occur in the RAA, summarizing their likely occurrence and potential interaction with Project activities. As discussed in Section 6.2.4 (and summarized in Table 10.4), 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 and black-legged kittiwake, which are 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, which 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. As discussed in Section 6.2.4, the RAA is at the northern periphery of the ranges of Bermuda, Desertas and Zino's petrels where they occasionally occur in very low numbers, and, except for Bermuda petrel, do not venture out of the warm waters of the North Atlantic Drift (northern component of the Gulf Stream).

Table 10.4 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 population)	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
Barrow's goldeneye (eastern population)	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
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

Table 10.4 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		
Lesser Yellowlegs	None	Under consideration for addition	Threatened	Least concern	• Occurs in Newfoundland during fall migration (1 July to 30 October), preferring coastal salt marshes, estuaries and ponds • Most migration takes place west of the RAA, although individuals have been in NL offshore • 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
Hudsonian Godwit	None	Under consideration for addition	Threatened	Least concern	• Occurs in Newfoundland during fall migration (1 August to 30 October), preferring coastal wetlands and mudflats • Most migration takes place west of the RAA, although individuals have been in NL offshore • Unlikely to occur in the Project Area
Red knot (*rufa* ssp., Northeastern South America wintering population)	Endangered	Under consideration for addition	Special Concern	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 in NL offshore • 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

Table 10.4 Bird Species at Risk and of Conservation Concern with Potential to Occur in the RAA

Species	NL ESA	Federal Status		IUCN Red List	Summary of Presence and Potential Interactions
		SARA Listing	COSEWIC Assessment		
Red knot (*rufa* ssp., Southeastern USA / Gulf of Mexico/ Caribbean wintering population)	Endangered	Under consideration for addition	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 in NL offshore • 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
Red knot (*rufa* ssp., Tierra del Fuego/ Patagonia wintering population)	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 in NL offshore • 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

Table 10.4 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; occasional sightings in the NL Offshore in fall migration • Unlikely to occur in the Project Area • Low potential for interaction with routine Project activities; could potentially be affected in the unlikely event of a spill reaching coastal waters
Red-necked phalarope	Vulnerable	Special Concern (Schedule 1)	Special Concern	None	• Form large flocks at sea and prey on zooplankton in areas of convergences and upwellings during spring and fall migration and during winter months • Could occur in small numbers in the RAA and potentially the Project Area
Black-legged Kittiwake	None	None	None	Vulnerable	• Present in large numbers in coastal RAA in the breeding season; large numbers in the RAA in non-breeding season, especially off the continental shelf, 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 in pack ice • 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

Table 10.4 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		
Ross's gull	None	Threatened (Schedule 1) Under consideration for status change	Endangered	None	• Breeds in arctic and subarctic habitats but has been recorded at a wintering area reaching from the Labrador Sea to Orphan Basin • Low potential for presence in the RAA and Project Area in the winter • Low potential for interaction with Project activities given likely low occurrence and seasonality of presence in the RAA
Peregrine falcon (*anatum/ tundrius* spp.)	Vulnerable	Special Concern (Schedule 1) Under consideration for status change	Not at Risk	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	Under consideration for addition	Threatened	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

Major threats identified in associated recovery strategies and action plans for these bird SAR are: predation at the nesting colony, competition for nesting habitat, erosion or fire at the nesting colony, flooding or pollution of coastal habitats, hunting, at-sea pollution, climate change (rising sea levels and food webs), competition with commercial fisheries, fisheries bycatch, and disease. Given the distance of most Project activities occurring offshore, Project effects with these bird SAR are expected to be negligible in magnitude, but low for Leach's storm-petrel, and are most likely to occur during this 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 10.3.1.2) will help to protect bird SAR.

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

10.3.4 Summary of Project Residual Environmental Effects

Table 10.5 summarizes the environmental effects assessment and prediction of residual environmental effects resulting from interactions between the Project and marine and migratory birds. The greatest potential for environmental effects on marine and migratory birds is related to artificial lighting associated with presence and operation of a MODU which may result in nocturnal attraction and stranding of birds (including Leach's storm-petrels) on the MODU. This will be mitigated through the development and implementation of protocols and training for systematic, daily searches, and for recovery, rehabilitation, and release of birds adhering to protocols detailed in ECCC's *Procedures for Handling and Documenting Stranded Birds Encountered on Infrastructure Offshore Atlantic Canada* (ECCC 2017b). As described in Chapter 9, 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 10.5 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
Geophysical (including VSP) Surveys	A	N-L	PA	ST	IR	R	D
Geological, Geotechnical and Environmental Surveys	N/A	N/A	N/A	N/A	N/A	N/A	N/a
Discharge	A	L	PA	ST	IR	R	D
Well Testing and Flaring	A	L	PA	ST	IR	R	D
Well Decommissioning, Suspension and Abandonment	A	N	PA	ST	IR	R	D

Table 10.5 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
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
Geophysical (including VSP) Surveys	A	N	PA	ST	UL	R	D
Geological, Geotechnical and Environmental Surveys	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Discharge	A	L	PA	ST	IR	R	D
Well Testing and Flaring	A	L	PA	ST	IR	R	D
Well Decommissioning, Suspension and Abandonment	A	N	PA	ST	IR	R	D
Supply and Servicing	A	L	LAA	ST	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 and migratory birds, and the planned implementation of mitigation, and residual changes to risk of mortality or physical injury, or to habitat quality and use, the Project is not likely to result in significant adverse effects on marine and migratory birds. Although Project-related components, activities and emissions may result in some localized, short-term effects with marine and migratory birds in parts of the Project Area and LAA primarily as a result of bird attraction to offshore lighting and other components, the Project is not predicted to result in a detectable decline in overall bird abundance or changes in the spatial and temporal distributions of bird populations within this area. The potential for interactions between individuals of SAR and the Project is limited, and no identified critical habitat is present in the Project Area, LAA, or RAA. The Project is therefore not predicted to jeopardize the overall abundance, distribution, or health of SAR. With mitigation and environmental protection measures, the residual environmental effects on marine and migratory birds (including SAR) are predicted to be not significant.

10.5 PREDICTION CONFIDENCE

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

10.6 FOLLOW-UP AND MONITORING

For the duration of the drilling program for each well:

- Systematic searches for stranded birds will be carried out daily on the MODU and supply vessels, per *Guidance for Developing Systematic Stranded Bird Survey Protocols for Vessels and Platforms* (ECCC-CWS 2021). This effort will be documented, by trained personnel according to search protocols designed specifically for each facility as per *Standard for Observers Conducting Seabird Surveys at Sea, and for Trainers Providing Instruction on Seabird Survey Methods* (ECCC 2020)
- Retrieval, rehabilitation, release and documentation of stranded birds will be conducted according to *Procedures for Handling and Documenting Stranded Birds Encountered on* Infrastructure *Offshore Atlantic Canada* (ECCC 2017b) and associated permit conditions under the MBCA authorizing the capture and handling of migratory birds

Results of the monitoring program will be shared publicly to help further improve the understanding of bird strandings and mortality in the NL offshore area.

10.7 REFERENCES

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