TABLE OF CONTENTS

6 AIR QUALITY 6-1

6.1 Environmental Assessment Boundaries 6-1
6.1.1 Spatial 6-1
6.1.2 Temporal 6-3
6.1.3 Administrative 6-3

6.2 Existing Conditions 6-5
6.2.1 Nearshore 6-5
6.2.1.1 Air Quality 6-6
6.2.1.2 Greenhouse Gas Emissions 6-7
6.2.2 Offshore 6-7
6.2.2.1 Air Quality 6-7
6.2.2.2 Greenhouse Gas Emissions 6-8

6.3 Project-Valued Ecosystem Components Interactions 6-9
6.3.1 Nearshore Project Activities 6-9
6.3.2 Offshore 6-10
6.3.2.1 Offshore Construction / Installation 6-10
6.3.2.2 Operation / Maintenance 6-11
6.3.2.3 Decommissioning / Abandonment 6-13
6.3.3 Summary 6-13

6.4 Definition of Significance 6-16
6.4.1 Change in Ambient Air Quality 6-16
6.4.2 Greenhouse Gas Emissions 6-16

6.5 Environmental Effects Analysis and Mitigation 6-17
6.5.1 Construction 6-17
6.5.1.1 Change in Ambient Air Quality 6-17
6.5.1.2 Greenhouse Gas Emissions 6-18
6.5.2 Operations and Maintenance 6-21
6.5.2.1 Change in Ambient Air Quality 6-21
6.5.3 Offshore Decommissioning and Abandonment 6-32
6.5.4 Accidents Malfunctions and Unplanned Events 6-33
6.5.4.1 Change in Air Quality 6-33
6.5.4.2 Greenhouse Gas Emissions 6-36
6.5.5 Cumulative Environmental Effects 6-38
6.5.5.1 Nearshore 6-39
6.5.5.2 Offshore 6-39

6.6 Determination of Significance 6-44
6.6.1 Change in Air Quality 6-44
6.6.2 Greenhouse Gas Emissions 6-45

6.7 Follow-up and Monitoring 6-46

LIST OF FIGURES

Figure 6-1 Nearshore Affected Area 6-2
Figure 6-2 Offshore Affected Area 6-3

LIST OF TABLES

Table 6-1 Temporal Boundaries of Study Areas 6-3
Table 6-2 Newfoundland and Labrador *Air Pollution Control Regulations* and *Canadian Environmental Protection Act* Ambient Air Quality Objectives 6-5
Table 6-3 Ambient Air Quality in and Surrounding the Nearshore Affected Area (Maximum Annual Values for 2009) 6-6
Table 6-4 Annual Emissions – Come By Chance North Atlantic Refinery, 2008 6-7
Table 6-5 2008 Annual Emissions of Criteria Air Contaminants – Existing Offshore Oil Platforms 6-7
Table 6-6 2008 Annual Emissions of Greenhouse Gas – Existing Offshore Oil Platforms 6-8
Table 6-7 National Greenhouse Gas Emissions Data by Sector, 2004 to 2007 6-8
Table 6-8 Potential Project-related Interactions: Air Quality 6-14
Table 6-9 Criteria Air Contaminant Emissions for Power Generation (Distillate Fuel versus Natural Gas) 6-18
Table 6-10 Greenhouse Gas Emissions from Gas Turbines – Distillate Fuel versus Natural Gas . 6-19
Table 6-11 Environmental Effects Assessment Matrix (Construction and Installation) 6-19
Table 6-12 Point and Volume Source Physical Parameters 6-24
Table 6-13 Air Dispersion Modelling Emission Rates 6-25
Table 6-14 Summary of Model Predictions – Maximum Predicted Ground-level Concentrations – First Year of Operation 6-25
Table 6-15 Summary of Model Predictions – Maximum Predicted Ground-level Concentrations – Peak Operation 6-27
Table 6-16 Greenhouse Gas Emissions from Flaring during Hebron Platform Operation 6-30
Table 6-17 Greenhouse Gas Emissions during the Operation of the Hebron Platform 6-30
Table 6-18 Environmental Effects Assessment: Operation and Maintenance 6-31
Table 6-19 Environmental Effects Assessment: Decommissioning and Abandonment 6-33
Table 6-20 Air Dispersion Modelling Emission Rates 6-35
Table 6-21 Summary of Model Predictions – Maximum Predicted Ground-level Concentrations - Flaring 6-35
Table 6-22 Environmental Effects Assessment: Accidental Events 6-37
Table 6-23 Air Dispersion Modelling Emission Rates 6-39
Table 6-24 Summary of Model Predictions – Maximum Predicted Ground-level Concentrations – Cumulative 1st Year of Operation 6-40
Table 6-25 Summary of Model Predictions – Maximum Predicted Ground-level Concentrations – Cumulative Peak Operation 6-42
Table 6-26 Cumulative Greenhouse Gas Emissions 6-44
Table 6-27 Residual Environmental Effects Summary: Change in Ambient Air Quality 6-45
Table 6-28 Residual Environmental Effects Summary: Greenhouse Gas Emissions 6-46

6 AIR QUALITY

Air Quality is considered a Valued Ecosystem Component (VEC) as its constituents are essential to sustain life and maintain the health and well-being of humans, wildlife, vegetation and other biota. The atmosphere is also a pathway for the transport of air emissions species to marine, freshwater, terrestrial and human environments.

The health and safety of the workers is of prime importance as well, and is ensured through programs of safety training, emergency response planning, and the engineering of the offshore facilities. The air quality situation with respect to workers comprises no issues that are more complex than those of other projects. The absence of hydrogen sulphide in the produced gas reduces the potential risks that are routinely handled on many other facilities. Existing legislation for worker health and safety and the Hebron Project (the Project)-specific planning that will occur as detailed engineering proceeds will provide the requisite degree of protection for workers on the facilities.

6.1 Environmental Assessment Boundaries

6.1.1 Spatial

The Nearshore and Offshore Study and Project Areas are defined in the Environmental Assessment Methods Chapter (Chapter 4).

The Nearshore Affected Area is the area which could potentially be affected by Project activities within and surrounding the Nearshore Project Area, including associated physical works and activities at the Nalcor Energy-Bull Arm Fabrication Site. The Nearshore Affected Area for air quality is set to encompass the residences on the land adjacent to Bull Arm, recognizing that it is important to consider the potential environmental effects of the air quality that the residents experience, although professional experience indicates that the environmental effects of emissions in construction would disperse to within the range of normal background levels at this distance. The Nearshore Affected Area is presented in Figure 6-1. The Offshore Affected Area is the area within and beyond the Offshore Project Area that could potentially be affected by Project works and activities. The Offshore Affected Area for the assessment of Air Quality is defined by the air dispersion modelling extents as an area that is 100 km by 65 km and is presented in Figure 6-2. This domain is sufficient to show the reduction of the Hebron Platform emissions to near background levels. The spatial boundary for greenhouse gas (GHG) emissions is global, as the effects on climate change are through the cumulative action of global emissions.

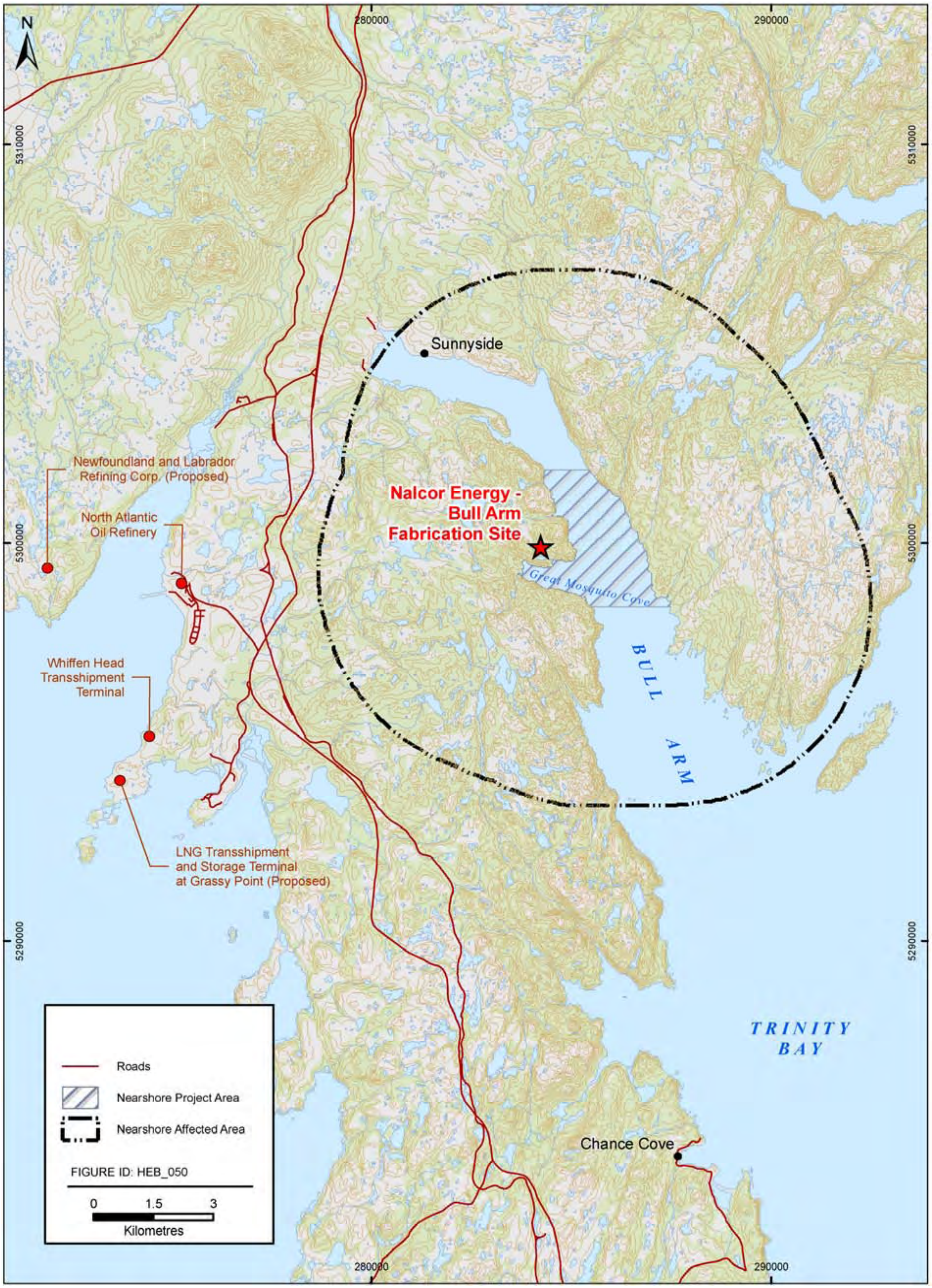

Figure 6-1 Nearshore Affected Area

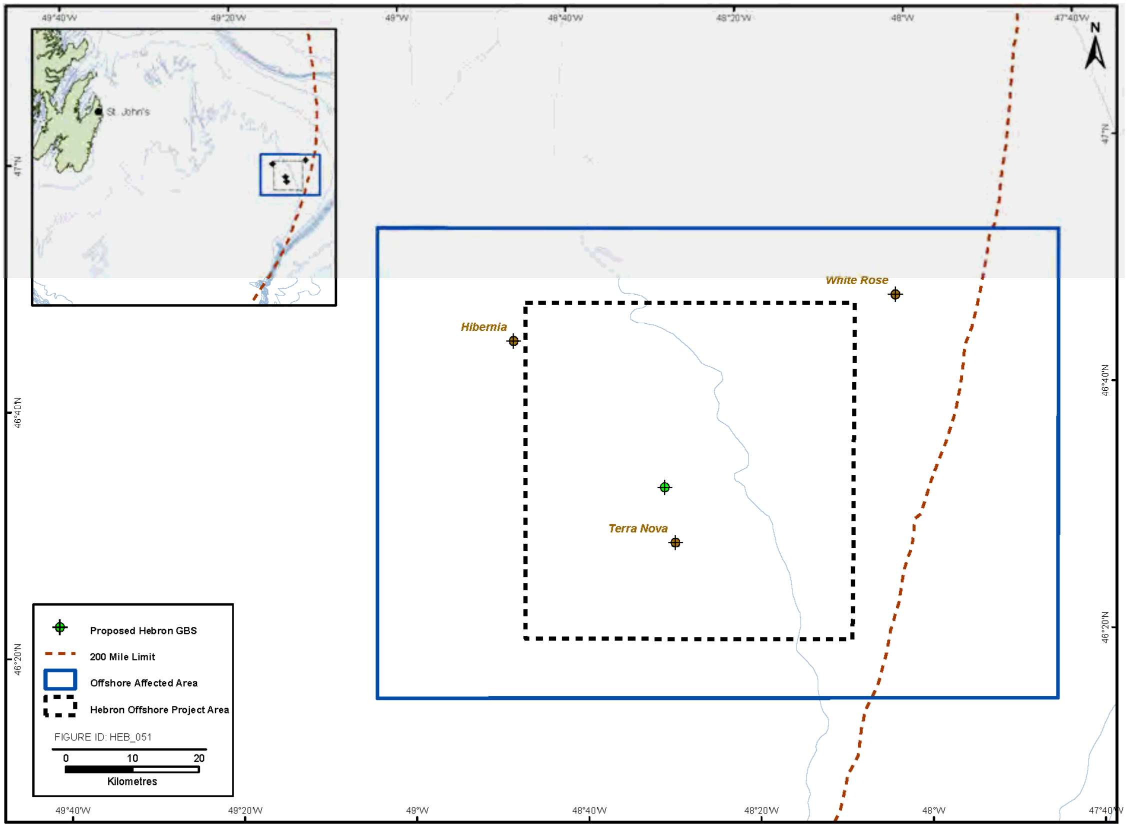

Figure 6-2 Offshore Affected Area

6.1.2 Temporal

The temporal boundary is defined in the Environmental Assessment Methods Chapter (Chapter 4). The nearshore and offshore temporal boundaries are summarized in Table 6-1.

Table 6-1 Temporal Boundaries of Study Areas

Study Area	Temporal Scope
Nearshore	• Construction: 2011 to 2016, activities will occur year-round
Offshore	• Surveys (geophysical, geotechnical, geological, environmental): 2011 throughout life of Project, year-round • Construction activities: 2013 to end of Project, year-round • Site preparation / start-up / drilling as early as 2015 • Production year-round through to 2046 or longer • Potential future activities - as required, year-round through to end of Project • Decommissioning / abandonment: after approximately 2046

6.1.3 Administrative

The administrative boundaries for Air Quality pertain mainly to regulatory limits and standards for the air emissions in the Nearshore and Offshore Project Areas, where such limits and standards exist. These limits are set by regulatory authorities to reflect environmental protection objectives, with the intent of being protective of air quality and human and environmental health.

Air quality will be assessed in the context of potential Project-related criteria air contaminants (CACs) and their ground-level concentrations (GLCs), as well as potential emissions of non-criteria air contaminants. For the purposes of this environmental assessment, the Project-related CACs include carbon monoxide (CO), nitrogen oxides (NO_x), sulphur dioxide (SO_2), total suspended particulate matter (TSP) and volatile organic compounds (VOCs). The non-criteria air contaminants are GHGs, including carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O).

The federal government has set objectives for air quality which are taken into account by federal agencies in project environmental assessment reviews. These objectives also tend to form the basis for the air quality regulations of several provinces, including Newfoundland and Labrador. The Newfoundland and Labrador regulatory limits generally correspond to the upper limit of the Maximum Acceptable category of air quality, which are set under the *Canadian Environmental Protection Act*. These objectives may also be used as reference by provincial or federal regulators. Additional guidelines are under development by the Canadian Council of Ministers of the Environment (CCME), and ultimately this body may develop Canada-wide Standards that harmonize the regulations in all jurisdictions.

The National Ambient Air Quality (NAAQ) Objectives and the Newfoundland and Labrador *Air Pollution Control Regulations* for specified CACs are presented in Table 6-2 for reference. In terms of the Hebron Project, the Newfoundland and Labrador Maximum Permissible Ground Level Concentrations would be applicable to the Nearshore Project Area and the NAAQ Objectives would be applicable to the Offshore Project Area.

The federal government of Canada has recently (March 2010) published *Planning for a Sustainable Future: A Federal Sustainable Development Strategy for Canada* that sets out the current targets for various environmental actions. Included as the target for the first goal is: *"(R)elative to 2005 emission levels, reduce Canada's total GHG emissions 17 percent by 2020"*. The strategy is open for comments. The second goal of the strategy is "Air Pollutants". According to the document, targets are under discussion between the federal and provincial governments, and the main implementation scheme is the Clean Air Regulatory Agenda. Within this agenda, the important activities include the National Pollutant Release Inventory (NPRI), as mandated by the *Canadian Environmental Protection Act* (1999), and the harmonization of vehicle emission regulations within Canada and with the United States. Additional federal initiatives include the Base Level Industrial Emission Requirements that aims to quantify the minimum facility or equipment performance standards to be applied to new and existing industrial facilities and equipment in Canada. These standards will represent a good level of environmental performance, and apply to smog-causing pollutants such as NO_x, SO_2, VOCs, and total particulate matter (TPM). Upstream oil and gas is a target sector for determination of Base Level Industrial Emission Requirements, and recommendations are expected in 2010, with enforcement expected in 2015.

Table 6-2 Newfoundland and Labrador *Air Pollution Control Regulations* and *Canadian Environmental Protection Act* Ambient Air Quality Objectives

Pollutant and Units (alternative units in brackets)	Averaging Time Period	Newfoundland and Labrador	Canada			
		Maximum Permissible Ground Level Concentration	Canada-Wide Standards	Ambient Air Quality Objectives		
				Maximum Desirable	Maximum Acceptable	Maximum Tolerable
Nitrogen Dioxide (NO_2) (µg/m^3) (ppb)	1 hour	400 (213)	-	-	400 (213)	1000 (532)
	24 hour	200 (106)	-	-	200 (106)	300 (160)
	Annual	100 (53)	-	60 (32)	100 (53)	-
Sulphur Dioxide µg/m^3 (ppb)	1 hour	900 (344)	-	450 (172)	900 (344)	-
	3 hour	600 (228)				
	24 hour	300 (115)	-	150 (57)	300 (115)	800 (306)
	Annual	60 (23)	-	30 (11)	60 (23)	-
Total Suspended Particulate Matter (TSP) (µg/m^3)	24 hour	120	-	-	120	400
	Annual	60	-	60	70	-
$PM_{2.5}$ (µg/m^3)	24 hour	25	30 (by 2010) Based on the 98th percentile ambient measurement anually, averaged over three consecutive years	-	-	-
PM_{10} (µg/m^3)	24 hour	50	-	-	-	-
Carbon monoxide (mg/m^3) (ppm)	1 hour	35 (31)	-	15 (13)	35 (31)	-
	8 hour	15 (13)	-	6 (5)	15 (13)	20 (17)
Oxidants – ozone (µg/m^3) (ppb)	1 hour	160 (82)	-	100 (51)	160 (82)	300 (153)
	8 hour	87 (45)	65 (by 2010) Based on 4th highest annual value, averaged over three consecutive years	-	-	-
	24 hour	-	-	30 (15)	50 (25)	-
	Annual	-	-	-	30 (15)	-

6.2 Existing Conditions

6.2.1 Nearshore

The air quality surrounding the Nearshore Project and Study Areas is generally good due to its remote location; however, industries surrounding the Bull Arm Site have had an effect on the local airshed over the past 100 years.

Environment Canada operates a series of ambient air monitoring stations across Canada under the National Air Pollution Surveillance Network. There are six monitoring locations in Newfoundland and Labrador, with St. John's being the closest to the Nearshore Project and Study Areas. Due to the distance between this monitoring station and the Nearshore Project and Study Areas, the measured data would not be representative of the local air quality. Instead, background air quality data for the Nearshore Project and Study Areas were summarized using information available from nearby industrial sites and from the NPRI and from the National GHG Report.

6.2.1.1 Air Quality

The closest industrial site to the Nearshore Project and Study Areas is the Come by Chance North Atlantic Refining Limited refinery, located approximately 9 km west of the Bull Arm Site and the Newfoundland Transshipment Terminal, located approximately 10 km south-west of the Bull Arm Site (Figure 6-1). Other nearby proposed facilities include the Grassy Point Liquefied Natural Gas Transshipment and Storage Terminal, the Newfoundland and Labrador Refining Corporation's Southern Head Marine Terminal and Associated Crude Oil Refinery and the Whiffen Head Transshipment Terminal (refer to Figure 6-1).

Background ambient air quality in and surrounding the Nearshore Affected Area was summarized in Newfoundland and Labrador's 2009 Air Quality Report (Newfoundland amd Labrador Department of Environment and Conservation (NLDEC) 2010). These data are presented in Table 6-3.

Table 6-3 Ambient Air Quality in and Surrounding the Nearshore Affected Area (Maximum Annual Values for 2009)

Pollutants ($\mu g/m^3$)	Time Frame	Arnolds Cove	Come by Chance	Sunnyside
SO_2	1-hour	138	204	193
	24-hour	20	65	50
$PM_{2.5}$	24-hour	16	17	18
PM_{10}	24-hour	-	-	22
NO_x	-	NA	NA	NA
NA = Not Available Source: NLDEC 2010				

The monitoring sites located closest to the Nearshore Project Area include Come by Chance and Sunnyside. These background concentrations indicate that the area meets the air quality regulations of the province, and attains the strictest NAAQ Objectives of Canada.

The annual emissions from the existing Come by Chance North Atlantic Refining Limited refinery have also been summarized using data available from the 2008 NPRI and are presented in Table 6-4.

Table 6-4 Annual Emissions – Come By Chance North Atlantic Refinery, 2008

Facility	Criteria Air Contaminants (tonnes/yr)				
	SO_2	CO	NO_X (as NO_2)	TSP	VOCs
North Atlantic Refinery	12,549	357	1,948	306	645
Source: Environment Canada 2009a					

The Bull Arm Site is an approved construction support facility and will, therefore, have local emissions characteristic of fabrication, such as welding, grinding, and similar activities. However, on a scale that includes the local communities, the refinery is the dominant source in the airshed.

6.2.1.2 Greenhouse Gas Emissions

According to the 2008 National GHG Emissions Report, the annual emissions of GHGs from the North Atlantic Refining Limited refinery in Come by Chance were approximately 1,285,356 tonnes CO_2eq (Environment Canada 2009b). These emissions represent 24 percent of the provincial total. This source will be the major local contributor to concentrations of GHGs.

6.2.2 Offshore

Given its offshore location, air quality within the Offshore Project and Study Areas is likely to be very good, with only occasional exposure to exhaust products from existing offshore oil production facilities (*i.e.*, Hibernia, Terra Nova and White Rose), supply ships and other vessels in the area, as each platform would generally be downwind of another less than 15 percent of the time. This region also receives long-range contaminants from the industrial mid-west and northeastern seaboard of the United States.

To assess the existing ambient air quality in the Offshore Study Area, site specific emissions data were collected from the NPRI and National GHG reports. These reports are completed and submitted annually by each of the offshore oil and gas operators located near the proposed Hebron Project and are presented in the following sub-sections.

6.2.2.1 Air Quality

The 2008 NPRI data for CACs for each of the existing offshore oil platforms located near the proposed Hebron Project are presented in Table 6-5.

Table 6-5 2008 Annual Emissions of Criteria Air Contaminants – Existing Offshore Oil Platforms

Facility	Criteria Air Contaminants (tonnes/yr)				
	SO_2	CO	NO_X (as NO_2)	TSP	VOCs
Hibernia	-	797	1,084	196	470
Terra Nova	-	731	2,313	208	6,717
White Rose	0.26	890	2,421	267	285
Source: Environment Canada 2009a					

6.2.2.2 Greenhouse Gas Emissions

The 2008 GHG data for each of the existing offshore oil platforms located near the Project and the provincial and national totals are presented in Table 6-6.

Table 6-6 2008 Annual Emissions of Greenhouse Gas – Existing Offshore Oil Platforms

Facility	Greenhouse Gases (tonnes CO_2eq per year)		
	CO_2	CH_4	N_2O
Hibernia	556,231	34,961	4,557
Terra Nova	576,456	31,274	10,597
White Rose	515,691	30,047	9,796
Provincial Total	5,140,424	97,037	35,955
National Total	247,400,881	7,983,044	4,897,951
Source: Environment Canada 2009b			

The reported GHG emissions from each of the existing oil platforms are representative and consistent with such a facility.

The national GHG emissions by sector during 2004 to 2007 are provided in Table 6-7.

Table 6-7 National Greenhouse Gas Emissions Data by Sector, 2004 to 2007

Sector	2004		2005		2006		2007	
	Emissions (kt CO_2eq)	% of Yearly Total	Emissions (kt CO_2eq)	% of Yearly Total	Emissions (kt CO_2eq)	% of Yearly Total	Emissions (kt CO_2eq)	% of Yearly Total
Mining, Quarrying and Oil and Gas Extraction	49,591	18	49,178	18	53,878	20	56,823	20
Utilities	121,459	43	123,787	44	115,868	43	121,401	44
Manufacturing	96,615	35	91,480	33	88,676	33	87,114	31
Other	11,589	4	14,148	5	13,483	5	12,755	5
Source: Environment Canada 2009b								

As presented in Table 6-7, the major contributors of GHG emissions by sector include the utilities sector, followed by the manufacturing sector, and oil and gas extraction (including other activities such as mining and quarrying). In 2007, the GHG emissions related to the mining, quarrying and oil and gas extraction sector represented approximately 20 percent of the national annual reported GHG emissions.

6.3 Project-Valued Ecosystem Components Interactions

6.3.1 Nearshore Project Activities

Project-related construction activities within the Nearshore Project Area, including the following activities, will generate air emissions from:

- Vessel traffic (supply, ferry, tow, diving support, barge, dredging) (CO, NO_x, TSP, VOCs, GHGs)
- Vehicle traffic (cars, trucks, buses, cranes, loaders) (CO, NO_x, TSP, VOCs, GHGs)
- Construction emissions from blasting, welding, concrete production and the re-establishment of the bund wall (TSP)

Therefore, potential interactions with Air Quality could result from the above-mentioned activities.

Typical air emissions from the operation of vessels during construction at the Bull Arm Site include CO, NO_x, TSP, VOCs and GHGs. Various types of vessels, including supply and ferry vessels, barges, tow vessels and diving support vessels, will be used while implementing nearshore construction activities (*i.e.*, concrete production, re-establish moorings at Bull Arm deepwater site, dredging of Bund Wall and disposal, tow-out of GBS, complete GBS construction and mate Topsides at Bull Arm deepwater site and surveys). The potential environmental effects associated with such activities will be assessed in Section 6.5 based on the operation of vessels.

Typical air emissions from the operation of vessels during construction at the Bull Arm Site include CO, NO_x, TSP, VOCs and GHGs. Various types of vessels will be used while implementing nearshore construction activities, including supply and ferry vessels, barges, tow vessels and diving support vessels.

Air emissions related to the operation of vehicles would be similar to that of vessels. Various types of vehicles will be used to carry out nearshore Project activities and include, but not limited to, cars, trucks, buses, cranes and loaders.

Emissions of CACs and GHGs will also result from typical construction activities such as blasting, welding and concrete production. The amount and type of equipment used during construction will vary depending on the construction contractor.

Electrical power for the Bull Arm Site will be acquired from the provincial utility power grid and, therefore, was not assessed in this assessment. However, there may be times during emergency situations or when power requirements are high, when additional power supply may be required. In such instances, the use of temporary generators may be required.

6.3.2 Offshore

6.3.2.1 Offshore Construction / Installation

As with the nearshore construction of the Hebron Platform, the offshore construction and installation activities (including hook-up and commissioning) also have the potential to interact with Air Quality. Air emissions associated with offshore construction and installation activities include:

- Vessel exhaust (*e.g.,* supply, support, tow, barge) and helicopter exhaust (CO, NO_x, TSP, VOCs, GHGs)
- Power generation exhaust (CO, NO_x, TSP, VOCs, SO_2, GHGs)
- Flaring (CO, NO_x, VOCs, TSP, GHGs)
- Fugitive and venting emissions (*e.g.,* leaks from valves, pump seals, compressor seals, flanges, pressure relief valves and fuel and chemical storage) (VOCs, GHGs)
- Construction activities (*e.g.,* welding, solvent use) (TSP, VOCs)

Various vessels will be required to carry out a number of activities (*i.e*., offshore loading system (OLS) installation and testing, concrete mattress pads / rock dumping over OLS offloading lines, installation of temporary moorings, platform tow-out / offshore installation, underbase grouting, offshore solid ballasting, placement of rock scour protection on seafloor around final Platform location and hook-up and commissioning) during offshore construction and installation of the Hebron Platform. The typical emissions associated with the operation of the vessels will be the same as those mentioned in Section 6.3.1. The potential environmental effects associated with such activities will be assessed in Section 6.5 based on the operation of vessels. Helicopters will be used to transport personnel and supplies to and from the Offshore Project Area. The typical emissions associated with the operation of helicopters are similar to those from the operation of vessels and are outlined above.

During the construction and installation of the Hebron Platform, power generation will be supplied from two dual-fuelled turbine generators operating at full capacity. These units will use distillate fuel (diesel fuel) during offshore construction and installation of the Hebron Platform and change to produced gas once the facility is operational and gas compression is online. During the early stages of the offshore construction and installation of the Hebron Platform; however, power may be supplied by temporary generators until the dual-fuelled turbines have been commissioned. The power requirements may not require the operation of both turbines at all times. For conservative purposes throughout this assessment; however, power generation for offshore construction and installation of the Hebron Platform was based on the full capacity operation of both turbines.

The primary emissions from turbine generators include NO_x, CO, TSP and VOCs.

The Project emissions will generally be the same when operating on either diesel or produced gas (during the operation phase), except that the diesel fuel may have some trace SO_2 emissions and release greater quantities of

CO_2, whereas natural gas will release lower quantities of CO_2 and TSP and greater quantities of NO_x.

Sulphur dioxide emissions could be of concern when the units are operating on distillate fuels, in which case, the sulphur emissions would be directly related to the sulphur content of the fuel.

Greenhouse gases, including CO_2, N_2O and CH_4, will also be emitted during the operation of dual-fuelled turbine generators. In terms of diesel fuel, CO_2 will be produced during the combustion process but the emissions of N_2O and CH_4 will be negligible. In terms of natural gas combustion, traces of CH_4 are present in the exhaust gas as unburned fuel and CO_2 will also be emitted via the combustion process, however at slightly lower quantities than from the burning of diesel fuel (US Environmental Protection Agency (EPA) 2000).

Flaring is an essential component of the safety system of an oil and gas production facility and it is vital to ensure safe working conditions on the platform. There will be occasions during the offshore construction and installation phase of the Hebron Platform when flaring of excess gas, test flaring and/or emergency flaring will be required. Typical emissions from a flaring event include CO, NO_x, VOCs, TSP and GHGs. The quantity of GHG emitted from flaring will be measurably higher during the construction and installation phase of the Hebron Platform, until the Hebron Platform is operational and gas compression is on-line.

Fugitive emissions of VOCs will also occur during the offshore construction and installation phase of the Hebron Platform via venting from chemical and fuel storage. However, these emissions are considered to be limited in quantity and largely controlled by, for example, using closed rather than open containers, and reventing where practicable. Limited quantities of TSP and VOC emissions will be emitted during various construction activities during the construction and installation phase of the Hebron Platform. There will be also be minor quantities of VOCs from fugitive emissions from the loading and unloading of fuels and chemicals and equipment leaks. These emissions will be similar in quantity to those released during the first year of operation and are therefore further discussed in Section 6.3.2.2.

6.3.2.2 Operation / Maintenance

Project offshore operations and maintenance activities have the potential to interact with Air Quality. Air emissions associated with offshore operation and maintenance activities include:

- Vessel (*e.g.,* supply, support, tow, standby) and helicopter traffic (CO, NO_x, TSP, VOCs, GHGs)
- Power generation (CO, NO_x, TSP, VOCs, SO_2, GHGs)
- Gas compression (CO, NO_x, TSP, VOCs, GHGs)
- Flaring (CO, NO_x, VOCs, TSP, GHGs)

- Fugitive and venting emissions (*e.g.*, product loading, unloading and storage, chemical and fuel storage, leaking valves, pumps seals, compressor seals, flanges / connectors, and pressure relief valves) (VOCs, GHGs)
- Maintenance activities (*e.g.,* welding) (TSP, VOCs)

Emissions produced from the operation of vessels and helicopters during the operation and maintenance phase of the Hebron Platform will be similar to those during the construction and installation phase of the platform, as discussed in Section 6.3.2.1. Vessel operation supports a number of project activities including geophysical and seismic surveys. The potential environmental effects associated with such activities will be assessed in Section 6.5 based on the operation of vessels.

During the operation of the platform and various well activities, it is planned that power generation will be supplied from four turbine generators (two dual-fuelled, one gas, and one spare). During the first year of operation (approximately eight months), only the two dual-fuelled turbine generators will be in operation and they will use diesel fuel. Once gas compression is online the two dual-fuelled units and the gas turbine generator will be in operation and will operate on produced gas. The air emissions associated with the use of these units were discussed above in Section 6.3.2.1.

Based on current design, gas compression will be accomplished via the use of two dual-fuelled turbine-driven compressors. The turbines will normally operate on natural gas with each compressor handling up to 60 percent of the design gas capacity. The air emissions will be similar to those released during power generation, as discussed in Section 6.3.2.1.

The produced water and water injection system will be operated by electrically-driven pumps and hence, there will be no direct related emissions of CACs or GHGs, as the emissions would have been accounted for through the generation of power by the turbine generators.

During operation of the Platform, there will be times when excess gas will be flared, for example, during well clean-up and unloading after initial completion of a well, during upset conditions, and during background flaring. Background flaring represents flaring associated with normal operations and encompasses pilot and sweep gas, blowdown valve leakage, pressure safety valve leakage, and compressor seals. The emissions released during these events will be similar to those released during the construction and installation of the platform, as discussed in Section 6.3.2.1, but smaller in quantity for background flaring, is much lower in volume, than during upset conditions.

Minor amounts of TSP and VOC emissions will be emitted during various routine maintenance activities, including welding, machine oils and cleaning solvents. There will also be some fugitive emissions of VOCs and GHGs from the loading and unloading of fuels and products and from leaking valves, pumps, seals, compressor seals, flanges / connectors, open ended lines and pressure relief valves.

6.3.2.3 Decommissioning / Abandonment

Project decommissioning and abandonment activities will be similar to those associated with the construction and installation of the Hebron Platform. Air emissions associated with decommissioning and abandonment include:

- Vessel (*e.g.,* supply, support, tow, standby) and helicopter traffic (CO, NO_x, TSP, VOCs, GHGs)
- Power generation (CO, NO_x, TSP, VOCs, GHGs)
- Emissions related to refloating and towing of the platform (CO, NO_x, TSP, VOCs, GHGs)

The air emissions emitted from vessel and helicopter operation related to various activities including removal of the Hebron Platform and OLS loading points, plugging and abandoning wells and the OLS pipeline, and power generation will be similar to those emitted during the construction and installation of the Hebron Platform and have been discussed in Section 6.3.2.1.

Some air emissions will result from work activities associated with the refloating and towing of the Hebron Platform. These emissions will be limited in quantity and temporary.

6.3.3 Summary

The interactions from nearshore and offshore construction and installation, and operation and maintenance activities with Air Quality that have the potential to result in an environmental effect include: vehicle traffic, power generation, gas compression, flaring, and vessel and helicopter operations. In summary, the Project can have potential effects on air quality that can be categorized as:

- A change in ambient air quality (CACs)
- A change in GHG emissions

A summary of the potential environmental effects resulting from Project-VEC interactions, including accidental and cumulative environmental effects is provided in Table 6-8. Most of the activities listed in Table 6-8 do contribute to air and GHG emissions because of the generation of power required to carry out the activity.

Table 6-8 Potential Project-related Interactions: Air Quality

Project Activities, Physical Works Discharges and Emissions	Potential Environmental Effects	
	Ambient Air Quality	Greenhouse Gas Emissions
Construction		
Nearshore Project Activities		
Presence of Safety Zone (Great Mosquito Cove zone followed by a deepwater site Zone)		
Bund Wall Construction (*e.g.,* sheet/pile driving, infilling)	x	x
Inwater Blasting		
Dewater Drydock / Prep Drydock Area	x	x
Concrete Production (floating batch plant)	x	x
Vessel Traffic *(e.g.,* supply, tug support, tow, diving support, barge, passenger ferry to / from deepwater site)	x	x
Lighting		
Air Emissions	x	x
Re-establish Moorings at Bull Arm deepwater site	x	x
Dredging of Bund Wall and Possibly Sections of Tow-out Route to deepwater site (may require at-sea disposal)	x	x
Removal of Bund Wall and Disposal (dredging / ocean disposal)	x	x
Tow-out of GBS to Bull Arm deepwater site	x	x
GBS Ballasting and De-ballasting (seawater only)		
Complete GBS Construction and Mate Topsides at Bull Arm deepwater site	x	x
Hook-up and Commissioning of Topsides		
Surveys (*e.g.,* geophysical, geological, geotechnical, environmental, ROV, diving)	x	x
Platform Tow-out from deepwater site	x	x
Offshore Construction / Installation		
Presence of Safety Zone		
OLS Installation and Testing	x	x
Concrete Mattress Pads / Rock Dumping over OLS Offloading Lines	x	x
Installation of Temporary Moorings	x	x
Platform Tow-out / Offshore Installation	x	x
Underbase Grouting	x	x
Possible Offshore Solid Ballasting	x	x
Placement of Rock Scour Protection on Seafloor around Final Platform Location	x	x
Hook-up and Commissioning of Platform	x	x
Operation of Helicopters	x	x
Operation of Vessels (supply, support, standby and tow vessels / barges / diving / ROVs)	x	x
Air Emissions	x	x
Lighting		
Potential Expansion Opportunities		
Presence of Safety Zone		
Excavated Drill Centre Dredging and Spoils Disposal	x	x
Installation of Pipeline(s) / Flowline(s) and Testing from Excavated Drill Centre(s) to Platform, plus Concrete Mattresses, Rock Cover, or Other Flowline Insultation	x	x
Hook-up and Commissioning of Drill Centres	x	x

Project Activities, Physical Works Discharges and Emissions	Potential Environmental Effects	
	Ambient Air Quality	**Greenhouse Gas Emissions**
Surveys (*e.g.,* geophysical, geological, geotechnical, environmental, ROV, diving)	x	x
Offshore Operations and Maintenance		
Presence of Safety Zone		
Presence of Structures		
Lighting		
Maintenance Activities (*e.g.,* diving, ROV)	x	x
Power Generation	x	x
Gas Compression	x	x
Flaring	x	x
Wastewater (*e.g.,* produced water, cooling water, storage displacement water, deck drainage)		
Chemical Use / Management / Storage (*e.g.,* corrosion inhibitors, well treatment fluids)	x	
WBM Cuttings		
Operation of Helicopters	x	x
Operation of Vessels (supply, support, standby and tow vessels / shuttle tankers / barges / ROVs)	x	x
Surveys (*e.g.*, geophysical, 2D / 3D / 4D seismic, VSP, geohazard, geological, geotechnical, environmental, ROV, diving)	x	x
Potential Expansion Opportunities		
Presence of Safety Zone		
Drilling Operations from MODU at Future Excavated Drill Centres	x	x
Presence of Structures		
WBM and SBM Cuttings		
Chemical Use and Management (BOP fluids, well treatment fluids, corrision inhibitors)	x	
Geophysical / Seismic Surveys	x	x
Offshore Decommissioning / Abandonment		
Presence of Safety Zone		
Removal of the Platform and OLS Loading Points	x	x
Lighting		
Plugging and Abandoning Wells	x	x
Abandoning the OLS Pipeline	x	x
Operation of Helicopters	x	x
Operation of Vessels (supply, support, standby and tow vessels, ROVs)	x	x
Surveys (*e.g.*, geophysical, geological, geotechnical, environmental, ROV, diving)		
Accidents, Malfunctions and Unplanned Events		
Bund Wall Rupture	x	x
Nearshore Spill (at Bull Arm Site)	x	
Failure or Spill from OLS	x	
Subsea Blowout	x	x
Crude Oil Surface Spill	x	
Other Spills (fuel, chemicals, drilling muds or waste materials on the drilling unit, GBS,Platform)	x	
Marine Vessel Incident (*i.e.*, fuel spills)	x	x
Collisions (involving Platform, vessel, and/or iceberg)	x	x

Project Activities, Physical Works Discharges and Emissions	Potential Environmental Effects	
	Ambient Air Quality	**Greenhouse Gas Emissions**
Cumulative Environmental Effects		
Hibernia Oil Development and Hibernia Southern Extension (drilling and production)	x	x
Terra Nova Development (drilling and production)	x	x
White Rose Oilfield Development and Expansions (drilling and production)	x	x
Offshore Exploration Drilling Activity	x	x
Offshore Exploration Seismic Activity	x	x
Marine Transportation (nearshore and offshore)	x	x
Commercial Fisheries (nearshore and offshore)	x	x

6.4 Definition of Significance

6.4.1 Change in Ambient Air Quality

For a change in ambient air quality a significant adverse residual environmental effect is one that degrades the quality of the air such that the maximum Project-related GLC of the CAC being assessed frequently exceeds stipulated air quality guidelines in the Nearshore or Offshore Study Area. Frequently is defined as once per week for 1-hour standards and once per month for 24-hour standards.

The air quality guidelines chosen for use in the evaluation of significance for the Hebron Project are NAAQ Objectives for the “acceptable” levels (as presented in Table 6-2). The maximum “acceptable” level is intended to provide protection against effects on soil, water, vegetation, visibility, and human wellbeing.

6.4.2 Greenhouse Gas Emissions

In determining the significance criteria for a change in GHG emissions, guidance published by the *Federal-Provincial Territorial Committee on Climate Change and Environmental Assessment* as per the Canadian Environmental Assessment Agency (CEA Agency 2003) was consulted. This guideline states the following:

> *“…the environmental assessment process cannot consider the bulk of GHG emitted from already existing developments. Furthermore, unlike most project-related environmental effects, the contribution of an individual project to climate change cannot be measured.”*

It is, therefore, recognized that it is not possible to assess the significance related to a measured environmental effect on climate change on a project-specific basis. Project emissions of GHGs will contribute to these cumulative environmental effects, but the contribution, although potentially important in comparison to local and provincial levels, will be small in a global context. Policies and regulations are being developed by the governments of Canada and Newfoundland and Labrador for regulating GHG emissions for specific sources or industry sectors.

Thus, instead of setting a specific significance criterion for environmental effects on greenhouse gas emissions and determining whether and how it can be met, a change in GHG emissions for this Project will be considered by conducting a preliminary scoping of GHG emissions, determining the industry profile (where possible), and by considering the magnitude, intensity and duration of Project emissions as directed by the CEA Agency guidance (CEA Agency 2003). Project-related GHG emissions will also be compared to similar projects, and to provincial and national greenhouse gas emissions.

6.5 Environmental Effects Analysis and Mitigation

The assessment of the environmental effects due to the construction / installation and decommissioning phases of the Hebron Platform at the Bull Arm Site on Air Quality have been assessed qualitatively as there is limited information available on the quantities of equipment in use at this stage of the Project design.

The assessment of the environmental effects due to the offshore construction / installation and operations / maintenance of the Hebron Platform has been conducted using an emissions inventory and modelling approach, in which the emissions inventory is used to predict the annual emissions released and the dispersion modelling is used to estimate the maximum GLCs.

6.5.1 Construction

6.5.1.1 Change in Ambient Air Quality

Nearshore

Emissions during the nearshore construction phase will result from typical construction activities, including blasting, grinding, welding, concrete production, vessel traffic, and the use of construction equipment, including for example, forklifts, cranes and trucks.

The primary air emissions associated with blasting, grinding, welding and concrete production are TSP and from construction equipment combustion gases. Such emissions however, will be temporary in nature and are considered to be localized, such as welding, or relatively minor in quantity and environmental effect.

Vessels will emit CO, NO_x, TSP and VOCs. However, these emissions are small in quantity, temporary and localized, and will be mitigated using vessels suitable for each work activity (*i.e.,* using appropriately sized vessels for each associated work activity) and by conducting inspections of the vessels to ensure they are being properly maintained.

Offshore

During the offshore construction and installation of the Hebron Platform, activities such as vessel and helicopter traffic and power generation have the potential to interact with Air Quality and potentially result in environment effects.

Supply and tow vessels and helicopters, will be required during the offshore construction phase of the Hebron Platform. The emissions from these sources will result from the combustion of diesel fuels (distillate fuel) in engines. Typical emissions will include CO, NO_x, TSP and small amounts of VOCs. These emissions however will be localized, small in relative quantity, temporary and mitigated by using vessels suitable for each activity and by conducting inspections of the vessels to ensure they are being properly maintained.

As described in Section 6.3.2.1, power generation during the construction and installation of the Hebron Platform will result in air emissions from the combustion of distillate fuel (diesel). The air emissions include CO_2, NO_x, TSP, VOCs and SO_2. The SO_2 would be directly related to the amount of sulphur in the fuel (anticipated to be very low).

The air emissions of the above CACs (with the exception of SO_2), based on power generation during offshore construction and installation (distillate fuel versus natural gas, for comparison) are presented in Table 6-9.

Table 6-9 Criteria Air Contaminant Emissions for Power Generation (Distillate Fuel versus Natural Gas)

Function	Criteria Air Contaminants (tonnes/year)			
	CO)	NO_x	TSP	VOC
Power Generation[A] (Distillate fuel)	95	448	25.8	0.88
Power Generation[B] (Natural Gas)	20	1,325	14.2	4.5

Notes:
A Assumed two turbines operating at full capacity(conversative case)
B Assumed peak operation (three turbines operating at full capacity)
Source: US EPA 2000; EMCP

The air emissions related to power generation on distillate fuel will be temporary in nature, and are small in magnitude (except for NO_x) and extent. ExxonMobil Canada Properties (EMCP) will investigate the use of efficient/reduced emission technology where appropriate and incorporate into the design if emission reduction provisions can be economically obtained.

The GLCs predicted for the offshore construction and installation phase of the Hebron Platform would be similar to those predicted for the first year of operation, prior to gas compression, and are presented in Section 6.5.2.1.

6.5.1.2 Greenhouse Gas Emissions

Nearshore

During the construction of the Project at the Bull Arm Site, GHG emissions will be associated with vessel traffic through the combustion of diesel fuel in engines. These temporary emissions will be limited in quantity and mitigated through similar measures as described above in Section 6.5.1.1.

Offshore

Emissions of GHGs during the construction and installation phases of the Hebron Platform at its offshore location will result from the operation of supply and tow vessels, helicopter traffic and power generation. The emissions from the operation of vessels and helicopters include CO_2 from the combustion of diesel fuel, and will be short term, relatively limited in quantity and mitigated using similar measures as discussed above in Section 6.5.1.1.

The estimated annual emissions of GHGs from power generation during the offshore construction and installation phases of the Hebron Platform are presented in Table 6-10. Emissions estimates based on using natural gas to fuel the turbines have also been included for comparison.

Table 6-10 Greenhouse Gas Emissions from Gas Turbines – Distillate Fuel versus Natural Gas

Function	Greenhouse Gas Emissions (tonnes CO_2eq per year)		
	CO_2	N_2O	CH_4
Power Generation[A] (Distillate fuel)	71,674	6.7	1
Power Generation[B] (Natural Gas)	269,024	19.9	5

Notes:
A Assumed two turbine generators operating at full capacity (conservative case)
B Assumed peak operation (assumed three turbines operating at full capacity)
Source: US EPA 2000; EMCP

A summary of the potential environmental effects on Air Quality during the construction and installation phases of the Hebron Platform is provided in Table 6-11 (only those activities that result in Project-VEC interactions are included). As indicated in Sections 6.3.1 and 6.3.2.1, several activities that indirectly affect Air Quality as a result of vessel traffic are assessed within the vessel traffic and operation of vessels activities of Table 6-11. Power Generation is included as an activity unique to the analysis of environmental effects to Air Quality.

Table 6-11 Environmental Effects Assessment Matrix (Construction and Installation)

Project Activity[A]	Potential Environmental Effect	Mitigation	Evaluation Criteria for Assessing Residual Adverse Environmental Effects				
			Magnitude	Geographic Extent	Duration/ Frequency	Reversibility	Ecological / Socio-economic Context
Nearshore Project Activities							
Bund Wall Construction (*e.g.,* sheet / pile driving, infilling)	• Change in Ambient Air Quality • Greenhouse Gas Emissions	• Vessel traffic mitigation strategies, including the use of vessels suitable for each work activity and vessel inspections	1	2	3/3	R	2

Project Activity[A]	Potential Environmental Effect	Mitigation	Evaluation Criteria for Assessing Residual Adverse Environmental Effects				
			Magnitude	Geographic Extent	Duration/ Frequency	Reversibility	Ecological / Socio-economic Context
Concrete Production (floating batch)	• Change in Ambient Air Quality • Greenhouse Gas Emissions	• Vessel traffic mitigation strategies, including the use of vessels suitable for each work activity and vessel inspections	1	2	4/6	R	1
Vessel Traffic (*e.g.,* supply, tug support, tow, diving support, barge, passenger ferry to / from deepwater site)	• Change in Ambient Air Quality • Greenhouse Gas Emissions	• Vessel traffic mitigation strategies, including the use of vessels suitable for each work activity and vessel inspections	1	2	3/6	R	1
Dredging of Bund Wall and Possibly Sections of Tow-out (Route to deepwater site)	• Change in Ambient Air Quality • Greenhouse Gas Emissions	• Vessel traffic mitigation strategies, including the use of vessels suitable for each work activity and vessel inspections	1	2	2/1	R	1
Tow-out of GBS to Bull Arm deepwater site	• Change in Ambient Air Quality • Greenhouse Gas Emissions	• Vessel traffic mitigation strategies, including the use of vessels suitable for each work activity and vessel inspections	1	2	1/1	R	1
Complete GBS Construction and Mate Topsides at Bull Arm deepwater site	• Change in Ambient Air Quality • Greenhouse Gas Emissions	• Vessel traffic mitigation strategies, including the use of vessels suitable for each work activity and vessel inspections	1	1	2/2	R	1
Offshore Construction / Installation							
Platform Tow-out / Offshore Installation	• Change in Ambient Air Quality • Greenhouse Gas Emissions	• Vessel traffic mitigation strategies, including the use of vessels suitable for each work activity and vessel inspections • Ensure the use of properly maintained and functioning equipment	1	4	2/6	R	2
Power Generation	• Change in Ambient Air Quality • Greenhouse Gas Emissions		2	2	3	R	2
Operation of Helicopters	• Change in Ambient Air Quality • Greenhouse Gas Emissions	• Ensure properly maintained and efficient operation	1	4	3/6	R	2
Operation of Vessels (supply, support, standby and tow vessels / barges / diving / ROVs)	• Change in Ambient Air Quality • Greenhouse Gas Emissions	• Vessel traffic mitigation strategies, including the use of vessels suitable for each work activity and vessel inspections	1	4	3/6	R	2

Project Activity[A]	Potential Environmental Effect	Mitigation	Evaluation Criteria for Assessing Residual Adverse Environmental Effects				
			Magnitude	Geographic Extent	Duration/ Frequency	Reversibility	Ecological / Socio-economic Context

KEY

Magnitude:
1 = Low: Within normal variability of baseline conditions, but is well below regulatory limits and objectives
2 = Medium: increase or decrease with regard to baseline but near regulatory limits and objectives
3 = High: Increase such that the quality of the air is degraded to values that substantively exceed the regulatory limits and objectives

Geographic Extent:
1 = <1 km^2
2 = 1-10 km^2
3 = 11-100 km^2
4 = 101-1,000 km^2
5 = 1,001-10,000 km^2
6 = >10,000 km^2

Duration:
1 = < 1 month
2 = 1-12 months.
3 = 13-36 months
4 = 37-72 months
5 = >72 months

Frequency:
1 = <11 events/year
2 = 11-50 events/year
3 = 51-100 events/year
4 = 101-200 events/year
5 = >200 events/year
6 = continuous

Reversibility:
R = Reversible
I = Irreversible

Ecological / Socio-economic Context:
1 = Area is relatively pristine or not adversely affected by human activity
2 = Evidence of adverse effects

A Where there is more than one potential environmental effect, the evaluation criteria rating is assigned to the environmental effect with the greatest potential for harm

6.5.2 Operations and Maintenance

6.5.2.1 Change in Ambient Air Quality

During the first year of operation and normal operations of the Hebron Platform air emissions will result from power generation, gas compression, flaring, fugitive sources and vessel and helicopter traffic. Other emissions related to well drilling and drilling production operations will be small in quantity and extent.

Power Generation and Gas Compression

During the operation of the Hebron Platform power generation will be accomplished via the use of four turbine generator units, with three units running and one spare, at peak production. Two of these units will have dual-fuelled capacity. During the first year of operation (for approximately the first eight months); however, only the two dual-fuelled units will be in operation and these units will operate on diesel fuel, similar to the offshore construction and installation of the Hebron Platform. Once gas compression is online all units will operate on produced gas, with diesel available as a back-up fuel source. Typical air emissions from the combustion of natural gas in stationary gas turbines include NO_x, CO, and to a lesser degree TSP and VOCs. There is potential for the SO_2 to be present in exhaust emissions later in field life if the producing reservoir sours; however, it is not initially anticipated in the emissions. The formation of NO_x is dependent upon the temperature and residence time in the flame, whereas emissions of CO and VOCs are a result of incomplete combustion. Emissions of TSP from stationary gas turbines are considered negligible for natural gas combustion. A number of models of turbine have been identified as candidates; however, the final selection will be made in detailed engineering.

Nitrogen oxides formation from the burning of either natural gas or diesel fuel in turbine generators can occur three ways: thermal NO_x, prompt NO_x, and fuel NO_x. For the most part, all of the NO_x produced from the combustion of natural gas is through thermal NO_x, which results from the thermal dissociation and subsequent reaction of nitrogen and oxygen molecules (US EPA 2000). Changes in ambient humidity and temperature can also cause variations of up to approximately 30 percent in NO_x emissions (US EPA 2000).

EMCP will investigate the use of efficient/reduced emission technology where appropriate and incorporate into the design if emission reduction provisions can be economically obtained.

Gas compression will be accomplished via two dual-fuelled turbine-driven compressors.

Flaring

The flare system is an essential component of the process safety control equipment on an offshore production facility. The flare system will be designed for pressure relief to prevent over-pressurization of equipment during process upset conditions and to dispose of associated gas produced during emergency situations. The air emissions during flaring include CO, NO_x and VOCs. Excess gas will be flared until gas compression is online, at which time it will be injected to the sub-surface. A small amount of fuel gas will be continuously flared during normal operations (background flaring). This background flaring represents flaring associated with normal operations and encompasses pilot and sweep gas, blowdown valve leakage, pressure safety valve leakage and compressor seals.

Fugitive Emissions

Fugitive VOC emissions from sources such as leaking valves, pump seals, compressor seals, flanges / connectors, and pressure relief valves will occur during operation of the platform and have been considered quantitatively in this assessment. Minor amounts of TSP and VOCs will be emitted during various routine maintenance activities including welding, grinding and solvent use. Standby generators and other similar on-platform machinery are either considered minor or displacement sources (they are used in place of primary sources like main generators).

Vessel and Helicopter Traffic

Throughout the life of the Project, standby vessels, supply vessels, product vessels and helicopters will routinely navigate between the Project's offshore location and the east coast of Newfoundland. Air emissions associated with vessel and helicopter traffic include CO, NO_x, TSP and VOCs. Air emissions from the operation of these units are considered to be minor and will be mitigated by implementing, where possible, mitigation measures described in Section 6.5.1.1.

Overall Operations

Air dispersion modelling was performed to predict the maximum ambient ground level concentrations of CACs during the first year of operation and during a peak year of operation of the Hebron Platform. Dispersion modelling is used to simulate the transport of pollutants in the atmosphere based on representative weather information, and on the emission information provided by the process engineering and design team. The model algorithms are contained in a computer program that has been accepted by regulators for such use. The US EPA approved model AERMOD was used for dispersion calculations in this project. AERMOD is the current recommended model by the US EPA, and is suitable for distances up to about 35 km, beyond which the accuracy deteriorates. In this project, preliminary calculations showed that this range was more than sufficient to reveal the maximum ground-level concentrations.

Meteorological data for the surface were obtained for the five most recent calendar years from the Hibernia platform (a similar production facility, operating in the northeast Grand Banks), and they were coupled with upper air data from St. John's. Three nested receptor grids were considered in the modelling to cover the Study Area at higher resolution in the vicinity of the proposed platform location. Discrete receptors, including each of the existing platforms, were also included in the modelling study. As noted above emissions from the operation of vessels and helicopters were not included in these models. The air emissions model were re-run to include the larger generators using generic vendor data and fugitive emissions estimates.

Two scenarios were modelled for the operational phase of the Platform and included the following:

- First Year of Operation – Two dual-fuelled turbines operating on distillate fuel, fugitive releases and flaring of excess gas
- Peak Hebron Platform Operation – three turbine generators operating on natural gas, two dual-fueled turbine-driven compressors operating on natural gas, fugitive releases and background flaring

The sources used in the modelling study, their physical stack characteristics and emission factors are presented in Tables 6-12 and 6-13, respectively. The following is a list of assumptions used in both modelling scenarios:

- Two dual-fueled turbines operating on distillate fuel for power generation during the first year of operation (conservative case)

- Three turbines operating on natural gas for power generation and two additional dual-fueled turbine-driven compressors for gas compression during peak operation of the Project
- Quantities of fugitive emission sources and emission rates were provided by EMCP
- The emission rates for NO_x, SO_2 and CO for the turbines were provided by EMCP
- The emission factors for TSP and VOCs for the turbines were acquired from the US EPA's AP-42 documentation for Stationary Turbines for uncontrolled units
- The emission rates for the other Grand Bank facilities were acquired from 2008 NPRI information and the stack characteristics were assumed to be similar to the Hebron Platform
- The emission rates for NO_x, CO, TSP and VOCs for flaring were provided by EMCP
- The stack physical information and the topside configuration were provided by EMCP
- Minor amounts of sulphur in the distillate fuel
- Methane gas will initially be sweet, therefore limited quantities of sulphur
- Water injection via electrically driven pumps
- Emissions of NO_x, CO, TSP and VOCs from vessel and helicopter traffic were not included in the model runs (but were assessed in terms of GHG emissions)
- Receptors within the 500 m safety radius surrounding the platform were excluded from the model

Table 6-12 Point and Volume Source Physical Parameters

Point Sources	Source Location UTM		Stack Physical Parameters				
	Easting (m)	Northing (m)	Base Elevation (m)	Stack Height (m)	Stack Diameter (m)	Exit Velocity (m/s)	Exit Temperature (°C)
Power Generation - Turbine 1	692285	5157070	30.5	61.8	2	31.5	427
Power Generation - Turbine 2	692284	5157073	30.5	61.8	2	31.5	427
Power Generation - Turbine 3	692294	5157073	30.5	61.8	2	31.5	427
Gas Compression - Turbine 4	692376	5157048	30.5	43.5	2	14.4	427
Gas Compression - Turbine 5	692380	5157048	30.5	43.5	2	14.4	427
Flare	692404	5157063	30.5	136.5	1.42	20	1,000
Hibernia	669419	5179807	36	47	3	31.5	427
Terra Nova	693372	5149964	36	47	3	31.5	427
White Rose	727708	5186021	36	47	3	31.5	427
Volume Source	**Source Location UTM**		**Base Elevation (m)**	**Release Height (m)**	**Initial Horizontal Dimension (σ_y)**		**Initial Vertical Dimension (σ_z)**
	Easting (m)	**Northing (m)**					
Platform Fugitive Emissions	692319	5157063	30.5	20	30		9.3

Table 6-13 Air Dispersion Modelling Emission Rates

Sources	Emission Factors (g/s)								
	1st Year of Operation					Peak Operation			
	NO_x	CO	VOCs	TSP	SO_2	NO_x	CO	VOCs	TSP
Power Generation – Turbine 1	78.3	4.44	0.013	0.39	1.85	39.2	2.22	0.085	0.283
Power Generation – Turbine 2	78.3	4.44	0.013	0.39	1.85	39.2	2.22	0.085	0.283
Power Generation – Turbine 3	-	-	-	-	-	39.2	2.22	0.085	0.283
Gas Compression – Turbine 4	-	-	-	-	-	39.2	2.22	0.085	0.183
Gas Compression – Turbine 5	-	-	-	-	-	39.2	2.22	0.085	0.183
Fugitive Emissions[A]			15.8					23.9	
Flare	1.46	11.7	0.058	-	-	Minimal			
Hibernia	-	-	-	-	-	-	-	-	-
Terra Nova	-	-	-	-	-	-	-	-	-
White Rose	-	-	-	-	-	-	-	-	-
A Fugitive emissions were modelled as a volume source									

In summary, the air emissions related to the first year of platform operation, cumulative first year of operation, peak operation and cumulative peak operation of the Hebron Platform would meet the NAAQ Objectives. The predicted air emissions during a flaring event would also meet the NAAQ Objectives for each time period modelled. Cumulative emissions from the operation of the existing platforms are presented in Section 6.5.5.2.

The air dispersion modelling results for the first year of operation of the Hebron Platform are shown in Table 6-14.

Table 6-14 Summary of Model Predictions – Maximum Predicted Ground-level Concentrations – First Year of Operation

Contaminant	Averaging Period	Receptor	Location (m)		Maximum Predicted GLC (µg/m³)	NAAQ Objectives (Max Acceptable) (µg/m³)
			UTM X	UTM Y		
NO_2	1 -hour Maximum	Maximum Prediction - Gridded Receptors	691,792	5,157,572	95.7	400
		Hibernia	669,419	5,179,807	7.34	
		Terra Nova	693,371	5,149,964	19.3	
		White Rose	727,725	5,186,025	5.04	
	24-hour Maximum	Maximum Prediction - Gridded Receptors	691,792	5,157,572	58.2	200
		Hibernia	669,419	5,179,807	1.05	
		Terra Nova	693,371	5,149,964	3.41	
		White Rose	727,725	5,186,025	0.73	
	Annual Average	Maximum Prediction - Gridded Receptors	691,792	5,157,572	3.16	100

Contaminant	Averaging Period	Receptor	Location (m)		Maximum Predicted GLC (µg/m³)	NAAQ Objectives (Max Acceptable) (µg/m³)
			UTM X	UTM Y		
		Hibernia	669,419	5,179,807	0.02	
		Terra Nova	693,371	5,149,964	0.09	
		White Rose	727,725	5,186,025	0.04	
CO	1 -hour maximum	Maximum Prediction - Gridded Receptors	693,792	5,157,072	47.5	35,000
		Hibernia	669,419	5,179,807	3.2	
		Terra Nova	693,371	5,149,964	10.6	
		White Rose	727,725	5,186,025	2.4	
	8-hour maximum	Maximum Prediction - Gridded Receptors	695,292	5,156,822	18.5	15,000
		Hibernia	669,419	5,179,807	0.9	
		Terra Nova	693,371	5,149,964	2.5	
		White Rose	727,725	5,186,025	0.8	
CO	Annual Average	Maximum Prediction - Gridded Receptors	695,292	5,157,572	0.7	NA
		Hibernia	669,419	5,179,807	0.01	
		Terra Nova	693,371	5,149,964	0.0	
		White Rose	727,725	5,186,025	0.02	
TSP	1 -hour Maximum	Maximum Prediction - Gridded Receptors	691,792	5,157,572	1.9	NA
		Hibernia	669,419	5,179,807	0.1	
		Terra Nova	693,371	5,149,964	0.4	
		White Rose	727,725	5,186,025	0.1	
	24-hour Maximum	Maximum Prediction - Gridded Receptors	692,792	5,157,572	1.2	120
		Hibernia	669,419	5,179,807	0.02	
		Terra Nova	693,371	5,149,964	0.07	
		White Rose	727,725	5,186,025	0.01	
	Annual Average	Maximum Prediction - Gridded Receptors	692,792	5,157,572	0.1	70
		Hibernia	669,419	5,179,807	0.0005	
		Terra Nova	693,371	5,149,964	0.002	
		White Rose	727,725	5,186,025	0.001	
VOCs[A]	1 -hour Maximum	Maximum Prediction - Gridded Receptors	691,792	5,156,322	1.95	NA
		Hibernia	669,419	5,179,807	0.092	
		Terra Nova	693,371	5,149,964	0.315	
		White Rose	727,725	5,186,025	0.046	
	24-hour Maximum	Maximum Prediction - Gridded Receptors	692,292	5,156,572	0.275	NA
		Hibernia	669,419	5,179,807	0.005	

Contaminant	Averaging Period	Receptor	Location (m)		Maximum Predicted GLC (µg/m^3)	NAAQ Objectives (Max Acceptable) (µg/m^3)
			UTM X	UTM Y		
		Terra Nova	693,371	5,149,964	0.041	
		White Rose	727,725	5,186,025	0.004	
	Annual Average	Maximum Prediction - Gridded Receptors	692,792	5,157,322	0.02	NA
		Hibernia	669,419	5,179,807	0.0001	
		Terra Nova	693,371	5,149,964	0.0007	
		White Rose	727,725	5,186,025	0.0001	
SO_2	1-hour Maximum	Maximum Prediction - Gridded Receptors	691,792	5,157,572	9.45	900
		Hibernia	669,419	5,179,807	0.694	
		Terra Nova	693,371	5,149,964	1.81	
		White Rose	727,725	5,186,025	0.476	
	24-hour Maximum	Maximum Prediction - Gridded Receptors	692,792	5,157,572	5.50	300
		Hibernia	669,419	5,179,807	0.099	
		Terra Nova	693,371	5,149,964	0.320	
		White Rose	727,725	5,186,025	0.068	
	Annual Average	Maximum Prediction - Gridded Receptors	692,792	5,157,572	0.299	60
		Hibernia	669,419	5,179,807	0.002	
		Terra Nova	693,371	5,149,964	0.008	
		White Rose	727,725	5,186,025	0.003	
A VOC values are presented in mg/m^3						

The air dispersion modelling results for the peak operations of the Hebron Platform are shown in Table 6-15.

Table 6-15 Summary of Model Predictions – Maximum Predicted Ground-level Concentrations – Peak Operation

Contaminant	Averaging Period	Receptor	Location (m)		Maximum Predicted GLC (µg/m^3)	NAAQ Objectives (Max Acceptable) (µg/m^3)
			UTM X	UTM Y		
NO_2	1 -hour Maximum	Maximum Prediction - Gridded Receptors	692,792	5,157,072	169	400
		Hibernia	669,419	5,179,807	10.4	
		Terra Nova	693,371	5,149,964	28.0	
		White Rose	727,725	5,186,025	7.17	
	24-hour Maximum	Maximum Prediction - Gridded Receptors	692,792	5,157,572	94.3	200
		Hibernia	669,419	5,179,807	1.43	
		Terra Nova	693,371	5,149,964	5.17	
		White Rose	727,725	5,186,025	1.09	

Contaminant	Averaging Period	Receptor	Location (m)		Maximum Predicted GLC (µg/m³)	NAAQ Objectives (Max Acceptable) (µg/m³)
			UTM X	UTM Y		
	Annual Average	Maximum Prediction - Gridded Receptors	692,792	5,157,572	6.5	100
		Hibernia	669,419	5,179,807	0.03	
		Terra Nova	693,371	5,149,964	0.14	
		White Rose	727,725	5,186,025	0.06	
CO	1 -hour maximum	Maximum Prediction - Gridded Receptors	692,792	5,157,072	38.3	35,000
		Hibernia	669,419	5,179,807	2.4	
		Terra Nova	693,371	5,149,964	6.3	
		White Rose	727,725	5,186,025	1.6	
	8-hour maximum	Maximum Prediction - Gridded Receptors	692,792	5,157,072	33.4	15,000
		Hibernia	669,419	5,179,807	1.0	
		Terra Nova	693,371	5,149,964	1.8	
		White Rose	727,725	5,186,025	0.5	
	Annual Average	Maximum Prediction - Gridded Receptors	692,792	5,157,572	1.5	NA
		Hibernia	669,419	5,179,807	0.007	
		Terra Nova	693,371	5,149,964	0.0	
		White Rose	727,725	5,186,025	0.01	
TSP	1 -hour Maximum	Maximum Prediction - Gridded Receptors	692,792	5,157,572	4.9	NA
		Hibernia	669,419	5,179,807	0.3	
		Terra Nova	693,371	5,149,964	0.8	
		White Rose	727,725	5,186,025	0.2	
	24-hour Maximum	Maximum Prediction - Gridded Receptors	692,792	5,157,572	2.7	120
		Hibernia	669,419	5,179,807	0.04	
		Terra Nova	693,371	5,149,964	0.15	
		White Rose	727,725	5,186,025	0.03	
	Annual Average	Maximum Prediction - Gridded Receptors	692,792	5,157,572	0.2	70
		Hibernia	669,419	5,179,807	0.001	
		Terra Nova	693,371	5,149,964	0	
		White Rose	727,725	5,186,025	0.002	
VOCs[A]	1 -hour Maximum	Maximum Prediction - Gridded Receptors	691,792	5,156,322	2.94	NA
		Hibernia	669,419	5,179,807	0.14	
		Terra Nova	693,371	5,149,964	0.477	
		White Rose	727,725	5,186,025	0.069	

Contaminant	Averaging Period	Receptor	Location (m)		Maximum Predicted GLC (µg/m³)	NAAQ Objectives (Max Acceptable) (µg/m³)
			UTM X	UTM Y		
	24-hour Maximum	Maximum Prediction - Gridded Receptors	692,792	5,157,072	0.416	NA
		Hibernia	669,419	5,179,807	0.008	
		Terra Nova	693,371	5,149,964	0.062	
		White Rose	727,725	5,186,025	0.005	
	Annual Average	Maximum Prediction - Gridded Receptors	692,792	5,157,322	0.03	NA
		Hibernia	669,419	5,179,807	0.0001	
		Terra Nova	693,371	5,149,964	0.001	
		White Rose	727,725	5,186,025	0.0001	
A VOCS are presented in mg/m^3						

Further details on the air dispersion modelling study, as well as the concentration contour plots, can be found in Stantec 2010b.

Results from the air dispersion modelling show that the results of emissions produced during the first year of operation and during peak operation of the Hebron Platform would meet the stipulated air quality criteria in the short-term and long-term, and in near-field and far-field locations. There were no exceedances of the NAAQ Objectives.

Greenhouse Gas Emissions

During peak operation of the Project, emissions of GHGs will be associated with power generation, gas compression, flaring and the operation of vessels and helicopters.

Power Generation and Gas Compression

Greenhouse gases, including CO_2, N_2O and CH_4, are emitted during the operation of turbine generators when operating on either distillate fuel or natural gas. Carbon dioxide and N_2O are produced during the combustion process, as is CH_4 in the case of distillate fuel oil. Greater amounts of CO_2 are released during the combustion of distillate fuel versus natural gas due to the higher carbon content. In terms of natural gas combustion, low levels of CH_4 are present in the exhaust gas as unburned fuel (US EPA 2000). It is anticipated that once the platform is fully operational the dual-fuelled turbines will operate on natural gas, therefore reducing the quantity of GHGs emitted.

Flaring

It is a common practice for existing offshore facilities to inject produced gas into the sub-surface. The injection of produced gas reduces GHG emissions to the atmosphere. Prior to the operation of the gas compression and injection system, it will be necessary to flare that portion of the gas not used to fuel the generators.

While the use of injection wells will greatly reduce the platform's GHG emissions, some flaring will still be required during upset conditions and during normal operations (background flaring), but as mentioned above, such quantities are expected to be minor. The estimated GHG emissions from flaring during the first year of operation and during peak operation are presented in Table 6-16.

Table 6-16 Greenhouse Gas Emissions from Flaring during Hebron Platform Operation

Greenhouse Gas	1st Year of Operation	Peak Operation
CO_2 (tonnes/yr)	152,884	92,849
CH_4 (tonnes/yr)	791	484
N_2O (tonnes/yr)	0.283	0.173
Total $CO_{2\ eq}$ (tonnes/yr)	261,053	103,060

Fugitive Emissions

Fugitive greenhouse gas emissions, in particular CH_4, may be released from sources such as leaking valves, pump seals, compressor seals, flanges / connectors, and pressure relief valves during the operation of the platform.

Vessel and Helicopter Traffic

Greenhouse gas emissions, including CO_2, will be emitted during the routine operation of standby vessels, supply vessels and helicopters through the combustion of diesel fuel.

Overall Operations

An emissions inventory for the GHG emissions related to the overall operation phase of the Hebron Platform was prepared and the results are presented in Table 6-17.

As presented in Table 6-17, the estimated GHG emissions for the operation of the Hebron Platform are similar to those reported for other existing oil platforms located near the Offshore Project Area.

A summary of the potential environmental effects on Air Quality during the operations and maintenance phase of the Hebron Platform is provided in Table 6-18 (only those activities that result in Project-VEC interactions are included). As indicated in Section 6.3.2.2, several activities that indirectly affect Air Quality as a result of vessel traffic are assessed within the Operations of Vessels activity in Table 6-18. Power Generation is indicated as an activity unique to the analysis of environmental effects to Air Quality.

Table 6-17 Greenhouse Gas Emissions during the Operation of the Hebron Platform

Function	Greenhouse Gas Emissions (tonnes/year)			
	CO_2	N_2O	CH_4	Total CO_2eq
Power Generation	269,024	19.9	5	275,298
Gas Compression	174,612	6.7	3.3	176,758

Function	Greenhouse Gas Emissions (tonnes/year)			
	CO_2	N_2O	CH_4	Total CO_2eq
Flaring	92,849	0.173	484	103,067
Fugitive Emissions	-	-	1346	28,266
Vessel Traffic	12,589	ND	ND	12,589
Helicopter Traffic	491	ND	ND	491
Hebron Total				596,469
Hibernia				595,749
Terra Nova				618,327
White Rose				555,534
Source: Rolls-Royoce Marine 1991; US EPA 2000; Sikorsky 2007; Environment Canada 2009a; EMCP unpublished data				

Table 6-18 Environmental Effects Assessment: Operation and Maintenance

Project Activity[A]	Potential Environmental Effect	Mitigation	Evaluation Criteria for Assessing Residual Adverse Environmental Effects				
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological / Socio-economic Context
Power Generation[B]	• Change in Ambient Air Quality • Greenhouse Gas emissions	• Investigate the use of efficient / reduced emission technology, where appropriate, and where technologically sound and economically justifiable incorporate into the design	2	2	5/6	R	2
Maintenance Activities (*e.g.,* diving, ROV, welding)	• Change in Ambient Air Quality		1	1	5/3	R	2
Flaring (upset conditions)	• Change in Ambient Air Quality • Greenhouse Gas Emissions	• Monitor the number of flaring events • Investigate the use of efficient / reduced emission technology, where appropriate, and where technologically sound and economically justifiable incorporate into the design.	2	3	1/1	R	2
Chemical / Fuel Management / Storage (*e.g.,* corrosion inhibitors, BOP fluids, methane leaks from valves)	• Change in Ambient Air Quality • Greenhouse Gas	• Develop and implement Standard Operaing Procedures (SOPs) for all chemical handling operations	1	1	5/6	R	2
Operation of Helicopters	• Change in Ambient Air Quality • Greenhouse Gas Emissions	• Ensure properly maintained and efficient operation	1	4	5/6	R	2

Project Activity[A]	Potential Environmental Effect	Mitigation	Evaluation Criteria for Assessing Residual Adverse Environmental Effects				
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological / Socio-economic Context
Operation of Vessels (supply, support, standby and tow vessels / shuttle tankers / barges / ROVs)	• Change in Ambient Air Quality • Greenhouse Gas Emissions	• Maintenance and inspections	1	4	5/6	R	2

KEY

Magnitude:
1 = Low: Within normal variability of baseline conditions, but is well below regulatory limits and objectives
2 = Medium: increase or decrease with regard to baseline but near regulatory limits and objectives
3 = High: Increase such that the quality of the air is degraded to values that substantively exceed the regulatory limits and objectives

Geographic Extent:
1 = <1 km^2
2 = 1-10 km^2
3 = 11-100 km^2
4 = 101-1,000 km^2
5 = 1,001-10,000 km^2
6 = >10,000 km^2

Duration:
1 = < 1 month
2 = 1-12 months.
3 = 13-36 months
4 = 37-72 months
5 = >72 months

Frequency:
1 = <11 events/year
2 = 11-50 events/year
3 = 51-100 events/year
4 = 101-200 events/year
5 = >200 events/year
6 = continuous

Reversibility:
R = Reversible
I = Irreversible

Ecological / Socio-economic Context:
1 = Area is relatively pristine or not adversely affected by human activity
2 = Evidence of adverse effects

A Where there is more than one potential environmental effect, the evaluation criteria rating is assigned to the environmental effect with the greatest potential for harm
B Includes Gas Compression

6.5.3 Offshore Decommissioning and Abandonment

Project activities associated with decommissioning and abandonment will be similar to those associated with construction and installation, with regard to air emissions. Particularly, emissions may result from the removal of the topside facilities, Hebron Platform and OLS loading points and from vessel and helicopter traffic. The effect of each of these activities will be temporary in nature, medium in magnitude, geographic extent and duration and the same mitigative measures will be implemented during decommissioning as were used during construction.

The summary of potential environmental effects on Air Quality from decommissioning and abandonment-related activities is provided in Table 6-19 (only those activities that result in Project-VEC interactions are included). As indicated in Section 6.3.2.3, several activities that indirectly affect Air Quality as a result of vessel and helicopter traffic are assessed within the Operation of Vessels and Operation of Helicopters in Table 6-19.

Table 6-19 Environmental Effects Assessment: Decommissioning and Abandonment

Project Activity[A]	Potential Environmental Effect	Mitigation	Evaluation Criteria for Assessing Residual Adverse Environmental Effects				
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological / Socio-economic Context
Removal of the Platform and OLS Loading Points	• Change in Ambient Air Quality	• Vessel traffic mitigation strategies, including the use of vessels suitable for each work activity and vessel inspections	2	2	2/1	R	2
Operation of Helicopters	• Change in Ambient Air Quality • Greenhouse Gas Emissions	• Maintenance and inspections	1	4	3/6	R	2
Operation of Vessels (supply, support, standby and tow vessels / barges / ROVs)	• Change in Ambient Air Quality • Greenhouse Gas Emissions	• Vessel traffic mitigation strategies, including the use of vessels suitable for each work activity and vessel inspections	1	4	3/6	R	2

KEY

Magnitude:
1 = Low: Within normal variability of baseline conditions, but is well below regulatory limits and objectives
2 = Medium: increase or decrease with regard to baseline but near regulatory limits and objectives
3 = High: Increase such that the quality of the air is degraded to values that substantively exceed the regulatory limits and objectives

Geographic Extent:
1 = <1 km^2
2 = 1-10 km^2
3 = 11-100 km^2
4 = 101-1,000 km^2
5 = 1,001-10,000 km^2
6 = >10,000 km^2

Duration:
1 = < 1 month
2 = 1-12 months.
3 = 13-36 months
4 = 37-72 months
5 = >72 months

Frequency:
1 = <11 events/year
2 = 11-50 events/year
3 = 51-100 events/year
4 = 101-200 events/year
5 = >200 events/year
6 = continuous

Reversibility:
R = Reversible
I = Irreversible

Ecological / Socio-economic Context:
1 = Area is relatively pristine or not adversely affected by human activity
2 = Evidence of adverse effects

[A] Where there is more than one potential environmental effect, the evaluation criteria rating is assigned to the environmental effect with the greatest potential for harm

6.5.4 Accidents Malfunctions and Unplanned Events

6.5.4.1 Change in Air Quality

Nearshore

As nearshore activities consist of routine fabrication of large marine structures, accidental releases of air emissions could result from collisions of vessels with the GBS and/or with other vessels or from a hydrocarbon spill. Either of these events could result in a release of fugitive gases to the atmosphere; however, the release would be very small in magnitude, geographic extent, and duration, and will be prevented or mitigated by implementing the following measures:

- Risk awareness, emergency response and preventative measures training
- Routine audits on the general contractors oil spill response preparedness program
- Training staff on spill response and awareness during "Tool Box Safety" meetings
- Routine inspections of equipment
- Use of oil containment booms when necessary

The most extensive incident, however, would be if either of the above events resulted in a fire. An uncontrolled fire involving distillate fuel may result in incomplete combustion and therefore the release of air emissions. Such emissions would possibly be greater in magnitude, extent and duration than the fugitive release.

Offshore

Accidental releases of air emissions in the Offshore Project Area could result from the failure of OLS pipelines, manifolds or risers, subsea blowout, hydrocarbon spill, chemical spill and/or marine vessel incident. Each of these events would result in the release of hydrocarbons and therefore the release of fugitive air emissions to the atmosphere. These air emissions will be small in magnitude, extent and duration because of a number of preventative or mitigative measures will be implemented to either aid in minimizing the likelihood of the event taking place or to minimize the effect on Air Quality if the event took place and include:

- Develop and implement Standard Operating Procedures (SOPs) for all oil handling operations
- Good communications and sound marine practices for all vessels
- Conducting periodic inspection and maintenance checks on product storage and handling and fuel transfer systems
- The general awareness of offshore workers will be increased through training, seminars and safety meetings
- Conducting periodic maintenance and inspections on helicopters and vessels

There is also a risk of an explosion and/or fire in the case of fuel and chemical leaks or spills. Appropriate systems, resources and training will be in place to reduce the frequency and magnitude of explosions and fires on the platform and to respond to any such incidents that occur. The air emissions related to a potential explosion or fire would be greater in magnitude, extent and duration than those released from a fuel or chemical spill, but still marginally small.

Accidental releases of air emissions could also result during emergency flaring events. Emergency flaring allows for the prevention of over-pressurization of equipment and safely disposes of associated gas during process upset conditions. Air dispersion modelling was performed to predict the maximum ambient GLCs during an emergency flaring event. One event was assumed to last for fifteen minutes. The flare system physical characteristics and the emission data (Table 6-20) was used in the model.

Table 6-20 Air Dispersion Modelling Emission Rates

Sources	Flaring (g/s)			
	NO_x	CO	VOCs	TSP
Flare	1.46	11.67	0.058	-

As the gas is initially sweet, the amount of particulate matter released from the flare will be much lower than if the flare was a sour gas flare. The use of modern efficient flare technology will further reduce the particulate that would be form as unburned hydrocarbons (soot). Particulate emissions from flaring are assumed to be minimal for this analysis.

The air dispersion modelling results for an emergency flaring event of the Hebron Platform are shown in Table 6-21.

Table 6-21 Summary of Model Predictions – Maximum Predicted Ground-level Concentrations - Flaring

Contaminant	Averaging Period	Receptor	Location (m)		Maximum Predicted GLC ($\mu g/m^3$)	NAAQ Objectives (Max Acceptable) ($\mu g/m^3$)
			UTM X	UTM Y		
NO_2	1 -hour Maximum	Maximum Prediction - Gridded Receptors	693,792	5,157,072	0.956	400
		Hibernia	669,419	5,179,807	0.059	
		Terra Nova	693,371	5,149,964	0.196	
		White Rose	727,725	5,186,025	0.039	
	24-hour Maximum	Maximum Prediction - Gridded Receptors	695,292	5,156,822	0.097	200
		Hibernia	669,419	5,179,807	0.008	
		Terra Nova	693,371	5,149,964	0.022	
		White Rose	727,725	5,186,025	0.006	
	Annual Average	Maximum Prediction - Gridded Receptors	694,792	5,159,322	0.002	100
		Hibernia	669,419	5,179,807	0.000	
		Terra Nova	693,371	5,149,964	0.001	
		White Rose	727,725	5,186,025	0.000	
CO	1 -hour maximum	Maximum Prediction - Gridded Receptors	693,792	5,157,072	30.6	35,000
		Hibernia	669,419	5,179,807	1.9	
		Terra Nova	693,371	5,149,964	6.3	
		White Rose	727,725	5,186,025	1.3	
	8-hour maximum	Maximum Prediction - Gridded Receptors	695,292	5,156,822	10.9	15,000
		Hibernia	669,419	5,179,807	0.5	
		Terra Nova	693,371	5,149,964	1.5	
		White Rose	727,725	5,186,025	0.4	

Contaminant	Averaging Period	Receptor	Location (m)		Maximum Predicted GLC (µg/m³)	NAAQ Objectives (Max Acceptable) (µg/m³)
			UTM X	UTM Y		
	Annual Average	Maximum Prediction - Gridded Receptors	694,792	5,159,322	0.1	NA
		Hibernia	669,419	5,179,807	5.5E-03	
		Terra Nova	693,371	5,149,964	0.02	
		White Rose	727,725	5,186,025	0.01	
VOCs	1 -hour Maximum	Maximum Prediction - Gridded Receptors	693,792	5,157,072	0.2	NA
		Hibernia	669,419	5,179,807	0.01	
		Terra Nova	693,371	5,149,964	0.03	
		White Rose	727,725	5,186,025	0.01	
	24-hour Maximum	Maximum Prediction - Gridded Receptors	695,292	5,156,822	0.02	NA
		Hibernia	669,419	5,179,807	1.3E-03	
		Terra Nova	693,371	5,149,964	3.4E-03	
		White Rose	727,725	5,186,025	9.5E-04	
	Annual Average	Maximum Prediction - Gridded Receptors	694,792	5,159,322	2.7E-04	NA
		Hibernia	669,419	5,179,807	2.7E-05	
		Terra Nova	693,371	5,149,964	1.1E-04	
		White Rose	727,725	5,186,025	4.9E-05	

Results from the air dispersion modelling for flaring show that the emissions produced from the Platform would meet the stipulated NAAQ Objectives in the short-term and long-term, and in near-field and far-field locations. The maximum grid values present the highest concentrations at any receptor.

6.5.4.2 Greenhouse Gas Emissions

Nearshore

The release of GHGs to the atmosphere from an unplanned or accidental event, including a collision or hydrocarbon spill would represent a short-term emergency situation. In the nearshore, such a release would most likely be related to a fuel spill and possibly related to a fire, and would certainly be small in magnitude, extent and duration, adding a very small amount of GHGs to the total inventory of GHG emissions for the Project.

Offshore

Accidental events that would lead to an unplanned release of GHGs in the Offshore Project Area would include an emergency depressurization to the flare, the rupture of OLS pipelines, subsea blowout or due to a fire resulting from a fuel or hydrocarbon spill. The volume of such emissions would be small relative to the Project's total GHG inventory, and such emissions would be limited by the specific measures as outlined above in Section 6.5.4.1.

A summary of the potential environmental effects on Air Quality due to accidents, malfunctions and unplanned events attributable to the Project is provided in Table 6-22 (only those activities that result in Project-VEC interactions are included). Emergency Flaring is included as an activity unique to the environmental effects analysis to Air Quality.

Table 6-22 Environmental Effects Assessment: Accidental Events

Project Activity[A]	Potential Environmental Effect	Mitigation	Evaluation Criteria for Assessing Residual Adverse Environmental Effects				
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological / Socio-economic Context
Nearshore Spill (at Bull Arm Site)	• Change in Ambient Air Quality	• Conduct periodic maintenance and repair on vessels • Train personnel in spill prevention and awareness • Oil containment booms	1	3	2/1	R	1
Failure or Spill from OLS	• Change in Ambient Air Quality	• Conduct periodic inspections, maintenance and repair of facilities and equipment • Train personnel in spill prevention and awareness	1	5	2/1	R	2
Subsea Blowout	• Change in Ambient Air Quality • Greenhouse Gas Emissions	• Drilling design and geotechnicla surveys • Alert / Emergency Response Contingency Plan	1	5	3/1	R	2
Crude Oil Surface Spill	• Change in Ambient Air Quality	• Conduct periodic maintenance and repair on Platform and vessels • Train personnel in spill prevention • SOPs for oil handling operations	1	5	2/1	R	2
Other Spills (fuel, chemicals, drilling muds or waste materials on the drilling unit, GBS, Platform)	• Change in Ambient Air Quality	• Conduct periodic inspection, maintenance and repair of facilities and equipment • Train personnel in spills management and awareness • SOPs for chemical handling and storage	1	1	2/1	R	2
Collisions (involving Platform, vessel and/or iceberg)	• Change in Ambient Air Quality	• Risk awareness, emergency response and preventative measures, training on fuel handling and storage	1	3	2/1	R	1
Emergency Flaring	• Change in Ambient Air Quality		2	2	1/2	R	2

Project Activity[A]	Potential Environmental Effect	Mitigation	Evaluation Criteria for Assessing Residual Adverse Environmental Effects				
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological / Socio-economic Context

KEY

Magnitude:
1 = Low: Within normal variability of baseline conditions, but is well below regulatory limits and objectives
2 = Medium: increase or decrease with regard to baseline but near regulatory limits and objectives
3 = High: Increase such that the quality of the air is degraded to values that substantively exceed the regulatory limits and objectives

Geographic Extent:
1 = <1 km^2
2 = 1-10 km^2
3 = 11-100 km^2
4 = 101-1,000 km^2
5 = 1,001-10,000 km^2
6 = >10,000 km^2

Duration:
1 = < 1 month
2 = 1-12 months.
3 = 13-36 months
4 = 37-72 months
5 = >72 months

Frequency:
1 = <11 events/year
2 = 11-50 events/year
3 = 51-100 events/year
4 = 101-200 events/year
5 = >200 events/year
6 = continuous

Reversibility:
R = Reversible
I = Irreversible

Ecological / Socio-economic Context:
1 = Area is relatively pristine or not adversely affected by human activity
2 = Evidence of adverse effect

A Where there is more than one potential enviromental effect, the evaluation criteria rating is assigned to the environmental effect with the greatest potential for harm

6.5.5 Cumulative Environmental Effects

The ambient air quality in the Study Area reflects the influence of emissions from other projects and activities occurring within or outside the Project Area. Other projects for consideration of cumulative environmental effects include the following:

- Hibernia Oil Development and Hibernia Southern Extension (drilling and production)
- Terra Nova Development (drilling and production)
- White Rose Oilfield Development and Expansions (drilling and production)
- Offshore exploration drilling activities
- Offshore exploration seismic activities
- Marine transportation
- Commercial fisheries

In addition, the North Atlantic Refinery, Newfoundland Transshipment Terminal, construction of the Long Harbour Processing Plant, and proposed Liquefied Natural Gas Transshipment and Storage Terminal and Southern Head Marine Terminal and Associated Crude Oil Refinery projects were considered in the cumulative environmental effects assessment for Air Quality.

Long-range transport of airborne emissions also contributes additional loading to the local airshed from sources located on the eastern seaboard of the United States and Canada, outside of the Study Area; however, these contributions are likely to be on the margin of detection due to the distance from the eastern seaboard to the Offshore Project Area.

6.5.5.1 Nearshore

The cumulative influences of the construction of nearshore components of the GBS with other existing or proposed projects, listed above, have the potential to result in an effect on Air Quality. However, the environmental effects of the air emissions related to the nearshore construction of the GBS are small in relative quantity, small in geographic extent and short in duration.

6.5.5.2 Offshore

Change in Ambient Air Quality

Air dispersion modelling was also conducted to assess the potential environment effects on Air Quality due to the cumulative environmental effects of the existing offshore oil platforms in the area with the operational phase of the Hebron Platform. The cumulative emissions predicted for the first year of operation would be similar to those produced during the offshore construction and installation of the Platform. The same modelling program, meteorological data, receptor grids, source physical characteristics and assumptions were used to model the Project commissioning and operation cumulative scenarios as were outlined in Section 6.5.2.1. The emission rates for each source are presented in Table 6-23.

Table 6-23 Air Dispersion Modelling Emission Rates

Sources	Project - 1st Year of Operation Cumulative				Project - Peak Operation Cumulative				
	NO_x	CO	VOCs	TPM	SO_2	NO_x	CO	VOCs	TPM
Power Generation - Turbine 1	78.3	4.44	0.013	0.39	1.85	39.2	2.22	0.085	.283
Power Generation - Turbine 2	78.3	4.44	0.013	0.39	1.85	39.2	2.22	0.085	0.283
Power Generation - Turbine 3	-	-	-	-	-	39.2	2.22	0.085	0.283
Gas Compression - Turbine 4	-	-	-	-	-	39.2	2.22	0.085	0.283
Gas Compression - Turbine 5	-	-	-	-	-	39.2	2.22	0.085	0.283
Fugitive Emissions[A]	-	-	15.8	-	-	-	-	23.9	-
Flare	1.46	11.67	0.058	-	-	Background Flaring			
Hibernia	34.4	25.3	14.9	6.2	-	34.4	25.3	14.9	6.2
Terra Nova	73.3	23.2	213	6.6	-	73.3	23.2	213	6.6
White Rose	76.8	28.2	9.04	8.47	-	76.8	28.2	9.04	8.47

Fugitive emissions were modelled as a volume source

The air dispersion modelling results for the cumulative environmental effect of the first year of operation for the Hebron Platform with the other existing oil platforms is presented in Table 6-24.

Table 6-24 Summary of Model Predictions – Maximum Predicted Ground-level Concentrations – Cumulative 1st Year of Operation

Contaminant	Averaging Period	Receptor	Location (m)		Maximum Predicted GLC (µg/m³)	NAAQ Objectives (Max Acceptable) (µg/m³)
			UTM X	UTM Y		
NO_2	1 -hour Maximum	Maximum Prediction - Gridded Receptors	691, 792	5,157,572	95.7	400
		Hibernia	669,419	5,179,807	7.83	
		Terra Nova	693,371	5,149,964	19.4	
		White Rose	727,725	5,186,025	5.25	
	24-hour Maximum	Maximum Prediction - Gridded Receptors	692,792	5,157,572	58.2	200
		Hibernia	669,419	5,179,807	1.38	
		Terra Nova	693,371	5,149,964	3.42	
		White Rose	727,708	5,186,021	0.83	
NO_x (assumed to be NO_2)	Annual Average	Maximum Prediction - Gridded Receptors	692,792	5,157,572	3.20	100
		Hibernia	669,419	5,179,807	0.03	
		Terra Nova	693,371	5,149,964	0.01	
		White Rose	727,708	5,186,021	0.06	
CO	1 -hour maximum	Maximum Prediction - Gridded Receptors	693,792	5,157,072	48.8	35,000
		Hibernia	669,419	5,179,807	4.5	
		Terra Nova	693,371	5,149,964	10.7	
		White Rose	727,725	5,186,025	3.3	
	8-hour maximum	Maximum Prediction - Gridded Receptors	695,292	5,156,822	18.8	15,000
		Hibernia	669,419	5,179,807	2.0	
		Terra Nova	693,371	5,149,964	2.5	
		White Rose	727,725	5,186,025	1.4	
	Annual Average	Maximum Prediction - Gridded Receptors	692,792	5,157,572	0.8	NA
		Hibernia	669,419	5,179,807	0.03	
		Terra Nova	693,371	5,149,964	0.1	
		White Rose	727,725	5,186,025	0.06	
TSP	1 -hour Maximum	Maximum Prediction - Gridded Receptors	729,292	5,187,572	12.9	NA
		Hibernia	669,419	5,179,807	0.9	
		Terra Nova	693,371	5,149,964	1.0	
		White Rose	727,725	5,186,025	0.8	

Contaminant	Averaging Period	Receptor	Location (m) UTM X	Location (m) UTM Y	Maximum Predicted GLC (µg/m³)	NAAQ Objectives (Max Acceptable) (µg/m³)
	24-hour Maximum	Maximum Prediction - Gridded Receptors	728,292	5,187,572	1.9	120
		Hibernia	669,419	5,179,807	0.15	
		Terra Nova	693,371	5,149,964	0.2	
		White Rose	727,725	5,186,025	0.1	
	Annual Average	Maximum Prediction - Gridded Receptors	692,792	5,157,572	0.1	70
		Hibernia	669,419	5,179,807	0.005	
		Terra Nova	693,371	5,149,964	0.01	
		White Rose	727,725	5,186,025	0.011	
VOCs[A]	1 -hour Maximum	Maximum Prediction - Gridded Receptors	695,292	5,150,072	1.95	NA
		Hibernia	669,419	5,179,807	0.092	
		Terra Nova	693,371	5,149,964	0.315	
		White Rose	727,725	5,186,025	0.046	
	24-hour Maximum	Maximum Prediction - Gridded Receptors	694,292	5,152,572	0.275	NA
		Hibernia	669,419	5,179,807	0.006	
		Terra Nova	693,371	5,149,964	0.041	
		White Rose	727,725	5,186,025	0.004	
	Annual Average	Maximum Prediction - Gridded Receptors	694,792	5,151,572	0.020	NA
		Hibernia	669,419	5,179,807	0.0002	
		Terra Nova	693,371	5,149,964	0.0007	
		White Rose	727,725	5,186,025	0.0002	
SO_2	1-hour Maximum	Maximum Prediction - Gridded Receptors	691,792	5,157,572	9.05	900
		Hibernia	669,419	5,179,807	0.69	
		Terra Nova	693,371	5,149,964	1.81	
		White Rose	727,725	5,186,025	0.48	
	24-hour Maximum	Maximum Prediction - Gridded Receptors	692,792	5,157,572	5.50	300
		Hibernia	669,419	5,179,807	0.099	
		Terra Nova	693,371	5,149,964	0.32	
		White Rose	727,725	5,186,025	0.068	
	Annual Average	Maximum Prediction - Gridded Receptors	692,792	5,157,572	0.299	60
		Hibernia	669,419	5,179,807	0.002	
		Terra Nova	693,371	5,149,964	0.008	
		White Rose	727,725	5,186,025	0.004	

A VOCs are presented in mg/m³

Results from the air dispersion modelling for the cumulative environmental effect of the first year of operation of the Platform with the existing oil platforms show that the emissions would meet the stipulated NAAQ Objectives for the short-term and long-term, and in near-field and far-field locations.

The air dispersion modelling results for the cumulative environmental effect of peak operation of the Hebron Platform with the other existing oil platforms is presented in Table 6-25.

Table 6-25 Summary of Model Predictions – Maximum Predicted Ground-level Concentrations – Cumulative Peak Operation

Contaminant	Averaging Period	Receptor	Location (m)		Maximum Predicted GLC (µg/m^3)	NAAQ Objectives (Max Acceptable) (µg/m^3)
			UTM X	UTM Y		
NO_2	1 -hour Maximum	Maximum Prediction - Gridded Receptors	692,792	5,157,072	169	400
		Hibernia	669,419	5,179,807	10.9	
		Terra Nova	693,371	5,149,964	28.1	
		White Rose	727,725	5,186,025	7.38	
	24-hour Maximum	Maximum Prediction - Gridded Receptors	692,792	5,157,572	94.3	200
		Hibernia	669,419	5,179,807	1.76	
		Terra Nova	693,371	5,149,964	5.17	
		White Rose	727,725	5,186,025	1.20	
	Annual Average	Maximum Prediction - Gridded Receptors	692,792	5,157,572	6.56	100
		Hibernia	669,419	5,179,807	0.04	
		Terra Nova	693,371	5,149,964	0.15	
		White Rose	727,725	5,186,025	0.08	
CO	1 -hour maximum	Maximum Prediction - Gridded Receptors	729,292	5,186,072	43.2	35,000
		Hibernia	669,419	5,179,807	3.8	
		Terra Nova	693,371	5,149,964	6.4	
		White Rose	727,725	5,186,025	3.6	
	8-hour maximum	Maximum Prediction - Gridded Receptors	692,792	5,157,072	33.4	15,000
		Hibernia	669,419	5,179,807	2.2	
		Terra Nova	693,371	5,149,964	1.8	
		White Rose	727,725	5,186,025	1.2	
	Annual Average	Maximum Prediction - Gridded Receptors	692,792	5,157,572	1.5	NA
		Hibernia	669,419	5,179,807	0.02	

Contaminant	Averaging Period	Receptor	Location (m)		Maximum Predicted GLC (µg/m³)	NAAQ Objectives (Max Acceptable) (µg/m³)
			UTM X	UTM Y		
		Terra Nova	693,371	5,149,964	0.1	
		White Rose	727,725	5,186,025	0.05	
TSP	1 -hour Maximum	Maximum Prediction - Gridded Receptors	729,292	5,157,572	12.9	NA
		Hibernia	669,419	5,179,807	224	
		Terra Nova	693,371	5,149,964	764	
		White Rose	729,292	5,157,572	12.9	
	24-hour Maximum	Maximum Prediction - Gridded Receptors	692,792	5,157,572	2.7	120
		Hibernia	669,419	5,179,807	12.9	
		Terra Nova	693,371	5,149,964	99.4	
		White Rose	727,725	5,186,025	9.0	
	Annual Average	Maximum Prediction - Gridded Receptors	692,792	5,157,572	0.2	70
		Hibernia	669,419	5,179,807	0.006	
		Terra Nova	693,371	5,149,964	0.01	
		White Rose	727,725	5,186,025	0.01	
VOCs[A]	1 -hour Maximum	Maximum Prediction - Gridded Receptors	695,292	5,150,072	2.94	NA
		Hibernia	669,419	5,179,807	0.14	
		Terra Nova	693,371	5,149,964	0.477	
		White Rose	727,725	5,186,025	0.069	
	24-hour Maximum	Maximum Prediction - Gridded Receptors	694,292	5,152,572	0.416	NA
		Hibernia	669,419	5,179,807	0.008	
		Terra Nova	693,371	5,149,964	0.062	
		White Rose	727,725	5,186,025	0.006	
	Annual Average	Maximum Prediction - Gridded Receptors	694,792	5,151,572	0.031	NA
		Hibernia	669,419	5,179,807	0.0002	
		Terra Nova	693,371	5,149,964	0.001	
		White Rose	727,725	5,186,025	0.0003	

A VOCs are presented in mg/m³

Results from the air dispersion modelling for the cumulative environmental effect of peak operation of the Platform with the existing oil platforms, show that the emissions would meet the stipulated NAAQ Objectives for the short-term and long-term, and in near-field and far-field locations.

Greenhouse Gases

The cumulative environmental effect of the release of GHGs during the operational phase of the platform with the operation of the existing production platforms was assessed in terms of preparing an emissions inventory of GHGs and comparing that to the national total.

The Project will emit GHGs (including CO_2, N_2O, and CH_4) from power generation, gas combustion, non-routine flaring and vessel and helicopter traffic. The individual contributions of GHGs from each of the existing platforms in the area and the Hebron Platform, as well as their combined contribution, and the national total are presented in Table 6-26.

Table 6-26 Cumulative Greenhouse Gas Emissions

Facility	Greenhouse Gas Emissions (tonnes CO_2eq per year)		
	CO_2	N_2O	CH_4
Hibernia	556,231	4,557	34,960
Terra Nova	576,456	10,597	31,274
White Rose	515,691	9,796	30,047
Hebron	549565	8300	38,604
Provincial Total	5,140,424	35,955	97,037
National Total	247,400,881	4,897,951	7,983,044
Percent Contribution of the Hebron Project to National Total	0.22%	0.17%	0.48%
Source: Rolls-Royce Marine 1991; US EPA 2000; Sikorsky 2007; Environment Canada 2009b; EMCP unpublished data			

As displayed in Table 6-26, the percent contribution of GHGs from the operation of the Hebron Platform to the overall national total is substantially small in magnitude.

Once in operation, the Project will report annual emissions of CACs and greenhouse gases to Environment Canada under the NPRI and the National GHG Reporting schemes, as well as meet the reporting requirements pursuant to the *Offshore Waste Treatment Guidelines*.

6.6 Determination of Significance

The determination of significance is based on the definition provided in Section 6.4. It considers the magnitude, geographic extent, duration, frequency, reversibility and ecological context of each environmental effect, and their interactions, as presented in the preceding analysis.

6.6.1 Change in Air Quality

Overall, as demonstrated by the preceding analysis, the change in air quality attributable to the Project is expected to be low to medium in magnitude, local in extent, and short term in duration. Components associated with all phases of the Project, including power generation, compression equipment, fugitive releases and non-routine flaring, as well as accidental releases and cumulative environmental effects, will result in emissions that will not frequently exceed applicable ground-level NAAQ Objectives. Adverse effects on air quality that could occur as a result of an accidental release of large amounts of raw gas through a blowout or pipe break could only occur in an event that is considered extremely unlikely.

Therefore, by implementing appropriate mitigation measures, the environmental effects on Air Quality during the construction, operations and decommissioning phases of the Project, including accidental and cumulative environmental effects, is predicted to be not significant. A summary of the environmental effects for a change in air quality is provided in Table 6-27.

Table 6-27 Residual Environmental Effects Summary: Change in Ambient Air Quality

Phase	Residual Adverse Environmental Effect Rating[A]	Level of Confidence	Probability of Occurrence (Likelihood)
Construction / Installation[B]	NS	3	N/A[D]
Operation and Maintenance	NS	3	N/A
Decommissioning and Abandonment[C]	NS	3	N/A
Accidents, Malfunctions and Unplanned Events	NS	3	N/A
Cumulative Effects	NS	3	N/A

KEY

Residual Environmental Effects Rating:	Level of Confidence in the Effect Rating:	Probability of Occurrence of Significant Effect:
S = Significant Adverse Environmental Effect	1 = Low level of Confidence	1 = Low Probability of Occurrence
NS = Not Significant Adverse Environmental Effect	2 = Medium Level of Confidence	2 = Medium Probability of Occurrence
	3 = High level of Confidence	3 = High Probability of Occurrence
		N/A = Not Applicable

A As determined in consideration of established residual environmental effects rating criteria.
B Includes all Bull Arm activities, engineering, construction, removal of the bund well, tow-out and installation of the Hebron Platform at the offshore site
C Includes decommissioning and abandonment of the GBS and offshore site
D Effect is not predicted to be significant, therefore the probability of occurrence rating is not required under CEAA

6.6.2 Greenhouse Gas Emissions

With respect to a change in GHG emissions, the magnitude is ranked as medium for both the construction and operations phases; however, the emissions are consistent with those currently being reported for other similar facilities in the same locale. The geographic extent is provincial, national and ultimately, global. The duration is short-term during construction and continues for the full period of operations. Nevertheless, it is not yet possible to determine the effect of these emissions on climate change. In the unlikely event of a large-scale accident or malfunction, the Project's GHG emissions will be temporarily increased.

Therefore, the Project-related change in GHG emissions, including accidental events, and the potential cumulative change in GHG emissions is rated as not significant. There is moderate level of confidence in this significance prediction due to the evolving nature of climate change science and the contributions of anthropogenic greenhouse gases to climate change. A summary of the environmental effects for a change in GHG is provided in Table 6-28.

Table 6-28 Residual Environmental Effects Summary: Greenhouse Gas Emissions

Phase	Residual Adverse Environmental Effect Rating[A]	Level of Confidence	Probability of Occurrence (Likelihood)
Construction / Installation[B]	NS	2	N/A[1]
Operation and Maintenance	NS	2	N/A
Decommissioning and Abandonment[C]	NS	2	N/A
Accidents, Malfunctions and Unplanned Events	NS	2	N/A
Cumulative Effects	NS	2	N/A

KEY

Residual Environmental Effects Rating:
S = Significant Adverse Environmental Effect
NS = Not Significant Adverse Environmental Effect

Level of Confidence in the Effect Rating:
1 = Low level of Confidence
2 = Medium Level of Confidence
3 = High level of Confidence

Probability of Occurrence of Significant Effect:
1 = Low Probability of Occurrence
2 = Medium Probability of Occurrence
3 = High Probability of Occurrence
N/A = Not Applicable

A As determined in consideration of established residual environmental effects rating criteria
B Includes all Bull Arm activities, engineering, construction, removal of the bund well, tow-out and installation of the Hebron Platform at the offshore site
C Includes decommissioning and abandonment of the GBS and offshore site
1 Effect is not predicted to be significant, therefore the probability of occurrence rating is not required under CEAA

6.7 Follow-up and Monitoring

In the Operations and Maintenance Phase, there is no suggested follow-up or monitoring required for Air Quality. The Project will adhere to proactive maintenance scheduling and procedures to monitor and reduce factors such as corrosion, vibration, mechanical wear and fatigue. During the operation of the facility, compliance with environmental regulatory requirements and standards and emissions of CACs and GHGs will be documented annually and submitted as required by federal government reporting program.

Emission estimates are based on vendor specifications and EPA guidance. The values estimated will be validated against vendor guaranteed emissions performance data, which can only be obtained once the equipment is purchased. Once in operations, the Hebron Project will be required to report annually to the NPRI, and will do so using industry standard reporting procedures (*i.e.*, CAPP guidance on NPRI reporting; CAPP 2007-0009). This will also serve to validate the emission estimates used in the CSR.