Table of Contents

LIST OF TABLES

16.0 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

Offshore oil and gas activities, and other marine activities taking place in the eastern Newfoundland offshore area are often influenced by environmental factors, including: climatological and meteorological conditions (wind, precipitation, fog, visibility); oceanographic conditions (waves, currents); seasonally-present sea ice and icebergs; and geology and seismicity. These environmental factors should be considered in the design and operation of offshore exploration activities, including measures to avoid or reduce the potential for incidents and accidents that may occur from unplanned interactions between Project activities and physical environmental conditions.

This chapter considers how existing environmental conditions and potential natural hazards in and around the Project Area could adversely affect the Project and potentially result in adverse effects on the environment. This consideration is required by Section 19(1)(h) of CEAA 2012, relating to any change to the designated Project that may be caused by the environment. Also discussed in this section are relevant engineering and environmental design criteria; industry standards; guidelines; regulatory conditions; and mitigation measures.

16.1 Key Environmental Considerations

The key components of the physical environment that could potentially affect the Project are: weather conditions; oceanographic conditions; sea ice, icebergs, and superstructure icing; and geological stability and seismicity. The following sections provide an overview of these key components; the physical environment is described in detail in Chapter 5 of the EIS.

16.1.1 Weather Conditions

The Project Area experiences weather conditions typical of a marine environment, with surrounding areas having a moderating effect on temperature. Marine climates generally experience cooler summers and milder winters than continental climates and have a smaller annual temperature range. Marine climates also tend to be humid, resulting in reduced visibilities, low cloud heights, and substantial amounts of precipitation.

The air temperature in the East Orphan Basin is coldest during the months of January and February, with a mean monthly air temperature of 0.4°C, for both months and is warmest in August, with a mean monthly air temperature of 12.3°C. Air temperatures in the West Orphan Basin range from -2.9°C to 11.6°C between February and August.

The Project Area experiences winds predominantly from the southwest to west throughout the year. There is a strong annual cycle in the wind direction; west to northwest winds are prevalent during the winter months and southwest winds are predominant during the summer months. The mean strength of the westerly flow is stronger in the winter months than the summer months.

The mean and maximum wind speeds at MSC50 grid points in the East and West Orphan Basins are shown in Table 16.1. The seasonal and annual percentage frequencies of wind direction at MSC50 grid points in the East and West Orphan Basins are provided in Table 16.2. In terms of percentage frequency of wind speeds, in the East Orphan Basin, strong (10.8 m/s to < 17.5 m/s) winds were most common (approximately 37% of the time), followed by moderate (5.7 m/s to < 10.8 m/s) winds (approximately 34% of the time). In the West Orphan Basin, strong winds were also most common (approximately 37.7% of the time), followed by moderate winds (approximately 34.7% of the time). Values for the East Orphan Basin are based on one MSC50 grid point, while those for the West Orphan Basin represent an average for three MSC50 grid points (see Figure 5.6 in Section 5.4.2).

Table 16.1 Mean and Maximum Wind Speeds (m/s) at MSC50 Grid Points in the East and West Orphan Basins

Period	East Orphan Basin[1]		West Orphan Basin[2]	
	Mean	Maximum	Mean	Maximum
Winter	12.24	32.4	12.17	32.8
Spring	9.42	31.2	9.29	29.9
Summer	6.94	23.7	6.70	22.5
Fall	9.79	30.4	9.72	33.1
Annual	9.58	32.4	9.46	33.1

Notes:
[1] Wind speeds based on MSC50 Grid Point 15340
[2] Wind speeds based on the average and maximum speeds of MSC50 Grid Points 16684, 17322, and 17427

Table 16.2 Seasonal and Annual Percentage Frequency of Wind Direction for MSC50 Grid Points in the East and West Orphan Basins

Period	East Orphan Basin[1]							
	NE	E	SE	S	SW	W	NW	N
Winter	3.9	5.0	7.3	11.0	18.3	30.6	17.4	7.8
Spring	7.3	7.6	8.5	12.7	18.3	18.7	16.1	11.2
Summer	5.0	5.6	7.6	17.0	30.7	16.6	11.7	8.6
Fall	4.9	4.6	6.4	13.2	20.5	23.0	19.4	8.8
Annual	5.3	5.7	7.5	13.5	22.0	22.2	16.1	9.1
Period	**West Orphan Basin[2]**							
	NE	**E**	**SE**	**S**	**SW**	**W**	**NW**	**N**
Winter	4.3	5.3	6.7	10.2	16.6	30.0	19.2	8.6
Spring	8.8	7.0	8.2	13.0	17.2	17.3	16.6	11.7
Summer	5.2	6.3	9.0	19.2	28.2	14.4	11.3	13.8
Fall	5.2	4.5	6.5	13.4	20.5	22.2	19.5	10.3
Annual	5.9	5.8	7.6	14.0	20.6	20.9	16.6	11.1

Notes:
[1] Percentage frequency of wind direction based on MSC50 Grid Point 15340
[2] Percentage frequency of wind direction based on an average of MSC50 Grid Points 16684, 17322, and 17427

During the winter there are three main storm tracks affecting the North Atlantic region: one from the Great Lakes Basin; one from Cape Hatteras, North Carolina; and one from the Gulf of Mexico. On average, these storm tracks bring eight low pressure systems per month over the eastern Newfoundland offshore area with intensities ranging from relatively weak features to major winter storms. In the summer, the main storm track is through the Gulf of St. Lawrence, or the Island of Newfoundland. During the summer, periods of southerly winds with mild conditions are typical with infrequent occurrence of extended storm conditions.

Precipitation may come in three forms in the Project Area: liquid precipitation (including drizzle and rain); freezing precipitation (freezing drizzle and freezing rain); and frozen precipitation (snow, snow pellets, snow grains, ice pellets, hail, and ice crystals). Rain and drizzle may occur at any time of the year but is most likely to occur when there are southerly or southwesterly winds. Snow and rain are possible any time from October through June, and snow is accompanied by winds from any direction. Freezing rain frequently persists for days in the spring along the east coast of Canada and is most common with easterly or northeasterly winds.

Precipitation is more frequent on an annual basis in the East Orphan Basin (EL 1149) (27.9% of the time) than the West Orphan Basin (ELs 1145, 1146, and 1148). Winter has the highest frequency of precipitation, with 48.8% of the observations reporting precipitation. Snow accounts for 24.2% of the occurrence of precipitation in the East Orphan Basin. Summer has the lowest frequency of precipitation, with a total frequency of occurrence of 15.5%. In the West Orphan Basin, precipitation occurs 20.2% of the time, with winter precipitation occurring 39.3% of the time. In the winter, 23.3% of this precipitation occurs as snow. During the summer months, precipitation occurs 10.2% of the time.

Freezing precipitation occurs when rain or drizzle enters negative air temperatures near the sea surface and becomes super-cooled so that droplets freeze upon impact with the surface. This typically occurs ahead of a warm front extending from low pressure systems passing west of the Project Area. As negative air temperatures are required for freezing precipitation, freezing rain occurs most frequently during the winter and spring months, with winter having a slightly higher frequency of occurrence than the spring. January has the highest frequency of freezing precipitation. Regionally, the West Orphan Basin experiences more freezing precipitation than the East Orphan Basin.

Thunderstorms and hail have the potential to occur year-round, although hail is most likely to occur in the winter, and thunderstorms are most likely to occur in the summer. Thunderstorms occur relatively infrequently over the Project Area, although they may occur in any month of the year. Hail only occurs during severe thunderstorms.

Lightning occurs year-round in offshore Newfoundland. Lightning strikes are stronger during the winter months. Lightning is most commonly produced in thunderstorms and is usually accompanied by thunder (Statoil Canada Ltd. 2017). Lightning can pose a safety risk to personnel and can potentially affect electronic systems on the MODU, PSVs and helicopters. With the implementation of the mitigation measures described in Section 16.2, lightning is not expected to affect the Project.

Visibility in the eastern Newfoundland offshore area is most favorable in the fall and winter and is most frequently restricted in the summer and spring. The eastern Newfoundland offshore area experiences some of the highest occurrences of marine fog in North American (Amec 2014). Horizontal visibility may be reduced by any of the following phenomena: fog, mist, haze, smoke, liquid precipitation, freezing precipitation, frozen precipitation, and blowing snow.

During the winter months, visibility is most affected by snow; however, mist and fog may also reduce visibilities at times. The amount of visibility reduction from snow decreases as spring approaches. Obscuration to visibility in the Project Area is highest during the month of July, most of which is in the form of advection fog, although frontal fog can also contribute to visibility reduction. Reduction in visibility is relatively low during fall and winter and is mainly attributed to the passage of low-pressure systems. In fall, fog is the main cause of reduced visibilities, and in winter, the main cause is snow. The lowest occurrence of reduced visibility occurs in November, when, on average, the air temperature has decreased below the sea surface temperature and it is not yet cold enough for snow.

Storm systems known as weather bombs are known to occur frequently in the Orphan Basin. These are formed by a rapid deepening of an extratropical cyclonic low-pressure area. These storm systems develop in the warm waters off Cape Hatteras, North Carolina, and move northeast across the Grand Banks and Orphan Basin.

The hurricane season in the North Atlantic Basin normally extends from June through November, although tropical storm systems occasionally occur outside this period. The strongest winds typically occur during the winter months and are associated with mid-latitude pressure systems, although storm-force winds may occur at any time of the year because of tropical systems. There has been a substantial increase in the number of hurricanes that have developed within the Atlantic Basin in the last 15 years. Because of the increase in tropical activity in the Atlantic Basin, there has also been an increase in tropical storms or their remnants entering the Canadian Hurricane Centre Response Zone. Between 1986 and 2015, there have been 30 tropical storms that have passed within 278 km of the Project Area (see Table 5.5 in Section 5.4.4).

Reduced visibility, high wind, and wave conditions, and other severe and/or extreme weather conditions may delay cargo and personnel transit. These conditions could also: increase the potential for PSV and/or helicopter collisions; increase potential for accidental spills; cause a delay or suspension of Project activities; require evacuation of the MODU; and in extreme cases, cause injury or fatality. Extreme weather conditions (e.g., high wind, high waves, freezing precipitation) can cause increased stress conditions on the MODU and, in extreme cases, like that of the *Ocean Ranger* disaster offshore Newfoundland in 1984, result in failure of the MODU superstructure and loss of life. During a fierce winter storm, the ingress of sea water into the ballast room of the *Ocean Ranger* platform ultimately led to the evacuation and sinking of the rig and the loss of all 84 crew members. The *Ocean Ranger* tragedy resulted in significant improvements for the Canadian offshore petroleum industry, including the establishment of the offshore petroleum boards in Newfoundland and Labrador and in Nova Scotia, and more rigorous requirements around safety training, equipment, and inspection (Stantec 2014).

16.1.2 Oceanographic Conditions

The Labrador Current is composed of the West Greenland, Baffin Island, and Irminger Currents, and is the dominant current in the Project Area. The Labrador Current originates from the Hudson Strait at 60°N and flows southward over the Labrador and Newfoundland Shelf and Slope to the tail end of the Grand Banks at 43°N (Lazier and Wright 1993).

The Labrador Current becomes two branches on the southern Labrador Shelf; an inshore branch with approximately 15% of the transport, and an offshore branch with approximately 85% of the transport (Lazier and Wright 1993). The main branch of the offshore Labrador Current typically flows along the Continental Slope between 300 and 1,500 m (Lazier and Wright 1993). The inshore branch generally has a weaker flow and is not well defined (Lazier and Wright 1993). The offshore branch has mean surface water velocities that typically range from 25 to 50 cm/s, while those of the inshore branch are weaker and range from 5 to 20 cm/s (Fissel and Lemon 1991; Lazier and Wright 1993; Colbourne 2000).

The currents on the Newfoundland Slope are highly variable which results in seasonal and interannual variations in velocity and transport in the Labrador Current. The upper waters of the Labrador Current are typically stronger in the fall and winter and weaker in spring (Lazier and Wright 1993; Han and Tang 1999; Han and Li 2004). Lazier and Wright (1993) found seasonal variations in circulation in the upper 400 m, but no significant variations were found deeper than the 1,000 m level.

The Labrador Current flows southward until it reaches the southern part of the Orphan Basin, where the bathymetry of Orphan Basin diverts it eastward. Upon reaching the entrance to the Flemish Pass, the current divides into two branches; one branch continues to flow eastward north of the Flemish Cap, and the other branch flows southward through the Flemish Pass (see Figure 5.21 in Section 5.6.1.1). East of the tail of the Grand Banks, the Gulf Stream loses its characteristics and divides into branches. One of these branches flows northward on the eastern side of the Flemish Cap to the Orphan Basin region.

Moored current measurements in the Orphan Basin have been carried out by the Bedford Institute of Oceanography (BIO) and by Oceans Ltd. In the West Orphan Basin, BIO had two moorings, while in the East Orphan Basin BIO had five moorings and Oceans Ltd. had two moorings (Great Barasway F-66 in 2006, Lona O-55 in 2010).

In the West Orphan Basin, the two BIO moorings (WOB_1 and WOB_2) measured currents between May 1991 and May 1992. Both mooring sites are close to EL 1148 in the Project Area (see Table 5.23 and Figure 5.22 in Section 5.6.1.2). Mean and maximum current speeds at these two locations are provided in Table 16.3.

Table 16.3 Mean and Maximum Current Speeds at Two Moorings in the West Orphan Basin

Mooring	Period	Depth (m)	Mean Current Speed (cm/s)	Maximum Current Speed (cm/s)	Month of Maximum Current Speed	Predominant Current Direction
WOB_1	May 1991 to November 1991	200	11.7	30.7	October	S-SE
WOB_1	May 1991 to November 1991	400	9.1	22.0	September	S-SE
WOB_1	May 1991 to November 1991	900	8.2	19.7	May	S-SE
WOB_2	November 1991 to May 1992	400	7.6	23.2	December	S-SE
WOB_2	November 1991 to May 1992	900	7.4	23.1	April	S-SE

In the East Orphan Basin, the five BIO moorings measured currents between June 2004 and May 2010 (see Table 5.24 and Figure 5.24 in Section 5.6.1.2). Mean and maximum current speeds for these five moorings (EOB_1, EOB_2, EOB_3, EOB_4, and EOB_5) are shown in Table 16.4.

Table 16.4 Mean and Maximum Current Speeds at Five Moorings in the East Orphan Basin

Mooring	Period	Depth (m)	Mean Current Speed (cm/s)	Maximum Current Speed (cm/s)	Month of Maximum Current Speed	Predominant Current Direction
EOB_1	June 2004 to May 2005	362	8.3	30.7	November	S from June to July, W from August to May
EOB_1	June 2004 to May 2005	712	8.0	21.7	November	S
EOB_1	June 2004 to July 2004	1,112	8.5	21.4	July	S-SE
EOB_1	June 2004 to May 2005	1,912	7.8	21.7	June and March	S-SE
EOB_1	June 2004 to May 2005	2,237	7.3	31.4	June	S-SW
EOB_2	June 2004 to May 2005	2,227	8.3	30.5	April	SE
EOB_3	May 2008 to March 2009	2,455	8.4	32.0	June	SE
EOB_4	May 2008 to May 2009	2,719	11.9	37.5	August	S-SE
EOB_5	May 2009 to March 2010	2,474	10.3	40.4	June	S-SE
EOB_5	May 2009 to March 2010	2,724	14.2	39.5	April	S-SE

Oceans Ltd. placed current meter moorings in the East Orphan Basin at the Great Barasway F-66 and Lona O-55 wellsites during a period of exploration drilling (see Figure 5.26 in Section 5.6.1.2). Mean and maximum current speeds for the Great Barasway F-66 and Lona O-55 wellsites are provided in Tables 16.5 and 16.6, respectively.

Table 16.5 Mean and Maximum Current Speeds at the Great Barasway F-66 Wellsite in East Orphan Basin (September 2006 to April 2007)

Depth (m)	Mean Current Speed (cm/s)	Maximum Current Speed (cm/s)	Predominant Current Direction
300	11.6	36.3	S-SE
650	10.21	31.3	S-SE
1,850	8.9	24.0	S-SE
2,328	7.1	23.6	SE

Table 16.6 Mean and Maximum Current Speeds at the Lona O-55 Wellsite in East Orphan Basin

Depth (m)	Mean Current Speed (cm/s)	Maximum Current Speed (cm/s)	Predominant Current Direction
20	75.4	162.1	NE
100	11.7	38.5	SE
1,135	8.1	24.5	S
2,488	20.6	49.3	S

The surface waters were warmest in the West Orphan Basin during the months of July to September with mean temperatures ranging from 6.62°C to 8.59°C. The coldest temperatures were in March and April with mean temperatures of -0.10°C and 0.02°C, respectively. In the East Orphan Basin, surface waters were also warmest during the months of July to September, with mean temperatures ranging from 8.80°C to 12.40°C. The coldest temperatures were also in the months of March and April, with mean temperatures of 1.45°C and 2.50°C, respectively.

Within the Project Area and surrounding areas, the largest seas are typically found the furthest offshore, usually during the winter season. Extra-tropical storms dominate the wave climate of the Project Area, primarily from October through March, although severe storms may occur outside of these months. Storms of tropical origin may occur during the early summer and early winter, but most often occur from late August through October. Hurricanes are usually reduced to tropical storm strength or evolve into extra-tropical storms by the time they reach the Project Area, but they are still capable of producing storm force winds and high waves.

The dominant direction of the combined significant wave height is from the west during fall and winter. During the months of March and April, the wind wave remains predominantly westerly while the swell begins to come from a southerly direction, which results in the vector mean direction of the combined significant wave heights being southwesterly. There is a mean southwesterly direction for the combined significant wave heights during the summer months. During the months of September and October, the wind wave will veer to the west and become a dominant component of the combined significant wave height.

Significant wave heights in the Orphan Basin peak during the winter months and have a mean monthly significant wave height in January ranging from 4.4 to 4.6 m in the West Orphan Basin, and 4.8 m in the East Orphan Basin. The lowest significant wave heights occur in the summer, with July having a mean monthly significant wave height of 1.7 m within the West Orphan Basin, and 1.8 in the East Orphan Basin. Mean significant wave heights for all months of the year are shown in Table 5.6 in Section 5.4.5.2.

Combined significant wave heights of 10.0 m or more occurred in each month between September and April in the West and East Orphan Basins, with the highest waves occurring during the months of December and January. The highest significant wave height of 15.3 m occurred in the Flemish Pass on December 16, 1997. The maximum significant wave heights tend to peak during the winter months, although a tropical system could pass through the area and produce high wave heights during any month of the year. Seasonal and annual maximum combined significant wave heights are shown below in Table 16.7.

Table 16.7 Maximum Combined Significant Wave Heights (m) in the East and West Orphan Basin

Period	East Orphan Basin[1]	West Orphan Basin[2]
Winter	15.3	15.1
Spring	12.6	11.7
Summer	8.4	7.2
Fall	13.6	12.8
Annual	15.3	15.1

Notes:
[1] Maximum combined significant wave heights are based on MSC50 Grid Point 15340
[2] Maximum combined significant wave height based on maximum of MSC50 Grid Points 16684, 17322, and 17427

Currents have the potential to cause increased stress on MODU infrastructure (including the riser) and PSVs, which could result in the disruption of operations (Statoil Canada Ltd. 2017).

In the case of extreme oceanographic events, a tsunami triggered by a seismic event or subsea landslide could potentially affect the Project. Given the relatively short duration of Project activities, it is unlikely that a tsunami would occur during the life of the Project. In the unlikely event that a tsunami occurs, it is not expected to affect the operation of the MODU; offshore, tsunamis will have a small wave height of 1 m or less and a long wave period (Husky Energy 2012). Moorings (if applicable) could potentially be affected as tsunamis can have associated current speeds of up to 70 cm/s. PSV and helicopter traffic could also be delayed in the event of a tsunami.

16.1.3 Sea Ice, Icebergs, and Superstructure Icing

The Project Area, like other parts of the eastern Newfoundland offshore area, are subject to seasonal intrusions of sea ice and icebergs, as well as superstructure icing during meteorological events. Sea ice conditions vary each year and by location and are influenced by winter conditions (colder or milder) and seasonal wind patterns. Ice is moved further offshore when there are cold and dry winds from the west and through the north, while ice is brought towards shore when there are northeasterly winds (Statoil Canada Ltd. 2017).

A weekly analysis of the Canadian Ice Service's Frequency of Sea Ice for the period 1981 to 2010 was determined for the Project Area (see Table 5.26 and Figure 5.1 in Section 5.8.1.2). These statistics show that the Project Area is primarily affected by sea ice beginning the week of January 08 and lasting until the week of July 02, with the highest frequency of sea ice observed the week of March 12 (see Figure 5.32 in Section 5.8.1.2).

The "Median of Ice Concentration" database considers total concentration of ice on a weekly period from January 01 to July 30 to generate charts that represent statistical "normal" ice concentrations for a given date (see Table 5.27 and Figure 5.33 in Section 5.8.1.3). These results indicate that the 30-year median concentration of sea ice reaches its maximum over the Project Area the week of March 19 (see Figure 5.34 in Section 5.8.1.3), with 42.5% of the region covered in 7/10ths or greater sea ice.

Over the past 30 years, there have been 2,068 iceberg sightings inside the Project Area. The highest number of iceberg sightings occurred in 2014 with 286 iceberg sightings, the second highest was in 1993 and 2015 when there were 242 icebergs sighted. The mean annual number of iceberg sightings in the Project Area over this time period (1986 to 2015) was 71. Icebergs sightings were recorded within the Project Area for each month of the year, with a peak in sightings between the months of March, April, and May, with over 300 sightings in each month (summed over the period from 1986 to 2015). Small icebergs are the most prominent, accounting for 26.1% of the observed icebergs. Large icebergs account for 11.3% of sightings, and very large icebergs account for 0.8% of sightings (see Figure 5.33 in Section 5.8.2.2).

Environmental factors such as iceberg concentration, ocean currents, and wind determine how icebergs will drift through the Project Area. Icebergs tend to follow bathymetric contours and as a result, very few are found on the East Orphan Basin part of the Project Area.

Spray icing can accumulate on PSVs when air temperatures are below the freezing temperature of water, and there is potential for spray generation. Icing severity depends on air temperature, water temperature, water salinity, wave conditions, and wind speed. The freezing of salt spray may also occur under certain conditions: air temperature is below -1.8°C, sea temperature is below 6°C, and wind speeds are greater than 10 m/s (Statoil Canada Ltd. 2017).

Sea ice and icebergs represent navigational hazards with potential to affect PSV transportation and the operation of the MODU. Supply and personnel movement to and from the MODU could be delayed, and the MODU may be required to disconnect and move off the wellsite to avoid collision with an iceberg. Sea ice and icebergs could also increase the risk of an accidental event, the human health risk, and/or risk of irreparable damage to the MODU.

Water depths in the Project Area range from less than 200 m on the Northeast Newfoundland Shelf to greater than 3,000 m in the East Orphan Basin. The vast majority of the Project Area, including all four ELs

(1145, 1146, 1148, 1149), is in water deeper than 1,000 m (see Figure 5.5 in Section 5.3) Therefore, there would be no risk of iceberg scour in the vast majority of the Project Area, and no risk of scour in any of the ELs.

Potential icing rates were computed by Oceans Ltd. using wind speed, air speed, and air surface observations from the ICOADS data set. Potential spray icing conditions start during the month of November, with a frequency of icing potential of 1.1% in the East Orphan Basin and 8% in the West Orphan Basin. As temperatures cool throughout the winter, the frequency of icing potential increases to a maximum in February. Extreme sea spray icing conditions (icing rate greater than 4.0 cm/hr) were calculated to occur during the months of January through March in the West Orphan Basin.

Superstructure icing can result in a raised centre of gravity, slower PSV speed, maneuvering difficulty, and problems with cargo-handling equipment (DFO 2012). Delays may occur if operations are slowed down or suspended to remove ice accumulations caused by superstructure icing. If icing is not managed, this could cause damage to the superstructure (DFO 2012).

16.1.4 Geological Stability and Seismicity

Eastern Canada is located within a relatively stable area of the North American Plate, where there has been a relatively low level of recorded seismic activity (Amec 2014). There are approximately 450 earthquakes that occur each year in Eastern Canada, and the majority of these have magnitudes between two and three (Amec 2014). The Seismicity Hazard Map of Canada (see Figure 5.3 in Section 5.2) shows the probability of earthquake occurrences across Canada, and this map indicates that the Project Area and RAA has been classified as having a low to moderate seismic hazard (NRCan 2016).

According to the National Earthquake Database, 36 earthquakes have occurred in the RAA between 1985 and 2018 (see Figure 5.4 in Section 5.2) (NRCan 2018). Of these, 28 had magnitudes of 2 to 4, and 8 of these had magnitudes of 4 to 4.7 (NRCan 2018). Six of these earthquakes occurred within or bordering on the Project Area; three of these had magnitudes of 2 to 4, and three had magnitudes of 4 to 4.7. In EL 1145, there has been one earthquake of a magnitude of 4 to 4.7 that occurred on the southern border of the EL. In EL 1146, there has been one earthquake of a magnitude of 4 to 4.7 that occurred on the northern border of the EL. There were no recorded earthquakes in ELs 1148 and 1149. Most of the earthquake epicentres shown in Figure 5.4 are in the northwest part of the Project Area.

Potential offshore geohazards, other than seismicity, include:

- slope instability
- sediment loading
- venting of shallow gas
- gas hydrates
- seabed instabilities

The gradient, magnitude of seismic acceleration, and sediment strength determine whether sediment failure will occur (Statoil Canada Ltd. 2017). Most sediments found on continental margins are relatively stable and would require seismic accelerations associated with a large earthquake, with a magnitude of five or greater, to cause sediment failure (Nadim et al. 2005), with the exception of slopes of more than a few degrees.

Analysis has indicated that there is a major risk of a landslide every 20,000 years, and risk of a minor one every few thousand years in any given area in the Eastern Canada offshore. Most of the large failures observed on the seabed date back more than 10,000 years during periods of glaciation when large amounts of sediment were deposited onto the slope of the continental shelf (NRCan 2013).

Large, complex landslides have been mapped along a 65 km length of northeast flank of the Flemish Pass that extends approximately 20 km downslope (Statoil Canada Ltd. 2017). Failed sediments have been observed out as far as 20 km onto the floor of the Flemish Pass, forming Mass Transport Deposits (slumps, slides and debris flows that were transported downslope by gravitational processes) that are typically 50 m thick These sediment failures in the Flemish Pass are thought to be the result of earthquake triggers and are believed to have occurred 27,000 and 20,500 years ago (Cameron et al. 2014).

In an assessment of geohazards in the Flemish Pass area, Piper and Campbell (2005) suggested that most large debris flow deposits in the area are the result of earthquake-triggered slumps on both flanks of the Flemish Pass. A major earthquake would likely be required to trigger future landslides, and it has been estimated that such an event would occur approximately every 10,000 years in a worst-case scenario (Cameron et al. 2014). The Study Area for Cameron et al. (2014) is near EL 1149 (in the East Orphan Basin); however, EL 1149 is not on a slope.

Oil and gas activities can be conducted safely in areas where submarine landslides have occurred, such as at Ormen Lange. Ormen Lange is a production field (gas) in the Norwegian Sea situated in 850 to 1,100 m water depths that is located at the site of a submarine clay landslide. This landslide was likely triggered by an extremely strong, low-probability earthquake (Kvalstad et al. 2005) and excess pore pressure (Leynaud et al. 2007). The landslide occurred approximately 8,200 years ago in water depths of approximately 300 to 2,500 m. The area covered by the slide was approximately 90,000 m^2 and 3,500 km^3 of sediment was moved approximately 800 km out into deep water (Solheim et al. 2005; Statoil 2011).

The slide caused a tsunami (approximately 10 to 20 m high) that made landfall on the Norwegian coast, Scotland and the Faroe Islands (Norsk Oljemuseum 2011; Nadim et al. 2005). Development activities in the Ormen Lange field were found to have negligible effects on seafloor stability and it was determined not to trigger tsunami-generating slides (Statoil Canada Ltd. 2017).

While the Project Area has been classified as having a low seismic hazard (see Figure 5.3 in Section 5.2), a seismic event could contribute to seafloor and sediment instability and could disrupt Project activities and increase the potential for accidental events.

It has been estimated that earthquakes with a magnitude of 6 or greater could cause structural damage to offshore facilities. This damage could occur either directly or indirectly by tsunamis and/or landslides caused by an earthquake of sufficient magnitude (Statoil Canada Ltd. 2017). Since 1985, when the National

Earthquake Database began recording seismic events, there have been no events of magnitude of 6 or higher in the Project Area or RAA (NRCan 2018).

Historic records dating back to 1663 show that there has been one earthquake with a magnitude of 7 or greater that has occurred in the Newfoundland and Labrador offshore area. This earthquake occurred on the Grand Banks and Laurentian slope in 1929 and had a magnitude of 7.2. Based on these historic records, the probability of an earthquake affecting the Newfoundland and Labrador offshore is 0.0028 per year (1 every 354 years), as no other seismic events with a magnitude greater than 6 occurred during that time period (Environmental Research Consulting 2017).

As Project activities are of short duration (up to seven years with estimated 60 days drilling required per well for up to 20 wells), the probability of a major seismic event (and potential for related tsunami or submarine landslide) and associated spill occurring during the life of the Project is low.

16.2 Mitigating Potential Effects of the Environment on the Project

The primary means of mitigating adverse effects of the environment on the Project is through detailed engineering and use of environmental design criteria, compliance with industry codes of practice, and avoidance of environmental hazards where possible.

Table 16.8 outlines mitigation measures for environmental conditions that may have an effect on the Project. These include general mitigation measures, as well as those specific to oceanographic conditions, sea ice, icebergs and superstructure icing, and geological stability and seismicity.

The following factors / measures, in addition to those described in Table 16.8, will reduce the potential of occurrence, and magnitude of effects of the environment on the Project:

- short-term duration of potential offshore activities between 2020 and 2026 (i.e., approximately 60 days drilling per well for up to 20 wells)
- absence of fixed offshore infrastructure
- harsh-weather design criteria for the MODU
- requirements of C-NLOPB's Operations Authorization for drilling an exploration well
- requirements of the *Newfoundland Offshore Certificate of Fitness Regulations* and the *Offshore Physical Environment Guidelines* (NEB et al. 2008)
- continuous monitoring of meteorological and oceanographic conditions
- operating limits and stop-work procedures in the event of unsafe conditions

In addition to design standards and compliance with regulatory guidelines as the primary means for reducing adverse effects of weather conditions on the Project, BP has a number of plans to respond to adverse conditions should they threaten Project operations. These plans include the EPP, Safety Plan, and Incident Management Plan (IMP). These plans include detailed mitigation measures for activities associated with exploration (see Section 2.10.2) and will include specific conditions of approval.

Along with mitigation measures outlined in Table 16.8, the following paragraphs provide further details on ice management in the Project Area. Iceberg management is a proactive operation and Ice Management Plans typically include detection, monitoring and assessment, and physical management. Sea ice and icebergs are detected and tracked by the following initiatives:

- airborne reconnaissance, conducted annually by radar-equipped aircraft over the Grand Banks and areas to the north by the Canadian and American governments and private industry (Husky Energy 2012)
- daily long-range, shore-based radars and satellite-based sensors survey areas off Canada's east coast
- a daily summary of ice distribution provided by the Canadian Ice Service during the ice season integrating data from both these sources, with this summary made available to oil and gas operators

Typically, physical iceberg management (e.g., towing or deflecting the iceberg off its free-drifting track) is conducted upstream to move potentially hazardous sea ice / icebergs safely past the offshore exploration operations (Statoil Canada Ltd. 2017). Iceberg towing uses either ropes or an iceberg tow net and is the staple of iceberg management in the eastern Newfoundland offshore area; there have been over 500 documented iceberg tows in the region (Husky Energy 2012). Oil and gas operators on the Grand Banks have implemented a coordinated ice management approach since 1988 that shares ice information and management resources among operators.

Other management procedures for sea ice, such as breaking up ice to assist with shipping, are commonplace in Canadian waters. Such management procedures use PSVs to break up large floes that meet or exceed the design limits of PSVs and/or the MODU. Water cannons positioned on PSVs are another ice management tool, where the PSV is positioned a few hundred metres from the MODU and opens a path / lead in the pack ice (Statoil Canada Ltd. 2017).

Table 16.8 Mitigation Measures for Potential Effects of the Environment on the Project

Environmental Condition	Mitigation Measures
General	• BP will obtain daily weather forecasts for the area of operations from a contracted third-party • Radio communications systems will be in place to contact other marine vessels • MODU, PSVs, and shore bases will have systems in place for communication • Compliance with Canadian regulations for engineering design, and adherence to international standards, where applicable. • Engineering design of a MODU will consider the type and magnitude of loads imposed by ice, snow, waves, tides, currents, wind and operating ambient temperatures • MODU selected will be a deep-water, all-weather MODU that is specifically designed to operate in extreme environments • A Certificate of Fitness will be obtained for the MODU from an independent third-party Certifying Authority prior to the commencement of drilling operations in accordance with the *Newfoundland Offshore Certificate of Fitness Regulations* • MODU will have capability to disconnect the riser from the well in a short period of time, to reduce the risk of damage to the well, riser, and MODU • PSVs used for the Project will be equipped for safe all-weather operations, including increased stability in rough seas • PSVs will undergo BP's marine assurance process, and external inspections / audits by the C-NLOPB as part of the pre-authorization inspection process

Environmental Condition	Mitigation Measures
	• Adequate food and water supplies will be stored on the MODU to accommodate delays • BP will collect detailed site-specific information on climatic, meteorological, and oceanographic conditions as part of the planning and design of an offshore program and its associated regulatory review and approval requirements (e.g., *Offshore Physical Environment Guidelines*; NEB et al. 2008)
Reduced visibility	• If the set visibility requirements for helicopter flights are not met, flights will not occur. There are also specific navigational lighting requirements on the MODU's helipad and exterior • While PSVs can operate in most weather conditions, slower speeds may be required during periods of reduced visibility • Obstruction lights, navigation lights, and foghorns will be maintained in working condition on the MODU and PSVs
Extreme weather conditions / events	• PSV captains, helicopter pilots, and the MODU's Offshore Installation Manager will have the authority to suspend or modify operations in the case of adverse weather that could compromise the safety of PSV, helicopter, or MODU operations • If required due to extreme weather, the riser will be disconnected from the well, and the MODU will be moved to reduce the risk of damage or injury
Lightning	• PSVs and the MODU will have lightening protection systems to ground lightning electrical charges and transfer the energy to the sea water where it can be dissipated • Safe work practices will be implemented to reduce the risk of lightening to Project personnel, such as restricting access to external areas of the PSVs and MODU
Currents	• MODUs and PSVs will incorporate water current loads into their design • BP will implement a physical environment monitoring program, including met-ocean monitoring, onsite weather observation, and ice management, as required by the *Offshore Physical Environment Guidelines* (NEB et al. 2008)
Extreme oceanographic events (e.g., tsunamis)	• A Certificate of Fitness will be obtained for the MODU from an independent third-party Certifying Authority prior to the commencement of drilling operations in accordance with *the Newfoundland Offshore Certificate of Fitness Regulations*, considering the potential environmental loads imposed by naturally-occurring phenomena
Sea ice / icebergs and superstructure icing	• BP will prepare and submit an Ice Management Plan as part of the application for Drilling Program Authorization as per the *Offshore Physical Environment Guidelines* (NEB et al. 2008). This Plan will include details on sea ice/ iceberg monitoring and detection, and risk assessment, mitigation, and contingency procedures.
Earthquake	• MODU will have capability to disconnect the riser from the well in a short period of time, to reduce the risk of damage to the well, riser, and MODU

16.3 Residual Effects Summary

A significant adverse residual effect of the environment on the Project is defined as one that:

- results in damage to Project infrastructure, causing harm to Project workers or the public
- results in damage to Project infrastructure, resulting in repairs that are not technically or economically feasible
- affects Project components and / or activities to the extent that it then results in an adverse environmental effect on ecological or socio-economic components that meets or exceeds respective thresholds for significant adverse environmental effects (see Sections 8.0 to 14.0)

As described in the above sections, the components of the physical environment that may affect the Project are: weather conditions; oceanographic conditions; sea ice, icebergs and superstructure icing; and geological stability and seismicity. The engineering design, operation procedures, and mitigation measures described in the previous sections will reduce the potential adverse effects of these environmental components on the Project.

Based on the significance criteria above, and the described mitigation measures, it is predicted that there will be no significant adverse residual effects of the environment on the Project.

Accidental events or malfunctions (potentially caused by an effect of the environment on the Project), and associated adverse effects on environmental components, are assessed in Chapter 15.

16.4 References

Amec (Amec Environment & Infrastructure). 2014. Eastern Newfoundland and Labrador Offshore Area Strategic Environmental Assessment Update. Draft Report, February 2014. Submitted to Canada-Newfoundland and Labrador Offshore Petroleum Board, St. John’s, NL.

Cameron, G.D.M., Piper, D.J.W. and MacKillop, A. 2014. Sediment failures in Northern Flemish Pass. Geological Survey of Canada Open File 7566.

Colbourne, E. 2000. Interannual variations in the stratification and transport of the Labrador Current on the Newfoundland Shelf. Northwest Atlantic Fisheries Centre, International Council for the Exploration of the Sea. Department of Fisheries and Oceans.

DFO (Fisheries and Oceans Canada). 2012. Ice Navigation in Canadian Waters. Icebreaking Program, Maritime Services, Canadian Coast Guard and Fisheries and Oceans Canada. ix + 153 pp.

Environmental Research Consulting. 2017. Analysis of Probability of Potential Blowouts and Spills from Offshore Wells and Activities: Statoil Newfoundland Southern PA & Northern PA Environmental Impact Assessment. Draft report prepared for Statoil Canada Ltd., Stantec Consulting Ltd., and RPS ASA. 131 pp.

Fissel, D.B. and D.D. Lemon. 1991. Analysis of the physical oceanographic data from the Labrador Shelf, summer 1980. Canadian Contractor Report of Hydrography and Ocean Sciences, No. 39.

Han, G. and J. Li. 2004. Sea surface height and current variability on the Newfoundland Slope from TOPES/Poseidon Altimetry. Canadian Technical Report of Hydrography and Ocean Sciences, 234.

Han, G. and C.L. Tang. 1999. Velocity and transport of the Labrador Current determined from altimetric, hydrographic and wind data. *Journal of Geophysical Research*.104:18.

Husky Energy. 2012. White Rose Extension Project Environmental Assessment. Prepared for Husky Energy by Stantec Consulting Ltd., St. John’s, NL Canada.

Kvalstad, T.J., F. Nadim, A.M. Kaynia, K.H. Mokkelbost and P. Byrn. 2005. Soil conditions and slope stability on the Ormen Lange area. Mar. Petrol. Geol., 22: 299-310.

Lazier, J.R. and D. Wright. 1993. Annual velocity variations in the Labrador Current. Journal of Physical Oceanography, 23: 659-678.

Leynaud, D., N. Sultan and J. Mienert. 2007. The role of sedimentation rate and permeability in the slope stability of the formerly glaciated Norwegian continental margin: The Storegga slide model. Landslides, 4: 294-309.

Nadim, F., T.J. Kvalstad and T. Guttormsen. 2005. Quantification of risks associated with seabed instability. Marine and Petroleum Geology, 22: 311-318.

NEB (National Energy Board), Canada-Newfoundland and Labrador Offshore Petroleum Board and Canada Nova Scotia Offshore Petroleum Board. 2008. Offshore Physical Environmental Guidelines. vii + 28 pp. + Appendices.

Norsk Oljemuseum. 2011. Oil and Gas Fields in Norway. Industrial Heritage Plan.

NRCan (Natural Resources Canada). 2013. National Earthquake Database. http://www.earthquakescanada.nrcan.gc.ca/stndon/NEDB-BNDS/bull-eng.php.

NRCan (Natural Resources Canada). 2016. Seismic Hazard Map # 5 (of 5): 2010 National Building Code of Canada. Available at: http://www.earthquakescanada.nrcan.gc.ca/hazard-alea/zoning-zonage/images/NBCC2010canPGApdf_e.pdf.

NRCan (Natural Resources Canada). 2018. Search of the Earthquakes Canada Database. Available at; http://www.earthquakescanada.nrcan.gc.ca/stndon/NEDB-BNDS/bull-en.php?shape_type=region&region_north=89.99&region_east=-50&region_south=40&region_west=-150.

Piper, D.J.W. and D.C. Campbell. 2005. Quaternary Geology of Flemish Pass and its Application to Geohazard Evaluation for Hydrocarbon Development, in Petroleum Resources and Reservoirs of the Grand Banks, Eastern Canadian Margin, R. Hiscott and A. Pullham (Eds). Geological Association of Canada, Special Paper 43, p. 29-43.

Shell Canada Ltd. 2014. Shelburne Basin Venture Exploration Drilling Project Environmental Impact Statement. Prepared by Stantec Consulting Ltd.

Solheim, A., P. Byrn, H.P. Sejrup, J. Meinart and K. Berg. 2005. Ormen Lange – An integrated study for the safe development of a deep-water gas field within the Storegga Slide Complex, NE Atlantic continental margin: Executive Summary. Mar. Petrol. Geol., 22: 1-9.

Statoil Canada Ltd. 2011. Example of a field development Ormen Lange. Presentation. Available at: http://www.uio.no/studier/emner/matnat/math/MEK4450/h11/undervisningsmateriale/modul-1/2%20-%20Field%20development.pdf

Statoil Canada Ltd. 2017. Flemish Pass Exploration Drilling Program - Environmental Impact Statement. Prepared by Amec Foster Wheeler and Stantec Consulting Ltd. St. John's, NL Canada, November 2017. 1484 pp.

17.0 SUMMARY OF ENVIRONMENTAL EFFECTS

17.1 Changes to the Physical Environment

This section summarizes the changes that may be caused by the Project on the components of the environment listed in sections 5(1)(a) and (b) of CEAA, 2012, including those that are directly linked or necessarily incidental to federal decisions that would allow the Project to proceed (Table 17.1). Conclusions in this section are summarized from the detailed analyses in Sections 8 through 16 and are categorized as follows:

- changes to components of the environment within federal jurisdiction
- changes to the environment that would occur on federal or transboundary lands
- changes to the environment that are directly linked or necessarily incidental to federal decisions

Table 17.1 Summary of Changes to the Environment from Routine Activities and Unplanned (Accidental) Events

Topic	Changes
Changes to Components of the Environment within Federal Jurisdiction	
Marine Fish and Fish Habitat (including species at risk)	• Change in Risk of Mortality or Physical Injury • Change in Habitat Quality and Use
Marine Mammals and Sea Turtles (including species at risk)	• Change in Risk of Mortality or Physical Injury • Change in Habitat Quality and Use
Marine and Migratory Birds (including species at risk)	• Change in Risk of Mortality or Physical Injury • Change in Habitat Quality and Use
Changes to the Environment that Would Occur on Federal or Transboundary Lands	
Special Areas	• Change in Habitat Quality
Commercial Fisheries and Other Ocean Users	• Change in Availability of Resources
Indigenous Peoples and Community Values	• Change in Commercial Communal Fisheries • Change in Current Indigenous Use of Lands and Resources for Traditional Purposes
Changes to the Environment that are Directly Linked or Necessarily Incidental to Federal Decisions	
Accord Acts Authorizations (Operations Authorization and Well Approval under the Accord Acts and *Newfoundland and Labrador Offshore Petroleum Drilling and Production Regulations*)	• Operations Authorizations and Well Approvals under the Accord Acts sanction offshore exploration drilling projects in their entirety. Therefore, the changes to the environment associated with Project activities and components are directly linked or necessarily incidental to these authorizations.
Authorization under section 35(2)(b) of the *Fisheries Act* (if applicable)	• Change in risk of mortality or physical injury and/or change in habitat quality and use that constitutes serious harm to fish that are part of or support a commercial, recreational, or Aboriginal fishery.

An analysis regarding the potential changes to the environment summarized in Table 17.1 is provided in Sections 17.1.1 to 17.1.3.

17.1.1 Changes to Components of the Environment within Federal Jurisdiction

Section 5(1)(a) of CEAA, 2012 requires consideration of changes that may be caused to the following components of the environment that are within federal jurisdiction (i.e., within the legislative authority of Parliament): fish and fish habitat, as defined in section 2(1) of the *Fisheries Act;* aquatic species, as defined in section 2(1) of SARA; and migratory birds, as defined in section 2(1) of the MBCA.

Changes affecting marine fish and fish habitat, marine and migratory birds, and marine mammals and sea turtles are summarized in Sections 17.1.1.1 to 17.1.1.3, respectively. Greater detail is provided in Chapter 8 (Marine Fish and Fish Habitat), Chapter 9 (Marine and Migratory Birds), and Chapter 10 (Marine Mammals and Sea Turtles).

17.1.1.1 Marine Fish and Fish Habitat

Marine benthic, demersal, and pelagic fish species (including species at risk (SAR) and species of conservation concern (SOCC)) and habitat are present in and around the Project Area, LAA, and RAA. There is a high abundance and diversity of structure-forming benthic invertebrate species that occur in the Newfoundland Shelf and Slope, including corals, sponges, and sea pens (Amec 2014). Within the Project Area, corals are reported to be present in the northwest section of EL1145 and EL1146. The Northern Grand Banks encompasses an area designated as critical habitat for both northern and spotted wolffish. The proposed northern wolffish critical habitat overlaps the Project Area along a portion (1.4% of the Project Area overlaps 1.9% of the northern wolffish critical habitat) of the Northeast Newfoundland Slope. Potential environmental effects of the Project on marine fish and fish habitat include the following:

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

Fish habitat includes all aspects of the physical marine environment (including the benthic habitat and water quality), and considers spawning, rearing, nursery, food supply, overwintering, migration corridors, and any other area upon which fish depend directly or indirectly in order to carry out their life processes. The assessment includes species of commercial, recreational, and Aboriginal (CRA) importance, SAR and SOCC.

Fish within the LAA may be subject to increased risk of mortality or physical injury due to underwater sound emissions during certain Project activities, within a highly localized area. The presence and operation of the MODU will generate underwater sound that may affect the quality of the underwater acoustic environment for fish species, and VSP operations will also temporarily generate increased sound levels. Benthic species (e.g., fish, shellfish, sponges, and corals) may also experience mortality or physical injury from crushing or smothering as a result of waste management activities, particularly the discharge of drill cuttings and muds. Underwater sound emissions from MODU operation, VSP surveys, PSV operations, and well abandonment may also temporarily degrade the quality of fish habitat and result in sensory disturbance that may trigger behavioural responses in fish within the LAA. The localized, temporary reduction of water and sediment quality from routine operational discharges and emissions, including the discharge of drill muds and cuttings as well as drilling and testing emissions, may similarly affect habitat quality and use for fish within the LAA. Marine plants such as macroalgae are not located in the Project Area (given water depth), and routine Project activities are not predicted to interact with marine plants which occur in the nearshore. Accidental events (e.g., spills), although unlikely to occur, could alter fish habitat and/or result in species mortality or injury within the affected area. Depending on the type and location of the spill, these effects could potentially be realized beyond the LAA into the RAA, including the nearshore environment, although likelihood of shoreline contact is predicted to be low.

As summarized in Section 8.3, in consideration of the extent of the interactions and the planned implementation of known and proven mitigation, the residual environmental effects of routine Project activities and components on fish and fish habitat are predicted to be not significant. With the development and implementation of proposed well control, spill response, contingency, and emergency response plans (refer to Section 15.3), a significant adverse residual effect is not predicted for marine fish and fish habitat.

17.1.1.2 Marine and Migratory Birds

Several species of pelagic (i.e., offshore) and neritic (i.e., inshore) seabirds, waterfowl, shorebirds, and migratory land birds are present in and around the Project Area, LAA, and RAA. The productive Grand Banks and adjacent waters are known to support large numbers of seabirds in all seasons (Lock et al. 1994; Fifield et al. 2009). Potential environmental effects of the Project on migratory birds include the following:

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

Marine and migratory birds within the LAA may be subject to increased risk of mortality or physical injury due to underwater sound emissions; collisions with the MODU, helicopters, and PSVs; harm from flaring from a well test on the MODU; and exposure to other MODU or vessel-based threats. The presence and operation of the MODU and PSVs have the greatest potential to result in changes to risk of mortality or physical injury for marine and migratory birds because they are known to congregate around drilling and production platforms as a result of night lighting, food, and other visual cues, potentially making them subject to increased risk of mortality due to physical strikes of structures, predation by other marine bird species, and incineration from flares (Wiese et al. 2001; Ronconi et al. 2015). A change in habitat quality and use for marine and migratory birds could potentially occur from Project activities, particularly due to the influence of sound, artificial lighting, and discharges associated with the MODU and PSVs. These changes in the marine habitat could potentially influence bird behaviour (most likely result in attraction). Helicopter traffic also has the potential to affect habitat quality and use by marine and migratory birds. Accidental events (e.g., spills), although unlikely to occur, could alter migratory bird habitat and/or result in species mortality or injury within the affected area, which could extend beyond the LAA into the RAA.

As summarized in Section 9.3, with the application of proposed mitigation and environmental protection measures, the residual environmental effects from routine Project activities on marine and migratory birds are predicted to be not significant. Under certain circumstances (refer to Section 15.5), some accidental event scenarios could potentially result in a significant adverse effect on marine and migratory birds. However, with the implementation of proposed well control, spill response, contingency, and emergency response plans (refer to Section 15.3), significant residual adverse environmental effects on marine and migratory birds are unlikely to occur.

17.1.1.3 Marine Mammals and Sea Turtles

Several species of baleen whales (mysticetes), toothed whales (odontocetes), seals (phocids), and sea turtles (including SAR and SOCC) are present in and around the Project Area, LAA, and RAA. Potential environmental effects of the Project on marine mammals and sea turtles include the following:

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

Marine mammals and sea turtles within the LAA may be subject to increased risk of mortality or physical injury due to auditory damage from underwater sound emissions during certain Project activities (i.e., MODU operation and VSP surveys) and collisions with transiting PSVs. Underwater sound emissions from MODU operation, VSP surveys, and PSV operations may temporarily degrade the quality of marine mammal and sea turtle habitat and result in sensory disturbance that triggers behavioural responses in marine mammals and sea turtles within the LAA. Sensory disturbance associated with well abandonment and the localized degradation of water quality from routine operational discharges and emissions, including the discharge of drill muds and cuttings as well as drilling and testing emissions, may similarly affect habitat quality and use for marine mammals and sea turtles within the LAA. There is also potential for helicopter traffic to affect habitat quality and use for marine mammals by eliciting temporary diving behaviour. Accidental events (e.g., spills), although unlikely to occur, could alter marine mammal and sea turtle habitat and/or result in species mortality or injury within the affected area, which could extend beyond the LAA into the RAA.

As summarized in Section 10.3, with the application of proposed mitigation and environmental protection measures, the residual environmental effects of routine Project activities and components on marine mammals and sea turtles are predicted to be not significant. A significant adverse residual environmental effect is not predicted for marine mammals and sea turtles in the event of an accidental spill, including a well blowout.

17.1.2 Changes to the Environment that Would Occur on Federal or Transboundary Lands

Section 5(1)(b) of CEAA, 2012 requires consideration of changes that may be caused to the environment that would occur on federal lands, in another province, or outside of Canada. Project activities and components described within the scope of this EIS have the potential to result in changes to the environment that would occur on federal lands, including federal submerged lands and the federal waters and airspace above those lands. The ELs are located in the Grand Banks Region, with ELs 1145, 1146, and 1148 located in the West Orphan Basin within Canada’s 200 nm EEZ, and EL 1149 located in the East Orphan Basin, beyond the EEZ. The helicopter route occurs in the airspace above these areas. All of these areas constitute federal lands as defined under section 2(1) of CEAA, 2012. Since the scope of the Project does not include any land-based activities or components, changes to the environment from routine Project activities are not anticipated to occur on terrestrial lands belonging to Her Majesty in right of Canada, or reserves, surrendered lands, or other lands that are set apart for the use and benefit of a band and are subject to the *Indian Act*.

For all VCs, an accidental event such as a large-scale oil spill (i.e., well blowout) could possibly result in transboundary effects by extending to other provinces of Canada or outside an area of Canada's jurisdiction, affecting environmental components (such as migratory fish, birds, or marine mammals and sea turtles) that extend across or move both within and outside the areas under the jurisdiction of Canada (refer to Section 15.4 and Appendix D). However, with the development and implementation of proposed well control, spill response, contingency, and emergency response plans (refer to Section 15.3), a major accidental event is extremely unlikely to occur and would not be left unmitigated.

Changes to marine fish and fish habitat, marine mammals and sea turtles, and marine and migratory birds will also occur on federal submerged lands and in federal waters; these components have been addressed in Section 17.1.1. Therefore, this section focuses on special areas, commercial fisheries and other ocean users, and Indigenous peoples and community values, with greater detail provided in Chapter 11 (Special Areas), Chapter 12 (Indigenous Peoples and Community Values), and Chapter 13 (Commercial Fisheries and Other Ocean Users).

17.1.2.1 Special Areas

The Project Area overlaps spatially with a portion of the Orphan Spur EBSA, Orphan Knoll Seamount Closures VME, the Northeast Newfoundland and Labrador Slope Closure marine refuge, the Bonavista Cod Box (experimental closure) and proposed northern wolffish critical habitat. The Northeast Shelf and Slope EBSA and Eastern Avalon EBSA are within the LAA portion surrounding the PSV route to the shorebase; several other special areas including proposed northern and spotted wolffish critical habitat are located within the RAA (see Section 6.1). The potential environmental effect of the Project on special areas is a change in habitat quality.

A change in habitat quality for special areas could potentially occur because of Project activities affecting the marine environment. Underwater sound from MODU operation, VSP surveys, PSV operations, and well abandonment may temporarily reduce the quality of habitat in the special areas encompassed by the LAA and result in localized sensory disturbance that may trigger behavioural responses in marine species within these areas. The presence of artificial night lighting and other attractants associated with MODU operation, and the localized reduction of water and sediment quality from routine operational discharges and emissions, including the discharge of drill muds and cuttings as well as drilling and testing emissions, may similarly cause localized and temporary effects on habitat quality. The deposition of drill muds and cuttings may smother marine benthos and cause changes to the composition of the benthic macrofauna community within a highly localized area. Accidental events (e.g., spills), although unlikely to occur, could temporarily affect habitat in special areas within the affected area, which could extend beyond the LAA into the RAA.

As summarized in Section 11.3, in consideration of the extent of the interactions and the planned implementation of known and proven mitigation, residual environmental effects on special areas are predicted to be not significant. With the implementation of proposed well control, spill response, contingency, and emergency response plans (refer to Section 15.3), a significant adverse residual environmental effect is not predicted for special areas in event of a well blowout.

17.1.2.2 Indigenous Peoples and Community Values

The EIS Guidelines identified five Indigenous groups in Newfoundland and Labrador, 13 groups in Nova Scotia, 16 groups in New Brunswick, two groups in Prince Edward Island and five groups in Quebec that have the potential to be affected by Project activities. Potential effects of the Project on Indigenous peoples and community values include the following:

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

The Project could affect commercial communal fisheries resources by direct or indirect effects on fished species and/or effects on fishing activity from displacement from fishing areas, gear loss or damage, and availability of fisheries resources. Revenue generated from commercial communal fishing activity is also a main source of revenue for many Indigenous communities; therefore, indirect socio-economic impacts are also qualitatively considered in the assessment. Although there is no known FSC fishing occurring in the Project Area, routine Project activities may interact with migratory species, including marine fish, marine mammals, and marine birds, traditionally and currently harvested by Indigenous communities at their traditional harvesting sites. The assessment also considers the social, spiritual, and cultural value of the FSC fishery to the Indigenous communities; however, it is difficult, if not impossible, to express the importance of this fishery as a monetary value, because it reflects the very nature of Indigenous culture.

The Project could potentially result in adverse effects to a change in commercial communal fisheries and change in current use of lands and resources for traditional purposes; however, these effects are not likely to result in measurable effects on socio-economic conditions for Indigenous communities or s. 35 rights. Routine Project activities are also not anticipated to result in changes to the environment that would influence physical and cultural heritage due to the Project’s location over 340 km from the nearest Indigenous community on the Island of Newfoundland, and even further from such communities in Labrador, the Maritime provinces, and Quebec.

As summarized in Section 12.3, in consideration of the extent of the interactions and the planned implementation of known and proven mitigation, residual environmental effects on the Indigenous peoples and community values are predicted to be not significant. However, under certain circumstances, some accidental event scenarios could potentially result in a significant adverse effect for Indigenous peoples and community values (refer to Section 15.5.5). However, with the development and implementation of proposed well control, spill response, contingency, and emergency response plans (refer to Section 15.3), significant residual adverse environmental effects on Indigenous peoples and community values are unlikely to occur.

17.1.2.3 Commercial Fisheries and Other Ocean Users

Commercial fisheries and other ocean users are present in and around the Project Area, LAA, and RAA. Commercial fishing activity includes deploying, setting, retrieving / hauling, and/or accessing gear in designated fishing grounds, and travel to and from those fishing grounds. Ocean research activities can also include similar processes, and other ocean uses can include shipping and planned military activities. The potential environmental effect of the Project on commercial fisheries and other ocean users is a change in availability of resources.

The establishment of a 500-m radius safety zone around the MODU may affect the availability of fisheries resources for commercial fishers by excluding commercial fishing activities within that radius. There is also potential for gear loss or damage to affect the availability of fisheries resources, most likely occur during transit of the drilling installation from one area to another, before the MODU is set in place and the safety zone is established. Underwater sound emissions from MODU operation and VSP surveys may affect the availability of fisheries resources for commercial fishers if associated sensory disturbance within the LAA results in behavioural responses in commercially-fished species (e.g., avoidance). However, given the small extent of the affected area, the temporary nature of the activities, the availability of other similar fishing areas, and the Notices to Shipping and Notices to Mariners that BP will provide regarding its operations, the potential for effects is considered low.

Physical, or behavioural effects on fish could indirectly affect other ocean users, including research activities. Oil and gas activities may also restrict certain areas for research or military exercises, which may result in changes in schedules, or moving to different areas. The presence of the MODU, due to its safety zone, can have similar interactions and outcomes with other ocean activities such as research programs and planned military exercises, and may require researchers and the military to re-route their program or wait until the safety zone is removed before they can begin their operations. Early and ongoing communication between other industries will help reduce the potential for interaction with other ocean users.

The reduction of water and sediment quality from routine operational discharges and emissions, including the discharge of drill muds and cuttings as well as drilling and testing emissions, is unlikely to affect resource availability for commercial fishers given the temporary and localized nature of the potential effects around the wellsite. The potential smothering of marine benthos within a highly localized area of the Project Area / LAA, including benthic prey species for commercially fished species, as a result of the deposition of drill muds and cuttings, is unlikely to affect the availability of fisheries resources for commercial fishers. Accidental events (e.g., spills), although unlikely to occur, could damage fishing gear, result in the imposition of fisheries closures due to contamination (actual or perceived) of fish species commonly harvested for human consumption through CRA fisheries, alter fish habitat, and/or result in species mortality or injury for commercially important species within the affected area, which could extend beyond the LAA into the RAA.

As summarized in Section 13.3, in consideration of the extent of the potential interactions and the planned implementation of known and proven mitigation, residual environmental effects on commercial fisheries and other ocean users are predicted to be not significant. However, under certain circumstances, some accidental event scenarios could potentially result in a significant adverse effect on commercial fisheries and other ocean users (refer to Section 15.5). With the implementation of proposed well control, spill response, contingency, and emergency response plans (refer to Section 15.3), significant residual adverse environmental effects on commercial fisheries and other ocean users are unlikely to occur.

17.1.3 Changes to the Environment that are Directly Linked or Necessarily Incidental to Federal Decisions

Section 5(2)(a) of CEAA, 2012 requires consideration of additional changes that may be caused to the environment and that are directly linked or necessarily incidental to a federal authority's exercise of a power or performance of a duty or function that would permit the carrying out, in whole or in part, of the designated project. The primary regulatory approvals necessary to conduct an offshore drilling program are an Operations Authorization (Drilling) and a Well Approval (Approval to Drill a Well) pursuant to the Accord Acts and their regulations. A *Fisheries Act* authorization is not expected to be required in support of the Project, as Project activities and components are not predicted to result in "serious harm to fish" (i.e., the death of fish or any permanent alteration to, or destruction of, fish habitat) for species that are part of or support a CRA fishery. Although drilling discharges will result in localized alteration of benthic habitat, these effects will not be permanent and are not anticipated to affect CRA species. In advance of drilling, seabed surveys at the proposed wellsites will be conducted to confirm the absence of sensitive environmental features (e.g., habitat-forming coral or species at risk) at the chosen drilling locations.

This section focuses on changes to the environment other than those referred to under section 5(1)(a) and (b) of CEAA, 2012, which are considered in Sections 17.1.1 and 17.1.2, respectively, of this EIS.

17.1.3.1 Atmospheric Environment

Project activities and components authorized by the C-NLOPB under these regulatory approvals may cause changes to the environment as outlined in Sections 17.1.1 and 17.2.2. Project activities and components could also result in a change to the atmospheric environment through the release of air emissions and generation of sound emissions associated with operation of the MODU, PSVs, and helicopters.

As noted in Section 2.8.1, the Project is predicted to emit approximately 534 tonnes of CO_2 equivalent (CO_2 eq) per day (64,080 tonnes CO_2 eq per year) from fuel combustion for the MODU, helicopters and PSVs. For 2015, ECCC reported an annual GHG emission value for the province of Newfoundland and Labrador of 10,300 kilotonnes of CO_2 eq per year (28,219 tonnes of CO_2 eq per day); the total Canadian GHG inventory was 722,000 kilotonnes of CO_2 eq (Environment and Climate Change Canada 2017). Assuming two wells are drilled in any given year (approximately 60 days each), BP's predicted annual CO_2 emissions for the Project from routine activities therefore represent approximately 0.46% of Newfoundland and Labrador's average annual emissions and 0.009% of the national 2015 inventory. Air emissions from the Project will adhere to applicable regulations and standards including the Newfoundland and Labrador *Air Pollution Control Regulations*, National Ambient Air Quality Objectives, Canadian Ambient Air Quality Standards, and regulations under MARPOL.

Underwater sound will be generated by the MODU and PSVs, as well as during VSP operations. Atmospheric or in-air sound (e.g., sound above the sea surface) is not considered to be a substantial concern given the relative low level of atmospheric sound sources (above sea level) and limited transmission of underwater sound through the air-sea interface. Potential receptors associated with this development or coastal communities on the Island of Newfoundland would not perceive atmospheric sound generated by Project activities due to separation distance. Atmospheric sound is assessed with respect to the Marine and Migratory Birds VC and residual environmental effects are predicted to be not significant (Chapter 9). Underwater sound is assessed with respect to Marine Fish and Fish Habitat (Chapter 8), Marine and Migratory Birds (Chapter 9), Marine Mammals and Sea Turtles (Chapter 10) and residual environmental effects for all VCs are predicted to be not significant.

11.4.1.1 Terrestrial Environment

As per the EIS Guidelines, the EIS must identify any changes related to the terrestrial environment including:

- landscape disturbance
- migratory bird habitat, including losses, structural changes, and fragmentation of habitat and wetlands used by migratory birds
- critical habitat for federally listed species at risk
- key habitat for species important to Indigenous current use of resources

Routine Project activities and components are not predicted to interact with the terrestrial environment, including migratory bird habitat, critical habitat for SAR, or key habitat for species important to Indigenous current use of resources.

The loading and refueling of PSVs in St. John's will occur at existing industrial facilities and not result in any landscape disturbance, or changes to migratory bird habitat, or critical habitat for SAR, or habitat for species important to Indigenous current use of resources. Section 6.2 describes areas of significance for migratory birds. PSVs will enter and leave St. John's Harbour using established shipping lanes. Incremental atmospheric sound emitted from the PSVs would be minor and incremental to existing vessel traffic noise in the Harbour and not expected to adversely affect migratory birds (including species at risk) nesting or foraging nearby.

Routine Project activities (including PSV operations) are not predicted to interact with the terrestrial environment and therefore will not affect key habitat for species important to Indigenous current use of resources.

In the unlikely event of a major accidental event (e.g., well blowout) or a PSV-related batch spill nearshore, there could potentially be some interaction with the shoreline environment, thereby potentially resulting in any or all of the changes to the terrestrial environment listed in the EIS Guidelines and referred above (Section 15.5 and Appendix D). However, with the development and implementation of proposed well control, spill response, contingency, and emergency response plans (Section 15.3), a major accidental event is extremely unlikely to occur and would not be left unmitigated. The Project is therefore not likely to result in any significant effects to the terrestrial environment.

17.2 Effects of Changes to the Environment

This section summarizes the effects of changes that may be caused by the Project on the components of the environment listed in section 5(1)(c) and 5(2)(b) of CEAA 2012, including those that are directly linked or necessarily incidental to federal decisions that would allow the Project to proceed. Conclusions in this section are summarized from the detailed analyses in Sections 8 through 14 and are categorized as follows:

- effects of changes to the environment occurring in Canada of changes to the environment on Indigenous people
- effects of changes to the environment that are directly linked or necessarily incidental to federal decisions

17.2.1 Effects of Changes to the Environment on Indigenous People

Effects of changes to the environment on Indigenous people as outlined in the EIS Guidelines are presented in Chapter 12 (Indigenous peoples and community values). This section of the EIS summarizes the effects of changes to the environment on Indigenous people caused by the Project in accordance with section 5(1)(c) of CEAA, 2012. In particular, changes to the following environmental components are summarized:

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

17.2.1.1 Health and Socio-Economic Conditions

Given that routine Project-related activities will occur in the marine environment over 340 km from the nearest Indigenous community on the Island of Newfoundland, and even further from such communities in Labrador, the Maritime provinces, and Quebec, it is unlikely that effects from routine activities will directly affect the physical or social health and well-being of Indigenous persons or communities. Activities will occur in a localized area, over a short period of time, and the standard mitigation practices will be implemented to reduce adverse effects. As discussed in Section 12.3, routine Project activities are therefore not anticipated to result in changes to the environment that would influence human health and well-being of Indigenous peoples.

Routine Project activities are not predicted to result in changes to the socio-economic conditions in the Indigenous communities. Given the offshore location of Project activities, routine activities are not predicted to interact with on-land or nearshore Indigenous activities that contribute to the socio-economic conditions, including with services and infrastructure within or used by Indigenous peoples and their communities. As discussed in Section 12.3, given the low likelihood of residual effects on Indigenous fisheries from routine activities, associated potential effects to socio-economic conditions such as employment and business activity and income, community revenue, and availability of culturally important species in the Indigenous communities are anticipated to be low.

Under certain circumstances, some accidental event scenarios could potentially result in a significant adverse environmental effect on commercial communal fisheries and / or current use of lands and resources for traditional purposes (refer to Section 15.5.5), which could in turn, potentially result in a change in health and socio-economic conditions for Indigenous peoples. However, with the development and implementation of proposed well control, spill response, contingency, and emergency response plans (refer to Section 15.3), effects on health and socio-economic conditions for Indigenous peoples are unlikely to occur.

17.2.1.2 Physical and Cultural Heritage

As described in the *Technical Guidance for Assessing Physical and Cultural Heritage or any Structure, Site or Thing that is of Historical, Archeological, Paleontological or Architectural Significance under CEAA, 2012*, heritage is associated with important aspects of human history and culture and can encompass social, economic, political, environmental, scientific, natural, and cultural dimensions. Cultural landscape also often describes a geographical area that has been modified, influenced, or given special cultural meaning by people (Agency 2015). As discussed in Section 12.3, there are no known heritage sites in the Project Area or LAA. Routine Project activities are also not anticipated to result in changes to the environment that would influence physical and cultural heritage due to the Project's location over 340 km from the nearest Indigenous community on the Island of Newfoundland, and even further from such communities in Labrador, the Maritime provinces, and Quebec.

17.2.1.3 Current Use of Lands and Resources for Traditional Purposes

A detailed discussion of the potential effects from routine Project activities and current use of lands and resources for traditional purposes is provided in Section 12.3.2. Current use of lands and resources related to traditional fisheries, also known as FSC fisheries, includes harvesting activities to collect resources that provide nourishment, or for use in traditional ceremonies and social events. There is potential that a change in current use of lands and resources for traditional purposes could occur from routine Project activities affecting the marine environment; however, with the implementation of mitigation, effects were predicted, in general, to be negligible to low in magnitude, localized (within the LAA), short-term in duration, and reversible.

As discussed in Section 7.3, Indigenous groups in Newfoundland and Labrador, the Maritime provinces, and Quebec, have an Aboriginal right to fish for food, social and ceremonial purposes, and Indigenous groups in the Maritime Provinces and the Gaspé Peninsula in Quebec have the right to fish for a 'moderate livelihood' established through Peace and Friendship Treaties, or in the case of the Nunatsiavut Government through Land Claims Agreements. Based on the Agency's initial review of potential or established Aboriginal and/or treaty rights, the Agency determined that there is a low likelihood of interaction between the Project under routine operations, and potential or established Aboriginal and/or treaty rights for each Indigenous group (Agency, pers. comm. 2018). The impact analysis presented in this EIS supports the Agency's initial determination.

Under certain circumstances, some accidental event scenarios could potentially result in a significant adverse environmental effect on current use of lands and resources for traditional purposes (refer to Section

15.5.5). However, with the development and implementation of proposed well control, spill response, contingency, and emergency response plans (refer to Section 15.3), significant residual adverse environmental effects on current use of lands and resources for traditional purposes are unlikely to occur.

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

There are no known physical and cultural sites, including structures, sites, or things of historical, archaeological, paleontological, or architectural significance in the Project Area or LAA. Routine Project activities are unlikely to adversely affect any structure, site or thing that is of historical, archaeological, paleontological, or architectural significance because of the offshore location of the Project and the localized extent of Project interactions.

17.2.2 Effects of Changes to the Environment that are Directly Linked or Necessarily Incidental to Federal Decisions

Section 5(2)(b) of CEAA, 2012 requires consideration of the effects of changes to the environment that are directly linked or necessarily incidental to a federal authority's exercise of a power or performance of a duty or function that would permit the carrying out, in whole or in part, of the designated project, if any of the following are affected:

- health and socio-economic conditions
- physical and cultural heritage and any structure, site or thing that is of historical, archaeological, paleontological or architectural significance

Table 17.2 summarizes the changes to the environment that are linked to federal decisions on the Project that are required under the Accord Acts and the *Fisheries Act*.

Operations Authorizations and Well Approvals under the Accord Acts sanction offshore exploration drilling projects in their entirety. Therefore, Project activities and components are directly linked or necessarily incidental to these authorizations.

Table 17.2 Summary of Changes to the Environment that are Potentially Contingent on Federal Decisions

Federal Decision	Changes (Potential Environmental Effects)	Affected VCs
Accord Acts Authorizations (Operations Authorization and Well Approval under the Accord Acts and *Newfoundland and Labrador Offshore Petroleum Drilling and Production Regulations*)	Change in Risk of Mortality or Physical Injury	• Marine Fish and Fish Habitat • Marine Mammals and Sea Turtles • Marine and Migratory Birds
	Change in Habitat Quality and Use	• Marine Fish and Fish Habitat • Marine Mammals and Sea Turtles • Marine and Migratory Birds
	Change in Habitat Quality	• Special Areas
	Change in Availability of Resources	• Commercial Fisheries and Other Ocean Users
	Change in Commercial Communal Fishing or Change in Current Indigenous Use of Lands and Resources for Traditional Purposes	• Indigenous Peoples and Community Values
Fisheries Act Authorization (Authorization for Serious Harm to Fish under section 35(2)(b) of the *Fisheries Act*)	Change in Risk of Mortality or Physical Injury	• Marine Fish and Fish Habitat
	Change in Habitat Quality and Use	• Marine Fish and Fish Habitat

For the same reasons as explained above with respect to the effects of changes to the environment on Indigenous people (refer to Section 17.2.1), Project activities and components are not expected to result in changes to the environment that would have an effect on health conditions; physical and cultural heritage; or any structure, site or thing that is of historical, archaeological, paleontological or architectural significance for Indigenous or non-Indigenous people. However, effects on socio-economic conditions may occur from the following potential changes to the environment:

- change in risk of mortality or physical injury for fish
- change in habitat quality and use for fish
- change in availability of resources (for commercial and Indigenous fisheries)
- change in traditional use for Indigenous people

Given that these potential changes to the environment are temporary and localized around the MODU and PSVs, and that other suitable fish habitat and fishing areas are readily available throughout the RAA, these potential changes to the environment are not anticipated to substantially affect socio-economic conditions for commercial or Indigenous fishers (refer to Chapters 12 and 13).

In consideration of the extent of the interactions and the planned implementation of known and proven mitigation, as described in Chapters 8, 12, and 13, residual environmental effects from routine activities on marine fish and fish habitat and associated residual environmental effects on socio-economic conditions pertaining to commercial fisheries and other ocean users and Indigenous peoples and community values, are predicted to be not significant.

Under certain circumstances, some accidental event scenarios have the potential to result in a significant effect (including associated socio-economic effects) on Indigenous peoples and community values, and commercial fisheries and other ocean users, if the spill trajectory overlaps spatially and temporally with fisheries resources. However, with the implementation of proposed well control, spill response, contingency, and emergency response plans (refer to Section 15.3), significant residual adverse environmental effects are unlikely to occur.

17.3 Summary

The Project has the potential to result in residual adverse environmental effects in relation to the following considerations:

- changes to components of the environment within federal jurisdiction
- changes to the environment that would occur on federal or transboundary lands
- changes to the environment that are directly linked or necessarily incidental to federal decisions
- effects of changes to the environment occurring in Canada of changes to the environment on Aboriginal people
- effects of changes to the environment that are directly linked or necessarily incidental to federal decisions

The residual environmental effects of routine Project activities and components on marine fish and fish habitat, marine and migratory birds, marine mammals and sea turtles, special areas, Indigenous peoples and community values, and commercial fisheries and other oceans users are predicted to be not significant.

In the unlikely event of a Project-related accidental event resulting in the large-scale release of oil (e.g., blowout), effects to marine and migratory birds, Indigenous peoples and community values, and commercial fisheries and other ocean users have potential to be significant if the spill trajectory overlaps spatially and temporally with sensitive receptors. However, with the implementation of proposed well control, spill response, contingency, and emergency response plans (refer to Section 15.3), significant residual adverse environmental effects are unlikely to occur.

17.4 References

Amec (Amec Environment and Infrastructure). 2014. Eastern Newfoundland and Labrador Offshore Area Strategic Environmental Assessment. Final Report. Submitted to Canada-Newfoundland and Labrador Offshore Petroleum Board, St. John's, NL. 527 pp. + appendices. Available at: http://www.cnlopb.ca/sea/eastern.php.p

Canadian Environmental Assessment Agency. 2015a. Technical Guidance for Assessing Physical and Cultural Heritage or any Structure, Site or Thing. Updated: March 2015

ECCC (Environment and Climate Change Canada). 2017. National Inventory Report, 1990-2015: Greenhouse Gas Sources and Sinks in Canada.

Fifield, D.A., K.P. Lewis, C. Gjerdrum, G.J. Robertson and R. Wells. 2009. Offshore Seabird Monitoring Program. Environmental Studies Research Funds ESRF Report, 183: 68 pp.

Lock, A.R., R.G.B. Brown and S.H. Gerriets. 1994. Gazetteer of Marine Birds in Atlantic Canada: An Aatlas of Seabird Vulnerability to Oil Pollution. Canadian Wildlife Service Atlantic Region. 137 pp.

Ronconi, R.A., Allard, K.A., and Taylor, P.D. 2015. Bird interactions with offshore oil and gas platforms: Review of impacts and monitoring techniques. J. Environ. Manage., 147: 34-45.

Wiese, F.K., Montevecchi, W.A., Davoren, G.K., Huettmann, F., Diamond, A.W., and Linke, J. 2001. Seabirds at risk around offshore oil platforms in the Northwest Atlantic. Marine Pollution Bulletin, 42(12):1285-1290.

18.0 CONCLUSIONS

BP proposes to conduct exploration drilling activities within the areas of its existing offshore ELs in the Orphan Basin, ranging from approximately 343 and 496 km northeast of St. John's, Newfoundland and Labrador, in the Northwest Atlantic Ocean. The Newfoundland Orphan Basin Exploration Drilling Program (the Project) may involve drilling up to 20 exploration wells, with an initial well proposed to be drilled in 2020, pending regulatory approval.

BP was awarded exploration rights to ELs 1145, 1146, and 1148 with its co-venturers Hess Canada Oil and Gas ULC and Noble Energy Canada ULC and EL 1149 with co-venturer Noble Energy Canada ULC by the C-NLOPB in 2016. The full term of these ELs extends from January 15, 2017 to January 15, 2026, with the first portion of the term (first term) ending January 15, 2023. BP will serve as the operator for the exploration drilling program.

18.1 Summary of Potential Effects

The assessment methods used in the preparation of this EIS included an evaluation of the potential environmental effects for each valued component (VC) that may arise during routine Project activities and potential accidental events. The assessment methods also included an evaluation of potential cumulative effects to consider whether there is potential for the residual environmental effects of the Project to interact cumulatively with the residual environmental effects of other past, present, or future (i.e., certain or reasonably foreseeable) physical activities in the vicinity of the Project.

A precautionary approach has been applied to assessing and reducing environmental effects in planning and designing the Project and throughout the EA process. This includes using standard equipment, methods, and technologies in Project design for which potential environmental interactions are well understood and managed using proven mitigation.

In support of the EA process, supporting studies were undertaken including drill waste dispersion modelling (Appendix B), an acoustic assessment (Appendix C), and oil spill fate and trajectory modelling (Appendix D).

The scope of the Project evaluated as part of this EIS was selected to align with the EIS Guidelines. Routine and accidental events were assessed against several VCs, specifically marine fish and fish habitat, marine and migratory birds, marine mammals and sea turtles, special areas, Indigenous peoples and community values, and commercial fisheries and other ocean users. Species at Risk (SAR) and Species of Conservation Concern (SOCC) were considered within marine fish and fish habitat, marine and migratory birds, and marine mammals and sea turtles.

Routine operations represent physical activities that would occur throughout the life of the Project and include the presence and operation of the MODU (including light and underwater sound emissions), VSP, discharges (including discharge of drill muds and cuttings and other discharges and emissions), well testing and flaring, well abandonment, and supply and servicing operations (helicopter transportation and PSV operations). These activities reflect the scope of the Project as outlined in the EIS Guidelines and represent physical activities that would occur throughout the life of the Project forming the basis of the effects assessment.

Accidental events that could potentially occur during exploration drilling and could potentially result in adverse environmental effects were identified and evaluated. Potential accidental events that were identified include: small spills which could occur during operations and maintenance activity; small to medium size batch spills that could occur on the MODU and PSVs; and a subsea blowout. Accidental events that could give rise to a spill are unlikely and the probability of a large oil spill occurring during an exploration drilling project is very low (refer to Section 15.2 and Appendix D). However, as discussed in Section 15.5, significant adverse residual environmental effects could potentially occur to marine and migratory birds, Indigenous peoples and community values, and commercial fisheries and other ocean users in the unlikely event of a large accidental spill from a blowout.

The key environmental factors that may affect the Project include reduced visibility, high winds and waves, geohazards (such as shallow gas pocket or abnormal pressure zones), and icebergs and sea ice. However, engineering design, operational procedures, geohazard assessments, and other mitigation measures will reduce the potential adverse effects on, and risks to, the Project. The MODU will be designed for harsh weather conditions. Adverse residual effects of the physical environment on the Project are predicted to be not significant.

Potential interactions between the VCs and Project activities included in the scope of the EIS, which formed the basis for the effects analysis, are presented in Table 18.1. Proposed mitigation measures are presented in Section 18.2 and an overview of the effects analysis is presented in Section 18.3.

Table 18.1 Potential Project-VC Interactions and Effects

Project Activities and Components	Marine Fish and Fish Habitat		Marine and Migratory Birds		Marine Mammals and Sea Turtles		Special Areas	Indigenous Peoples and Community Values		Commercial Fisheries and Other Ocean Users
	Change in Risk of Mortality or Physical Injury	Change in Habitat Quality and Use	Change in Risk of Mortality or Physical Injury	Change in Habitat Quality and Use	Change in Risk of Mortality or Physical Injury	Change in Habitat Quality and Use	Change in Habitat Quality	Change in Commercial Communal Fisheries	Change in Current Use of Lands and Resources for Traditional Purposes	Change in Availability of Resources
Routine Activities										
Presence and operation of a MODU (including drilling, associated safety zone, lights, and MODU lighting)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Vertical seismic profiling (VSP) operations	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Discharges (e.g., drill muds / cuttings, liquid discharges)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Well evaluation and testing (including flaring)	-	-	✓	✓	-	-	-	-	✓	-
Well abandonment and decommissioning	-	✓	-	-	-	-	✓	✓	✓	✓
Supply and servicing operations (including helicopter transportation and PSV operations)	-	✓	✓	✓	✓	✓	✓	✓	✓	✓
Accidental Events										
Well Blowout Incident	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
10 bbl Diesel Spill	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
100 bbl Diesel Spill	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PSV Diesel Spill	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SBM Spill	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

18.2 Summary of Mitigation, Monitoring and Follow-up

Mitigation is proposed to reduce or eliminate adverse environmental effects. Most potential environmental effects can be managed effectively with general design mitigation and standard operating procedures, many of which are captured in BP's own policies and procedures, regulations, and/or guidelines. In some cases, Project-specific mitigative commitments are proposed to reduce or eliminate potential adverse effects on VCs. A summary of standard mitigation and Project-specific commitments to be implemented is provided in Table 18.2.

Table 18.2 Summary of Standard and Project-Specific Mitigation

No.	Proponent Commitments	EIS Reference
General		
1	Contractors and subcontractors will be required to demonstrate conformance with the requirements that have been established, including HSSE standards and performance requirements.	Section 2.10
2	A Certificate of Fitness will be obtained for the MODU from an independent third-party Certifying Authority prior to the commencement of drilling operations in accordance with the *Newfoundland Offshore Certificate of Fitness Regulations*.	Sections 2.4.1, 16.2
3	The observation, forecasting and reporting of physical environment data will be conducted in accordance with the *Offshore Physical Environment Guidelines* (NEB et al. 2008).	Sections 16.2
4	BP and contractors working on the Project will regularly monitor weather forecasts to forewarn PSVs, helicopters and the MODU of inclement weather or heavy fog before it poses a risk to their activities and operations. Extreme weather conditions that are outside the operating limits of PSVs or helicopters will be avoided, if possible. Captains / Pilots will have the authority and obligation to suspend or modify operations in case of adverse weather or poor visibility that compromises the safety of PSV, helicopter, or MODU operations.	Section 16.2
5	BP will prepare and submit an Ice Management Plan as part of the application for Drilling Program Authorization as per the *Offshore Physical Environment Guidelines* (NEB et al. 2008). This Plan, which will form part of the Safety Plan submission, will include details on sea ice/ iceberg monitoring and detection, and risk assessment, mitigation, and contingency procedures.	Section 16.2
6	Safe work practices will be implemented to reduce exposure of personnel to lightning risk (e.g., restriction of access to external areas on the MODU or PSV during thunder and lightning events).	Section 16.2
7	Prior to any drilling activity, BP will conduct a comprehensive regional geohazard baseline review, followed by detailed geohazard assessments for each proposed wellsite.	Section 2.2
Presence and Operation of the MODU		
8	A safety zone will be established around the MODU in accordance with the *Newfoundland Offshore Petroleum Drilling and Production Regulations* SOR/2009-316.	Sections 2.4, 12.3, 13.3
9	BP will provide details of the safety zone to the Marine Communication and Traffic Services for broadcasting and publishing in the Notices to Shipping and Notices to Mariners. Details of the safety zone will also be communicated during ongoing engagement with commercial and Indigenous fishers.	Sections 12.3, 13.3

<table>
<tr><th>No.</th><th>Proponent Commitments</th><th>EIS Reference</th></tr>
<tr><td>10</td><td>To maintain navigational safety at all times during the Project, obstruction lights, navigation lights and foghorns will be kept in working condition on board the MODU. Radio communication systems will be in place and in working order for contacting other marine vessels as necessary.</td><td>Sections 12.3, 13.3,16.2</td></tr>
<tr><td>11</td><td>The MODU will be equipped with local communication equipment to enable radio communication between the PSVs and the MODU’s bridge. Communication channels will also be put in place for internet access and enable communication between the MODU and shore.</td><td>Section 2.10.3</td></tr>
<tr><td>12</td><td>BP will conduct an imagery-based seabed survey at the proposed wellsite(s) to confirm the absence of shipwrecks, debris on the seafloor, unexploded ordnance, and sensitive environmental features, such as habitat-forming corals or species at risk. The survey will be carried out prior to drilling and will encompass an area within a 500-m radius from the wellsite. If any environmental or anthropogenic sensitivities are identified during the survey, BP will notify the C-NLOPB immediately to discuss an appropriate course of action. This may involve further investigation and/or moving the wellsite if it is feasible to do so. This survey will also serve to provide baseline data for coral and sensitive benthic habitat that may be present and be used to inform discussions on potential follow-up and monitoring with respect to drill waste discharges.</td><td>Sections 8.3, 13.3</td></tr>
<tr><td>13</td><td>Artificial lighting will be reduced to the extent that worker safety and safe operations are not compromised.</td><td>Sections 8.3, 9.3</td></tr>
<tr><td>14</td><td>Stranded birds on the MODU and PSVs will be recovered using the methods from Procedures for Handling and Documenting Stranded Birds Encountered on Infrastructure Offshore Atlantic Canada (ECCC 2016).</td><td>Section 9.3</td></tr>
<tr><td colspan="3">VSP Operation</td></tr>
<tr><td>15</td><td>As required in the Geophysical, Geological, Environmental and Geotechnical Program Guidelines (C-NLOPB 2017), mitigation measures applied during geophysical surveys (VSP) will be consistent with those outlined in the Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment (SOCP) (DFO 2007). The following are key mitigation measures that will be employed during VSP surveys:
Marine Mammal Observers (MMOs) will be used to monitor and report on marine mammal and sea turtle sightings during VSP surveys to advise shutdown and ramp-up procedures
A ramp-up procedure (i.e., gradually increasing seismic source elements over a period of approximately 30 minutes until the operating level is achieved) will be implemented before any VSP activity beings. This measure is aimed at reducing the potential for auditory injury to marine animals in close proximity to the source at the onset of activity. It is based on the assumption that the gradual increase in emitted sound levels will provide an opportunity for marine animals to move away from the sound source before potentially injurious sound levels are achieved close to the source. This procedure will include a pre-ramp up observation period. Ramp-up will be delayed if any marine mammal or sea turtle is detected within the 500 m safety zone.
Shut down procedures (i.e., shutdown of air gun source array) will be implemented if a marine mammal or sea turtle listed on Schedule 1 of SARA as well as all baleen whales and sea turtles are observed within 500 m of the wellsite.</td><td>Sections 8.3, 9.3, 10.3, 11.3</td></tr>
</table>

No.	Proponent Commitments	EIS Reference
	• Passive acoustic monitoring (PAM) will be used to detect vocalizing marine mammals during conditions of low visibility (e.g., fog and darkness). The technical specifications and operational deployment configuration of the PAM system will be optimized within the bounds of operational and safety constraints in order to maximize the likelihood of detecting cetacean species anticipated being in the area.	
Discharges		
16	Air emissions from the Project will adhere to applicable regulations and standards including the Newfoundland and Labrador *Air Pollution Control Regulations*, National Ambient Air Quality Objectives, Canadian Ambient Air Quality Standards, regulations under MARPOL and the intent of the Global Gas Flaring Reduction Partnership.	Section 2.8.1
17	Selection and screening of chemicals to be discharged, including drill fluids, will be in accordance with the *Offshore Chemical Selection Guidelines* (NEB et al. 2009). Where feasible, lower toxicity drilling muds and biodegradable and environmentally friendly properties activities within muds and cements will be used. The chemical components of drilling fluids, where feasible, will be those that have been rated as being least hazardous under the Offshore Chemical Notification Scheme (OCNS) and Pose Little or No Risk to the Environment by the Convention for the Protection of the Marine Environment of the North-East Atlantic (refer to Section 2.9 for more information on chemical selection).	Sections 2.9, 8.3, 9.3, 10.3, 11.3
18	Offshore waste discharges and emissions associated with the Project (i.e., operational discharges and emissions from the MODU and PSVs) will be managed in accordance with relevant regulations and municipal bylaws as applicable, such as the OWTG and MARPOL, of which Canada has incorporated provisions under various sections of the *Canada Shipping Act*. Waste discharges not meeting legal requirements will not be discharged to the ocean and will be brought to shore for disposal.	Section 2.8, 8.3
19	SBM drill cuttings will be returned to the MODU and treated in accordance with the OWTG before being discharged into the marine environment. The concentration of SBM on cuttings will be monitored onboard the MODU, and in accordance with OWTG, no excess or spent SBM will be discharged, and any of this excess or spent SBM that cannot be reused will be brought back to shore for disposal. WBM drill cuttings will be discharged without treatment.	Section 2.8, 8.3
20	Excess cement may be discharged to the seabed during the initial phases of the well, which will be drilled without a riser. Unused cement bulks and additives will be transported to shore for future re-use or disposed at an approved facility.	Section 2.8
21	Small amounts of produced water may be flared. If volumes of produced water are large, some produced water may be brought onto the MODU for treatment so that it can be discharged in line with the OWTG.	Section 2.8
22	Deck drainage and bilge water will be discharged according to the OWTG which state that deck drainage and bilge water can only be discharged if the residual oil concentration of the water does not exceed 15 mg/L.	Section 2.8
23	Ballast water will be discharged according to IMO *Ballast Water Management Regulations* and Transport Canada's *Ballast Water Control and Management Regulations.* The MODU will carry out ballast tank flushing prior to arriving in Canadian waters.	Section 2.8
24	Putrescible solid waste, specifically food waste generated offshore on the MODU and PSVs, will be disposed according to OWTG and MARPOL requirements. In particular, maceration of kitchen waste will be conducted in accordance with MARPOL and OWTG. There will be no discharge of macerated food waste within 3 nm from land.	Section 2.8

No.	Proponent Commitments	EIS Reference
25	Sewage will be macerated in accordance with MARPOL and in line with the OWTG prior to discharge.	Section 2.8
26	Cooling water will be discharged in line with the OWTG which states that any biocides used in cooling water are selected in line with a chemical management system developed in line with the OCSG.	Section 2.8
27	BOP fluids and any other discharges from the subsea control equipment will be discharged according to OWTG and OCSG.	Section 2.8
28	Liquid wastes, not approved for discharge in OWTG such as waste chemicals, cooking oils or lubricating oils, will be transported onshore for transfer to an approved disposal facility.	Section 2.8
29	The transfer of hazardous wastes will be conducted in accordance with the *Transportation of Dangerous Goods Act*, and any applicable approvals for the transportation, handling, and temporary storage of hazardous waste will be obtained, as required.	Section 2.8
Well Testing and Evaluation		
30	If flaring is required, BP will discuss flaring plans with the C-NLOPB including steps to reduce adverse effects on migratory birds. This may involve restricting flaring to the minimum required to characterize the wells' hydrocarbon potential and as necessary for the safety of the operation, minimizing flaring during periods of migratory bird vulnerability, and the use of a water curtain to deter birds from the general vicinity of the flare.	Section 9.3
Well Abandonment and Decommissioning		
31	Once wells have been drilled and evaluation programs completed (if applicable), the wells will be plugged and abandoned in line with applicable BP practices and C-NLOPB requirements. The final well abandonment program has not yet been finalized; however, these details will be confirmed to the C-NLOPB as planning for the Project continues.	Sections 8.3, 11.3
32	A seabed survey will be conducted at the end of the drilling program using an ROV to survey the seabed for debris.	Section 2.10
33	BP will communicate locations of suspended and/or abandoned wellsite locations to the appropriate authorities for inclusion on nautical charts for use by commercial fishers and other mariners.	Section 13.3
Supply and Servicing Operations		
34	PSVs will undergo BP's internal assurance process as well as external inspections / audits inclusive of the C-NLOPB's pre-authorization inspection process in preparation for the Project.	Section 2.4.5
35	Routes of helicopters transiting to and from the MODU will avoid transiting near migratory bird nesting colonies and will comply with provincial *Seabird Ecological Reserve Regulations*, 2015, and, ECCC's *Avoidance Guidelines* for seabird and waterbird colonies. Appropriate flight altitudes and horizontal buffer zones will be established to minimize disturbance to colonies in accordance with the Seabird Ecological Reserve Regulations, 2015 and the ECCC's *Avoidance Guidelines*. Specific details will be provided in the EPP.	Section 9.3
36	PSV routes transiting to and from the MODU will be planned to avoid passing within 300 m of migratory bird nesting colonies during the nesting period and will comply with provincial *Seabird Ecological Reserve Regulations*, 2015 and federal guidelines to minimize disturbance to colonies (ECCC 2017b). Specific details will be provided in the EPP.	Section 9.3
37	PSVs travelling between the Project Area and shorebase will follow established shipping lanes in proximity to shore.	Sections 10.3, 12.3, 13.3

No.	Proponent Commitments	EIS Reference
38	During transit to/from the Project Area, PSVs will travel at vessel speeds not exceeding 22 km/hour (12 knots), except as needed in the case of an emergency. In the event that a marine mammal or sea turtle is detected in proximity to the vessel, vessel speed will be reduced. Marine mammal and sea turtle sightings will be recorded opportunistically during PSV transit. In the unlikely event of a vessel collision with a marine mammal or sea turtle, BP will contact the Canadian Coast Guard within 24 hours following the collision.	Sections 10.3, 13.3
39	Lighting on PSVs will be reduced to the extent that safety of operations is not compromised.	Section 9.3
40	To maintain navigational safety at all times during the Project, obstruction lights, navigation lights and foghorns will be kept in working condition on board the PSVs. Radio communication systems will be in place and in working order for contacting other marine vessels as necessary.	Sections 12.3, 13.3
Accidental Events		
41	BP will implement multiple preventative and response barriers to manage risk of incidents occurring and mitigate potential consequences. As noted in Section 15.3, the Project will operate under an Incident Management Plan (IMP) which will include contingency plans for responding to specific emergency events, including potential spill or well control events. The IMP and supporting specific contingency plans, such as a Spill Response Plan (SRP), will be submitted to the C-NLOPB prior to the start of any drilling activity as part of the Operations Authorizations (OA) process. The SRP will specify tactical response methods, procedures and strategies for safely responding to different spill scenarios. Tactical response methods that will be considered following a spill incident include but are not limited to: offshore containment and recovery; surveillance and tracking; dispersant application; in-situ burning; shoreline protection; shoreline clean up; and oiled wildlife response. Refer to Section 15.3 for details on incident management and spill response.	Sections 15.5.1, 15.5.2, 15.5.3, 15.5.4, 15.5.5, 12.5.6
42	BP will undertake a Spill Impact Mitigation Assessment (SIMA) / Net Environmental Benefit Analysis (NEBA) as part of the OA process with the C-NLOPB. The SIMA is a structured process that will qualitatively evaluate the risks and trade-offs of all feasible and effective response options, when compared to no action. The SIMA process will inform the selection of an overall spill response strategy for the Project.	Sections 15.3.3, 15.5.1, 15.5.2, 15.5.3, 15.5.4, 15.5.5, 15.5.6
43	If identified as a preferred response option, use of chemical dispersants would not occur without first obtaining regulatory approval.	Sections 15.3.3, 15.5.1, 15.5.2, 15.5.3, 15.5.4, 15.5.5, 15.5.6
44	In the unlikely event of a spill, specific monitoring (e.g., environmental effects monitoring) and follow-up programs may be required and will be developed in consultation with regulatory agencies, Indigenous groups, and fisheries stakeholders as applicable.	Sections 15.5.1, 15.5.2, 15.5.3, 15.5.4, 15.5.5, 15.5.6
45	In the event that oil threatens or reaches the shoreline, shoreline protection measures, including deflection from sensitive areas, will be implemented as practical. Shoreline Clean-up Assessment Technique (SCAT) teams will be mobilized to the affected areas to conduct shoreline surveys to document the type and degree of any shoreline oiling, and inform shoreline clean-up and remediation as applicable. SCAT teams will also be used to monitor and evaluate the effectiveness of the clean-up operations	Section 15.5.2
46	BP will develop a Wildlife Response Plan and, for incidents where wildlife is threatened, engage specialized expertise to implement the Plan, including the recovery and rehabilitation of wildlife species as needed (refer to Section 15.3 for BP's oiled wildlife response approach).	Sections 15.3.3,15.5.2, 15.5.3

No.	Proponent Commitments	EIS Reference
Indigenous and Stakeholder Engagement		
47	BP will continue to engage Indigenous communities to share Project details as applicable and facilitate coordination of information sharing. An Indigenous Fisheries Communication Plan (IFCP) will be used to facilitate coordinated communication with Indigenous fishers. The IFCP will include procedures for informing fishers of an accidental event and appropriate response.	Section 12.3
48	BP will continue to engage commercial fishers to share Project details, as applicable and determine the need for a fisheries liaison officer during mobilization and demobilization of the MODU. This engagement will be coordinated through One Ocean, Fish, Food and Allied Workers-Unifor, Ocean Choice International, Association of Seafood Producers, and Groundfish Enterprise Allocation Council. A Fisheries Communication Plan will be used to facilitate coordinated communication with fishers (FCP). The FCP will include procedures for informing fishers of an accidental event and appropriate response.	Section 13.3
49	BP will maintain ongoing communications with the NAFO Secretariat, through DFO as the Canadian representative, regarding planned Project activities, including timely communication of drilling locations, safety zone, and decommissioned wellsites.	Section 13.3
50	BP will develop and implement a compensation program for damages resulting from Project activities. This compensation program will be developed in consideration of C-NLOPB guidelines, including the *Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activities* (C-NLOPB and CNSOPB 2017).	Sections 12.3, 13.3
51	BP will contact DFO regarding timing and locations of planned DFO research surveys.	Section 13.3
52	BP will contact DND regarding timing of planned offshore military exercises.	Section 13.3

Under CEAA 2012, a follow-up program is defined as a program for "verifying the accuracy of the environmental assessment of a designated project" and "determining the effectiveness of any mitigation measures." In most cases, the effects of routine exploration drilling activities and effectiveness of mitigation measures are well-understood (refer to Chapter 8-13). Where the level of confidence in effects prediction is low or an interest has been expressed by Indigenous groups, or regulatory or public stakeholders for additional information, follow-up has been proposed.

BP is proposing to implement a follow-up program to address uncertainty regarding residual effects of drill waste discharges on the marine benthic environment in consideration of the proximity of Significant Benthic Areas to BP's Project Area and concerns raised by Indigenous groups about potential effects on cold-water corals. As noted in Table 18.2, BP will conduct an imagery-based seabed survey at the proposed wellsite(s) to confirm the absence of sensitive environmental features, such as habitat-forming corals or species at risk prior to drilling. If any environmental sensitivities are identified during the survey, BP will notify the C-NLOPB immediately to discuss an appropriate course of action. This may involve further investigation and/or moving the wellsite if it is feasible to do so. This survey will also serve to provide baseline data for coral and sensitive benthic habitat that may be present and be used to inform discussions on potential follow-up with respect to drill waste discharges. BP plans to conduct a visual survey of the seafloor using an ROV after drilling activities to assess the visual extent of sediment dispersion and validate drill waste modelling predictions. The specific details of the follow-up program will be determined in consultation with the C-NLOPB and DFO in consideration of the pre-drill survey results.

In addition, the following monitoring programs are proposed to gather data and reduce potential interactions with marine and migratory birds (refer to Chapter 9), marine mammals and sea turtles (refer to Chapter 10), and special areas (refer to Chapter 11).

- For the duration of the drilling program for each well, routine systematic checks will be conducted for stranded birds on the MODU and PSVs by trained personnel in accordance with Procedures for Handling and Documenting Stranded Birds Encountered on Infrastructure Offshore Atlantic Canada (ECCC 2016) and associated permit conditions under the MBCA authorizing the capture and handling of migratory birds. Results of the monitoring program will be shared publicly to help further improve the understanding of bird strandings and mortality in the Newfoundland and Labrador offshore area.
- BP will develop a marine mammal and sea turtle monitoring plan to be implemented during VSP surveys as outlined in Section 10.3.2. The Plan will include MMO requirements, shutdown and ramp-up procedures and reporting requirements.
- In the unlikely event of a collision with a marine mammal or sea turtle, BP will contact the Canadian Coast Guard within 24 hours following the collision.

BP will submit a report to the C-NLOPB documenting the implementation schedule of commitments and additional conditions of approval, as applicable (prior to drilling) and will also report on the outcome of follow-up and monitoring programs (post-abandonment) of each well, along with any additional conditions of approval, as applicable. The implementation schedule and results will be shared with Indigenous groups and made available online for public information.

In addition to monitoring and reporting associated with mitigative commitments presented in this EIS, BP will be responsible for reporting to the C-NLOPB in accordance with the *Drilling and Production Regulations* and *Data Acquisition and Reporting Regulations*. The *Drilling and Production Guidelines* (C-NLOPB and CNSOPB 2017) and *Data Acquisition and Reporting Guidelines* (C-NLOPB 2011) describe the extensive testing, measurement, monitoring and reporting requirements to be conducted during an exploratory well drilling program. Incidents will be reported in accordance with the *Incident Reporting and Investigation Guidelines* (C-NLOPB and CNSOPB 2018). Examples of C-NLOPB reporting requirements for exploration drilling include (but are not limited to):

- survey plan to confirm the location of the well on the seafloor
- Daily Drilling Report summarizing drilling and related operations, including completion, workover, well intervention, or any other well operation
- daily site-specific meteorological forecast and report of ice conditions
- compliance monitoring and reporting for waste discharges, where specific qualitative or quantitative discharge limits are identified in the EPP
- annual Safety Report including a summary of lost or restricted workday injuries, minor injuries and safety-related incidents and near-misses that have occurred during the preceding year; and efforts undertaken to improve safety
- Well Termination Record (within 30 days of well termination date)
- Environmental Report within 90 days of the rig release date for each exploration well including a physical environment report and summary of environmental performance matters

18.3 Residual Environmental Effects

Chapters 8 to 13 of this EIS present the residual environmental effects for routine operations for each VC. Table 18.3 summarizes the residual effect findings for each VC and indicates the significance of these effects. Section 15 of this EIS presents the residual environmental effects for accidental events for each VC. Table 18.4 summarizes the residual effect findings for each VC and indicates the significance of these effects. Where an effect is predicted to be significant (refer to Chapters 8-13 for significance criteria for each VC), the likelihood of that effect occurring is also presented.

Table 18.3 Summary of Residual Effects for Routine Operations

Valued Components	Area of Federal Jurisdiction (CEAA, 2012 s.5 "environmental effect")	Potential Effect	Project Activity	Mitigation Reference (refer to Table 18.2)	Residual Effect Characterization					Other Criteria Used to Determine Significance	Significance of Residual Effect	Likelihood of Significant Effect
					Magnitude	Extent	Duration	Frequency	Reversibility			
Marine Fish and Fish Habitat	s. 5(1)(a)(i)	Change in Risk of Mortality or Physical Injury	Presence and Operation of a MODU	See Section 8.3 and Table 18.2	L	PA	MT	IR	R	D	N	N/A
			VSP Operations		L	PA	ST	IR	R	D	N	N/A
			Discharges		L	PA	MT-LT	IR	R	D	N	N/A
		Change in Habitat Quality and Use	Presence and Operation of a MODU		L	PA-LAA	MT	IR	R	D	N	N/A
			VSP Operations		L	PA-LAA	ST	IR	R	D	N	N/A
			Discharges		L	PA	MT-LT	IR	R	D	N	N/A
			Well Abandonment and Decommissioning		L	PA	ST-LT	IR	R	D	N	N/A
			Supply and Servicing Operations		L	LAA	MT	IR	R	D	N	N/A
Marine and Migratory Birds	s. 5(1)(a)(iii)	Change in Risk of Mortality or Physical Injury	Presence and Operation of a MODU	See Section 9.3 and Table 18.2	L	RAA	ST-MT	IR	R	D	N	N/A
			VSP Operations		N-L	PA	ST	IR	R	D	N	N/A
			Discharges		L	PA	ST	IR	R	D	N	N/A
			Well Evaluation and Testing		L	PA	ST	IR	R	D	N	N/A
			Supply and Servicing Operations		L	LAA	ST	IR	R	D	N	N/A
		Change in Habitat Quality and Use	Presence and Operation of a MODU		L	RAA	ST-MT	IR	R	D	N	N/A
			VSP Operations		N	PA	ST	UL	R	D	N	N/A
			Discharges		L	PA	ST	UL	R	D	N	N/A
			Well Evaluation and Testing		L	PA	ST	IR	R	D	N	N/A
			Supply and Servicing Operations		L	LAA	ST	IR	R	D	N	N/A
Marine Mammals and Sea Turtles	s. 5(1)(a)(ii)	Change in Risk of Mortality or Injury	Presence and Operation of a MODU	See Section 10.3 and Table 18.2	N	PA	ST-MT	UR	R	D	N	N/A
			VSP Operations		N-L	PA	ST-MT	UL	R	D	N	N/A
			Supply and Servicing Operations		N-L	LAA	ST-MT	UL	R	D	N	N/A
		Change in Habitat Quality and Use	Presence and Operation of a MODU		L	PA-LAA	ST-MT	IR	R	D	N	N/A
			VSP Operations		L	PA	ST-MT	IR	R	D	N	N/A
			Discharges		N	PA	ST	UL	R	D	N	N/A
			Well Abandonment and Decommissioning		N	PA	ST	UL	R	D	N	N/A
			Supply and Servicing Operations		L	PA	ST	IR	R	D	N	N/A

Valued Components	Area of Federal Jurisdiction (CEAA, 2012 s.5 "environmental effect")	Potential Effect	Project Activity	Mitigation Reference (refer to Table 18.2)	Residual Effect Characterization					Other Criteria Used to Determine Significance	Significance of Residual Effect	Likelihood of Significant Effect
					Magnitude	Extent	Duration	Frequency	Reversibility			
Special Areas	s. 5(1)(b)(i)	Change in Habitat Quality	Presence and Operation of a MODU	See Section 11.3 and Table 18.2	L-M	PA	ST	IR	R	D	N	N/A
			VSP Operations		L	PA	ST	IR	R	D	N	N/A
			Discharges		L-M	PA	ST-MT	IR	R	D	N	N/A
			Well Abandonment and Decommissioning		L	PA	ST-LT	IR	R	D	N	N/A
			Supply and Servicing Operations		L	LAA	ST	IR	R	D	N	N/A
Indigenous Peoples and Community Values	s.5(1)(c)(i) s.5(1)(c)(iii)	Change in Commercial Communal Fisheries	Presence and Operation of a MODU	See Section 12.3 and Table 18.2	L	PA	ST	IR	R	D	N	N/A
			VSP Operations		N-L	PA	ST	IR	R	D	N	N/A
			Discharges		L	PA	MT	IR	R	D	N	N/A
			Well Abandonment and Decommissioning		N-L	PA	ST-LT	IR	R	D	N	N/A
			Supply and Servicing Operations		N-L	LAA	ST	IR	R	D	N	N/A
Indigenous Peoples and Community Values	s.5(1)(c)(i) s.5(1)(c)(iii)	Change in Current Use of Lands and Resources for Traditional Purposes	Presence and Operation of a MODU		L	PA	ST	IR	R	D	N	N/A
			VSP Operations		L	PA	ST	IR	R	D	N	N/A
			Discharges		L	PA	MT	IR	R	D	N	N/A
			Well Evaluation and Testing		L	PA	ST	IR	R	D	N	N/A
			Well Abandonment and Decommissioning		N-L	PA	ST-LT	IR	R	D	N	N/A
			Supply and Servicing Operations		L	LAA	ST	IR	R	D	N	N/A
Commercial Fisheries and Other Ocean Users	s. 5(2)(b)(i)	Change in Availability of Resources	Presence and Operation of a MODU	See Section 13.3 and Table 18.2	L	PA	ST	IR	R	D	N	N/A
			VSP Operations		L	PA	ST	IR	R	D	N	N/A
			Discharges		L	PA	ST	IR	R	D	N	N/A
			Well Abandonment and Decommissioning		L	PA	ST-LT	IR	R	D	N	N/A
			Supply and Servicing Operations		L	LAA	ST	IR	R	D	N	N/A

Valued Components	Area of Federal Jurisdiction (CEAA, 2012 s.5 “environmental effect”)	Potential Effect	Project Activity	Mitigation Reference (refer to Table 18.2)	Residual Effect Characterization					Other Criteria Used to Determine Significance	Significance of Residual Effect	Likelihood of Significant Effect
					Magnitude	Extent	Duration	Frequency	Reversibility			
					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	**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	**Significance:** S: Significant N: Not Significant	**Likelihood:** U: Unlikely L: Likely N/A: Not applicable

Key/Note:
VC specific definitions included for each VC in Chapters 8-13.
Environmental Effects under CEAA, 2012:
5(1)
(a) a change that may be caused to the following components of the environment that are within the legislative authority of Parliament:
- (i) fish as defined in section 2 of the *Fisheries Act* and fish habitat as defined in subsection 34(1) of that Act,
- (ii) aquatic species as defined in subsection 2(1) of the *Species at Risk Act*,
- (iii) migratory birds as defined in subsection 2(1) of the *Migratory Birds Convention Act*, 1994, and
- (iv) any other component of the environment that is set out in Schedule 2 of [CEAA, 2012];

(b) a change that may be caused to the environment that would occur
- (i) on federal lands,
- (ii) in a province other than the one in which the act or thing is done or where the physical activity, the designated project or the project is being carried out, or
- (iii) outside Canada; and

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

Certain additional environmental effects must be considered under section 5(2) of CEAA, 2012 where the carrying out of the physical activity, the designated project, or the project requires a federal authority to exercise a power or perform a duty or function conferred on it under any Act of Parliament other than CEAA, 2012.
5(2)
(a) a change, other than those referred to in paragraphs (1)(a) and (b), that may be caused to the environment and that is directly linked or necessarily incidental to a federal authority’s exercise of a power or performance of a duty or function that would permit the carrying out, in whole or in part, of the physical activity, the designated project or the project; and
(b) an effect, other than those referred to in paragraph (1)(c), of any change referred to in paragraph (a) on
- (i) health and socio-economic conditions,
- (ii) physical and cultural heritage, or

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

Table 18.4 Summary of Residual Effects for Accident Events

Valued Components	Area of Federal Jurisdiction (CEAA, 2012 s.5 "environmental effect")	Potential Effect	Accidental Event Scenario	Mitigation Reference (refer to Table 18.2)	Residual Effect Characterization					Other Criteria Used to Determine Significance	Significance of Residual Effect	Likelihood of Significant Effect
					Magnitude	Extent	Duration	Frequency	Reversibility			
Marine Fish and Fish Habitat	s. 5(1)(a)(i)	Change in Risk of Mortality or Physical Injury / Change in Habitat Quality and Use	Well Blowout Incident	See Section 15.5 and Table 11.2	M-H	RAA*	ST-MT	S	R	D	N	N/A
			10 bbl Diesel Spill		L	LAA	ST	S	R	D	N	N/A
			100 bbl Diesel Spill		M	RAA	ST	S	R	D	N	N/A
			PSV Diesel Spill		M	RAA	ST-MT	S	R	D	N	N/A
			SBM Spill		L	LAA	ST-LT	S	R	D	N	N/A
Marine and Migratory Birds	s. 5(1)(a)(iii)	Change in Risk of Mortality or Physical Injury / Change in Habitat Quality and Use	Well Blowout Incident	See Section 15.5 and Table 11.2	H	RAA*	ST-MT	S	R	D	S	U
			10 bbl Diesel Spill		L	LAA	ST	S	R	D	N	N/A
			100 bbl Diesel Spill		M	RAA	ST	S	R	D	S	U
			PSV Diesel Spill		M	RAA	ST-MT	S	R	D	S	U
			SBM Spill		L	LAA	ST	S	R	D	N	N/A
Marine Mammals and Sea Turtles	s. 5(1)(a)(ii)	Change in Risk of Mortality or Physical Injury / Change in Habitat Quality and Use	Well Blowout Incident	See Section 15.5 and Table 11.2	H	RAA*	ST-MT	S	R	D	N	N/A
			10 bbl Diesel Spill		L	LAA	ST	S	R	D	N	N/A
			100 bbl Diesel Spill		M	LAA	ST	S	R	D	N	N/A
			PSV Diesel Spill		M	LAA	ST-MT	S	R	D	N	N/A
			SBM Spill		L	LAA	ST	S	R	D	N	N/A
Special Areas	s. 5(1)(b)(i)	Change in Habitat Quality	Well Blowout Incident	See Section 15.5 and Table 11.2	H	RAA*	MT	S	R	D	N	N/A
			10 bbl Diesel Spill		L	LAA	ST	S	R	D	N	N/A
			100 bbl Diesel Spill		M	LAA	ST	S	R	D	N	N/A
			PSV Diesel Spill		L-M	LAA	ST-MT	S	R	D	N	N/A
			SBM Spill		L	LAA	ST-LT	S	R	D	N	N/A
Indigenous Peoples and Community Values	s.5(1)(c)(i) s.5(1)(c)(iii)	Change in Commercial Communal Fisheries / Change in Current Use of Lands and Resources for Traditional Purposes	Well Blowout Incident	See Section 15.5 and Table 11.2	H	RAA	LT	S	R	D	S	U
			10 bbl Diesel Spill		N-L	LAA	ST	S	R	D	N	N/A
			100 bbl Diesel Spill		M	RAA	MT	S	R	D	S	U
			PSV Diesel Spill		M	RAA	MT	S	R	D	S	U
			SBM Spill		N-L	LAA	ST	S	R	D	N	N/A
Commercial Fisheries and Other Ocean Users	s. 5(2)(b)(i)	Change in Availability of Resources	Well Blowout Incident	See Section 15.5 and Table 11.2	H	RAA*	LT	S	R	D	S	U
			10 bbl Diesel Spill		L	LAA	ST	S	R	D	N	N/A
			100 bbl Diesel Spill		M	RAA	MT	S	R	D	S	U
			PSV Diesel Spill		M	RAA	MT	S	R	D	S	U
			SBM Spill		L	LAA	ST	S	R	D	N	N/A

Notes:

* In certain scenarios, effects may extend beyond the RAA.

See Table 18.3 for key.

Table 18.5 summarizes the significance of residual effects identified in Tables 18.3 and 18.4 for each VC for routine operations, cumulative effects and accidental events, and, where applicable, the likelihood of significant residual adverse environmental effects occurring.

Table 18.5 Summary of Residual Environmental Effects for Routine Operations, Accidental Events and Cumulative Effects

VC	Routine Operations	Accidental Effects		Cumulative Effects
	Significance of Residual Environmental Effect	Significance of Residual Environmental Effect	Likelihood of Significant Effect	Significance of Residual Environmental Effect
Marine Fish and Fish Habitat	N	N	N/A	N
Marine and Migratory Birds	N	S	U	N
Mammals and Sea Turtles	N	N	N/A	N
Special Areas	N	N	N/A	N
Indigenous Peoples and Community Values	N	S	U	N
Commercial Fisheries and Other Ocean Users	N	S	U	N
Key: N = Not significant residual environmental effect (adverse) S = Significant residual environmental effect (adverse) U = Unlikely N/A = Not Applicable				

Using the precautionary approach, effects predictions and implementation of recommended mitigation were conservative in nature assuming that each VC is present in the Project Area and therefore potential for Project-VC interaction. The characterization of range of magnitude (range of natural variability) considers the reasonable worst-case scenario and is therefore considered to provide a conservative indication of effects. Mitigation is proposed to reduce or eliminate adverse environmental effects (Table 18.2). Mitigation measures have been proposed to address potential Project and cumulative effects and address all components of the Project scope. They include both general Project mitigation measures and best management practices as well as VC-specific mitigation measures. With the implementation of these proposed mitigation measures, residual adverse environmental effects of routine Project activities and components are predicted to be not significant for all VCs.

In the highly unlikely event of a Project-related accidental event resulting in the large-scale release of oil, effects to marine and migratory birds, Indigenous peoples and community values, and commercial fisheries and other ocean users have potential to be significant under certain circumstances. However, with the implementation of proposed well control, spill response, contingency, and emergency response plans, significant residual adverse environmental effects are unlikely to occur.

In summary, the Project is not likely to result in significant residual adverse environmental effects, including cumulative environmental effects, provided that the proposed mitigation is implemented.

BP recognizes the challenge of managing and meeting growing worldwide demand for energy while addressing climate change and other environmental and social issues. The proposed Project will contribute to energy diversification and is expected to generate industrial, employment, and social benefits. The Project is also expected to contribute to technological and scientific knowledge sharing in Canada and Newfoundland and Labrador, advancing the understanding of deep-water drilling operations offshore Newfoundland and Labrador.