



Grays Bay Road and Port Project Impact Statement

Volume 5 – Atmospheric Environment



Grays Bay Road and Port Impact Statement



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Proponent

- **West Kitikmeot Resources Corp. (WKR):** established by the Kitikmeot Inuit Association in 2014 as an Inuit-owned and Inuit-led company to conduct mineral exploration, primarily on Inuit Owned Lands (IOL) in the Kitikmeot Region of Nunavut

Location

- **Grays Bay Port** is located at approximately 67° 48' 21.62" N, 10° 52' 17.69" W
- Nearest communities to the port: Kugluktuk (approximately 180 km west) and Cambridge Bay (approximately 280 km northeast)
- Southern end of **Grays Bay Road** is located at Jericho Station; approximately 66° 01' 6.36" N, 111° 28' 28.27" W

Components and Activities

- Development and operation of a **deep water port** at Grays Bay on the Coronation Gulf including two large vessel wharves, a medium vessel wharf, a barge landing area with two berths, and a small craft harbour for approximately 24 vessels
- Construction and operation of an **Aerodrome** at the port
- Construction and operation of a 230 km **all-season controlled access road** (Grays Bay Road), including the construction and operation of Jericho Station
- Construction and operation of a **winter road** connecting Jericho Station to the Tibbitt Contwoyto Winter Road (TCWR) alignment on Contwoyto Lake (*Tahikyoak*)

Phases

- **Construction phase** of the Project will take approximately five years to complete (both pre-construction and construction) with a proposed starting date in September 2029
- **Operations and Maintenance phase** of the Project will start in 2035 and will continue in perpetuity

Knowledge Perspectives

- WKR, as well as the previous proponents, the Government of Nunavut and the Kitikmeot Inuit Association, have been engaging on the Project since 2016
- one primary source: *Kitikmiut Knowledge of the Proposed Kogloktokyoak (Grays Bay) Port and Road Project* (Banci and Spicker 2024) that was compiled by the Kitikmeot Inuit Association and its consultants from the Naonaiyaotit Traditional Knowledge Project (NTKP), a repository of Inuit Knowledge maintained in a Geographic Information System (GIS)-based database
- Inuit, Indigenous, and community knowledge, as well as feedback from engagement, has been reviewed, considered, and integrated where appropriate into project planning and the IS

Environment

- Two years of baseline studies building on decades of baseline work completed by previous proponents
- 11 volumes totalling over 7,000 pages of analysis
- With the implementation of mitigation, management, and enhancement measures, residual project and cumulative effects are predicted to be not significant
- Monitoring programs and ongoing engagement will inform adaptive management strategies

Benefits

- **Economic – Transformative Benefits**
 - approximately **\$750 million** additional annual GDP growth by 2040 because of the Project
 - an estimated **670 jobs** in Nunavut each year during construction
 - an estimated **390 jobs** during operations and maintenance created by the Project and related expenditure
- **Community and Social – Supply Chain Resilience**
 - new transportation route to the western Arctic will strengthen supply chain resiliency by creating alternative access to essential goods
 - enhanced safety for both marine and land travel, supporting more reliable and secure movement within the Coronation Gulf and throughout the Northwest Passage
- **Sovereignty and Security – Strategic Presence**
 - first deep water port in the western Arctic
 - critical year-round strategic presence in the region

VS.5 Volume Summary – Scope of the Atmospheric Environment Assessment

Changes in the atmospheric environment have been recorded and passed down through Inuit knowledge, both to understand the seasons and how to live on the ocean and land. For Inuit, the land, water, and ice are places of peace, where quiet is part of life and essential for hunting, travel, and connection to the land.

“Less snow meant that travel during the winter was more difficult. Dust and contaminants had affected the quality of snow” (Banci and Spicker 2024).

“We used to travel inland to caribou hunt. In spring the ice on rivers and lakes thaws faster than on the ocean and water flows in lakes and streams. With climate change it’ll happen faster. We have to protect water bodies from contamination like ice roads. We hear about tractors going through the ice. People should be careful if they are building ice roads. The gravel makes the ice melt faster.” (Banci and Spicker 2024).

Short-term or long-term noise and vibration can disturb wildlife, make harvesting harder, and change the experience of peace and quiet on the land. This assessment respects these values and focuses on protecting both the natural sound environment and the ability of Inuit to use the land in the ways they always have.

“Caribou always seem to move away from noise disturbances, same as people. They are still very noise sensitive.” (Banci and Spicker 2024)

The value of the atmospheric environment is holistic; evaluating the potential effects on air quality, climate change and noise and vibration are important to respect these values and focus on protecting the natural atmospheric environment and the ability of Inuit to use the land in the ways they always have. WKR collected baseline condition information by combining Inuit-led and collaborative knowledge gathering (including the project-specific NTKP and IAG workshops), publicly available information from Indigenous groups considered in the context of the Project, and engagement feedback shared by Kitikmiut, other Indigenous groups, and other potentially affected communities with technical studies collected through western scientific methods. The combination of these knowledge perspectives and western science were used to inform and evaluate the impact statement for all three components of the atmospheric environment.

Grays Bay Road and Port Project (the “Project”) is a deep-water port and 230 km all-season road development being proposed by West Kitikmeot Resources Corp. (WKR), located within the Kitikmeot region of Nunavut. The port will be located within the Coronation Gulf, approximately 50 km south of the North West Passage route through the Arctic and will connect via the all-season road to the closed Jericho Mine site at Jericho Station, on the northwest side of Contwoyto Lake, NU. The all-season road will connect seasonally to the Tibbett to Contwoyto Winter Road (TCWR) annually. WKR has prepared an Impact Statement to identify and assess potential environmental and Socio-economic effects resulting from the Project that meets the requirements outlined in the Nunavut Agreement and the Nunavut Impact

Review Board Guidelines for the Preparation of an Impact Statement for the (NIRB File No. 24XN038; NIRB 2026). This volume of the IS presents the assessment of potential environmental effects for air quality, noise and vibration and includes statements on the climate.

Spatial and temporal boundaries have been established to support the development of the valued components (VC) assessments, informed by the current understanding of potential Project effects and other relevant factors. The Project Development Area (PDA) encompasses the physical footprint of all Project components, including both permanent and temporary disturbances (e.g., extent of Project infrastructure, planned clearing, and laydown areas). The Local Assessment Area (LAA) is the maximum area where project-specific environmental effects can be qualitatively estimated with a reasonable degree of accuracy and confidence. For the assessment of air quality, the LAA was defined as a 5 km buffer around the PDA, which complies with regulatory requirements and is large enough to qualitatively discuss the extents of the influence for the air contaminants of potential interest (ACPI) emissions from the Project activities. The LAA for noise and vibration was defined as a 1.5 km buffer around the PDA which is consistent with regulatory guidance for noise assessment study areas.

The Regional Assessment Area (RAA) provides context for project-specific effects and represents the area within which cumulative effects with other projects and activities may occur. The RAA for air quality was defined as a 5 km buffer around the PDA and was established to comply with regulatory requirements and to capture air quality effects of the specific components being assessed. The RAA is the same size as the LAA because the cumulative air quality effects attributable to other projects (past, present or reasonably foreseeable) were expected to be negligible beyond the LAA due to natural atmospheric attenuation (e.g., natural dilution due to atmospheric mixing) of the Project's ACPI emissions. For the assessment of noise and vibration, a smaller RAA was established (3 km buffer around the PDA) in recognition of natural atmospheric attenuation and ground absorption of noise and vibration.

Spatial assessment boundaries were not defined for the Climate section, as the greenhouse gas (GHG) assessment considered GHG emissions released from project activities and compared these emissions to Nunavut's and Canada's GHG emission releases for context.

VS.5.1 Air Quality

Air quality has been assessed because of its importance to the health and well-being of people, wildlife, vegetation, and other ecosystems biota. The air quality assessment considered potential changes in ambient air quality during the Construction and Operations and Maintenance phases. The potential changes for the air contaminants of potential interest (ACPI) were compared to established ambient air quality standards, objectives and guidelines (SOGs). ACPIs that were considered in the assessment included total suspended particulate (TSP), inhalable particulate matter with an aerodynamic diameter less than 10 µm (PM10), respirable particulate matter with an aerodynamic diameter less than 2.5 µm (PM2.5), sulphur dioxide (SO₂), nitrogen dioxide (NO₂), and carbon monoxide (CO). Predicted changes were subsequently evaluated in other VC sections for their potential effects on vegetation, caribou, freshwater fish and fish habitat, and traditional land, marine and resource use and community health and well-being.

VS.5.1.1 Baseline

The Project is located within the Kitikmeot region in a remote area where air quality is largely unaffected by local industrial, residential and transportation activities. The baseline air quality in the Kitikmeot can generally be classified as pristine due to the limited number of large sources of ACPI. Local air emissions include stationary (e.g., power generators, heating) and mobile sources (e.g., trucks, snowmobiles, ATVs), while marine vessel traffic impacts local air quality during the open-water season. Long-range transport of air contaminants can also influence air quality in the Kitikmeot region. Representative baseline air quality concentrations for the Project were established based on measured ACPI concentrations for other recently proposed projects in the Kitikmeot. The Project baseline concentrations are lower than the corresponding SOGs. Overall, the baseline air quality in the Air Quality LAA is considered very good.

VS.5.1.2 Project Effects

Project activities during Construction and Operation and Maintenance phases will generate ACPI emissions and may result in a change to air quality. Potential air quality effects during Project Construction and Operations and Maintenance are expected from operation of the diesel power plant at the Port and Jericho Station, the use of equipment and vehicles with combustion engines (e.g., on-road and off-road equipment and light duty vehicles and marine vessels), the detonation of explosives at the quarries, operation of aircraft, and domestic waste incineration. Air quality effects are also expected from the generation of fugitive dust from drilling and blasting at the quarries, surface disturbance activities including road use, and wind erosion. A numerical atmospheric dispersion model was used to quantitatively predict ground-level concentrations for the ACPIs outside the PDA boundary. The modelling approach, which followed regulatory guidance, is considered conservative (i.e., overstated rather than understated adverse effects) as it assumed the use of older equipment with higher emissions, assessed the peak-year emission rates for construction and operation and maintenance, and included conservative emission rates. This conservative modelling scenario predicts higher future project-related emissions and concentrations relative to those that are likely to be realized.

The model's predicted concentrations for the ACPI were compared to the Nunavut Ambient Air Quality Standards (NAAQS) outlined in the Nunavut Environmental Guideline for Ambient Air Quality, and other provincial and federal benchmarks. Model predictions were made for multiple receptor locations outside the PDA boundary and within the LAA, including at the two closest potentially sensitive receptor sites: High Lake Mineral Exploration Camp and the Ulu Mineral Exploration Camp. The potential effects for human health at these two receptors were assessed in the Human Health and Ecological Risk Assessment Report (Appendix 26A).

Air dispersion modelling results to predict potential Project-related effects on air quality can be summarized as follows:

- Most predicted air contaminant concentrations remain below established SOGs at most locations within the LAA outside the PDA boundary.
- Some ACPI—specifically TSP and PM₁₀ during construction, and NO₂ during construction and operations—are predicted to exceed applicable SOGs outside the PDA boundary.

- TSP and PM₁₀ exceedances during construction are infrequent (fewer than 5 days per year) and limited to areas immediately around the PDA boundary.
- During construction, maximum 1-hour NO₂ exceedances above the Canadian Ambient Air Quality Standard extend up to 2 km along the shoreline and 6 km over Grays Bay, with the highest frequency along the PDA boundary (up to 127 days/year).
- NO₂ exceedances decrease with distance, dropping to fewer than 30 days/year within 1.5 km of the shoreline.
- During the Operations and Maintenance phase, 1-hour NO₂ exceedances are infrequent (fewer than 14 days/year) and limited to areas immediately surrounding the PDA boundary.
- At the nearest sensitive receptor (High Lake Mineral Exploration Camp), all ACPI concentrations remain below applicable SOGs during both Construction and Operations and Maintenance.

Although there will be ACPI emissions at the Jericho Station, these emissions will be substantially lower than at the Port location due to the lower activity levels at Jericho Station and therefore these emissions were not numerically modelled. Residual effects on air quality (i.e., after application of mitigation and management measures as described below) are summarized as follows:

- Residual effects on air quality during the Construction phase are predicted to be adverse and range from low to high magnitude (depending on the predicted concentrations for ACPI), are limited to the LAA in geographic extent, and occur over a short-term duration (during the Construction phase). Although emissions will occur continuously over this time, the frequency for a change in air quality is considered an irregular event because predicted ambient concentrations at a given location are variable in time depending on meteorological conditions.
- Residual effects on air quality during the Operations and Maintenance phase are also predicted to be adverse and range from low to high magnitude, are limited to the LAA in geographic extent, and occur as irregular events over a long-term duration.

VS.5.1.3 Cumulative Effects

Cumulative effects from other sources, including the activities related to past, present, past and reasonably foreseeable, and reasonably foreseeable induced projects, were considered in the air quality assessment. Past physical activities do not have the potential to cumulatively interact with the residual air quality effects for the Project because past projects do not have emissions that overlap temporally with the Project emissions. The overlapping effects of Present physical activities and resources use, such as marine traffic and mineral exploration projects, have been captured in the representative baseline concentrations established for the Project. Reasonably foreseeable (RF) and reasonably foreseeable induced (RFI) projects that are outside the RAA are far from the Project and the extent of their emissions do not overlap spatially with the extent of Project emissions. The RF and RFI activities that are inside the RAA may result in increased vehicle traffic levels and occasional emissions of small magnitude that do not contribute to a substantial increase in the emissions from the Project. The RF and RFI activities, should they proceed, will be subject to a regulatory review process which will consider potential cumulative interactions with the Project. During these review processes, additional mitigation measures may be identified to further reduce the potential for significant adverse effects. In summary, cumulative

residual environmental effects on air quality are not expected to increase substantially compared to the residual environmental effects on air quality from the Project alone.

VS.5.1.4 Significance

The dispersion modelling assessment has demonstrated that the maximum predicted concentrations for most ACPI during Project Construction and Operations and Maintenance remain below the established SOGs outside of the PDA boundary. While some ACPI (TSP, PM₁₀ and NO₂) may occasionally exceed the SOGs outside the PDA boundary, these exceedances are expected to be localized close to the PDA boundary and occur infrequently. With the implementation of best management practices (BMPs) and adaptive management strategies, Project residual effects and the cumulative residual effects on air quality during Project construction and operations and maintenance are predicted to be not significant.

VS.5.1.5 Mitigation, Management, and Enhancement Measures

The Project will implement an Air Quality Management Plan which will include BMPs to manage air quality including:

- Vehicle and equipment operation and maintenance measures to reduce ACPI emissions from engines and exhaust systems
- Blasting design to reduce ACPI emissions
- Project design and operational practices to reduce fugitive dust emissions
- Dust suppression (e.g., application of water) to reduce dustfall on vegetation and watercourses or waterbodies

An air quality monitoring and adaptive management program will measure ambient particulate matter concentrations (PM₁₀, TSP). Monitoring requirements will be reviewed and adaptive management techniques will be used to reduce emissions to within the acceptable limits, where required.

VS.5.2 Climate

Climate change and its impacts are of notable importance to Kitikmiut, other Indigenous groups, and other potentially affected communities as it impacts the environment and traditional land, marine, and resource use (TLMRU; e.g., travel, animal migrations, hunting). These groups have highlighted that the weather has become less predictable and changes in climate in the Kitikmeot Region include increased wildfires, unpredictable ice conditions, melting permafrost, decreased precipitation, and fluctuating water levels. Observed impacts of the changes in climate and weather include coastal erosion, change in snow quality, quantity, and coverage, and changes in plants and wildlife. Examples of how the changing climate has affected communities include thinner ice and earlier melting of ice influencing seasonal travel and wildlife activities (e.g., caribou migration patterns), lower water levels influencing travel and aquatic life (e.g., Arctic char), poorer quality snow for emergency igloo building, and the rapid pace of permafrost thaw and its impact on the overall environment and traditional activities.

Anthropogenic-driven climate change is a major environmental challenge and adds complexity and uncertainty to both projecting future conditions and in the reliability of project design, infrastructure, and mitigation strategies. The Project has the potential to both influence climate change through greenhouse gas (GHG) emissions and to be influenced by climate change. The Project may be impacted by long term changes in climatic conditions (e.g., changes in sea ice cover and concentration, ocean wave activity) as well as by weather events (e.g., heavy rainfall, heavy snowfall, high winds).

Section 12 presents discussions on observed climate change in the West Kitikmeot Region, a Climate Profile, a greenhouse gas emissions assessment (how the Project may contribute to climate change), and a climate change risk assessment (how the Project may be impacted by climate change and weather events). These climate discussions and assessments were informed by engagement and Inuit, Indigenous, and Community Knowledge on the assessment. The Climate Profile, greenhouse gas emissions assessment, and climate change risk assessment are briefly summarized below.

VS.5.2.1 Climate Profile

The Project is linear and ranges in location from the northern extreme at Grays Bay to the southern extent at Jericho Station with 230 km between the two. The climate in the area is characterized by extremes. Canada's Changing Climate Report (Cohen et al. 2019) indicates that, in Northern Canada (defined as the geographical region north of 60° north latitude), annual mean temperature has increased by 2.3 degrees Celsius (°C) during the 1948–2016 period, with the strongest increase observed in the winter season (4.3°C). Under the high emissions Representative Concentration Pathway (RCP8.5) scenario, annual mean temperature for Northern Canada is projected to increase by approximately 2.7°C for the 2031–2050 period and by 7.8°C for the 2081–2100 period, relative to the 1986–2005 period. Due to the sparse observing (weather station) network in Northern Canada, historical long-term changes in precipitation are difficult to quantify. However, all available sites used in the report indicate increases in precipitation. Under RCP8.5, annual mean precipitation for Northern Canada is projected to increase by 11.3 percent (%) for the 2031–2050 period and by 33.3% for the 2081–2100 period, relative to the 1986–2005 period.

VS.5.2.2 Greenhouse Gas Emissions

The Project will release GHG emissions to the atmosphere from activities during construction and operations and maintenance. The Government of Canada has established legislation, policies, and guidance documents related to GHG emissions to help mitigate global climate change.

The combustion of fossil fuels (e.g., diesel, jet A) in heavy equipment (e.g., loaders, dump trucks, aircraft) is the main source of GHG emissions from the Project. Some GHG emissions will also occur from blasting (the combustion of explosives). Monitoring fuel usage, as well as maintaining and using appropriately sized construction equipment, is planned to mitigate GHG emissions from project activities.

A conservative estimate (i.e., potentially overstating rather than understanding) of GHG emissions from construction activities is estimated to be the highest in year three of construction at 145,566 t CO_{2e} and approximately 87,326 t CO_{2e} per year for the remaining construction years, excluding emissions from land-use change. GHG emissions during construction will represent approximately 15% to 20% of Nunavut's annual GHG emissions and approximately 0.02% of Canada's GHG emissions annually.

A conservative estimate of GHG emissions from operations and maintenance activities is approximately 57,789 t CO_{2e} per year when diesel is used for power generation. GHG emissions during operations will represent approximately 8% of Nunavut's annual GHG emissions and approximately 0.001% of Canada GHG emissions annually.

VS.5.2.3 Climate Change Risk Assessment

A Climate Change Risk Assessment (CCRA) was completed for the Project with the intent to identify risks associated with the current and anticipated climate impacts on the planned Project infrastructure and assets. Adaptation strategy recommendations were also developed to address the risks and improve Project resilience and guide design and monitoring plans. Operations and Maintenance related recommendations are intended to address potential climate-related hazards and guide the development of maintenance, operations, and personnel health and safety policies and procedures. The following are examples of adaptation strategy recommendations included in the CCRA report:

- Consider climate-adjusted design criteria to promote long-term resilience. For instance, incorporate projected changes in extreme rainfall in culvert design (sizing). Increased resiliency of the drainage system will help reduce road structure and embankment and airstrip/runway impacts associated with extreme rainfall. Additionally, consider runoff volumes with no vegetation present in design criteria decisions (allowing for consideration of vegetation loss due to tundra fire).
- Design and install permanent erosion control measures (e.g., gabion, mesh, netting, woven geotextile) in areas anticipated to be susceptible to erosion, such as embankments built with Terrain Type II materials.
- Where permafrost is present, apply monitoring and engineered reinforcements.
- Establish an Operations and Maintenance policy to conduct regular inspections of above ground pipes/piping during extreme cold events and manually thaw as necessary to reduce the potential for damage to the pipes and water/wastewater facility operations shutdown.
- Consider installing high Minimum Efficiency Reporting Value (MERV) air filtration in buildings to improve indoor air quality, particularly during poor air quality conditions due to tundra fire smoke or dust generation during high wind events. Perform regular inspection and clearing or replacing of filters.

VS.5.3 Noise and Vibration

For Inuit, the land, water, and ice are places of peace, where quiet is part of life and essential for hunting, travel, and connection to the land. Short-term or long-term noise and vibration can disturb wildlife, make harvesting harder, and change the experience of being on the land. The Noise and Vibration VC focuses on protecting both the natural sound environment and the ability of Kitikmiut, other Indigenous groups, and other potentially affected communities to use the land in the ways they always have. The assessment focuses on areas where Inuit and other land users live, work, and travel, including Traditional Land, Marine, and Resource Use (TLMRU) areas, permanent accommodations, and mobile camps. Receptors located along or near the PDA, including the Jericho Station PDA boundary and the Grays Bay Road PDA boundary, were also assessed. Noise and vibration effects on wildlife, including caribou, birds, marine mammals, and marine fish and fish habitat, are addressed in their respective VCs.

VS.5.3.1 Baseline

Inuit, Indigenous, and Community Knowledge perspectives, engagement feedback, baseline noise monitoring and vibration modeling were used to characterize the baseline noise and vibration conditions. Noise and vibration levels within the LAA are currently generally low, with most sounds coming from natural sources such as wind, water, and wildlife. The baseline sound level measurements for the Project follow approaches prescribed by AER Directive 038, where baseline sound level of L_{dn} of 45 dBA was used as the baseline threshold for the Project. Some human-related noise occurs at existing camps and along seasonal travel routes. Inuit land use in these areas is often seasonal, and activities such as hunting and fishing can be sensitive to high noise or vibration levels.

VS.5.3.2 Project Effects

Project activities during Construction and Operations and Maintenance activities will generate noise and vibration which may annoy permanent and seasonal residents, and land users. These activities include road building, quarrying, blasting, aircraft and traffic-related operations, and equipment use. Predictive modelling was conducted to predict sound and vibration levels within the LAA and RAA to estimate exposure of receptors, assess changes from baseline levels, and assess compliance with regulatory guidelines. Predicted Project effects on noise and vibration are summarized as follows:

Change in noise levels:

- Noise effects during Construction are predicted to meet regulatory thresholds at all receptors with the implementation of site-specific or situation measures required at some receptors at the Jericho Station PDA Boundary and Grays Bay Road PDA boundary.
- Noise effects during Operations and Maintenance are predicted to meet regulatory thresholds at all receptors with the implementation of site-specific or situational measures required at the road and permanent quarry site boundary where short-term noise effects are predicted.

- Operations and Maintenance activities at Grays Bay Port and Jericho Station are predicted to result in long-term noise effects although these effects will be managed through the use of standard design and operating practices.
- Residual effects on noise levels are predicted to be of moderate magnitude within the RAA and occur continuously over a short-term duration during the Construction phase and a medium-term duration during the Operations and Maintenance phase. These effects will be reversible should Project activities cease.

Change in vibration levels:

- Vibration effects, including blast-related vibration effects during Construction and Operations and Maintenance, are predicted to meet regulatory thresholds with the implementation of site-specific or situational measures required at permanent accommodations, mobile camps, and the Grays Bay Port PDA boundary.
- Residual effects on vibration levels will be intermittent, of short duration during Construction and medium-term duration during Operations and Maintenance, and will occur only during specific Construction, or Operations and Maintenance activities (e.g., blasting, piling). These effects will be reversible should Project activities cease.

Project noise and vibration are not expected to travel beyond the RAA or cause transboundary effects to neighbouring regions or communities.

VS.5.3.3 Cumulative Effects

Stationary and mobile noise emissions from other present and reasonably foreseeable induced project activities may interact with the residual noise effects of the Project if the activities overlap with the Project temporally and spatially. These other projects and physical activities include: present mineral exploration; reasonably foreseeable induced mines, marine traffic and land transportation; and present and reasonably foreseeable renewable resource harvesting, land-based tourism and scientific research.

Project-related noise is expected to attenuate to levels well below the background level within 3 km of their source and cumulative noise effects are not expected to exceed applicable noise thresholds at receptors. Given the highly localized and intermittent nature of Project-related vibration, overlap with other sources of vibration were considered unlikely and thus vibration was not considered in the cumulative effects assessment.

Cumulative noise effects are predicted to be moderate in magnitude and limited to the RAA. The timing would be continuous during periods of activity, but duration would remain medium-term.

VS.5.3.4 Significance

After mitigation, residual project noise and vibration effects are predicted to be not significant. Applicable noise and vibration thresholds established through regulatory guidelines will not be exceeded. Effects will remain moderate in magnitude, with short- to medium-term duration, and will not cause lasting harm to land users, wildlife, or community well-being.

Cumulative noise effects are also predicted to be not significant. No cumulative vibration effects are anticipated.

VS.5.3.5 Mitigation, Management, and Enhancement Measures

The Project will use engineering controls, good operating practices, and site-specific measures to keep noise and vibration levels low. These measures will be guided by continued engagement with Inuit communities. Key measures include:

- Designing blasting to reduce ground vibration and noise
- Reducing equipment idling and using natural or built barriers where possible
- Orienting camps to face away from noise sources
- In specific areas where exceedances may occur, scheduling project activities outside sensitive harvesting or migration periods, through engagement with Kitikmiut land users
- Using adaptive management to adjust mitigation if monitoring shows unexpected effects

VS.5.4 Atmospheric Environment Impact Statement

An evaluation of the potential influence of the Grays Bay Road and Port Project on air quality or noise and vibration predicted residual effects and cumulative effects to be not significant.

VS.5 Hilap Avatingit

Aalaguqnigut hilap avataani titiraqtauyut tuniyauvlutiklu Inuit qauyimayaitigut, kagiqhiyaagani hilap aalaguqnigut qanuqlu inuuyaagani taqyumi nunamilu. Hapkununga Inuinangnun, nuna, imaq, uvalu hiku nunat nipaiqpiaqniq, humi nipaiqniq ilauyuq inuuhiqmun uvalu ihagiagiyauyuq anguniaqniqmun, aulaaqniqmun, uvalu atadjutinun nunamun.

'Aputiqalluanguinmat taimaa aullaariami ukiumi ayurnatqiyauyuq. Puyuvalluit halumailrullu hulaqutigiyaat qanurinia aput' (Banci unalu Spicker 2024).

"Aulaaqpakhimayugut nunamun tuktuhiugiaptigini. Upin'ngakhami hiku kuukkani tattinilu mahakpaktuq qilaminnuq tariurmit imaq lu kuuktuq tattini kuukkanilu. Hilaup aalannguqtirninga qilaminnuq piniaqtuq. Munariyakhavut imaq halumailrunit hikumi apqutauyunit. Tuhaavaktugut akhaluutiryuat hikumi. Inuit qayagiyukhat hikuliulurumik apqutinik. Uyaraliaq hiku mahaktirutauyuq qilamik.' (Banci unalu Spicker 2024).

Naittumik-hivituniani aturaakpaktakhamiluunniit nipiquqtuhiniq hajukniqlu ihuirutittaaqtuq huradjanik, anguniarniq ajurnarhitivaktuq, aallanguqtihugulu pidjuti ihumaalungnaittumik nipaiqpiarnikkullu nunami. Una naunaiyaut pittiaqtait hapkua ukpigiyaat uvalu tugaaqhimayut munagilugit tamangnik idjuhia tuhaanaqtuq avatikput uvalu piyaaqniq Inuit atugianganani nuna idjuhiitigut.

'Tuktut ahinungaunginnaqtut nipiquqtuyunit ulapiqutinit, aadjikkutaanik inungnit. Nipiquqtuyutut itpaktut.' (Banci unalu Spicker 2024)

Iluangnirit hilap avatingit tamatkiumayut; naunaiyaqhugit hulaqutauniaqtut hilap qanuginianun, hilap aalanguqtirniaranun uvalu nipiquqtuhinikkut uvalu hayungnirit aghuungnaqtut pittiaqlugit hapkua aghuurutit uvalu tugaaqhimallugit munaridjutikhat idjuhia hilap avatingit uvalu piyaangnirit Inuit aturianganani nuna idjuhiitigut. WKR-kut katitiriyut qanuriniganik hivunihijutinik atautimukhugit Inuinait hivuliqhuqtauyut havaqatiriigutiniklu qauyimaniqmik katitiqniginik (ukualu havaami-pijutiqaqtunik NTKP-mi IAG-kulu ayuiqhavikmi), inuknit qahaktunik hivunihijutinik Nunaqaqaqtunit ikayuqtiriinit ihumagiyauyut uqauhiuyuni Havaami, ilauniginiklu uqauhiuyut uqauhiuyut Kitikmiut-nit, ahiilu Nunaqaqaqtut ikayuqtiriit, ahiilu aktuqtaulaaqtut nunagiyauyut nutauniqhanik ilituqhautinik katitigayut ualiqhiani naunaiyautini pigiarutini. Atautimuknigut ukua qauyimayaayunik ihumagiyauyut ualiqhiani naunaiyautinik atuqtauhimayut qauyupkarianganani naunaiyarianganilu aktuqnigagut uqauhiq tamaini pigahuni ilagiyaini hilap avatauyuup.

Qurluqtuaryungmi Apqutikhaa Umiat Tulakvikhat Havaktauyukhaq (tamna 'Havaaqhaq') itiyumi imarmi tulugtaqvikhaq taima 230nik kilaamitanik ukiuk tamaat apqutikharnik pivallidjutikharnik tukhiqtauhimayut tapkuninga Uataani Kitikmeot Resources Corp. (WKR), nayugaqaqtuq talvani Kitikmeotmi Nunavunmi. Tulaktaqvikhaq nayugaqarniaqtuq talvani Coronation Gulfmi, taima 50nik kilaamitanik ungahiktilaaqarniaqtuq hivuraani talvani Tunungani Uataani Apqutikharnik talvuuna Ukiuktaqtuniitunik katitihimaniaqturlu talvuuna ukiuk tamaat apqunmi talvunga umikhimayumun Jericho Uyaraqhiuqtunik nayugaanun talvani Jericho Stationmi, tunungani uativyaani haniani Contwoyto Tahiani, NU. Tamna ukiuk tamaat apqut katitihimaarniaqtuq ukiuk tamaat talvunga Tibbett talvunga Contwoyto Winter Road (TCWR) ukiuk tamaat. WKR upalungaiyaiyut Hulaqutinun Naunaitkutunik naunaiyarianganini uvalu

ihivriuglugit avatingnun uvalu Inuuhinut-piyangaiyautikkut hulaqutait pidjutauyut hapkunanga Havaaghanin tapkua ihuaqtut piyakhat titiraqhimayut uvani Nunavunmi Nunataarutaanut Angirutaa ukualu Nunavunmi Avatilirinirmut Katimayit Atugahait Upalungaiyautinun Hulaqutinun Titiqqat haffumunga (NIRB File No. 24XN038; NIRB 2026). Una makpiraaq IS-mi tuniyuq naunaiyainiq piniaruknaqhiuq avatinganut ayurhauingit anirhaaktaptiknik, nipiquqtuyumik hayukninnganiklu ilaliutiyuqlu uqaqtamiknik hilaup qanurittaakhaanik.

Inikhangit kiklivikhangitlu naunaiyagiikhimayut ikayuutikharnik pivalliadjutikharnik akhurnaqtunik hanaqidjutikharnik (VC) ihivriudjutikharnik, naunairutiqaqtun talvuuna aulayunik kangikhidjutikharnik pigiaqaqtun Havaaqaqhangit ayungnautiqarniaqtun allaniklu aulahimayut naunairutingnik. Tamna Havaaqaqhangit Pivalliadjutikharnik Nayugaani (PDA) ilauqaqtuq iqaiyalinikkut nayugaingit tamaita Havaaqaqhangit hanaqidjutikhangit, ilauyutlu tamangnik aulayukharnik tadjakaffuklu ayungnautiqaqtunik (imaatun itun, hivutunikharnik Havaaqaqhangit igluqpangit, upalungaikhimayut piiyaqtauniaqtun, iliugaivikhangitlu nayugaingit). Nunalaani Ihivriudjutikharnik Nayugaani (LAA) kiklivikhaqaqtun nayugaani taima havaaqaqhangit aulahimayut avatiliqinikkut ayungnautiqarniaqtun ihuaqtumik nallautiqhimayunik ayungnairutikharnik. Ihivgiugutinun hilap qanuginianun, LAA naunaiyaqtauhimayuq imaa 5 km kiklii avatiini PDA, kitut malikhugit maligahat piyakhat uvalu angiyuq uqaqtigiyaangani anginiqhait hulaqutit hilap halumailguut ihumagiyaayut (ACPI) hiamitiqtut hapkunanga Havaaghap hulidjutaini. Tamna LAA nipiquqtuhinikkut uvalu hayuknikkut naunaiyaqtauhimayuq imaa 1.5 km kiklii avatiini PDA kitut ihuaqtut maligahanun maligahanun haffumunga nipiquqtunikkut ihivgiuqnikkut nayugaini.

Avikturhimayumi Naunaiyainiq Nayuganga (RAA) tuniyuq qanurittaakhaanik havauhikhamut-ihuaqtumut ayurhauingit pipkaidjutiyaqlu talvani talvani angikliyuumiqtuq ayurhauingit aadlanut havauhikhat hulilukaarutingillu piniaqtuq. RAA hilap qanuginiatigut naunaiyaqtauhimayuq imaa 5 km kiklii avatiini PDA uvalu havaktauhimayuq malikhugit maligahat piyakhat uvalu piyaangani hilap qanuginia hulaqutainun kitunun ilaayunun ihivgiuqtauyut. RAA aadjikkutariyaa LAA taimaa angikliyuumiqtuq hilap qanurittaakhaanik ayurhauingit pipkaidjutiyaq aadlanut havauhikhat (qangaraalukmit, tadjamit ihuaqtumikluuniit ihumagiyaayuyut) ihumagiyaayuyut qayagiyaungittuq avataanut LAA piyuq hilaumut ikikliyuumiutinga (ukunatitut, nunamit avguqtiqtuq hilaumut avguqhimayuq) uumannga Havauhikhap ACPI hiamitiqtuq. Naunaiyariagani nipaaqniginik hayuktuniklu, mikitiqiyaaq RAA iniqhimayuq (3-kilaamitanik haniani PDA-mi) ilitariyaagani hilap qanuriniga ikiklivalianiga nunaplu nipiquqtuhivalianigani hayuktuuyaaganilu.

Nayugait ihivriungnikkut kikliit naunaiyaqhimangitut haffumunga Hilap ilangani, taimaali puyuum anialailaqtata (GHG) naunaiyautait ihumagiyaayut GHG hiamitiqtut havaktaqhatigut hulidjutinun uvalu aadjiliurutigiblugit hapkua hiamitiqtut Nunavunmi Kanatamilu GHG hiamitiqtut hiamitiqtut titiraqhimayut..

VS.5.1 Hilap Qanuginia

Hilap qanuginia ihivgiuqtauyuyut taimaali akhuuqnaqtuq aaniaqtailiniqmun uvalu inuuhiaqtiiaqnikkut inungnun, hugadja, nauhimayut, uvalu aalat avatingit uumayuit. Hilap qanuginia ihivgiugutit ihumagiyaayut aalanguqtiqniit hilap qanuginia havaktautilugu uvalu Auladjutit uvalu Munagidjutit havaktautilugit. Aalanguqtiqniagunnaqhiyut hilap halumailguut ihumagiyaayut (ACPI) aadjiliuqtauyut havaktauhimayunun hilap qanuginiitigut atugahat, pinahuagutit uvalu atugahat (SOGs). ACPIs

ihumagiyaayut naunaiyaininngani ilaliutiuyuk atauttimut nutqaqtauyut hunavaluit (TSP), anirhaaqtaaqut hunavaluit puplaktuqumik mikitqiaq 10 µm (PM10), anirhaaktaqtut hunavaluit puplaktuqumik mikitqiaq 2.5 µm (PM2.5), sulphur dioxide (SO₂), nitrogen dioxide (NO₂), unalu carbon monoxide (CO). Nalautaagaayut aalaguqnigig kiguani ilituqhaqtauyut ahiini VC-mi uiguini ihuiljitaaulaqtunik nautianik, tuktunik, tahikmiutanik iqaluknik iqaluilu nunagiyaainik, igilraat nunani, taqyumi ihuaqutiniklu atuqniginik nunagiyaayumilu aaniagitaagani inuuhiquatiaqnikhamiklu.

VS.5.1.1 Tungavia

Tamna Havaaqhaq nayugaqaqtuq talvani Kitikmeotmi Avikturviani avaliqangitumik nayugaani taima anirhaarutikharnik ayungnautiqangitun nunalaani havakvikyuangit, igluqaqtunik ingilradjutikharnik hulilukaaktunik. Kiklinga anirhaaktaptiknik qanurittaakhaanik Kitingmeonmi naunaiqtaunginnarialik nakuungittuq pikmat kikliqarmat qaffiuyut angiyut pipkaidjutingit ACPI-mik. Nunamingni hilaamut anianiit ilaayut nutqangayut (e.g., pauwatuutit ingniqutit, uunaqutit) uvalu nuutiqtataqtut ikayuutit (imaa aghaluutiryuat, sikiiutut, haatat), taimaalu tariumi umiat auladjutait hulaqutaayut nunamingni hilap qanuginianik atuqtilugu hikuiqniq. Ungahiktumun aulagitaayut hilaamun halumailgut hulaqutiginaqtaat hilap qanuginia Kitikmeoni. Pipkaidjutiuyuk tunngavinga hilaamut qanurittaakhaanik katitiquhimayut Havauhikhamut piliurhimayuk piyuk uumannga naunaiyainiq ACPI katitirinnaga aadlanut qangannuaq pitquyayut havauhikhat Kitikmeoni. Havaaghap kikliit iluaniitut mikitqiat ilaayunin SOGnin. Tamainun, kiklivikhangha anirhaarutikharnik qanuritmangaangit talvani Hilap Qanuritmangaangit LAA ihumagiyaayuk nakuuqpiiaqtuq.

VS.5.1.2 Havaaq Aktuqnigig

Havaaqhangit hulilukaaktukharnik talvuuna Napaqtirutikharnik Auladjutikharnik Ihuaqhaidjutikharnik aulagititinaqtun ACPI-nik hiamititqutunik naunairutiqarniaqtun allanguqtirutikharnik hilap qanuritmangaangit. Hilap qanuginia hulaqutauniaqtut havaktautilugit uvalu Auladjutit uvalu Munagidjutit nigiuqtauyut auladjutainun hapkua uquhuqyuaqtuqtut pauwaqarviit uvani Tulaktaqvik uvalu Jericho Stationmi, atuqniit tamayat uvalu aghaluutit ikualaaqtut ingniqutit (imaa apqut uvalu apqutailgumi tamayat uvalu mikiyut aghaluutit uvalu umiat), qagaqtautit uyarakhiuqviit, auladjutait tingmitit, uvalu iglumingni iqakunik ikualativik. Hilap qanuginia hulaqutait nigiuqtauyut aulaniitigut puyuvalluit ikuutangnikkut uvalu qagaqtaunikkut uyagakhiuqviit, nunap qaanganiitut hulaqutainun ilaayut apqutit atuqtauyut, uvalu anurip nungutiqtuq. Nampangit hilaamut hiamitirinnaga uukuutunga atuqtauyuk qaffiutillaanganik itqurnarutaayuk nunap qanuraaluktut katitiquhimayut ACPI-nut hilataani PDA kiklinganit. Atugahatigut upautiniq, kitut malikhugit maligahat maligahat, ihumagiyaayut ihualuangitumik (imaa avatqutugit uqaqhimayut ihuangitumik hulaqutit) ihumagiyaayut atungnirit utuqanguqtut tamayat angitqiamik puyuaqatut, ihivriuhugit anginiqhakkut ukiumi hiamititqut aktilaangit igluqpinikkut uvalu auladjutinun uvalu ihuaqhaidjutinun, uvalu ilaayut ihuangnikkut hiamitiqunikkut aktilaangit. Una ihuangnikkut atugahag ihumagiyaayuk itqungniarutiuyuk anginiqharmik hivuniptingni havaaghanun-ilaayut hiamitiririt uvalu iluaniitut ilaayut tahapkununga tapkua ilituriyauniaqtut.

Uukuut itqurnarutaayuk katitiquhimayut ACPI naunaiyaqtauyut uumunnga Nunavut Hilami Qanurittaakhaanik Maliktakhat (NAAQS) naunaiqhimayuk uumani Nunavut Avatinga Maliktakhangit uumunnga Hilaup Qanurittaakhaanik, aadlallu qablunaat nunagiyangani kaanatap naunaitkutangit.

Atugahat itqungniarutit havaktauhimayut amigaitunun récepteurs nayugait hilataani PDA kikliini uvalu iluani LAA, ilaayut malruk qanitqiaq qayangnaqtuk nayugait: High Lake Uyagakhiuqtut Qiniqhiayut Maniqami uvalu Ulu Uyagakhiuqtut Qiniqhiayut Maniqami. Pidjutauniarungnaqhiyut hulaqutainun inungnun inuuhinun hapkunani malrungni récepteurs ihivriutaayut uvani Inungnun Aaniaqtailinikkut uvalu Avatingnun Qayangnautikkut Ihivgiugutikkut Uniudjutini (Naunaitkutani 26A).

Hilap hiamitpalianinga qanurilivalianiga qanurinigit nalautaariagani Havaami-pijutiqaqtunik aktuqniqaqniginik hilap qanurinigani naitumik uqauhiulaaqtut imaa:

- Amihut itqurnarutaayut hilaamut halumailrungit ittut ataani piliurhimayut SOGs amihuni nayuganginni LAA hilataani PDA kiklingani.
- Ilangit ACPI—unalluaq TSP unalu PM10 nappaqtiqtillugit, unalu NO₂ nappaqtiqtautilluni aulapkaininngalu—itqurnarutaayut qaangiutiniaqtuq ihuaqtuq SOGs hilataani PDA kiklinganit.
- TSP unalu PM10 avatqumayut hanayautitlugit atuqtauluangitut (ikitqiat talimat ublut ukiumi) kikliqaqtut nayugainun haniani PDA kikliini.
- Hanatillugit, anginiqhaq 1-ikaaqnimik NO₂ avatquttugit qulaani Kanadian Hilami Nakuunianik Atupagait hivitunიაqtut imaatut 2 km hinaani imaalu 6 km qulaani Qurluqtuaryungmi, anginiqharmik atuqtaugattaqpaktuq tahamuuna PDA kiklingani (imaatut 127 ublut/ukiuq).
- NO₂ avatqutait mikhiyuumiqtut ungahingniitigut, ikiliyuumiqhutik ikitqiamik 30 ublut/ukiumi imaa 1.5 km hinaanin.
- Atuqtilugu Auladjutit uvalu Ihuaqhainikkut havauhiit, attauhiq ikaangniq NO₂ avatqutugit atuqtauluangitut (ikitqiaq 14 ublut/ukiuq) kikliqaqtut nayugainun avatiini PDA kikliini.
- Qanitqiami qayangnaqtumi (High Lake Mineral Exploration Camp), tamaita ACPI katitiqhimayut ataani ihuaqtut SOGs tamangni Nappaqtirnikkut Aulapkainikkullu Munarinikkullu.

Piqaraluaqtilugu APCI puyunit Jericho Station-mi, ukua puyuit ikitqiyauniaqtut Tulaktaqvikmit pijutauniganit ikitqiyaniq huliutit Jericho Station-mi taimainigagut ukua puyuit nahautinik uuktuutaugitut. Ilavaluit hulaqutait hilap qanuginiatigut (imaa iliugaqtaukpata ihuaqhainikkut uvalu munagidjutikkut aktilaangit naunaiyaqhimayut ataani) naittumik naunaiyaqhimayut imaa:

- Ilakuit hulaqutit hilap qanuginianun havaktautilugu itqungniaqtauyut ihuangitumik uvalu aktilaangit mikiyumin anginiqhaqmun (qanuginiitigut itqungniaqtauyut iluaniitut hapkununga ACPImun), kikliqaqtut hapkununga LAA nunatigut aktilaangit, uvalu atuqtauyut naitumik hivituniani (atuqtilugu Hananikkut havaktauyut). Taimaali hiamitirnit aulahimaangniaqtut tadj, aktilaangit aalanguqtirnit hilap qanuginia ihumagiyaayut ihuangitumik taimaali itqungniaqtauyut avatipitingni iluaniitut nayugaini aalanguqataaqtut qakugunguraangat qanuriniitigut hilap qanuginiatigut.
- Ilakuit hulaqutit hilap qanuginianun atuqtilugu Auladjutit uvalu Ihuaqhainikkut havauhiit itqungniaqtauyut ihuangitumik uvalu aktilaangit mikiyumik anginiqhaqmun, kikliqaqtut hapkununga LAA nunatigut aktilaangit, uvalu atuqtauyut ihuangitumik hulidjutit hivituyumik.

VS.5.1.3 Angikliyuumiqtuq Qanuriliurutingit

Katitqhimayut hulaqutit aalanin ikayuutinin, ilauyut hulidjutit ilauyut kinguani, tadjamin, kinguani uvalu ihuangnikkut ihumagiyaayut, uvalu ihuangnikkut ihumagiyaayut pidjutaayut havaaghat, ihumagiyaayut hilap qanuginiatigut naunaiyautini. Kinguani iqaiyangnikkut hulidjutit piqangitut amigaiquumilugit pidjutigilugit ilakuit hilap qanuginia hulaqutainun Havaaghamun taimaali kinguliit havaaghat piqanginmata hiamitiqtunik tapkua atadjutiqaqtut tadjakaffuk Havaaghap puyuinin. Qaliriiknigut akturningit Taja takuukhauyunik hulijutunik ihuaqutiniklu atuqniginik, ila taja aulaniginik uyaraktaakhanik qiniqhiayut havaani, takuukhauyut takuukhauyuni tungaviyuni atautimiuyut iniqhimayut Havaamut. Ihuaqtumik tautungnaqtut (RF) uvalu ihuangnikkut ihumagiyaayut (RFI) havaaghat tapkua hilataani RAA ungahiktut Havaaghamin uvalu aktilaangit hiamitirnit atadjutiqaqtut aktilaangitigut Havaaghap puyuit. RF unalu RFI hulidjutit iluaniit RAA pidjutiqaqniaqtut amigaiquumilugit aghaluutit auladjutait uvalu ilaani hiamitiqtut mikiyut tapkua pidjutaangitut angiyumik amigaiquuminirmun hiamitirnit Havaaghamin. RF unalu RFI hulipkaidjutikhat, aullaliqqata, pidjutiqaqniaqtut maliruagakhanik ihivriughilutik havauhikhanik ihumaliurutauhunguyut amigaiquumidjutikhainik Havaakhamut. Ihivriughtautilugit havauhiit, ilaliutihimayut ihuaqhaidjutighat naunaiyaqtauniaqtut hivumut ikiliyuumiriangani anginirharmik ihuirutunik. Naittumik, angikliyuumiqtuq ilakunga avatinga ayurhautingit anirhaaktaptiknik ihumagiyaayut angikliyuumiqniaqtuq akhuraaluk uumannga ilakunga avatinga ayurhautingit anirhaaktaptiknik uumannga Havauhikhaq avaliittumit.

VS.5.1.4 Anginiqhaq

Hiamitirnit atugahat ihivriurutit tautungnaqtut tapkua anginiqhait itqungniaqtauyut iluaniit tamavyainun ACPI havaktautilugit uvalu Auladjutit uvalu Ihuaqhaidjutit ataani havaktauhimayut SOGs hilataani PDA kikliini. Ilangit ACPI (TSP, PM10 unalu NO2) qakunguraangat avatqutpaktait SOG-ngit hilataani PDA kiklinganit, hapkuat qaangiutiniit niriuktauyut haniani PDA kiklinganut piqattayutituklu. Atutqtipkailirnikkut nakuutqijaujunik aulapkainikkut havagutunik (BMPs) unalu hungiutinikkut aulapkainikkut parnaqutikhanik, Havaktaujukhami ilakunga hulaqutinik angikliyuumiqtiqhimaajunilu hulaqutinik anirhaaktaptikni talvani Havaktaujukhami nappaqtirningani aulapkaidjutainnilu munarinikkullu itqurnarutaujun angivalaangitun.

VS.5.1.5 Ingattaqtailiniq, Munariniq, unalu Ihuarhainiq Qanuriliurutingit

Havaaghaq atuliqniaqtuq Hilap Qanuginiitigut Munagidjutikkut Upalungaiyautit kitut ilauniaqtut BMPs munagiyaangani hilap qanuginia ilauyut:

- Aghaluutit uvalu tamayat auladjutait uvalu ihuaqhainikkut aktilaangit ikiliyuumigiangani ACPI hiamitiqtut ingniqutit uvalu puyuvit auladjutait
- Qagaqtiniq idjuhikhaa uvalu auladjutikkut atugahat ikiliyuumigiangani puyuvit hiamitiqtut
- Puyulaitkutikhat (imaa iluirainiq imarmik) mikhiyuumigiangani puyuvit nauhimayunun uvalu imaqnun uvaluuini imaqnun

Hilap qanuginiatigut munagidjutit uvalu hungiutinikkut munagidjutikkut pinahuagutit aktilaagutiginiaqtait avatiptingni halumailgut iluaniitut (PM10, TSP). Munagidjutikkut piyakhat ihivgiuqtauniaqtut uvalu hungiutinikkut munagidjutikkut havauhiit atuqtauniaqtut ikiliyuumigianganani hiamitiqtut ihuaqtunun kikliinun, humi piyakhaqaqtat.

VS.5.2 Hilaup Hilaa

Hilaup allanguqtiginikkut ayungnautigiyaingitlu tautuminaqtun akhurnaqtun Kitikmiununun, allanunlu Nunaqaqqaqhimayunik katimayiinun, allanunlu ayungnautiqarniaqtun nunalaanun taima ayungnautiqarniaqtun avatiptingnun pitquhingniklu nunanik, tariurmi, hanaqidjutikharnik atugiangani (TLMRU; imaatun itun, aulaaqtunik, huradja aulaviingit, anguniarnikkutlu). Ukua ikayuqtiriit uqatiaqtut hila nalunaqhivalianiganik aalaguqniginiklu hilap Kitikmeoni Nunami ilaqaqtut amigaiqpalianiginik ikulaaqtut, nalunaqtut hikuit qanuriniginik, mahaktiqhuni nunap qiqumania, nipalukpaliqpaliavluni, aalaguqpaliavlunilu immavaluit. Tautukhimayauvaktunik nakungikgativaktunik mikharut alanguktikattakpaktunik hilaup hilalu ilauhimayunik hinaanik nungutpaliavaktunik, alangukpaliavaktunik aputit kanukgitakhainik, kufiutilanginik, imalu nungumagiktunik, uvunlu alanguktikattakpaktunik nauttianik imalu huranik. Uuktuutigiyayut qanuqtut aadlangurninnga hilaup ayurhaqtipkaiyuq nunallaanut ilaliutihimayut hatutqiyayut hiku mahahaliqhuni hiku pipkaidjutiuyuk ukiup ilaani aullaqtut huradjallu hulilukaarutingit (ukunatitut, tuktut ingilravingit qanuriliurutingit), ikikliyuumiqtut imaq pipkaidjutiuyuk aullaqtunut imarmiutanullu uumayunut (ukunatitut, Iqalukpiit), nakuulluanguinmat apidjut qilamiuqtuqaliqqat igluliuriami, kayumiktumiklu nunap qiqumania mahaktiqtut ayurhauingalu tamainnut avatinganut qangaraaluknitat hulilukaarutingit.

Inungnin-pidjutiqaqtut hilaup aalannguqtirninga angiyuq avatiliqinikkut ayuqhautauyuq imaalu ayurnaqhitiavaktut nalunaqtuniklu tamagingnut hivunikhaliurutikhanut qanurinniit ihuaqtumiklu havaakhap qanurinnikhanut, nappaqtirutikhanut, ingattaqtailitikhanullu qanuriliurutikhat. Havaaghaq pidjutiqaqtut tamangnun pidjutigilugit hilap aalanguqtirniranun haffumuuna puyuum anialailaqtata (GHG) hiamitirnira pidjutaunilu hilap aalanguqtirniranun. Tamna Havaaghaq ayungnautiqarniaqtut hivutunigaalukmik allanguqtiginikkut hilaup qanuritmangaangit (imaatun itunik, allanguqtiginikkut tarium hikunga katitihimayuniklu, tariumi malingit hulilukaaktunik) unalu hilarlukpalaarnirmin (imaatun itunik, nipalukpalaqtunik, apidjuaqtunik, anuqhiryuaqtuniklu).

Ilanga 12 tuniyuq uqaqatigiikniq qun'ngiaqtauyuk hilaup aadlangurninnga Uataani Kitikmeoni, Hilaup Naunaitkutaa, puyuum anialailaqtata anianiinnik naunaiyainiq (qanuqtut Havauhikhaq tuniniaqtut hilaup aadlangurninnganut), unalu hilaup aadlangurninnga qayangnaqtut naunaiyainiq (qanuqtut Havauhikhaq pilaqtuniaqtut hilaup aadlangurninnganut hilaup aadlangurninnganut). Hapkua hilap uqaqatigiit uvalu ihivgiugutit tuhaqtauyut ilauqatigiiknikkut uvalu Inuit, Nunaqaqqaqtut, uvalu Nunallaat Ilihimagait ihivgiugutini. Hilaup Naunaitkutaa, puyuum anialailaqtata anianiit naunaiyautikhat, unalu hilaup aalannguqtirninga qayangnaqtunik naunaiyautikhat naittumik titraqhimayut ataani.

VS.5.2.1 Hilap Qanuriniga

Havaaghaq nalruyumik uvalu aktilaanga nayugaa tunungani uvani Grays Baymi hamunga hivuraani aktilaanga uvani Jericho Stationmi imaa 230 km qitqani malguk. Hilaa nayugaani pidjutiqaqtut aghut aalangayumik. Kanatap Aalanguqtinqiatigut Hilap Uniudjutit (Cohen et al. 2019) naunaiyaqhimayut tapkua, Tunungani Kanatami (naunaiyaqhimayut nunatigut aviktungniit tunungani 60° tunungani nunamun), ukiumi uunaqniit amigaiquyumiyut imaa 2.3 deგრés Celsius (°C) atuqtilugu 1948-2016, hakugikniqhaq amigaiquyumiyuq tautuktauyuq ukiumi (4.3°C). Ataani anginiqhakkut hiamitirnit Pidjutiqaqtut Katitiqhimayut Apqutit (RCP8.5) ihumagiyaayut, ukiumi uunangnirit Tunungani Kanatami ihumagiyaayut akituquyumilutik imaavyak 2.7°C haffumani 2031–2050 hivituniani uvalu imaa 7.8°C haffumani 2081–2100 atuqtilugu, aadjiliurutigiblogu hamanga 1986–2005 atuqtilugu. Pijutauniganit takuukhauginiganit (hilaliqivik) havaqatiriigutit Ukiuqtaqtumi Kanatami, taimani hivunikhami aalaguqnigut nipaluit ayuqnaqtut naunaitiariagani. Kihimi, tamaita piinialigut nayugait atuqtauyut uniudjutini naunaiyaqhimayut amigaiquyumiyut nipaluit. Ataani RCP8.5, ukiumi nipaluktut Tunungani Kanatami ihumagiyaayut amigaiquyumilutik imaa 11.3 pusat (%) haffumani 2031-2050 atuqtilugu uvalu imaa 33.3 pusat haffumunga 2081-2100 atuqtilugu, aadjiliurutigiblogu 1986-2005 atuqtilugu..

VS.5.2.2 Puyuum Anialailaqtata Anianiit

Havaakhaq hiamitiqirniaqtat GHG tingivgalaaktut hiamut hulipkaidjutaniit nappaqtiqtautitlugit aulapkaidjutikhainullu munaqhidjutikhanullu. Kanadaup Kavamanga piliuqtut maliruagakhanik, atugakhanik, maliktakhaniklu titiqqanik pidjutiqaqtunik GHG pujuinnik ikajuutikhanik ikiglinahuarutikhanik nunarjuami hilaup aalannguqtirninga.

Ikualapkainiq tuquhimayunit uqhuryuakhat (e.g., uqhuquyat, tingmitit (tingmitit) angiyuni akhaluutini (e.g., pualrihautit, agyaqtautit akhaluutit, tingmitit) pidjuttaullaqpaktut GHG tingivgalaaqtunik Havaakhamit. Ilangit GHG hiamitiqtut piniaqtut qagaqtautinit (ikualayut qagaqtautit). Munariplugit uqhuryuanik aturniit, munaqhidjutikhainiklu ihuaqtunik aktilanginik nappaqtirutikhanut ingilrutit, upalungaiaqtauhimayut ikiglinahuarutikhanut GHG tingivgalaaktut havaakhat hulipkaidjutainit.

Ihuangnikkut itqungniarutit (imaa avatqutugit kangiqhimangitut) GHG tingivgalaangnirit igluqpinikkut itqungniaqtauyut anginiqhauyut pingahuani ukiungani napaqtirinirmun imaa 145,566 t CO₂e uvalu naamavyaktuq 87,326 t CO₂e attauhirmi ukiumi ilanginun igluqpinikkut ukiuni, ilaungitut hiamitirnit nunamik-atungnikkut aalanguqtirnit. GHG tingivgalaarningit nappaqtiqtautitlugit pidjutiqarniaqtut imaattut 15%-mit 20%-mut Nunavutim ukiuq tamaat GHG tingivgalaaktut imaalu imatut 0.02% Kanadap GHG anianiit ukiuq tamaat.

Ihuangnikkut itqungniarutit GHG tingivgalaangnirit auladjutikkut ihuaqhainikkullu hulidjutinun naamavyaktuq 57,789 t CO₂e attauhirmi ukiumi uqhuquyaq atuqtaugaangat pauwatuutinun. GHG hiamitiqtut aulapkaititlugit pipkaidjutiniaqtuq 8pusantnguyuuq Nunavuutim ukiumi GHG anianiit unalu 0.001pusantnguyuuq Kaanataup GHG anianiit atauhiqmi ukiumi.

VS.5.2.3 Hilaup Aalannguqtirninga Hivuranarniq Qauyihaidjutikhaq

Hilaup Aalannguqtirninga Qayangnaqtunik Ihivriurniq (CCRA) iniqtauhimayuq Havaakhamut naunaiqhithikanik qayangnaqtunik pidjutiqaqtunik tadjahuriyaayuniklu hilaup aktuutauniinik upalungaiyautikhaliuqhimayunut Havaakhap nappaqtirutikhanut piqutainullu. Hungiutivallianikkut hanaqidjutit pitquyaayut havaktauhimayut uqautigiyaangani qayangnautit uvalu ihuaqhiyuumiqlugit Havaaghat hakugingniit uvalu maligahat idjuhikhait uvalu munaridjutikkut upalungaiyautit. Aulatjutaayut munarinigagulu pijutiqaqtut atuliquyaayunik pijutaayut ihuaqhiyaangani hilaup aalaguqniganik aannirutaulaaqtunik tikuaqtuilutiklu pivalianiganik munarijutinik, aulaniginik, havaktulu aaniagitaangani aaniagitaaganilu pitquhiyut pigiarutilu. Hapkua uuktuutit hungiutinirmun hanaqidjutit pitquyaayut ilaayut uvani CCRA uniudjutaini:

- Ihumagilugit hilaup ihuaqhaqhimayut idjuhikhait aghuurutigilugu hivituyumik-kikliqaqtuq mahulingainiq. Uuktuutigilugu, ilaliutilugit ihumagiyaayut aalanguqtmirrit nipalliqliaqqata turhuat idjuhiit (aktilaangit). Amigaigyuumilugit mahulingaitkutikhat qurluarviit ikayuutauhunguyut ikiglinahuarutikhanik apqutit qanurinnikhainik imaalu qurluarviit milviit/milviit pidjutaavaktut nipalliqliarangat. Ilauyukharnik, ihumagilugit kuukviingit angiktilaangit taima nauhimayunik piqangitun talvani havakhimayukharnik atuqtakharnik ihumaliurutikharunik (piyaangat ihumaliurutikharunik nunami nauhimayunik tamaqpaliayut talvuuna nunami ikualaaqtunik).
- Havaklugit uvalu iliugaqlugit nunap nungutiqpalianikkut munagidjutikkut aktilaangit (imaa gabion, kuvyat, kuvyat, nuviqhaqhimayut nunat) nayugaini nigiktauyut nunap nungutiqniatigut, imatun hinait havaktauhimayut Nunap Qanurinia II tamayat.
- Talvani nunap qiqumania piqaqtuq, iliurarlugu munarinik piliurhimayullu hakugiktirutingit.
- Piliuqlutik aulatjutaayut munarinigagulu atugakhamik ihivriuaqtariami nunam qaangani tuqhuat/tuqhuat alappaarnaqpiqaqtilluni mahaktiqlugulu ihariagiyaupat ikikliyuumiriami ahiruqtirniq turhuangit imaqtut/kuvigaqhimayumiklu imaq havakvingit aulapkainnngit qamitauniaqtut.
- Ihumagilugit iliurailutik anginiqharmik Mikitiqamik Ihuangnikkut Uniudjutikkut Aktilaanga (MERV) anugikkut halumaqhijut igluqpangni ihuaqhiyuumigiangani iglup iluani anirhaagutikhaa, tapkualuat hilap nakuuluangitumik pidjutaayut nunami ikualaaqnikkut ihik uvaluuniin puyumik anuqhiyuaqtillugu. Ihivriuhigattarlutit imaalu unngavaqtirlugit himmauhirlugilluuniit halumaqhitiit.

VS.5.3 Nipaaqnigut Hayuknigilu

Hapkununga Inuinangnun, nuna, imaq, uvalu hiku nunat nipaiqpiaqniq, humi nipaiqniq ilaayut inuuhimun uvalu ihagiagiyaayut anguniaqniqmun, aulaaqniqmun, uvalu atadjutinun nunamun. Naittumik-hivituniani aturaakpaktakhamiluunniit nipiquqtuhiniq hajukniqlu ihuirutittaaqtuq huradjanik, anguniarniq ajurnarhitivaktuq, aallanguqtihugulu pidjuti haniqpaniidjutimi. Tamna Nipiquqtuhinikkut Hayuktitiyuniklu VC ihumagiylugit munariplugit tamangnik idjuhia nivyaqtunik avatingnit pittaaqtainiklu Kitikmiut, aallat Nunaqaqqaarhimayut katimayit, aallallu aktuqtauniarunaqhiyut nunallaat aturiangani nuna atuqpakhimayamingnik. Tamna ihivriudjutikhaq ihumaginiaqtun hanigaini humi Inuit allatlu nunamik atuqtunik nunagiyaingit, havakhimaaqtaingit, tingmivakhimayutlu, ilaayutlu Pitquhiliqinikkut Nunaani, Tariirmi, Hanaqidjutikharnik Atuqtauyukharnik (TLMRU) nayugaingit, hiniktaqvikhangit,

nuutigiaqaqtuniklu tangmaarviikharnik. Auladjutit nayugait haniani uvaluuniin haniani PDA, ilaayut Jericho Station PDA kikliit uvalu Qurluqtuaryungmi Apqutaani PDA kikliit, ihivriutauyullu. Nipaaqnigit hayuknigilu akturningit uumayut, tuktulu, tikmijat, tagiumi uumayut, tagiumilu iqaluit iqaluilu nunagiyainiklu, ihuaqhiyauvaktut nanminiriyamikni VC-giyamikni.

VS.5.3.1 Nalautiqhimayut

Inuit, Nunaqaqaqtut uvalu Nunallaat Ilihimayaitigut ihumagiyait, ilauqatigiiknikkut uqautauyut, tungaviit nipiquqtuhinikkut aktilaangit atuqtauyut naunaiyagianganani tungaviit qanuginiit. Nipiquqtuhiniq hayukniqlu iluani LAA tatja mikiyut, amigainiqhat nivyaarutit pivaktut nunamin anurimit, imaqmit, uumayunitlu. Kiklivikhanga nivyaarutikharnik uuktuutikhangit Havaaqharnun malikhautiqaqutun atuqtakharnik naunaiyagiikhmayut talvani AER Atuqtakharnik 038mi, taima aulavikhangit nivyaangit qullirutikhangit Ldn taima 45 dBA atuqtauvakhimayut kiklivikhanga talvani Havaaqharni. Ilangit inungnit-pihimayut nipait atuqtauyut aulaaqviini uvalu ukiutigut aulaaqviini. Inuit nunat atuqni tahapkunani nunani ilaani ukiup ilaani, huliniit tahapkuatut angunahuarniq iqalukhiurniqlu ikpigiyaaqalat nipaaqnit hayukniluniit puqtunit.

VS.5.3.2 Havaami Aktuqnigit

Havaaqhangit hulilukaaktukharnik talvuuna Napaqtirutikharnik Auladjutikharnik Ihuaqhaidjutikharnik hulilukaaktunik aulatitiniyaqtun nipiquqtunirmik hayuktitiyuniklu taima ayungnautiginiyaqtun nunaqaqtunik ukiuk tamaat nunaqaqtunik, nunaniklu atuqtunik. Hapkua hulidjutit ilaayut apqutuluqtut, uyagaqtaqviit, qagaqtiqtut, tingmitit uvalu aghaluutituqtut auladjutit, uvalu tamayat atuqtauyut. Itqurnarutauyut uuktuutingit piyait itqurnarutauyut nipinganik hayuktuniklu qanuraaluktut uumani LAA unalu RAA itqurnarutauyut pipkaidjutininnganik, naunaiyariami aadlangurninngit tunngavinganait, naunaiyariamilu maligiamikni maligamut maliktakhat. Itqungniaqtauyut Havaaghat hulaqutainun nipiquqtuhinikkut uvalu hayuknikkut naittumik titiraqhimayut imaa:

Aalanguqniit nipiquqtuhinikkut aktilaangit:

- Nipiquqtuhinikkut hulaqutit havaktautilugit itqungniaqtauyut maligahatigut kiklikhait tamaini auladjutini atulingnikkut nayugaini-kitunun uvaluuniin qanuginiitigut aktilaangit piyakhat ilangini auladjutit uvani Jericho Station PDA Kikliini uvalu Grays Bay Apqutaani PDA kikliini.
- Nipiquqtuhinikkut hulaqutit atuqtilugu Auladjutit uvalu Ihuaqhaidjutit itqungniaqtauyut pidjutigilugit maligahat kiklikhait tamaini auladjutini atulingnikkut nayugaini-kitunun uvaluuniin qanuginiitigut aktilaangit piyakhat apqutini uvalu uyarakhiuqviup kikliini humi naitumik nipiquqtuhinikkut hulaqutainun itqungniaqtauyut.
- Auladjutit uvalu Ihuaqhainikkut hulidjutit uvani Qurluqtuaryungmi Tulaktaqvik uvalu Jericho Stationmi itqungniaqtauyut pidjutiqaqniaqtut hivituyumik nipiquqtuyumik hulaqutainun kihimi hapkua hulaqutait munagiyauniaqtut atungnikkut idjuhikhaitigut uvalu auladjutikkut atuqtauyut.
- Ilakuit hulaqutait nipiquqtuhinikkut aktilaangit itqungniaqtauyut mikiyumik aktilaangit iluani RAA uvalu aulahimaaqtut naitumik hivituniani Havaktautilugit uvalu qitqani-kikliqaqtut atuqtilugu Auladjutit uvalu Ihuaqhainikkut havauhiit. Hapkua hulaqutait himmautauniaqtut Havaaghat hulidjutait nutqaqata.

Aalanguqniit hayungnirit aktilaangit:

- Hayungnirit hulaqutit, ilauyut qagaqtautikkut hayungnirit havaktautilugit uvalu Auladjutit uvalu Ihuaqhaidjutit, itqungniaqtauyut pidjutigilugit maligahat atulirmiitigut nayugaini-kitunun uvaluuniin qanuriniitigut aktilaangit piyariaqaqtut nayugaini, nuutiqtaaqut hiniktarviit, uvalu Qurluqtuaryungmi Tulakvikhat PDA kikliini.
- Ilakuit hulaqutit hayungniitigut aktilaangit qakungugaangat, naitumik atuqtilugu Hananiq uvalu qitqani-kikliqaqtuq atuqtilugu Auladjutit uvalu Ihuaqhaidjutit, uvalu atuqtauniaqtut kitunun Hananirmun, uvaluuniin Auladjutinun uvalu Ihuaqhainikkut hulidjutit (imaa qagaqtiqnikkut, tungaviit). Hapkua hulaqutait himmautuniaqtut Havaaghat hulidjutait nutqaqata.

Havaaqhangit nipaangit hayuktautikhangitlu aulalimaitun avataanun RAA unaluuniit ayungnautiqarniaqtun avatingnun avikturningnun nunalaanunluuniit.

VS.5.3.3 Angikliyuumiqtuq Qanuriliurutingit

Nutqangayut uvalu nuutiqtaaqut nipiquqtuyut aalanin tadjamin uvalu ihuangnikkut ihumagiyaayut pidjutaayut havaaghat hulidjutit pidjutiqaangiaqtut ilakuit nipiquqtuhinikkut hulaqutainun Havaaghat hulidjutit atadjutiqaqata haffumunga Havaaghamun tadjakaffuk uvalu nayugaani. Hapkua aalat havaaghat iqaiyangnikkut hulidjutit ilauyut: hadja uyaraqhiurnikkut; ihumagiyaayut uyarakhiuqtut, tariukkut aulayut uvalu nunakkut ingilradjutit; uvalu tadjamin uvalu ihuangnikkut tautuknaqtut anguniaqtut anguniaqnikkut, maniqami-pihimayut aquinikkut uvalu nalunaqtuliqinikkut ihivgiugutit.

Havaaghamun-ilauyut nipait niriuktauyut mikhiyuumiqlutik aktilaanginun ataani kinguani aktilaangit imaa 3 km nayugaanin uvalu amigaiquumiyut nipiquqtuhinikkut hulaqutait nigiuktaungitut avatqulugit nipiquqtuhinikkut aktilaangit auladjutini. Pidjutigiblugit anginiqhakkut nayugait uvalu qakungugaangat qanuriniit Havaaghat-ilauyut hayungnirit, qaliriiktut aalanun hayungnirit ihumagiyaayut piyaulimaitut taimaali hayungnirit ihumagiyaungitut katitqhimayut hulaqutit ihivriurutini.

Angikliyuumiqtuq nipiquqtuyumik qanuriliurutingit itqurnarutauyuq angivallaangittuq kikliqaqtuqlu RAA-mut. Hivitunia aulahimaangiaqtuq atuqtilugu hulidjutit, kihimi hivitunia aulalimaituq qitqani-kiklia.

VS.5.3.4 Anginiqhaq

Kinguani ihuaqhaidjutit, ilakuit havaaghat nipait uvalu hayungnirit hulaqutait itqungniaqtauyut angivalaangitut. Atuqtaaqut nipiquqtuhinikkut uvalu hayungnikkut kikliit havaktauhimayut maligatigut atugahatigut avatqulimaitut. Hulaqutait aulalimaitut angivalaangitumik, naittumik-qitqani-kikliqaqtut hivituniit, pidjulaulimaitut hivituyumik hulaqutinik nunamik atuqtunun, hugadjanun, uvaluuniin nunallaat inuuhiqattiarnirmun.

Amigaiquumiyut nipiquqtuyut hulaqutait itqungniaqtauyut angivalaangitut. Amigaiquumilimaitut hayungnirit niriuktauyut.

VS.5.3.5 Ihuaqhautighat, Munaridjutit, Ihuaqhaidjutighallu Aktilaarutit

Tamna Havaaqhaq aturniaqtun hanayiyuyukharnik munagidjutikharnik, ihuaqtumik auladjutikharnik atuqtakharnik, nayugaangitlu naunaitunik hanaqidjutikharnik nipiquqtuhinautumik hayuktailiyaangatlu. Hapkuat maliqatqujahimajut naunaiqtauhungujut aullaranginnaqtumik ilaupkaidjutikhanik Inuit nunanginni. Maliqatqujahimajut ilaujut:

- Havaklugit qagaqtautit ikiliyuumigiangani nunap hayungnirit nipiquqtuhinirmunlu
- Ikikliyuumiqlugit tamayat kayumiitumik uvalu atuqlugit idjuhiit uvaluuniin havaktauhimayut hapukuutait humi piyaaqqat
- Naunaiyaqlugit tangmarviit haahimalugit nipiquqtuyunun
- Kituni nayugaini humi avatqutugit atuqtauyut, atugahat havaaghat hulidjutit hilataani qayangnaqtut anguniaqviit uvaluuniin aulaniit hivituniit, ilauqatigiblugit Kitikmiut nunamik atuqtut
- Atuqhugit hungiutinikkut munagidjutit ihuaqhaqlugit ihuaqhaidjutit munagidjutit tautuknaqtut niriuktaungitut hulaqutit

VS.5.4 Hilap Avatingani Hulaqutikkut Uqaqtait

Ihivgiugutit hulaqutinun haffuma Qurluqtuaryungmi Apqutaani uvalu Tulaktaqvikhaq Havaaghaq hilap qanuginiatigut uvaluuniin nipiquqtuyumik uvalu hayuknikkut itqungniaqtauyut ilakuit hulaqutait uvalu katitiqhimayut hulaqutait angivalaangitut.

[illegible][illegible][illegible][illegible][illegible][illegible]

[illegible]

[illegible][illegible][illegible]

VS.5.2.2 ຈຸດສຳຄັນ ແມ່ນການສຶບສຽດຊຸມ ແລະ ການສຶບສຽດຊຸມ

VS.5.2.3 ሥርዐቱን ለማረጋገጥ ለሚያስፈልጉት ሰነዶች ማግኘት ይቻላል።

[illegible]

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VS.5 Résumé du volume – Portée de l'évaluation du milieu atmosphérique

Les changements du milieu atmosphérique ont été enregistrés et transmis par l'intermédiaire du savoir inuit, tant pour comprendre les saisons que pour vivre sur l'océan et sur la terre ferme. Pour les Inuits, la terre, l'eau et la glace sont des lieux de paix, où le calme fait partie de la vie et est essentiel pour la chasse, les déplacements et la connexion à la terre.

« Moins de neige rendait les déplacements en hiver plus difficiles. La poussière et les contaminants ont affecté la qualité de la neige » (Banci et Spicker, 2024).

« On voyageait à l'intérieur des terres pour chasser les caribous. Au printemps, la glace des rivières et des lacs dégèle plus vite que sur l'océan, et l'eau s'écoule dans les lacs et ruisseaux. Avec les changements climatiques, le processus va être plus rapide. Nous devons protéger les plans d'eau contre la contamination comme les routes de glace. On entend parler de tracteurs qui traversent la glace. Les gens devraient faire attention s'ils construisent des routes de glace. Le gravier fait fondre la glace plus vite » (Banci et Spicker 2024).

Le bruit et les vibrations à court ou long terme peuvent perturber la faune, rendre la récolte plus difficile et changer l'expérience de paix et de tranquillité sur la terre. La présente évaluation respecte ces valeurs et se concentre sur la protection à la fois de l'environnement naturel sain et de la capacité des Inuits à utiliser la terre comme ils l'ont toujours fait.

« Les caribous semblent toujours s'éloigner des nuisances sonores, tout comme les gens. Ils restent très sensibles au bruit » (Banci et Spicker 2024).

La valeur du milieu atmosphérique est globale; il est important d'évaluer les effets potentiels sur la qualité de l'air et les changements climatiques, le bruit et les vibrations afin de respecter ces valeurs et de se concentrer sur la protection du milieu atmosphérique naturel ainsi que sur la capacité des Inuits à utiliser la terre comme ils l'ont toujours fait. West Kitikmeot Resources (WKR) a recueilli des renseignements de référence sur la situation en combinant la collecte de connaissances menée par les Inuits et collaborative (y compris les ateliers du Naonaiyaotit Traditional Knowledge Project [NTKP] et du Groupe consultatif autochtone [IAG] propres au projet), des renseignements publics provenant de groupes autochtones pris en compte dans le cadre du projet, ainsi que de la rétroaction sur la mobilisation communiquée par les Kitikmiuts, d'autres groupes autochtones et d'autres communautés potentiellement touchées, avec des études techniques recueillies par des méthodes scientifiques occidentales. La combinaison de ces perspectives du savoir et de la science occidentale a été utilisée pour éclairer et évaluer l'énoncé des répercussions environnementales des trois éléments du milieu atmosphérique.

Le projet de la route et du port de Grays Bay (le « projet ») est un port en eaux profondes et un aménagement routier praticable en toute saison de 230 km proposé par West Kitikmeot Resources Corp. (WKR), situé dans la région de Kitikmeot au Nunavut. Le port sera situé dans le golfe Coronation, à environ 50 km au sud de la voie du passage du Nord-Ouest par l'Arctique, et reliera par route en toute saison le site fermé de la mine Jericho à la station Jericho, sur la rive nord-ouest du lac Contwoyto (NU). Chaque année, la route praticable en toute saison sera reliée toute la saison à la route hivernale qui va du lac Tibbitt au lac Contwoyt, officiellement appelée Tibbett to Contwoyto Winter Road (TCWR). WKR a préparé un énoncé des répercussions environnementales pour repérer et évaluer les effets environnementaux et socio-économiques potentiels résultant du projet, qui répond aux exigences énoncées dans l'Accord du Nunavut et les lignes directrices préliminaires normalisées pour l'élaboration d'un Énoncé des répercussions environnementales (ERE) de la Commission du Nunavut chargée de l'examen des répercussions (dossier CNER n° 24XN038; CNER 2026). Le présent volume de l'ERE présente l'évaluation des effets environnementaux potentiels sur la qualité de l'air, le bruit et les vibrations, et inclut des énoncés sur le climat.

Des limites spatiales et temporelles ont été établies pour soutenir la réalisation des évaluations des composantes valorisées (CV), éclairées par la compréhension actuelle des effets potentiels du projet et d'autres facteurs pertinents. Le secteur d'aménagement du projet (SAP) comprend l'emprise au sol de toutes les composantes du projet, y compris les perturbations permanentes et temporaires (par exemple, l'étendue de l'infrastructure du projet, le défrichement prévu et les zones de déblaiement). La zone d'évaluation locale (ZEL) est la zone maximale où les effets environnementaux propres au projet peuvent être estimés de manière qualitative avec un degré raisonnable de précision et de confiance. Pour l'évaluation de la qualité de l'air, la ZEL a été définie comme une zone tampon de 5 km autour du SAP, qui respecte les exigences réglementaires et est suffisamment grande pour discuter de manière qualitative de la portée de l'influence des émissions de contaminants atmosphériques potentiellement intéressants (CAPI) provenant des activités du projet. La ZEL pour le bruit et les vibrations a été définie comme une zone tampon de 1,5 km autour du SAP, ce qui est conforme aux directives réglementaires pour les zones d'étude d'évaluation du bruit.

La zone d'évaluation régionale (ZER) met en contexte les effets propres au projet et représente la zone dans laquelle des effets cumulatifs avec d'autres projets et activités peuvent survenir. La ZER pour la qualité de l'air a été définie comme une zone tampon de 5 km autour du SAP et a été établie pour respecter les exigences réglementaires et pour saisir les effets sur la qualité de l'air des composantes spécifiques faisant l'objet de l'évaluation. La ZER est de la même taille que la ZEL parce que les effets cumulatifs sur la qualité de l'air attribuables à d'autres projets (passés, présents ou raisonnablement prévisibles) devraient être négligeables en dehors de la ZEL en raison de l'atténuation atmosphérique naturelle (par exemple, dilution naturelle due au mélange atmosphérique) des émissions de CAPI découlant du projet. Pour l'évaluation du bruit et des vibrations, une ZER plus petite a été établie (zone tampon de 3 km autour du SAP) en reconnaissance de l'atténuation atmosphérique naturelle et de l'absorption par le sol du bruit et des vibrations.

Les limites de l'évaluation spatiale n'ont pas été définies pour la section Climat, car l'évaluation des gaz à effet de serre (GES) a pris en compte les émissions de GES libérées par les activités du projet et a comparé ces émissions aux émissions de GES du Nunavut et du Canada aux fins de contexte.

VS.5.1 Qualité de l'air

La qualité de l'air a été évaluée en raison de son importance pour la santé et le bien-être des personnes, de la faune, de la végétation et d'autres biotes des écosystèmes. L'évaluation de la qualité de l'air a pris en compte les changements potentiels de la qualité de l'air ambiant durant les phases de construction, d'exploitation et de maintenance. Les changements potentiels relatifs aux CAPI ont été comparés aux normes, objectifs et lignes directrices établis en matière de qualité de l'air ambiant. Les CAPI qui ont fait l'objet de l'évaluation comprenaient les particules en suspension totale (PST), les particules inhalables d'un diamètre aérodynamique inférieur à 10 µm (P₁₀), les particules respirables d'un diamètre aérodynamique inférieur à 2,5 µm (P_{2,5}), le dioxyde de soufre (SO₂), le dioxyde d'azote (NO₂) et le monoxyde de carbone (CO). Les changements prévus ont ensuite été évalués pour d'autres sections des CV pour leurs effets potentiels sur la végétation, les caribous, les poissons d'eau douce et leur habitat, sur l'utilisation traditionnelle des terres, des zones marines et des ressources, ainsi que sur la santé et le bien-être communautaires.

VS.5.1.1 Base de référence

Le projet est situé dans la région de Kitikmeot, dans une zone isolée où la qualité de l'air n'est pour ainsi dire pas touchée par les activités industrielles, résidentielles et de transport locales. La qualité de l'air de référence de la région de Kitikmeot peut généralement être classée comme intacte en raison du nombre limité de sources de CAPI de grande envergure. Les émissions atmosphériques locales comprennent des sources stationnaires (par exemple, génératrices d'électricité, chauffage) et mobiles (par exemple, camions, motoneiges, véhicules tout-terrain [VTT]), tandis que la circulation des navires a une incidence sur la qualité de l'air local pendant la saison des eaux libres. Le transport à longue distance de contaminants atmosphériques peut également avoir des incidences sur la qualité de l'air dans la région de Kitikmeot. Des concentrations de référence représentatives de qualité de l'air ont été établies pour le projet en fonction des concentrations de CAPI mesurées pour d'autres projets récemment proposés dans la région du Kitikmeot. Les concentrations de référence du projet sont inférieures aux normes, lignes directrices et objectifs correspondants. Dans l'ensemble, la qualité de l'air de référence dans la ZEL pour la qualité de l'air est considérée comme très bonne.

VS.5.1.2 Répercussions du projet

Les activités du projet durant les phases de construction, d'exploitation et de maintenance généreront des émissions de CAPI et pourraient entraîner un changement de la qualité de l'air. Des effets potentiels sur la qualité de l'air lors des phases de construction, d'exploitation et de maintenance du projet sont attendus du fait du fonctionnement de la centrale électrique fonctionnant au diesel au port et à la station Jericho, de l'utilisation d'équipements et de véhicules équipés de moteurs à combustion (par exemple, équipements routiers et hors route, véhicules légers et navires), de la détonation d'explosifs dans les carrières, de l'exploitation des aéronefs et de l'incinération des déchets domestiques. On s'attend aussi à des effets sur la qualité de l'air liés à la génération de poussières diffuses lors du forage et du dynamitage dans les carrières, des activités de perturbation de la surface, y compris l'utilisation des routes et de l'érosion éolienne. Un modèle numérique de dispersion atmosphérique a été utilisé pour prédire de manière quantitative les concentrations au niveau du sol pour les CAPI en dehors des limites du SAP.

L'approche de modélisation, qui suivait les directives réglementaires, est considérée comme conservatrice (c'est-à-dire exagérée plutôt que sous-estimée), car elle supposait l'utilisation d'équipements plus anciens avec des émissions plus élevées, évaluait les taux d'émissions de l'année de pointe pour la construction, l'exploitation et l'entretien, et incluait des taux d'émission conservateurs. Ce scénario de modélisation conservateur prédit des émissions et des concentrations futures liées aux projets plus élevées par rapport à celles qui sont susceptibles d'être générées.

Les concentrations prévues par le modèle pour les CAPI ont été comparées aux normes de qualité de l'air ambiant du Nunavut définies dans les lignes directrices environnementales du Nunavut pour la qualité de l'air ambiant (Nunavut Environmental Guideline for Ambient Air Quality), ainsi qu'à d'autres références provinciales et fédérales. Des prévisions du modèle ont été établies pour plusieurs emplacements de récepteurs en dehors des limites du SAP et dans la ZEL, y compris aux deux sites de récepteurs potentiellement sensibles les plus proches : le camp d'exploration minérale de High Lake et le camp d'exploration minérale d'Ulu. Les effets potentiels sur la santé humaine de ces deux récepteurs ont été évalués dans le rapport d'évaluation des risques pour la santé humaine et l'environnement (annexe 26A).

Voici le résumé des résultats de la modélisation de la dispersion atmosphérique en ce qui concerne la prévision des effets potentiels liés au projet sur la qualité de l'air :

- La plupart des concentrations prévues de contaminants atmosphériques restent en dessous des NOLD établis dans la plupart des emplacements à l'intérieur de la ZEL en dehors des limites du SAP.
- Pour certains CAPI – notamment les PST et les P10 pendant la construction, et le NO₂ pendant la construction et l'exploitation – on prévoit un dépassement des NOLD applicables en dehors des limites du SAP.
- Les dépassements de PST et de P10 pendant la construction sont rares (moins de 5 jours par année) et limités aux zones se trouvant immédiatement autour des limites du SAP.
- Pendant la construction, les dépassements maximaux de NO₂ pendant une heure au-dessus des normes canadiennes de qualité de l'air ambiant s'étendent jusqu'à 2 km le long du rivage et 6 km au-dessus de Grays Bay, avec la fréquence la plus élevée le long des limites du SAP (jusqu'à 127 jours/année).
- Les dépassements de NO₂ diminuent avec la distance, descendant à moins de 30 jours par an dans un rayon de 1,5 km du rivage.
- Pendant la phase d'exploitation et de maintenance, les dépassements de NO₂ d'une heure sont rares (moins de 14 jours/année) et sont limités aux zones à proximité immédiate des limites du SAP.
- Au récepteur sensible le plus proche (camp d'exploration minérale de High Lake), toutes les concentrations de CAPI restent en dessous des NOLD applicables pendant la construction, l'exploitation et la maintenance.

Bien qu'il y aura des émissions de CAPI à la station Jericho, ces émissions seront nettement plus faibles qu'à l'emplacement du port en raison des niveaux d'activité plus faibles à la station Jericho, et donc ces émissions n'ont pas été modélisées numériquement. Voici le résumé des effets résiduels sur la qualité de l'air (c'est-à-dire après application des mesures d'atténuation et de gestion décrites ci-dessous) :

- Les effets résiduels sur la qualité de l'air pendant la phase de construction devraient être défavorables et varier d'une magnitude faible à élevée (selon les concentrations prévues pour les CAPI), ils devraient être limités à la ZEL en ce qui concerne l'étendue géographique, et survenir sur une courte durée (pendant la phase de construction). Bien que les émissions soient générées continuellement pendant cette période, la fréquence d'un changement de qualité de l'air est considérée comme un événement irrégulier, car les concentrations ambiantes prévues à un endroit donné varient dans le temps en fonction des conditions météorologiques.
- Les effets résiduels sur la qualité de l'air pendant la phase d'exploitation et de maintenance devraient également être défavorables et varier d'une magnitude faible à élevée; ils devraient être limités à la ZEL en termes d'étendue géographique, et survenir en tant qu'événement irrégulier sur le long terme.

VS.5.1.3 Effets cumulatifs

Les effets cumulatifs provenant d'autres sources, y compris les activités associées à des projets passés, présents, passés et raisonnablement prévisibles ou raisonnablement prévisibles induits, ont été pris en compte dans l'évaluation de la qualité de l'air. Les activités physiques passées n'ont pas le potentiel d'interagir cumulativement avec les effets résiduels sur la qualité de l'air pour le projet, car les projets passés n'ont pas d'émissions qui se chevauchent temporellement avec celles du projet. Les effets croisés des activités physiques actuelles et de l'utilisation des ressources, telles que le trafic maritime et les projets d'exploration minérale, ont été saisis dans les concentrations de référence représentatives établies pour le projet. Les projets raisonnablement prévisibles (RP) et raisonnablement prévisibles induits (RPI) qui sont en dehors de la ZER sont éloignés du projet et l'étendue de leurs émissions ne chevauche pas spatialement l'étendue des émissions du projet. Les activités RP et RPI à l'intérieur de la ZER peuvent entraîner une augmentation du trafic automobile et des émissions occasionnelles de faible magnitude qui ne contribuent pas à une augmentation substantielle des émissions du projet. Les activités RP et RPI, si elles se poursuivent, seront soumises à un processus d'examen réglementaire qui étudiera les interactions cumulatives potentielles avec le projet. Au cours de ces processus d'examen, des mesures d'atténuation supplémentaires peuvent être identifiées afin de réduire davantage le risque d'effets indésirables importants. En résumé, les effets environnementaux résiduels cumulatifs sur la qualité de l'air ne devraient pas augmenter considérablement par rapport aux effets environnementaux résiduels sur la qualité de l'air provenant du projet seul.

VS.5.1.4 Importance

L'évaluation par modélisation de la dispersion a démontré que les concentrations maximales prévues pour la plupart des CAPI lors des phases de construction, d'exploitation et de maintenance du projet restent inférieures aux NOLD établis en dehors des limites du SAP. Bien que certains CAPI (PST, P₁₀ et NO₂) puissent parfois dépasser les NOLD à l'extérieur des limites du SAP, ces dépassements sont censés être localisés à proximité des limites du SAP et surviennent rarement. Avec la mise en œuvre des pratiques exemplaires de gestion et des stratégies de gestion adaptées, les effets résiduels du projet et les effets résiduels cumulatifs sur la qualité de l'air pendant les phases de construction, d'exploitation et de maintenance du projet ne devraient pas être significatifs.

VS.5.1.5 Mesures d'atténuation, de gestion et d'amélioration

Le projet mettra en œuvre un plan de gestion de la qualité de l'air qui comprendra des pratiques exemplaires de gestion de la qualité de l'air, notamment :

- des mesures relatives à l'exploitation et à l'entretien des véhicules et des équipements pour réduire les émissions de CAPI des moteurs et des systèmes d'échappement;
- la conception de dynamitage pour réduire les émissions de CAPI;
- la conception du projet et des pratiques opérationnelles visant à réduire les émissions de poussière diffuses;
- le dépoussiérage (par exemple, application d'eau) pour réduire les retombées de poussière sur la végétation, les cours d'eau ou les plans d'eau.

Un programme de surveillance de la qualité de l'air et de gestion adaptée mesurera les concentrations en particules ambiantes (P₁₀, PST). Les exigences de surveillance seront passées en revue et des techniques de gestion adaptée seront utilisées pour réduire les émissions dans une fourchette acceptable, au besoin.

VS.5.2 Climat

Les changements climatiques et ses conséquences sont d'une importance notable pour les Kitikmiuts, d'autres groupes autochtones et d'autres communautés potentiellement concernées, car ils ont une incidence sur l'environnement ainsi que sur l'utilisation traditionnelle des terres, des zones marines et des ressources (par exemple, les déplacements, les migrations animales, la chasse). Ces groupes ont souligné que les conditions météorologiques sont devenues moins prévisibles et que les changements climatiques dans la région de Kitikmeot comprennent l'augmentation des feux de forêt, des conditions de glace imprévisibles, la fonte du pergélisol, une diminution des précipitations et des fluctuations des niveaux d'eau. Les conséquences observées des changements climatiques et météorologiques comprennent l'érosion côtière, la modification de la qualité, de la quantité et de la couverture des neiges, ainsi que des changements au niveau de la faune et de la flore. Parmi les exemples de l'impact des changements climatiques sur les communautés, on peut citer la glace plus mince et sa fonte plus précoce qui ont une incidence sur les déplacements saisonniers et les activités fauniques (par exemple, mouvements migratoires des caribous), la baisse des niveaux d'eau qui a des conséquences sur les

déplacements et la vie aquatique (par exemple, omble chevalier), la baisse de la qualité de la neige pour la construction d'igloos d'urgence, ainsi que le rythme rapide du dégel du pergélisol et ses effets sur l'environnement global et les activités traditionnelles.

Les changements climatiques anthropiques représentent un défi environnemental majeur et ajoute de la complexité et de l'incertitude tant aux projections des conditions futures qu'à la fiabilité de la conception des projets, de leurs infrastructures et des stratégies d'atténuation requises. Le projet est susceptible à la fois d'influencer les changements climatiques par les émissions de gaz à effet de serre (GES) et d'être influencé par les changements climatiques. Le projet est susceptible d'être influencé par des changements à long terme des conditions climatiques (par exemple, modifications de la couverture et de la concentration de la glace de mer, l'activité des vagues océaniques) ainsi que par des événements météorologiques (par exemple, fortes précipitations, fortes chutes de neige, vents violents).

La section 12 présente des discussions sur les changements climatiques observés dans la région de Kitikmeot Ouest, un profil climatique, une évaluation des émissions de GES (de quelle façon le projet pourrait contribuer aux changements climatiques) et une évaluation des risques liés aux changements climatiques (de quelle façon le projet pourrait subir l'incidence des changements climatiques et des événements météorologiques). Ces discussions et évaluations climatiques ont été éclairées par la mobilisation et les connaissances des Inuits, des Autochtones et des communautés en ce qui concerne l'évaluation. Le profil climatique, l'évaluation des émissions de GES et l'évaluation des risques liés aux changements climatiques sont brièvement résumés ci-dessous.

VS.5.2.1 Profil climatique

Le projet est linéaire et s'étend de l'extrémité nord à Grays Bay à l'extrémité sud à la station Jericho, 230 km séparent les deux extrémités. Le climat de la région se caractérise par des extrêmes. Le *Rapport sur le climat changeant du Canada* (Cohen et coll. 2019) indique que, dans le Nord du Canada (défini comme la région géographique située au nord de la latitude 60° nord), la température moyenne annuelle a augmenté de 2,3 degrés Celsius (°C) durant la période 1948-2016, la plus forte augmentation étant observée durant la saison hivernale (4,3 °C). Dans le cadre du Profil représentatif d'évolution de concentration (RCP 8.5) des émissions élevées, la température moyenne annuelle dans le Nord du Canada devrait augmenter d'environ 2,7 °C pour la période 2031-2050 et de 7,8 °C pour la période 2081-2100, par rapport à la période 1986-2005. En raison du réseau d'observation (stations météorologiques) clairsemé dans le Nord du Canada, les changements historiques à long terme des précipitations sont difficiles à quantifier. Cependant, tous les sites disponibles utilisés dans le rapport indiquent une augmentation des précipitations. Selon le RCP8,5, la moyenne annuelle des précipitations pour le Nord du Canada devrait augmenter de 11,3 % (%) pour la période 2031-2050 et de 33,3 % pour la période 2081-2100, par rapport à la période 1986-2005.

VS.5.2.2 Émissions de gaz à effet de serre

Le projet libérera des émissions de GES dans l'atmosphère lors des activités des phases de construction, d'exploitation et de maintenance. Le gouvernement du Canada a établi des lois, des politiques et des documents d'orientation relatifs aux émissions de GES afin d'aider à atténuer les changements climatiques mondiaux.

La combustion des combustibles fossiles (par exemple, diesel, carburéacteur Jet A) dans les équipements lourds (par exemple, chargeurs, camions à benne, aéronefs) est la principale source d'émissions de GES du projet. Certaines émissions de GES se produiront aussi à la suite du dynamitage (combustion d'explosifs). On prévoit que la surveillance de la consommation de carburant, ainsi que l'entretien et l'utilisation d'équipements de construction de taille appropriée atténueront les émissions de GES découlant des activités du projet.

Une estimation prudente (c'est-à-dire potentiellement surévaluées plutôt que sous-évaluées) des émissions de GES provenant des activités de construction indique qu'elles seront les plus élevées au cours de la troisième année de construction où elles atteindront 145 566 t de CO_{2e}. Elles devraient ensuite s'établir à environ 87 326 t de CO_{2e} par an pour les années de construction restantes, en excluant les émissions liées au changement d'utilisation des sols. Les émissions de GES pendant la construction représenteront environ 15 à 20 % des émissions annuelles de GES du Nunavut et environ 0,02 % des émissions annuelles de GES du Canada.

Une estimation prudente des émissions de GES découlant des activités d'exploitation et de maintenance est d'environ 57 789 t de CO_{2e} par année lorsque le diesel est utilisé pour la production d'électricité. Les émissions de GES pendant l'exploitation représenteront environ 8 % des émissions annuelles de GES du Nunavut et environ 0,001 % des émissions annuelles de GES du Canada.

VS.5.2.3 Évaluation des risques liés aux changements climatiques

Une évaluation des risques liés aux changements climatiques a été réalisée pour le projet dans le but de cerner les risques associés aux effets des changements climatiques actuels et à venir sur l'infrastructure et les actifs prévus du projet. Des recommandations de stratégies d'adaptation ont également été élaborées pour atténuer les risques, améliorer la résilience du projet et orienter la conception ainsi que le suivi des plans. Les recommandations concernant le fonctionnement et l'entretien (F et E) visent à atténuer les risques potentiels liés au climat et à orienter l'élaboration des politiques et procédures relatives à l'entretien, à l'exploitation ainsi qu'à la santé et à la sécurité du personnel. Voici des exemples de recommandations de stratégies d'adaptation figurant dans le rapport de l'évaluation des risques liés aux changements :

- Prendre en compte des critères de conception adaptés au climat pour promouvoir la résilience à long terme. Par exemple, intégrer les changements prévus en ce qui concerne les précipitations extrêmes dans la conception des ponts (dimensionnement). Une résilience accrue du système de drainage aidera à réduire les conséquences associées aux précipitations extrêmes sur les remblais et la structure des routes ainsi que sur les pistes et les bandes d'atterrissage. De plus, on examinera les volumes de ruissellement sans végétation pour prendre des décisions au sujet des critères de conception (en permettant la prise en compte de la perte de végétation due au feu de toundra).
- Concevoir et installer des mesures permanentes de contrôle de l'érosion (par exemple, gabion, maille, filet, géotextile tissé) dans des zones susceptibles d'être sujettes à l'érosion, comme les remblais construits avec des matériaux de type Terrain II.
- Là où il y a du pergélisol, assurer la surveillance et concevoir des renforts.

- Établir une politique de F et E pour effectuer des inspections régulières des tuyaux et des canalisations en surface lors d'épisodes de froid extrême et les dégeler manuellement au besoin afin de réduire les risques de canalisations endommagées ou d'arrêt du fonctionnement des installations d'approvisionnement en eau et d'assainissements des eaux usées.
- Envisager l'installation d'une filtration d'air avec une valeur minimale de déclaration de l'efficacité (MERV) élevée dans les bâtiments afin d'améliorer la qualité de l'air intérieure, particulièrement lors de mauvaises conditions de qualité de l'air dues à la fumée des incendies de toundra ou à la production de poussière lors d'événements de vents forts. Effectuer des inspections régulières et nettoyer ou remplacer les filtres.

VS.5.3 Bruit et vibration

Pour les Inuits, la terre, l'eau et la glace sont des lieux de paix, où le calme fait partie de la vie et est essentiel pour la chasse, les déplacements et la connexion à la terre. Le bruit et les vibrations à court ou long terme peuvent perturber la faune, rendre la récolte plus difficile et changer l'expérience d'être sur la terre. La CV du bruit et des vibrations vise à protéger à la fois l'environnement sonore naturel et la capacité des Kitikmiuts, d'autres groupes autochtones et d'autres communautés potentiellement touchées à utiliser la terre comme ils l'ont toujours fait. L'évaluation se concentre sur les zones où les Inuits et d'autres utilisateurs des terres vivent, travaillent et se déplacent, y compris les zones d'utilisation traditionnelle des terres, des zones marines et des ressources (TLMRU), les hébergements permanents et les campements mobiles. Les récepteurs situés le long ou à proximité du SAP, y compris des limites du SAP de la station Jericho et du SAP de la route de Grays Bay ont également été évalués. Les effets du bruit et des vibrations sur la faune, y compris sur les caribous, les oiseaux, les mammifères marins, les poissons et les habitats marins sont abordés dans leurs CV respectives.

VS.5.3.1 Base de référence

Les perspectives des connaissances inuites, autochtones et communautaires, les rétroactions de la mobilisation, la surveillance des bruits de référence et la modélisation des vibrations ont été utilisées pour caractériser les conditions de bruit et de vibration de référence. Les niveaux de bruit et de vibration au sein de la ZEL sont actuellement généralement faibles, la plupart des sons provenant de sources naturelles comme le vent, l'eau et la faune. Les mesures de référence du niveau sonore pour le projet suivent les approches prescrites par la directive 038, Noise Control de l'Alberta Energy Regulator (AER) dans laquelle le niveau sonore moyen jour-nuit (DNL) de référence de 45 dBA a été utilisé comme seuil de référence pour le projet. Certains bruits liés aux activités humaines sont générés dans les camps existants et le long des itinéraires de déplacements saisonniers. L'utilisation des terres par les Inuits dans ces régions est souvent saisonnière, et des activités comme la chasse et la pêche peuvent être sensibles à des niveaux élevés de bruit ou de vibration.

VS.5.3.2 Répercussions du projet

Les activités du projet pendant les phases de construction, d'exploitation et de maintenance généreront du bruit et des vibrations qui pourraient déranger les résidents permanents et saisonniers, ainsi que les utilisateurs des terres. Ces activités comprennent la construction de routes, l'exploitation des carrières, le dynamitage, les activités associées aux aéronefs et à la circulation, ainsi que l'utilisation d'équipement. Des modélisations prédictives ont été réalisées pour prévoir les niveaux de bruit et de vibration au sein des ZEL et ZER afin d'estimer l'exposition des récepteurs, d'évaluer les changements par rapport aux niveaux de référence ainsi que la conformité aux directives réglementaires. Voici un résumé des effets prévus du projet sur le bruit et les vibrations :

Changement des niveaux de bruit :

- Les conséquences de la phase de construction en matière de bruit devraient respecter les seuils réglementaires à tous les récepteurs, avec la mise en place de mesures propres au site ou à la situation requises pour certains récepteurs situés à proximité des limites des SAP de la station Jericho et de la route Grays Bay.
- Les conséquences des phases d'exploitation et de maintenance en matière de bruit devraient respecter les seuils réglementaires à tous les récepteurs, avec la mise en œuvre de mesures propres au site ou à la situation requises aux limites de la route et de la carrière permanente où des conséquences à court terme sont prévues en matière de bruit.
- Les activités d'exploitation et de maintenance au port de Grays Bay et à la station Jericho devraient entraîner des effets sonores à long terme, bien que ces effets soient gérés par l'utilisation de pratiques normalisées de conception et d'exploitation.
- On prévoit que les effets résiduels sur les niveaux de bruit seront d'ampleur modérée au sein de la ZER. Ils devraient se produire continuellement sur une courte durée pendant la phase de construction et à moyen terme pendant la phase d'exploitation et de maintenance. Ces effets seront réversibles lorsque les activités du projet cesseront.

Modification des niveaux de vibration :

- Les effets de vibration, y compris les effets liés aux explosions pendant les phases de construction, d'exploitation et de maintenance, devraient respecter les seuils réglementaires avec la mise en œuvre de mesures propres au site ou à la situation requises dans les hébergements permanents, les campements mobiles et dans les limites du SAP du port de Grays Bay.
- Les effets résiduels sur les niveaux de vibration seront intermittents, de courte durée pendant la phase de construction et de durée moyenne pendant les phases d'exploitation et de maintenance, et ne surviendront que lors d'activités spécifiques de construction, d'exploitation ou de maintenance (par exemple, dynamitage, pieux). Ces effets seront réversibles lorsque les activités du projet cesseront.

Le bruit et les vibrations du projet ne devraient pas être perçus en dehors de la ZER et ne devraient pas entraîner d'effets transfrontaliers dans les régions ou communautés voisines.

VS.5.3.3 Effets cumulatifs

Les émissions de bruit fixe et mobile provenant d'autres activités du projet actuelles et raisonnablement prévisibles induites peuvent interagir avec les effets sonores résiduels du projet si ces activités se chevauchent avec le projet sur le plan temporel et spatial. Ces autres projets et activités physiques incluent : l'exploration minérale actuelle; les mines raisonnablement prévisibles induites, le trafic maritime et le transport terrestre; et la récolte actuelle et raisonnablement prévisible des ressources renouvelables, le tourisme terrestre et la recherche scientifique.

Les bruits liés au projet devraient s'atténuer à des niveaux bien en dessous du niveau de fond dans un rayon de 3 km autour de leur source et les effets cumulatifs des bruits ne devraient pas dépasser les seuils de bruit applicables aux récepteurs. Étant donné la nature très localisée et intermittente des vibrations liées au projet, le chevauchement avec d'autres sources de vibration est jugé improbable et n'a donc pas été pris en compte dans l'évaluation des effets cumulatifs.

On prévoit que les effets cumulatifs des bruits seront d'ampleur modérée et se limiteront à la ZER. Le calendrier serait continu pendant les périodes d'activité, mais la durée resterait à moyen terme.

VS.5.3.4 Importance

Après leur atténuation, les effets résiduels des bruits et des vibrations du projet ne devraient pas être importants. Les seuils de bruit et de vibration applicables établis par les directives réglementaires ne seront pas dépassés. L'ampleur des effets demeurera modérée et de courte à moyenne durée. Les effets ne causeront pas de dommages durables aux utilisateurs des terres, à la faune ou au bien-être des communautés.

On prévoit que les effets cumulatifs des bruits ne soient pas importants. Aucun effet cumulatif des vibrations n'est prévu.

VS.5.3.5 Mesures d'atténuation, de gestion et d'amélioration

Le projet utilisera des contrôles d'ingénierie, de bonnes pratiques d'exploitation et des mesures propres au site pour maintenir un niveau bas de bruits et de vibrations. Ces mesures seront orientées par une mobilisation continue auprès des communautés inuites. Les principales mesures comprennent :

- la conception du dynamitage pour réduire les vibrations et les bruits au niveau du sol;
- la réduction des bruits et des vibrations de l'équipement au ralenti et l'utilisation des barrières naturelles ou construites lorsque c'est possible;
- l'orientation des camps pour qu'ils ne fassent pas face aux sources de bruit;
- dans des zones précises où des dépassements peuvent survenir, la planification des activités de projet en dehors des périodes sensibles de récolte ou de migration, par l'intermédiaire d'activités de mobilisation auprès des utilisateurs des terres Kitikmiut;
- l'utilisation de la gestion adaptée pour rajuster les mesures d'atténuation si la surveillance révèle des effets inattendus.

VS.5.4 Énoncé des répercussions sur le milieu atmosphérique

Une évaluation de l'influence potentielle du projet de la route et du port de Grays Bay R sur la qualité de l'air ou les bruits et les vibrations prévoit que les effets résiduels et cumulatifs ne seront pas importants.

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Abbreviations

2030s.....	2021-2050
2050s.....	2041-2070
2080s.....	2071-2100
AAQO	ambient air quality objectives
ACPI	air contaminants of potential interest
AER Directive 038.....	the AER Directive 038: Noise Control
AER	Alberta Energy Regulator
ANFO	ammonium nitrate fuel oil
AQMP	air quality management plan
ASL.....	Ambient Sound Level
Baseline (climate).....	1991-2020
BC	British Columbia
BMP	best management practice
BMPP	Best Management Practices Plan
BSL.....	Basic Sound Level
CAAQS.....	CCME Canadian Ambient Air Quality Standards
CCME.....	Canadian Council of Ministers of the Environment
CCRA	climate change risk assessment
CH ₄	methane
CO	carbon monoxide
CO ₂	carbon dioxide
CO _{2e}	carbon dioxide equivalent
ECCC	Environment and Climate Change Canada
ENVP.....	British Columbia Ministry of Environment and Parks

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EPA	Environmental Protection Act (1988)
FTA.....	Federal Transit Administration
GHG	greenhouse gas
GN-DOE	Government of Nunavut, Department of Environment
GWP.....	global warming potential
IAG	Inuit Advisory Group
IAG	Inuit Advisory group
ID.....	identification
IS	Impact Statement
ISO	International Organization for Standardization
LAA.....	Local Assessment Area
LFN.....	low frequency noise
MECP.....	Ontario Ministry of the Environment Conservation and Parks
MNL.....	mitigation noise level
MOVES3	Motor Vehicle Emission Simulator Model version 3
N ₂ O.....	nitrous oxide
NIRB.....	Nunavut Impact Review Board
NO	nitrogen oxide
NO ₂	nitrogen dioxide
noise.....	study of sound
NOx	oxides of nitrogen
NPRI.....	National Pollutant Release Inventory
NTKP	Naonaiyaotit Traditional Knowledge Project
O ₂	oxygen
OBPS	Output-based Pricing System
PAI.....	Potential Acid Input

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PCO.....	Pollution Control Objective
PDA	Project Development Area
PM	particulate matter
PM ₁₀	inhalable particulate matter with an aerodynamic diameter less than 10 micrometres
PM _{2.5}	respirable particulate matter with an aerodynamic diameter less than 2.5 micrometres
Project, the	Grays Bay Road and Port Project
PSL.....	permissible sound level
PWL.....	sound power level
RAA	Regional Assessment Area
RFI.....	reasonably foreseeable induced
SACC	Strategic Assessment of Climate Change
SO ₂	sulfur dioxide
SOG	standards, objectives and guidelines
SPL.....	sound pressure level
SSP	Shared Socioeconomic Pathway
SSP2-4.5.....	intermediate emissions Shared Socioeconomic Pathway
SSP5-8.5.....	high emissions Shared Socioeconomic Pathway
TCWR.....	Tibbitt to Contwoyto Winter Road
TLMRU	Traditional Land, Marine, and Resource Use
TMR.....	Technical Modelling Report
TSP	total suspended particulates
U.S. EPA	United States Environmental Protection Agency
US	United States
VC	Valued Component
VOC.....	Valued Component
WKR.....	West Kitikmeot Resources Corp.

Symbols and Units of Measure

%HA	percent highly annoyed
°C	degrees Celsius
µg/m ³	microgram per cubic metre
µm	micrometre
dB	decibel
dBA	A-weighted decibel
dBc	C-weighted decibel
g/L	grams per litre
Hz	hertz
keq H ⁺ ha ⁻¹ y ⁻¹	kiloequivalents of hydrogen ion per hectare per year
km	kilometre
km/h	kilometres per hour
kt	kilotonnes
kW	kilowatt
kWh	kilowatt hour
L _d	daytime equivalent sound level
L _{dn}	day-night equivalent sound level
L _{eq}	energy equivalent sound level
L _{max}	maximum A-weighted sound level
L _n	nighttime equivalent sound level
m	metre
mg/dm ² /day	milligrams per square decimetre per day
mm	millimetre
mm/s	millimetres per second
ms	milliseconds

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MW megawatt
ppb parts per billion
t tonnes
t/y..... tonnes per year
VdB..... vibration decibel
Year Project Year (i.e., project phase year, not calendar year)

Glossary

Term	Definition
acoustic attenuation	A measure of the energy loss of sound propagation in media.
acoustic environment	Audible sound quality of a place including anthropogenic and natural sounds.
ambient noise	All noises that exist in an area and are not related to a facility. Includes sound from other industrial noise not being measured, transportation sources, animals, and nature. Ambient noise is the same as background sound level.
ambient sound level (ASL)	All noise or sound in an area that is not related to regulated facilities. This includes sound from other nonregulated industrial facilities, transportation sources, animals, and nature. The ASL does not include any energy-related industrial component and must be measured without it. The ASL can be measured when the sound level in an area is not felt to be represented by the BSLs. The ASL must be measured under representative conditions. As with comprehensive sound levels, representative conditions do not constitute absolute worst-case conditions (i.e., the quietest day in this case) but conditions that portray typical conditions for the area.
bands (octave, 1/3 octave)	A series of electronic filters separate sound into discrete frequency bands, making it possible to know how sound energy is distributed as a function of frequency. Each octave band has a centre frequency that is double the centre frequency of the octave band preceding it.
basic sound level (BSL)	The A-weighted Leq sound level commonly observed to occur in the designated land use categories with industrial presence. The BSL is assumed to be 5 dBA above the ASL and is set out in Table 1 of AER noise guideline.
category	A classification of a dwelling unit in relation to transportation routes used to arrive at a BSL.
Construction and Operation and Maintenance phases	Project phases involving the development and long-term use of infrastructure, including roads, port facilities, airstrip, crossings, accommodations, and support systems, with ongoing maintenance and seasonal access. Temporary components will be reclaimed as per permit requirements.
daytime	The hours from 07:00 AM to 10:00 PM.

Term	Definition
dB - Decibel	A logarithmic unit associated with sound pressure levels and sound power levels.
dBA - decibel, A-weighted	A logarithmic unit where the recorded sound has been filtered using the A frequency weighting scale. A-weighting somewhat mimics the response of the human ear to sounds at different frequencies. A-weighted sound pressure levels are denoted by the suffix 'A' (i.e., dBA), and the term pressure is normally omitted from the description (i.e., sound level or noise level).
dB(C) - decibel, C-weighted	The logarithmic units associated with a sound pressure level, where the sound pressure signals have been filtered using the C frequency weighting. The C-weighting approximates the sensitivity of human hearing at industrial noise levels (above about 85 dBA). C-weighted sound pressure levels are denoted by the suffix 'C' (i.e., dB(C)). C-weighted levels are often used in low frequency noise analysis, as the filtering effect is nearly flat at lower frequencies.
decibel addition	In acoustics, due to the logarithmic nature of the decibel scale, the addition of two or more sound pressure levels (denoted as SPL_1, SPL_2 ... SPL_n) is done as follows: $SPL_1 + SPL_2 + \dots + SPL_n = 10 \log (10 (SPL_1/10) + 10(SPL_2/10) + \dots + 10(SPL_n/10))$ As an example: $50 \text{ dB} + 50 \text{ dB} = 53 \text{ dB}$

Term	Definition
dwelling unit	Any permanently or seasonally occupied structure used for habitation for the purpose of human rest; including a nursing home or hospital, except for an employee or worker residence, dormitory, or construction camp located within an energy-related industrial plant (PDA) boundary. Trailer parks and campgrounds may qualify as a dwelling if it can be demonstrated that they are in regular and consistent use. A permanent dwelling is a fixed residence occupied on a full-time basis. In the case of a condominium or apartment complex, each unit is considered a dwelling. A seasonally occupied dwelling is a fixed residence that, while not being occupied on a full-time basis, is occupied on a regular basis. A regular basis does not imply a scheduled occupancy but implies use of six weeks per year or more. The dwelling must not be mobile and should have some sort of foundation or features of permanence (e.g., electrical power, domestic water supply, septic system) associated with it. Summer cottages or manufactured homes are examples of seasonally occupied dwellings, while a holiday trailer simply pulled onto a site is not.
dwelling unit (most affected)	The most affected dwelling(s) is those subject to the highest average weighted sound level relative to the permissible sound level. The nearest dwelling unit may not necessarily be the one most adversely affected because of factors such as topography or man-made features. For example, the nearest dwelling unit to a facility may be located behind an intervening ridge, while a more distant dwelling unit may be in direct line of sight with the facility. Care must be taken in determining the most affected dwelling unit.
emission	Propagation of sound and vibration
energy equivalent sound level (L_{eq})	An energy average sound level taken over a specified period of time. It represents the average sound pressure encountered for the period. The time period is often added as a suffix to the label (e.g., $L_{eq, 24hr}$ for the 24-hour equivalent sound level). L_{eq} is usually A-weighted. A L_{eq} value expressed in dBA is a good, single-value descriptor of the annoyance of noise.
frequency	Number of cycles per unit of time. In acoustics, frequency is expressed in hertz (Hz) (i.e., cycles per second).

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Term	Definition
heavily travelled road	Generally, includes highways and any other road where the average traffic count is at least 10 vehicles per hour over the nighttime period. It is acknowledged that highways are sometimes lightly travelled during the nighttime period, which is usually the period of greatest concern.
hertz (Hz)	Unit of measurement of frequency, numerically equal to cycles per second.
low frequency noise (LFN)	Noise in the low frequency range (AER noise guideline definition), 20 Hz up to 250 Hz, where a clear tone is present below and including 250 Hz and the difference between the overall C-weighted sound level and the overall A weighted sound level exceeds 20 dB.
nighttime	The hours from 10:00 PM to 07:00 AM.
noise	Unwanted sound.
noise level	Same as Sound Level, except applied to unwanted sounds.
permanently occupied dwelling	A fixed dwelling occupied on a full-time basis.
permissible sound level (PSL)	The maximum sound level that a facility should not exceed at a point 15 metres from the nearest or most affected dwelling unit. The PSL is the sum of the BSL, daytime adjustment, Class A adjustment, and Class B adjustment.
permanently	Project components, such as the road and port, intended to operate indefinitely with ongoing maintenance. A 75 year design life for the permanent infrastructure refers to component longevity, not the lifespan of the infrastructure as a whole.
seasonally occupied dwelling	A fixed dwelling that, while not being occupied on a full-time basis, is occupied on a regular basis. A regular basis does not imply a scheduled occupancy but implies use of six weeks per year or more. The dwelling must not be mobile and should have some sort of foundation or features of permanence (e.g., electrical power, domestic water supply, septic system) associated with it. Summer cottages or mobile homes are examples of seasonally occupied dwellings, while a holiday trailer simply pulled onto a site is not.
sound	A dynamic (fluctuating) pressure.

Term	Definition
sound pressure level (SPL)	The logarithmic ratio of the root-mean-square sound pressure to the sound pressure at the threshold of hearing. The sound pressure level is defined by the equation below, where P_{RMS} is the RMS pressure due to a sound and P_0 is the reference pressure. P_0 is usually taken as 2.0×10^{-5} Pascals. $SPL (dB) = 20 \log(P_{RMS}/P_0)$
sound power level (PWL)	The logarithmic ratio of the instantaneous sound power of a noise source to that of the reference power. The sound power level is defined by the equation below, where W is the sound power of the source in watts, and W_0 is the reference power of 10-12 watts. $PWL (dB) = 10 \log(W/W_0)$
spectrum	The description of a sound wave's resolution into its components of frequency and amplitude.
tonal components	Industrial facilities often exhibit tonal components. Examples of tonal components are transformer hum, sirens, and piping noise. The test for the presence of tonal components consists of two parts (as per tonality prescribed in AER noise guideline). The first part must demonstrate that the sound pressure level of any one of the slow response, A-weighted, 1/3 octave bands between 20 kHz and 16 kHz is 10 dBA or more than the sound pressure level of at least one of the adjacent bands within two 1/3 octave bandwidths. In addition, there must be a minimum of a 5 dBA drop from the band containing the tone within two bandwidths on the opposite side. The second part is that the tonal component must be a pronounced peak clearly obvious within the spectrum.

11 Assessment of Potential Effects on Air Quality

The assessment of potential effects on air quality is valuable for its importance to the health and well-being of people, wildlife, vegetation, and other ecosystems biota. As described in the project-specific Inuit Knowledge report, Inuit of the Kitikmeot Region (hereafter referred to as Kitikmiut) are experiencing concerning changes in water quality, snow conditions, and in the environment as a result of dust and airborne pollutants (Banci and Spicker 2024). Therefore, Air Quality has been selected as a Valued Component (VC) to be assessed for the Grays Bay Road and Port Project (the Project) being proposed by West Kitikmeot Resources Corp. (WKR). This section describes and assesses the potential effects on Air Quality from the Project (during all project phases).

The assessment of potential effects on air quality considers Air Contaminants of Potential Interest (ACPI). The ACPI assessment considers risks from air contaminant emissions to human health and the environment. The assessed ACPI are air pollutants that cause smog, acid rain and other environmental and health hazards, and can affect visibility by contributing to ice fog. They are typically products of fossil fuel combustion, and are emitted from many sources in industry, mining, transportation, electricity generation and agriculture. Project activities such as construction equipment operation, camp operations, airplane operations, marine vessel operations, and quarry development and operations (including blasting and crushing, and road traffic) are expected to generate ACPI.

Through the project-specific engagement program, Kitikmiut vocalized their view that changes in air quality—such as dust or smoke—can disrupt wildlife, make harvesting more difficult, and alter the experience of being on the land (Banci and Spicker 2024; GBRP 2025; IAG 2025a, 2025b). This assessment honours traditional values and focuses on protecting both the integrity of the air and the ability of Kitikmiut, other Indigenous groups, and other potentially affected communities to live, move, and thrive in harmony with their surroundings.

This assessment is linked to other VC assessments, either through integration (information from other VCs is incorporated into this assessment) or support (information from this assessment is incorporated into the assessment of other VCs). Components of this assessment may be used to inform the following VCs:

- Vegetation (Volume 6, Section 15)
- Caribou (Volume 6, Sections 16)
- Freshwater Fish & Fish Habitat (Volume 7, Section 20)
- Traditional Land, Marine, and Resource Use (Volume 9, Section 24)
- Community Health and Well-being (Volume 9, Section 26)

11.1 Scope of Assessment

An air quality assessment was conducted to determine potential residual and cumulative changes to ambient air quality. The air quality assessment estimates air emissions from the planned project activities and uses an atmospheric dispersion model to predict the potential changes in ambient air quality associated with project emissions. The air quality assessment considers substances for which there are applicable air quality objectives and standards adopted by the Government of Nunavut, Department of Environment's (GN-DOE) Environmental Protection Division, the British Columbia (BC) Ministry of Environment and Parks (ENVP), and Environment and Climate Change Canada (ECCC). The predicted effects are assessed relative to these criteria.

The air quality assessment considers the following ACPIs:

- Total suspended particulate (TSP) matter with an aerodynamic diameter less than 30 micrometres (μm)
- Inhalable particulate matter with an aerodynamic diameter less than 10 μm (PM_{10})
- Respirable particulate matter with an aerodynamic diameter less than 2.5 μm ($\text{PM}_{2.5}$)
- Sulphur dioxide (SO_2)
- Nitrogen dioxide (NO_2)
- Carbon monoxide (CO)

Total particulate deposition (dustfall) is another ACPI and refers to the settling of airborne particulate matter, specifically the portion that falls out of the atmosphere due to gravity. It is expressed in terms of milligram per square decimetre per day ($\text{mg}/\text{dm}^2/\text{day}$).

Potential Acid Input (PAI) is another ACPI and is defined as the difference between deposited acidic anions and basic cations. It is expressed in terms of kiloequivalents of hydrogen ion per hectare per year ($\text{keq H}^+ \text{ha}^{-1} \text{y}^{-1}$).

11.1.1 Influence of Engagement and Inuit, Indigenous, and Community Knowledge on the Assessment

WKR continues to engage with Kitikmiut, other Indigenous groups, and other potentially affected communities about the Project. A summary of engagement activities conducted from 2016 into 2025 is presented in Volume 3, Section 6 (Public Engagement). In addition to these activities, WKR conducted community-based primary research with residents and organizations of the Kitikmeot communities of Cambridge Bay, Gjoa Haven, Kugaaruk, Kugluktuk, and Taloyoak, along with organizations in Yellowknife. Additionally, an Inuit Advisory Group (IAG) was established to advise WKR on potential environmental and socio-economic effects or concerns related to the Project, planned mitigation approaches, and aspects of the environmental assessment, including, but not limited to, baseline understanding, significance determination, and consideration and integration of Inuit and Community Knowledge. Members were selected by the Kitikmeot Inuit Association and WKR based on their knowledge of many aspects of the natural and human environment, including but not limited to wildlife, fish, climate, land use and access, archaeology, and/or water.

To further inform the project design, a project-specific Inuit Knowledge report titled *Kitikmiut Knowledge of the Proposed Kogloktoktyok (Grays Bay) Port and Road Project Final Report* (Banci and Spicker 2024) was commissioned by WKR. This report, compiled from Inuit Knowledge contained in the Naonaiyaotit Traditional Knowledge Project (NTKP), was made available to WKR through a licensing agreement with the Kitikmeot Inuit Association.

In addition, publicly available sources of Inuit and Indigenous Knowledge were reviewed to provide further context about baseline conditions and how conditions are changing, as well as potential mitigation measures recommended on previous projects that could be considered for the Project. Results from monitoring studies and other community-based research were also reviewed.

Through the project-specific engagement program, Kitikmiut, other Indigenous groups, and other potentially affected communities, shared comments, perspectives, concerns, and recommendations related to air quality. Through reviewing the information, Inuit, Indigenous, and Community Knowledge has influenced key components of the air quality assessment. WKR commits to continued engagement with Kitikmiut, other Indigenous groups, and other potentially affected communities during the advancement of project design, planning, and monitoring and throughout the life of the Project.

11.1.1.1 *Influence of Inuit, Indigenous, and Community Knowledge on Assessment Boundaries*

Inuit, Indigenous, and Community Knowledge was reviewed with consideration to the proposed spatial boundaries. For example, the Local Assessment Area (LAA) considers the area where project-specific environmental effects on air quality can be qualitatively estimated including effects identified by Kitikmiut, other Indigenous groups, and other potentially affected communities, such as dust (see Section 11.1.4.1).

11.1.1.2 *Influence of Inuit, Indigenous, and Community Knowledge on Baseline Conditions*

WKR collected baseline condition information by combining Inuit-led and collaborative knowledge gathering (including the project-specific NTKP and IAG workshops), publicly available information from Indigenous groups considered in the context of the Project, and engagement feedback shared by Kitikmiut, other Indigenous groups, and other potentially affected communities with technical studies collected through western scientific methods. Pertinent baseline information from Inuit, Indigenous, and Community Knowledge sources is not presented in Appendix 11A; rather, this information has been considered and summarized in Section 11.2.2.1 Table 11.4. This includes information about air quality concerns affecting environmental factors (see Section 11.2).

11.1.1.3 *Influence of Inuit, Indigenous, and Community Knowledge on the Assessment of Project Effects*

WKR discussed with Kitikmiut, other Indigenous groups, and other potentially affected communities how project activities (e.g., clearing, blasting, etc.) and project infrastructure could affect socio-economic conditions or culturally important interests including air quality within the air quality LAA. Through community meetings, IAG workshops, and public engagement opportunities, Kitikmiut, other Indigenous groups, and other potentially affected communities including transboundary communities provided

perspectives and values, which were considered and integrated into the potential effects to be considered. This includes perspectives about air quality and the effects Kitikmiut, other Indigenous groups, and other potentially affected communities are observing in the environment as a result of air quality changes.

Expression of concerns surrounding vegetation health, wildlife exposure, and snow and water quality due to the generation of dust from project activities validated the need to assess dust deposition. Information shared regarding the potential for effects of dust on other resources as well as the results of dust deposition modelling were provided to authors of relevant VCs (e.g., vegetation, wildlife and wildlife habitat [e.g., caribou], and water resources) for consideration and integration of effects. Input regarding specific project operations that may impact the generation of dust (e.g., vehicle movements) confirmed the need to consider these sources in dust mitigation planning. Feedback has been integrated in the assessment of project effects on air, where applicable (see Section 11.3).

11.1.1.4 *Influence of Inuit, Indigenous, and Community Knowledge on the Assessment of Cumulative Effects*

Through workshops and regional discussions, Kitikmiut Knowledge Holders, other Indigenous groups, and other potentially affected communities assisted WKR in identifying culturally important areas, species, and practices that may experience combined effects from the Project and other projects and activities in the Project's Regional Assessment Areas (RAA).

WKR wove Inuit, Indigenous, and Community perspectives with western science to develop a holistic view of how multiple changes could affect land-based livelihoods, cultural continuity, and environmental integrity over time. The analysis recognizes that snow quality can be impacted by dust deposition, which can interact cumulatively (through increased traffic levels) to possibly further degrade snow quality adjacent to the Project (see Section 11.4).

11.1.1.5 *Influence of Inuit, Indigenous, and Community Knowledge on Assessing Significance of Effects*

Significance criteria were informed with input from Inuit, Indigenous, and Community Knowledge. The concept of significance in the assessment was guided by Inuit, Indigenous, and Community values and detailed ecological observations about resource health, along with understanding of socio-economic conditions and Traditional Land, Marine, and Resource Use. Taking into consideration Inuit, Indigenous, and Community values and perspectives (see Volume 3) supported WKR's consideration of whether project-related environmental effects degrade the quality of the ambient air to a degree described in Table 11.4. In addition, members of the IAG provided additional criteria to consider when identifying whether a project is likely to have significant, or unacceptable, effects (see Sections 11.1.6 and 11.5).

To be considered "non-significant" or acceptable, IAG members advised WKR to implement comprehensive measures and commitments that align with Inuit, Indigenous, and Community priorities and values.

- **Proactive Protection Measures:** WKR's commitment to avoiding or strictly mitigating known high-risk activities is crucial. This includes controlling fugitive dust through regular road watering and limiting the speed of the mobile equipment on unpaved roads.
- **Incorporation of Inuit, Indigenous, and Community Knowledge into Management:** The commitment to incorporate Inuit, Indigenous, and Community Knowledge and Western Science in all assessment sections, as appropriate, from baseline to monitoring, fostered dialogue and an inclusive project. The request for Inuit monitors to enforce mitigation measures in real-time shows that inclusion requires active Inuit participation in the Project's management (IAG 2025a, 2025b).
- **Adaptive Management:** The use of adaptive management plans that can be revised based on ongoing monitoring and the ongoing sharing of Inuit, Indigenous, and Community Knowledge is seen as essential for success and acceptability, given the unpredictable nature of climate (IAG 2025a, 2025b).
- **Holistic Approach to Benefits:** The Project's success is tied to its broader social and economic benefits, such as contributing to more resilient supply chains and providing job/training opportunities for Inuit and other Indigenous groups. The protection of all wildlife and water resources, beyond just caribou, was also a key part of the holistic equation for acceptability (IAG 2025b).

11.1.1.6 *Influence of Inuit, Indigenous, and Community Knowledge on the Development of Mitigation, Management, and Enhancement Measures*

Through engagement activities, community-based primary research, IAG workshops, and review of publicly available literature, measures to reduce negative effects from the Project and enhance benefits from the Project were shared. Feedback also helped focus the Project's design on sensitive timing and locations for monitoring and mitigation.

Proposed mitigation, management, and enhancement measures were discussed and reviewed with Inuit community representatives during IAG workshops and community meetings with the intent of developing and implementing measures that consider both the biophysical and human environment. Adjustments were made as appropriate based on advice from IAG members and the Kitikmeot Inuit Association, in addition to Indigenous groups and other potentially affected communities through engagement. For example, during IAG workshops, participants stated that WKR should implement mitigation measures that have proven successful on other projects in Nunavut rather than inventing new measures (IAG 2025b). Inuit, Indigenous, and Community Knowledge also emphasized the importance of some of the mitigation measures listed in Section 11.3.2.3. The Project will apply mitigation measures combined with adaptive management (see Section 11.5.3). Many of these mitigation measures revolve around the control of dust to limit and minimize the impact of dust deposition on the surrounding lands, which is a key concern of local Inuit communities (see Table 11.5).

Inuit, Indigenous, and Community Knowledge informed the development of practical, culturally responsive mitigation and monitoring measures. IAG members emphasized the importance of protecting air quality and limiting dust (IAG 2025a, b) and the following monitoring measures are planned:

- Meteorological monitoring (wind speed and direction, air temperature and relative humidity and rain precipitation) and ambient particulate monitoring for TSP and PM₁₀ will be conducted to reduce effects on air quality.
- Adaptive management techniques will be used to reduce emissions to within the acceptable limits, where required. Monitoring requirements will be reviewed on a case-by-case basis should any complaints related to air quality occur from Kitikmiut, other Indigenous groups, or other potentially affected communities because of the project activities.

11.1.1.7 *Influence of Inuit, Indigenous, and Community Knowledge on Transboundary Effects*

WKR engaged with and received feedback from Indigenous groups and other potentially affected communities, governments, and organizations in regions outside of the Kitikmeot Region to understand if project activities could affect socio-economic conditions, resources, wildlife, or culturally important areas shared between regions. This feedback has been integrated into the transboundary effects assessment (Volume 10, Section 33) and is not discussed further in this section.

11.1.2 Regulatory and Policy Setting

This assessment is guided by the *Guidelines for the Preparation of an Impact Statement for West Kitikmeot Resources Corp's Grays Bay Road and Port Proposal* (NIRB File No. 24XN038; NIRB 2026), along with applicable legislation and other relevant policies, guidelines, and frameworks summarized in Table 11.1. Together, these documents outline the statutory, regulatory requirements, and guidance relevant to the assessment and management of air quality.

The GN-DOE is responsible for enforcing the *Environmental Protection Act* (1988), which was established to promote pollution prevention and safeguard both the environment and human health, thereby supporting sustainable development. Ambient air quality standards, objectives and guidelines (SOGs) have been developed by the Canadian federal government and individual provinces and territories to assist or mandate the management of common air contaminants. The air quality assessment incorporates the Nunavut Ambient Air Quality Standards outlined in the Nunavut Environmental Guideline for Ambient Air Quality (GN 2023a; GN 2011). The GN-DOE issued an updated Guideline in 2023 that supersedes the 2011 version and contains updated objectives for NO₂ and removed the standards for TSP. This report utilizes the updated NO₂ objectives but continues to compare TSP to the standards in the 2011 Guideline for consistency.

Table 11.1 Summary of Key Legislation, Policy, and Regulatory Guidance Documents for Air Quality

Regulation or Policy	Description
Federal	
<i>Canadian Environmental Protection Act, S.C. 1999, c. 33</i>	c. 33 allows for the establishment of non-statutory air quality criteria (standards) in the country.
Canadian Ambient Air Quality Standards Handbook (CCME 2025)	The purpose of this document is to compile information about Canadian Ambient Air Quality Standards (CAAQS) and answer the most common questions related to their history, purpose, development and implementation.
Guidance Document on Achievement Determination for Canadian Ambient Air Quality Standards for Nitrogen Dioxide (CCME 2020a)	Provides information on the CAAQS and management levels for NO ₂ and information on the procedures, methodologies and criteria for determining whether the CAAQS for NO ₂ are achieved or exceeded at monitoring stations and within air zones.
Guidance Document on Achievement Determination for Canadian Ambient Air Quality Standards for Sulphur Dioxide (CCME 2020b)	Provides information on the CAAQS and management levels for SO ₂ and information on the procedures, methodologies and criteria for determining whether the CAAQS for SO ₂ are achieved or exceeded at monitoring stations and within air zones.
Guidance Document on Achievement Determination for Canadian Ambient Air Quality Standards for Fine Particulate Matter and Ozone (CCME 2012)	Intended as a reference tool for jurisdictions and the public, providing information, methodologies, criteria and procedures for reporting on achievement of the CAAQS for PM and ozone.
Territorial	
<i>Environmental Protection Act (1988)</i>	This Act provides for the protection of the environment in Nunavut.
<i>Nunavut Planning and Project Assessment Act</i>	Part 3 sets out the requirements for screening and review of projects in Nunavut.
Environmental Guideline Ambient Air Quality (GN 2023a)	This Guideline has been prepared by the Environmental Protection Division of GN-DOE to increase awareness and understanding of the risks, hazards, and best management practices associated with common airborne contaminants.
Provincial – British Columbia	
Dustfall Monitoring and Pollution Control Objectives (ENVP 2020)	Pollution control objectives are used to evaluate potential impacts to soil, water and vegetation in BC.

The GN-DOE has adopted the Canadian Council of Ministers of the Environment (CCME) Canadian Ambient Air Quality Standards (CAAQS; CCME 2025) for NO₂, SO₂ and PM_{2.5} for use in Nunavut. The CAAQS have been developed as non-regulatory health and environmentally based ambient air objectives to assess general air quality in air zones and reflect desirable concentrations of contaminants in air from all sources (MECP 2024). The CAAQS were not intended to assess compliance at a facility's property line or at specific locations but rather to assess and improve regional air quality. Therefore, the CAAQS were used as conservative benchmarks for evaluating the project's air quality effects.

Nunavut does not have Guidelines or Standards for some of the ACPIs. In these cases, SOGs from other Canadian jurisdictions such as BC (ENVP 2021), referred to as Ambient Air Quality Objectives (AAQO), have been used for these ACPI. The BC Pollution Control Objective (PCO) for dust deposition (dustfall), were used to evaluate potential dustfall effects on soil, water and vegetation (ENVP 2020). The BC PCO

for dustfall have been revoked for compliance purposes with the rationale that dustfall monitoring cannot be used for adaptive management of dust emissions because the 30-day averaging period is too long for taking adaptive actions, and if the objective of the monitoring is to protect human health, ambient air monitoring of PM_{2.5} and PM₁₀ is more appropriate (ENVP 2020). However, the PCO values for dustfall were nonetheless used as reference values in the assessment to provide context for the magnitude and spatial extent of dustfall due to the project activities.

The ambient air quality SOGs that are used in the air quality assessment are summarized in Table 11.2.

Table 11.2 Ambient Air Quality Standards, Objectives and Guidelines

ACPI	Averaging Period	Nunavut ^a (µg/m ³)	CAAQS ^b (µg/m ³)	BC AAQO (µg/m ³)
TSP	24-hour	120	-	-
	Annual ^c	60	-	-
PM ₁₀	24-hour	-	-	50
PM _{2.5}	24-hour ^d	27	27	-
	Annual ^e	8.8	8.8	-
NO ₂	1-hour ^f	79	79	-
	Annual ^g	23	23	-
SO ₂	1-hour ^h	170	170	-
	Annual ⁱ	10	10	-
CO	1-hour ^j	-	-	14,300
	8-hour	-	-	5,500
Dustfall ^k	30-day (residential/parkland)	-	-	1.75 mg/dm ² /day
	30-day (industrial/other)	-	-	2.90 mg/dm ² /day

Notes:

^a Government of Nunavut 2023 (GN 2023a; 2011 version for TSP)

^b CAAQS (CCME 2025)

^c Expressed as the geometric mean

^d The 24-hour PM_{2.5} is based on the annual 98th percentile (8th highest) of daily average concentrations, averaged over three consecutive years

^e The annual PM_{2.5} is based on the three-year average of the annual average of the daily 24-hour average concentrations

^f The 1-hour NO₂ is based on the annual 98th percentile (8th highest) of daily maximum 1-hour average concentrations, averaged over three consecutive years.

^g The annual NO₂ is based on the average of all 1-hour average concentrations over one year

^h The 1-hour SO₂ is based on the annual 99th percentile (4th highest) of daily maximum 1-hour average concentrations, averaged over three consecutive years.

ⁱ The annual SO₂ is based on the average of all 1-hour concentrations over one year.

^j The 1-hour CO based on 9th highest of all 1-hour concentrations.

^k Dustfall PCOs for the mining, smelting and related industries, corresponding to residential/parkland and industrial/other areas (ENVP 2020). The dustfall PCOs have been rescinded and are for reference only.

µg/m³ - micrograms per cubic metre

mg/dm²/day – milligrams per square decimetre per day

11.1.3 Potential Effects, Pathways, and Measurable Parameters

Changes in ambient air quality can be expressed collectively or individually by a change in the ambient concentrations of ACPI, including TSP, PM₁₀, PM_{2.5}, SO₂, NO₂, and CO. Activities during both the Construction and Operations and Maintenance phases have the potential to change ambient air quality. Emissions sources during the Construction phase could include the creation of dust from grading, blasting, excavation, crushing, quarry development, fuel combustion from vehicle and equipment use, camp operations, vehicle movement, power generation, marine vessels and incineration of waste. Emissions sources during the Operations and Maintenance phase include the incineration of domestic waste, power generation, marine vessels and the creation of dust resulting from road maintenance activities, fuel combustion, fuel storage and fueling activities, facilities resupply and equipment and camp operation at Grays Bay Port and Jericho Station.

The potential effect addressed in the air quality assessment is the “change in ambient air quality” due to project emissions. Measurable parameters facilitate qualitative or quantitative measurement of project effects and provide a means to evaluate the change to a VC. Potential effects, effects pathways and measurable parameters for Air Quality are described in Table 11.3. Effect pathways and measurable parameters have been identified to facilitate qualitative or quantitative measurement of change in project-specific and cumulative effects potentially caused by the Project.

Table 11.3 Potential Effects, Effects Pathways and Measurable Parameters for Air Quality

Potential Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in air quality	Atmospheric dispersion of air emissions from project equipment and activities during project Construction and Operations and Maintenance phases	- Ambient concentrations of ACPIs, including NO₂, SO₂, and CO, in microgram per cubic metre (µg/m³) - Ambient concentrations of particulate ACPIs (TSP, PM₁₀ and PM_{2.5}) in µg/m³ - Deposition of PM (i.e., dustfall) in milligrams per square decimetre per day (mg/dm²/day) - PAI expressed in terms of kiloequivalents of hydrogen ion per hectare per year (keq H⁺ ha⁻¹ y⁻¹).

Notes:

Particulate matter (PM) consists of different particle size fractions:

TSP: total suspended PM with an aerodynamic diameter less than 30 µm

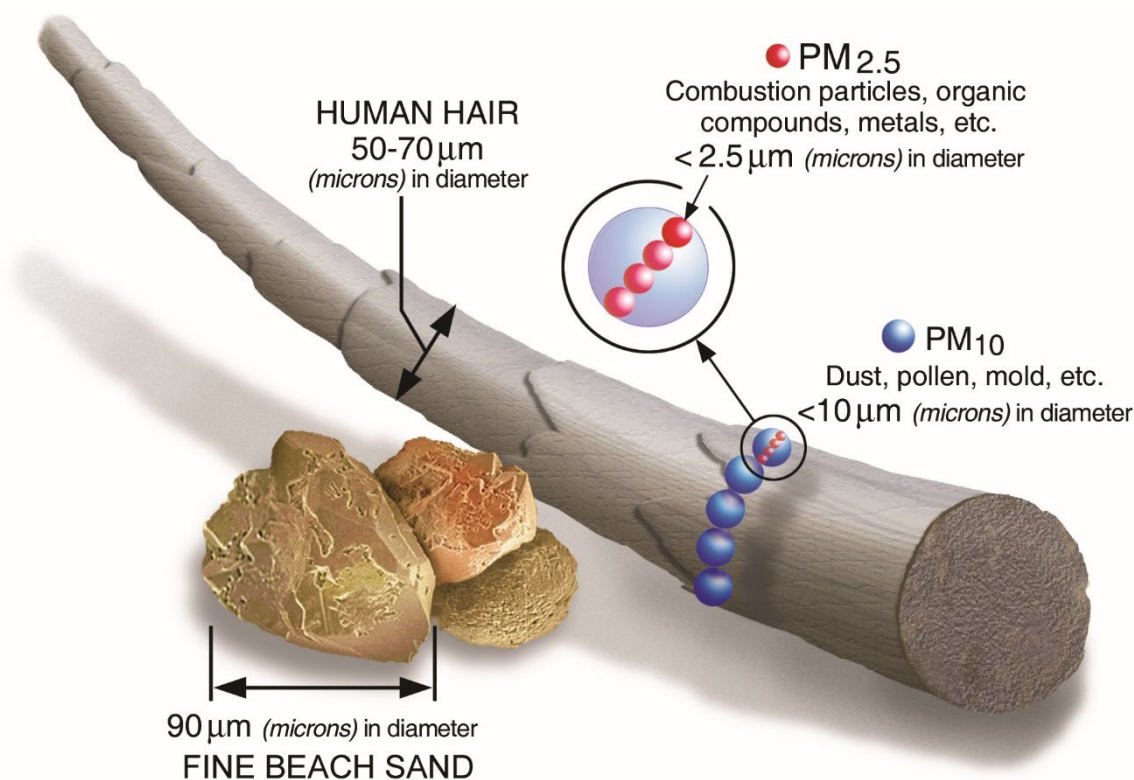
PM₁₀: respirable PM with an aerodynamic diameter less than 10 µm, and

PM_{2.5}: fine PM with an aerodynamic diameter less than 2.5 µm.

11.1.3.1 Particulate Matter

Particulate matter is a general term to describe many types of “dust” that have a wide variety of particle diameters. As defined by BC ENVP, ECCC and the United States Environmental Protection Agency (U.S. EPA), particulate matter (PM) is comprised of solid particles and aerosols ranging in size from visible particles to microscopic particles with an aerodynamic diameter less than $1\text{ }\mu\text{m}$ (BC ENVP 2024a; ECCC 2013a; U.S. EPA 2023a). Figure 11.1 shows the range of PM in comparison to a human hair. Larger particles tend to deposit close to the source of the emissions and are primarily associated with visible dust generated by movement of geological materials during excavation, earthworks, blasting, road dust, and other activities during construction or from wind erosion of exposed soils. The larger dust particles are removed near the disturbance area by gravitational settling and are the main contributor to dustfall. The smaller particles can be suspended in the air and transported from the source ranging from several metres to several kilometres for the smallest particles. These finer particles are associated with combustion sources like construction equipment exhausts, generators, boilers, burning of materials, and wildfires. The particles with aerodynamic diameters less than $10\text{ }\mu\text{m}$ are small enough to enter the human lungs and have been linked to cardiac and respiratory diseases (ECCC 2013a).

Figure 11.1 Comparison of Particulate Matter Sizes to Human Hair



Source: (U.S. EPA 2023a)

The common PM size ranges that are part of ambient air quality are:

- Fine Particulate Matter (PM_{2.5}) – PM that is less than 2.5 µm in aerodynamic diameter.
- Coarse Particulate Matter (PM₁₀) – PM that is less than 10 µm in aerodynamic diameter (includes PM_{2.5}).
- Total Suspended Particulate (TSP) – PM that is less than 30 µm in aerodynamic diameter (includes PM_{2.5} and PM₁₀).

11.1.3.2 Nitrogen Dioxide

Oxides of Nitrogen (NO_x) are almost entirely made up of nitrogen oxide (NO) and nitrogen dioxide (NO₂) and are produced in most combustion processes (ECCC 2013b; BC ENVP 2024b; U.S. EPA 2023b). In the atmosphere, NO is quickly oxidized with oxygen (O₂), ground level ozone (O₃), and other oxidants to form NO₂. Because NO is short lived and NO₂ is considered a respiratory irritant, a regulatory ambient air quality objective exists for NO₂ but not for NO or NO_x (Alberta Environment 2007).

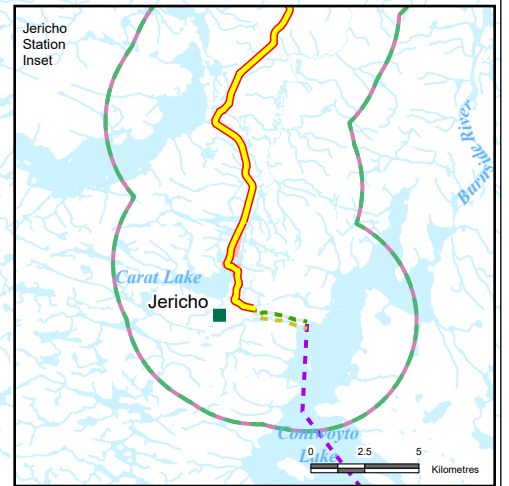
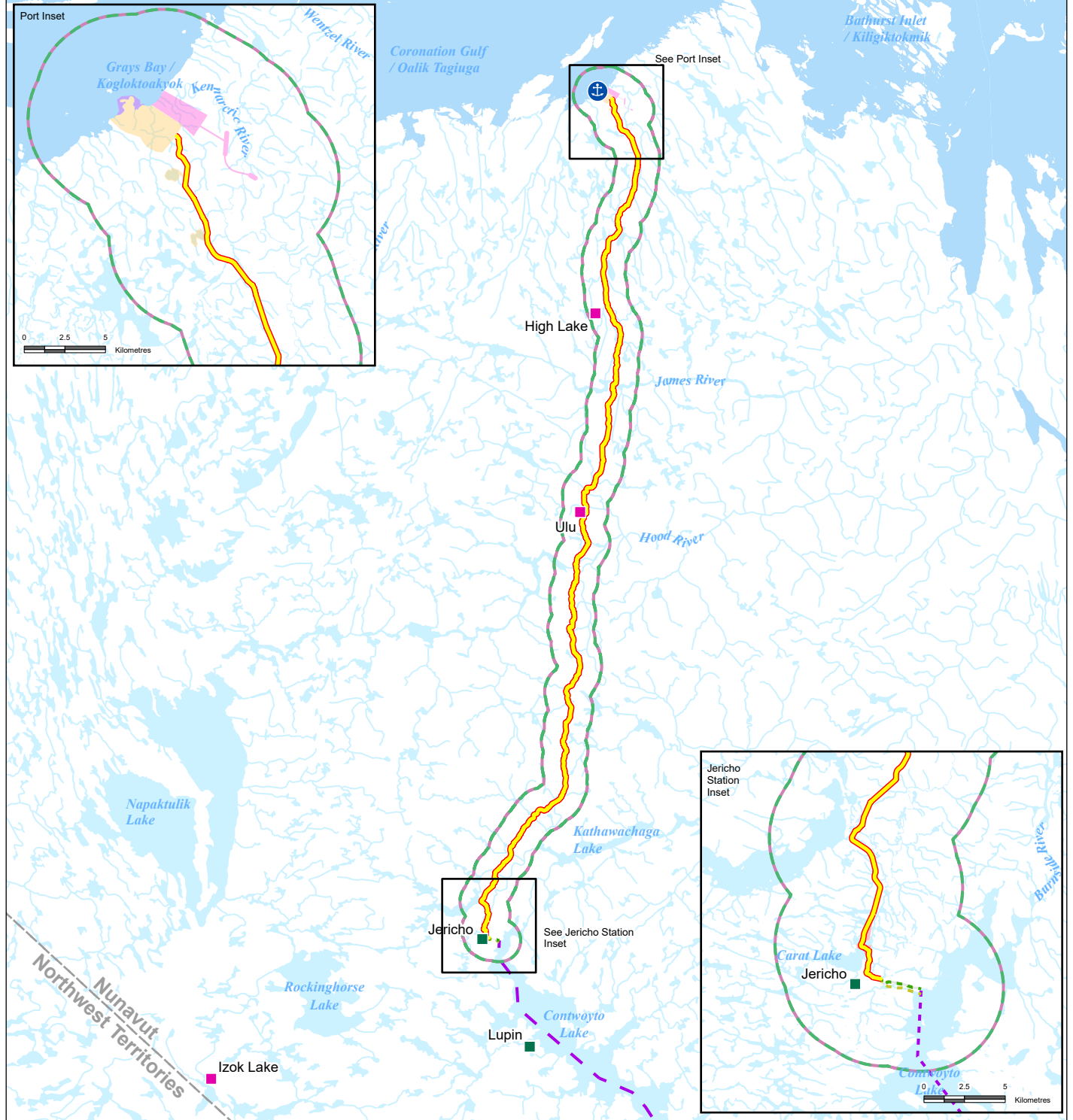
NO₂ is an orange to brown gas that is corrosive and irritating at high concentrations (Alberta Environment 2011). NO₂ will dissolve in atmospheric water to form nitric acid (acid rain) or react with other gases and particles to form nitrates and secondary PM_{2.5}. NO_x, in combination with volatile organic compounds and sunlight, form ground-level ozone, which is commonly known as smog. Exposure to NO₂ by humans can cause short-term respiratory symptoms and airway inflammation with long term exposures linked to asthma, allergic responses, respiratory infections, and potential harm to the cardiovascular and reproductive systems (BC ENVP 2024b).

11.1.4 Boundaries

11.1.4.1 Spatial Boundaries

The spatial boundaries selected for Air Quality were based on consideration of Inuit, Indigenous and Community values and perspectives, public interest, guidance from regulators, past project experience and professional judgment. The boundaries represent the areas where data was available to characterize baseline conditions in support of the project-specific effects assessment and the cumulative effect assessment, including effects identified by Kitikmiut, other Indigenous groups, and other potentially affected communities.

The spatial boundaries for Air Quality are presented in the sections below and are shown in Figure 11.2.



Notes

1. Coordinate System: WGS 1984 UTM Zone 12N

2. Data Sources: Governments of Nunavut and Canada, Stantec

- Local Assessment Area
- Regional Assessment Area
- ⚓ Grays Bay Port
- Grays Bay Road
- Grays Bay Winter Road
- Grays Bay Winter Road Optional Alignment
- Aerodrome
- Jericho Station
- Port (Landside Infrastructure)
- Port (Marine-based Infrastructure)
- Advanced Mineral Exploration Site
- Closed Mine Site
- Territorial Boundary
- Tibbitt to Contwoyto Winter Road
- Watercourse
- Ocean
- Waterbody

0 10 20 Kilometres

(At original document size of 8.5x11) 1:1,350,000



NUNAMI
STANTEC LIMITED

WEST KITKMEOT RESOURCES CORP

Project Location
Kitikmeot Region, Nunavut

Prepared by DSPRY on 2026-02-02
TR by SL on 2026-02-02

Client/Project

West Kitikmeot Resources Corp
Grays Bay Road and Port

123514888_071

Figure No.

11.2

Title

Air Quality Assessment Area

Project Development Area

The Project Development Area (PDA) encompasses the physical footprint of all project components, including both permanent and temporary disturbances (e.g., extent of project infrastructure, planned clearing, and laydown areas). The PDA includes six sub-areas based on the types of components to be developed: the Port (which is further divided into marine and landside infrastructure), Road, Aerodrome, Jericho Station, and Winter Road PDAs. The boundaries of the PDAs were created by applying buffers around where the project components will be sited, and varies by each of the sub-areas depending on necessary flexibility for final siting of certain project components based on conditions on the ground. For the Road PDA and Winter Road PDA, a 75-metre (m) buffer was applied to the road centreline, for the Port PDA and the Aerodrome PDA, the areas were subdivided based on the conceptual project component locations and then buffered approximately 1,000 m for the landside Port PDA, approximately 300 m for the marine Port PDA, and 500 m for the Aerodrome PDA. The Jericho Station PDA was buffered based on the existing development from the old Jericho Mine site that will be used for the Project and the need for additional space to accommodate the project components that will be developed as part of the Project for this location. The Winter Road PDA will only exist annually between the beginning of February and end of March, will be built on land where the existing Jericho Station road ends, at the southeastern portion of Jericho Station, to the shoreline of Contwoyto Lake where it will connect to the Tibbitt to Contwoyto Winter Road (TCWR). For the purposes of the impact assessment, the PDA is the same as the Site Study Area identified in the IS Guidelines.

Local Assessment Area

LAAs have been developed for each VC to represent the maximum area within which project environmental effects, both direct and indirect, can be predicted or measured with a reasonable degree of accuracy and confidence. The LAAs include the PDA and adjacent areas where environmental effects may reasonably be expected to occur. The LAAs typically vary from one VC to another, depending on factors such as local conditions, species abundance, socioeconomic factors, and cultural values.

The LAA for air quality was defined as a 5-kilometre (km) buffer around the PDA and was established to comply with regulatory requirements and to capture air quality effects of the specific components being assessed. The LAA is the maximum area where project-specific environmental effects on air quality can be qualitatively estimated with a reasonable degree of accuracy and confidence. The LAA is large enough to qualitatively discuss the extents of the influence for the ACPI emissions from the project activities. Project-related air quality effects may be present within the LAA; outside the LAA, air quality effects are expected to be small due to natural atmospheric attenuation (natural dilution due to atmospheric mixing). Project residual air quality effects are not expected to extend beyond the LAA.

Regional Assessment Area

RAAs have been developed to represent the areas that provides context to the changes occurring in the LAA for each VC. For example, this could include the area occupied by the VC population, so that effects to the VC can be characterized or quantified. The RAA is also the area within which the Project's environmental effects to a VC may interact or accumulate with the environmental effects of other projects or activities that have been or will be carried out such that cumulative environmental effects may

potentially occur. The RAA for each VC depends on physical and biological conditions and the type and location of other past, present, or reasonably foreseeable projects or activities that have been or will be carried out.

The RAA represents the area within which cumulative effects on air quality are likely to occur, depending on the location of other past, present, or likely future projects or activities. The RAA for air quality was defined as a 5 km buffer around the PDA and was established to comply with regulatory requirements and to capture air quality effects of the specific components being assessed. The RAA is the same size as the LAA because the cumulative air quality effects attributable to other projects (past, present or reasonably foreseeable) were expected to be negligible beyond the LAA due to natural atmospheric attenuation (e.g., natural dilution due to atmospheric mixing) of the Project's ACPI emissions.

Local communities and areas of interest located within the RAA were reviewed for potential identification as sensitive receptors for the assessment. That review indicated one potential sensitive receptor: the High Lake Mineral Exploration Camp. This camp is located approximately 730 m to the west of the proposed road. The camp will re-open in 2027 and be open yearly between May to October.

11.1.4.2 Temporal Boundaries

The temporal boundaries for the assessment are based on the timing and duration of project activities and the nature of the interactions with each VC. The purpose of a temporal boundary is to identify when an environmental effect may occur in relation to specific project phases and activities. Temporal boundaries for the Project include the Construction phase and the Operations and Maintenance phase. The IS Guidelines state that temporal boundaries should also include:

...temporary closure (care and maintenance), final closure (decommission and reclamation) and post-closure periods. The temporary closure period (or care and maintenance) covers the period of untimely closure of the Project and includes care and maintenance activities; the final closure period covers decommission, and reclamation activities; and the post-closure period covers the period after the Project has been decommissioned and abandoned, and the site has been reclaimed and returned as much as possible to its natural state.

Assuming that all regulatory environmental approvals are in place, the Project is proposed to begin in 2029, with major construction commencing in 2030. The major construction activities are anticipated to span approximately five years. Operations and maintenance is anticipated to commence in 2035 and continue indefinitely, as the project components are considered permanent infrastructure. As the project facilities are designed as being permanent, there are no plans for closure and reclamation other than areas used solely for pre-construction/construction activities that are not required for ongoing operations and maintenance. Further details associated with these project phases are outlined in Volume 2, Section 2.6.

11.1.5 Residual Effects Characterization

Air quality effects are assessed using the following characterizations: direction, magnitude, geographic extent, timing, duration, frequency, and reversibility. Each characterization is described, along with their respective possible outcome, in Table 11.4.

The assessment is also guided by Inuit *Qaujimaningit*, which encompasses “Inuit traditional knowledge (and variations thereof or Inuit *Qaujimajatuqangit*), local and community-based knowledge, as well as Inuit knowledge systems as it relates to Inuit Societal Values and Inuit Knowledge (both traditional and contemporary)” (NIRB 2018). Inuit Societal Values, including traditional values, beliefs, and principles are referred to as Inuit *Qaujimajatuqangit* principles (NIRB 2018). For more detail see Volume 3. The Kitikmeot Inuit Association recommended use of the term Inuit Knowledge in the IS. WKR has adopted this terminology and understands Inuit Knowledge encompasses Inuit *Qaujimajatuqangit* principles, which have been incorporated into the assessment of effects on air quality.

Table 11.4 Characterization of Residual Effects on Air Quality

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect	Positive – a residual effect that moves measurable parameters in a direction beneficial to air quality relative to baseline. Adverse – a residual effect that moves measurable parameters in a direction detrimental to air quality relative to baseline. Neutral – no net change in measurable parameters for the air quality relative to baseline.
Magnitude	The extent of a change in measurable parameters or the VC from baseline conditions.	No Measurable Change – model predicted ambient air quality levels are less than 10% of baseline conditions and do not result in exceedances of the ambient air quality standards, objectives and guidelines (SOGs) Low – model predicted ambient air quality levels are greater than 10% of baseline conditions, but less than 50% of the ambient air quality SOGs Moderate – model predicted ambient air quality levels are between 50% and 100% of the ambient air quality SOGs High – model predicted ambient air quality levels are greater than the ambient air quality SOGs
Geographic Extent	The spatial area(s) in which an effect is predicted to be detectable.	PDA – residual effects are restricted to the PDA LAA – residual effects extend into the LAA RAA – residual effects interact with those of other projects in the RAA
Timing	Considers when an effect is predicted to occur, where relevant to the VC.	No sensitivity – Effect does not depend on seasonal aspects or the time of day. Moderate sensitivity – Effect moderately depends on seasonal aspects or the time of day. High sensitivity – Effect highly depends on seasonal aspects or the time of day.

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Duration	The time required until the measurable parameter or the VC returns to its existing condition, or the residual effect can no longer be measured or otherwise perceived.	Short-term – the residual effect is restricted to no more than the duration of the Construction phase (5 years) Long-term – the residual effect lasts more than 5 years
Frequency	How often an effect is predicted to occur.	Single event – residual effect occurs once Multiple irregular event – residual effect occurs at no set schedule Multiple regular event – residual effect occurs at regular intervals Continuous – residual effect occurs continuously
Reversibility	The degree to which a VC can be returned to baseline conditions or other established reference point after relevant activities have ceased.	Reversible – the residual effect is likely to be reversed after activity completion Irreversible – the residual effect is unlikely to be reversed

The main characterization to determine significance is the magnitude of project ACPI concentrations relative to relevant standards, guidelines and objectives. Significance is further described in Section 11.1.6.

11.1.6 Significance Definition

During the September 2025 IAG workshop, participants discussed significance, with the goal of identifying effects that are considered acceptable or unacceptable to members. Through the discussion, a holistic suite of considerations that must be integrated into the Project's social, environmental, and economic plans emerged. With respect to air quality, feedback received from IAG members (IAG 2025b) identified the following priorities, when considering unacceptable changes as a result of the Project:

- That Inuit perspectives are considered and addressed in Project design,
- That the Project is located where community members can benefit,
- That the Project does not negatively affect peoples' ability to harvest caribou and put food on the table,
- That water and wildlife are protected,
- That healthy caribou herds are supported (including predator control),
- That the Project provides access for hunters and supplies for hunters at both Grays Bay and Jericho,
- That the Project reduces cost of living,
- That the Project provides employment opportunities, and
- That the Project provides training opportunities.

For a change in ambient air quality, a significant adverse residual environmental effect is defined as a project-related environmental effect that degrades the quality of the ambient air such that the maximum ground-level concentrations of ACPI from the Project (in various phases) frequently exceeds the respective air quality SOGs presented in Table 11.2.

This significance threshold considers all the characterizations described in Table 11.4 when making a determination of significance. Direction is addressed in this significance threshold by the fact that, by definition, a degradation of ambient air quality as a result of the project activities relates to an adverse condition. Magnitude is considered because the threshold considers whether air emissions released to the environment exceed the applicable SOG. Geographic extent is considered in this significance threshold by predicting project-related ground-level concentrations of ACPI beyond the PDA boundary. Frequency and duration are considered by establishing threshold levels for ground-level concentrations for the ACPI assessed over a specific time period (in this case, the maximum off-site (beyond the PDA boundary) 1-hour, 8-hour, 24 hour or annual average) and predicting whether or not air quality objectives will be exceeded on a frequent basis.

The remaining characterization, reversibility, informs the determination of significance in terms of understanding whether or not ambient air quality will return to baseline conditions once the project activity has ceased.

11.2 Baseline Conditions

11.2.1 Methods

The Project is located within the western Kitikmeot Region in a remote area largely unaffected by local industrial, residential and transportation activities. There is limited information on background air quality conditions in the region. The air quality in the Kitikmeot Region can generally be classified as pristine due to the limited number of significant sources of ACPI. Local air emissions consist of stationary (e.g., power generators, heating) and mobile sources (e.g., trucks, snowmobiles, all terrain vehicles), while marine vessel traffic also impacts local air quality during the open-water season. Long-range transport of air contaminants can also play a significant role influencing air quality in the Kitikmeot Region.

Ambient air quality data is limited within Nunavut as there is only one National Air Pollution Surveillance station in Iqaluit operated by ECCC. Measurements from this station, however, would not be representative of the pristine air found in the Kitikmeot due to the urban influence of the Iqaluit community. Furthermore, the station is located approximately 2,000 km from the proposed Grays Bay Port.

The Government of Northwest Territories operates long-term air quality monitoring stations throughout the territory, including stations at Yellowknife, Ford Liard, Norman Wells and Inuvik. However, like the station in Iqaluit, many of these stations are located near communities that will impact the Criteria Air Contaminants concentrations through local emissions. Furthermore, some of these stations are located more than 1,000 km from the proposed Grays Bay Port. Thus, these sites may not be representative of the pristine air quality of the Kitikmeot.

Therefore, a review of recent Environmental Impact Statements and Project Proposals submitted to the Nunavut Impact Review Board (NIRB) was performed to determine appropriate baseline ACPI levels. Priority was given to projects being proposed within the Kitikmeot Region. This review was completed to determine acceptable baseline data. Given the monitoring location of the Mary River Project, the values from this monitoring program are deemed to be the most representative of air quality values in the Grays Bay Port region. However, where values of contaminants were reported to be higher for other projects, those values were used as a conservative estimate of background levels. Furthermore, all reported dustfall values were converted to units of mg/dm²/day for comparison to the BC PCO. Section 3.3 of Appendix 11A provides a detailed description of baseline ambient air quality.

In addition, a review of project-specific engagement feedback, publicly available literature, the project-specific Inuit report compiled from the NTKP database, IAG workshops, and community-based primary research to identify Inuit, Indigenous, and Community perspectives and values in the context of the Project was conducted. As discussed in Section 11.1.1, this information identified interests, concerns, and potential recommendations from Kitikmiut, other Indigenous groups, and other potentially affected communities related to air quality to inform the air quality assessment and project design.

11.2.2 Overview

To inform understanding of air quality, multiple sources of information were considered, including Inuit, Indigenous, and Community Knowledge perspectives, engagement feedback and baseline ambient air quality concentrations observed in the region.

11.2.2.1 *Inuit, Indigenous, and Community Knowledge and Engagement Feedback*

Through the project-specific engagement program delivered from 2016 into 2025, including community meetings, workshops, community-based primary research, the project-specific Inuit Knowledge report compiled from the NTKP database, and through a review of publicly available information, Kitikmiut, other Indigenous groups, and other potentially affected communities shared information, expressed concerns, and provided recommendations related to air quality. This feedback has been considered and summarized in Table 11.5 and where applicable, has been integrated into the assessment of potential effects on air quality that follows.

Table 11.5 Summary of Inuit, Indigenous, and Community Knowledge and Engagement Feedback

Comment	Source	WKR Response	Where Addressed
NTKP consultants, IAG members, and community members of the Kitikmeot expressed concerns about vegetation health, wildlife exposure, and snow and water quality due to the generation of dust from Project activities and vehicles traveling on the road, and the resulting dust deposition.	Banci and Spicker 2024; GBRP 2025; IAG 2025a	The effects of dust and dust deposition on vegetation, wildlife and wildlife habitat, and water resources are assessed in the associated VC chapters. A Best Management Practices Plan (BMPP) for dust will be developed and implemented during all phases of the Project. The BMPP will also outline standard best management practices for the reduction of air emissions from construction activities (ECCC, 2005; EMLI and ENVP 2023) and mining activities (CEMI 2010).	The effects of the Project on vegetation, wildlife (caribou), freshwater fish and fish habitat and traditional land, marine and resource use from changes in dust deposition are assessed in: • Volume 6, Section 15, • Volume 6, Section 16, • Volume 7, Section 20, and • Volume 9, Section 24
IAG members and community members of the Kitikmeot, during different phases of engagement, expressed the need for dust management and air quality mitigation measures that should be included in the environmental management plans. They noted that the plans need to include effects monitoring.	GBRP 2017; GBRP 2025; IAG 2025a	WKR plans to develop dust management measures to mitigate effects of dust, including the use of water and dust suppressant techniques and vehicle speed limits. An Air Quality Management Plan (AQMP) will be developed that will describe measures to mitigate effects from dust produced by construction, operations, and maintenance activities. The AQMP will incorporate a variety of best practices, including those recommended by the Government of Nunavut.	For mitigation measures to reduce effects on air quality, see Section 11.3.2.3. Mitigation options are also discussed in Appendix 11A (Air Quality Technical Modelling Report).
IAG members expressed concerns about the effects of blasting on air quality.	IAG 2025a	Potential emissions from Project blasting operations are included in the air quality assessment for all phases of the Project.	The effects of blasting were considered in the air quality assessment, see Appendix 11A (Air Quality Technical Modelling Report).
IAG members raised questions about the use of renewable energy.	IAG 2025a	WKR has committed to investigating the viability of renewable energy sources for implementation at a later phase of the Project.	Section 11.3.2.3 for a discussion of impacts of renewable energy sources on effects.
IAG members stated that light and unfamiliar smells can attract or disturb caribou.	IAG 2025b	Odour was not included in the assessment as it is not expected to be a substantive ACPI for the Project. WKR committed to minimizing sensory disturbance.	Appendix 11A (Air Quality Technical Modelling Report), Section 4.2. Sensory disturbances effects on wildlife and wildlife habitat are considered in: • Volume 6, Section 16, and • Volume 7, Section 20

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Comment	Source	WKR Response	Where Addressed
During a public scoping meeting with the NIRB, Gjoa Haven community members expressed concern regarding air quality and dust from Project activities.	NIRB 2025b	This concern is addressed in the air quality assessment by predicting dust deposition in the LAA due to Project construction and operations. The predicted dustfall levels are compared to criteria developed to protect against nuisance or aesthetic effects of dustfall. Additionally, the effects of the predicted dust and dust deposition levels due to the Project on vegetation, wildlife and wildlife habitat, and water resources are assessed in their associated VC chapters. A Best Management Practices Plan (BMPP) for dust will be developed and implemented during all phases of the Project. The BMPP will also outline standard best management practices for the reduction of air emissions from construction activities (ECCC 2005; EMLI and ENVP 2023) and unpaved roads.	Sections 11.3.2 and 11.4.2 as well as the Air Quality TMR (Appendix 11A) The effects of the Project on vegetation, wildlife (caribou), freshwater fish and fish habitat and traditional land, marine and resource use from changes in dust deposition are assessed in: • Volume 6, Section 15, • Volume 6, Section 16, • Volume 7, Section 20, and • Volume 9, Section 24.
During Project-related engagement activities and a public comment period for the NIRB, Athabasca Denesųliné Né Né Land Corporation expressed concern about dust as a result of the Project.	NIRB 2024, 2025a	This concern is addressed in the air quality assessment by predicting dust deposition in the LAA due to Project construction and operations. The predicted dustfall levels are compared to criteria developed to protect against nuisance or aesthetic effects of dustfall. Additionally, the effects of the predicted dust and dust deposition levels due to the Project on vegetation, wildlife and wildlife habitat, and water resources are assessed in their associated VC chapters. A Best Management Practices Plan (BMPP) for dust will be developed and implemented during all phases of the Project. The BMPP will also outline standard best management practices for the reduction of air emissions from construction activities (ECCC 2005; EMLI and ENVP 2023) and unpaved roads.	Sections 11.3.2 and 11.4.2 as well as the Air Quality TMR (Appendix 11A) The effects of the Project on vegetation, wildlife (caribou), freshwater fish and fish habitat and traditional land, marine and resource use from changes in dust deposition are assessed in: • Volume 6, Section 15, • Volume 6, Section 16, • Volume 7, Section 20, and • Volume 9, Section 24.

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Comment	Source	WKR Response	Where Addressed
During engagement on a previous project, Tłı̨cho Elders expressed concern that mines, and the associated effects, including smoke, will disrupt migration patterns and, therefore, caribou distribution and vegetation. The Elders attributed loud noise and the smell of fumes and smoke during the construction phase of Ekati Mine Site as the reason that caribou travelled away. They added that they have observed caribou growing accustomed to loud noise such as planes, and the elders are therefore fearful that the caribou will become accustomed to the noise, smell of fumes and smoke associated with mines.	GKP 2010a	The Project is a road with port facilities and does not include mine construction or operations, although new mines may affect the Project through increased traffic levels. It is anticipated that future mines will be subject to an environmental assessment by its respective proponent, with these evaluations considering interactions with the Project, including smoke and odours. A BMPP for dust will be developed and implemented during all phases of the Project. The BMPP will also outline standard best management practices for the reduction of air emissions from construction activities (ECCC 2005; EMLI and ENVP 2023) and unpaved roads.	Section 11.4.2.
During engagement on a previous project, the Tłı̨cho Government expressed concern about effects on wildlife and members' ability to hunt and trap as a result of dust and smells from road construction and operations.	TG 2014	The Project air quality assessment predicted dust deposition in the LSA due to Project construction and operations. The predicted dustfall levels are compared to criteria developed to protect against nuisance or aesthetic effects of dustfall. Additionally, the effects of the predicted dust and dust deposition levels due to the Project on vegetation, wildlife and wildlife habitat are assessed in their associated VC chapters. A BMPP for dust will be developed and implemented during all phases of the Project. The BMPP will also outline standard best management practices for the reduction of air emissions from construction activities (ECCC 2005; EMLI and ENVP 2023) and road dust.	Sections 11.3.2 and 11.4.2 as well as the Air Quality TMR (Appendix 11A). The effects of the Project on vegetation, wildlife and wildlife habitat, and water resources from changes in dust deposition are assessed in: • Volume 6, Section 15, • Volume 6, Section 16, • Volume 7, Section 20, and • Volume 9, Section 24.

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Comment	Source	WKR Response	Where Addressed
During engagement on a previous project, North Slave Métis Alliance expressed concerns about mining, stating that when caribou smell the smoke, it scares them away. They added that the dust contaminates the caribou food sources, including lichen.	NSMA 2001	The Project is a road with port facilities and does not include mine construction or operations, although new mines may affect the Project through increased traffic levels. It is anticipated that future mines will be subject to an environmental impact assessment by its respective proponent, with these evaluations considering interactions with the Project, including smoke and odours. The Project air quality impact assessment included predicted dust deposition in the LSA due to Project construction and operations. The predicted dustfall levels are compared to criteria developed to protect against nuisance or aesthetic effects of dustfall. Additionally, the effects of the predicted dust and dust deposition levels due to the Project on vegetation, wildlife and wildlife habitat (e.g., caribou) are assessed in their associated VC chapters. A Best Management Practices Plan (BMPP) for dust will be developed and implemented during all phases of the Project. The BMPP will also outline standard best management practices for the reduction of air emissions from construction activities (ECCC 2005; EMLI and ENVP 2023) and unpaved roads.	Sections 11.3.2 and 11.4.2 as well as the Air Quality TMR (Appendix 11A). The effects of the Project on vegetation, wildlife and wildlife habitat(e.g., caribou) from changes in dust deposition are assessed in: • Volume 6, Section 15, • Volume 6, Section 16, • Volume 7, Section 20, and • Volume 9, Section 24.
During a public scoping meeting for the NIRB, community members in Inuvik and Yellowknife expressed concern for potential contaminants in the area and the migration of airborne dust that may affect fish, caribou, and other species.	NIRB 2025b	This concern is addressed in the air quality assessment by predicting dust deposition in the LAA due to Project construction and operations. The predicted dustfall levels are compared to criteria developed to protect against nuisance or aesthetic effects of dustfall. Additionally, the effects of the predicted dust and dust deposition levels due to the Project on vegetation, wildlife and wildlife habitat, and water resources are assessed in their associated VC chapters. A Best Management Practices Plan (BMPP) for dust will be developed and implemented during all phases of the Project. The BMPP will also outline standard best management practices for the reduction of air emissions from construction activities (ECCC 2005; EMLI and ENVP 2023) and unpaved roads.	Sections 11.3.2 and 11.4.2 as well as the Air Quality TMR (Appendix 11A) The effects of the Project on vegetation, wildlife (caribou), freshwater fish and fish habitat and traditional land, marine and resource use from changes in dust deposition are assessed in: • Volume 6, Section 15, • Volume 6, Section 16, • Volume 7, Section 20, and • Volume 9, Section 24.

11.2.3 Baseline Summary

The baseline ambient air quality concentrations used in the air quality assessment are summarized in Table 11.6. Overall, the existing air quality in the LAA is considered good and the baseline values summarized in Table 11.6 are considered representative of the existing conditions. Long-range transport of ACPI can play a substantial role influencing the existing ambient air quality in the Kitikmeot Region. As discussed in the Grays Bay Road and Port Project - Air Quality Technical Modelling Report (TMR) [Appendix 11A] there are no long-term ambient air quality monitoring stations near the Project and the assumed baseline ACPI values were established based on values in Environmental Impact Statements (EIS) and Project Proposals for recently proposed projects within the Kitikmeot Region. The ACPI baseline values presented in those EISs and Project Proposals are based on measured ACPI concentrations in the Kitikmeot Region and therefore would include the influence of long-range transport of the ACPI.

Table 11.6 Assumed Background Air Contaminant Concentrations for the Project

ACPI	Assumed Background Concentration ($\mu\text{g}/\text{m}^3$)	Averaging Period
TSP	7.5	24-hour
	7.5	Annual
PM ₁₀	3.8	24-hour
PM _{2.5}	7	24-hour
	2	Annual
NO ₂	9.4	1-hour
	6	Annual
SO ₂	16.3	1-hour
	5	Annual
CO	1250	1-hour
	875	8-hour
Dustfall (mg/dm ² /day)	1.1	24-hour

Through the project-specific Inuit Knowledge report, NTKP consultants shared information about current air quality in the Kitikmeot Region.

Even in the middle of nowhere. That's what we are finding. We are finding a lot of these snow swirls that collect these finer dusts. These holes where it collects in there, and the dust stays there for the most part of the winter. When the snow melts, you find these as the snow melts. The snow is not pure white anymore. It's more of a brownish colour. (Banci and Spicker 2024)

Over the winter, even here sometimes, you see this really, really fine snow, more like a flour coming down. It's not snow; it's like flour coming down. They're not like snowflakes, it's like dust coming down. (Banci and Spicker 2024)

The baseline meteorology and climate conditions are described in Air Quality TMR (see Appendix 11A, Section 3.2 Climate and Meteorology).

11.3 Assessment of Project Effects on Air Quality

11.3.1 Project Interactions with Air Quality

Table 11.7 identifies, for each potential effect, the project activities that might interact with the VC and result in the identified effect. These interactions are indicated by a check mark or a dash and are discussed in detail in the following sections, in the context of effects pathways, standard and project-specific mitigation measures, and residual effects.

The potential interactions between project activities and the environment were considered for the Construction and Operations and Maintenance phases of the Project. The identification of project activities and their potential interactions was based on engagement with interested parties, including Kitikmiut, other Indigenous, and other potentially affected communities, the professional judgment of technical specialists involved in the assessment, and a review of existing conditions. The selection of interactions is also informed by the potential effects and effects pathways for each VC as described in Volume 4.

Table 11.7 Project Interactions with Air Quality

Project Activities	Effects
	Increase in Concentrations of Ambient Air Pollutants
Construction Phase	
Mobilization/demobilization of machinery /equipment, vehicles, materials, and fuel (e.g., by barge, sea lift, boat, or road)	✓
Staging and storage of materials, fuel, equipment and prefabricated components	✓
Chemical and hazardous material transport, storage and management (including explosives)	✓
Establishment and operation of camps (e.g., mobile camps and permanent accommodations), maintenance yards, and laydowns	✓
Machinery/equipment and vehicle refuelling / fuel storage handling	✓
Site preparation and earthworks of disturbance area (e.g., vegetation clearing, stripping and stockpiling of organic and overburden materials, grading, blasting, drilling)	✓
Construction of port landside facilities, aerodrome, road, and Jericho Station (e.g., buildings/facilities, fuel storage, laydown areas; public use area; access roads; water intake; power generation - diesel (may include wind turbine or solar array); all-season gravel airstrip)	✓
Borrow source and quarry development (e.g., blasting, crushing, sorting, stockpiling of temporary and permanent areas)	✓
Water withdrawal to support construction activities (e.g., winter road construction, dust control, material compaction)	-
Watercourse crossing construction (e.g., bridge and culvert installation)	✓
Ground based transportation (e.g., workforce, materials, supplies)	✓

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Project Activities	Effects
	Increase in Concentrations of Ambient Air Pollutants
Air transport (e.g., personnel transport, resupply)	✓
Waste management and sewage facilities (e.g., development and use of a permanent waste management facility and on-site landfill; handling and storage of hazardous and non-hazardous waste; incineration of domestic waste; open air burning; management of black and grey water)	✓
Construction of marine-based infrastructure (e.g., construction of large vessel wharves, medium vessel wharf, small craft harbour, barge landing area, desalination line, vessel refuelling line / fuel line to bulk fuel storage, including nearshore dredging, infilling, pile driving, blasting)	✓
Taxes, Contracts, Purchases (e.g., procurement of goods and services; employment of workers)	-
Closure and reclamation of temporary borrow sources/quarries, camps, workspaces, laydowns (e.g., erosion stabilization, revegetation, restoration of natural drainage patterns, prevention of future vehicular access)	✓
Operations and Maintenance Phase	
Port landside operations (e.g., use and maintenance of accommodations, borrows, roads, power generation; aerodrome operations including use and maintenance of airstrip and facilities; and Jericho Station operation and maintenance).	✓
Marine port use and operations (e.g., vessels and cargo loading/unloading, barge landing operations, small craft harbour operations, maintenance dredging)	✓
Borrow source and quarry operations (e.g., blasting, crushing, sorting, and stockpiling of permanent areas)	✓
Desalination operation and wastewater treatment (e.g., marine water use and effluent discharge)	-
Water withdrawal / use (e.g., potable water, dust control, maintenance)	-
Road maintenance / use (e.g., transport of equipment, workers, and supplies; maintenance of bridge/culverts; snow clearing; grading and gravel replacement; dust control)	✓
Bulk Fuel Storage (e.g., operation of permanent fuel facilities)	-
Vessel Fuel Line / Refuelling (e.g., directly offloading from east wharf or use of floating fuel pipeline; above ground insulated pipeline to bulk fuel storage tanks)	-
Equipment maintenance	-
Chemical and hazardous material transport, storage and management (including explosives)	✓
Winter road construction and use (e.g., annual winter road construction and maintenance)	✓
Air transport (e.g., personnel transport, resupply)	✓
Waste management (e.g., use of a permanent waste management facility and on-site landfill; handling and storage of hazardous and non-hazardous waste; incineration of domestic waste; open air burning; management of black and grey water)	✓
Taxes, Contracts, Purchases (e.g., procurement of goods and services; employment of workers)	-

Notes:

✓ = Potential interaction

– = No interaction

During the Construction phase, “Water withdrawal to support construction activities” is not expected to increase concentrations of ACPI due to these being “wet” activities and, therefore, will not release ACPI. Similarly, during the Operations and Maintenance phase, “Desalination Operation” and “Water withdrawal/use” will also be “wet” activities and, therefore, will not release ACPI.

During the Operations and Maintenance phase, “Bulk Fuel Storage”, “Vessel Fuel Line / Refuelling”, and “Equipment maintenance” are not expected to increase concentrations of ACPI due to the minimal emissions of ACPI expected with these activities.

During both Construction and Operations and Maintenance phases, “Taxes, Contracts, Purchases” activities are not expected to increase concentrations of ACPI because there are no emissions associated with these “desktop” activities.

A summary of key feedback shared by Kitikmiut, other Indigenous groups, and other potentially affected communities relevant to air quality and available at the time of filing is consolidated in Table 11.5 and integrated into the assessment of potential effects on air quality where applicable. WKR will continue to respond to questions and concerns from Kitikmiut, other Indigenous groups, and other potentially affected communities through its ongoing engagement efforts and information provided following submission of the IS will be reviewed in the context of the IS and for incorporation into project planning, as appropriate.

11.3.2 Assessment of Residual Effects

WKR discussed with Kitikmiut, other Indigenous groups, and other potentially affected communities how project activities (e.g., clearing, blasting, etc.) and project infrastructure could affect environmental and socio-economic conditions and culturally important interests, including but not limited to wildlife movement and mortality, resource availability, harvesting areas, cultural sites, and travel and access. Feedback helped focus on sensitive areas and timing in the Project’s Local Assessment Areas, reflecting *Avatittinnik Kamatsiarniq* in protecting wildlife and the land and *Ikajuqtigiinniq* in identifying potential effects collaboratively.

The potential residual effects assessed for the Project considered the air quality effects which may affect Kitikmiut, Indigenous groups, and other potentially affected communities or the resources, habitat, and environmental conditions that they rely on (Volume 9, Sections 24 and 25). Two key concerns of Kitikmiut and other Indigenous groups (see Table 11.5) are odour and dust, including the effects of dust on snow quality. NTKP consultants, IAG members, and community members of the Kitikmeot expressed concerns about vegetation health, wildlife exposure, and snow and water quality due to the generation of dust from project activities and vehicles traveling on the road, and the resulting dust deposition (Banci and Spicker 2024; GBRP 2025; IAG 2025a). During project-related engagement activities, Athabasca Denesųliné Né Né Land Corporation also expressed concern about dust as a result of the Project (NIRB 2025a). IAG members stated that light and unfamiliar smells can attract or disturb caribou (IAG 2025b). During engagement on a previous project, the Tłıchų Government expressed concern about effects on wildlife and members’ ability to hunt and trap as a result of dust and smells from road construction and operations (TG 2014). Additionally, during engagement on a previous project, North Slave Métis Alliance expressed concerns about mining, stating that when caribou smell the smoke, it scares them away. They added that the dust contaminates the caribou food sources, including lichen (NSMA 2001). IAG members raised questions about the use of renewable energy on the Project (IAG 2025a).

11.3.2.1 *Analytical Assessment Techniques*

The first stage of the ambient air quality assessment estimates emission rates for the worst-case year of the project Construction phase (Year 2) and project Operations and Maintenance phase (Year 7). The worst-case years of Construction phase emissions and Operations and Maintenance phase emissions were selected based on the greatest intensity of concurrent (simultaneous) activities resulting in the highest total annual emissions. Emissions during the Construction and Operations and Maintenance phases include diesel exhaust emissions from mobile equipment, fugitive dust emissions from construction and maintenance activities (e.g., drilling, blasting, off-road equipment movement, grading, material transfers), emissions from aircraft operations (e.g., taxi in and out, take off, climb out, approach, landing), emissions from shipping vessel operations (e.g., hoteling, maneuvering, cruising), diesel emissions from power generation, and waste incineration. The magnitude of emissions and emission estimation methods for the worst-case years of the Construction and Operations and Maintenance phases are discussed below in Section 11.3.2.2.

Project construction is anticipated to proceed year-round, with work advancing simultaneously from both the northern (Grays Bay Port) and southern (Jericho Station) ends of the Project. Therefore, the PDA has been divided into two sections:

1. The Northern Domain, including:
 - the Grays Bay Port with marine-based and land-based infrastructure
 - the Aerodrome
 - the Northern segment of the Grays Bay Road connected to the Port (assumed half of the Grays Bay Road length, approximately 115 km)
2. The Southern Domain, including:
 - the Jericho Station, including the gravel airstrip
 - the Southern segment of the Grays Bay Road connected to the Jericho Station (assumed half of the Grays Bay Road length, approximately 115 km).

The effects of project emissions on ambient air quality are evaluated by using a numerical atmospheric dispersion model. Atmospheric dispersion models simulate transport, dispersion, transformation, and deposition of emissions in the atmosphere. Dispersion models are used to predict ambient concentrations for a wide range of meteorological conditions and account for terrain influences. For this assessment, the AERMOD model system was used to determine the effect of the project emissions from the Construction phase and the Operations and Maintenance phase on ambient air quality.

AERMOD was developed by U.S. EPA (U.S. EPA 2004b), in collaboration with the American Meteorological Society, and is the U.S. EPA's regulatory air dispersion model. AERMOD is a steady-state plume dispersion model that is applicable to rural and urban areas, flat and complex terrain, surface and elevated releases, and multiple sources (including, point, area and volume sources). Parameters that directly influence the dispersion of pollutants include wind speed and direction, atmospheric stability, and mixing layer depth.

The AERMOD model was used to simulate the transport, dispersion and deposition of emissions from the Northern Domain during construction and operations and maintenance. Construction emissions from the Southern Domain (Jericho Station and Southern segment of the Grays Bay Road) were not modelled as emissions in the Southern Domain are less than emissions in the Northern Domain as summarized in Table 11.8 (Northern Domain) and Table 11.9 (Southern Domain). Similarly, the emissions from operations and maintenance are summarized in Table 11.10 (Northern Domain) and Table 11.11 (Southern Domain). The model predictions for the Northern Domain provide a conservative estimate of the potential air quality effects for the entire Project. The most recent model version available at the time of the assessment (v. 24142) was used. In the absence of air quality dispersion modelling guideline from Nunavut, the modelling system was applied in accordance with the BC Air Quality Dispersion Modelling Guideline (the Guideline; ENVP 2022).

The AERMOD model domain for the Northern Domain was selected as a 30 km by 30 km area centered on the Grays Bay Port and encompasses Grays Bay Port, the aerodrome and approximately 15 km segment of the Grays Bay Road connected to the Port. The extent of the AERMOD model domain is sufficient to capture the overall predicted maximum concentrations of ACPI for the worst-case construction and operations and maintenance emission scenarios. A nested receptor grid was created in the model domain following the spacing requirements in the Guideline (ENVP 2022). In addition to the nested receptor grid, receptors were also placed along the PDA boundary with 20 m spacing. Model predictions were made at the receptor locations, including at the two closest potentially sensitive receptor sites: High Lake Mineral Exploration Camp and the Ulu Mineral Exploration Camp. The potential effects for human health at these two receptors were assessed in the Human Health and Ecological Risk Assessment Report (see Volume 9, Appendix 26A).

The air quality assessment considers substances for which there are ambient air quality objectives adopted by territorial (Nunavut), provincial (BC) or national regulatory agencies. The predicted ambient concentrations, dustfall, and PAI during worst-case year of the Construction phase and the Operations and Maintenance phase, in combination with baseline ambient concentration levels accounting for other more distant natural and anthropogenic emission sources, are compared to the applicable SOGs in Table 11.2. Ambient concentrations are expressed in units of microgram per cubic metre ($\mu\text{g}/\text{m}^3$), dustfall is expressed as a deposition rate in milligram per square metre per day ($\text{mg}/\text{m}^2/\text{day}$), and PAI is expressed in terms of kiloequivalents of hydrogen ion per hectare per year ($\text{keq H}^+ \text{ha}^{-1}\text{y}^{-1}$). Concentrations inside the PDA are not compared to the SOGs because public access is expected to be generally restricted in this area.

Details on the AERMOD model implementation are provided in the Grays Bay Road and Port Project - Air Quality Technical Modelling Report (Appendix 11A).

11.3.2.2 *Project Effects Pathways*

Through community meetings, IAG workshops, and public engagement opportunities, Kitikmiut, other Indigenous groups, and other potentially affected communities provided perspectives and values, which were considered and integrated into the potential effects to be considered. Inuit, Indigenous, and Community Knowledge helped to target and to validate the potential effect pathways.

The sources of air emissions during the Construction and Operations and Maintenance phases of the Project are:

- Fugitive dust emissions from activities such as drilling, blasting, quarrying activities (inclusive of, primary and secondary crushing, screening, stacking and material transfer of aggregate material), vehicle movement of both on-road and non-road mobile equipment¹ on unpaved roads at the Port and Jericho Station and along the Grays Bay Road. These activities result in particulate matter (PM) emissions of various size ranges (e.g., TSP, PM₁₀, and PM_{2.5}) that can be deposited outside the PDA onto the ground and water surfaces (i.e., dustfall). Larger dust particles are removed near the disturbance area by gravitational settling and are the main contributor to dustfall. TSP, PM₁₀ and PM_{2.5} emissions are carried outside the PDA by the wind with the smaller PM_{2.5} and PM₁₀ fractions tending to be transported further downwind.
- Diesel combustion exhaust (tailpipe) emissions from non-road equipment (e.g., haul trucks, excavators, loaders, bulldozers, graders) and on-road trucks and light duty vehicles. The exhaust emissions contain by-products of diesel fuel combustion that include ACPIs.
- Diesel combustion emissions from diesel-fueled power generation facilities at the Port and Jericho Station. The exhaust emissions contain by-products of diesel fuel combustion that include ACPI.
- Explosives detonation emissions from blasting. Blasting emissions include NO_x, SO₂ and CO from the detonation of ammonium nitrate fuel oil (ANFO) explosives.
- Incineration of domestic waste at the Port and Jericho Station. The expected emissions include NO_x, SO₂, CO, TSP, PM₁₀, and PM_{2.5} and negligible trace amounts of dioxins and furans.
- Jet-A fuel combustion exhaust during the landing and take-off flight phases of small cargo planes at the Port aerodrome and Jericho Station. The exhaust emissions contain by-products of Jet-A fuel combustion that include NO_x, SO₂, CO, TSP, PM₁₀, and PM_{2.5}.
- Shipping vessel fuel combustion exhaust during vessel cruising, maneuvering, and hoteling. The exhaust emissions contain by-products of marine diesel fuel combustion that include NO_x, SO₂, CO, TSP, PM₁₀, and PM_{2.5}.

The Project will be powered via diesel-fueled, power generation facilities, with the potential to be augmented by wind and/or solar power in the future.

The consideration of potential adverse health effects from exposure to volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons, and diesel particulate matter is described in the Human Health Risk Assessment Report (see Volume 9, Appendix 26A, Section 4.2.1).

¹ Non-road mobile equipment refers to powered vehicles, either wheeled or tracked, designed for movement and operation on undeveloped or rough terrain, rather than public roads. Sometimes referred to as off-road mobile equipment.

Dioxins and furans from waste incineration were not considered in this assessment as the waste incinerators and associated building will be designed in accordance with the ECCC Technical Document for Batch Incineration (ECCC 2010), including:

- Incinerators with controlled air dual chambers with a residence time of at least one (1) second and a temperature higher than 1000 degrees Celsius (°C).
- The incinerators being installed inside a building, that will be equipped with sufficient fresh air inlet capacity for the incinerator.
- Stack gases will be released to the atmosphere at a temperature higher than 700°C to reduce the chances of the inadvertent formation of dioxins and furans through the de novo synthesis process.

With the implementation of the items above and the recommended operational considerations, the waste emissions from the incinerators are expected to be less than the Canada-wide Standards for dioxins and furans (CCME 2001).

Appreciable ozone formation that can result in elevated concentrations is not anticipated because ozone concentrations in the arctic are lower on average than in southern latitudes. Measured ozone concentrations in the arctic are consistently much lower than the CAAQS. Ozone production requires the presence of NO_x and VOCs and conducive meteorological conditions. While photochemical modelling studies and ambient measurements have shown that marine shipping has been demonstrated to increase ozone concentrations, these increases are small (typically less than 5 ppb) and generally occur when background ozone concentrations are low (Raut et. al. 2022). The absence of industrial activity significantly limits the potential for anthropogenic ozone production. The increases to regional and project NO_x and VOC emissions are not anticipated to materially affect ozone levels which are expected to remain much less than the CAAQS (Aliabadi et. al. 2015, ECCC 2018).

Emission Sources during Project Construction and Operations and Maintenance

The emission quantification methods and assumptions for each emission source during construction and operations and maintenance are described in the sections below:

Incineration of Domestic Waste

Domestic waste, greywater and sewage waste from the mobile camps will be transported to the permanent construction camps at the Port and Jericho Station for incineration in two (2) waste incinerators. NO_x, SO₂, CO, TSP, PM₁₀, and PM_{2.5} are the emissions assessed from the incinerators. These emissions were estimated using worker camp capacities, waste generation rates and acceptable emissions levels from the Ontario Ministry of Environment Conservation and Parks Guideline A-7: Air Pollution Control, Design and Operation Guidelines for Municipal Waste Thermal Treatment Facilities, Table 1 (MECP 2016).

Drilling and Blasting Activities

IAG members expressed concerns about the effects of blasting on air quality (IAG 2025a). Holes are drilled and used for placing explosives for blasting. Drilling of holes can occur throughout the workday. Emissions from drilling include particulate emissions (TSP, PM₁₀, PM_{2.5}). Drilling emissions were estimated using the typical blasting area from the U.S. EPA AP-42, Chapter 11.9, Table 11.9-3 (Western Surface Coal Mining) (U.S. EPA, 1998) and emission factors for particulates for boring/blast hole drilling from ECCC National Pollutant Release Inventory (NPRI) Pits and Quarries Reporting Guide (ECCC, 2017).

Blasting occurs to provide aggregate for the construction and maintenance activities at the Port, along the road, and at Jericho Station. Blasting emissions include fugitive dust (TSP, PM₁₀, and PM_{2.5}) generated from the blast and explosives emissions (NO_x, SO₂, and CO) from the detonation of ANFO. Fugitive dust emissions from blasting activities were estimated using the typical blasting area from U.S. EPA AP-42, Chapter 11.9, Table 11.9-3 (Western Surface Coal Mining) (U.S. EPA 1998) and particulate emission factors for blasting from the ECCC NPRI Pits and Quarries Reporting Guide (ECCC 2017). Explosives gaseous emissions were estimated using emission factors from the ECCC NPRI Pits and Quarries Reporting Guide, Table 1 (Blasting Explosives) (ECCC 2017).

Quarrying Activities

Quarrying activities generate particulate matter emissions from drilling, material handling, crushing and screening rock. The following sources are considered:

- Drilling of unfragmented rock/aggregate after blasting but before crushing activities. TSP, PM₁₀, and PM_{2.5} are the expected emissions. Particulate emissions for wet drilling were estimated using emission factors in U.S. EPA AP-42, Chapter 11.19.2 (Crushed Stone Processing and Pulverized Mineral Processing) Table 11.19.2-1 (U.S. EPA 2004a).
- Material transfers of aggregate to and from the crushers, screens and stacker. TSP, PM₁₀, and PM_{2.5} are the expected emissions from these operations. Particulate emissions for material unloading/dropping were estimated using Equation (1) in U.S. EPA AP-42, Chapter 13.2.4 (Aggregate Handling and Storage Piles) (U.S. EPA 2006a). A 50% mitigation efficiency for particulate matter was utilized, assuming drop points are partially enclosed. The Western Regional Air Partnership Report (WRAP 2006) notes a mitigation efficiency of 75% for partial (3-sided) enclosure – the 50% value used is expected to be conservative.
- Primary crushing (using a jaw crusher), secondary crushing (using a cone crusher) and screening of aggregate. TSP, PM₁₀, and PM_{2.5} are the expected emissions from these operations. Particulate emissions for crushing and screening were estimated using emission factors in U.S. EPA AP-42, Chapter 11.19.2 (Crushed Stone Processing and Pulverized Mineral Processing) Table 11.19.2-1 (U.S. EPA, 2004a). An 86% control for particulate matter was utilized, assuming the crushing operations are partially enclosed (TCEQ, 2002).

Site Preparation

Site preparation activities will generate particulate matter emissions from overburden removal and grading. Site preparation emissions were calculated only for the Construction phase. The following sources are considered:

- Overburden removal from the Port, Jericho Station and the road construction segments (using bulldozers and/or front-end loaders). TSP, PM₁₀, and PM_{2.5} are the expected emissions. Particulate emissions were estimated using emission factors in U.S. EPA AP-42, Chapter 11.9, Table 11.9-2 (Western Surface Coal Mining) (U.S. EPA, 1998). No controls were assumed on the removal of overburden.
- Grading of the sites after overburden removal for the efficient operation of construction equipment and maintaining of road surfaces. TSP, PM₁₀, and PM_{2.5} are the expected emissions. Particulate emissions for grading were estimated using emission factors in U.S. EPA AP-42, Chapter 11.9, Table 11.9-2 (Western Surface Coal Mining) (U.S. EPA 1998). During the summer months, a 70% control (i.e., reduction) was used, assuming that grading occurs on roads that have been treated with water.

Diesel Combustion in Non-Road Equipment and On-Road Vehicles

Diesel combustion in non-road equipment and on-road vehicles within the PDA will generate NO_x, SO₂, CO, TSP, PM₁₀, and PM_{2.5} emissions. The fleet will consist of heavy equipment units including excavators, wheeled loaders, haul trucks, drills, wheeled and tracked dozers, graders, and other support vehicles. Vehicle tailpipe emissions for on-road vehicle emissions were estimated using the U.S. EPA's Motor Vehicle Emission Simulator Model version 3 (MOVES3) (U.S. EPA 2021). For the MOVES3 model, it was conservatively assumed that the mobile equipment will be older, Tier 3 equipment, manufactured between 2007 and 2014, which results in higher emissions. The emission factors generated by the model are based on the horsepower of the vehicle and will vary based on the contaminant and the vehicle horsepower. For a worst-case scenario, it was assumed that all of the equipment would be operating simultaneously.

Diesel Combustion for Power Generation

Electrical power for the Port will be provided by a diesel power plant that will include four (4) generator units with a capacity of approximately 6 megawatts (MW). Demand is not anticipated to regularly exceed 4 MW based on the Project Description (Volume 2). Two of the units will operate regularly to meet routine demand, and two will be on standby for occasional peaks and emergency use. A diesel power plant at Jericho Station will include two (2) generator units with a capacity of approximately 3 MW. Demand is not anticipated to regularly exceed 1 MW. One of the units will operate regularly to meet routine demand, and one will be on standby for occasional peaks and emergency use. The power plants will be constructed in a location to reduce the length of transmission and fuel lines. Location of the power plants and associated infrastructure will be confirmed during detailed design of the Project.

Generator emissions were estimated for an assumed diesel generator model CAT 3516C with a continuous power of 1,825 kilowatts (kW), compliant with Tier 2 off-road diesel engine emission standards. The Off-road Compression Ignition (Mobile and Stationary) and Large Spark-Ignition Engine Emission Regulations (SOR/2020-258) require new off-road and stationary diesel engines to meet U.S. EPA Tier 4 emission standards. However, Section 12(1) of SOR/2020-258 allows diesel engines that are to be used exclusively to provide a primary source of electrical power in a remote location to meet Tier 2 emission standards that are less stringent than Tier 4 standards. A "remote location" is defined in the Regulation as geographic areas that are serviced neither by an electrical distribution network nor a natural gas distribution network. The Project meets the definition of "remote location" for the purpose of the Regulation.

Diesel combustion from the diesel power generators will generate NO_x, SO₂, CO, TSP, PM₁₀, and PM_{2.5} emissions. Emissions were estimated for two (2) 1,825 kW continuously operating diesel generators at the Port and one (1) 1,825 kW continuously operating diesel generator at Jericho Station. These emissions were estimated using emission factors from the manufacturer's specifications for NO_x, CO and PM (Caterpillar 2025). It was assumed that the PM consists 100% of the PM_{2.5} fraction. SO₂ emissions were estimated based on 15 mg/kg sulphur limit in off-road diesel fuel as required by the Sulphur in Diesel Fuel Regulations (SOR/202-254).

Unpaved Road Dust

Non-road equipment (e.g., haul trucks, excavators, loaders, bulldozers, graders) and on-road trucks and light duty vehicles will travel within the PDA via unpaved roads. Particulate matter (TSP, PM₁₀, PM_{2.5}) emissions from road dust were estimated using Equation (1) in U.S. EPA AP-42, Chapter 13.2.2 (Unpaved Roads) (U.S. EPA 2006b). The amount of dust emissions from an unpaved road is directly related to the speed and type of vehicle using the road, with emissions varying linearly with vehicle speed (Figure 3-3, Federation of Canadian Municipalities and National Research Council, 2005). Equation (1) of U.S. EPA AP-42, Chapter 13.2.2 assumes vehicles travelling at 72 kilometres per hour (km/h); therefore, the emission factors were scaled down based on the average speed in the construction areas of 15 km/hr. A control efficiency of 75% was assumed for the use of watering and chemical dust suppressants for summer operations (May to September) (WRAP 2006), while a 95% control efficiency was assumed for snow cover in winter (October to April) (Golder 2012).

Jet-A Fuel Combustion

Small cargo planes using Jet-A fuel will be used to transport goods to and from the PDA during the Construction phase. The expected emissions are NO_x, SO₂, CO, TSP, PM₁₀, and PM_{2.5}. Emissions were estimated using emission factors for the landing and take-off flight phases provided in Appendix B.1 of the *National Pollutant Inventory: Emission Estimation Technique Manual for Airports* (Australian Government Department of the Environment, Water, Heritage and the Arts 2008).

Shipping Vessels

Emissions from marine shipping vessels travelling to and from Gray's Bay Port were calculated for hoteling, maneuvering, and slow cruising using published emission factors and calculation methodology for marine vessels from the Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data (U.S. EPA 2000). Modelling was completed for one berthed vessel and another waiting for a berth within approximately a 27 km radius of the port which is the approximate distance of the shipping route that is located within the 30 km by 30 km model domain.

Construction Phase Emission Summary

A summary of annual emissions during the worst-case year of construction (Year 2) for the Northern Domain is provided in Table 11.8 and for the Southern Domain is provided in Table 11.9. The summary for the Northern Domain (Table 11.8) indicates that:

- The main source of TSP, PM₁₀, and PM_{2.5} emissions for the Northern Domain during construction is movement of non-road equipment and on-road vehicles on unpaved roads, followed by quarry activities (drilling, material transfer, crushing and screening).
- The main source of NO_x emissions is diesel combustion from power generation and non-road equipment and on-road vehicles (tailpipe exhaust).
- The main sources of SO₂ emissions are waste incineration and blasting operations.
- The main source of CO emissions is diesel combustion from non-road equipment and on-road vehicles (tailpipe exhaust), followed by power generation and blasting operations.

The summary for the Southern Domain (Table 11.9) indicates that:

- The main source of TSP, PM₁₀, and PM_{2.5} emissions for the Southern Domain during construction is movement of non-road equipment and on-road vehicles on unpaved roads, followed by quarry activities (drilling, material transfer, crushing and screening).
- The main sources of NO_x emissions are diesel combustion from power generation and non-road equipment and on-road vehicles (tailpipe exhaust).
- The main sources of SO₂ emissions are waste incineration and blasting operations.
- The main source of CO emissions is diesel combustion from non-road equipment and on-road vehicles (tailpipe exhaust) followed by power generation and blasting operations.

As evident from Table 11.8 and Table 11.9, the Jericho Station emissions during construction are less than half of the construction emissions from the Port (36% for TSP emissions and 43% for NO_x emissions), and the emissions from the Southern segment of Grays Bay Road are approximately the same as the emissions from the Northern segment of the road. Therefore, the air quality effects (and model-predicted concentrations) from the Southern Domain will be less than the Northern Domain and subsequently, the Southern Domain was not modelled. Since the emissions along the Northern and Southern segments of the Grays Bay Road are similar in magnitude, the model-predicted concentrations along the Northern segment of the road are expected to be representative of the magnitude and spatial distribution of concentrations along the Southern segment of the road.

Table 11.8 Northern Domain Annual Construction Emissions (Year 2)

Project Emission Source	Northern Domain Construction Phase Emissions (tonnes/year)					
	TSP	PM ₁₀	PM _{2.5}	NO _x	SO ₂	CO
Northern Domain (Grays Bay Port and Grays Bay Road Segment)						
Grays Bay Port						
Waste incineration	0.39	0.39	0.39	5.6	1.6	1.1
Blasting ^a	1.5	0.75	0.04	5.0	0.60	21
Quarrying Activities – drilling, material handling, crushing and screening	26	12	5.3	-	-	-
Site Preparation (e.g., overburden removal, grading)	15	3.3	1.4	-	-	-
Diesel Combustion in Non-Road Equipment and On-Road Vehicles	4.8	4.8	4.6	88	0.11	31
Diesel Combustion from Power Generation	1.7	1.7	1.7	261	0.21	21
Unpaved Road Dust Emissions from Non-Road Equipment and On-Road Vehicle Movement on unpaved roads within the Port	86	24	2.4	-	-	-
Jet-A Fuel Combustion	0.0022	0.0022	0.0022	0.031	0.0021	0.285
Shipping Vessels (hoteling, maneuvering, cruising)	0.13	0.13	0.12	5.3	0.26	0.46
Grays Bay Port Total Emissions:	135	48	16	364	2.8	75
Northern Grays Bay Road Segment (115 km) ^b						
Blasting ^c	2.9	1.5	0.09	8.9	1.1	37.7
Quarrying Activities – drilling, material handling, crushing and screening	30	14	7.4	-	-	-
Site Preparation (e.g., overburden removal, grading)	15	3.2	1.5	-	-	-
Diesel Combustion in Non-Road Equipment and On-Road Vehicles	6.0	6.0	5.8	117	0.15	39
Unpaved Road Dust Emissions from Non-Road Equipment and On-Road Vehicle Movement on unpaved roads on the Northern Road	124	35	3.5	-	-	-
Northern Grays Bay Road Segment Total Emissions:	178	60	18	126	1.3	76
Northern Domain Total Emissions:	313	107	34	490	4.0	151

Notes:

^a Blasting for the Grays Bay Port occurs once per day, 104 days per year

^b Emissions are estimated for the Northern Segment of the Grays Bay Road (approximately 115 km)

^c Blasting for the Northern Road occurs once per day, 208 days per year

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Table 11.9 Southern Domain Annual Construction Emissions (Year 2)

Project Emission Source	Southern Domain Construction Phase Emissions (tonnes/year)					
	TSP	PM ₁₀	PM _{2.5}	NO _x	SO ₂	CO
Southern Domain (Jericho Station and Grays Bay Road Segment)						
Jericho Station						
Waste incineration	0.39	0.39	0.39	5.6	1.6	1.1
Blasting ^a	1.5	0.75	0.04	0.5	0.06	2.1
Quarrying Activities – drilling, material handling, crushing and screening	13	6.4	3.5	-	-	-
Site Preparation (e.g., mucking, grading)	4.0	0.76	0.42	-	-	-
Diesel Combustion in Non-Road Equipment and On-Road Vehicles	1.2	1.2	1.2	19	0.03	8.1
Diesel Combustion from Power Generation	0.86	0.86	0.86	130	0.10	11
Jet-A Fuel Combustion	0.0018	0.0018	0.0018	0.024	0.0017	0.224
Unpaved Road Dust Emissions from Non-Road Equipment and On-Road Vehicle Movement on unpaved roads in Jericho Station	27	6.5	0.78	-	-	-
Jericho Station Total Emissions:	49	17	7.1	155	1.8	22
Percent Jericho Station Construction Emissions from Port Emissions:	36%	35%	44%	43%	64%	29%
Southern Grays Bay Road Segment (115 km) ^b						
Blasting ^c	2.9	1.5	0.09	5.5	0.68	23
Quarrying Activities – drilling, material handling, crushing and screening	17	8.5	5.5	-	-	-
Site Preparation (e.g., mucking, grading)	15	3.2	1.5	-	-	-
Diesel Combustion in Non-Road Equipment and On-Road Vehicles	7.0	7.0	6.8	143	0.18	45
Unpaved Road Dust Emissions from Non-Road Equipment and On-Road Vehicle Movement on unpaved roads on the Southern Road	144	41	4.1	-	-	-
Southern Grays Bay Road Segment Total Emissions:	186	61	18	148	0.9	68
Southern Domain Total Emissions:	235	78	25	303	2.6	90

Notes:

^a Blasting for Jericho Station occurs once per day, 104 days per year

^b Emissions are estimated for the Southern Segment of the Grays Bay Road (approximately 115 km)

^c Blasting for the Southern Road occurs once per day, 208 days per year

Operations and Maintenance Phase Emission Summary

A summary of annual emissions during the worst-case year of operations and maintenance (Year 7) for the Northern Domain is provided in Table 11.10 and for the Southern Domain in Table 11.11. The summary for the Northern Domain (Table 11.10) indicates that:

- The main source of TSP, PM₁₀, and PM_{2.5} emissions for the Northern Domain during operations and maintenance is movement of non-road equipment and on-road vehicles on unpaved roads, followed by quarry activities (drilling, material transfer, crushing, and screening).
- The main source of NO_x emissions is diesel combustion from power generation, followed by non-road equipment and on-road vehicles (tailpipe exhaust).
- The main source of SO₂ emissions is waste incineration.
- The main sources of CO emissions are diesel combustion from power generation and non-road equipment and on-road vehicles (tailpipe exhaust).

The summary for the Southern Domain (Table 11.11) indicates that:

- The main source of TSP, PM₁₀, and PM_{2.5} emissions for the Southern Domain during operations and maintenance is movement of non-road equipment and on-road vehicles on unpaved roads, followed by quarry activities (drilling, material transfer, crushing and screening).
- The main source of NO_x emissions is diesel combustion from power generation, followed by non-road equipment and on-road vehicles (tailpipe exhaust).
- The main source of SO₂ emissions is waste incineration.
- The main sources of CO emissions are diesel combustion from power generation and non-road equipment and on-road vehicles (tailpipe exhaust).

During the Operations and Maintenance phase, the TSP emissions from Jerico Station are estimated to be similar to the emissions from the Port (91%), while the NO_x emissions are approximately half of the emissions from the Port (52%) (Table 11.10 and Table 11.11). Similar to the Construction phase, the emissions from the Southern segment of Grays Bay Road are approximately the same as the emissions from the Northern segment of the road. Therefore, the effects on air quality from the Southern Domain during the Operations and Maintenance phase are expected to be less than the Northern Domain and the Southern Domain emissions were not modelled. Since the emissions along the Northern and Southern segments of the Grays Bay Road are similar in magnitude, the model-predicted concentrations along the Northern segment of the road during operations and maintenance are expected to be representative of the magnitude and spatial distribution of concentrations along the Southern segment of the road.

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Table 11.10 Northern Domain Annual Operations and Maintenance Emissions (Year 7)

Project Emission Source	Northern Domain Operations and Maintenance Phase Emissions (tonnes/year)					
	TSP	PM ₁₀	PM _{2.5}	NO _x	SO ₂	CO
Northern Domain (Grays Bay Port and Grays Bay Road Segment)						
Grays Bay Port						
Waste incineration	0.39	0.39	0.39	5.6	1.6	1.1
Blasting ^a	0.61	0.32	0.02	0.72	0.09	3.0
Quarrying Activities – drilling, material handling, crushing and screening	3.9	1.9	1.2	-	-	-
Diesel Combustion in Non-Road Equipment and On-Road Vehicles	1.6	1.6	1.6	25	0.04	11
Diesel Combustion from Power Generation	1.7	1.7	1.7	261	0.21	21
Unpaved Road Dust Emissions from Non-Road Equipment and On-Road Vehicle Movement on unpaved roads within the Port	29	8.3	0.83	-	-	-
Jet-A Fuel Combustion	0.0024	0.0024	0.0024	0.032	0.0023	0.320
Shipping Vessels (hoteling, maneuvering, cruising)	0.19	0.18	0.17	7.5	0.37	0.65
Grays Bay Port Total Emissions:	38	14	5.9	299	2.3	37
Northern Grays Bay Road Segment (115 km) ^b						
Diesel Combustion in Non-Road Equipment and On-Road Vehicles	2.4	2.4	2.3	39	0.06	15
Unpaved Road Dust Emissions from Non-Road Equipment and On-Road Vehicle Movement on unpaved roads on the Northern Road	49	14	1.4	-	-	-
Northern Grays Bay Road Segment Total Emissions:	51	16	3.7	39	0.06	15
Northern Domain Total Emissions:	89	31	10	338	2.3	53

Notes:

^a Blasting for maintenance of the Northern Segment of the Grays Bay Road occurs once per day, 44 days per year.

^b Emissions are estimated for the Northern Segment of the Grays Bay Road (approximately 115 km)

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Table 11.11 Southern Domain Annual Operations and Maintenance Emissions (Year 7)

Project Emission Source	Southern Domain Operations and Maintenance Phase Emissions (tonnes/year)					
	TSP	PM ₁₀	PM _{2.5}	NO _x	SO ₂	CO
Southern Domain (Jericho Station and Grays Bay Road Segment)						
Jericho Station						
Waste incineration	0.39	0.39	0.39	5.6	1.6	1.1
Blasting ^a	0.61	0.32	0.02	0.72	0.09	3.0
Quarrying Activities – drilling, material handling, crushing and screening	3.9	1.9	1.2	-	-	-
Diesel Combustion in Non-Road Equipment and On-Road Vehicles	1.2	1.2	1.2	19	0.03	8.1
Diesel Combustion from Power Generation	0.86	0.86	0.86	130	0.10	11
Jet-A Fuel Combustion	0.0018	0.0018	0.0018	0.0243	0.0017	0.224
Unpaved Road Dust Emissions from Non-Road Equipment and On-Road Vehicle Movement on unpaved roads in Jericho Station	27	6.5	0.78	-	-	-
Jericho Station Total Emissions:	34	11	4.4	155	1.8	23
Percent Jericho Station Operation Emissions from Port Emissions:	91%	77%	75%	52%	79%	62%
Southern Grays Bay Road Segment (115 km) ^b						
Diesel Combustion in Non-Road Equipment and On-Road Vehicles	2.4	2.4	2.3	39	0.06	15
Unpaved Road Dust Emissions from Non-Road Equipment and On-Road Vehicle Movement on unpaved roads on the Southern Road	49	14	1.4	-	-	-
Southern Grays Bay Road Segment Total Emissions:	51	16	3.7	39	0.1	15
Southern Domain Total Emissions:	86	27	8.1	194	1.9	38

Notes:

^a Blasting for maintenance of the Southern Segment of the Grays Bay Road occurs once per day, 44 days per year.

^b Emissions are estimated for the Southern Segment of the Grays Bay Road (approximately 115 km)

11.3.2.3 *Mitigation, Enhancement, and Management Measures*

IAG members and community members of the Kitikmeot, during different phases of engagement, expressed the need for dust management and air quality mitigation measures that should be included in the environmental management plans. They noted that the plans need to include effects monitoring (GBRP 2017; GBRP 2025; IAG 2025a).

Mitigation measures will be implemented to manage and reduce project emissions during all project phases. Meteorological conditions are currently measured by an onsite meteorological tower located at the Grays Bay Port site (Grays Bay Meteorology Station; UTM Zone 12W, 505916 m E, 7520765 m N). Air temperature, relative humidity, wind speed and direction, barometric pressure, solar radiation, and snow depth data have been measured since late August 2024. Ambient air quality monitoring for particulate matter (TSP, PM₁₀, PM_{2.5}) will be implemented to provide an understanding of site ambient concentrations, and to determine the need for additional mitigation. Based on the measured wind conditions and ambient concentration levels, appropriate mitigation options will be considered to reduce project emissions.

Mitigation by Project Design

Mitigation measures that are incorporated in the project design to reduce ACPI emissions include:

- Waste incinerators will be designed and operated in accordance with ECCC Technical Document for Batch Waste Incineration: Executive Summary and Overview of the Six-Step Process for Batch Waste Incineration (ECCC 2010).
- Quarry crushing and screening operations will incorporate standard emissions control measures (e.g., partial enclosure).

Best Management Practices

Emissions during all phases of the Project will be managed and reduced following standard best management practices (BMP) for the reduction of air emissions from construction activities (ECCC 2005; EMLI and ENVP 2023) and operations and maintenance activities (CEMI 2010).

The following BMPs will be implemented for the management and reduction of diesel exhaust emissions and associated ACPI from non-road equipment and vehicles during all phases of the Project:

- Manage vehicle and equipment emissions by conducting regular maintenance of engines and exhaust systems.
- Construction and maintenance mobile equipment speed will be limited to 15 km/h on project road surfaces.
- Equipment idling will be reduced to the extent possible.
- Cold starts of equipment will be limited to the extent possible.
- Contractors will be encouraged to use multi-passenger vehicles (e.g., passenger van or bus) to move crews.

- Vehicles and equipment will be maintained regularly and in good working order.
- Construction contractors will be encouraged to use newer equipment that meets Tier 4 emission standards and are no older than 13-years (built in or after 2012), where possible.

The following BMPs will be implemented for the management and reduction of fugitive dust emissions during all phases of the Project:

- A dust control program using water will be implemented, and where applicable, dust suppression will follow the Nunavut Environmental Guideline: Dust Suppressants (GN 2023b).
- Storage areas will be kept in a condition that reduces dust emissions.

The following BMPs will be implemented for the management and reduction of emissions and associated ACPI from incinerator processes during all phases of the Project:

- Incinerators will be operated in accordance with manufacturer's specifications, will comply with Nunavut standards, and emissions will meet Ontario Ministry of the Environment Conservation and Parks (MECP) Guideline A-7: Air Pollution Control, Design and Operation Guidelines for Municipal Waste Thermal Facilities (MECP 2016).
- Details of management and operation of incinerators will be included in the Waste Management Plan.

Additional mitigation measures can be implemented on an as-required basis.

Air Quality Monitoring

An Air Quality Management Plan (AQMP) will be developed and implemented for all phases of the Project after submission of the IS. The AQMP will specify the mitigation measures for the management and reduction of emissions during all project phases, the ambient air quality and meteorology monitoring program, and the reporting requirements of monitoring results to ENV.

Ambient air quality and meteorology monitoring will include:

- Meteorological monitoring (temperature, wind speed, wind direction, relative humidity, solar radiation and rainfall)
- Ambient PM monitoring

Visual inspection and the results of the ambient PM monitoring will be used to assess the effectiveness of the dust mitigation measures and to evaluate the need for more rigorous dust mitigation.

Monitoring requirements will be reviewed on a case-by-case basis should any complaints related to air quality occur from Kitikmiut, other Indigenous groups, and other potentially affected communities because of project activities.

The implementation of the mitigation measures and other commitments described in this section will be the responsibility of WKR and/or contractors. The mechanisms used to require contractors and subcontractors to comply with these measures are expected to include environmental protection plans and contract documents, in conjunction with the required management plans (Volume 11).

The proposed mitigation measures are generally considered to be industry standards and are effective for use in similar applications and environmental conditions. This assessment is based on professional judgment of engineers and scientists in consideration of standard design codes and practices and industry standards. Regulations, industry standards, or best practices have been cited where applicable to justify the selection. The key industry standard mitigation measures related to the control of fugitive dust are regular road watering and limiting the speed of the mobile equipment on unpaved roads. Both mitigation measures have been proven to be effective and will be implemented.

Blasting occurs to provide aggregate material for various construction and maintenance activities. As stated in Section 11.3.2.2, blasting generates NO_x emissions from the detonation of ANFO explosives. A potential mitigation measure that will be considered by WKR is the use of emulsion type explosives instead of ANFO, as they typically have lower NO_x emissions (U.S. EPA 1980).

Detailed design of the Project and mitigation strategies is currently ongoing. Mitigation measures will be implemented to manage and reduce emissions during the Construction and Operations and Maintenance phases. Mitigation measures will be refined in consideration of environmental assessment approval conditions and permit stipulations that will be incorporated into final environmental management planning. Finalized mitigation measures will be outlined in the Air Quality Monitoring and Management Plan (Volume 11), including best management practices for dust. The effectiveness of these mitigation measures will be confirmed by qualified environmental professionals and engineers as part of the development of detailed mitigation and environmental management planning. These detailed mitigation measures and monitoring programs, including adaptive management procedures, will be reviewed by applicable regulatory agencies prior to their implementation.

Ambient air quality monitoring will be implemented to provide an understanding of meteorological conditions and offsite ambient concentrations, and to determine the need for additional mitigation to those outlined in the AQMP and Best Management Practices Plan. Monitoring systems may include the installation and operation of a meteorological tower (wind speed and wind direction) and / or ambient particulate matter monitoring equipment. Based on the current wind conditions and measured ambient concentration levels, appropriate and effective mitigation options will be implemented to reduce emissions. Emissions mitigation management follows an “adaptive management” approach. For example, if it was later determined from monitoring that fugitive dust from traffic along unpaved roads was causing elevated PM concentrations then additional road watering could be implemented.

Key mitigation measures to avoid or reduce adverse effects on air quality during all project phases include the following:

- Manage vehicle and equipment emissions by conducting regular maintenance of engines and exhaust systems.
- A policy will be established to reduce unnecessary idling of equipment.
- Cold starts of equipment will be limited to the extent possible.
- Reduce fugitive dust emissions from the optimizing movement of construction equipment.
- Operate waste incinerators following best management practices from ECCC
- Use partial enclosures for quarry crushing and screening operations to reduce dust emissions

- Speed limit for construction and operation and maintenance mobile equipment travelling on project roads
- Encourage contractors to use multi-passenger vehicles (e.g., passenger van or bus) to move crews
- Develop and implement a dust control program that follows the Nunavut Environmental Guideline: Dust Suppressants (GN 2023)
- Material storage areas will be kept in a condition that reduces visible dust emissions
- Use proper blasthole stemming to reduce fugitive dust from blasting
- Shipping vessels (hoteling, maneuvering and cruising) will follow speed limits

Additional mitigation measures can be implemented on an as-required basis. These measures take into consideration the values identified by Kitikmiut, other Indigenous groups, and other potentially affected communities

Alternative Renewable Energy Operations and Maintenance Scenario

An investigation of renewable energy technology options was undertaken to determine the feasibility of replacing a portion of the provided diesel power with renewable energy during the Operations and Maintenance phase (Nunami Stantec Limited 2024). The implementation of renewable energy would lower emissions from the Operations and Maintenance phase scenario. Two renewable power options are being considered for the Project. The energy requirement for the Project is 22,646,060 kilowatt hour (kWh). Of this energy required to operate the Project, the first option assumes that solar power will supply 885,838 kWh of energy, but only 757,308 kWh offsetting diesel supplied energy and the balance (~128,530 kWh) as excess electricity. The second option assumes that wind power will supply 17,756,783 kWh of energy, with 11,197,634 kWh displacing diesel supplied energy, with the remainder to be partly stored or becoming excess electricity (Nunami Stantec Limited 2024; Rahmin 2025). Table 11.12 summarizes the change in emissions under these two scenarios and highlights the emissions savings by utilizing renewable energy sources. Under the solar power scenario, emissions will decrease by 1.2% to 2.2% depending on ACPI, while the wind power scenario provides reductions of 17.1% to 32.1%.

Table 11.12 Project Operation and Maintenance Phase – Annual Emissions (Year 7)

Project Operations and Maintenance Scenario	Operation and Maintenance Phase Emissions (tonnes/year)					
	TSP	PM ₁₀	PM _{2.5}	NO _x	SO ₂	CO
Base Case (100% Diesel Power)	2.56	2.56	2.56	391	0.31	32
Renewable Power Option 1 (Solar Only)	2.53	2.53	2.53	386	0.30	32
Renewable Power Option 1 (Wind Only)	2.11	2.11	2.11	323	0.21	27

11.3.2.4 *Project Residual Effects*

Maximum ambient concentrations, dustfall, and PAI for the ACPI are predicted for the worst-case year of the Construction phase (Year 2) and the Operations and Maintenance phase (Year 7) within the 30 km x 30 km Northern model domain (see Section 11.3.2.1), which includes the LAA.

Existing air quality conditions are represented by the baseline concentrations. Baseline concentrations are added to the maximum predicted concentrations to account for other existing emission sources (natural and anthropogenic) that are otherwise not directly included in the model simulation.

The maximum model predicted concentrations outside the PDA boundary, including the baseline contribution, are compared to the applicable SOGs. The maximum predicted concentrations within the 30 km by 30 km model domain are based on areas along and outside the PDA (i.e., locations where public access is not restricted). The maximum predicted concentrations and dustfall results are discussed separately for the Construction and Operations and Maintenance phases in the following sections.

Project Construction Phase

Summaries of the maximum predicted ACPI concentrations for project construction over the 30 km x 30 km model domain and at the High Lake Mineral Exploration Camp are provided in Table 11.13 and Table 11.14, respectively. The maximum predicted concentrations for the ACPI are compared to the applicable SOGs for each averaging period. Concentration contour maps for project construction are presented in Appendix 11A (see Appendix 11A, Appendix C - Concentration Contour Plots for Construction).

The model results indicate that the predicted maximum 24-hour average TSP and PM₁₀ concentrations and the predicted maximum 1-hour average NO₂ concentration outside the PDA boundary are greater than the respective SOGs. For the other gaseous and PM ACPI and dustfall, the maximum predicted values are less than the applicable SOGs. The highest predicted concentrations for ACPI from the Northern Domain construction occur along the PDA boundary and reduce with increased distance from the boundary. The TSP and PM₁₀ exceedances during construction are infrequent (fewer than 5 days/year) and limited to areas immediately around the PDA boundary. The predicted maximum 1-hour NO₂ concentrations above the CAAQS extend up to 2 km along the shoreline and 6 km over Grays Bay, NO₂ exceedances decrease with distance, with the highest frequency of exceedance along the PDA boundary up to 127 days/year and dropping to fewer than 30 days/year within 1.5 km of the PDA boundary along the shoreline. All predicted ACPI concentrations at the High Lake Mineral Exploration Camp during construction remain below applicable SOGs. Detailed discussion of the dispersion model predictions for each assessed ACPI is provided below.

Table 11.13 Project Construction Phase – Maximum Predicted Concentrations

ACPI	Averaging Period	Baseline Concentration (µg/m³)	Maximum Predicted Concentration in the LAA (µg/m³)	Maximum Predicted Concentration Including Baseline Concentration (µg/m³)	Maximum Frequency Above SOG (d/y)	SOG ^a (µg/m³)	CAAQS ^b (µg/m³)	% Max. Value of SOG ^o	% Max. Value of CAAQS
TSP	24-hour ^c	7.5	221	229	5	120	-	190%	-
	Annual ^d	7.5	16.7	24.2	-	60	-	40%	-
PM ₁₀	24-hour ^c	3.8	107	111	4	50 ^e	-	221%	-
PM _{2.5}	24-hour ^f	7.0	12.3	19.3	-	27	27	71%	71%
	Annual ^g	2.0	2.13	4.13	-	8.8	8.8	47%	47%
NO ₂	1-hour ^h	9.4	148	158	127 ⁿ	79	79	199%	199%
	Annual ⁱ	6.0	17.3	23.3	-	23	23	101%	101%
SO ₂	1-hour ^j	16.3	45.7	62.0	-	170	170	36%	36%
	Annual ⁱ	5.0	0.162	5.16	-	10	10	52%	52%
CO	1-hour ^k	1,250	605	1,855	-	14,300 ^e	-	13%	-
	8-hour ^c	875	3,461	4,336	-	5,500 ^e	-	79%	-
Dustfall (mg/dm²/day)	30-day	1.1	0.49	1.59	-	1.75 ^l / 2.9 ^m	-	93% / 56%	-
Potential Acid Input (keq H⁺/ha/y)	Annual	0.00123	0.0782	0.0794	-	-	-	-	-

Notes:

- ^a Values based on Government of Nunavut (2023a; 2011 version for TSP) unless otherwise indicated
- ^b CAAQS (CCME 2025)
- ^c The maximum (1st highest) concentration
- ^d Expressed as the geometric mean
- ^e BC AAQO (ENVP 2021)
- ^f The annual 98th percentile (8th highest) of daily average concentrations, averaged over three consecutive years
- ^g The three-year average of the annual average of the daily 24-hour average concentrations
- ^h The annual 98th percentile (8th highest) of the daily maximum 1-hour average concentrations, averaged over three consecutive years
- ⁱ The annual average of 1-hour average concentrations, averaged over one year
- ^j The annual 99th percentile (4th highest) of the daily maximum 1-hour concentrations, averaged over three consecutive years
- ^k The 1-hour CO based on 9th highest of all 1-hour concentrations
- ^l Dustfall PCO for residential/parkland areas (ENVP 2020)
- ^m Dustfall PCO for industrial/other areas (ENVP 2020)
- ⁿ Seven (7) days of exceedance were removed from the maximum days of exceedance per day to be consistent with the 1-hour NO₂ CAAQS metric
- ^o The Maximum Predicted Application Case (Project plus background) value was used to calculate the percentage of the SOG.

d/y – days per year

Baseline Concentrations provided as maximum over the relevant averaging period.

Bold values are greater than the applicable regulatory criteria.

Table 11.14 Project Construction Phase – Maximum Predicted Concentrations at the High Lake Mineral Exploration Camp

ACPI	Averaging Period	Baseline Concentration (µg/m³)	Maximum Predicted Concentration at the Camp (µg/m³)	Maximum Predicted Concentration including Baseline Concentration (µg/m³)	SOG ^a (µg/m³)	CAAQS ^b (µg/m³)	% Max. Value of SOG	% Max. Value of CAAQS
TSP	24-hour ^c	7.5	8.99	16.5	120	-	14%	-
	Annual ^d	7.5	1.0	8.5	60	-	14%	-
PM ₁₀	24-hour ^c	3.8	2.7	6.5	50 ^e	-	13%	-
PM _{2.5}	24-hour ^f	7.0	0.36	7.4	27	27	27%	27%
	Annual ^g	2.0	0.090	2.1	8.8	8.8	24%	24%
NO ₂	1-hour ^h	9.4	22	31	79	79	40%	40%
	Annual ⁱ	6.0	0.89	6.9	23	23	30%	30%
SO ₂	1-hour ^j	16.3	0.0385	16.3	170	170	9.6%	9.6%
	Annual ⁱ	5.0	0.0013	5.0	10	10	50%	50%
CO	1-hour ^k	1,250	8.87	1,259	14,300 ^e	-	8.8%	-
	8-hour ^c	875	5.2	880	5,500 ^e	-	16%	-

Notes:

- ^a Values based on Government of Nunavut (2023a; 2011 version for TSP) unless otherwise indicated
- ^b CAAQS (CCME 2025)
- ^c The maximum (1st highest) concentration
- ^d Expressed as the geometric mean
- ^e BC AAQO (ENVP 2021)
- ^f The annual 98th percentile (8th highest) of daily average concentrations, averaged over three consecutive years
- ^g The three-year average of the annual average of the daily 24-hour average concentrations
- ^h The annual 98th percentile (8th highest) of the daily maximum 1-hour average concentrations, averaged over three consecutive years
- ⁱ The annual average of 1-hour average concentrations, averaged over one year
- ^j The annual 99th percentile (4th highest) of the daily maximum 1-hour concentrations, averaged over three consecutive years
- ^k The 1-hour CO based on 9th highest of all 1-hour concentrations

Baseline Concentrations provided as maximum over the relevant averaging period.

Maximum TSP Concentrations

The maximum predicted 24-hour average TSP concentration including baseline is 229 $\mu\text{g}/\text{m}^3$ and is greater than the SOG of 120 $\mu\text{g}/\text{m}^3$. The maximum annual average TSP concentration including baseline is 24.2 $\mu\text{g}/\text{m}^3$, which is less than the SOG of 60 $\mu\text{g}/\text{m}^3$.

The maximum predicted 24-hour and annual TSP concentrations occur on the northeast PDA boundary at the Port (see Appendix 11A, Appendix C, Figure C.1 and Figure C.3). TSP concentrations greater than the 24-hour SOG (120 $\mu\text{g}/\text{m}^3$) are predicted to occur infrequently (5 days/year) and are limited to areas immediately around the PDA boundary (see Appendix 11A, Appendix C, Figure C.2).

Maximum PM₁₀ Concentrations

The maximum predicted 24-hour average PM₁₀ concentration including baseline is 111 $\mu\text{g}/\text{m}^3$, which is greater than the SOG (50 $\mu\text{g}/\text{m}^3$).

The maximum predicted 24-hour PM₁₀ concentration occurs on the northeast Port PDA boundary at the Port (see Appendix 11A, Appendix C, Figure C.4). PM₁₀ concentrations greater than the 24-hour SOG (50 $\mu\text{g}/\text{m}^3$) are predicted to occur infrequently (4 days/year) and are limited to areas immediately around the PDA boundary (see Appendix 11A, Appendix C, Figure C.5).

Maximum PM_{2.5} Concentrations

The maximum predicted 24-hour and annual average PM_{2.5} concentrations including baseline are 19.3 $\mu\text{g}/\text{m}^3$ and 4.13 $\mu\text{g}/\text{m}^3$, respectively, and are less than the respective SOG/CAAQS.

The maximum predicted 24-hour and annual PM_{2.5} concentrations occur on the northeast PDA boundary at the Port (see Appendix 11A, Appendix C, Figure C.6 and Figure C.7).

Maximum NO₂ Concentrations

The maximum predicted 1-hour average NO₂ concentration in the metric of the CAAQS, including baseline, is 158 $\mu\text{g}/\text{m}^3$ and is greater than the 1-hour CAAQS (79 $\mu\text{g}/\text{m}^3$). The maximum predicted annual average NO₂ concentration, including baseline, is 23.3 $\mu\text{g}/\text{m}^3$ and is at the annual CAAQS (23 $\mu\text{g}/\text{m}^3$).

The maximum predicted 1-hour and annual NO₂ concentrations occur on the northeast PDA boundary at the Port (see Appendix 11A, Appendix C, Figure C.8 and Figure C.10). Predicted NO₂ concentrations greater than the 1-hour CAAQS (79 $\mu\text{g}/\text{m}^3$) extend up to 2 km from the PDA boundary along the shoreline and 6 km over Grays Bay (see Appendix 11A, Appendix C, Figure C.9). The maximum predicted exceedances along the northeast PDA boundary are 127 days/year. NO₂ exceedances decrease with distance, dropping to fewer than 30 days/year within 1.5 km along the shoreline from the PDA boundary.

Maximum SO₂ Concentrations

The maximum predicted 1-hour and annual average SO₂ concentrations including baseline are 62.0 $\mu\text{g}/\text{m}^3$ and 5.16 $\mu\text{g}/\text{m}^3$, respectively, and are less than the respective CAAQS.

Maximum CO Concentrations

The maximum predicted 1-hour (9th highest) and 8-hour average CO concentrations including baseline are 1,855 µg/m³ and 4,336 µg/m³, respectively, and are less than the respective SOGs.

The maximum predicted 1-hour (9th highest) CO concentration occurs on the southwest PDA boundary at the Port (see Appendix 11A, Appendix C, Figure C.13). The maximum predicted 8-hour CO concentration occurs on the northeast PDA boundary at the Port (see Appendix 11A, Appendix C, Figure C.14).

Maximum Dustfall

The maximum predicted 30-day average dustfall including baseline is 1.62 mg/dm²/day and is less than the BC PCO for residential/parkland areas (1.75 mg/dm²/day) and industrial/other areas (2.9 mg/dm²/day).

The maximum predicted dustfall occurs on the northeast PDA boundary at the Port (Figure C.15).

Maximum Potential Acid Input

The maximum predicted annual PAI including baseline is 0.0794 keq H⁺ /ha/y.

Model Predictions at High Lake Mineral Exploration Camp

The ACPI were assessed at the High Lake Mineral Exploration Camp, the nearest sensitive receptor to the Project. The maximum predicted concentrations of all ACPI at the High Lake Mineral Exploration Camp are below their relevant SOGs.

Project Operations and Maintenance Phase

Summaries of the maximum predicted ACPI concentrations for Operations and Maintenance over the 30 km x 30 km model domain and at the High Lake Mineral Exploration Camp are provided in Table 11.15 and Table 11.16, respectively. The maximum predicted concentrations for the ACPI are compared to the applicable SOGs for each averaging period. Concentration contour maps for the Operations and Maintenance phase are presented in Appendix 11A (see Appendix D - Concentration Contour Plots for Operations and Maintenance).

The model results indicate that the predicted maximum 1-hour average NO₂ concentration outside the PDA boundary are greater than the respective SOGs. For the other gaseous and PM ACPI and dustfall, the maximum predicted values are less than the applicable SOGs. The highest predicted concentrations for ACPI from the Northern Domain operations and maintenance occur along the PDA boundary and reduce with increased distance from the boundary. The NO₂ exceedances during operations and maintenance are infrequent (fewer than 14 days/year) and limited to areas immediately around the PDA boundary. All predicted ACPI concentrations at the High Lake Mineral Exploration Camp during operations and maintenance remain below applicable SOGs. Detailed discussion of the dispersion model predictions for each assessed ACPI is provided below.

Table 11.15 Project Operations and Maintenance Phase – Maximum Predicted Concentrations in the LAA

ACPI	Averaging Period	Baseline Concentration (µg/m³)	Maximum Predicted Concentration in the LAA (µg/m³)	Maximum Predicted Concentration Including Baseline Concentration (µg/m³)	Maximum Frequency Above SOG (d/y)	SOG ^a (µg/m³)	CAAQS ^b (µg/m³)	% Max. Value of SOG	% Max. Value of CAAQS
TSP	24-hour ^c	7.5	51.5	59.0	-	120	-	49%	-
	Annual ^d	7.5	2.77	10.3	-	60	-	18%	-
PM ₁₀	24-hour ^c	3.8	26.4	30.2	-	50 ^e	-	%	-
PM _{2.5}	24-hour ^f	7.0	2.19	9.19	-	27	27	34%	34%
	Annual ^g	2.0	0.434	2.43	-	8.8	8.8	28%	28%
NO ₂	1-hour ^h	9.4	108	117	14 ⁿ	79	79	149%	149%
	Annual ⁱ	6.0	5.88	11.9	-	23	23	52%	52%
SO ₂	1-hour ^j	16.3	8.65	25.0	-	170	170	15%	15%
	Annual ⁱ	5.0	0.051	5.05	-	10	10	51%	51%
CO	1-hour ^k	1,250	261	1,511	-	14,300 ^e	-	11%	-
	8-hour ^c	875	622	1,497	-	5,500 ^e	-	27%	-
Dustfall (mg/dm²/day)	30-day	1.13	0.13	1.26	-	1.75 ^l / 2.9 ^m	-	72% / 43%	-
Potential Acid Input (keq H ⁺ /ha/y)	Annual	0.00123	0.0662	0.0674		-	-	-	-

Notes:

- ^a Values based on Government of Nunavut 2023 (2011 version for TSP) unless otherwise indicated
- ^b CAAQS (CCME 2025)
- ^c The maximum (1st highest) concentration
- ^d Expressed as the geometric mean
- ^e BC AAQO (ENVP 2021)
- ^f The annual 98th percentile (8th highest) of daily average concentrations, averaged over three consecutive years
- ^g The three-year average of the annual average of the daily 24-hour average concentrations
- ^h The annual 98th percentile (8th highest) of the daily maximum 1-hour average concentrations, averaged over three consecutive years
- ⁱ The annual average of 1-hour average concentrations, averaged over one year
- ^j The annual 99th percentile (4th highest) of the daily maximum 1-hour concentrations, averaged over three consecutive years
- ^k The 1-hour CO based on 9th highest of all 1-hour concentrations
- ^l Dustfall PCO for residential/parkland areas (ENVP 2020)
- ^m Dustfall PCO for industrial/other areas (ENVP 2020)
- ⁿ Seven (7) days of exceedance were removed from the maximum days of exceedance per day to be consistent with the 1-hour NO₂ CAAQS metric
- d/y – days per year
- Baseline Concentrations provided as maximum over the relevant averaging period.
- Bold** values are greater than the applicable regulatory criteria.

Table 11.16 Project Operations and Maintenance Phase – Maximum Predicted Concentrations at the High Lake Mineral Exploration Camp

ACPI	Averaging Period	Baseline Concentration (µg/m³)	Maximum Predicted Concentration in the LAA (µg/m³)	Maximum Predicted Concentration Including Baseline Concentration (µg/m³)	SOG ^a (µg/m³)	CAAQS ^b (µg/m³)	% Max. Value of SOG	% Max. Value of CAAQS
TSP	24-hour ^c	7.5	0.49	8.0	120	-	6.7%	-
	Annual ^d	7.5	0.044	7.5	60	-	13%	-
PM ₁₀	24-hour ^c	3.8	0.16	4.0	50 ^e	-	7.9%	-
PM _{2.5}	24-hour ^f	7.0	0.024	7.0	27	27	26%	26%
	Annual ^g	2.0	0.0061	2.0	8.8	8.8	23%	23%
NO ₂	1-hour ^h	9.4	2.1	11	79	79	15%	15%
	Annual ⁱ	6.0	0.085	6.1	23	23	26%	26%
SO ₂	1-hour ^j	16.3	0.010	16.3	170	170	9.6%	9.6%
	Annual ⁱ	5.0	0.00034	5.0	10	10	50%	50%
CO	1-hour ^k	1,250	0.919	1,251	14,300 ^e	-	8.7%	-
	8-hour ^c	875	0.55	876	5,500 ^e	-	16%	-

Notes:

- ^a Values based on Government of Nunavut (2023a; 2011 version for TSP) unless otherwise indicated
- ^b CAAQS (CCME 2025)
- ^c The maximum (1st highest) concentration
- ^d Expressed as the geometric mean
- ^e BC AAQO (ENVP 2021)
- ^f The annual 98th percentile (8th highest) of daily average concentrations, averaged over three consecutive years
- ^g The three-year average of the annual average of the daily 24-hour average concentrations
- ^h The annual 98th percentile (8th highest) of the daily maximum 1-hour average concentrations, averaged over three consecutive years
- ⁱ The annual average of 1-hour average concentrations, averaged over one year
- ^j The annual 99th percentile (4th highest) of the daily maximum 1-hour concentrations, averaged over three consecutive years
- ^k The 1-hour CO based on 9th highest of all 1-hour concentrations
- Baseline Concentrations provided as maximum over the relevant averaging period.

Maximum TSP Concentrations

The maximum predicted 24-hour and annual average TSP concentrations including baseline are $59.0 \mu\text{g}/\text{m}^3$ and $10.3 \mu\text{g}/\text{m}^3$, respectively, and are less than the relevant SOGs.

The maximum predicted 24-hour and annual TSP concentrations occur on the northeast PDA boundary at the Port (see Appendix 11A, Appendix D, Figure D.1 and Figure D.2).

Maximum PM₁₀ Concentrations

The maximum predicted 24-hour average PM₁₀ concentration including baseline is $30.2 \mu\text{g}/\text{m}^3$ and is less than the SOG ($50 \mu\text{g}/\text{m}^3$).

The maximum predicted 24-hour PM₁₀ concentration occurs on the northeast Port PDA boundary at the Port (see Appendix 11A, Appendix D, Figure D.3).

Maximum PM_{2.5} Concentrations

The maximum predicted 24-hour and annual average PM_{2.5} concentrations including baseline are $9.19 \mu\text{g}/\text{m}^3$ and $2.43 \mu\text{g}/\text{m}^3$, respectively, and are less than the respective SOG/CAAQS.

The maximum predicted 24-hour and annual PM_{2.5} concentrations occur on the northeast PDA boundary at the Port (see Appendix 11A, Appendix D, Figure D.4 and Figure D.5).

Maximum NO₂ Concentrations

The maximum predicted 1-hour average NO₂ concentration in the metric of the CAAQS, including baseline, is $117 \mu\text{g}/\text{m}^3$ and is greater than the 1-hour CAAQS ($79 \mu\text{g}/\text{m}^3$). The maximum predicted annual average NO₂ concentration, including baseline, is $11.9 \mu\text{g}/\text{m}^3$ and is less than the annual CAAQS ($23 \mu\text{g}/\text{m}^3$).

The maximum predicted 1-hour and annual NO₂ concentrations occur on the northeast PDA boundary at the Port (Appendix 11A, Appendix D, Figure D.6 and Figure D.8). NO₂ concentrations greater than the 1-hour CAAQS ($79 \mu\text{g}/\text{m}^3$) are predicted to occur infrequently (14 days/year) and are limited to areas immediately around the PDA boundary (see Appendix 11A, Appendix D, Figure D.7).

Maximum SO₂ Concentrations

The maximum predicted 1-hour and annual average SO₂ concentrations including baseline are $25.0 \mu\text{g}/\text{m}^3$ and $5.05 \mu\text{g}/\text{m}^3$, respectively, and are less than the respective CAAQS.

The maximum predicted 1-hour and annual SO₂ concentrations occur on the northeast PDA boundary at the Port (see Appendix 11A, Appendix D, Figure D.9 and Figure D.10).

Maximum CO Concentrations

The maximum predicted 1-hour (9th highest) and 8-hour average CO concentrations including baseline are 1,511 µg/m³ and 1,497 µg/m³, respectively, and are less than the respective SOGs.

The maximum predicted 1-hour (9th highest) and 8-hour CO concentrations occur on the northeast PDA boundary at the Port (see Appendix 11A, Appendix D, Figure D.11 and Figure D.12).

Maximum Dustfall

The maximum predicted 30-day average dustfall including baseline is 1.26 mg/dm²/day and is less than the BC PCO for residential/parkland areas (1.75 mg/dm²/day) and industrial/other areas (2.9 mg/dm²/day).

The maximum predicted dustfall occurs on the northeast PDA boundary at the Port (see Appendix 11A, Appendix D, Figure D.13).

Maximum Potential Acid Input

The maximum predicted annual PAI including baseline is 0.0794 keq H⁺/ha/y.

Model Predictions at High Lake Mineral Exploration Camp

The ACPI were assessed at the High Lake Mineral Exploration Camp, the nearest sensitive receptor to the Project. The maximum predicted concentrations of all ACPI at the High Lake Mineral Exploration Camp are below their relevant SOGs.

11.3.3 Summary of Project Residual Effects

Table 11.17 summarizes project residual effects on Air Quality. A discussion of the residual effects characterization follows Table 11.17.

Table 11.17 Project Interactions with Air Quality

Residual Effect	Residual Effects Characterization							
	Project Phase	Direction	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
Changes in Air Quality	C	A	L/M/H	LAA	MS	ST	IR	R
	O	A	L/M/H	LAA	MS	LT	IR	I
Key: See Table 11.3 for detailed definitions Project Phase: C: Construction O: Operations and Maintenance Direction: P: Positive A: Adverse N: Neutral Magnitude: NMC: No Measurable Change L: Low M: Moderate H: High Geographic Extent: PDA: Project Development Area LAA: Local Assessment Area RAA: Regional Assessment Area Timing: NS: No sensitivity MS: Moderate sensitivity HS: High sensitivity Duration: ST: Short-term LT: Long-term Frequency: S: Single event IR: Irregular event R: Regular event C: Continuous Reversibility: R: Reversible I: Irreversible N/A: Not applicable								

The following provides description and rationale for the characterizations provided in Table 11.17.

- Direction:
 - The direction for change in air quality during the Construction phase is rated adverse (A) because the Construction phase results in a residual effect that moves measurable parameters in a direction detrimental to air quality relative to baseline.
 - The direction for change in air quality during the Operations and Maintenance phase is rated adverse (A) because the Operations and Maintenance phase results in a residual effect that moves measurable parameters in a direction detrimental to air quality relative to baseline.
- Magnitude:
 - The magnitude for change in air quality during the Construction phase is rated low (L) to high (H) because the Construction phase results in predicted ambient concentrations for ACPI that are (i) greater than 10% of baseline concentrations but less than 50% of the ambient air quality SOG (L), (ii) greater than 50% of ambient air quality SOG (M), and (iii) greater than their SOG/CAAQS (TSP, PM₁₀, and NO₂). The TSP and PM₁₀ exceedances during construction are infrequent (fewer than 5 days/year) and limited to areas immediately around the PDA boundary. The predicted maximum 1-hour NO₂ concentrations above the CAAQS extend up to 2 km along the shoreline and 6 km over Grays Bay. NO₂ exceedances decrease

- with distance, with the highest frequency of exceedance along the PDA boundary up to 127 days/year and dropping to fewer than 30 days/year within 1.5 km of the PDA boundary along the shoreline. Due to natural atmospheric dispersion, the model predicted air quality effects for NO₂ decrease rapidly with the increasing distance from the sources and the PDA boundary. The air dispersion modelling was conducted following regulatory guidance, but the results are considered conservative because of the use of older equipment with higher emissions, and the worst-case emissions year was assessed. At the High Lake Mineral Exploration Camp, the predicted ACPI concentrations remain below applicable SOGs.
- The magnitude for change in air quality during the Operations and Maintenance phase is rated low (L) to high (H) because the Operations and Maintenance phase results in predicted ambient concentrations of ACPI that are (i) greater than 10% of baseline concentrations but less than 50% of the ambient air quality SOG (L), (ii) greater than 50% of ambient air quality SOG (M), and (iii) greater than the SOG/CAAQS (NO₂). However, where 1-hour NO₂ concentrations are predicted to be greater than the CAAQS, the exceedances are infrequent (fewer than 14 days/year) and limited to areas immediately around the PDA boundary.
 - Geographic Extent:
 - The geographic extent for change in air quality during the Construction phase is the LAA because the Construction phase results in increased predicted ambient concentrations and dustfall within the LAA.
 - The geographic extent for change in air quality during the Operations and Maintenance phase is the LAA because the Operations and Maintenance phase results in increased predicted ambient concentrations and dustfall within the LAA.
 - Timing:
 - Air emissions released during the Construction phase and the corresponding ambient concentrations and dustfall vary with season and time of day. Therefore, timing is moderate sensitivity (MS) as effects may occur during a lower sensitive period of a critical life stage or may partially overlap with culturally important activities.
 - Air emissions released during the Operations and Maintenance phase and the corresponding ambient concentrations and dustfall vary with season and time of day. Therefore, timing is moderate sensitivity (MS) as effects may occur during a lower sensitive period of a critical life stage or may partially overlap with culturally important activities.
 - Duration:
 - The duration for change in air quality during the Construction phase is short-term (ST) because the predicted increase in ambient concentrations and dustfall due to project construction extends through the Construction phase, which is a period of 5 years.
 - The duration for change in air quality during the Operations and Maintenance phase is long-term (LT) because the predicted increase in ambient concentrations and dustfall due to project operations extends through the Operations and Maintenance phase, which is longer than 5 years.

- Frequency:
 - The frequency for change in air quality during the Construction phase is rated irregular event (IR) because the predicted ambient concentrations at a given location are variable in time depending on the current meteorological conditions, although emissions could be continuous.
 - The frequency for change in air quality during the Operations and Maintenance phase is rated irregular event (IR) because the predicted ambient concentrations at a given location are variable in time depending on the current meteorological conditions, although emissions could be continuous.
- Reversibility:
 - The reversibility for changes in air quality during the Construction phase is rated reversible (R) because the predicted increase in ambient concentrations and dustfall due to the Construction phase would return to baseline conditions after the end of the Construction phase.
 - The reversibility for changes in air quality during the Operations and Maintenance phase is rated irreversible (I) because the predicted increase in ambient concentrations and dustfall due to the Operations and Maintenance phase will not cease because the temporal scales for the Project do not include decommissioning and/or closure.

11.3.4 Transboundary Effects

An assessment of the potential for transboundary effects on air quality is provided in Volume 10, Section 33 Transboundary Effects Assessment.

11.3.5 Effects of Climate Change on Air Quality

The emissions and dispersion of ACPI from project activities can be influenced by climate change. Kitikmiut have reported changes in snow conditions, water quality, vegetation, wildlife, and other factors as a result of increased dust, which has been attributed to climate change. Emissions from the Project are not expected to notably change due to climate change. Some reduction in heating energy use and increase in cooling requirements may occur; however, this change is expected to be minimal overall as the majority of energy use for the Project is not related to heating and cooling (e.g., off- and on-road diesel use).

Changes in the precipitation regime (due to climate change) can result in drier or wetter conditions that directly influence the generation of fugitive dust from open sources, such as stockpiles and haul roads. Changes to winter (frozen) conditions and the amount of precipitation are factors used to calculate natural dust control rates (dust emission rates) in the air dispersion modelling. Warmer air temperatures can extend the duration of the summer season when most of the fugitive dust will be generated by project activities. Climate change is expected to increase the frequency of wildfires and, therefore, there will be a corresponding increase in the frequency of the ambient air quality being negatively affected by wildfire smoke drifting over the project area.

Meteorological data used for air dispersion modelling is based on weather data observations for a recent historical time period. Meteorological data for five years (2020 to 2024) were used for the air dispersion modelling. Climate change may result in some changes in average and extreme values; however, the five-year meteorological data set is still considered adequate for predicting air quality effects because it uses many combinations of different meteorological conditions to identify worst-case dispersion conditions. The magnitude of changes to meteorological data due to climate change are generally expected to be small compared to the range of values evaluated using the five-year data set. The range in the values of air temperatures in the five-year meteorological data set used for the air dispersion modelling (i.e., -48°C to +36°C) is large compared to the expected shift in the climate change predictions for the mean and maximum air temperatures (i.e., a few degrees Celsius projected by the SSP5-8.5 climate change model for the 2021 to 2050 period [Appendix 12A]). The published guidance (ENVP 2022) was followed for the air dispersion modelling and there is no accepted methodology to adjust meteorological data to account for climate change. As a result, no additional air dispersion modelling iterations (sensitivity analysis) for dust and gaseous emissions are required to address the potential effects of climate change on the model-predicted ambient air quality.

11.4 Assessment of Cumulative Effects

11.4.1 Project Residual Effects Likely to Interact Cumulatively

Appendix 9A in Volume 4, Effects Assessment Methodology, presents the Project Inclusion List, which identifies other projects and physical activities whose effects might act cumulatively with the residual effects of the Project. Where residual effects from the Project act cumulatively with residual effects from other projects and physical activities (Table 11.18), a cumulative effects assessment is carried out.

Table 11.18 Interactions with the Potential to Contribute to Cumulative Effects

Physical Activities	Effects
	Change in Ambient Air Quality
Past	
Bathurst Inlet	–
Omingmaktok	–
Snap Lake Mine	–
Present	
Arcadia Bay Project	–
B2Gold George Property	–
B2Gold Marine Laydown Area	–
Bulk Carriers	✓
Cambridge Bay	–
Chuk and Fire Shear Blocks	–
Commercial Cargo	✓
Commercial and Domestic Harvesting	–
Coppermine Project	–

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Physical Activities	Effects
	Change in Ambient Air Quality
Coppermine River Project	–
Diavik Diamond Mine	–
Ekati Diamond Mine	–
Epworth Project	–
Fishing Vessels	✓
Gahcho Kué Diamond Mine	–
Goose Mine	–
Hackett River Project	–
High Lake (Izok Corridor Project)	–
High Lake East	–
Hood River Gold Project	–
Hope Bay Project	–
Hydroelectric	–
Icebreakers	✓
Itchen Lake Property	–
Izok Lake (Izok Corridor Project)	–
Jericho Mine	–
Kennady North - Exploration	–
Kugluktuk	–
Lupin Mine	–
Muskox Nickel Property	–
Nunavut Community Infrastructure	–
NT Community Infrastructure	–
Overflights	–
Passenger Ships and Pleasure Craft	✓
Pistol Lake Project	–
Rae Copper Exploration Project	–
Rockinghorse (Koamaogaktok) Project	–
Roma Project	–
Scientific Research	–
South Kitikmeot Gold Project	–
Tanker Ships	✓
Tibbitt to Contwoyto Winter Road	–
Tourism	–
Tree River Lodge	–
TTMG Project	–
Tugs/Barges	✓

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Section 11: Assessment of Potential Effects on Air Quality
March 2026

Physical Activities	Effects
	Change in Ambient Air Quality
Ulu Gold Project	–
Wolf/Mistake Lake Property	–
Yellowknife City Gold Project	–
Past and Reasonably Foreseeable	
Indin Lake Gold Project	–
Mon Mine	–
Yellowknife Gold Project	–
Project-Related Physical Activities	
Reasonably Foreseeable	
Arctic Economic and Security Corridor	–
Courageous Lake Mine	–
NICO	–
Reasonably Foreseeable Induced	
Grays Bay Road and Port: Bulk Fuel Storage Expansion, Grays Bay Port	✓
Grays Bay Road and Port: Bulk Fuel Storage Expansion: Jericho	✓
Grays Bay Road and Port: Airstrip Expansion	✓
Grays Bay Road and Port: Road Traffic	✓
Grays Bay Road and Port: Port Traffic	✓
Grays Bay Road and Port: Air Traffic	✓
Grays Bay Road and Port Phase 2 – Jericho Mine to NT Border	✓
Hackett River Project	–
Hackett and Back River Access Road	✓
High Lake Mine (Izok Corridor Project)	✓
Izok Lake Mine (Izok Corridor Project)	–
Izok Lake Access Road	✓

Notes:

✓ = Other projects and physical activities whose residual effects are likely to interact cumulatively with the Project residual effects.

– = Interactions between the residual effects of other projects and residual effects of the Project are not expected.

Effects identified in Table 11.18 as not likely to interact cumulatively with residual effects of other projects and physical activities (no check mark) are briefly discussed below. The assessment of the cumulative effects that are likely to result from the Project in combination with other projects and physical activities are discussed in subsequent sections.

Past Physical Activities and Resource Uses (e.g., Bathurst Inlet) do not have the potential to cumulatively interact with the residual air quality effects for the Project because past projects do not have air contaminant emissions that could interact with the Project's air contaminant emissions. During engagement on a previous project, Tłıcho Elders expressed concern that mines, and the associated effects, including smoke, will disrupt migration patterns and, therefore, caribou distribution and vegetation. The Elders attributed loud noise and the smell of fumes and smoke during the construction phase of Ekati Mine Site as the reason that caribou travelled away. They added that they have observed caribou growing accustomed to loud noise such as planes, and the elders are therefore fearful that the caribou will become accustomed to the noise, smell of fumes and smoke associated with mines (GKP 2010).

Present Physical Activities and Resource Use located outside of the air quality RAA (e.g., Lupin closed mine) are unlikely to interact cumulatively with the Project due to being substantially geographically removed from the Project. Emissions from a source emitting into the atmosphere will disperse as they are carried downwind, with the ambient concentration in the plume decreasing with increasing distance from the source, until eventually it will reach a level at which the concentration of the chemical in the plume is indistinguishable from the ambient background level. Therefore, the potential for emissions sources to interact cumulatively will decrease with increasing distance between the two sources.

Some Present Physical Activities and Resource Uses are located inside the air quality RAA however, many of these activities (e.g., Chuk and Fire Shear Blocks, High Lake mineral exploration, Hood River Gold, Roma, Ulu, and Mistake Lake) are currently in the mineral exploration phase (with no active mining) and will have emissions of ACPI that are typically minor, localized and of short duration. As a result, ACPI plumes generated by these activities are anticipated to have minimal interaction with ACPI plumes generated by the Project.

The TCWR is not anticipated to have cumulative air quality effects with the Project for the following reasons:

- Only 13% of the TCWR is on land and the remainder (87%) is over frozen lakes during the winter. There would be negligible dust from the TCWR during January to April (see Volume 4, Appendix 9A).
- The gaseous emissions of ACPI from the TCWR during those four months would be short term (non-continuous) and transient/mobile in nature.
- The only part of the TCWR that would interact with the Project is near Jericho Station, the majority of the TCWR footprint is too far away from the RAA for the plumes of ACPI to cumulatively interact.

The closed Lupin mine site is located more than 25 km southeast of Jericho Station. At this separation distance there would be negligible interactions of the ACPI plumes and therefore negligible air quality cumulative effects. The closed Lupin mine is located approximately 5 km southwest of the Grays Bay Winter Road. Similar to TCWR, the physical activities and ACPI emissions associated with the Grays Bay Winter Road would be for four months and would be short term (non-continuous) and transient/mobile in nature. For these reasons there would be negligible interactions of the ACPI plumes and therefore negligible air quality cumulative effects.

The three reasonably foreseeable physical activities (Arctic Economic and Security Corridor, Courageous Lake Mine and NICO) are greater than 50 km from the Project and due to the large separation distances, there would be negligible interactions of the ACPI plumes and therefore negligible air quality cumulative effects.

The assessment of the potential cumulative effects for the Reasonably Foreseeable Induced Projects is discussed below in Section 11.4.2.3.

11.4.2 Change in Concentrations of Ambient Air Pollutants

11.4.2.1 Cumulative Effect Pathways

Cumulative effects for a change in ambient air quality are possible if a present or future physical activity is in close enough proximity to the Project that their ACPI emissions could overlap. In addition, the present or future physical activity and the Project have to occur at the same time for a cumulative effect to occur. The air contaminant emissions from the Present Physical Activities and Resource Use identified in Table 11.17 (primarily marine traffic), have the potential to cumulatively interact with the Project's residual effects for a change in ambient air quality. The baseline values (Section 11.2) conservatively included emissions from sources similar to these Present Physical Activities and Resource Use and were therefore inherently considered in the Project's residual effects assessment for a change in ambient air quality.

11.4.2.2 Mitigation, Management, and Enhancement Measures for Cumulative Effects

The mitigation measures for the Project are described in Section 11.3.2.3 above. Measures for mitigating ACPI concentrations from the Project will also mitigate cumulative ambient air quality effects; as such, no additional mitigation specific to cumulative effects is proposed. These mitigation measures can, generally, be implemented by other parties (i.e., proponents of projects listed in Table 11.17 to reduce the potential cumulative effects for a change in ambient air quality of their projects.

11.4.2.3 Cumulative Effects

With mitigation, the maximum predicted concentrations of all ACPI in the Application Case (the Project plus background) are less than the applicable SOG during the Operations and Maintenance phase, with the exception of infrequent 1-hour average NO₂ concentrations (see Section 11.3.2.4). NO₂ concentrations in the RAA are primarily influenced by and diesel combustion from power generation, diesel combustion in vehicles travelling within the Port PDA, and contributions from landing and take-off cycles occurring at the airstrip. It is predicted that NO₂ concentrations greater than the 1-hour value of 79 µg/m³ outside of the Port PDA during operations and maintenance may occur infrequently at 14 days per year and are limited to areas immediately around the northeast Port PDA boundary.

Given the proximity and description of Reasonably Foreseeable activities (Table 11.18), project-specific residual environmental effects will likely act cumulatively with other physical activities, but the resulting cumulative effects are unlikely to exceed acceptable levels with the application of management practices and proposed mitigation measures at each project. The residual cumulative effect (i.e., the effect of all future foreseeable activities) on ambient air quality is anticipated to be adverse in direction, high in magnitude (a measurable change higher than the regulatory limits is predicted for hourly NO₂, as discussed in Section 11.3.2.4, while all other ACPI are below their regulatory criteria), limited to the LAA, long-term in duration, infrequent regular events in frequency and irreversible within the airshed. Due to natural atmospheric dispersion, the model predicted air quality effects for NO₂ decrease rapidly with the increasing distance from the sources and the PDA boundary. The air dispersion modelling was conducted following regulatory guidance, but the results are considered conservative because of the use of older equipment with higher emissions, and the worst-case emissions year was assessed.

Dust deposition (i.e., dustfall) was raised as a key concern during engagement and consultation with the Kitikmiut and other Indigenous groups (see Section 11.2.2). The residual cumulative effect on ambient air quality, relative to particulate matter, is anticipated to be adverse in direction, moderate in magnitude, limited to the LAA, long-term in duration, infrequent regular events in frequency and reversible within an airshed that is typical of northern Canada. Timing will be of moderate sensitivity as the increase in ambient levels of particulates may be affected by seasonal variations in road dust control efficiencies.

Cumulative Effects – Reasonably Foreseeable Induced Activities

Some reasonably foreseeable induced (RFI) activities located in the air quality RAA will have the potential to cumulatively interact with the residual air quality effects for the Project. RFI activities were not modelled due to limited availability of the necessary descriptive information on these activities, and estimations of equipment usage, fuel consumption rates, and additional quarrying operations were not made due to the high degree of uncertainty. Many of the RFI activities are separated in both time and location from each other and from the activities related to the Project. Nonetheless, some overlap may occur locally where the RFI and project activities coincide. Some RFI activities are anticipated to increase vehicle traffic levels for the Project, resulting in increased ACPI emissions.

The dispersion model predictions of the Operations and Maintenance phase (Table 11.14 and Table 11.15) when most RFI activities are expected, indicate that the concentrations of all other ACPI (excluding NO₂) are less than their relevant SOG, suggesting that the Project and the RAA have capacity to accommodate increased emissions without significant adverse cumulative effects. Regarding NO₂, increases in shipping activities are anticipated within Grays Bay and at the Port; however, as discussed in Section 11.3.2.4, and further highlighted in the Concentration Contour Plots for Construction (see Appendix 11A, Appendix C, Figure C.9), shipping vessels do not contribute substantially to the 1-hour NO₂ values that the air dispersion model predicted to be greater than the CAAQS for areas outside of the PDA. Consequently, the increased shipping movements due to RFI activities are not anticipated to alter this conclusion.

Furthermore, as discussed in Section 11.3.2.4, concerns regarding snow quality impacted by dust deposition were raised during engagement and consultation with Kitikmiut and other Indigenous groups. RFI activities have the potential to interact cumulatively with the Project (through increased traffic levels) to possibly further degrade snow quality adjacent to the Project.

It is anticipated that each RFI activity will be subject to an environmental assessment by its respective proponent, with these evaluations considering interactions with the Project. During such assessments, proponents may also recommend targeted mitigation measures to further reduce the potential for significant adverse effects.

The project model predictions (Table 11.14 and Table 11.15) depend on the representativeness of the source and emission inventory, the meteorological conditions used in the model, and the algorithms used to represent atmospheric physics and chemistry processes. Predicting effects on air quality associated with transportation and mining-related projects is challenging as ACPI (including vehicle emissions and fugitive dust) emission sources are intermittent and spatially variable. The magnitude of emissions depends upon dynamic environmental (e.g., changing road conditions) and meteorological factors (e.g., seasons, wind speed, temperature, humidity, precipitation). Emission inventory methods necessarily simplify these complexities by applying conservative simplifying assumptions that overestimate expected emissions. Accordingly, the magnitude of model predictions for transportation and mining-related projects with fugitive dust sources are inherently uncertain. This is not a unique characteristic of the Project. Consequently, the capacity of the LAA/RAA to accommodate ACPI may be greater than estimated in this assessment.

11.4.3 Summary of Cumulative Effects

Table 11.19 summarizes cumulative effects on Air Quality during the Operations and Maintenance phase.

Table 11.19 Residual Cumulative Effects on Air Quality

Residual Cumulative Effect	Residual Cumulative Effects Characterization						
	Direction	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
Changes in Air Quality	A	L/M/H	LAA	MS	LT	IR	I*
Contribution from the Project to Residual Cumulative Effect for Air Quality	In combination with present and reasonably foreseeable induced activities, the Project will result in increase in cumulative air quality effect with low magnitude, RAA extent, moderate sensitivity to timing, short-term duration, irregular frequency, and reversible.						
Key: See Table 11.3 for detailed definitions							
Direction: <i>P: Positive</i> <i>A: Adverse</i> <i>N: Neutral</i>		Geographic Extent: <i>PDA: Project Development Area</i> <i>LAA: Local Assessment Area</i> <i>RAA: Regional Assessment Area</i>			Frequency: <i>S: Single event</i> <i>IR: Irregular event</i> <i>R: Regular event</i> <i>C: Continuous</i>		
Magnitude: <i>NMC: No Measurable Change</i> <i>L: Low</i> <i>M: Moderate</i> <i>H: High</i>		Timing: <i>NS: No sensitivity</i> <i>MS: Moderate sensitivity</i> <i>HS: High sensitivity</i>			Reversibility: <i>R: Reversible</i> <i>I: Irreversible</i>		
		Duration: <i>ST: Short-term</i> <i>MT: Medium-term</i> <i>LT: Long-term</i>			<i>N/A: Not applicable</i>		

Note:

* the operations and maintenance phase of the Project is expected to extend into perpetuity

The following provides description and rationale for the characterizations provided in Table 11.19.

- **Direction:**
 - The direction for change in air quality is rated adverse (A) because the cumulative effects assessment results in a residual effect that moves measurable parameters in a direction detrimental to air quality relative to baseline.
- **Magnitude:**
 - The magnitude for change in air quality, related to hourly NO₂, is rated high (H) because the cumulative effects assessment predicts a measurable change in air quality greater than the SOG (similar in magnitude to the Operations and Maintenance phase alone). Due to natural atmospheric dispersion the model predicted NO₂ concentrations are reduced rapidly with increasing distance from the sources of the NO₂ emissions and the PDA boundary. The air dispersion modelling was conducted following regulatory guidance, but the results are considered conservative because of the use of older equipment with higher emissions, and the worst-case emissions year was assessed. Furthermore, where ambient concentrations

- are predicted to be greater than their SOG/CAAQS, the exceedances are anticipated to occur less than 10% of the time for the relevant averaging period.
- The magnitude for change in air quality, related to the other ACPI, is rated as low (L) to moderate (M) because the cumulative effects assessment predicts a measurable change in air quality less than 50% of the applicable SOG, but less than 100% of the SOG.
 - Geographic Extent:
 - The geographic extent for change in air quality is the LAA because the increase in ambient concentrations and dustfall is expected to be within the LAA.
 - Timing:
 - Air emissions, and the corresponding ambient concentrations and dustfall, vary with season and time of day. Therefore, timing is moderate sensitivity (MS) as effects may occur during a lower sensitive period of a critical life stage or may partially overlap with culturally important activities.
 - Duration:
 - The duration for change in air quality is long-term (LT) because the predicted increase in ambient concentrations and dustfall extends through the Operations and Maintenance phase, which is longer than 5 years.
 - Frequency:
 - The frequency for change in air quality is rated irregular event (IR) because the predicted ambient concentrations at a given location are variable in time depending on the current meteorological conditions, although emissions could be continuous.
 - Reversibility:
 - The reversibility for changes in air quality during is rated irreversible (I) because the potential increase in ambient concentrations and dustfall will continue throughout all the project phases and the temporal scales for the Project do not include decommissioning and/or closure.

11.5 Significance of Effects

11.5.1 Significance of Project Residual Effects

For a change in ambient air quality, a significant adverse residual environmental effect is defined as a project-related environmental effect that degrades the quality of the ambient air such that the maximum ground-level concentrations of ACPI from the Project (in various phases) often exceeds the respective air quality SOG, as outlined in Table 11.2. A widely adopted convention of significance is the 5% level (Fisher 1926; Tippet 1951; Snedecor & Cochran 1971), such that an event that occurs less than 5% of the time is not considered significant. Furthermore, although typically used for vegetative studies, the Braun-Blanquet Frequency Classes (Braun-Blanquet 1964) defines occurrences of <5% to be “very rare” and occurrences of 5 – 25% to be “rare”. These thresholds are used here to consider the significance of exceedances for the SOGs. Criteria identified by IAG members help to further define significant or unacceptable effects.

As discussed in Section 11.1.6, the CAAQS are non-regulatory health and environmentally based ambient air quality objectives that are used to assess general air quality in air zones and reflect desirable concentrations of contaminants in air from all sources (MECP 2024). Furthermore, dispersion models often produce results that are conservative (i.e., they overpredict the ambient concentrations due to project activities) (Pace 2005; Countess 2007; Pouliot et al. 2010). Consequently, predicted concentrations that are greater than the applicable SOGs, in themselves, do not imply that the effect on ambient air quality is significant.

For the Construction phase, the Project is predicted to increase ACPI concentrations above baseline, with some ACPI (24-hour average TSP and PM₁₀, and 1-hour and annual average NO₂) having maximum predicted concentrations within the LAA greater than their applicable SOG. The maximum predicted concentrations of all other ACPI are below their SOG/CAAQS throughout the LAA. For 24-hour average TSP and PM₁₀, the predicted spatial extents of exceedances in the LAA are small (immediately around the PDA boundary) and rare (fewer than five days per year). The model predicted hourly average NO₂ concentrations greater than the CAAQS may occur up to 2 km along the shoreline and 6 km over Grays Bay. Due to natural atmospheric mixing the model predicted NO₂ concentrations reduce rapidly with increasing distance from the NO₂ emission sources and the PDA boundary. The air dispersion modelling was conducted following regulatory guidance, but the results are considered conservative because of the use of older equipment with higher emissions, and the worst-case emissions year was assessed. The highest frequency is 127 days per year at the PDA boundary dropping to less than 30 days per year within 1.5 km of the PDA boundary at the shoreline. Furthermore, all ACPI are predicted to be less than their air quality standards at the High Lake Mineral Exploration Camp, which is the nearest sensitive receptor. Given the limited duration of the Construction phase (5 years), and the infrequent or limited spatial extent of ACPI concentrations above relevant SOGs in areas where the potential for individual exposure is expected to be low (since there are no permanent communities), the Construction phase residual environmental effects on air quality in the LAA are not significant.

For the Operations and Maintenance phase, the Project is predicted to increase ACPI concentrations above baseline, with only one ACPI (1-hour average NO₂) having a maximum predicted concentration within the LAA greater than the applicable ambient air quality objective. The predicted hourly average NO₂ concentrations greater than the CAAQS may occur fewer than 14 days per year and limited to immediately around the PDA boundary. The ACPI are predicted to be less than their SOGs at the High Lake Mineral Exploration Camp, the nearest sensitive receptor. Since the hourly NO₂ concentrations greater than the CAAQS are infrequent and only in areas with a low potential for individual exposure, the Operations and Maintenance phase residual environmental effects on air quality in the LAA are not significant.

11.5.2 Significance of Cumulative Effects

When considered alongside past, present, and future activities, the Project's residual environmental effects on air quality within the LAA are not significant. While the magnitude of the residual effect on air quality is high, relative to NO₂, the magnitude is moderate or low for all other ACPI. Furthermore, the effects are limited to the LAA, long-term in duration, infrequent regular events in frequency and irreversible within an airshed that is typical of northern Canada.

When considering RFI activities, as discussed in Section 11.4.2.3, many of these activities are separated by both time and space from each other and from the Project. Additionally, Table 11.14 and Table 11.15 show that during the Operations and Maintenance phase, when RFI activities may occur, concentrations of key ACPI remain less than their relevant SOGs. Future advancements in air contaminant emissions reduction technologies, especially for the mobile and stationary equipment that relies on fossil fuel combustion, will reduce the potential air quality effects from the RFI activities. In addition, each RFI activity is expected to undergo an environmental assessment by the respective proponent, which will include consideration of potential interactions with the Project to avoid significant adverse air quality effects.

11.5.3 Summary of Mitigation, Management, and Enhancement Measures

The effects management measures described in Section 11.3.2.3 for air quality emissions have been considered in the assessment of the residual effects and no additional effects management measures are proposed to reduce the effects. These measures take into consideration the values identified by Kitikmiut, other Indigenous groups, and other potentially affected communities.

11.6 Prediction Confidence and Uncertainty

The air quality assessment depends on air quality simulation models to link emissions to air quality changes, and the model predictions depend on the representativeness of the source and emission inventory, the meteorological conditions used in the model, and the algorithms used to represent atmospheric physics and chemistry processes in the models.

WKR will continue to respond to questions and concerns from Kitikmiut, other Indigenous groups, and other potentially affected communities through its ongoing engagement efforts and information provided following submission of the IS will be reviewed in the context of the IS and for incorporation into project planning, as appropriate.

11.6.1 Emission Uncertainty

Diesel exhaust emissions from construction and non-road equipment were based on emission factors generated by the U.S. EPA's MOVES3 (U.S. EPA 2021). Therefore, the level of confidence associated with the estimation of gaseous ACPI emissions (e.g., NO_x, SO₂, and CO) and PM from these sources is moderate to high.

Diesel exhaust emissions from power generation were based on manufacturer specifications and therefore, the level of confidence associated with the estimation of ACPI emissions (e.g., NO_x, SO₂, CO and PM) from these sources is moderate to high.

Aircraft exhaust emissions were estimated using emission factors based on aircraft category without a provided rating. Therefore, the level of confidence associated with the estimation of ACPI emissions (e.g., NO_x, SO₂, and CO) and PM from these sources is low.

Fugitive NO₂ emissions due to blasting operations are estimated using algorithms developed by the U.S. EPA that have a low emission factor rating. Consequently, the level of confidence associated with the estimation of NO₂ from blasting operations is low.

Fugitive PM (i.e., blasting operations, earth moving operations, quarrying activities, movement of non-road equipment and on-road vehicles along unpaved roads), and associated TSP, PM₁₀, and PM_{2.5} emission rates, depend on the properties of the surface material, the occurrence and history of surface disturbances, and meteorological conditions. While the air quality assessment uses emission estimation algorithms developed by the U.S. EPA, there is uncertainty associated with estimating these emissions. Particularly, fugitive road dust emissions estimated with the U.S. EPA emission factors have been found to substantially overpredict PM emissions. This emissions overprediction results in overprediction of the associated ambient TSP, PM₁₀, and PM_{2.5} concentrations and dustfall deposition. Multiple investigators have found consistent overpredictions when comparing the predicted fugitive PM concentrations from air quality models to measured PM concentrations, typically by a factor of 2 to 6 (Pace 2005; Countess 2007; Pouliot et al. 2010).

Pace (2005) states that “Most experts agree that this overestimation is due to a combination of shortcomings in the inventory modelling process: 1) the multiplier used to “scale” or infer PM_{2.5} from PM₁₀ emissions in the inventory, 2) faulty emission factor algorithms, 3) imprecise or difficult to obtain activity data to apply these algorithms (including inability to account for the effect of actual meteorological conditions on emissions), and 4) modelling deficiencies (especially in the treatment of particles near their point of emissions).”

Practitioners often reduce particulate matter emission rates by a factor between 2 and 6 to account for these issues. In this assessment, fugitive dust emissions estimated using the U.S. EPA approach were used without reduction to obtain a first order understanding of potential magnitude, geographic extent, and frequency of the maximum concentrations in the LAA due to the Project. Therefore, the PM concentration and deposition predictions are expected to be conservative and overstated.

There is uncertainty about the future ACPI emissions related to the RFI activities. The uncertainty is related to the future technological advancements that are anticipated to reduce the future ACPI emissions from the RFI activities. Research is ongoing, especially for the stationary and mobile engines that rely on fuel combustion, and lower emitting energy sources could result in a reduction in ACPI emissions from the RFI activities. However, the pace and result of those technological advancements are uncertain.

11.6.2 Meteorology Uncertainty

The application of five years of hourly meteorological data includes a wide range of conditions which reduces the level of uncertainty related to meteorology. The use of five years of meteorological data is consistent with the recommendations provided in the BC Air Quality Dispersion Modeling Guideline (ENVP 2022). The level of confidence related to the meteorological data is rated as moderate to high.

11.6.3 Model Uncertainty

In terms of the air quality model algorithms, the U.S. EPA (2005) states:

“Models are reasonably reliable in estimating the magnitude of highest concentrations occurring sometime, somewhere within an area. For example, errors in highest estimated concentrations of ± 10 to $\pm 40\%$ are found to be typical, i.e., certainly well within the often-quoted factor of two accuracy that has long been recognized for these models.”

In addition, they also state,

“it is desirable to quantify the accuracy or uncertainty associated with concentration estimates used in decision making. Communications between modelers and decision makers must be fostered and further developed.”

The U.S. EPA (2005) indicates that the application of regulatory dispersion models is viewed as a best estimate approach and that this approach should be viewed as acceptable to the decision maker. The model approach that was used for this assessment is viewed as being a best practice approach. The level of confidence related to the air dispersion model is rated as moderate to high.

11.6.4 Overall Prediction Confidence for Changes in Air Quality

The level of confidence is high for the representativeness of the meteorological data, the selected model approach, and the overall effectiveness of the proposed mitigation measures. The prediction confidence associated with the estimated combustion emissions and estimation of fugitive dust emissions is low to moderate with emissions expected to primarily be over-estimated. For this reason, an ambient air quality and meteorology monitoring program is recommended during construction to confirm that the emission predictions are conservative for the worst-case project phase.

11.7 Follow-up and Monitoring

As described in Section 11.3.2.3, an AQMP will be created for all phases of the Project. The AQMP will include adaptive management recommendations to reduce fugitive dust emissions and evaluate the need for additional dust mitigation.

Monitoring will include meteorological monitoring (wind speed and direction, air temperature and relative humidity and rain precipitation) and ambient particulate monitoring for TSP. As will be outlined in the AQMP, review of the air quality and meteorological monitoring data and concurrent project activities that may release PM will be conducted, and the need for modification to water application rates or frequencies, or use of alternate dust suppressants will be evaluated. See Volume 11 for additional information on the Management Plans. WKR will continue to respond to questions and concerns from Kitikmiut, other Indigenous groups, other potentially affected communities through its ongoing engagement efforts.

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12 Climate

Climate change and its impacts are of notable importance to Inuit of the Kitikmeot Region (hereafter referred to as Kitikmiut), other Indigenous groups, and other potentially affected communities as it impacts the environment and traditional land, marine, and resource use (TLMRU; e.g., travel, animal migrations, hunting). Changes in climate and weather have been highlighted by Kitikmiut, with reports including experiencing increased wildfires, unpredictable ice conditions, melting permafrost, decreased precipitation, fluctuating water levels, coastal erosion, and changes in plants and wildlife, which are affecting communities (GBRP 2025; Banci and Spicker 2024; McLennan et al. 2022; WKSSS 2001).

Anthropogenic-driven climate change is a major environmental challenge and adds complexity and uncertainty to both projecting future conditions and in the reliability of project design, infrastructure, and mitigation strategies. Greenhouse gas (GHG) emissions that are released into the atmosphere contribute to changes in the climate (global warming). A GHG is any chemical that, in the atmosphere, absorbs and re-emits infrared radiation, which can warm the lower levels of the atmosphere. The chief GHGs are carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O); other GHGs include certain refrigerants (e.g., hydrofluorocarbons), sulphur hexafluoride, and nitrogen trifluoride. While CO₂, CH₄, and N₂O are readily emitted from both natural and human made activities (e.g., fossil fuel combustion), other GHGs are typically emitted from human activities (e.g., refrigerants). The Grays Bay Road and Port Project (Project) has the potential to both influence climate change through GHG emissions and to be influenced by climate change. The Project may be impacted by long term changes in climatic conditions (e.g., changes in sea ice cover and concentration, ocean wave activity) as well as by weather events (e.g., heavy rainfall, heavy snowfall, high winds).

This section of the Project Impact Statement (IS) presents discussions on climate change in the West Kitikmeot Region, an assessment of how the Project may contribute to climate change, and an assessment of how the Project may be impacted by climate change and weather events. These discussions were informed by engagement and Inuit, Indigenous, and Community Knowledge on the assessment (Section 12.1) and regulatory guidance for the two assessments (Section 12.2).

A climate summary for the West Kitikmeot Region, including observations by Inuit, Indigenous, and other communities and projected changes in annual and seasonal temperature and precipitation, is presented in Section 12.3. A Climate Profile (Appendix 12A) was prepared for the Project to support climate change considerations incorporated in the IS. The Climate Profile provides information on baseline (historical) and projected climate conditions for the Project as well as descriptions of the climate data sources and climate projections utilized to support the IS.

A GHG emissions assessment was completed to assess how the Project may contribute to climate change and is presented in Section 12.4. Project activities will release GHGs during construction and operations and maintenance and the GHG emissions assessment includes quantifying these emissions. Mitigation and management measures for GHG emissions are also presented. Reducing GHG emissions using best available technologies and best environmental practices reduces the effect that the Project has on climate. Canada has established GHG emission reduction targets, with the goal to have net-zero GHG emissions by 2050, through the *Canadian Net-Zero Emissions Accountability Act*.

A Climate Change Risk Assessment (CCRA) was completed to assess how the Project may be impacted by climate change and weather events. Climate change has the potential to impact the Project during construction and operations and maintenance phases. Climate risk refers to the possibility that an asset or asset component would be adversely affected if it had a severe and/or prolonged interaction with a climate-related hazard. Identifying climate-related risks to the Project (e.g., physical, functional, operational and maintenance) through a risk assessment and developing adaptation strategies will improve the Project's resilience to climate change. Adaptation strategy recommendations were developed to address the high-risk climate hazard-asset interactions identified in the CCRA. A summary of the CCRA is presented in Section 12.5 and the full report is presented in Appendix 12B.

12.1 Influence of Engagement and Inuit, Indigenous, and Community Knowledge on the Assessment

West Kitikmeot Resources Corp. (WKR) continues to engage with Kitikmiut, other Indigenous groups, and other potentially affected communities about the Project. A summary of engagement activities conducted from 2016 into 2025 is presented in Volume 3, Section 6 (Public Engagement). In addition to these activities, WKR conducted community-based primary research with residents and organizations of the Kitikmeot communities of Cambridge Bay, Gjoa Haven, Kugaaruk, Kugluktuk, and Taloyoak, along with organizations in Yellowknife. Additionally, an Inuit Advisory Group (IAG) was established to advise WKR on potential environmental and socio-economic effects or concerns related to the Project, planned mitigation approaches, and aspects of the environmental assessment, including, but not limited to, baseline conditions, and consideration and integration of Inuit, Indigenous, and Community Knowledge. Members were selected by the Kitikmeot Inuit Association and WKR based on their knowledge of many aspects of the natural and human environment, including but not limited to wildlife, fish, climate, land use and access, archaeology, and water in the project area.

To further inform the project design, a project-specific Inuit Knowledge report titled *Kitikmeot Knowledge of the Proposed Kogloktokyoak (Grays Bay) Port and Road Project Final Report* (Banci and Spicker 2024) was commissioned by WKR. This report, based on Inuit Knowledge contained in the Naonaiyaotit Traditional Knowledge Project (NTKP), was made available to WKR through a licensing agreement with the Kitikmeot Inuit Association.

Through the project-specific engagement program, Kitikmiut, other Indigenous groups, and other potentially affected communities shared comments, perspectives, concerns, and recommendations related to climate. Pertinent baseline information from Inuit, Indigenous, and Community Knowledge sources is not presented in the Climate Profile (Appendix 12A) and Climate Change Risk Assessment (Appendix 12B); rather, this information has been considered and summarized in Section 12.1.1 Table 12.1. This includes insight into baseline climate conditions and observed changes being experienced by Kitikmiut and other Indigenous groups. WKR commits to continued engagement with Kitikmiut, other Indigenous groups, and other potentially affected communities during the advancement of project design, planning, and monitoring, throughout the life of the Project.

At the time of filing the IS, no project-specific comments, concerns, or recommendations specifically related to GHGs have been shared through engagement.

12.1.1 Inuit, Indigenous, and Community Knowledge and Engagement Feedback

Through the project-specific engagement program delivered from 2016 into 2025, including community meetings, workshops, community-based primary research, the project-specific Inuit Knowledge report compiled from the NTKP database, and through a review of publicly available information, Kitikmiut, other Indigenous groups, and other potentially affected communities shared information, expressed concerns, and provided recommendations related to climate. This feedback has been considered and summarized in Table 12.1 and, where applicable, has been integrated into the assessment of potential project effects on climate (GHG emissions assessment) and the assessment of how the Project may be impacted by climate change and weather events (climate change risk assessment) that follow.

Table 12.1 Summary of Inuit, Indigenous, and Community Knowledge and Engagement Feedback

Comment	Source	WKR Response	Where Addressed
NTKP consultants shared that the weather and climate are changing and temperatures are increasing. <i>It used to get really cold. Now it's getting warmer. The ocean doesn't freeze anymore; it's like slush.</i> During early engagement on the Project, Kugluktuk Hunters and Trappers Organization reported that the warming climate is affecting caribou.	Banci and Spicker 2024; GBRP 2017	WKR acknowledges these observations and concerns and has incorporated Inuit, Indigenous, and Community observations of the weather and climate in the baseline climate discussion and concerns into the relevant sections of the IS (e.g., VC assessments). Inuit, Indigenous, and Community Knowledge and engagement feedback and climate-related concerns provided insight and guidance into relevant climate parameters for consideration in the Project, including the Climate Profile and Climate Change Risk Assessment. The Climate Change Risk Assessment also includes adaptive measures and long-term resilience strategy recommendations. WKR commits to continued engagement on weather and climate and the influence on other topics (e.g., wildlife) as applicable during the advancement of project design, planning, and monitoring throughout the life of the Project.	See Sections 12.3 and 12.3.1 for a discussion of baseline climate in the West Kitikmeot Region. See Appendix 12A for the Climate Profile. See Appendix 12B for the Climate Change Risk Assessment. A summary of the assessment is also provided in Section 12.5. See Volume 6, Section 16.4.7 for a discussion on the effects of climate change on caribou and Section 16.7.3 for a discussion on mitigation, management, and enhancement measures for caribou. See also the Wildlife Mitigation and Monitoring Plan

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Comment	Source	WKR Response	Where Addressed
NTKP consultants stated that sea levels are changing, with some stating that, the levels are going down. Consultants have also observed the freshwater levels going down as well, including in the Bathurst Inlet area. They expressed concern about the ability of Arctic char to travel up the rivers.	Banci and Spicker 2024	See above.	See Sections 12.3 and 12.3.1 for a discussion of baseline climate in the West Kitikmeot Region. See Volume 7, Section 20.2.2.4.1 and Volume 8, Section 22.2.2.3.3 for discussions on Arctic char, Volume 7, Section 20.3.6 and Volume 8, Section 22.3.7 for discussions on the effects of climate change on freshwater and marine fish and fish habitats, respectively, and Volume 7, Section 20.5.3 and Volume 8, Section 22.5.3 for discussions on mitigation, management, and enhancement measures for freshwater and marine fish and fish habitats, respectively.
NTKP consultants reported changes in lake and sea ice, including that the ice is thinner, slushy, arriving later, and melting earlier. They stated that the decreased ice quality poses a safety concern to people. These changes have been observed in several locations in the vicinity of the Project, including Bay Chimo, Cambridge Bay, and Bathurst Inlet. During early engagement on the Project, participants from Kuugaruk expressed concern about the thickness of ice as a result of climate change.	Banci and Spicker 2024; GBRP 2017	See above.	See Sections 12.3 and 12.3.1 for a discussion of baseline climate in the West Kitikmeot Region.
NTKP consultants reported that the winds are increasing and while the amount of precipitation from rain is declining, they sometimes experience rain at unpredictable times, such as during winter.	Banci and Spicker 2024	See above.	See Sections 12.3 and 12.3.1 for a discussion of baseline climate in the West Kitikmeot Region.

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Comment	Source	WKR Response	Where Addressed
NTKP consultants reported that there is less snowfall than there used to be, which makes travel in winter more difficult. In addition, dust and contaminants are affecting the quality of the snow they do get.	Banci and Spicker 2024	See above.	See Sections 12.3 and 12.3.1 for a discussion of baseline climate in the West Kitikmeot Region. See the Air Quality Monitoring and Management Plan for dust management measures.
NTKP consultants reported that they are seeing new insects, such as hornets, horseflies, and red ants; however, butterflies, which were once common, are decreasing. They attribute this change to the changing winds and dust carrying the insects and to climate change.	Banci and Spicker 2024	See above.	See the Air Quality Monitoring and Management Plan for dust management measures.
NTKP consultants noted that water quality and quantity are declining, including in lakes, rivers, and freshwater springs. They attributed these changes to less precipitation, climate change, increased contaminants from development, melting permafrost, airborne pollutants, increased tourism and waste, and an increasing goose population. These effects are being experienced more in coastal areas, although there are changes inland as well. <i>The climate is changing and the weather is different now. Even the lakes have changed. Long ago when you made tea using water from the river or lakes it used to be good. Now the water doesn't make very good tea anymore. The Coppermine River is starting to change too. Inuit have begun to talk about the changes now. Even to drink out of the river is not very good because the water is changing.</i> Kitikmeot Inuit Association also expressed concern about climate change and the effects melting permafrost has on the environment and on TLMRU.	Banci and Spicker 2024; MVRB 2016	See above.	See Sections 12.3 and 12.3.1 for a discussion of baseline climate in the West Kitikmeot Region. See Volume 7, Section 19.3 for a discussion on the effects of climate change on freshwater resources. See Volume 6, Section 14.3.6 for a discussion on the effects of climate change on terrain, soils, and permafrost. See Volume 9, Section 24.3.8 for a discussion on the effects of climate change on TLMRU. See also the Permafrost Protection Plan.

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Comment	Source	WKR Response	Where Addressed
NTKP consultants reported that there are more moose present in the Kitikmeot Region than there were in the past, attributed to climate change.	Banci and Spicker 2024	See above.	See Volume 6, Section 16 and Section 18 for a discussion on the effects of climate change on caribou and on other terrestrial wildlife.
During engagement on the Project, participants from Gjoa Haven reported concerns about wildfires.	GBRP 2025	See above.	See Sections 12.3 and 12.3.1 for a discussion of baseline climate in the West Kitikmeot Region.
During a public scoping meeting for the NIRB, Taloyoak community members commented that, due to climate change, sea ice has melted.	NIRB 2025	See above.	See Sections 12.3 and 12.3.1 for a discussion of baseline climate in the West Kitikmeot Region.
During a public scoping meeting for the NIRB, Gjoa Haven community members expressed concern regarding warmer weather. They shared that climate change is effecting wildlife and the environment.	NIRB 2025	See above.	See Sections 12.3 and 12.3.1 for a discussion of baseline climate in the West Kitikmeot Region.
During a public scoping meeting with NIRB, Cambridge Bay community members shared that tundra fires are more frequent.	NIRB 2025	See above.	See Sections 12.3 and 12.3.1 for a discussion of baseline climate in the West Kitikmeot Region. See Appendix 12A for the Climate Profile, which includes a discussion on tundra fires (baseline and projections).
During Project engagement, Kitikmeot Inuit Association commented that the Arctic is becoming more accessible due to the effects of climate change. The Kugaaruk HTO added that climate change was affecting the west Kitikmeot Region more than the east.	GBRP 2025	See above.	See Sections 12.3 and 12.3.1 for a discussion of baseline climate in the West Kitikmeot Region.
IAG members reported that they are seeing raptors, including bald and golden eagles, move north as a result of climate change. They stated that eagles came to Contwoyto Lake in approximately 2010. This change is increasing as a result of increased wildfires.	IAG 2025	See above.	See Volume 6, Section 17 for a discussion on the effects of climate change on birds.

Comment	Source	WKR Response	Where Addressed
Athabasca Denesųliné Né Né Land Corporation expressed concern regarding the effects to caribou from climate change.	NIRB 2024	See above.	See Volume 6, Section 16 for a discussion on the effects of climate change on caribou.
The Tłıchų Research and Training Institute described the summer of 2023 as “hot and too dry” (Dedats’eetsaa 2024:15). In July that year, there were tundra fires at Contwoyto Lake. Dry weather and reduced water levels in lakes, muskeg and ponds, led to a shorter growing season. These conditions were not consistent with the summer weather reported for previous years, which since 2016, has been a mix of wet and windy, cool and windy, and warm and dry summers.	Dedats’eetsaa 2024	See above.	See Sections 12.3 and 12.3.1 for a discussion of baseline climate in the West Kitikmeot Region. See Volume 7, Section 19.3.7 for a discussion on the effects of climate change on freshwater resources.
Yellowknives Dene First Nation reported that climate change and other project developments have put increased pressure on caribou.	YKDFN 2016	See above.	See Volume 6, Section 16 for a discussion on the effects of climate change on caribou.
During a public scoping meeting for the NIRB, community members in Yellowknife commented that climate changes has affected the thickness of the ice, which is becoming thinner.	NIRB 2025	See above.	See Sections 12.3 and 12.3.1 for a discussion of baseline climate in the West Kitikmeot Region.

12.2 Regulatory and Policy Setting

In 2020, the Government of Canada released a Draft Technical Guide related to the Strategic Assessment of Climate Change (SACC; <https://www.strategicasessmentclimatechange.ca/>). The purpose of the SACC is to provide proponents of projects that may require a federal Impact Assessment pursuant to the *Impact Assessment Act* with technical guidance on conducting assessments. The SACC was designed to provide a “consistent, predictable, efficient, and transparent consideration of climate change throughout the impact assessment process.” (GOC 2020). Draft Technical Guides related to the SACC are as follows:

- *Guidance on Quantification of Net GHG Emissions, Impact on Carbon Sinks, Mitigation Measures, Net-Zero Plan and Upstream GHG Assessment* (GOC 2021).
- *Assessing Climate Change Resilience* (GOC 2022).

The SACC outlines GHG and climate change information applicable to the impact assessment process. Climate change considerations and assessments completed for the Project Impact Statement (IS) in consideration of the SACC are presented in this Valued Component section. The GHG assessment presented in Section 12.4 and the climate change risk assessment is summarized in Section 12.5 and presented in Appendix 12B.

12.3 West Kitikmeot Region Climate Summary

Inuit, Indigenous, and Community Knowledge provides qualitative holistic descriptions of observed changes including descriptions of changes in the meteorology, climatology, hydrology, geology, vegetation, and wildlife of a region. Western science (e.g., instrumental records, gridded data) provides quantitative descriptions of local (i.e., weather station-based point locations) to regional descriptions of changes. These knowledge systems complement and supplement each other in developing an understanding of baseline and historical conditions and observed changes of a region. Inuit, Indigenous, and Community Knowledge can provide guidance into climate parameter selection for climate change considerations in a project IS and related climate assessments, but may not provide information on all climate parameters of interest for the IS and/or the quantitative details necessary to complete assessments. Additionally, as noted in Prno et al. (2011), it is important to acknowledge limitations in coverage of both Inuit, Indigenous, and Community Knowledge, and instrumental records for the establishment of baseline climate conditions:

Inuit direct observation is limited by the age of the respondent, depth of Traditional Knowledge that they have learned, his/her relative experience operating in the local environment and his/her recollection... daily weather records for some communities in northern Canada have only been available since the late 1970s (Prno et al. 2011).

Changing climate and weather in the project region and larger Kitikmeot Region, however, has been highlighted by the local and Inuit people in the Kitikmeot Region as well as by instrumental records (e.g., weather station observations) and the scientific community. Observed changes in climate as highlighted by Inuit people in the Kitikmeot Region are presented in Section 12.3.1. To support climate change considerations incorporated in the IS, a Climate Profile was prepared for the Project (Appendix 12A). Based in Western science, the Climate Profile provides information on baseline (historical) and projected climate conditions for project-relevant climate parameters and thresholds as well as general climate conditions (e.g., annual mean temperature and total precipitation). In the Climate Profile, baseline climate conditions are presented for the 1991–2020 period and climate projections are presented for the 2030s (2021–2050), 2050s (2041–2070), and 2080s (2071–2100) under the high and intermediate emissions Shared Socioeconomic Pathway (SSP) climate change scenarios, SSP5-8.5 and SSP2-4.5 respectively (details on SSP scenarios are provided in Appendix 12A). Climate data are provided for the Grays Bay, Ulu, and Jericho-Lupin regions, representing the northern, central, and southern portions of the Project, respectively. Descriptions of the climate data sources and climate projections utilized to support the IS, including a discussion on the levels of confidence in the climate projections, are also provided in the Climate Profile. Climate parameters included in the Climate Profile are listed in Table 12.2. A summary of the projected changes under continued climate change are presented in Section 12.3.2.

Table 12.2 Climate Parameters for the Project Region Presented in the Climate Profile

Climate Parameters
Mean, Maximum, and Minimum Temperature (Seasonal, Annual)
Extreme Heat
Extreme Cold
Freeze-thaw Cycles
Freezing Degree Days (the number of degrees Celsius the daily mean temperature is below 0°C accumulated over a time period, e.g., annually)
Thawing Degree Days (the number of degrees Celsius the daily mean temperature is above 0°C accumulated over a time period, e.g., annually)
Growing Degree Days (the number of degrees Celsius the daily mean temperature is above a selected threshold [e.g., 5°C, 10°C, or 15°C] accumulated over a time period, e.g., annually)
Total Precipitation (Seasonal, Annual)
Extreme Precipitation
Total Snowfall (Annual)
Dry Spells (Frequency and Maximum Length)
Permafrost Thaw
Wildfire (Fire Weather and Fire Activity)
Icing (Freezing Rain Ice Accretion)
Riverine Flooding (Probability of Event)
Wind (Frequency of High Wind Events)
Relative Sea Level
Sea Surface Temperature
Sea Ice (Cover and Concentration)
Wave Activity

Note:

See Section 2.3.2 of the Climate Profile (Appendix 12A) for details on historical and projected conditions as well as levels of confidence in the projections.

12.3.1 Climate Change Observations in the Kitikmeot Region

Inuit Elders in the West Kitikmeot noted a warmer climate in the 1990s, with an earlier spring and later fall (WKSSS 2001). Inuit Elders noted that shore leads were opening earlier, the ice was thinner, water levels had dropped, and vegetation was larger and more lush. The caribou have shifted their migration to these areas of larger, lush vegetation and this has been a positive effect for the caribou. The earlier melting of ice in rivers, lakes, and the coast has also resulted in changes to migration routes; caribou now seem to be avoiding rivers as the rushing water filled with large chunks of ice is dangerous for them. Elders also believe that earlier melting is resulting in caribou falling through thin ice where it used to be thick, and that the incidence of drowning is increasing. They also noted that there seem to be more freeze-thaw cycles, which leave vegetation coated in ice, and much less accessible to caribou for food.

Continued changes in the climate, weather, and related impacts (e.g., vegetation and wildlife) have been highlighted by Inuit in the project-specific NTKP study (Banci and Spicker 2024) and a public scoping meeting for the Project (NIRB 2025). For example, NTKP consultants attributed localized drops in caribou and muskox numbers at Bathurst Inlet and Ekaloktok (Wellington Bay) in the 1970s with a harsh winter with freezing rain and snow that was covered in ice (negatively impacting the animals' ability to forage and resulting in starvation). Furthermore, Inuit people are also anticipating additional and, at times, drastic changes under further global climate change (Banci and Spicker, 2024). Comments from NTKP consultants include general statements such as “[t]he climate is changing and the weather is different now” and “[i]t used to get really cold. Now it’s getting warmer. The ocean doesn’t freeze anymore; it’s like slush”, indicating that “[t]he weather was no longer predictable” and “a lot of times, there are drastic changes in weather” (Banci and Spicker 2024), to specific observed changes including the following statements from NTKP consultants:

The weather is really different...The wind, even the snow has changed. I teach my son, the winds come from the west, the snow drifts show this. But now some are not right from the west, the snowdrifts are really changing. You used to travel by the snowdrifts. I showed my son like my dad showed me, how to use the snow drifts. You have to notice the sun, wind, sun. It used to be calm out, and now it’s different. (Banci and Spicker 2024)

In wintertime, January, sometimes you get rain showers. The oddest one that happened was a thunderstorm with snow in the spring, while there was still snow on the ground. It’s what we witnessed at Pellatt Lake. In springtime, late April, we always see clouds and everything, and now all of a sudden we start seeing lightning over there. There still was snow on the ground. That’s what we have witnessed over the last little while, the last 20, 25 years. (Banci and Spicker 2024)

Long ago there used to be a lot of rain so the rivers were always raging with fast water... Today it isn’t like that anymore... The land is so different from long ago. The land seems to be so dry and hardly any water due to very little rain nowadays. (Banci and Spicker 2024)

Elsewhere in the Canadian Arctic, similar changes have been observed, such as by Knowledge Holders from Gjoa Haven (Ursuqtuq), Inuvik, and Clyde River (McLennan et al. 2022):

Discussions from an Indigenous Knowledge workshop held July 7, 2021 noted: *In Inuvik there have been changes to the sea ice and the weather is less predictable. In Gjoa Haven there is an increase in the amount of cloud, changes to precipitation and differences in the length of the snowmelt. Also, there have been observable differences in sea ice thickness with the past year having exceptionally thick ice that lasted longer. In Clyde River the weather is getting warmer resulting in ice formation later than observed decades before, a longer breakup season, and an earlier snowmelt. The ice and rain have changed with less snow than two decades ago, and less blizzards, cold northern winds and cold temperatures in general. As well, Clyde River used to get blizzards that lasted one to two weeks and now blizzards are only one to two days, and the wind direction is less consistently from the North.*

Permafrost thaw under a warming climate has also been observed throughout Northern Canada, including the Kitikmeot Region. As part of the NTKP (Banci and Spicker 2024), an NTKP consultant noted that *“a lot of this permafrost is receding very fast.”* The Kitikmeot Inuit Association expressed concern about the effects of climate change on permafrost, stating *“Elders of all groups have expressed many concerns about the melting of permafrost with climate change and its impact on their traditional activities, as well as the environment”* (PR#285 p58) (MVRB 2016).

Additional, parameter-specific observed changes reported by Inuit people in the Kitikmeot Region include those presented below:

Snow

Inuit people have observed changes in the quality, quantity, and coverage of snow through the NTKP study (Banci and Spicker 2024). An NTKP consultant stated *“What we are seeing in the snow, from our travels, it’s not the same snow as 40 or 50 years ago... because of the content of the snow and the water.”* The change in consistency of the snow (as well as dust and contaminants in the snow) has been observed, for example during igloo building, with the following comments made during the NTKP:

Over the winter, even here [Kugluktuk] sometimes, you see this really, really fine snow, more like a flour coming down. It’s not snow; it’s like flour coming down. They’re not like snowflakes, it’s like dust coming down... It’s powder. Doesn’t even have snowflakes in it, it’s just powder. If it’s a really good snowflake, it will make water, but not this. Talking about snow, igloo building snow, the quality is not there anymore. Over the winter you notice that the snow has turned into ice because there is hardly any fresh snow coming down. It turns into ice from all the wind and the age because there is no fresh stuff underneath. (If you had to make an emergency igloo when travelling today), you probably could but it wouldn’t be very strong... Inuit knew that the snow had changed because of the quality when building an igloo. Igloos are still used today as emergency shelters when travelling or hunting. (Banci and Spicker 2024)

If you were on a hunting trip or something, or going on a trip, like myself to Bathurst with my dad. Sometimes the storm would be there all the time. It would be very difficult to put up a tent sometimes in this storm. And if you have to build yourself an igloo, something, to shade yourself from the storm. So we just make a quick igloo for the night. Can be any kind of consistency as long as it can hold itself for the night... It’s very, very different today. It’s not snow anymore. It becomes water but it’s a little bit different. There is something left after you rub on it. A film is left behind. (Banci and Spicker 2024)

Inuit have also observed changes in snow cover, with less snow resulting in more difficult travel during the winter (Banci and Spicker, 2024). NTKP consultants noted *“[a] lot of our winters, our hunters are complaining lots that there isn’t very much snow in our hunting areas”* and *“[s]ome of the land never gets snow because of the wind (kakiaktok). There is no fresh snow because of the wind”* (Banci and Spicker 2024).

They have also attributed changes in snow accumulations to observed changes in surface water levels, with a NTKP consultant noting *“[t]hat’s one reason why our waters are so low. There’s hardly any more snow”* (Banci and Spicker 2024).

Wind

Inuit observations of wind conditions in the Kitikmeot Region highlight differences observed between summer and winter conditions, with “*Wind was a major factor affecting travel in the Grays Bay area and could cause difficult conditions in winter. Travel in summer was more pleasurable*” (Banci and Spicker, 2024). In Grays Bay, an NTKP consultant said “*In summer there is always a south wind 20 knots [37 kilometres per hour]. It is calm 3 miles [4.8 kilometres] out. There is always a south wind in the summer, all summer.*” An NTKP consultant noted the influence of windy days and blowing snow:

There are too many windy days and the snow blows away before it gets down packed enough to stay. When I was a young man the snow would slowly fall over time without being windy and therefore the snow would be very deep and make it hard to walk on. Today the snow does not accumulate enough for it to be deep because it is always windy. (Banci and Spicker 2024)

NTKP consultants also provided details of the micro-climates in the region and their influence on travel:

When there are big mountains, the wind is different between the ocean and land (Grays Bay area). The land has mountains. There are really high hills there and a strong south wind. It becomes really windy, it takes up speed in that area when there's a south wind. There is a slow wind when blowing from the ocean (from the north). When you travel inland, everything gets blown around when there's a south wind, like a mini hurricane. When you get down to ocean level the wind dies down. (Banci and Spicker 2024)

People still travel even when it's rough or windy because we use skidoos today. It's far and gas is expensive by skidoo, but people go by boat in summer. They have to watch the weather when they travel there. (Banci and Spicker 2024)

Riverine Water Levels

Observed changes in water levels in the rivers in the Kitikmeot Region by Inuit people, which have been recorded as part of the NTKP (Banci and Spicker 2024), highlight lower water levels noting that “*in current times, general water levels were not higher but lower due to less snow and rain*”, include the following:

Long ago there used to be a lot of rain so the rivers were always raging with fast water... Today it isn't like that anymore... The land is so different from long ago. The land seems to be so dry and hardly any water due to very little rain nowadays. (Banci and Spicker 2024)

The rivers around that area (Bathurst Inlet and coast), they seem to be dryer faster. Normally when they run through springtime, they level off but they will stay at that level. What we have noticed is that when we travel around that area, the rivers are a lot lower than what they are supposed to be. So we don't know if the charr are getting up the rivers or not. Because some of those rivers have dried out. (Banci and Spicker 2024)

This is in the Bathurst Inlet area. The ones that we noticed the most were Gordon Bay River (Kokiviayok). They seem to be drying out more every year as we go down there when we do our traveling. Every year they are drying up a little bit more. (Banci and Spicker 2024)

Not only the rivers. Everywhere is really changed. Since we know, we have been here (in Kugluktuk) now for 17, 18 years. When we travel home (Omingmaktok and Bathurst Inlet area), every area that we went through, there is about ... that much missing, the water level had dropped. The water level was higher. You could see where ... the lines, the lines where the water level has dropped over the years. It's not only in the rivers, but the whole ocean. That's how much water has been gone since 17 years have passed. (Banci and Spicker 2024, statement made in 2013)

The NTKP consultants also highlighted a “particularly bad flood” in the Bathurst Inlet region that occurred in 2007 or 2008 and that “floods occurred during spring break-up because the ice was melting faster however during the rest of the year there were drought like conditions.” Specific observations of the 2007 or 2008 flood made by the NTKP consultants include the following:

Five or six years ago, during breakup the water was 10, 15 feet higher, probably due to our snow to the south. During breakup, around Bathurst, it was probably 10 to 15 feet higher. The water was higher. I guess it was like that all over. It took some cabins, moved some cabins that were in lower spots. (Banci and Spicker 2024)

Relative Sea Level

Through the NTKP (Banci and Spicker, 2024), Inuit people in the Kitikmeot Region have reported observations of lower relative sea level:

We went back home over a week ago for about a week (summer 2013 boat trip from Kugluktuk). We went to Arctic Sound, Katimanak, where my wife was born. We noticed that anywhere we go boating you have to be careful where you go because the water levels were so low. In the past where we used to go boating fast, and anywhere you want to go, you can't anymore because it's shallow all over the place now. (Banci and Spicker 2024)

There will be a lot of spots there (in Grays Bay) that were very deep before won't be as deep now. They probably have to check the whole route again, to make sure it's safe to do so, to shipping in there. (Banci and Spicker 2024)

It has changed a lot. A lot of people have noticed the water. The scientists are saying that the water will be rising due to ice melting. But what we are seeing at this stage in time we're noticing that the water levels are going down, even in the big ocean. We went home (Omingmaktok) about over a week ago, for a week. There's one little island, way back when we're still living in Bay Chimo, Omingmaktok, we always used to go boating by it, in between the point and the little island. The island was about this big when it was showing, as big as this table (the boardroom table). Now that island is as big as the whole building itself. (Banci and Spicker 2024)

We went home to Bay Chimo which is our homeland a few weeks ago and we noticed the water level was way down. We were in this area for a long time and we noticed the water level was pretty low. (Banci and Spicker 2024, interview took place in 2013)

Sea Ice

Declines in sea ice extent, volume, concentration, quality, and timing (e.g., later freeze-up) have been observed by Inuit people of the Kitikmeot Region (Banci and Spicker 2024) and elsewhere in the Canadian Arctic (NIRB 2025). Through the NTKP (Banci and Spicker 2024), observed changes recorded note “[m]ajor changes in both lake and ocean [sea] ice had been documented, not only in increased melting time, but also in decreased ice quality and thus safety for people,” “it has been getting worse. It has taken really long to freeze this year (2005) in the Cambridge area,” and “there was open water this winter (2005) between islands in northwest Kilingoyak (Bathurst Inlet) and the mainland,” as well as the following observations:

The ice is thinner for both lakes and ocean, but especially the ocean. It used to take maybe a month for the ice to go away from the area, and now it only takes two days sometimes.
(Banci and Spicker 2024)

We stop our snowmachines going out hunting about one month earlier, because the ice is really rotten, too dangerous to go out there. So, we stop our spring hunt in early April or middle of May. We used to go hunting until June with snowmobiles and now we can’t even go past May.
(Banci and Spicker 2024, interview took place in 2018)

If you have to walk on new ice, you have to carry a harpoon to test the ice. One to two chops, or three chops, that means it’s safe. If it goes through, it’s not very safe. That’s how you test the ice when you want to go out fishing in the fall time or carrying water, making water hole. (Banci and Spicker 2024)

What we are seeing in the snow, from our travels, it’s not the same snow as 40 or 50 years ago. And what we’re seeing is the same thing with ice conditions, it’s not the same as 50 years ago, because of the content of the snow and the water. (Banci and Spicker 2024)

Wave Activity

The NTKP (Banci and Spicker 2024) notes “ocean travel was the most important mode to access the Kogloktokoyok (Grays Bay) area” and that “the Kogloktokoyok marine environment was dynamic with strong currents upwellings, open water and thin ice during winter”. Marine observations reported by NTKP consultants include the following:

The area surrounding Eglohokoyok (Hepburn Island) ten km offshore of the mainland was ice free during winter because of strong currents. Travelers had to be mindful when travelling by dogteam, snowmachine and by boat. Safe harbours were found at Aniyak and on the mainland at Kogloktokoyok. (Banci and Spicker 2024)

We need to map shallow areas, shoals, they likely are not charted. There’s a really bad one around there (south of east part of Eglohokoyok), you can’t see it until its rough. The only time you can see that shoal is when it’s rough, when its calm, you can’t see it. When you get five-to-six-foot swells, you can see it, but when its calm you can’t see it. (Banci and Spicker 2024)

12.3.2 Climate Change Projections

The Climate Profile provides information on baseline (historical) and projected climate conditions for the climate parameters listed in Table 12.2, for project-relevant thresholds, as well as general climate conditions (e.g., annual mean temperature and total precipitation). In the Climate Profile, climate data are provided for the Grays Bay, Ulu, and Jericho-Lupin regions, representing the northern, central, and southern portions of the Project, respectively. A summary of historical and projected annual and seasonal temperature and precipitation for the Grays Bay and Jericho-Lupin regions under the SSP5-8.5 high emissions scenario (see Table 12.3) and the SSP2-4.5 intermediate emissions scenario are also presented below (see Table 12.4). The full Climate Profile is presented in Appendix 12A.

Table 12.3 Summary of Projected Changes in Temperature and Precipitation under SSP5-8.5 in the Project Region

Region	Time Frame	1991-2020 Baseline	Projections under SSP5-8.5 (Change from Baseline)		
			2030s (2021-2050)	2050s (2041-2070)	2080s (2071-2100)
Mean Temperature (°C Change)					
Grays Bay	Annual	-14.2	-12.0 (+2.2)	-9.7 (+4.5)	-5.8 (+8.4)
	Winter	-31.1	-28.2 (+2.9)	-25.0 (+6.1)	-18.8 (+12.4)
	Spring	-20.0	-18.1 (+1.9)	-16.1 (+3.9)	-12.7 (+7.3)
	Summer	4.5	6.1 (+1.6)	7.6 (+3.0)	10.1 (+5.6)
	Fall	-10.2	-7.6 (+2.6)	-5.2 (+5.0)	-1.8 (+8.4)
Jericho-Lupin	Annual	-10.2	-8.1 (+2.1)	-6.0 (+4.2)	-2.5 (+7.7)
	Winter	-27.2	-24.5 (+2.7)	-21.7 (+5.5)	-16.3 (+10.9)
	Spring	-14.8	-12.9 (+1.9)	-11.1 (+3.7)	-8.0 (+6.8)
	Summer	9.4	11.0 (+1.6)	12.4 (+3.0)	14.8 (+5.4)
	Fall	-8.0	-5.7 (+2.3)	-3.5 (+4.5)	-0.3 (+7.7)

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Region	Time Frame	1991-2020 Baseline	Projections under SSP5-8.5 (Change from Baseline)		
			2030s (2021-2050)	2050s (2041-2070)	2080s (2071-2100)
Maximum Temperature (°C Change)					
Grays Bay	Annual	-10.7	-8.6 (+2.1)	-6.4 (+4.3)	-2.7 (+8.0)
	Winter	-27.7	-24.8 (+2.9)	-21.8 (+5.9)	-15.9 (+11.8)
	Spring	-16.0	-14.3 (+1.7)	-12.5 (+3.5)	-9.5 (+6.6)
	Summer	8.3	10.1 (+1.8)	11.5 (+3.2)	14.1 (+5.7)
	Fall	-7.4	-4.9 (+2.5)	-2.7 (+4.7)	0.4 (+7.8)
Jericho-Lupin	Annual	-6.4	-4.5 (+1.9)	-2.4 (+4.0)	0.9 (+7.3)
	Winter	-23.8	-21.2 (+2.6)	-18.6 (+5.2)	-13.5 (+10.3)
	Spring	-10.7	-9.0 (+1.7)	-7.4 (+3.3)	-4.6 (+6.1)
	Summer	13.9	15.6 (+1.7)	17.0 (+3.1)	19.5 (+5.6)
	Fall	-5.1	-2.9 (+2.2)	-0.9 (+4.2)	2.0 (+7.1)
Minimum Temperature (°C Change)					
Grays Bay	Annual	-7.2	-5.0 (+2.2)	-2.5 (+4.7)	1.7 (+8.8)
	Winter	-24.3	-21.3 (+3.0)	-17.9 (+6.4)	-11.3 (+12.9)
	Spring	-12.1	-9.9 (+2.2)	-7.8 (+4.2)	-4.1 (+8.0)
	Summer	12.1	13.6 (+1.5)	15.0 (+2.9)	17.5 (+5.4)
	Fall	-4.5	-1.8 (+2.7)	0.9 (+5.4)	4.6 (+9.0)
Jericho-Lupin	Annual	-14.0	-11.9 (+2.1)	-9.6 (+4.4)	-5.8 (+8.2)
	Winter	-30.9	-28.1 (+2.8)	-25.1 (+5.8)	-19.3 (+11.6)
	Spring	-19.0	-16.8 (+2.2)	-14.9 (+4.1)	-11.5 (+7.5)
	Summer	4.8	6.3 (+1.5)	7.6 (+2.8)	10.1 (+5.3)
	Fall	-11.0	-8.5 (+2.5)	-6.2 (+4.8)	-2.7 (+8.3)

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Region	Time Frame	1991-2020 Baseline	Projections under SSP5-8.5 (Change from Baseline)		
			2030s (2021-2050)	2050s (2041-2070)	2080s (2071-2100)
Total Precipitation (% Change)					
Grays Bay	Annual	233.2	256.8 (+10.1%)	276.3 (+18.5%)	316.3 (+35.6%)
	Winter	36.8	41.7 (+13.2%)	47.5 (+29.3%)	61.4 (+67.1%)
	Spring	35.6	39.2 (+10.1%)	41.8 (+17.4%)	48.2 (+35.5%)
	Summer	85.1	90.0 (+5.8%)	93.1 (+9.5%)	97.9 (+15.0%)
	Fall	75.7	84.9 (+12.2%)	93.0 (+22.8%)	107.9 (+42.4%)
Jericho-Lupin	Annual	315.6	339.3 (+7.5%)	366.4 (+16.1%)	415.9 (+31.8%)
	Winter	27.7	31.5 (+13.8%)	35.1 (+26.8%)	44.8 (+61.6%)
	Spring	78.1	83.3 (+6.7%)	90.9 (+16.4%)	104.5 (+33.9%)
	Summer	128.5	129.5 (+0.8%)	137.2 (+6.7%)	144.1 (+12.2%)
	Fall	81.4	90.0 (+10.6%)	98.4 (+20.9%)	112.7 (+38.5%)

Notes:

°C = degrees Celsius

mm = millimetres

Meteorological season values presented:

- Winter = December, January, February
- Spring = March, April, May
- Summer = June, July, August
- Fall = September, October, November

Baseline (1991–2020) data:

- Grays Bay: Combination of PCIC-Blend gridded data (1991–2012) and downscaled multi-model ensemble mean data (2013–2020).
- Jericho-Lupin: Environment and Climate Change Canada composite Lupin record developed using the Lupin A (ID: 23026HN) and Lupin CS (ID: 230N002) stations.

Table 12.4 Summary of Projected Changes in Temperature and Precipitation under SSP2-4.5 in the Project Region

Region	Time Frame	1991-2020 Baseline	Projections under SSP2-4.5 (Change from Baseline)		
			2030s (2021-2050)	2050s (2041-2070)	2080s (2071-2100)
Mean Temperature (°C Change)					
Grays Bay	Annual	-14.2	-12.3 (+1.9)	-10.8 (+3.4)	-9.4 (+4.8)
	Winter	-31.1	-28.4 (+2.7)	-26.6 (+4.6)	-24.4 (+6.8)
	Spring	-20.0	-18.4 (+1.6)	-17.1 (+2.9)	-16.0 (+4.0)
	Summer	4.5	5.7 (+1.2)	6.8 (+2.2)	7.8 (+3.3)
	Fall	-10.2	-7.8 (+2.4)	-6.4 (+3.9)	-5.0 (+5.2)
Jericho-Lupin	Annual	-10.2	-8.4 (+1.8)	-7.1 (+3.1)	-5.8 (+4.4)
	Winter	-27.2	-24.8 (+2.4)	-23.1 (+4.1)	-21.1 (+6.1)
	Spring	-14.8	-13.2 (+1.6)	-12.0 (+2.8)	-10.9 (+3.9)
	Summer	9.4	10.6 (+1.2)	11.6 (+2.2)	12.6 (+3.2)
	Fall	-8.0	-5.9 (+2.1)	-4.6 (+3.4)	-3.3 (+4.7)
Maximum Temperature (°C Change)					
Grays Bay	Annual	-10.7	-8.9 (+1.8)	-7.4 (+3.3)	-6.1 (+4.6)
	Winter	-27.7	-25.1 (+2.6)	-23.3 (+4.4)	-21.1 (+6.6)
	Spring	-16.0	-14.5 (+1.5)	-13.4 (+2.6)	-12.4 (+3.7)
	Summer	8.3	9.6 (+1.3)	10.7 (+2.3)	11.8 (+3.4)
	Fall	-7.4	-5.1 (+2.3)	-3.8 (+3.6)	-2.5 (+4.8)

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 March 2026

Region	Time Frame	1991-2020 Baseline	Projections under SSP2-4.5 (Change from Baseline)		
			2030s (2021-2050)	2050s (2041-2070)	2080s (2071-2100)
Jericho-Lupin	Annual	-6.4	-4.7 (+1.7)	-3.4 (+3.0)	-2.2 (+4.2)
	Winter	-23.8	-21.6 (+2.2)	-19.8 (+4.0)	-18.0 (+5.8)
	Spring	-10.7	-9.3 (+1.4)	-8.1 (+2.6)	-7.2 (+3.5)
	Summer	13.9	15.1 (+1.2)	16.2 (+2.3)	17.2 (+3.3)
	Fall	-5.1	-3.1 (+2.0)	-1.9 (+3.2)	-0.8 (+4.3)
Minimum Temperature (°C Change)					
Grays Bay	Annual	-7.2	-5.2 (+2.0)	-3.6 (+3.5)	-2.2 (+5.0)
	Winter	-24.3	-21.6 (+2.7)	-19.6 (+4.7)	-17.3 (+7.0)
	Spring	-12.1	-10.4 (+1.7)	-8.9 (+3.1)	-7.7 (+4.4)
	Summer	12.1	13.2 (+1.1)	14.3 (+2.1)	15.3 (+3.1)
	Fall	-4.5	-2.0 (+2.5)	-0.4 (+4.1)	1.1 (+5.5)
Jericho-Lupin	Annual	-14.0	-12.2 (+1.8)	-10.7 (+3.3)	-9.3 (+4.7)
	Winter	-30.9	-28.4 (+2.5)	-26.6 (+4.3)	-24.6 (+6.3)
	Spring	-19.0	-17.3 (+1.7)	-15.9 (+3.1)	-14.8 (+4.2)
	Summer	4.8	5.9 (+1.1)	6.9 (+2.1)	7.8 (+3.0)
	Fall	-11.0	-8.7 (+2.3)	-7.3 (+3.7)	-6.0 (+5.0)

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Section 12: Assessment of Potential Effects on Climate
 March 2026

Region	Time Frame	1991-2020 Baseline	Projections under SSP2-4.5 (Change from Baseline)		
			2030s (2021-2050)	2050s (2041-2070)	2080s (2071-2100)
Total Precipitation (% Change)					
Grays Bay	Annual	233.2	250.5 (+7.4%)	265.8 (+14.0%)	278.8 (+19.6%)
	Winter	36.8	40.8 (+10.8%)	44.6 (+21.3%)	48.8 (+32.8%)
	Spring	35.6	39.0 (+9.5%)	40.2 (+12.8%)	42.3 (+18.7%)
	Summer	85.1	89.2 (+4.8%)	92.6 (+8.9%)	94.4 (+11.0%)
	Fall	75.7	82.0 (+8.3%)	87.5 (+15.6%)	92.5 (+22.1%)
Jericho-Lupin	Annual	315.6	333.6 (+5.7%)	351.9 (+11.5%)	371.0 (+17.6%)
	Winter	27.7	30.7 (+10.7%)	33.3 (+20.0%)	36.2 (+30.5%)
	Spring	78.1	83.2 (+6.5%)	87.2 (+11.7%)	91.6 (+17.3%)
	Summer	128.5	131.8 (+2.6%)	134.3 (+4.5%)	140.6 (+9.4%)
	Fall	81.4	87.5 (+7.5%)	93.3 (+14.6%)	97.6 (+20.0%)

Notes:

°C = degrees Celsius

mm = millimetres

Meteorological season values presented:

- Winter = December, January, February
- Spring = March, April, May
- Summer = June, July, August
- Fall = September, October, November

Baseline (1991–2020) data:

- Grays Bay: Combination of PCIC-Blend gridded data (1991–2012) and downscaled multi-model ensemble mean data (2013–2020).
- Jericho-Lupin: Environment and Climate Change Canada composite Lupin record developed using the Lupin A (ID: 23026HN) and Lupin CS (ID: 230N002) stations.

12.4 Greenhouse Gas Emissions Assessment

12.4.1 Scope of Assessment

The scope of this GHG emissions assessment includes the quantification of GHG emissions that would be released from project activities during the Project's lifetime. These emissions are compared to Nunavut's and Canada's GHG emission releases for context.

The GHG emissions from users of the road and port are not included in this assessment, as these are sources that are not under the control of WKR and are therefore considered outside the scope of the project-level GHG emissions assessment.

12.4.1.1 Regulatory Context

The Government of Canada has established legislation, policies, and guidance documents related to GHG emissions. These include:

- Greenhouse Gas Reporting Program (ECCC 2025a), which is a mandatory reporting program for facilities that emit greater than 10,000 tonnes carbon dioxide equivalent (CO₂e) annually. This also includes construction activities for facilities.
- Federal Output-based Pricing System (OBPS), which is a reporting and emissions compliance program that applies to facilities in certain jurisdictions (including Nunavut) that release at least 10,000 tonnes (t) CO₂e per year.
- Strategic Assessment of Climate Change (GOC 2020), which is a framework for assessing whether a project will hinder or contribute to Canada's emissions reduction targets. Three guidance documents related to GHG emissions quantification, carbon sink impact, net-zero plans, upstream GHG emissions, climate resilience, and best-in-class performance for oil and gas projects have been issued.
- Pan Canadian Framework on Clean Growth and Climate Change (ECCC 2016), which identifies the goal to reduce GHG emissions 30% below 2005 by 2030.
- *Canadian Net Zero Emissions Accountability Act*, which updates the national emission reduction target for 2030 and establishes new targets 2035, 2040, and 2045, as well as the commitment to achieve net-zero GHG emissions by 2050.

Nunavut does not have legislation or policies regarding GHG emissions. However, Nunavut has established a Climate Change Secretariat that is focused on climate change adaptation and mitigation, as well as knowledge mobilization among the Nunavummiut (Government of Nunavut n.d.).

12.4.2 Project Activities, Technologies, and Practices

During Construction, heavy equipment such as bulldozers, cranes, and excavators will be used to install infrastructure and build the road. Blasting will be used to clear rock and provide material for road building. Some aircraft and marine vessels are needed during Construction. Road and port maintenance activities during Operations and Maintenance will also require this equipment. Power generation for the Project will use diesel generators during Construction and Operations and Maintenance. There is no electrical grid in the area. There is potential for renewable solar or wind power to be commissioned during Operations and Maintenance, which would reduce diesel generator usage. This will be further assessed for feasibility during the Operations and Maintenance phase by WKR and are briefly discussed in Section 12.4.3.3.

The magnitude of a project's GHG emissions is influenced by the technologies and practices used. A high level best available technology and best environmental practices review was made to guide the selection of technologies for equipment and mitigation measures. Because blasting represents a minor source of GHG emissions, it was not included in the technology and practice review.

The outcome of the review is provided in Table 12.5. In general, given the cold climate, the logistics of bringing fuel to site, and the state of lower-emitting technologies in heavy equipment, diesel or renewable diesel are the practical and currently feasible choices for best available technology. Renewable diesel is made from agricultural products and is chemically transformed to be identical to petroleum-based diesel. It can be used either on its own or mixed with petroleum-based diesel. Biodiesel is not considered feasible for operation in the cold climate. Practices that reduce fuel use were selected as these directly reduce GHG emissions. As the Project's Operations and Maintenance phase progresses, lower emitting GHG technologies and practices may become feasible and adopted.

Table 12.5 Best Available Technologies and Practices

Equipment	Phase	Technologies	Practices
Heavy Equipment, Aircraft, Marine Vessels, Generators	Construction	• Diesel • Renewable diesel • Jet A • Marine diesel	• Monitor fuel usage and track efficiency • Maintain equipment in good working order • Reduce idling as much as practical
	Operations and Maintenance	• Diesel • Renewable diesel • Jet A • Marine diesel • Solar power • Wind power	• Monitor fuel usage and track efficiency • Maintain equipment in good working order • Reduce idling as much as practical

12.4.3 GHG Emissions Quantification

12.4.3.1 Methods

Because GHGs vary in the strength of the warming effect caused in the atmosphere, the net warming effect is stated based on CO₂e. Each GHG has a global warming potential (GWP) that is established by the Intergovernmental Panel on Climate Change. The current set of GWPs used by Environment and Climate Change Canada (ECCC) for CO₂, CH₄, and N₂O are 1, 28, and 265, respectively (ECCC 2025b).

Estimated annual diesel, jet A fuel, and marine diesel fuel consumption for the anticipated construction and operations and maintenance activities are provided in Table 12.6. The annual fuel amounts are multiplied by fuel-specific emission factors from the 2025 National Inventory Report (ECCC 2025b). The emission factors used for fuel combustion are provided in Table 12.6.

Table 12.6 GHG Emission Factors

Fuel	CO ₂ (g/L)	CH ₄ (g/L)	N ₂ O (g/L)
Diesel	2,681	0.07	0.23
Marine Diesel	2,681	0.25	0.72
Jet A	2,560	0.02	0.07

Notes:

NIR (ECCC 2025b), Table A6.1-15 (rounded)

To provide conservative GHG emissions estimates, it is assumed that fuels without a biogenic component will be used. If fuels with a biogenic component were used, the CO₂ emissions would be reduced by an amount equivalent to the percent of biofuel used (e.g., 20% biodiesel blend reduces CO₂ emissions by 20%). ECCC requires that biogenic CO₂ emissions are reported separately from the CO₂ emissions from the fossil fuel CO₂. Only the fossil fuel CO₂ is attributed to an emitter because biogenic CO₂ emissions are not considered to contribute to climate change. This is because the carbon in renewable fuels was more recently part of the carbon cycle and does not cause a net increase in GHG emissions in the atmosphere.

CO₂ emissions from blasting were estimated using the emission factor of 0.189 t CO₂ per tonne of ammonium nitrate/fuel oil from the Mining Association of Canada (MAC 2014).

As a result of excavations of soil during on-land work, some organic carbon within the soil is expected to be disturbed resulting in CO₂ emissions from land-use change. Information on the area disturbed, including assumptions, are presented in Table 12.7.

Table 12.7 Land-use Change Assumptions

Component	Dimensions of Permanent Disturbance (ha)	Assumed Percentage of Area Excavated (%)	Assumed Depth of Disturbance (m)
Road	379	100	0.2
Aerodrome	55.4	100	0.2
Jericho Station	31.6	50	0.1
On-land Port	65.1	50	0.1

Notes:

NIR (ECCC 2025b), Table A6.1-15 (rounded)

The amount of organic carbon in the soil by depth was estimated based on information in a paper on soil organic carbon by depth in the Southern Arctic ecozone (Hossain et al. 2015). The density of soil by depth was estimated based on a paper studying the bulk density of mineral and organic soils in the Canada's Arctic and Subarctic (Sothe et al. 2022). The vegetation in the Project Development Area is mainly shrubby. Very few trees are found in the area. Because of this, GHG emissions from clearing of vegetation have not been estimated.

12.4.3.2 Construction

The GHG emissions from construction activities are presented in Table 12.8 for Year 3, which is the year with the highest construction GHG emissions.

The highest annual GHG emissions from the Construction period are estimated to be 145,566 t CO₂e per year (excluding emissions from land-use change). In total, construction GHG emissions over five years in consideration of the construction schedule are estimated to be 436,634 t CO₂e or approximately 87,326 t CO₂e per year (excluding emissions from land-use change). Carbon dioxide emissions from land-use change are from biomass sources (soil organic carbon in this case). Canada accounts for this CO₂ separately from CO₂ from fossil fuel combustion.

Table 12.8 Summary of GHG Emissions – Construction (Y3)

Activity	CO ₂ (t/y)	CH ₄ (t/y)	N ₂ O (t/y)	CO ₂ e (t/y)
Electricity Generation				
Port Operation	50,106	108	NA	53,119
Jericho Station	50,106	108	NA	53,119
Mobile Operation				
North Road	17,230	0.43	1.33	17,595
South Road	20,314	0.49	1.52	20,730
Marine Equipment	232	0.001	0.01	236
Aircraft	77.5	0.004	0.003	78.4
Incineration				
Port Operation	109	0.01	0.001	109
Jericho Station Operation	109	0.01	0.001	109
Biogenic Waste Combustion	72.6	-	-	72.6
Total Fuel Combustion	138,284	216	2.87	145,097
Land-use Change	264,786	-	-	264,786
Blasting				
Port	118	-	-	118
Jericho	11.8	-	-	11.8
North Road	210	-	-	210
South Road	129	-	-	129
Total Blasting	469	-	-	469
Total Construction Emissions (Excluding Land-use Change)	138,753	216	2.87	145,566

Note:

A relevant emission factor for N₂O from electricity generation using a diesel generator was not available. N₂O emissions are expected to be a small fraction of CO₂ emissions.

12.4.3.3 Operations and Maintenance

The GHG emissions from operations and maintenance activities are presented in Table 12.9 for Year 7 (Calendar Year 2036), which is the year with the highest operations and maintenance GHG emissions, including the use of diesel for power generation.

Table 12.9 Summary of GHG Emissions – Operations and Maintenance (Year 7)

Activity	CO ₂ (t/y)	CH ₄ (t/y)	N ₂ O (t/y)	CO ₂ e (t/y)
Electricity Generation				
Port Operation	50,106	108	NA	53,119
Mobile Operation				
Road Maintenance (Diesel)	4,154	0.12	0.36	4,253
Marine Equipment	328	0.001	0.01	330
Aircraft	14.3	0.001	0.001	14.5
Incineration				
Port Operation	27.2	0.001	0.0002	27.3
Jericho Station Operation	27.2	0.001	0.0002	27.3
Biogenic Waste Combustion	9.08	-	-	9.08
Blasting				
Road Maintenance	16.9	-	-	16.9
Total Operations and Maintenance Emissions (excl. biogenic)	54,673	108	0.37	57,789

Note:

A relevant emission factor for N₂O from electricity generation using a diesel generator was not available. N₂O emissions are expected to be a small fraction of CO₂ emissions.

The highest annual GHG emissions from the operations and maintenance period are 57,789 t CO₂e per year when diesel is used for power generation. In total, operations and maintenance period GHG emissions are estimated to be 1,211,570 t CO₂e or approximately 57,694 t CO₂e per year (excluding emissions from land-use change). The implementation of renewable energy would lower emissions from the operations and maintenance period. Two renewable power options are being considered for the Project. Of the 23 megawatts of power required to operate the Project, the first option assumes that solar power will supply megawatt hours of power, while the second assumes that wind power will supply 18 GWh of power. Table 12.10 summarizes the change in emissions under these two scenarios. Under the solar power scenario, emissions would decrease by 1%, while the wind power scenario provides a reduction of 15%.

Table 12.10 Summary of GHG Emissions – Operations and Maintenance (Year 7) from Diesel, Solar, and Wind

Activity	CO ₂ (t/y)	CH ₄ (t/y)	N ₂ O (t/y)	CO ₂ e (t/y)
Total Using Diesel	54,673	108	0.37	57,789
Total Using Solar	54,144	107	0.37	57,265
Total Using Wind	46,841	90.9	0.37	49,523

12.4.4 Comparison to Territorial and National GHG Emissions

The 2025 National Inventory Report indicates that, in 2023, Nunavut's estimated GHG emissions were 714 kilotonnes (kt) CO₂e (ECCC 2025b). Therefore, the Project's annual GHG emissions during Construction will range from 15% to 20% of Nunavut's annual GHG emissions. This comparison excludes the CO₂ from land-use change as it is accounted for separately in national inventory reporting. During operations and maintenance, the Project's GHG emissions will represent approximately 8% of Nunavut's annual GHG emissions.

Canada's estimated GHG emissions in 2023 were 693,912 kt CO₂e (ECCC 2025b). Therefore, the Project's annual GHG emissions during Construction are approximately 0.2% of Canada's annual GHG emissions. During Operations and Maintenance, the Project's GHG emissions will represent approximately 0.01% of Canada's annual GHG emissions.

12.4.5 Summary of Mitigation, Management, and Enhancement Measures

Mitigation for GHG emissions is mainly the reduction of fuel use as well as use of diesel with a biogenic portion when available (based on supplier availability). The technologies and practices that reduce fuel use will reduce the release of GHGs from project activities. The mitigation and management measures selected for the Project include:

- Monitoring fuel usage and efficiency to proactively identify when equipment is not functioning optimally. This measure will also assist with GHG emissions estimation during the Project's lifetime.
- Establishing a maintenance system for project equipment that tracks when maintenance activities are required as per manufacturer recommendations.
- Optimal sizing of project equipment to reduce inefficient fuel use.
- A policy will be established to reduce unnecessary idling of equipment.

12.4.6 Prediction Confidence and Uncertainty

The prediction confidence of the estimated GHG emissions is high. CO₂ emissions from fossil fuel combustion represent the majority of GHG emissions; because these emissions are directly linked to the amount of carbon in the fuel and the compositions of these fuels are relatively consistent, CO₂ emissions estimates have high confidence. CH₄ and N₂O emissions from fossil fuel combustion are less certain as these can fluctuate based on the equipment type and operational characteristics; however, these emissions are generally known to be emitted in smaller quantities than CO₂. Conservative assumptions were used as part of the quantification, including assuming that the:

- Carbon in the fuel is completely oxidized to CO₂
- CH₄ emissions occur even though methane is not a component of diesel and the carbon is completely oxidized for CO₂
- Areas of organic soil disturbance are approximately 50% to 100% of the Project's permanently disturbed areas (Table 12.7)
- Depth of disturbance is 0.1 metre (m) to 0.2 m in organic soil (Table 12.7)

The key activity data in the assessment are fuel use estimates. These were based on construction and operations and maintenance planning activities and represent the best available information at the time of the assessment.

The confidence in the use of mitigation measures for GHG emissions through the reduction of fossil fuel consumption is high. GHG emissions are directly generated from fossil fuel combustion; reducing fossil fuel consumption during construction and operations and maintenance will reduce GHG emissions from project activities.

12.4.7 Follow-up and Monitoring

Fuel consumption during project activities will be monitored for the purpose of estimating GHG emissions for comparison to legislative thresholds for reporting. It is expected that the Project will meet the reporting thresholds for the ECCC GHG Reporting Program during construction but will not meet the reporting threshold during operations and maintenance (i.e., >10 kt CO₂e). Similarly, the Project is unlikely to meet the reporting threshold for reporting under the federal OBPS program.

12.5 Climate Change Risk Assessment

A CCRA was completed for the Project and is provided in Appendix 12B. The intent of the CCRA was to identify the current and anticipated climate impacts on the planned infrastructure and assets of the Project and identify associated risks. Adaptation strategy recommendations were also developed to address the high-risk climate hazard-asset interactions identified in the CCRA and improve the resilience of the Project. Adaptation strategy recommendations are intended to provide insight and guidance for how engineers and designers might incorporate climate considerations into their design and monitoring plans to improve the resilience of the physical assets to the identified risks associated with climate change. Operations and Maintenance phase-related recommendations are intended to provide insight and guidance into how monitoring, responding, and/or adapting to climate-related hazards might be incorporated into maintenance, operations, and personnel health and safety policies and procedures.

The CCRA applied a methodology that is consistent with the Government of Canada's Strategic Assessment of Climate Change (Government of Canada 2020; 2022) and the Public Infrastructure Engineering Vulnerability Committee (PIEVC) Protocol (<https://pievc.ca/protocol/>; PIEVC Global Partnership, 2021). The PIEVC Protocol was developed by Engineers Canada is now under the ownership and control of the partnership of the Institute for Catastrophic Loss Reduction, Climate Risk Institute, and Deutsche Gesellschaft für Internationale Zusammenarbeit. Additionally, the CCRA methodology is consistent with the following international standards:

- ISO 31000:2018 – Risk Management – Principles and Guidelines (ISO 2018)
- ISO 14090:2019 – Adaptation to climate change — Principles, requirements, and guidelines (ISO 2019)
- ISO 14091:2021 – Adaptation to climate change — Guidelines on vulnerability, impacts and risk assessment (ISO 2021).

Climate risk refers to the possibility that an asset or asset component would be adversely affected if it had a severe and/or prolonged interaction with a climate-related hazard. In the CCRA, risk is expressed as the following function:

$$\text{Risk} = \text{Probability of Climate Hazard Occurring} \times \text{Consequence of Impact}$$

Risk to each asset was assessed under baseline climate (1991-2020) and three future climate periods (2030s, 2050s, and 2080s).

The CCRA considered both planned assets (e.g., diesel-fueled power plant at the port) and potential assets (e.g., wind turbine and solar photovoltaic array). As the Project is in schematic design stage, the CCRA is a high-level assessment, considering assets at the asset component level (e.g., road structure, building superstructure and substructure, large vessel wharf structures) and general subcomponent level as applicable. Each asset grouping of the Project was assessed and reported on separately as follows:

- Road assets
- Jericho Station assets
- Port – Marine-based assets

- Port – Landside assets
- Aerodrome assets

For the CCRA, the road assets assessment included the all-season roadway, quarry/storage areas, roadway support buildings (e.g., at quarries and roadside emergency shelters), and the winter road connecting the all-season road to the northern terminus of the Tibbitt to Contwoyto Winter Road. The assessments also considered personnel (including administrative staff, operations and maintenance staff, and/or users of the project assets) and all-season roadway, marine and port, and aerodrome and aircraft operations.

Inuit, Indigenous, and Community Knowledge provided guidance into climate hazard selection for the CCRA. Kitikmiut, other Indigenous groups, and other potentially affected communities highlight that the weather has become less predictable and noted, for instance, the following climate parameters as of interest and/or concern:

- The rapid pace of permafrost thaw and its impact on the environment and traditional activities.
- Thinner ice and earlier melting of ice in rivers, lakes, and along the coast and its influence on travel and wildlife activities (e.g., caribou migration patterns).
- Lower water levels in rivers and the ocean, which NTKP consultants have attributed to less snow and rain (Banci and Spicker 2024), and its influence on travel and aquatic life (e.g., Arctic char).
- Freezing rain occurrences and its impact on snow cover (which influences the caribou's ability to forage).
- Changes in the wind regime and its impact on travel.
- Changes in snow quality, quantity, and coverage and its impact on travel, including emergency igloo building.

Fourteen climate hazards (listed below) were considered for all the asset groupings, with relative sea level change, wave activity, and sea ice ride-up also considered for the port assets:

- Extreme cold
- Extreme heat
- Extreme rainfall – short duration high intensity rainfall
- Extreme rainfall – sustained rainfall
- Heavy snowfall
- Freeze-thaw cycles
- Dry spells
- Tundra fire
- High winds
- Icing (due to freezing rain, freezing fog)
- Permafrost thaw
- Spring melt (including aufeis) and spring freshet/riverine flooding

- Fog
- Whiteout conditions (due to blowing snow)

The CCRA and report (Appendix 12B) focus on risks calculated under the SSP5-8.5 high emissions climate change scenario, which provides a conservatively high estimate of climate change that may occur. Summaries of the highest risks identified in the CCRA, organized by asset grouping, are presented as follows:

- Table 12.11: Road highest risks
- Table 12.12: Jericho Station highest risks
- Table 12.13: Port – Marine highest risks
- Table 12.14: Port – Landside highest risks
- Table 12.15: Aerodrome highest risks

Climate-related high risks to personnel are also presented in Table 12.16. Full risk matrices and details of high risks under SSP5-8.5 are presented for each asset grouping in the main report (Appendix 12B).

Table 12.11 Summary of Highest Risk Climate Hazard-Asset Interactions to the Road

Summary of Highest Risk Climate Hazard-Asset Interactions to the Road		
Component	Climate Hazard	Potential Impacts
All-season roadway	Extreme cold	Contraction of culverts under extreme cold and ice accumulation may result in damage to culverts.
	Permafrost thaw	- Ground shifting due to permafrost thaw could lead to settlement and degradation of the road system and potentially damage road embankments. - Permafrost thaw and related impacts may result in increased need for maintenance, including repairing physical damage. Limited usage or temporary closure (i.e., suspended operations) may be required to repair assets.
Roadway support buildings	Tundra fire	- Potential damage or loss of structures (e.g., roadway support buildings). - Smoke from tundra fires can increase the demand on air ventilation systems, clog air filters, and require more frequent replacement of filters.
All-season roadway operations	Tundra fire	Potential road closures due to tundra fire activity.
	Permafrost thaw	- Road damage due to permafrost thaw may result in reduced usage or partial or full closure of sections of the road system. - Limited usage or temporary closure (i.e., suspended operations) may be required to repair road damage due to permafrost thaw.

Table 12.12 Summary of Highest Risk Climate Hazard-Asset Interactions to Jericho Station

Summary of Highest Risk Climate Hazard-Asset Interactions to Jericho Station		
Component	Climate Hazard	Potential Impacts
Buildings	Extreme heat	• Extreme heat (and in combination with UV radiation) can accelerate deterioration of seals and sealants, result in decreased lifespans and more frequent/earlier replacements. • Potential for damage to electrical equipment due to overheating during high heat conditions.
	Tundra fire	• Potential damage or loss of structures. • Smoke from tundra fires can increase the demand on air ventilation systems, clog air filters, and require more frequent replacement of filters.
	Permafrost thaw	• Ground shifting due to permafrost thaw could lead to settlement and degradation of foundations as well as potentially damage assets, including the building structure and interior components through cascading impacts. • Permafrost thaw and related impacts may result in increased need for maintenance, including repairing physical damage to assets, releveling or relocating skid mounted assets, and/or earlier replacement or reconstruction of assets. Limited usage or temporary closure may be required to repair assets.
Water facilities	Extreme cold	• Potential for pipe failure due to freeze up under extreme cold conditions. Pipe failure could subsequently result in the loss of operations, including in association with the treatment plant. • Extreme cold can accelerate deterioration of seals and sealants, result in decreased lifespans and more frequent/earlier replacements.
Freshwater water intake	Extreme cold	
Waste facilities	Extreme cold	
Power facilities	Tundra fire	• Potential damage and/or disruption of power supply due to fire (e.g., damage to powerline and poles). • Accumulation of ash on electrical equipment can increase the risk of electric arcing and pole fires, which would result in damage to equipment and outages.
	High winds	• Potential disruption of power supply due to high wind impacts on powerline (e.g., galloping of lines, increases stress on pole-mounted equipment such as transformers and building connections).
Laydown/storage areas	Tundra fire	• Potential damage or loss of storage units.

Summary of Highest Risk Climate Hazard-Asset Interactions to Jericho Station		
Component	Climate Hazard	Potential Impacts
Airstrip	Permafrost thaw	- Ground shifting due to permafrost thaw could lead to settlement and degradation of the airstrip. - Permafrost thaw and related impacts may result in increased need for maintenance, including repairing physical damage. Limited usage or temporary closure (i.e., suspended operations) may be required to repair assets.
	Spring melt and spring freshet/riverine flooding	Aufeis¹ could reduce drainage capacity or completely block culverts and result in increased maintenance needs (e.g., thawing/removal of ice to return to full functionality).

Note:

¹ Aufeis: a sheet-like mass of layered ice accumulated on the ground and/or on top of river/lake ice. Aufeis is formed by the freezing of successive overflows of water that may be from surface water or seeping groundwater, flow from a spring, or emerge from below river/lake ice through fractures. Aufeis can range in extent from a few square metres to several square kilometres and can vary in thickness from a few centimetres to many metres (Turcotte et al., 2024a; 2024b).

Table 12.13 Summary of Highest Risk Climate Hazard-Asset Interactions to the Port – Marine

Summary of Highest Risk Climate Hazard-Asset Interactions to the Port – Marine		
Component	Climate Hazard	Potential Impacts
Small craft harbour area	Wave activity	Increased wave height and/or period (beyond design wave action) could damage floats, connections, and anchors associated with the seasonal floating docks.
Marine operations	High winds	High winds, wave activity (e.g., storm surge), and sea ice ride-up may present an operational hazard to shipping operations (e.g., berthing/mooring) and port operations (e.g., loading/unloading cargo from ships), potentially resulting in temporary suspension of marine and/or port operations.
	Wave activity	
	Sea ice ride-up	

Table 12.14 Summary of Highest Risk Climate Hazard-Asset Interactions to the Port – Landside

Summary of Highest Risk Climate Hazard-Asset Interactions to the Port – Landside		
Component	Climate Hazard	Potential Impacts
Buildings	Permafrost thaw	- Ground shifting due to permafrost thaw could lead to settlement and degradation of foundations as well as potentially damage assets, including the building structure and interior components through cascading impacts. - Permafrost thaw and related impacts may result in increased need for maintenance, including repairing physical damage to assets, releveling or relocating skid mounted assets, and/or earlier replacement or reconstruction of assets. Limited usage or temporary closure may be required to repair assets.
Water/wastewater piping	Extreme cold	Potential for pipe failure due to freeze up under extreme cold conditions. Pipe failure could subsequently result in the loss of operations, including in association with the plants.
Seawater inlet/outlet and desalination plant	Extreme cold	
Lake water treatment plant	Extreme cold	
Wastewater treatment plant and lagoon	Extreme cold	Potential for water pipe failure due to freeze up under extreme cold conditions. Pipe failure could subsequently result in the loss of operations associated with the treatment plant.
	Extreme rainfall – sustained rainfall	Increased runoff due to heavy rainfall could potentially overwhelm the lagoon wetland treatment system and result in the release of untreated water.
	Spring melt and spring freshet/riverine flooding	Flooding could result in increased water input into the lagoon, potentially overwhelming the lagoon wetland treatment system and resulting in the release of untreated water.
Stormwater conveyance	Extreme cold	Contraction of culverts under extreme cold and ice accumulation may result in damage to culverts.
	Permafrost thaw	- Ground shifting due to permafrost thaw could lead to settlement and degradation of the road system and potentially damage culverts. - Permafrost thaw and related impacts may result in increased need for maintenance, including repairing physical damage. Limited usage or temporary closure (i.e., suspended operations) may be required to repair assets.
Diesel-fueled power plant generation facilities	Tundra fire	- Potential damage and/or disruption of power supply due to fire (e.g., damage to powerline and poles). - Accumulation of ash on electrical equipment can increase the risk of electric arcing and pole fires, which would result in damage to equipment and outages.
	High winds	Potential disruption of power supply due to high wind impacts on powerline (e.g., galloping of lines, increases stress on pole-mounted equipment such as transformers and building connections).

Summary of Highest Risk Climate Hazard-Asset Interactions to the Port – Landside		
Component	Climate Hazard	Potential Impacts
Incinerator	Permafrost thaw	• Ground shifting due to permafrost thaw could lead to settlement and degradation of the building foundation as well as potentially damage the building and/or interior components through cascading impacts. • Permafrost thaw and related impacts may result in increased need for maintenance, including repairing physical damage to assets and/or earlier replacement or reconstruction of assets. Limited usage or temporary closure (i.e., suspended operations) may be required to repair assets.

Table 12.15 Summary of Highest Risk Climate Hazard-Asset Interactions to the Aerodrome

Summary of Highest Risk Climate Hazard-Asset Interactions to the Aerodrome		
Component	Climate Hazard	Potential Impacts
Airstrip and apron	Extreme rainfall – sustained rainfall	• Runoff due to intense rainfall may transport and displace gravel, with potential for pothole development or washout, and result in increased maintenance needs of assets. • Runoff due to intense rainfall may overwhelm stormwater conveyance systems, resulting in localized flooding and erosion of the runway and apron.
	Permafrost thaw	• Ground shifting due to permafrost thaw could lead to settlement and degradation of the airstrip and apron. • Permafrost thaw and related impacts may result in increased need for maintenance, including repairing physical damage. Limited usage or temporary closure (i.e., suspended operations) may be required to repair assets.
	Spring melt and spring freshet/riverine flooding	• Localized flooding may transport and displace gravel, with potential for pothole development or washout, and result in increased maintenance needs of assets. • Localized flooding may overwhelm stormwater conveyance systems and result in erosion of airstrip and apron. • Development of auefs¹ could potentially damage road airstrip and apron surfaces.
Navigation aids	Permafrost thaw	• Ground shifting due to permafrost thaw could lead to settlement and result in misalignment of navigation aids. • Permafrost thaw and related impacts may result in increased need for maintenance. Limited usage or temporary closure (i.e., suspended operations) may be required to repair assets.
Air Terminal Building and Field Electrical Centre	Permafrost thaw	• Ground shifting due to permafrost thaw could lead to settlement and degradation of foundations as well as potentially damage assets, including the building structure and interior components through cascading impacts. • Permafrost thaw and related impacts may result in increased need for maintenance, including repairing physical damage to assets, releveling or relocating skid mounted assets, and/or earlier replacement or reconstruction of assets. Limited usage or temporary closure may be required to repair assets.

Summary of Highest Risk Climate Hazard-Asset Interactions to the Aerodrome		
Component	Climate Hazard	Potential Impacts
Aircraft operations	Extreme rainfall – sustained rainfall	Ponding and localized flooding can result in reduced aircraft operations due to increased potential for reduced or loss of control in areas with accumulated water, or temporary suspension of operations.
	Tundra fire	Airborne ash and tundra fire activity can result in temporary suspension of aircraft operations.
	High winds	- Increased potential for dust generation or blowing snow, which could result in reduced visibility and cause reduced operations. - Snow drifting could result in reduced use or temporary suspension of aircraft operations, with increased maintenance required to clear snow. - High winds, especially crosswinds, present an operational hazard for aircraft and can result in temporary suspension of operations.
	Icing	- Aircraft may require additional de-icing. - Ice accumulation on airstrip, requiring maintenance before aircraft operations.
	Permafrost thaw	- Airstrip damage due to permafrost thaw may result in reduced usage or suspension of aircraft operations. - Limited usage or temporary closure (i.e., suspended operations) may be required to repair airstrip damage due to permafrost thaw.
	Spring melt and spring freshet/riverine flooding	Localized flooding and aufeis events can result in reduced usage or temporary suspension of aircraft operations.
	Fog	Reduced visibility due to fog can result in temporary suspension of aircraft operations.
	Whiteout conditions	Reduced visibility due to whiteout conditions can result in temporary suspension of aircraft operations.

Note:

¹ Aufeis: a sheet-like mass of layered ice accumulated on the ground and/or on top of river/lake ice. Aufeis is formed by the freezing of successive overflows of water that may be from surface water or seeping groundwater, flow from a spring, or emerge from below river/lake ice through fractures. Aufeis can range in extent from a few square metres to several square kilometres and can vary in thickness from a few centimetres to many metres (Turcotte et al., 2024a; 2024b).

Table 12.16 Climate-related High Risks to Personnel

High Risks to Personnel	
Climate Hazard	Potential Impacts
Extreme cold	• Cold-related health and safety risks to personnel (e.g., frostbite) as well as reduced productivity.
Extreme heat	• Heat-related health and safety risks to personnel (e.g., fatigue, heat exhaustion) as well as reduced productivity.
Heavy snowfall	• Snow clearing activities pose a health and safety risk to personnel (e.g., slip-and-falls, muscle or back strains).
Tundra fire	• Tundra fire activity poses a health and safety risk and may require evacuation of personnel. • Smoke from tundra fires can pose a health and safety risk (e.g., respiratory issues) to personnel as well as reduced productivity.
High winds	• Dust generated by high winds can pose a health and safety risk (e.g., respiratory issues) to personnel as well as reduced productivity. • High winds present an operational hazard to large vehicles (e.g., potential for tipping over), which could result in harm to personnel.
Icing	• Ice accumulation presents a health and safety risk to personnel (e.g., increased potential for vehicle accidents, slip-and-fall risk).
Spring melt and spring freshet/riverine flooding	• Localized flooding and aufeis¹ can pose health and safety risks (e.g., underwater tripping hazards, slip-and-falls). • Localized flooding and aufeis present operational hazards to vehicles (e.g., increased potential for loss of control and vehicle accidents), which could result in harm to personnel.
Fog	• Reduced visibility due to fog can cause hazardous driving conditions, increasing the potential for vehicle accidents and harm to personnel.
Whiteout conditions	• Reduced visibility due to whiteout conditions can cause hazardous driving conditions, increasing the potential for vehicle accidents and harm to personnel.
Wave activity	• Wave activity (e.g., storm surge) could present a health and safety risk to port personnel (e.g., overtopping waves, slip-and-falls).
Sea ice ride-up	• Sea ice ride-up could present a health and safety risk to port personnel (e.g., muscle or back strains during ice clearing activities).

Note:

¹ Aufeis: a sheet-like mass of layered ice accumulated on the ground and/or on top of river/lake ice. Aufeis is formed by the freezing of successive overflows of water that may be from surface water or seeping groundwater, flow from a spring, or emerge from below river/lake ice through fractures. Aufeis can range in extent from a few square metres to several square kilometres and can vary in thickness from a few centimetres to many metres (Turcotte et al., 2024a; 2024b).

Adaptation strategies were developed for each asset grouping, with focus on the high risks identified in the CCRA. The following are examples of adaptation strategy recommendations included in the CCRA report:

- Consider climate-adjusted design criteria to promote long-term resilience. For instance, incorporate projected changes in extreme rainfall in culvert design (sizing). Increased resiliency of the drainage system will help reduce road structure and embankment and airstrip/runway impacts associated with extreme rainfall. Additionally, consider runoff volumes with no vegetation present in design criteria decisions (allowing for consideration of vegetation loss due to tundra fire).
- Design and install permanent erosion control measures (e.g., gabion, mesh, netting, woven geotextile) in areas anticipated to be susceptible to erosion, such as embankments built with Terrain Type II materials.
- Where permafrost is present, consider the following adaptation strategies:
 - Apply active and/or passive heat mitigation techniques such as thermosyphons, air convection embankments, air ducts and heat drains, reflective surfaces, insulation, and embankment thickening to help maintain thermal integrity and ground stability.
 - Install woven geotextile to reinforce embankments and reduce differential settlement.
 - Employ methods to reduce thermal disturbance (e.g., incorporating approaches to lowering the water table in the immediate vicinity of the roadbed by using ditches or similar components).
 - Install remote monitoring equipment (e.g., thermistors, video cameras) to monitor permafrost conditions and track changes (e.g., settlement) to help make informed decisions. Consider establishing an alert system that can be triggered when sensors indicate exceedance of thresholds defined in an operations and maintenance policy – e.g., exceedance of a specific ground temperature triggers an inspection of the road section.
- Consider increasing insulation and adding additional heat tracing on above ground pipes, if feasible, to reduce the risk of freeze-up under extreme cold conditions. Prioritize critical infrastructure pipes/piping and pipes sections with increased vulnerability to freezing.
- In areas with underground pipes (e.g., in laydown areas), consider a thicker gravel pad to provide additional insulation and reduce the risk of freeze-up under extreme cold conditions.
- Establish an operations and maintenance policy to conduct regular inspections of above ground pipes/piping during extreme cold events and manually thaw as necessary to reduce the potential for damage to the pipes and water/wastewater facility operations shutdown.
- Consider installing remote monitoring equipment (e.g., ground temperature probes, equipment on the pipes) to monitor permafrost conditions and track changes (e.g., settlement of ground and level/alignment of piping) to help make informed decisions and complete proactive repairs. Consider establishing an alert system that can be triggered when sensors indicate exceedance of thresholds defined in an operations and maintenance policy.
- Consider installing high Minimum Efficiency Reporting Value air filtration in buildings to improve indoor air quality, particularly during poor air quality conditions due to tundra fire smoke or dust generation during high wind events. Perform regular inspection and clearing or replacing of filters.

- Consider galloping in design of the power distribution system and infrastructure configuration. Possible options for reducing the potential for galloping lines include the following:
 - Increasing the spacing between conductors (i.e., lines) and/or adding spacer insulators to reduce potential for line contact (if multiple lines).
 - Increasing the number of poles (decreasing the length of line between poles reduces the potential for galloping).
 - Installing dampers to reduce galloping.
- Consider higher resistance poles (e.g., fibre glass, composite, or steel) to increase resilience of the power distribution system. If wooden poles are used, consider installing fire mesh to reduce the potential for tundra fire activity burning the poles.
- If glycol de-icing is selected for aircraft, consider the following:
 - Develop a glycol management plan. A glycol recovery system would reduce the glycol importing needs, as glycol would be recuperated and reused on site.
 - Identify a designated area for aircraft de-icing, including a de-icing pad and the glycol recovery system.
 - Plan for an adequate supply of glycol on site for de-icing activities and consider also maintaining a glycol reserve at the aerodrome for backup.

A number of adaptation strategies included in the CCRA can help to reduce risks associated with multiple climate hazards, assets, and/or impacts. Adaptation strategy recommendations are presented for each asset grouping in the main report (Appendix 12B).

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13 Assessment of Potential Effects on Noise and Vibration

For Inuit, the land, water, and ice are places of peace, where quiet is part of life and essential for hunting, travel, and connection to the land. Short-term or long-term noise and vibration can disturb wildlife, make harvesting harder, and change the experience of being on the land. This assessment respects these values and focuses on protecting both the natural sound environment and the ability of Kitikmiut, other Indigenous groups, and other potentially affected communities to use the land in the ways they always have.

The Impact Statement (IS) presents the evaluation of project effects from noise and vibration as a standalone section. The Project has the potential to increase noise and vibration levels due to Grays Bay Road and Port Project (Project) activities in the Project Development Area (PDA) during Construction and Operations and Maintenance phases. The term “noise” without capitalization refers to the study of sound. Sound is audible and noise refers to “unwanted sound.” Vibration includes ground-borne vibration and air overpressure effects.

This section describes and assesses the potential effects of the Project on the Noise and Vibration Valued Component (VC), with a focus on noise and vibration effects on human noise sensitive receptors. Noise and vibration effects can affect other ecosystemic and socio-economic environments, including the following:

- Wildlife (Volume 6, Sections 16 to 18)
- Marine Mammals (Volume 8, Section 23)
- Marine Fish and Fish Habitat (Volume 8, Section 22)
- Traditional Land, Marine, and Resource Use (Volume 9, Section 24)
- Community Health and Well-being (Volume 9, Section 26)

The noise and vibration VC assessment focused on the two project phases: Construction and Operations and Maintenance. The Project includes multi-user and multi-use facilities that will be of public benefit in perpetuity. The facilities are anticipated to operate permanently and, therefore, West Kitikmeot Resources Corp. (WKR) has not proposed a conceptual closure and reclamation plan for the infrastructure.

An assessment of baseline noise levels was conducted to establish existing acoustic conditions for the Project. The Grays Bay Road and Port Project Acoustic Baseline Report in Appendix 13A presents the monitoring setup, methods, and measured sound level based on noise monitoring conducted at two locations during September 2017 and August 2022. The Grays Bay Road and Port Project Noise and Vibration Technical Modelling Report (TMR) in Appendix 13B provides technical details on noise and vibration modelling methods and results.

13.1 Scope of Assessment

This section defines and describes the scope of the assessment of potential effects on the noise and vibration VC.

13.1.1 Influence of Engagement and Inuit, Indigenous, and Community Knowledge on the Assessment

WKR continues to engage with Kitikmiut, other Indigenous groups, and other potentially affected communities about the Project. A summary of engagement activities conducted from 2016 into 2025 is presented in Volume 3, Section 6 (Public Engagement). In addition to these activities, WKR conducted community-based primary research with residents and organizations of the Kitikmeot communities of Cambridge Bay, Gjoa Haven, Kugaaruk, Kugluktuk, and Taloyoak, along with organizations in Yellowknife. Additionally, an Inuit Advisory Group (IAG) was established to advise WKR on potential environmental and socio-economic effects or concerns related to the Project, planned mitigation approaches, and aspects of the environmental assessment including, but not limited to, baseline understanding, significance determination, and consideration and integration of Inuit and Community Knowledge. Members were selected by the Kitikmeot Inuit Association and WKR based on their knowledge of many aspects of the natural and human environment including, but not limited to, wildlife, fish, climate, land use and access, archaeology, and/or water in the Project area.

To further inform the Project design, a project-specific Inuit Knowledge report titled *Kitikmeot Knowledge of the Proposed Kogloktokyoak (Grays Bay) Port and Road Project Final Report* (Banci and Spicker 2024) was commissioned by WKR. This report, compiled from Inuit Knowledge contained in the Naonaiyaotit Traditional Knowledge Project (NTKP), was made available to WKR through a licensing agreement with the Kitikmeot Inuit Association.

In addition, publicly available sources of Inuit and Indigenous Knowledge were reviewed to provide further context about baseline conditions and how conditions are changing, as well as potential mitigation measures recommended on previous projects that could be considered for the Project. Results from monitoring studies and other community-based research were also reviewed.

Through the project-specific engagement program, Kitikmiut, other Indigenous groups, and other potentially affected communities shared comments, perspectives, concerns, and recommendations related to noise and vibration. Information shared regarding the potential for effects of noise and vibration on other resources (e.g., wildlife and fish) has been provided to authors of relevant VCs for consideration and integration. Through reviewing the information, Inuit, Indigenous, and Community Knowledge has influenced key components of the noise and vibration assessment. WKR commits to continued engagement with Kitikmiut, other Indigenous groups, and other potentially affected communities during the advancement of project design, planning, monitoring and throughout the life of the Project.

13.1.1.1 *Influence of Inuit, Indigenous, and Community Knowledge on Assessment Boundaries*

Inuit, Indigenous, and Community Knowledge was reviewed with consideration to the proposed spatial boundaries. For example, the Local Assessment Area (LAA) considers the area where project-specific environmental effects on noise and vibration can be measured including effects identified by Kitikmiut, other Indigenous groups, and other potentially affected communities, such as noise (see Section 13.1.4.1).

13.1.1.2 *Influence of Inuit, Indigenous, and Community Knowledge on Baseline Conditions*

WKR collected baseline condition information by combining technical studies collected through western scientific methods with Inuit-led and collaborative knowledge gathering (including the project-specific NTKP and IAG workshops), publicly available information from Indigenous groups considered in the context of the Project, and engagement feedback shared by Kitikmiut, other Indigenous groups, and other potentially affected communities. Pertinent baseline information from Inuit, Indigenous, and Community Knowledge sources is not presented in Appendix 13A or 13B; rather, this information has been considered and summarized in Section 13.2.2.1 Table 13.5. This includes information about noise and vibration concerns affecting environmental factors, including noise disturbing caribou and muskox (Banci and Spicker 2024; IAG 2025a) (see Section 13.2.2).

13.1.1.3 *Influence of Inuit, Indigenous, and Community Knowledge on the Assessment of Project Effects*

WKR discussed with Kitikmiut, other Indigenous groups, and other potentially affected communities how project activities (e.g., clearing, blasting, etc.) and project infrastructure could affect socio-economic conditions or culturally important interests including noise and vibration within the noise and vibration LAA. Through community meetings, IAG workshops, and public engagement opportunities, Kitikmiut, other Indigenous groups, and other potentially affected communities including transboundary communities provided perspectives and values, which were considered and integrated into the potential effects to be considered. This includes perspectives about noise and vibration and the effects Kitikmiut, other Indigenous groups, and other potentially affected communities are observing in the environment as a result of associated changes.

Traditional Land, Marine, and Resource Use (TLMRU) activities, such as harvesting areas, gathering places, and travel routes, may occur in areas that intersect the Project's construction activities (Banci and Spicker 2024). For these activities, where it is difficult to define a discrete receptor location, the assessment used a buffer distance approach in which noise and vibration levels were predicted at different distances from the activities. The buffer approach is commonly used in noise and vibration assessments. This approach quantifies the noise effect at different distances from the construction and operation and maintenance activities along the Road PDA. Feedback has been integrated in the assessment of project effects on air, where applicable (see Section 13.3).

13.1.1.4 *Influence of Inuit, Indigenous, and Community Knowledge on the Assessment of Cumulative Effects*

Through workshops and regional discussions, Kitikmiut Knowledge Holders, other Indigenous groups, and other potentially affected communities assisted WKR in identifying culturally important areas, species, and practices that may experience combined effects from the Project and other projects and activities in the Project's Regional Assessment Areas (RAA).

WKR wove Inuit, Indigenous, and Community perspectives with western science to develop a holistic view of how multiple changes could affect land-based livelihoods, cultural continuity, and environmental integrity over time. The analysis recognizes the importance of long-term monitoring where local, Inuit co-developed data collection will track combined effects to inform adaptive management plans (see Section 13.4.2.2).

13.1.1.5 *Influence of Inuit, Indigenous, and Community Knowledge on Assessing Significance of Effects*

Significance criteria were informed with input from Inuit, Indigenous, and Community Knowledge. Taking into consideration Inuit, Indigenous, and Community values and perspectives (see Volume 3) and supported WKR's consideration of whether project-related noise and vibration effects frequently result in a high magnitude change in the LAA in the medium or longer term. In addition, members of the IAG provided additional criteria to consider when identifying whether a project is likely to have significant, or unacceptable, effects (see Sections 13.1.6 and 13.5).

To be considered "non-significant" or acceptable, IAG members advised WKR to implement comprehensive measures and commitments that align with Inuit, Indigenous, and Community priorities and values.

- **Proactive Protection Measures:** WKR's commitment to avoiding or strictly mitigating known high-risk activities is crucial. This includes implementing design measures, standard operating practices, and site-specific or situational measures to reduce the noise and vibration effects to acceptable levels for affected receptors, including Kitikmiut, other Indigenous, and other community land users.
- **Incorporation of Inuit, Indigenous, and Community Knowledge into Management:** The commitment to incorporate Inuit, Indigenous, and Community Knowledge and Western Science in all assessment sections, as appropriate, from baseline to monitoring, fostered dialogue and an inclusive project. The request for Inuit monitors to enforce mitigation measures in real-time shows that inclusion requires active Inuit participation in the Project's management (IAG 2025a, 2025b).
- **Adaptive Management:** The use of adaptive management plans that can be revised based on ongoing monitoring and the ongoing sharing of Inuit, Indigenous, and Community Knowledge is seen as essential for success and acceptability, given the unpredictable nature of climate (IAG 2025a, 2025b).

- Holistic Approach to Benefits: The Project's success is tied to its broader social and economic benefits, such as contributing to more resilient supply chains and providing job/training opportunities for Inuit and other Indigenous groups. The protection of all wildlife and water resources, beyond just caribou, was also a key part of the holistic equation for acceptability (IAG 2025b).

13.1.1.6 *Influence of Inuit, Indigenous, and Community Knowledge on the Development of Mitigation, Management, and Enhancement Measures*

Through engagement activities, community-based primary research, IAG workshops, and review of publicly available literature, measures to reduce negative effects from the Project and enhance benefits from the Project were shared. For example, during IAG workshops, participants stated that WKR should implement mitigation measures that have proven successful on other projects in Nunavut rather than inventing new measures (IAG 2025b). Feedback also helped focus the Project's design on sensitive timing and locations for monitoring and mitigation.

Proposed mitigation, management, and enhancement measures were discussed and reviewed with Inuit community representatives during IAG workshops and community meetings with the intent of developing and implementing measures that consider both the biophysical and human environment. Adjustments were made as appropriate based on advice from IAG members and the Kitikmeot Inuit Association, in addition to Indigenous groups and other potentially affected communities through engagement. Inuit, Indigenous, and Community Knowledge emphasized the importance of some of the mitigation measures listed in Sections 13.3.2.3 and 13.3.3.3. Inuit co-developed monitoring and reporting will be incorporated to support ongoing involvement and accountability (see Section 13.5.3).

Inuit, Indigenous, and Community Knowledge informed the development of practical, culturally responsive mitigation and monitoring measures. IAG members emphasized the importance of managing noise (IAG 2025a, 2025b) and the following monitoring measures are planned:

- Noise Monitoring: Where required, this will be considered to monitor the effectiveness of mitigation, management, and enhancement measures.
- Vibration Monitoring: Where required, vibration will be monitoring to determine the effectiveness of project mitigation, management, and enhancement measures.

13.1.1.7 *Influence of Inuit, Indigenous, and Community Knowledge on Transboundary Effects*

WKR engaged with and received feedback from Indigenous groups and other potentially affected communities, governments, and organizations in regions outside of the Kitikmeot Region to understand if project activities could affect socio-economic conditions, resources, wildlife, or culturally important areas shared between regions. This feedback has been integrated into the transboundary effects assessment (Volume 10, Section 33) and is not discussed further in this section.

13.1.2 Regulatory and Policy Setting

The assessment provides an overview of issues, concerns, and the regulatory environment regarding noise and vibration effects. It includes baseline conditions, and the project activities that may result in an increase in noise and vibration effects within the assessment spatial and temporal boundaries. The assessment also provides quantified predictions of project emission sources (propagation of sound and vibration are referred to as emissions), descriptions of modelling and data sources, and the results.

This assessment is guided by the Guidelines for the Preparation of an Impact Statement for West Kitikmeot Resources Corp's Grays Bay Road and Port Proposal (NIRB File No. 24XN038; NIRB 2026), in addition to applicable legislation, guidance documents, and international standards relevant to the assessment and management of noise and vibration, and is summarized in Table 13.1.

Nunavut has a Workers' Safety and Compensation Commission that oversees workplace safety and health, including occupational noise exposure for workers. The noise assessment focuses on human receptors not associated with the Project and off duty workers only. There is no other community-based noise regulation in Nunavut. As such, in the absence of territorial guidance and regulations, the assessment of noise and vibration adopts relevant guidelines from other jurisdictions, specifically the Alberta Energy Regulator (AER) and the Ontario Ministry of the Environment, Conservation and Parks (MECP). summarized in

Table 13.1 Summary of Key Legislation and Policies for Noise and Vibration

Regulation or Policy	Description
International	
United States (US) Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (FTA 2018)	The US FTA Transit Noise and Vibration Impact Assessment Manual (FTA 2018) provides guidance on different targets due to vibration effects from mobile heavy equipment. The annoyance threshold for equipment related ground-borne vibration is expressed in terms of velocity decibel levels (VdB). The US FTA guidance is used in this assessment in the absence of similar provincial or federal guidance.
Federal	
Health Canada's Guidance for Evaluating Human Health Effects in Impact Assessment: Noise (Health Canada 2023)	- Health Canada's Guidance for Evaluating Human Health Effects in Impact Assessment: Noise (Health Canada 2023) provides noise thresholds for annoyance and sleep disturbance. This guidance provides predictions of health risks resulting from noise emissions common to major infrastructure projects. - Measurable parameters such as daytime or nighttime equivalent sound levels (L_d and L_n, respectively), day-night equivalent sound levels (L_{dn}), mitigation noise level (MNL), change in percent highly annoyed (%HA), and maximum sound level (L_{max}) are used to quantify noise effects. - In addition to the noise threshold, Health Canada also provides a threshold for the air overpressure effect based on the number of blasts per day.

Regulation or Policy	Description
Provincial / Territorial	
AER Directive 038: Noise Control (AER Directive 038; AER 2024)	- The AER Directive 038: Noise Control (AER 2024) specifies best practices for noise control for resource (i.e., mining, oil and gas) activities in Alberta. AER Directive 038 pertains only to normal operation (not emergency situations) and does not provide defined noise level limits for construction and decommissioning activities. - AER Directive 038 indicates that all new AER-regulated facilities, when in operation, must meet a daytime (07:00 AM to 10:00 PM) and nighttime (10:00 PM to 07:00 AM) permissible sound level (PSL) at the nearest residential dwellings or at a distance of 1.5 kilometres (km) (1.5 km criteria boundary) from the facility boundary if there are no closer dwellings. The daytime PSL is set at 10 decibels (dB) above the nighttime value. The determination of daytime and nighttime PSL at a residential noise sensitive receptor is a function of residential density and proximity to transportation. - Low frequency noise (LFN) effects must be considered when the following two conditions are met: - A clear tonal component exists at a frequency at or below 250 hertz. - Arithmetic difference between the overall C-weighted sound level (dBC) and the overall A-weighted sound level (dBA) exceeds 20 dB (i.e., dBC minus dBA is greater than 20 dB). - If either of these conditions are not met, the potential for a low frequency noise effect at a residential noise sensitive receptor is deemed to be low, and no further mitigations are required.
Ontario MECP NPC-119 Blasting Guideline (MECP 1982)	- Ontario Ministry of the Environment, Conservation and Parks - The Ontario MECP NPC-119 Blasting (MECP 1982) guidance recommends standard targets for blast-related ground vibration and overpressure. The cautionary targets are the more conservative blast-related vibration targets.

13.1.3 Potential Effects, Pathways, and Measurable Parameters

Potential effects, effects pathways, and measurable parameters for the Noise and Vibration VC are described in Table 13.2.

Table 13.2 Potential Effects, Effects Pathways and Measurable Parameters for Noise and Vibration

Potential Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Increased noise levels causing annoyance to permanent residences, seasonal residences, and land users.	Construction and Operations and Maintenance activities associated with the Grays Bay Port, Road, and Jericho Station.	- A-weighted sound pressure levels (dBA), including daytime equivalent sound levels (L_d), nighttime equivalent sound levels (L_n), and day-night equivalent sound levels (L_{dn}), as well as maximum sound level (L_{max}) - Mitigation Noise Level (MNL) - Change in percent highly annoyed (%HA) - Low frequency noise effects (C weighted [dBC] sound pressure level)

Potential Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Increased vibration levels causing annoyance to permanent residences, seasonal residences, and land users.	- Blast-related ground-borne vibration and air overpressure - Vibration from mobile Construction and Operations and Maintenance equipment	- Blast-related ground-borne peak-particle velocity vibration level measured in millimetres per second (mm/s) - Blast-related air overpressure measured in dB - Equipment-related vibration level measured in VdB

13.1.4 Boundaries

13.1.4.1 Spatial Boundaries

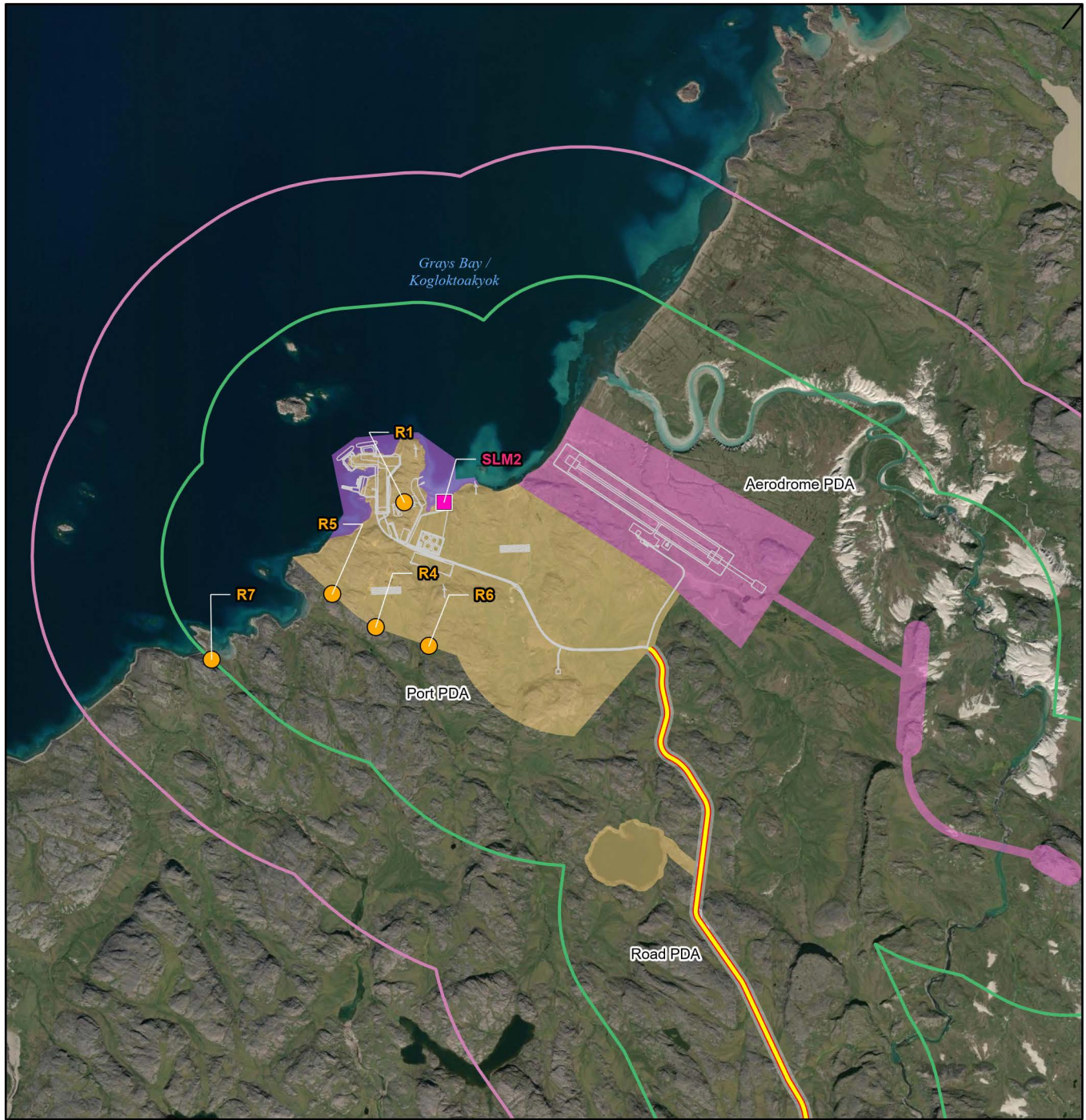
The spatial boundaries selected for Noise were based on consideration of Inuit, Indigenous and Community values and perspectives, public interest, guidance from regulators, past project experience and professional judgment. The boundaries represent the areas where data was available to characterize baseline conditions in support of the project-specific effects assessment and the cumulative effect assessment, including effects identified by Kitikmiut, other Indigenous groups, and other potentially affected communities.

The PDA, LAA, and RAA presented in this section are the areas where data were compiled/collected to allow for an understanding of the environment in support of the project-specific effects assessment and the cumulative effect assessment.

Project Development Area

The PDA encompasses the physical footprint of all project components, including both permanent and temporary disturbances (e.g., extent of project infrastructure, planned clearing, and laydown areas). The PDA includes six sub-areas based on the types of components to be developed: the Port (which is further divided into marine and landside infrastructure), Road, Aerodrome, Jericho Station, and Winter Road PDAs. The boundaries of the PDAs were created by applying buffers around where the project components will be sited and varies by each of the sub-areas depending on necessary flexibility for final siting of certain project components based on conditions on the ground. For the Road PDA and Winter Road PDA, a 75 metre (m) buffer was applied to the roads centreline, for the Port PDA and the Aerodrome PDA, the areas were subdivided based on the conceptual project component locations and then buffered approximately 1,000 m for the landside Port PDA, approximately 300 m for the marine Port PDA, and 500 m for the Aerodrome PDA. The Jericho Station PDA was buffered based on the existing development from the old Jericho Mine site that will be used for the Project and the need for additional space to accommodate the project components that will be developed as part of the Project for this location. The Winter Road PDA will only exist annually between the beginning of February and end of March, will be built on land where the existing Jericho Station road ends, at the southeastern portion of Jericho Station, to the shoreline of Contwoyto Lake where it will connect to the Tibbitt to Contwoyto Winter Road. For the purposes of the impact assessment, the PDA is the same as the Site Study Area identified in the IS Guidelines. The extent of the PDA at the Grays Bay Port, Grays Bay Road, and Jericho Station is shown Figure 13.1, Figure 13.2, and Figure 13.3, respectively.

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Notes
1. Coordinate System: WGS 1984 UTM Zone 12N
2. Data Sources: Government of Canada, Stantec, Earthstar Geographics

- Noise Receptor
- Sound Level Meter
- Grays Bay Road
- Grays Bay Port
- Project Development Area (PDA)**
 - Aerodrome
 - Port (Landside Infrastructure)
 - Port (Marine-based Infrastructure)
 - Road
- Local Assessment Area (LAA)
- Regional Assessment Area (RAA)

0 0.5 1 Kilometres
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WEST KITIMEOT
RESOURCES
CORP

NUNAMI
STANTEC LIMITED

Project Location
West Kitimeot-Region
Nunavut

Prepared by SL on 2025-11-21
TR by SZ on 2025-11-21

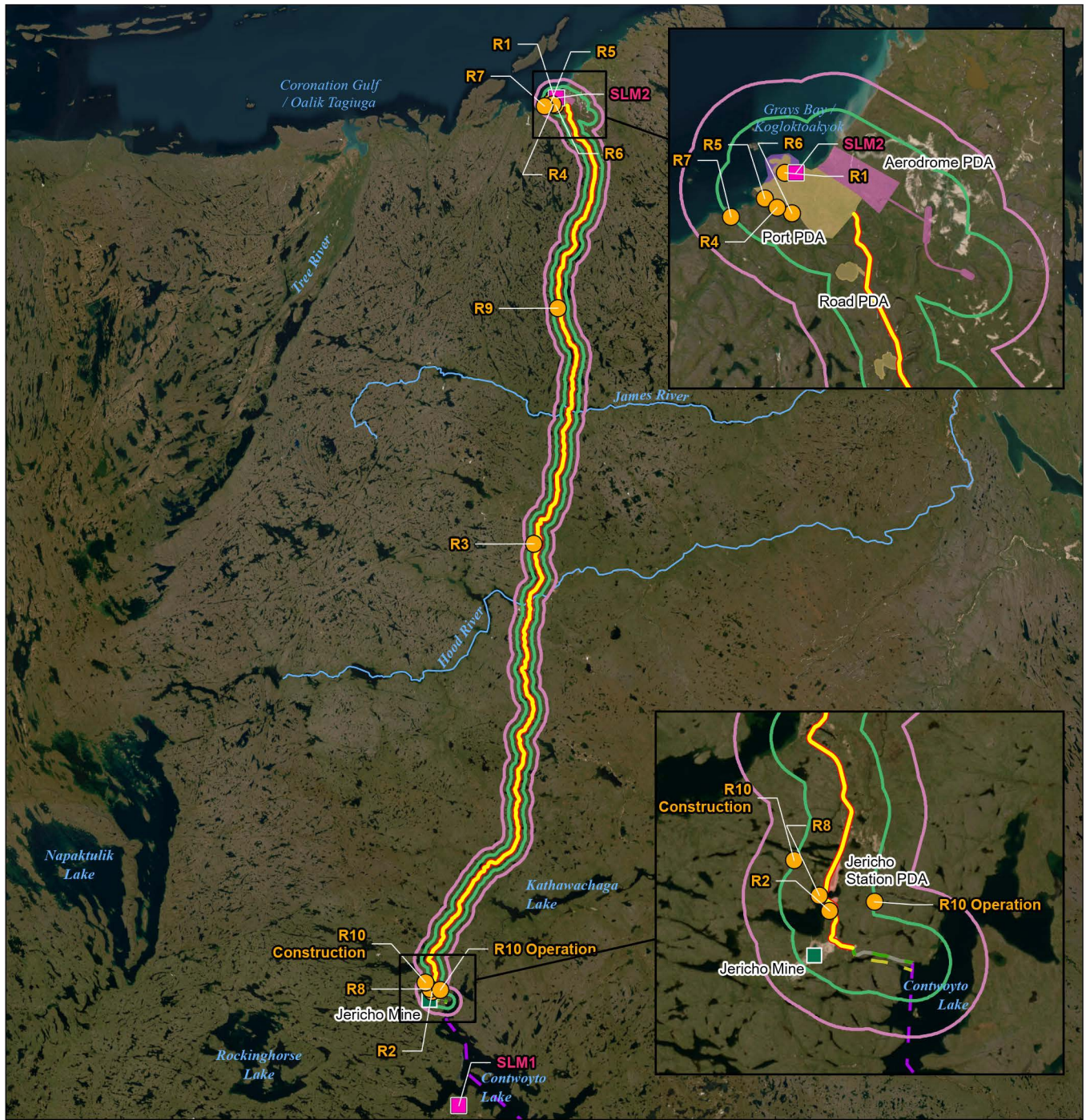
Client/Project
West Kitimeot Resources Corp
Grays Bay Road and Port

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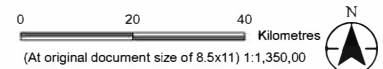
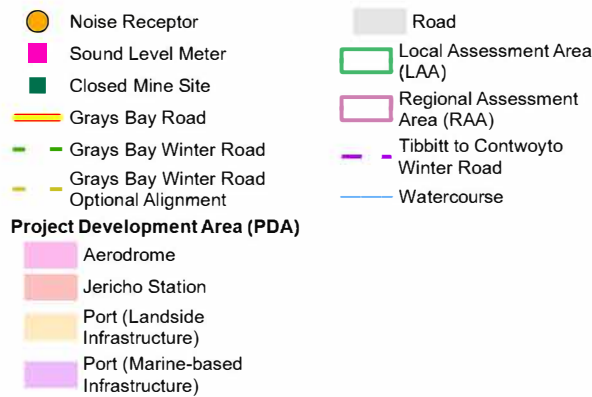
Figure No.
13.1

Title
**Noise and Vibration Assessment
Area - Grays Bay Port**

Disclaimer: This document has been prepared based on information provided by others as cited in the Notes section. Stantec has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result. Stantec assumes no responsibility for data supplied in electronic format, and the recipient accepts full responsibility for verifying the accuracy and completeness of the data. Preliminary Concept Design Only.



Notes
 1. Coordinate System: WGS 1984 UTM Zone 12N
 2. Data Sources: Government of Canada, Stantec, Earthstar Geographics

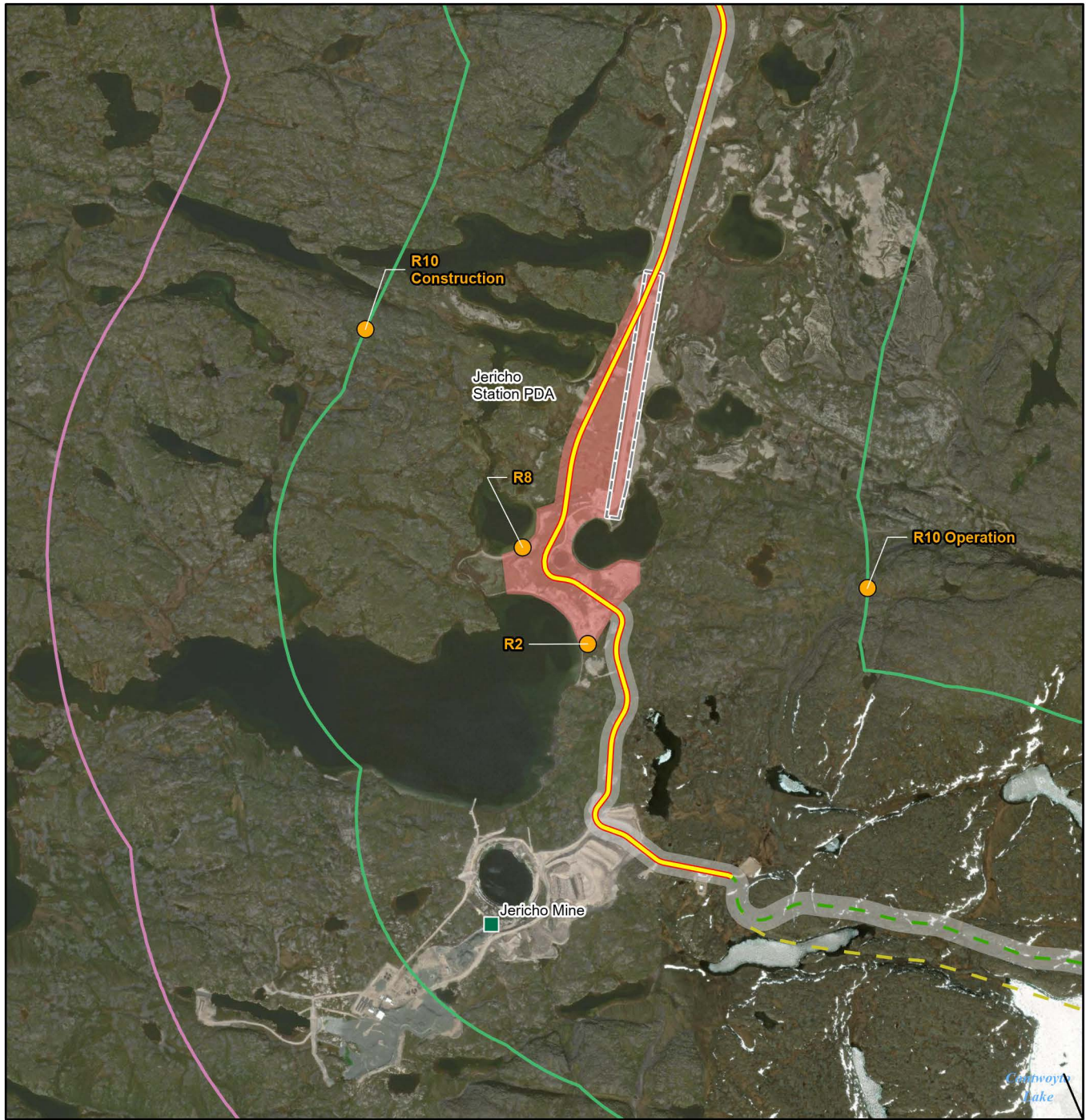


Project Location: West Kitikmeot-Region, Nunavut
 Prepared by SL on 2025-11-21, TR by SZ on 2025-11-21

Client/Project: West Kitikmeot Resources Corp, Grays Bay Road and Port
 123514868_092

Figure No. 13.2
 Title

Noise and Vibration Assessment Area - Grays Bay Road



Notes
1. Coordinate System: WGS 1984 UTM Zone 12N
2. Data Sources: Government of Canada, Stantec, Earthstar Geographics

- Noise Receptor
- Closed Mine Site
- Grays Bay Road
- Grays Bay Winter Road
- Grays Bay Winter Road Optional Alignment
- Project Development Area (PDA)
 - Jericho Station
 - Road
- Local Assessment Area (LAA)
- Regional Assessment Area (RAA)
- Existing Airstrip

0 0.5 1 Kilometres
(At original document size of 8.5x11) 1:40,000



Project Location: West Kitikmeot Region, Nunavut
Prepared by SL on 2025-11-21, TR by SZ on 2025-11-21

Client/Project: West Kitikmeot Resources Corp, Grays Bay Road and Port
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Figure No. 13.3

Title: Noise and Vibration Assessment Area - Jericho Station

Local Assessment Area

The LAA includes an area extending 1.5 km out from the PDA. The LAA is the area where project-specific environmental effects on noise and vibration can be predicted or measured with a reasonable degree of accuracy and confidence. The 1.5 km buffer is consistent with the buffer distance prescribed by AER Directive 038 for noise assessment study areas. The extent of the LAA at the Grays Bay Port, Grays Bay Road, and Jericho Station is shown in Figure 13.1, Figure 13.2, and Figure 13.3, respectively.

A total of eleven discrete noise receptors were identified. These receptors included TLMRU areas, permanent and seasonal residences (e.g., campsite), permanent accommodations (Grays Bay Port and Jericho Station), and mobile camps. Two permanent accommodations (i.e., R1 and R2) are inside the PDA, and nine receptors are located along or outside the PDA within the LAA (i.e., R3, R4, R5, R6, R7, R8, R9, R10 Construction, and R10 Operations). The selection of noise and vibration receptors outside and within the PDA is based on the Health Canada noise guidance (Health Canada 2023), AER Directive 038 (AER 2024), and feedback from Inuit communities regarding noise effects within areas of cultural and traditional use. The Inuit indicated concerns regarding the effects of noise on their traditional practice, including travelling and camping, and sense of place, such as quiet and peaceful areas, spiritual connection, undisturbed places, and reduced wilderness experience (see Table 13.5). In response to these concerns, Inuit, Indigenous, and Community Knowledge has been integrated into the receptor identification process. Receptor locations were selected to consider not only residential dwellings, in accordance with AER and Health Canada, but also areas identified by Inuit that may not align with conventional definitions of noise receptors. This approach enhances the cultural relevance of the noise and vibration assessments and seeks to address unique Inuit concerns about noise effects on their land. As such, receptors include permanent accommodations and TLMRU areas. There are no seasonal or permanent residential dwellings within the LAA. There are two non-project related workers' camps and two project-related workers permanent accommodations proposed within the PDA. The noise and vibration receptors are summarized in Table 13.3. The mobile camps are not used in the table as only fixed receptor locations are presented. Receptors at the Grays Bay Port, Grays Bay Road, and Jericho Station are shown in Figure 13.1, Figure 13.2, and Figure 13.3, respectively.

TLMRU activities may occur in areas that intersect the Project PDA. For these activities, where it is difficult to define a discrete receptor location, the assessment used a buffer distance approach. The approach involved predicting the Project's noise levels at various distances from the PDA, focusing on locations expected to experience the highest predicted noise and vibration effects on TLMRU. Examples of such locations include a straight section of Grays Bay Road or a nearby quarry.

Table 13.3 Noise and Vibration Receptor Summary

ID	Name	Description	Universal Transverse Mercator		
			Easting	Northing	Zone
R1	Grays Bay Port Stationery Camp	Project permanent accommodation	505983	7520600	12
R2	Jericho Station Stationery Camp	Project permanent accommodation	478691	7321323	12
R3 ¹	Ulu Gold Camp	Ulu Gold workers' camp	501371	7421181	12
R4 ²	Grays Bay Port PDA Boundary	TLMRU	505652	7519156	12
R5 ³	Grays Bay Port PDA Boundary	TLMRU	505150	7519539	12
R6 ⁴	Grays Bay Port PDA Boundary	TLMRU	506267	7518939	12
R7 ⁵	Grays Bay Port LAA Boundary	TLMRU	503755	7518782	12
R8 ²	Jericho Station PDA Boundary	TLMRU	478262	7321961	12
R9 ¹	High Lake Camp	High Lake workers' camp	506706	7473727	12
R10 Construction ⁵ R10 Operations ⁶	Jericho Station LAA Boundary	TLMRU	477225 ⁵ 480538 ⁶	7323402 ⁷ 7321691 ⁸	12

Notes:

¹ non-Project related receptor

² Location with the highest predicted noise effect during Construction and Operations and Maintenance

³ Location with the highest predicted vibration effect from port embarkment blasting activities

⁴ Location with the highest predicted vibration effect from the closest road quarry blasting activities

⁵ R10 during Construction phase

⁶ R10 during Operations and Maintenance phase

⁷ LAA boundary location with the highest predicted noise effect during Construction

⁸ LAA boundary location with the highest predicted noise effect during Operations and Maintenance

Regional Assessment Area

The RAA represents the area within which cumulative effects of noise and vibration effects may occur, depending on the location and type of other existing, approved, or planned developments. The RAA for characterization of existing conditions was set as a 3 km buffer around all components of the PDA. The RAA accounts for other existing and future physical activities that may have effects that act cumulatively with the project effects, and to provide context for project-specific effects and cumulative effects. Physical activities located beyond the 3 km buffer are not expected to interact with the project residual noise effects due to natural atmospheric attenuation and ground absorption. The extent of the RAA at the Grays Bay Port, Grays Bay Road, and Jericho Station is shown in Figure 13.1, Figure 13.2, and Figure 13.3, respectively.

13.1.4.2 Temporal Boundaries

The following temporal boundaries are used in the assessment of noise and vibration:

- **Baseline Reference Point:** The **baseline reference point** is 2024-2025, which is when the baseline was completed
- **Construction:** The Construction phase (both pre-construction and construction) is scheduled to begin in 2029, with major construction commencing in 2030. The major construction activities are anticipated to span approximately five years.
- **Operations and Maintenance:** The Operations and Maintenance phase of the Project is anticipated to commence in 2035 and will continue indefinitely.

13.1.5 Residual Effects Characterization

Table 13.4 presents definitions and criteria that are used to characterize the residual effects on the Noise and Vibration VC.

Table 13.4 Characterization of Residual Effects on Noise and Vibration

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect	Positive – a residual effect that moves measurable parameters in a direction beneficial to Noise and Vibration VC relative to baseline. Adverse – a residual effect that moves measurable parameters in a direction detrimental to (Noise and Vibration VC relative to baseline. Neutral – no net change in measurable parameters for the Noise and Vibration VC relative to baseline.
Magnitude	The extent of a change in measurable parameters or the VC from baseline conditions.	No Measurable Change – no measurable change in the measurable parameter of the noise and vibration thresholds at all receptors. Low – a measurable change from existing conditions, but the effect meets or is below the applicable noise and vibration thresholds at all receptors Moderate – measurable change from existing conditions, but the effect meets or is below the applicable noise and vibration thresholds at all receptors High – measurable change exceeds applicable noise and vibration thresholds at all receptors
Geographic Extent	The spatial area(s) in which an effect is predicted to be detectable.	PDA – residual effects are restricted to the PDA LAA – residual effects extend into the LAA RAA – residual effects interact with those of other projects in the RAA

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Timing	Considers when an effect is predicted to occur, where relevant to the VC.	No sensitivity – Noise and vibration effects do not occur during land user activities, or timing otherwise does not directly influence the effects Moderate sensitivity - Noise and vibration effects may occur during a period of lower receptor sensitivity High sensitivity – Noise and vibration effects occur during important land use activities (e.g., plant harvesting or festival time)
Duration	The time required until the measurable parameter or the VC returns to its existing condition, or the residual effect can no longer be measured or otherwise perceived.	Short-term – the residual effect is restricted to the duration of the Construction phase (i.e., 4 years) Medium-term –the residual effect extends through the Operations and Maintenance phase (75 years) Long-term – the residual effect extends beyond the life of the Project
Frequency	How often an effect is predicted to occur.	Single event – occurs once Multiple irregular event – occurs at no set schedule Multiple regular event – occurs at regular intervals Continuous – occurs continuously
Reversibility	The degree to which a VC can be returned to baseline conditions or other established reference points after relevant activities have ceased.	Reversible – the residual effect is likely to be reversed Irreversible – the residual effect is unlikely to be reversed

13.1.6 Significance Definition

Noise and vibration VC is considered significant if the Project's noise and vibration effects result in a high magnitude change (such as exceedance of applicable noise and vibration thresholds) in the LAA with medium-term or longer duration, and continuous frequency.

Furthermore, during the September 2025 IAG workshop, participants discussed significance, with the goal of identifying effects that are considered acceptable or unacceptable to members. Through the discussion, a holistic suite of considerations that must be integrated into the Project's social, environmental, and economic plans emerged. With respect to noise and vibration, feedback received from IAG members (IAG 2025b) identified the following priorities, when considering unacceptable changes as a result of the Project:

- That Inuit perspectives are listened to when designing the Project,
- That all wildlife species and water are protected, and
- That the Project does not affect peoples' ability to harvest caribou and put food on the table.

13.2 Baseline Conditions

13.2.1 Methods

Baseline conditions allow for a characterization of the interaction between the Project noise and vibration effect and the existing environment.

13.2.1.1 Noise

The baseline sound level represents the existing acoustic environment within the LAA and RAA, which is affected by natural sound and, to a lesser extent, anthropogenic noise sources. The baseline sound level at the receptors is defined by several guidelines and data sources, such as noise monitoring within the PDA. The following sections describe the methods used in the estimation of the baseline sound level.

In addition, a review of project-specific engagement feedback, publicly available literature, the project-specific Inuit Knowledge report compiled from the NTKP database, IAG workshops, and community-based primary research to identify Inuit, Indigenous, and Community perspectives and values in the context of the Project was conducted.

Through the project-specific Inuit Knowledge report compiled from the NTKP database, Inuit of the Kitikmeot Region (hereafter referred to as Kitikmiut) stated: “Caribou always seem to move away from noise disturbances, same as people. They are still very noise sensitive” (Banci and Spicker 2024).

As discussed in Section 13.1.1.1, this information identified interests, concerns, and potential recommendations from Kitikmiut, other Indigenous groups, and other potentially affected communities related to air quality to inform the noise assessment and project design.

AER

AER Directive 038 (AER 2024) prescribes two different approaches to quantifying baseline sound level. One approach estimates values for different community types, and the other measures them.

The estimation method described in AER Directive 038 is recommended for rural communities and other more densely populated areas. The baseline sound level of L_d of 45 dBA and L_n of 35 dBA is prescribed for a rural environment. The L_d of 45 dBA and L_n of 35 dBA correspond to the L_{dn} of 45 dBA. There is no prescribed baseline sound level for pristine areas. A pristine area is defined as a natural area that might have a dwelling but no industrial presence, including energy, agricultural, forestry, manufacturing, recreational or other industries that affect the noise environment.

AER Directive 038 also indicates that baseline sound level can be quantified by measurements. Section 13.2.2.2 discusses the noise monitoring conducted to quantify the baseline sound level.

Health Canada

Health Canada Noise Guidance (Health Canada 2023) recommends that baseline sound can be determined by measurement or estimation in noise impact assessments. In the estimation approach, the Health Canada noise guidance recommends the baseline L_{dn} equal to or less than 45 dBA for a quiet rural area.

13.2.1.2 *Vibration*

In contrast to noise, the background environmental ground-borne vibration levels in an outdoor rural area without local human activities are typically below the threshold of human perception. Vibration levels are applicable to individual events or occurrences only and do not consider existing vibration levels. The vibration model is, therefore, based on comparing the effects from project only events (e.g., blasting or equipment vibration) to the applicable thresholds. The effect from background vibration level or cumulative vibration level from another event is typically not included. As such, a vibration baseline study was not performed.

13.2.1.3 *Inuit Qaujimaningit*

The noise and vibration assessment is guided by Inuit, Indigenous and Community Knowledge (as outlined in Section 13.1.1 and defined in Volume 3). Inuit Knowledge may also be referred to as *Inuit Qaujimaningit*, which encompasses “Inuit traditional knowledge (and variations thereof or *Inuit Qaujimaqatuqangit*), local and community-based knowledge, as well as Inuit epistemology as it relates to Inuit Societal Values and Inuit Knowledge (both traditional and contemporary)” (NIRB 2018). Inuit Societal Values, including traditional values, beliefs, and principles are referred to as *Inuit Qaujimaqatuqangit* principles (NIRB 2018). The Kitikmeot Inuit Association recommended use of the term Inuit Knowledge in the IS. WKR has adopted this terminology and understands Inuit Knowledge encompasses Inuit *Qaujimaqatuqangit* principles, which have been incorporated into the assessment of effects on food security and food sovereignty. The *Inuit Qaujimaqatuqangit* principles have been incorporated into this assessment.

13.2.2 Overview

13.2.2.1 *Inuit, Indigenous, and Community Knowledge and Engagement Feedback*

Through the project-specific engagement program delivered from 2016 into 2025, including community meetings, workshops, community-based primary research, the project-specific Inuit Knowledge report compiled from the NTKP database, and through a review of publicly available information, Kitikmiut, other Indigenous groups, and other potentially affected communities shared information, expressed concerns, and provided recommendations related to noise and vibration. This feedback has been considered and summarized in Table 13.5 and where applicable, has been integrated into the assessment of potential effects on noise and vibration that follows.

Table 13.5 Summary of Inuit, Indigenous, and Community Knowledge and Engagement Feedback

Comment	Source	WKR Response	Where Addressed
NTKP consultants and IAG members stated that caribou (<i>tuktuut</i>) are sensitive to noise and will move away when there is noise disturbance. IAG members also reported that muskox are sensitive to noise and will run away from loud noises like vehicles.	Banci and Spicker 2024; IAG 2025a	WKR has identified mitigation measures to reduce noise levels resulting from project activities. The effects of the Project on caribou, moose and other wildlife from changes in noise are assessed in the Wildlife VCs (Volume 9, Sections 16, 17, and 18). WKR is committed to ongoing engagement with Kitikmiut, other Indigenous groups, and other potentially affected communities during the advancement of project design and planning. WKR will engage with communities to inform them of the activities and the noise and vibration sources that will occur prior to construction.	For mitigation measures to reduce effects on noise levels, see Section 13.3.2.3. The effects of the Project on wildlife from changes in noise are assessed in Volume 6, Section 16.4.2 (caribou and moose change in habitat); Volume 6, Section 17.4.1 (bird change in habitat), Volume 6, Section 18.4.1 (Wildlife Other change in habitat).
During engagement on a previous project, (Bay Chimo) community members expressed concern about the effects of vibration and sound on land animals, including caribou and moose, as a result of wind farms. Members reported that caribou have changed their migration routes because of noise and vibration.	NIRB 2024	The noise and vibration effects for one proposed wind turbine are included in the assessment (Volume 9, Sections 13.3.2.4 and 13.3.3.4). The effects of the Project on caribou, moose, and other wildlife from changes in noise are assessed in the Wildlife VCs (Volume 9, Sections 16, 17, and 18). WKR is committed to ongoing engagement with Kitikmiut, other Indigenous groups, and other potentially affected communities during the advancement of project design and planning. The WKR will engage with communities to inform them of the activities and the noise sources that will occur prior to construction.	Section 13.4.1 addresses the vibration effect due to the wind turbine. Section 13.4.2.1 addresses the noise effect due to one wind turbine. The effects of the Project on wildlife from changes in noise are assessed in Volume 6, Section 16.4.2 (caribou and moose change in habitat); Volume 6, Section 17.4.1 (bird change in habitat), Volume 6, Section 18.4.1 (Wildlife Other change in habitat).

Grays Bay Road and Port Project –Impact Statement
Volume 5: Atmospheric Environment

Section 13: Assessment of Potential Effects on Noise and Vibration
March 2026

Comment	Source	WKR Response	Where Addressed
IAG members expressed concern about noise and blasting impacts on land animals, fish habitats, and terrestrial mammals and the long range that blasting noise travels. They expressed the need for mitigation measures that should be included in the environmental management plans.	IAG 2025a	WKR has assessed noise and blast effects (Sections 13.3.2.4 and 13.3.3.4) and identified mitigation measures to reduce noise and blast effects (Sections 13.3.2.3 and 13.3.3.3). The effects of the Project noise and blast effects on caribou, moose and other wildlife from changes in noise are assessed in the Wildlife VCs (Sections 16, 17, and 18), Freshwater Fish and Fish Habitat VC (Section 20), and Marine Fish and Fish Habitat VC (Section 22). WKR is committed to ongoing engagement with Kitikmiut, other Indigenous groups, and other potentially affected communities during the advancement of project design and planning. WKR will engage with communities to inform them of the activities and the noise sources that will occur prior to construction.	For mitigation measures to reduce the effects of noise, see Section 13.3.2.3. For mitigation measures to reduce the effects of vibration, see 13.3.3.3. The effects of the Project on wildlife from changes in noise are assessed in Volume 6, Section 16.4.2 (caribou and moose change in habitat); Volume 6, Section 17.4.1 (bird change in habitat), Volume 6, Section 18.4.1 (Wildlife Other change in habitat), Volume 7, Section 20.3.2 (Change in Fish Habitat), and Section 22.3.2 (Change in Habitat).
IAG members stated that noises can attract or disturb caribou and added that helicopters and blasting can deter caribou. Members recommended limiting blasting and equipment use to non-sensitive time periods and suggested these activities be further restricted when wildlife are near the Project.	IAG 2025b	WKR acknowledges this concern and proposes timing restrictions on blasting and traffic and is committed to reduce sensory disturbance.	For mitigation measures to reduce the effects of noise, see Section 13.3.2.3. For mitigation measures to reduce the effects of vibration, see 13.3.3.3.
During project engagement, the Kugaaruk Hamlet expressed concern for effects to wildlife from blasting.	GBRP 2025	WKR has assessed blast effects (Section 13.3.3.4) and identified mitigation measures to reduce blast effects (Section 13.3.3.3). The effects of the Project noise and blast effects on caribou, moose and other wildlife from changes in noise are assessed in the Wildlife VCs (Sections 16, 17, and 18). WKR is committed to ongoing engagement with Kitikmiut, other Indigenous groups, and other potentially affected communities during the advancement of project design and planning. WKR will engage with communities to inform them of the activities and the noise sources that will occur prior to construction.	For mitigation measures to reduce the effects of vibration, see Section 13.3.3.3. The effects of the Project on wildlife from changes in noise are assessed in Volume 6, Section 16.4.2 (caribou and moose change in habitat); Volume 6, Section 17.4.1 (bird change in habitat), Section 18.4.1 (Wildlife Other change in habitat),

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Comment	Source	WKR Response	Where Addressed
During a public scoping meeting with the NIRB, Gjoa Haven community members recommended for blasting to be done during the summer months, as sound doesn't carry as far.	NIRB 2025b	WKR has assessed blast effects (Section 13.3.2.4) and identified mitigation measures to reduce blast effects (Section 13.3.3.3).	For mitigation measures to reduce the effects of vibration, see Section 13.3.3.3.
During project-related engagement activities, Athabasca Denesųliné Né Né Land Corporation expressed concern about noise as a result of the Project.	NIRB 2025a	WKR has assessed noise effects (Section 13.3.2.4) and identified mitigation measures to reduce the effects (Section 13.3.2.3).	For mitigation measures to reduce the effects of noise, see Section 13.3.2.3.
During engagement on a previous project, the Tłı̄chų Government expressed concern about effects on wildlife and members' ability to hunt and trap as a result of noise from road construction and operations	TG 2014	WKR has assessed noise and blast effects (Sections 13.3.2.4 and 13.3.3.4) and identified mitigation measures to reduce noise and blast effects (Sections 13.3.2.3 and 13.3.3.3). The effects of the Project noise and blast effects on caribou, moose and other wildlife from changes in noise are assessed in the Wildlife VCs (Sections 16, 17, and 18), Freshwater Fish and Fish Habitat VC (Section 20), and Marine Fish and Fish Habitat VC (Section 22). WKR is committed to ongoing engagement with Kitikmiut, other Indigenous groups, and other potentially affected communities during the advancement of project design and planning. WKR will engage with communities to inform them of the activities and the noise and vibration sources that will occur prior to construction.	For mitigation measures to reduce the effects of noise, see Section 13.3.2.3. For mitigation measures to reduce the effects of vibration, see Section 13.3.3.3. The effects of the Project on wildlife from changes in noise are assessed in Section 16.4.2 (caribou and moose change in habitat); Section 17.4.1 (bird change in habitat), Section 18.4.1 (Wildlife Other change in habitat), Section 20.3.2 (Change in Fish Habitat), and Section 22.2.2 (Change in Habitat).
During engagement on a previous project, North Slave Métis Alliance reported that caribou will run away when they hear blasting.	NSMA 2001	WKR acknowledges this concern and proposes timing restrictions on blasting and is committed to reduce sensory disturbance.	For mitigation measures to reduce the effects of vibration, see Section 13.3.3.3.
During a public scoping meeting for the NIRB, community members in Inuvik commented that underwater noise can travel.	NIRB 2025b	The effects of the Project underwater noise on freshwater and marine fish from change in habitat are assessed in the Freshwater Fish and Fish Habitat VC (Section 20), and Marine Fish and Fish Habitat VC (Section 22). WKR is committed to ongoing engagement with Kitikmiut, other Indigenous groups, and other potentially affected communities during the advancement of project design and planning.	The effects of the Project underwater noise on freshwater and marine fish from change in habitat are assessed in Volume 7, Section 20.3.2 (Change in Fish Habitat), and Section 22.3.2 (Change in Habitat).

Comment	Source	WKR Response	Where Addressed
During a public scoping meeting for the NIRB, community members in Yellowknife expressed concern for noise generated by the road.	NIRB 2025a	WKR has identified mitigation measures to reduce noise levels resulting from project activities. WKR will engage with communities to inform them of the activities and the noise and vibration sources that will occur prior to construction.	For mitigation measures to reduce effects on noise levels, see Section 13.3.2.3.

13.2.2.2 Noise

To inform understanding of the noise and vibration setting, multiple sources of information were considered, including Inuit, Indigenous, and Community Knowledge perspectives, engagement feedback, the noise baseline monitoring program, and vibration modeling.

Noise Monitoring

The baseline sound level measurements for the Project follow approaches prescribed by AER Directive 038. The three hours per daytime and nighttime are considered the minimum representative sample period. AER Directive 038 also recommends that invalid or abnormal data not typical of an average ambient sound level should be excluded from the measurement. Invalid data includes periods with non-representative weather conditions, such as rain precipitation and wind speed over 15 kilometres per hour (km/hr).

The first monitoring was conducted in a remote area 23 km south of Jericho Station (SLM1, Figure 13.2). Continuous noise measurements were taken for a 3-day period from September 13 to September 15, 2017, covering both daytime and nighttime. The location is representative of a remote area without any human activity. The second monitoring was conducted at a site within the Grays Bay Port PDA (SLM2, Figure 13.1), approximately 1.4 km south of the coastline. Continuous noise measurements were taken for a 5-day period from August 15 to August 19, 2024, covering both daytime and nighttime. Detailed methods for the noise baseline monitoring program are presented in Appendix 13A.

The acoustic environment at SLM1 was influenced by the natural environment (i.e., wind, rain, and birds). The wind speed ranged from calm conditions up to 34 km/hr during the monitoring period. The acoustic environment at SLM2 was influenced by the natural environment (i.e., birds, insects, tidal waves, vegetation rustling, and wind); and, to a lesser extent, anthropogenic noise (i.e., occasional aircraft flyovers). The wind speed ranged from calm conditions up to 31 km/hr during the monitoring period.

Two scenarios were considered in estimating the baseline sound level. In Scenario 1, following the AER Directive 038 approach, data recorded under non-representative weather conditions (the wind speed more than 15 km/hr) were excluded before calculating averages and statistical values. In Scenario 2, all data were included without wind isolation, as the area consistently experiences high wind conditions throughout the year.

Table 13.6 summarizes the measurement results for both scenarios at SLM1 and SLM2. Detailed results for the noise baseline monitoring program are presented in Appendix 13A. The monitoring results at SLM1 and SLM2 are representative of a remote area where the acoustic environment is influenced by natural sound. In remote areas with little or no anthropogenic noise sources, the natural environment and weather conditions are the key factors that affect baseline sound levels.

Table 13.6 Baseline Sound Level Results

ID	Description	Scenario 1 (include wind isolation)			Scenario 2 (no wind isolation)		
		L _d (dBA)	L _n (dBA)	L _{dn} (dBA)	L _d (dBA)	L _n (dBA)	L _{dn} (dBA)
SLM1	Within Grays Bay Port LAA	43.5	40.3	47.3	49.8	49.0	55.6
SLM2	23 km South of Jericho Station	36.0	36.9	43.2	40.0	39.0	45.5

The results are compared to the estimated baseline sound level from the AER Directive 038 noise guideline and Health Canada noise guidance. Health Canada noise guidance recommends a baseline sound level equal to or less than 45 dBA L_{dn} for a quiet rural area. Similarly, the AER Directive 038 noise guideline recommends a baseline sound level of 45 dBA L_{dn} for rural areas. This recommended baseline sound level of 45 dBA L_{dn} for rural areas is within the range of 43.2 dBA and 47.3 dBA L_{dn} Scenario 1 results shown in Table 13.6 for SLM1 and SLM2, respectively. The L_{dn} of 45 dBA will be applied to represent the baseline sound level within the Project LAA and RAA with little or no anthropogenic noise sources.

13.2.2.3 Vibration

The FTA noise and vibration guideline (FTA 2018) recommends that background vibration velocity level in residences is usually 50 VdB or lower, and the threshold of perception for humans is approximately 65 VdB.

Vibration targets are applicable to individual events or occurrences only and do not consider existing vibration levels. The vibration model is, therefore, based on comparing the effects from project only events (e.g., blasting and heavy equipment) to the targets. The effect from background vibration level or cumulative vibration level from another event is typically not included.

13.3 Assessment of Project Effects on Noise and Vibration

13.3.1 Project Interactions with Noise and Vibration

Table 13.7 identifies, for each potential effect, the project activities that might interact with the VC and result in the identified effect. These interactions are indicated by a check mark or a dash and are discussed in detail in the following sections, in the context of effects pathways, standard and project-specific mitigation measures, and residual effects.

Table 13.7 Project Interactions with Noise and Vibration

Project Activities	Effects	
	Noise	Vibration
Construction		
Mobilization/demobilization of machinery /equipment, vehicles, materials, and fuel (e.g., by barge, sea lift, boat, or road)	✓	✓
Staging and storage of materials, fuel, equipment and prefabricated components	✓	✓
Chemical and hazardous material transport, storage and management (including explosives)	✓	✓
Establishment and operation of camps (e.g., mobile camps and permanent accommodations), maintenance yards, and laydowns	✓	✓
Machinery/equipment and vehicle refueling/ fuel storage handling	✓	✓
Site preparation and earthworks of disturbance area (e.g., vegetation clearing, stripping and stockpiling of organic and overburden materials, grading, blasting, drilling)	✓	✓
Construction of port landside facilities, aerodrome, road, and Jericho Station (e.g., buildings/facilities, fuel storage, laydown areas; public use area; access roads; water intake; power generation - diesel (may include wind turbine or solar array); all-season gravel airstrip)	✓	✓
Borrow source and quarry development (e.g., blasting, crushing, sorting, stockpiling of temporary and permanent areas)	✓	✓
Water withdrawal to support construction activities (e.g., winter road construction, dust control, material compaction) *	-	-
Watercourse crossing construction (e.g., bridge and culvert installation)	✓	✓
Ground based transportation (e.g., workforce, materials, supplies)	✓	✓
Air transport (e.g., personnel transport, resupply)	✓	-
Waste management and sewage facilities (e.g., development and use of a permanent waste management facility and on-site landfill; handling and storage of hazardous and non-hazardous waste; incineration of domestic waste; open air burning; management of black and grey water) *	-	-
Construction of Marine-based infrastructure (e.g., construction of large vessel wharves, medium vessel wharf, small craft harbour, barge landing area, desalination line, vessel refuelling line / fuel line to bulk fuel storage, including nearshore dredging, infilling, pile driving, blasting)	✓	✓
Taxes, Contracts, Purchases (e.g., procurement of goods and services; employment of workers) *	-	-

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Project Activities	Effects	
	Noise	Vibration
Closure and reclamation of temporary borrow sources/quarries, camps, workspaces, laydowns (e.g., erosion stabilization, revegetation, restoration of natural drainage patterns, prevention of future vehicular access) *	-	-
Operations and Maintenance		
Port landside operations (e.g., use and maintenance of accommodations, borrows, roads, power generation; aerodrome operations, including use and maintenance of airstrip and facilities; and Jericho Station operation and maintenance)	✓	✓
Marine port use and operations (e.g., vessels and cargo loading/unloading, barge landing operations, small craft harbour operations, maintenance dredging)	✓	✓
Borrow source and quarry operations (e.g., blasting, crushing, sorting, and stockpiling of permanent areas)	✓	✓
Desalination operation and wastewater treatment (e.g., marine water use and effluent discharge) *	-	-
Water withdrawal / use (e.g., potable water, dust control, maintenance) *	-	-
Road maintenance / use (e.g., transport of equipment, workers, and supplies; maintenance of bridge/culverts; snow clearing; grading and gravel replacement; dust control)	✓	✓
Bulk Fuel Storage (e.g., operation of permanent fuel facilities) *	-	-
Vessel Fuel Line / Refuelling (e.g., directly offloading from east wharf or use of floating fuel pipeline; above ground insulated pipeline to bulk fuel storage tanks) *	-	-
Equipment maintenance	✓	✓
Chemical and hazardous material transport, storage and management (including explosives)	✓	✓
Winter road construction and use (e.g., annual winter road construction and maintenance)	✓	✓
Air transport (e.g., personnel transport, resupply)	✓	-
Waste management (e.g., use of a permanent waste management facility and on-site landfill; handling and storage of hazardous and non-hazardous waste; incineration of domestic waste; open air burning; management of black and grey water) *	-	-
Taxes, Contracts, Purchases (e.g., procurement of goods and services; employment of workers) *	-	-

Notes:

✓ = Potential interaction

– = No interaction

* Activities such as water withdrawal, waste management, taxation, contracting, purchasing, and closure/reclamation are expected to generate negligible or reduced noise and vibration emissions compared to other construction-phase activities. During Operations and Maintenance, desalination, water withdrawal, bulk fuel storage, vessel refuelling, waste management, and administrative activities (e.g., taxes, contracts, purchases) are also expected to produce minimal noise or vibration. Air transport is anticipated to have negligible vibration emissions.

A summary of key feedback shared by Kitikmiut, other Indigenous groups, and other potentially affected communities relevant to noise and vibration and available at the time of filing is consolidated in Table 13.5 and integrated into the assessment of potential effects on noise and vibration where applicable. WKR will continue to respond to questions and concerns from Kitikmiut, other Indigenous groups, and other potentially affected communities through its ongoing engagement efforts and information provided following submission of the IS will be reviewed in the context of the IS and for incorporation into project planning, as appropriate.

13.3.2 Noise

13.3.2.1 Analytical Assessment Techniques

Potential noise effects during Construction, as well as Operations and Maintenance of the port, road and Jericho station, are assessed based on the following approach:

- Defined LAA, RAA, and receptors.
- Established baseline sound level at the noise receptors.
- Identified modelling scenarios that will reflect worst-case Construction (Year 2) in terms of noise emissions.
- Identified modelling scenarios that represent Operations and Maintenance in terms of noise emissions.
- Determined noise emission sources from project Construction as well as Operations and Maintenance activities.
- Characterized sources by their sound power levels (PWL) using manufacturers' data, equipment lists, design data, equipment noise ratings, acceptable theoretical calculation methods, or similar equipment noise data from an archived database of measurements.
- Developed a noise model for each modelling scenario.
- Predict sound levels within the LAA and RAA, and at receptors by applying the emission sources in noise models for Construction and Operations and Maintenance.
- Combined predicted project noise with baseline levels to estimate total sound exposure at each receptor
- Compare the predicted sound levels from each scenario to the established baseline levels at the receptors to assess changes in %HA.
- Assessed compliance of the Project by comparing the modelled results to the applicable noise targets (Section 13.1.2).
- If the model results are compliant with applicable criteria, the noise effect is considered to be acceptable. Otherwise, specific mitigation measures are identified to manage the noise effects.

Noise modelling used the latest version of the Cadna/A® software (DataKustik 2025), which incorporates International Organization for Standardization (ISO) Standard 9613 (ISO 1993, 1996) algorithms. ISO 9613 standards are commonly used by acoustic practitioners for modelling sound propagation and are accepted by AER and Health Canada. Details on modelling are provided in the Noise and Vibration TMR (Appendix 13B).

13.3.2.2 *Project Effects Pathways*

Noise emissions from construction activities for the Grays Bay Port, Grays Bay Road, and Jericho Station may result in a change in noise levels that cause annoyance. Short-term construction noise effects were predicted at Jericho Station and along the road. Construction noise effect along the road includes road building, quarry operations, and bridge pier construction at three to four water crossings. Long-term construction noise effects were predicted for the Grays Bay Port. These noise effects include construction of the Grays Bay Port infrastructure, quarry operation within the port PDA, and usage of the airfield. TLMRU activities such as gathering places, travel routes, and seasonal camps, may occur in areas that intersect the PDA of project components (i.e., Grays Bay Port, Grays Bay Road, and Jericho Station). In some instances, these activities may be as close as the project component PDA boundaries. The construction short-term and long-term noise effects are compared to applicable noise guidelines for the receptors. These receptors included permanent accommodations and PDA boundary locations. If required, site specific and situational measures are required to reduce the noise level at some receptor locations to acceptable levels.

During Operations and Maintenance, noise emitted from the maintenance of Grays Bay Port, Grays Bay Road, and Jericho Station may result in a change in noise levels that cause annoyance. Short-term noise effects include maintenance related activities along the road and the operations of the permanent quarry. Long-term noise effects include the operations of the Grays Bay Port and Jericho Station. Activities related to TLMRU, such as gathering places, travel routes, and seasonal camps, may occur in areas that intersect the project component PDA boundaries. In some cases, Inuit land users may be located as close as the edge of active operations areas, making them exposed to short-term exceedances and perceptible changes in the sound environment. The Operations and Maintenance short-term and long-term noise effects are compared to applicable noise guidelines for the receptors. These receptors included permanent accommodations and PDA boundary locations. If required, site specific and situational mitigation measures will be implemented to reduce the noise level to acceptable levels.

These pathways may also result in effects on noise, which may affect Kitikmiut, Indigenous groups, and other potentially affected communities or the resources, habitat, and environmental conditions that they rely on (Volume 9, Sections 24 and 25).

13.3.2.3 *Mitigation, Enhancement, and Management Measures*

Construction

The following mitigation, enhancement, and management measures will be considered to reduce the noise effects at these PDA boundary locations when construction activities are nearby. These measures take into consideration the values identified by Kitikmiut, other Indigenous groups, and other potentially affected communities. The measures are presented in the following three sections:

- Design Measures: mitigation measures that are inherently in the project design.
- Standard Operating Practices: practices that are necessary to reduce the noise effect.
- Site-specific or Situational Measures: additional measures to further reduce noise exceedance.

Design Measures

The following measures were incorporated into the noise model and represent project design elements or assumptions already built into the Project:

- Vehicles and equipment will use standard manufacturers recommended noise muffling equipment
- Equipment selection based on typical noise emission levels.
- Sufficient ventilation systems in mobile worker camps to allow windows to remain closed during rest periods.
- Use broadband backup alarms for mobile equipment at the quarry where a mobile camp is nearby to reduce tonal noise

Standard Operating Practices

These standard operating practices will be considered to reduce predicted construction noise levels. It includes the following:

- Reduce equipment idling when not in operation.
- Reduce aircraft and helicopter idling.
- Ensuring equipment is well maintained.
- Use structure (e.g., storage containers) or landscape (e.g., earth berm, hills) as barriers
- Orient permanent accommodations, such as sleeping quarters with windows, in a direction away from construction noise sources

Site-Specific or Situational Measures

These measures may be considered in specific areas where modelled or measured exceedances occur, particularly near receptors or traditional land use areas. The applicability of these measures will be affected by the seasonality and time-sensitivity of the land use. WKR is committed to ongoing engagement with Kitikmiut, other Indigenous groups, and other potentially affected communities during the advancement of project design and planning. WKR will engage with communities to inform them of the activities and the noise effects that will occur prior to construction. The site-specific or situational measures are summarized as follows:

- Installation of temporary earth berms, portable noise barriers, or temporary structures as barriers during road construction activities.
- Use broadband backup alarms for mobile equipment.
- Adaptive management may include reducing the quantity or duration of selected noisy equipment operation based on monitoring results or community concerns.
- Construction activities occur during less sensitive periods; assessed on a case-by-case basis
- Seasonal avoidance or temporary restrictions of high noise level equipment (i.e., dozer, backup alarm).

Operations and Maintenance

The following mitigation, enhancement, and management measures will be considered to reduce the noise effects at these PDA boundary locations when Operations and Maintenance activities are nearby. The measures are presented in the following three sections:

- Design Measures: mitigation measures that are inherently in the project design
- Standard Operating Practices: practices that are necessary to reduce the noise effect
- Site-specific or Situational Measures: additional measures to further reduce noise exceedance

Design Measures

The following measures were incorporated into the noise model and represent project design elements or assumptions already built into the Project such as the use of stationary equipment (e.g., generators, conveyors) housed within enclosures or buildings.

Standard Operating Practices

These standard operating practices will be considered to reduce predicted operations noise levels. It includes the following:

- Selection of quieter equipment models or use of electric powered machinery where feasible.
- Optimize site layout to maximize distance and shielding between noise sources and receptors.
- Reduce the idling of mobile equipment when not operating.
- Reduce the idling of aircraft and helicopter
- Equipment is fitted with appropriate mufflers and silencers

- Using enclosures, berms, acoustic screening and shrouding where stationary sources requiring control is identified
- Using well maintained equipment
- Housing stationary sources in buildings
- Other possible general noise abatement measures that can be implemented on site to minimize static noise due to generators, vehicles, and other sources.

Site-Specific or Situational Measures

These measures may be considered in specific areas where modeled or measured exceedances occur, particularly near receptors or traditional land use areas. The applicability of these measures will be affected by the seasonality and time-sensitivity of the land use.

- WKR is committed to ongoing engagement with Kitikmiut, other Indigenous groups, and other potentially affected communities during the advancement of project design and planning.
- WKR will engage with communities to inform them of the activities and the noise sources that will occur prior to construction.
- Temporary earth berms, portable noise barriers, or temporary structures as barriers during road maintenance activities.
- Use broadband backup alarms for mobile equipment.
- Reduce quantity or duration of selected high noise emission equipment operation based on monitoring results or community concerns.

13.3.2.4 *Project Residual Effects*

Construction

Construction noise is assessed for short-term (e.g., less than one year) and long-term (e.g., more than one year) activities. Long-term activities include construction of the Grays Bay Port. Short-term activities include construction of the Jericho Station and Grays Bay Road with three main components: road, quarries, and watercourse crossings. The road construction will progress in a linear fashion from the port site at the north end, and from the Jericho Station site at the south end of the Project. As construction progresses, new quarries will be commissioned roughly every three months to support roadway construction. The assessment was focused on three to four water crossing locations (Burnside River/Ayapaktokvik, Kennarctic River/Koglokoakyok, Crossing 68 unnamed) where bridge construction will require pile driving activities. Details about noise emissions and other modelling assumptions are provided in the Noise and Vibration TMR (Appendix 13B).

Annoyance can be described as the effect of noise that most people are aware of and that is creating a negative effect on the community. The %HA value estimates the percentage of a typical community that would report being “highly annoyed.” %HA has been widely used as one way to estimate a community response to noise levels and has been synthesized from self-reported annoyance in numerous large, community-based surveys. Health Canada uses the change in %HA as an appropriate indicator of noise

induced human health effects from exposure to project construction noise and to long-term construction noise exposure. The change in %HA is determined by the difference in %HA values associated with the noise level before (e.g., baseline) and after a project (e.g., residual noise effects). Health Canada noise guidance recommends the highest increase for change in %HA is 6.5 percent at a receptor for project activities with a duration of more than one year. If the change in %HA exceeds 6.5 percent, effects are of concern and may require additional mitigation.

Long term (i.e., more than one year) construction activity noise effects from the Grays Bay Port is compared to the Health Canada change in %HA threshold in Table 13.8. Results are not included for the Project permanent accommodations receptors (i.e., R1 and R2) as they are located within the PDA and did not exist prior to the Project. As such, the %HA is not applicable to these receptors. Ulu Camp and High Lake Camp (i.e., R3 and R9) is not included because only short-term construction noise effects due to road construction are expected at this camp. The change in %HA sample calculation for R4 is provided in Appendix 13B.

Results indicate that the change in %HA is below the 6.5 percent threshold at receptors R4, R5, R6, and R7.

Table 13.8 Long Term Construction Noise Effects

ID	Name	Baseline		Project	Baseline and Project		Change in %HA (%)	Exceeds 6.5%
		L _{dn} (dBA)	%HA ¹ (%)	L _{dn} (dBA)	L _{dn} ² (dBA)	%HA ¹ (%)		
R4	Grays Bay Port PDA Boundary	45	4.1	51.2	52.1	2.9	1.7	No
R5	Grays Bay Port PDA Boundary	45	4.1	48.7	50.3	8.0	3.8	No
R6	Grays Bay Port PDA Boundary	45	4.1	47.4	49.4	7.2	3.0	No
R7	Grays Bay Port LAA Boundary	45	4.1	42.6	47.0	5.3	1.2	No

Notes:

¹ “Peace and Quiet” adjustment of +10 dB has been included in the %HA calculation. The effect of this +10 dB adjustment in quiet rural areas is to produce a greater change in %HA than would occur with unadjusted noise levels.

² Baseline and Project L_{dn} is the logarithmic addition of Baseline L_{dn} and Project L_{dn}

Table 13.9 summarizes the noise effects from short term (i.e., less than one year) activities from the Grays Bay Road construction, quarry operation, Jericho Station, and bridge construction. The results are compared to the Health Canada MNL limit. Similar to the change in %HA comparison, results are not included for the Project permanent accommodations receptors (i.e., R1 and R2) located inside the PDA. The short-term noise level will meet the MNL at all PDA locations. The PDA boundary locations will require site-specific measures to reduce the noise effects. Section 13.3.2.3 presents potential mitigation to reduce the noise effects at the PDA boundary.

Table 13.9 Short Term Construction Noise Effects

ID	Name	L _{dn} (dBA)	MNL (dBA)	Exceeds MNL
R3 ¹	Ulu Gold Camp	46.5	57 ³	No
R8	Jericho Station PDA Boundary	51.8 ²	52 ⁴	No
R9	High Lake Camp	38.2	57 ³	No
R10 Construction	Jericho Station LAA Boundary	42.4	52 ⁴	No
-	Grays Bay Road North Bound PDA Boundary	61.7 ²	62 ⁵	No
-	Grays Bay Road South Bound PDA Boundary	61.8 ²	62 ⁵	No
-	Grays Bay Quarry Boundary	61.1 ²	62 ⁵	No
-	Water Crossing PDA Boundary	61.7 ²	62 ⁵	No

Notes:

“-“ not applicable because road construction, quarry, and water crossing locations vary along the Grays Bay Road.

¹ Non-project related receptor

² Site-specific or situational mitigation measures included

³ MNL threshold for construction activities less than two months

⁴ MNL threshold for construction activities less than one year

⁵ MNL threshold for construction activities less than two months and no tonality

Sleep disturbance effects at all permanent accommodations and mobile camps are compared to the Health Canada threshold. Table 13.10 summarizes the sleep disturbance assessment results for workers residing indoors in permanent accommodations and mobile camps. The results are below the thresholds at all receptors.

Table 13.10 Sleep Disturbance Noise Effects during Construction

ID	Name	Outdoor		Outdoor to Indoor Transmission Loss ² (dB)	Indoor		
		L _d or L _n (dBA)	L _{max} (dBA)		L _d or L _n (dBA)	L _{max} (dBA)	Exceed L _n of 30 dBA or L _{max} 45 dBA
R1	Grays Bay Port Stationery Camp	49.9	55.9	27	22.9	28.9	No
R2	Jericho Station Stationery Camp	47.2	52.9	27	20.2	25.9	No
R3	Ulu Gold Camp	40.1	41.8	27	13.1	14.8	No
R9	High Lake Camp	31.8	38.8	27	4.8	11.8	No
-	Mobile Camps	51.5	57.0	27	24.5	30.0	No

Notes:

“-“ not applicable because mobile camp locations vary along the Grays Bay Road

² outdoor-to-indoor sound transmission loss with fully closed windows

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TLMRU activities may occur in areas that intersect the Grays Bay Road, quarries, Jericho Station, or watercourse bridge construction activities, where short term noise effects are anticipated to occur. In some instances, these activities may be as close as the edge of road, quarry, or bridge construction PDA. For these activities, where it is difficult to define a discrete receptor location, the assessment used a buffer distance approach in which construction noise levels were predicted at different distances from the PDA for a 1 km stretch of the Grays Bay Road construction, a quarry, and bridge construction. The buffer approach is commonly used in noise assessments. This approach quantifies the noise effects at different distances from the construction activities along the road.

Table 13.11 summarizes the L_d , L_n , and L_{dn} noise levels results for a 1 km stretch of Grays Bay Road construction at different distances (i.e., 0 m to 3,000 m) from the edge of the road PDA. The L_{dn} results are below the Health Canada MNL limit of 62 dBA. The results include the implementation of site-specific or situational mitigation measures.

Table 13.11 Construction Sound Levels at Different Distances from Grays Bay Road

Distance from PDA ¹ (m)	North Approach ² Predicted Sound Level (dBA)			South Approach ³ Predicted Sound Level (dBA)		
	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
0	55.3	55.3	61.7	55.4	55.4	61.8
10	55.0	55.0	61.4	55.0	55.0	61.4
20	54.6	54.6	61.0	54.7	54.7	61.1
50	53.7	53.7	60.1	53.8	53.8	60.2
100	52.3	52.3	58.7	52.4	52.4	58.8
200	50.0	50.0	56.4	50.1	50.1	56.5
300	48.1	48.1	54.5	48.2	48.2	54.6
400	46.4	46.4	52.9	46.6	46.6	53.0
500	45.0	45.0	51.4	45.2	45.2	51.6
1000	39.5	39.5	45.9	39.8	39.8	46.2
1500	35.7	35.7	42.1	36.1	36.1	42.6
2000	32.9	32.9	39.3	33.4	33.4	39.8
2500	30.5	30.5	36.9	31.1	31.1	37.5
3000	28.5	28.5	34.9	29.1	29.1	35.5

Notes:

¹ Road PDA width is 150 m, road width is 10 m, and road fill area is approximately 20 m.

² Road construction crew starts from Grays Bay Port, advancing south

³ Road construction crew starts from Jericho Station, advancing north

Table 13.12 summarizes the highest predicted L_d , L_n , and L_{dn} noise levels results for a quarry and bridge construction at different distances (i.e., 0 m to 3,000 m) from the edge of the PDA. The L_{dn} results are below the Health Canada MNL limit of 62 dBA. The results include the implementation of site-specific or situational mitigation measures.

Table 13.12 Construction Sound Levels at Different Distances from Quarry Operation and Bridge Construction

Distance from PDA ¹ (m)	Predicted Sound Level (dBA) for Quarry			Predicted Sound Level (dBA) for Bridge Construction		
	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
0	55.4	55.4	61.9	55.3	55.3	61.7
10	52.6	52.6	59.0	54.7	54.7	61.1
20	50.9	50.9	57.3	54.2	54.2	60.6
50	47.5	47.5	53.9	52.8	52.8	59.2
100 ²	43.9	43.9	50.3	50.8	50.8	57.2
200	40.0	40.0	46.5	47.8	47.8	54.2
300	38.9	38.9	45.3	45.6	45.6	52
400	41.4	41.4	47.8	43.8	43.8	50.2
500 ³	48.1	48.1	54.5	42.3	42.3	48.7
1000	30.0	30.0	36.4	36.9	36.9	43.3
1500	25.2	25.2	31.7	33.9	33.9	40.3
2000	22.4	22.4	28.8	31.6	31.6	38.1
2500	20.2	20.2	26.6	30.1	30.1	36.6
3000	18.3	18.3	24.7	28.4	28.4	34.8

Notes:

¹ PDA is the edge of quarry and bridge construction area

² Closest distances to the receptor from bridge pier construction at water crossing

³ Closest distances to mobile camp from a quarry

Operations and Maintenance

The Operations and Maintenance phase includes the Operations and Maintenance of Grays Bay Port, Jericho Station, and Grays Bay Road.

Grays Bay Port includes a deep-water port, workforce accommodation, a permanent airfield, a small craft harbour, maintenance equipment, and equipment associated with the staging, storage, loading and offloading of inbound and outbound material. One wind turbine (4.6 megawatts (MW)) and a solar farm (up to 3.3 MW) are proposed as options. As a conservative approach, noise emissions from the wind turbine and solar farm are included with the proposed diesel power generation.

Grays Bay Road Operations and Maintenance includes maintenance activities such as snow clearing, grading, and bridge and culvert maintenance and repair. It is intended that approximately every third quarry (approximately every 21 km) will be developed as a permanent quarry to be used for road surfacing and maintenance during Operations and Maintenance. The Operations and Maintenance duration at each permanent quarry is assumed to be less than two months. At each of these permanent quarry locations, a two-week period of drill or blast exercise will be completed to produce the necessary volume of aggregate required for the Operations and Maintenance year. The quarry crew would likely complete this quarrying task during summer months and likely would undertake it all in a 20-week period for all 11 permanent quarries; however, the program may be completed in a shorter period.

Jericho Station will consist of an airstrip, vehicle parking area, permanent accommodations for around twelve people, offices, weather station, refuelling facilities, storage facility for up to 20 megalitres diesel fuel, refuge station, and all associated water, waste and power facilities.

Similar to the Construction phase assessment, the Operations and Maintenance phase activities are classified into long term and short-term noise effects. The Grays Bay Port and Jericho Station Operations and Maintenance is considered long term while road maintenance and permanent quarry operation is considered short-term.

Long term (i.e., more than one year) activities from the Grays Bay Port and Jericho Station Operations and Maintenance are compared to the Health Canada change in %HA threshold. Table 13.13 summarizes the change in %HA results for receptors R4, R5, R6, R7, R8, and R10. Results indicate that change in %HA is below the 6.5 percent threshold at all receptors.

Table 13.13 Long Term Operations and Maintenance Noise Effects

ID	Name	Baseline		Project	Baseline and Project		Change in %HA (%)	Exceeds 6.5%
		L _{dn} (dBA)	%HA (%)		L _{dn} (dBA)	%HA (%)		
R4	Grays Bay Port PDA Boundary	45	4.1	45.7	48.4	6.3	2.2	No
R5	Grays Bay Port PDA Boundary	45	4.1	43.4	47.3	5.5	1.4	No
R6	Grays Bay Port PDA Boundary	45	4.1	41.2	46.5	5.0	0.9	No
R7	Grays Bay Port LAA Boundary	45	4.1	39.2	46.0	4.7	0.6	No
R8	Jericho Station PDA Boundary	45	4.1	51.5	52.4	10.3	6.2	No
R10 Operation	Jericho Station LAA Boundary	45	4.1	35.6	45.5	4.4	0.3	No

Table 13.14 summarizes the noise effects from short term (i.e., less than one year) activities from the Grays Bay Road maintenance and quarry operation. The results are compared to the Health Canada MNL limit. Similar to the change in %HA comparison, results are not included for the project permanent accommodations receptors (i.e., R1 and R2) located inside the PDA. The short-term noise level meets the MNL at all receptor locations. The permanent quarry boundary location will require site-specific or situational measures to reduce the noise effects. Section 13.3.2.3 presents potential mitigation to reduce the noise effects at the permanent quarry boundary location.

Table 13.14 Short Term Operations and Maintenance Noise Effects

ID	Name	L _{dn} (dBA)	MNL (dBA)	Exceeds MNL
R3 ¹	Ulu Gold Camp	43.4	57 ³	No
R9 ¹	High Lake Camp	34.8	57 ³	No
-	Grays Bay Road PDA Boundary	61.5 ²	62 ⁴	No
-	Permanent Quarry Sites Boundary ¹	61.1 ²	62 ⁴	No

Notes:

“-“ not applicable because road maintenance and quarry locations vary along the Grays Bay Road.

¹ Non-project related receptor

² Site-specific or situational mitigation measures included

³ MNL threshold for construction activities less than two months

⁴ MNL threshold for construction activities less than two months and no tonality

Sleep disturbance effect at all permanent accommodations are compared to the Health Canada threshold. Table 13.15 summarizes the sleep disturbance assessment results for permanent accommodations at the Grays Bay Port, Jericho Station, Ulu Gold Camp, and High Lake Camp. Mobile camp receptors are not included as they are not required during Operations and Maintenance. The results are below the thresholds at four permanent accommodations.

Table 13.15 Sleep Disturbance Noise Effects during Operations and Maintenance

ID	Name	Outdoor		Outdoor to Indoor Transmission Loss (dB)	Indoor		
		L _n (dBA)	L _{max} (dBA)		L _n (dBA)	L _{max} (dBA)	Exceed L _n of 30 dBA or L _{max} 45 dBA
R1	Grays Bay Port Stationery Camp	49.4	54.8	27	22.4	27.8	No
R2	Jericho Station Stationery Camp	36.4	52.9	27	9.4	25.9	No
R3	Ulu Gold Camp	37.0	41.1	27	10.0	14.1	No
R9	High Lake Camp	28.4	36.0	27	1.4	19.0	No

Table 13.16 compares the cumulative sound level results to the AER PSL noise limit for the Ulu Gold Camp (R3) and High Lake Camp (R9). The Ulu Gold and High Lake third-party camps (not project-related) is considered a residential dwelling because it is located outside the Project PDA. In addition, receptor R7 represents a location with the highest noise effects along a 1.5 km distance boundary from the port. The cumulative sound level is the combined noise effects of the ambient sound level (prescribed by AER) and the Project noise level. The cumulative sound level results at R3, R7, and R9 are below the PSL noise limit of 50 dBA daytime and 40 dBA nighttime.

Table 13.16 Operations and Maintenance Noise Effects Alberta Energy Regulator Permissible Sound Level Comparison

ID	Name	Ambient Sound Level (dBA)		Project Noise Level (dBA)		Cumulative Sound Level (dBA)		Exceeds PSL
		L _d	L _n	L _d	L _n	L _d	L _n	
R3	Ulu Gold Camp	45	35	37.0	37.0	45.6	39.1	No
R7	Grays Bay Port LAA Boundary	45	35	32.8	32.8	45.3	37.0	No
R9	High Lake Camp	45	35	28.4	28.4	45.1	35.9	No
R10 Operation	Jericho Station LAA Boundary	45	35	29.8	29.1	45.1	36.0	No

In addition to the PSL threshold, AER prescribes thresholds for low frequency noise at a dwelling. The predicted L_d and L_n is 49.9 dBC and 48.3 dBC at R3 and R9, respectively. The difference between the C-weighted and A-weighted sound levels is 12.9 dB for R3 and 19.9 dB for R9, lower than the AER 20 dB threshold for LFN. The potential for a low frequency noise effects at a R3 and R9 are deemed to be low, and no further mitigations are required.

TLMRU activities may occur in areas that intersect the Grays Bay Road and permanent quarries. For these activities, where it is difficult to define a discrete receptor location, the assessment used a buffer distance approach. The approach involved predicting project noise levels at various distances from the PDA, focusing on locations expected to experience the highest predicted noise and vibration effects on TLMRU. Examples of such locations include a straight section of Grays Bay Road or a nearby quarry. The buffer approach is commonly used in noise assessments. This approach quantifies the noise effects at different distances from the Operations and Maintenance activities along the road.

Table 13.17 summarizes the highest predicted L_d, L_n, and L_{dn} noise levels results for Grays Bay Road maintenance and quarry operation at different distances (i.e., 0 m to 3,000 m) from the edge of the PDA. The L_{dn} results are below the Health Canada MNL limit of 62 dBA. Results for the permanent quarry include the implementation of site-specific or situational measures.

Table 13.17 Operations and Maintenance Sound Levels at Different Distances from Grays Bay Road

Distance from PDA ¹ (m)	Predicted Sound Level (dBA) for Road Maintenance			Predicted Sound Level (dBA) for Permanent Quarry		
	L _d	L _n	L _{dn}	L _d	L _n	L _{dn}
0	55.1	55.1	61.5	55.4	55.4	61.9
10	54.7	54.7	61.1	52.6	52.6	59.0
20	54.4	54.4	60.8	50.9	50.9	57.3
50	53.4	53.4	59.8	47.5	47.5	53.9
100	52.0	52.0	58.4	43.9	43.9	50.3
200	49.7	49.7	56.1	40.0	40.0	46.5
300	47.7	47.7	54.1	38.9	38.9	45.3
400	46.0	46.0	52.4	41.4	41.4	47.8
500	44.4	44.4	50.8	48.1	48.1	54.5
1000	38.5	38.5	44.9	30.0	30.0	36.4
1500	34.3	34.3	40.7	25.2	25.2	31.7
2000	31.0	31.0	37.4	22.4	22.4	28.8
2500	28.3	28.3	34.7	20.2	20.2	26.6
3000	26.0	26.0	32.4	18.3	18.3	24.7

Note:

¹ Road PDA width is 150 m, road width is 10 m, and road filled area is approximately 20 m. Quarry PDA diameter is 500 m.

13.3.3 Vibration

13.3.3.1 Analytical Assessment Techniques

During the Construction phase, heavy equipment such as piling rigs, excavators, compactors, and haul trucks will be used. Based on methods recommended in the FTA noise and vibration guideline (FTA 2018), ground vibration effects due to pile driving, excavator, compactor, drilling, and large bulldozers were assessed at receptors closest to the construction activities. These pieces of equipment were selected because they typically produce higher vibration levels than other construction equipment.

In the vibration assessment of blasting at the port and quarries during construction and operations and maintenance, equations commonly used and accepted by the industry were used to predict the blast-induced ground vibration and air overpressure. Ground vibration level related to blast activities is defined in terms of peak-particle velocity and is measured in millimetres per second (mm/s), representing the highest instantaneous positive or negative peak of the vibration signal. During blasting, blast energy that liberates into the atmosphere generates air overpressure. Air overpressure is the additional pressure above normal atmospheric pressure that is generated from a blast and is measured in dB. Air overpressure often feels like a gust of wind by a receptor as a confined blast will generally result in an

inaudible air overpressure. Commonly used and accepted equations from the International Society of Explosives Engineers technical literature Blasters' Handbook (ISEE 2011) were used to predict ground vibration and air overpressure levels for quarries and construction activities.

13.3.3.2 *Project Effects Pathways*

During the Construction phase, heavy equipment activities associated with earthworks, piling, and drilling for the port infrastructure and road will result in some changes in vibration levels. However, these changes are anticipated to remain below regulatory threshold. In addition, potential blast-related activities at the port embarkment and approximately 40 quarries will also result in ground vibration and air overpressure effects. During the construction phase, blast-related vibration effect exceeds the overpressure threshold of 125 dB at R1 and mobile camps.

Similarly, in the Operations and Maintenance phase, vibration levels from heavy equipment activities associated with the port operations and maintenance and road maintenance are expected to remain below thresholds and not required mitigation. In addition, potential blast-related activities at approximately 11 permanent quarries will also result in ground vibration and air overpressure effects. Blast-related vibration effect exceeds the overpressure threshold of 125 dB at R1, R2, and R6.

TLMRU activities such as gathering places and travel routes may occur in areas that intersect the PDA of Grays Bay Road, quarries, or bridge pier construction activities. In some instances, these activities may be as close as the edge of road, quarry, or bridge construction PDA. Blast-related effects at the PDA boundary of quarry are predicted to exceed the ground vibration threshold of 12.5 mm/s and overpressure threshold of 125 dB.

As a result, mitigation, enhancement, and management measures are focused on blast-related effects at receptor locations and PDA boundaries during nearby construction and operations and maintenance activities, where these exceedances are expected.

Through the project-specific engagement program, feedback has been considered and summarized in Table 13.5. Concerns about the vibration effects on wild animal and land usage has been integrated into vibration effect pathway. These pathways may also result in effects on vibration, which may affect Kitikmiut, Indigenous groups, and other potentially affected communities or the resources, habitat, and environmental conditions that they rely on (Volume 9, Sections 24 and 25).

13.3.3.3 *Mitigation, Management, and Enhancement Measures*

The following mitigation, enhancement, and management measures will be considered to reduce the vibration effects at these PDA boundary locations when activities are nearby during the Construction and Operation and Maintenance phases. These measures take into consideration the values identified by Kitikmiut, other Indigenous groups, and other potentially affected communities. The measures are presented in the following three sections:

- Design Measures: mitigation measures that are inherently in the Project design
- Standard Operating Practices: practices that are necessary to reduce vibration effect
- Site-specific or Situational Measures: additional measures to further reduce vibration exceedance

Design Measures

The following measures were incorporated into the vibration model and represent project design elements or assumptions already built into the Project. Vibration from heavy equipment and stationary sources (e.g., generators, crushers, drilling rigs) was assessed as part of the broader vibration study and found to be below the applicable annoyance thresholds at receptor locations, except in limited cases (e.g., impact piling within 164 m of receptors). As a result, these sources did not require design-level mitigation and are not addressed in this section. Detailed assessment results are provided in Section 13.3.3.4.

Design measures in this section, therefore, focus on blasting, which was identified as the primary source of vibration and air overpressure expected to exceed thresholds at off-site receptors or PDA boundaries.

To reduce vibration and air overpressure effects from blasting, the following design elements were incorporated into the vibration model:

- Reduce the highest explosive per time delay per hole by increasing the number of holes per blast.
- Only one hole/delay will be fired in the blast.
- Minimum time delay between holes in blasts will not be less than 8 milliseconds (ms).

Standard Operating Practices

Standard operating practices will be considered to reduce predicted vibration levels. This includes a vibration monitoring program that measures ground vibration and air overpressure at different distances from a blast event. The measured data will enhance the blast design. For example, a reduced blast charge can be increased if the monitoring results indicate vibration levels are below the model predicted value at a location.

Vibration effects from heavy equipment and stationary sources (e.g., generators, crushers, mobile equipment) were assessed and found to remain below the applicable annoyance thresholds at receptor locations. As a result, no operational mitigation measures are required for these sources.

Site-specific or Situational Measures

Site-specific or situational vibration management measures focus on blasting activities, as these are the only sources predicted to result in exceedances of vibration or overpressure thresholds at receptor locations or TLMRU areas. In contrast, vibration from heavy equipment and stationary sources (e.g., generators, crushers, and dozers) was assessed and found to remain below applicable annoyance thresholds at the distances between these sources and receptors (see Section 13.3.3.4). Therefore, no site-specific mitigation is required for these sources.

The following measures will be considered in specific areas where modeled or measured exceedances occur, particularly near receptors or TLMRU areas. The applicability of these measures will be affected by the seasonality and time-sensitivity of the land use.

- Where feasible, quarries will be located at sufficient buffer distances from receptors or sensitive land use areas to reduce the need for intensive blast mitigation. The mobile camp is assumed to be 500 m from quarry blasting.
- In cases where receptors or land use areas are located closer to blasting activities, reductions in blast charge per hole/delay will be considered to manage vibration and overpressure levels within thresholds. Blasting intensity or timing will be adjusted where feasible during periods when traditional land use activities are occurring near the PDA.
- Continued engagement with Inuit land users will help identify opportunities for avoidance, respite periods, or other culturally appropriate mitigation measures in locations that are seasonally or situationally significant.
- For impact piling, which may exceed perceptibility thresholds under certain conditions, potential mitigation could include maintaining an appropriate buffer distance from sensitive areas or timing work to minimize disturbance during land use activities.

13.3.3.4 *Project Residual Effects*

Blasting

During the construction phase, the assessment focused on blasting activities associated with the port embankment and multiple quarry locations along the road alignment. Representative blast charges were used in the modelling to predict ground vibration and air overpressure levels. Site-specific or situational mitigation scenarios, including reduced blast charges near sensitive receptors (e.g., workers' permanent accommodations or community areas), were also considered where necessary.

During the Operations and Maintenance phase, blasting activities are expected to occur at permanent quarry sites along the road. Higher blast charges were modelled for these operations, with potential reductions applied near receptors as part of mitigation planning.

Table 13.18 summarizes the predicted ground vibration and air overpressure level at the Grays Bay Port permanent accommodation (R1) and the Grays Bay Port PDA boundary location (R5) due to blasting activities during Construction and Operations and Maintenance phases. The results indicate that ground vibration and air overpressure levels at R1 and R5 are below the applicable threshold of 12.5 mm/s and 125 dB, respectively.

Table 13.18 Blast Related Vibration Effects at Permanent Accommodations

ID	Name	Closest Distance to Blast Activities ¹ (m)	Blast Related Vibration Effects		Meet 12.5 mm/s and 125 dB threshold?
			Ground Vibration PPV (mm/s)	Air Overpressure (dB)	
R1	Grays Bay Port Stationery Camp	500	3.2	117	Yes
R5	Grays Bay Port PDA Boundary	1000	1.0	110	Yes

Note:

¹ Distance between receptor and embankment (i.e., barge landing area)

Table 13.19 presents the predicted ground vibration and air overpressure level for receptors due to blasting activities at the closest Grays Bay Road quarry during construction. During construction, predicted ground vibration levels are below the applicable threshold of 12.5 mm/s at all receptors. Site-specific or situational measures are required to meet the applicable threshold of 125 dBA at receptors R1 and mobile camps during construction. Mitigation measures being considered are discussed Section 13.3.3.3 to reduce the overpressure effects to acceptable levels.

Table 13.19 Vibration Effects due to Grays Bay Road Quarry Blast Activities during Construction

ID	Name	Closest Distance to Blast Activities ¹ (m)	Predicted Vibration Levels		Meet 12.5 mm/s and 125 dB threshold?
			Ground Vibration (mm/s)	Air Overpressure (dB)	
R1	Grays Bay Port Stationery Camp	250	0.3 ²	125 ²	Yes
R2	Jericho Station Stationery Camp	600	0.5	124	Yes
R3	Ulu Gold Camp	1100	0.2	119	Yes
R6	Grays Bay Port PDA Boundary	600	0.5	124	Yes
R9	High Lake Camp	1000	0.2	120	Yes
-	Mobile Camps	500	0.6 ²	125 ²	Yes

Notes:

¹ Distance between receptor and closest road quarry

² Site-specific or situational measures are included

“-“ not applicable because mobile locations vary along the Grays Bay Road.

Table 13.20 presents the predicted ground vibration and air overpressure level for receptors due to blasting activities at the closest Grays Bay Road permanent quarry during Operations and Maintenance. During Operations and Maintenance, predicted ground vibration levels are below the applicable threshold of 12.5 mm/s at all receptors. Site-specific or situational measures are required to meet the applicable threshold of 125 dB at receptors R1, R2, and R6 during Operations and Maintenance. The measures being considered are discussed in Section 13.3.3.3 to reduce the overpressure effects to acceptable levels.

Table 13.20 Vibration Effects Due to Grays Bay Road Quarry Blast Activities during Operations and Maintenance

ID	Name	Closest Distance to Blast Activities ¹ (m)	Predicted Vibration Levels		Meet 12.5 mm/s and 125 dB threshold?
			Ground Vibration (mm/s)	Air Overpressure (dB)	
R1	Grays Bay Port Stationery Camp	250	0.4	125 ²	Yes
R2	Jericho Station Stationery Camp	600	0.8	125 ²	Yes
R3	Ulu Gold Camp	1100	0.7	123	Yes
R6	Grays Bay Port PDA Boundary	600	0.8	125 ²	Yes
R9	High Lake Camp	1000	0.8	124	Yes

Notes:

¹ Distance between receptor and closest road quarry

² Site-specific or situational measures are included

“-“ not applicable as mobile camps are not required during Operations and Maintenance phase

TLMRU activities may occur in different areas near the Grays Bay Port and the Grays Bay Road quarries. For these activities where it is difficult to define a discrete receptor location, the assessment used a buffer distance approach. The approach involved predicting project vibration levels at various distances from the PDA, focusing on locations expected to experience the highest predicted noise and vibration effects on TLMRU. Examples of such locations include a straight section of Grays Bay Road or a nearby quarry. In addition to the predicted effects at various distances, the distances at which the ground vibration and overpressure result in meeting the thresholds are provided. Receptors located within the specified distances will experience effects above the corresponding thresholds.

Table 13.21 summarizes the prediction results for ground vibration and overpressure at various distances from the blast. The results include the implementation of site-specific or situational measures.

Table 13.21 Blast Related Vibration Effects at Different Distances from Blasting Activities at Port and Road Quarry

Distance from Road Quarry PDA (m)	Construction - Port		Construction – Road Quarry		Operations and Maintenance – Permanent Road Quarry	
	Ground Vibration (mm/s)	Air Overpressure (dB)	Ground Vibration (mm/s)	Air Overpressure (dB)	Ground Vibration (mm/s)	Air Overpressure (dB)
5	5033.5	161	3283.9	164	12096.4	168
10	1660.4	154	930.1	158	3425.9	162
20	547.7	148	263.4	153	970.3	157
30	286.3	144	125.9	149	463.9	153
40	180.7	141	74.6	147	274.8	151
50	126.4	139	49.7	145	183.1	149
60	94.4	137	35.7	143	131.4	147

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Distance from Road Quarry PDA (m)	Construction - Port		Construction – Road Quarry		Operations and Maintenance – Permanent Road Quarry	
	Ground Vibration (mm/s)	Air Overpressure (dB)	Ground Vibration (mm/s)	Air Overpressure (dB)	Ground Vibration (mm/s)	Air Overpressure (dB)
70	73.8	136	26.9	142	99.2	146
80	59.6	135	21.1	141	77.8	145
90	49.4	133	17.1	140	62.8	144
100	41.7	132	14.1	139	51.9	143
110	35.8	132	11.8	138	43.6	142
120	31.2	131	10.1	137	37.2	142
130	27.4	130	8.7	137	32.2	141
140	24.3	129	7.6	136	28.1	140
150	21.8	129	6.7	136	24.8	140
160	19.7	128	6.0	135	22.0	139
170	17.8	127	5.4	135	19.7	139
180	16.3	127	4.8	134	17.8	138
190	14.9	126	4.4	134	16.1	138
200	13.8	126	4.0	133	14.7	137
250 ¹	9.6	124	2.7	131	9.8	135
300	7.2	122	1.9	130	7.0	134
350	5.6	120	1.4	128	5.3	132
400	4.5	119	1.1	127	4.2	131
450	3.8	118	0.9	126	3.4	130
500	3.2	117	0.8	125	2.8	129
550 ²	2.7	116	0.6	125	2.3	129
600	2.4	115	0.5	124	2.0	128
650	2.1	115	0.5	123	1.7	127
700	1.9	114	0.4	123	1.5	127
750	1.7	113	0.4	122	1.3	126
800	1.5	113	0.3	121	1.2	126
850 ³	1.4	112	0.3	121	1.1	125
900	1.2	111	0.3	121	1.0	125
950	1.1	111	0.2	120	0.9	124
1000	1.0	110	0.2	120	0.8	124
1100	0.9	110	0.2	119	0.7	123
1200	0.8	109	0.2	118	0.6	122
1300	0.7	108	0.1	117	0.5	121
1400	0.6	107	0.1	117	0.4	121
1500	0.5	107	0.1	116	0.4	120
1600	0.5	106	0.1	116	0.3	120

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Distance from Road Quarry PDA (m)	Construction - Port		Construction – Road Quarry		Operations and Maintenance – Permanent Road Quarry	
	Ground Vibration (mm/s)	Air Overpressure (dB)	Ground Vibration (mm/s)	Air Overpressure (dB)	Ground Vibration (mm/s)	Air Overpressure (dB)
1700	0.4	105	0.1	115	0.3	119
1800	0.4	105	0.1	115	0.3	119
1900	0.4	104	0.1	114	0.2	118
2000	0.3	104	0.1	114	0.2	118
2100	0.3	103	0.1	113	0.2	117
2200	0.3	103	0.1	113	0.2	117
2300	0.3	102	0.0	113	0.2	117
2400	0.3	102	0.0	112	0.2	116
2500	0.2	102	0.0	112	0.1	116
2600	0.2	101	0.0	112	0.1	116
2700	0.2	101	0.0	111	0.1	115
2800	0.2	101	0.0	111	0.1	115
2900	0.2	100	0.0	111	0.1	115
3000	0.2	100	0.0	110	0.1	114

Notes:

¹ threshold distance for overpressure due to blasting at port embarkment during construction

² threshold distance for overpressure due to blasting at road quarry during construction

³ threshold distance for overpressure due to blasting at permanent quarry during Operations and Maintenance

Table 13.22 summaries the threshold distance from different blast activities to meet the applicable threshold. During construction, the threshold distances to meet the overpressure threshold of 125 dB is 250 m and 600 m for blasting at the port embarkment and quarry, respectively. During Operations and Maintenance, the threshold distances to meet the overpressure threshold of 125 dB is 950 m from the permanent quarry. The vibration effects at a closer distance may result in a vibration level greater than the corresponding threshold. In some instances, TLMRU activities may occur in different areas within the threshold distances presented in Table 13.22. If required, mitigation measures are recommended in Section 13.3.3.3 should be considered to reduce the vibration effects to acceptable levels.

Table 13.22 Threshold Distances from Blast Activities to Meet Threshold

Project Phase	Blast Location	Ground Vibration Threshold (12.5 mm/s) Distance from Blast Center (m)	Air Overpressure Threshold (125 dB) Distance from Blast Center (m)
Construction	Port Embankment	250	250
	Road Quarry	110	600
Operations and Maintenance	Road Quarry	250	950

Stationery and Mobile Equipment

This section presents the vibration assessment results due to stationery and mobile equipment. The prediction results are compared to the ground vibration annoyance of 72 VdB (FTA 2018).

Construction

Construction activities along Grays Bay Road have a 150 m right-of-way within the PDA. The road filled area will be approximately 20 m. Construction equipment located along the outside of the road filled area can be located 60 m from the PDA. Table 13.23 summarizes the predicted vibration levels at 60 m for different mobile equipment. The result indicates ground vibration level below the annoyance threshold for all equipment except the impact piling rig. Mitigation measures (Section 13.3.3.3) can be implemented to reduce the impact piling rig vibration effects. Along the Grays Bay Road PDA boundary, ground vibration effects from vibratory roller, drilling, and impact piling rig could be perceptible as the predicted levels are above the perceptibility level of 65 dBA.

Table 13.23 Ground Vibration at 60 m for Construction Equipment

Construction Equipment	Ground Vibration (VdB)	Exceed Annoyance Threshold of 72 VdB	Exceed Perceptibility Threshold of 65 VdB
Haul Truck	59	No	No
Vibratory Roller	67	No	Yes
Bulldozer	60	No	No
Drilling	67	No	Yes
Shovel	60	No	No
Impact Piling Rig	85	Yes	Yes

Table 13.24 summarizes the distance threshold that will result in ground vibration effects exceeding the thresholds. A receptor located at a distance less than the threshold distance will result in vibration level greater than the corresponding annoyance threshold. A minimum distance of 164 m is required to meet the annoyance threshold during impact piling operation. Impact piling rig will be required for bridge pier construction at three to four water crossing locations. Mitigation measures are recommended in Section 13.3.3.3 to reduce the ground vibration overpressure effects to acceptable levels.

Table 13.24 Ground Vibration Threshold Distance for Equipment

Construction Equipment	Threshold Distance (m) to meet 72 VdB
Haul Truck	22
Vibratory Roller	41
Bulldozer	24
Drilling	41
Shovel	24
Impact Piling	164

Road quarry mobile and stationery equipment such as generator, crusher, screener, stacker, drilling rig, loader, and dozer may result in local ground vibration effects. Based on the threshold distance presented in Table 13.24, ground vibration effects from the equipment are not expected to exceed the annoyance threshold outside quarry PDA (i.e., 100 m by 100 m).

Operations and Maintenance

During the Operations and Maintenance phase, ground vibration effects are expected from stationary equipment such as the generators, conveyors, and motors. However, the vibration effects due to the equipment are confined within the equipment buildings. Mobile equipment in the Grays Bay Port PDA will be operating within the laydown area and permanent quarry. The closest distance between this mobile equipment and the PDA boundary is at least 500 m away. Based on the threshold distance presented in Table 13.24 (i.e., 41 m for drilling, 24 m for dozer, and 22 m for haul trucks) for annoyance threshold, ground vibration effects from mobile equipment within the port is expected to be negligible.

Equipment type and quantity requirement is less during the Operations and Maintenance phase. Ground vibration from operation equipment for the Grays Bay Road and permanent quarries is expected to be less than effects presented for the Construction phase above.

One 4.6 MW wind turbine may be considered as an optional power generation source within the port PDA. Vibration effects of a wind turbine are not expected to extend beyond the port PDA. Closest distance from potential wind turbine locations is 550 m to R1 and 600 m to the closest PDA boundary. Vibration effect from the wind turbine is unlikely to exceed the 72 VdB annoyance threshold.

13.3.4 Summary of Project Residual Effects

Noise effects were predicted for the short-term and long-term activities during both Construction and Operations and Maintenance phases. During the Construction phase, noise effects were predicted to meet the regulatory thresholds at all receptors. Site-specific or situational measures are required at some receptors. These receptors include the Jericho Station PDA boundary (R8) and Grays Bay Road PDA boundary for road construction, quarry development, and watercourse crossings (bridge pier) construction. During the Operations and Maintenance phase, noise effects are predicted to meet the regulatory thresholds at all receptors. Site-specific or situational measures are required at the road and permanent quarry site boundary. Vibration effects were predicted for construction and operations and maintenance activities. During the Construction phase, blast-related vibration effects are predicted to meet the regulatory thresholds. Site-specific or situational measures are required at R1 and mobile camps. During the Operations and Maintenance phase, predicted blast-related vibration effects are predicted to meet the regulatory thresholds. Site-specific or situational measures are required at R1, R2, and R6.

Despite these vibration effect site-specific or situational measures, residual effects from blasting may still occur at some receptors, particularly in cases where proximity to the PDA makes full mitigation impractical. These residual effects are expected to be intermittent, of short duration, and reversible, and will occur only during specific construction or operations and maintenance activities (e.g., blasting, piling). Where applicable, engagement with Inuit land users and seasonal mitigation (e.g., scheduling) will further reduce the potential for adverse effects.

Therefore, residual effects related to pilling and blasting are considered to be intermittent, short in duration, localized and reversible, and are characterized as moderate in magnitude at specific receptors during discrete activities. Measurable residual vibration effects may occur near the PDA but not beyond the LAA. There is low likelihood of temporal and spatial overlap with other past, present, foreseeable, and foreseeable induced projects. Therefore, vibration is not considered further in the cumulative effects assessments.

Table 13.25 summarizes project residual effects on Noise and Vibration.

Table 13.25 Project Interactions with Noise and Vibration

Residual Effects	Residual Effects Characterization							
	Project Phase	Direction	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
Noise	C	A	M	RAA	NS	ST	C	R
	O	A	M	RAA	NS	MT	C	R
Vibration	C	A	M	LAA	NS	ST	R	R
	O	A	M	LAA	NS	MT	R	R
Key: See Table 13.4 for detailed definitions Project Phase: C: Construction O: Operations and Maintenance Direction: P: Positive A: Adverse N: Neutral Magnitude: NMC: No Measurable Change L: Low M: Moderate H: High Geographic Extent: PDA: Project Development Area LAA: Local Assessment Area RAA: Regional Assessment Area Timing: NS: No sensitivity MS: Moderate sensitivity HS: High sensitivity Duration: ST: Short-term MT: Medium-term LT: Long-term Frequency: S: Single event IR: Irregular event R: Regular event C: Continuous Reversibility: R: Reversible I: Irreversible N/A: Not applicable								

13.3.5 Transboundary Effects

An assessment of the potential for transboundary effects on noise and vibration is provided in Volume 10, Section 33 Transboundary Effects Assessment.

13.3.6 Effects of Climate Change on Noise and Vibration

Climate change will affect atmospheric conditions. Propagation of sound is affected by temperature, relative humidity, wind speed, and wind direction. Summer conditions with moderate temperature, high relative humidity, and downwind condition enhances noise propagation when compared to winter conditions with lower temperature, lower relative humidity, and upwind conditions. Background sound level will increase with rain precipitation and subsequently higher water flow in creeks and rivers.

Blast-related overpressure is also affected by atmospheric conditions. Air overpressure is predictable on a calm, clear day with steady atmospheric conditions. Temperature inversion (e.g., a layer of warm air above a layer of cooler air) and downwind conditions will enhance the propagation of blast-related overpressure. Climate change may affect the occurrence and intensity of temperature inversion. If temperature inversion frequency and intensity increase, it may lead to more conditions that enhance blast-related overpressure effects.

The change in the seasonality pattern will also affect traffic along Grays Bay Road due to accessibility. For example, shorter winters may result in increased traffic volume during the spring, summer, and fall seasons. Increased traffic will contribute to increased noise and vibration effects.

The change in atmospheric conditions and seasonality may increase the noise and vibration effects. Effects management measures presented in Sections 13.3.2.3 and 13.3.3.3 can reduce these effects if required.

13.4 Assessment of Cumulative Effects

13.4.1 Project Residual Effects Likely to Interact Cumulatively

Volume 4 (Effects Assessment Methodology), Appendix 9A, presents the Project Inclusion List, which identifies other projects and physical activities that might act cumulatively with the Project. Where residual effects from the Project act cumulatively with residual effects from other projects and physical activities (Table 13.26), a cumulative effects assessment is carried out.

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Table 13.26 Interactions with the Potential to Contribute to Cumulative Effects

Physical Activities	Effects	
	Noise	Vibration
Past		
Bathurst Inlet	-	-
Omingmaktok	-	-
Snap Lake Mine	-	-
Present		
Arcadia Bay Project	-	-
B2Gold George Property	-	-
B2Gold Marine Laydown Area	-	-
Bulk Carriers	-	-
Cambridge Bay	-	-
Chuk and Fire Shear Blocks	-	-
Commercial Cargo	-	-
Commercial and Domestic Harvesting	✓	-
Coppermine Project	-	-
Coppermine River Project	-	-
Diavik Diamond Mine	-	-
Ekati Diamond Mine	-	-
Epworth Project	-	-
Fishing Vessels	✓	-
Gahcho Kué Diamond Mine	-	-
Goose Mine	-	-
Hackett River Project	-	-
High Lake (Izok Corridor Project)	✓	-
High Lake East	-	-
Hood River Gold Project	✓	-
Hope Bay Project	-	-
Hydroelectric	-	-
Icebreakers	-	-
Itchen Lake Property	-	-
Izok Lake (Izok Corridor Project)	-	-
Jericho Mine	✓	-
Kennady North - Exploration	-	-
Kugluktuk		
Lupin Mine	-	-
Muskox Nickel Property	-	-

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Physical Activities	Effects	
	Noise	Vibration
Nunavut Community Infrastructure	-	-
NWT Community Infrastructure	-	-
Overflights	✓	-
Passenger Ships and Pleasure Craft	-	-
Pistol Lake Project	-	-
Rae Copper Exploration Project	-	-
Rockinghorse (Koamaogaktok) Project	-	-
Roma Project	✓	-
Scientific Research	-	-
South Kitikmeot Gold Project	-	-
Tanker Ships	-	-
Tibbit to Contwoyto Winter Road	-	-
Tourism	✓	-
Tree River Lodge	-	-
TTMG Project	-	-
Tugs/Barges	-	-
Ulu Gold Project	✓	-
Wolf/Mistake Lake Property	-	-
Yellowknife City Gold Project	-	-
Past and Reasonably Foreseeable		
Indin Lake Gold Project	-	-
Mon Mine	-	-
Yellowknife Gold Project	-	-
Project-Related Physical Activities		
Reasonably Foreseeable		
Arctic Economic & Security Corridor	-	-
Courageous Lake Mine	-	-
NICO	-	-
Reasonably Foreseeable Induced		
Grays Bay Road and Port: Bulk Fuel Storage Expansion, Grays Bay Port	✓	-
Grays Bay Road and Port: Bulk Fuel Storage Expansion: Jericho	✓	-
Grays Bay Road and Port: Airstrip Expansion	✓	-
Grays Bay Road and Port: Road Traffic	✓	-
Grays Bay Road and Port: Port Traffic	✓	-
Grays Bay Road and Port: Air Traffic	✓	-
Grays Bay Road and Port Phase 2 –Jericho Mine to NWT Border	✓	-
Hackett River Project	-	-

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Physical Activities	Effects	
	Noise	Vibration
Hackett and Back River Access Road	✓	-
High Lake Mine (Izok Corridor Project)	✓	-
Izok Lake Mine (Izok Corridor Project)	-	-
Izok Lake Access Road	✓	-

Notes:

✓ = Other projects and physical activities whose residual effects are likely to interact cumulatively with project residual effects.

– = Interactions between the residual effects of other projects and residual effects of the Project are not expected.

Past Physical Activities and Resource Use are not included in the cumulative assessment because their noise and vibration effects were temporary and ended when those activities were completed. As noise and vibration effects do not persist in the environment, there is no temporal overlap between past activities and the Project, and cumulative vibration effects with past activities are not possible.

Cumulative effects from vibration have not been assessed in detail because vibration is a localized and transient effect that does not persist once the activity has ceased. As a result, cumulative interaction between vibration effects from present activities is not anticipated. Table 13.25 identifies these activities and shows that no spatial or temporal overlap exists for vibration-related effects; therefore, cumulative interaction is not expected.

Past and Reasonably Foreseeable Physical Activities were considered together; however, because vibration effects from past activities do not persist, there is no mechanism by which they could interact cumulatively with vibration effects from reasonably foreseeable activities or with the Project.

Reasonably Foreseeable Physical Activities, including mineral exploration, renewable resource harvesting, land-based tourism, and scientific research, may generate vibration primarily from heavy equipment (e.g., haul trucks, excavators, and drilling rigs) or vehicular traffic. The vibration effect is transient with short duration and the short distances (i.e., 22 m for a haul truck and 41 m for a drilling rig, see Table 13.24).

Reasonably Foreseeable Induced Physical Activities are not expected to occur as a result of the Project in a manner that would generate additional vibration beyond that already considered.

While noise is assessed cumulatively where overlapping effects are possible, vibration is not carried forward in the cumulative effects assessment due to its transient nature, localized extent, and lack of overlap with other activities including reasonably foreseeable mining (e.g., the proposed High Lake Mine), which is not expected to blast simultaneously with the Project.

13.4.2 Noise

13.4.2.1 *Cumulative Effect Pathways*

Based on input provided by Inuit, regulators, and community members, as well as the current understanding of the conceptual project design, WKR identified projects and physical works that could have potential cumulative effects on noise in Table 13.26.

Noise effects from past activities do not persist once activities are completed, there is no mechanism by which they could interact cumulatively with noise effects from reasonably foreseeable activities or with the Project. There are no cumulative effects from past projects and physical activities as the noise effects cease after the activities are completed; therefore, no past projects have been included in the cumulative assessment.

Present Physical Activities and Resource Use include ongoing mineral exploration and mining, may involve heavy stationary and mobile equipment use. Where these activities occur within the Noise and Vibration RAA and overlap temporally with project activities, their noise emissions may contribute cumulatively to the residual noise effects of the Project. Present activities located outside the Noise and Vibration RAA are not expected to interact cumulatively with project noise due to distance-related attenuation.

Both stationary and mobile noise emissions may contribute to residual noise effects of the Project. Additionally, noise from the construction and operations and maintenance of Grays Bay Road and Port Phase 2 is likely to overlap with the Projects' residual effects if their noise emissions coincide temporally and spatially within the Noise and Vibration RAA. Noise effect associated with Reasonably Foreseeable Physical Activities, such as present and reasonably renewable resource harvesting, land-based tourism, and scientific research may result from vehicular traffic. These traffic-related noise effects may overlap with the residual noise effects of the Project. Where public information is available, noise effects due to these projects or physical activities can be quantified in the cumulative assessment. Reasonably foreseeable projects and physical activities that are located outside the Noise and Vibration RAA are also not expected to interact cumulatively with noise effects from the Project, as noise from the Project activities is expected to attenuate to levels well below the background level within 3 km of their source.

Reasonably Foreseeable Induced Physical Activities are not expected to occur as a result of the Project in a manner that would generate additional noise beyond that already considered; therefore, cumulative noise effects associated with induced activities are not anticipated.

13.4.2.2 *Mitigation, Management, and Enhancement Measures for Cumulative Effects*

No mitigation or effects management measures additional to those presented in Section 13.3.2.3 for project noise effects is proposed for the Project's contribution to the cumulative change in the Noise and Vibration LAA and RAA

13.4.2.3 Cumulative Effects

Present and reasonably foreseeable activities within the Noise and Vibration RAA that are likely to interact with noise from the Project are presented in Table 13.26. These activities may overlap either spatially or temporally with the noise effects of the Project.

Present mineral exploration activities (i.e., Ulu Gold, Roma, Chuk and Fire Shear Blocks, Hood River, and High Lake) are likely to generate noise emission from equipment use such as drilling, excavation, and vehicular traffic. Cumulative noise effect is not expected at the Grays Bay Stationery permanent accommodation and Jericho Station Stationery permanent accommodation due to no spatial overlap. Noise effect from the mineral exploration activities may overlap either spatially or temporally with the Project noise effects at Ulu Camp, mobile camps, and several sections of the Grays Bay Road. The application of analytical assessment techniques, such as noise modelling, was not possible for these mineral exploration activities due to the lack of availability of public information (i.e., noise emission type, quantity, and frequency). Therefore, noise effects from reasonably foreseeable mineral exploration activities cannot be quantified.

Present and reasonably foreseeable activities due to marine shipping, renewable resource harvesting, land-based tourism, and scientific research involves marine vessels and vehicular traffic. These mobile noise emissions may interact with the residual noise effects of the Project if the activities overlap with the Project temporally and spatially. Quantitative analytical assessment techniques, such as noise modelling, were not feasible for these activities due to the limited availability of public information (i.e., noise emission type, quantity, and frequency). However, proponents of reasonably foreseeable projects that require a future environmental assessment would be expected to characterize and quantify project-specific noise emissions and assess potential cumulative noise effects, including interactions with the Project. Where applicable, mitigation measures similar to those implemented for the Project would be identified and implemented to avoid or minimize cumulative noise effects.

Cumulative Effects – Reasonably Foreseeable Inducted Activities

Reasonably foreseeable inducted (RFI) activities summarized in Table 13.26 will have the potential to interact cumulative with the Project noise effects. These activities include the construction and operation of RFI projects such as the Grays Bay Road and Port airstrip expansion, Grays Bay Road and Port traffic (i.e., road, port, and air), Grays Bay Road and Port Phase 2, Hackett and Back River Access Road, High Lake Mine, and Izok Lake Access Road.

Some details are provided for Izok Corridor Project and Hackett River Project which include estimates of construction equipment quantity and usage for the spur road construction. There is limited information on the equipment usage for the operation of these projects. The High Lake Mine Project is located with the Project RAA; however, there is limited information on equipment type and usage for the construction and operation of the High Lake Mine Project. Estimates of construction equipment quantity and usage for the Grays Bay Road and Port airstrip expansion and Grays Bay Road and Port Phase 2 road construction is available. The type and quantity of equipment is similar to the project road construction. Detailed information for the Operations and Maintenance phase of the Grays Bay Road and Port third-party traffic usage and Grays Bay Road and Port Phase 2 are limited.

RFI activities identified with potential noise effect interaction in Table 13.26 will require increase equipment usage, vehicle traffic, marine vessel traffic, and air traffic. The noise effects associated with these activities will occur at different time periods and locations, which may not interact temporally or spatially with project activities. Predicting the noise effect associated with these RFI activities is challenging due to the degree of certainty and extent of descriptive details, both low given assumptions, including under a maximum use scenario. These RFI activities are expected to undergo environmental assessment by its respective proponent. Proponents would be expected to assess and quantify noise effects to the extent practicable using conservative assumptions, best available information, and, where appropriate, maximum use or worst-case scenarios. Where quantitative assessment is not feasible, a qualitative assessment would be conducted. If required, mitigation measures will be recommended to further reduce the potential for significant adverse effects.

13.4.3 Summary of Cumulative Effects

Table 13.27 summarizes cumulative effects on noise.

Table 13.27 Residual Cumulative Effects on Noise

Residual Cumulative Effects	Residual Cumulative Effects Characterization						
	Direction	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
Noise	A	M	RAA	MS	MT	C	R
Contribution from the Project to Residual Cumulative Effects for Noise	In combination with present and reasonably foreseeable activities, the Project will result in increase in cumulative noise effects with moderate magnitude, RAA extent, moderate sensitivity timing, medium term duration, continuous frequency, and reversible.						
Key: See Table 13.4 for detailed definitions Direction: <i>P: Positive</i> <i>A: Adverse</i> <i>N: Neutral</i> Magnitude: <i>NMC: No Measurable Change</i> <i>L: Low</i> <i>M: Moderate</i> <i>H: High</i> Geographic Extent: <i>PDA: Project Development Area</i> <i>LAA: Local Assessment Area</i> <i>RAA: Regional Assessment Area</i> Timing: <i>NS: No sensitivity</i> <i>MS: Moderate sensitivity</i> <i>HS: High sensitivity</i> Duration: <i>ST: Short-term</i> <i>MT: Medium-term</i> <i>LT: Long-term</i> Frequency: <i>S: Single event</i> <i>IR: Irregular event</i> <i>R: Regular event</i> <i>C: Continuous</i> Reversibility: <i>R: Reversible</i> <i>I: Irreversible</i> <i>N/A: Not applicable</i>							

Other projects and physical activities within the RAA area have the potential to interact cumulatively with the Project's residual effects on noise, including the following:

- present mineral exploration
- RFI mines, marine traffic, and land transportation
- present and reasonably foreseeable renewable resource harvesting, land-based tourism and scientific research

The cumulative noise effects during Construction and Operations and Maintenance phases will result in an increase in noise levels (adverse); however, the magnitude of residual cumulative effects is moderate because noise effect meets or are below the applicable noise thresholds at receptors.

Stationary and mobile noise emissions from other present and reasonably foreseeable induced project activities may interact with the residual noise effects of the Project if the activities overlap with the Project temporally and spatially. However, it is not possible to quantify the measurable change for these activities due to the lack of availability of public information (i.e., noise emission type, quantity, and frequency). A qualitative assessment indicates that cumulative noise effects are unlikely to result in exceedance of applicable noise thresholds at receptors.

The residual cumulative effects will occur continuously during the Project. The residual effects timing is non-sensitive because noise emissions and the presence of most receptors within the RAA are not seasonally sensitive. The residual effect extent is within the RAA. Residual effects for the Project will be reversible once noise-generating activities cease.

13.5 Significance of Effects

13.5.1 Significance of Project Residual Effects

The Noise and vibration VC is considered significant if the Project noise and vibration effects result in a high magnitude effect (such as exceedance of regulatory criteria) within the LAA with medium-term or longer duration, and continuous frequency.

13.5.1.1 Noise

During construction, the assessment indicates short-term and long-term noise effect meeting the relevant regulatory noise thresholds at all applicable receptors. For short-term activities, site-specific or situational mitigation measures are required at the PDA boundary for project Grays Bay Road components (i.e., road construction, quarry operation, and bridge pier construction). These locations represent potential TLMRU activities along the PDA boundary while the construction activities occur along Grays Bay Road. Site-specific or situational mitigation measures are required at R8 during short-term construction activities. R8 represents a location along the Jericho Station PDA at which TLMRU activities may occur. Sleep disturbance noise effects at all permanent accommodation locations (i.e., R1, R2, R3, and R9) are below regulatory noise thresholds.

During the Operations and Maintenance phase, short-term and long-term activities noise effects meet the relevant regulatory noise thresholds at all applicable receptors. Short-term operations and maintenance activities meet the threshold at the road and permanent quarry PDA boundary. Sleep disturbance noise effects at all permanent accommodation locations (i.e., R1, R2, and R9) are below regulatory noise thresholds. Noise effects meet the AER noise thresholds at all applicable receptors (i.e., R3 and R6). The permanent quarry boundary location will require site-specific or situational measures to reduce the noise effects.

13.5.1.2 *Vibration*

During the Construction phase, blast-related vibration effects are predicted to meet the regulatory thresholds. Site-specific or situational measures are required at R1 and mobile camps. During the Operations and Maintenance phase, predicted blast-related vibration effects are predicted to meet the regulatory thresholds. Site-specific or situational measures are required at R1, R2, and R6. Despite these measures, residual effects from blasting may still occur at some receptors, particularly in cases where proximity to the PDA makes full mitigation impractical. These residual effects are expected to be of short duration, regular frequency, local, and reversible, and will occur only during specific construction or operations and maintenance activities (e.g., blasting, piling). Where applicable, engagement with Inuit land users and seasonal mitigation (e.g., scheduling) will further reduce the potential for adverse effects.

13.5.1.3 *Summary*

With the implementation of the mitigation, management, and enhancement measures, noise and vibration effects will be reduced to acceptable levels below the regulatory thresholds. Therefore, the magnitude of noise and vibration effects is predicted to be moderate. Construction noise and vibration effect is short term with continuous frequency. Operations and maintenance noise and vibration effect is medium term with continuous frequency. Effects on the noise and vibration VC are considered not significant as the magnitude is moderate within the LAA with short- to medium-term duration, and regular to continuous frequency.

13.5.2 *Significance of Cumulative Effects*

In combination with present and reasonably foreseeable activities, the Project will result in an increase in cumulative noise effects with moderate magnitude. The cumulative noise effect geographic extent is within the RAA. The timing is moderately sensitive with medium term duration and continuous frequency. The cumulative noise effect is reversible. The cumulative noise effect is considered significant if the Project noise effect results in a high magnitude beyond the LAA with medium-term or longer duration, and continuous frequency. There are no cumulative vibration effects with past, present, and likely future projects and activities. The noise and vibration VC is considered not significant as the cumulative noise effect magnitude is moderate with medium-term duration, and continuous frequency.

13.5.3 Summary of Mitigation, Management, and Enhancement Measures

Design measures, standard operating practices, and site-specific or situational measures will reduce the noise and vibration effects to acceptable levels for affected receptors, including Kitikmiut, other Indigenous, and other community land users. These measures are recommended in Sections 13.3.2.3 and 13.3.3.3 for noise and vibration effects, respectively.

Noise related design measures included engineering control and design. Standard operating practices include the reduction of equipment idling, using structures or landscape as barriers, and orienting permanent accommodations, such as sleeping quarters with windows, in a direction away from construction noise sources. Site-specific or situational measures, including noise control (i.e., temporary earth berms, portable noise barriers, or temporary structures), broadband backup alarms on mobile equipment, and adaptive management, may include reducing the quantity or duration of selected noisy equipment. The applicability of these measures will be affected by the seasonality and time-sensitivity of the land use.

Vibration related design measures included blast design the reduce ground vibration and overpressure effects (i.e., increase the number of holes per blast, one hole/delay, minimum time delay between holes less than 8 ms). Standard operating practices include blasting during a less sensitive period (i.e., shift change) and implementation of a monitoring program to support adaptive management for blast design. Site-specific or situational measures, including optimized blast design (e.g., reduced charge per delay) and strategic quarry location selection, are proposed to reduce vibration effects to acceptable levels wherever feasible.

13.6 Prediction Confidence and Uncertainty

Overall, the accuracy of predictions for the noise model depends on several factors, including the accuracy of the project design information, noise source data, and the sound propagation algorithm. The latest project design information available at the time of this model was used. The sound power levels of the noise sources were established with field measurements of similar equipment or vendor sound emission data, where available.

The Cadna/A model predicts outdoor noise propagation in accordance with ISO 9613. The ISO 9613 standard assumes metrological conditions that enhance sound propagation, such as downwind conditions and temperature inversions. These conditions are not constant but represent worst-case scenarios for noise transmission. The accuracy of the ISO 9613 algorithms is stated to be 3 dB over source-receiver distances between 100 m and 1,000 m, though accuracy for distances exceeding 1.5 km is not explicitly provided. The ISO 9613 model also produces results representative of meteorological conditions enhancing sound propagation (e.g., downwind and temperature inversion conditions). These conditions do not occur all the time; therefore, model predictions are expected to be conservative.

To account for the level of uncertainty in the noise predictions, conservative assumptions regarding the Project have been made. These include the assumptions that downwind conditions exist 100% of the time and that the maximum number of equipment operates at rated capacity for each scenario assessed. The confidence in the noise predictions during the Construction and Operations and Maintenance phases are high because the model was based on conservative assumptions and methods commonly accepted by the industry.

The prediction methods for blast-related ground-borne vibration are based on upper bound equations. Upper bound equations will generally estimate the highest potential vibration level with at least 95% confidence. The prediction methods for blast-related overpressure levels are based on best fit equation. Statistically the best fit equations are meant to estimate the expected air overpressure level.

The equations are useful for blasts that are well designed and implemented properly in the field. The confidence in the blast vibration predictions is high, since the analytical approach and methodology used in this model have been tested and verified in many blast audits worldwide. The confidence in the vibration predictions during the Construction and Operations and Maintenance phases are high because the model was based on methods commonly accepted by the industry.

WKR will continue to respond to questions and concerns from Kitikmiut, other Indigenous groups, and other potentially affected communities through its ongoing engagement efforts and information provided following submission of the IS will be reviewed in the context of the IS and for incorporation into project planning, as appropriate.

13.7 Follow-up and Monitoring

Noise effect mitigation, management, and enhancement measures will reduce the noise effects at selected locations (e.g., R8, project component PDA boundary) to acceptable levels below the regulatory threshold. If required, noise monitoring can be considered at these locations to monitor the effectiveness of mitigation, management, and enhancement measures.

Vibration effect mitigation, management, and enhancement measures will reduce the vibration effects to acceptable levels below the thresholds at selected locations (R1, mobile camp, R2, and R6). A vibration monitoring program will be considered at these locations. The program will monitor the effectiveness of project mitigation, management, and enhancement measures.

WKR will continue to respond to questions and concerns from Kitikmiut, other Indigenous groups, and other potentially affected communities through its ongoing engagement efforts and information provided following submission of the IS will be reviewed in the context of the IS and for incorporation into project planning, including adaptive management and monitoring, as appropriate

13.8 Knowledge and Literature Cited

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Appendix 11A

Air Quality Technical Modelling Report

Grays Bay Road and Port Project Air Quality Technical Modelling Report

Prepared for:

West Kitikmeot Resources Corp

Prepared by:

Nunami Stantec Limited

March 2026

Project No.: 123514868



Sign-off

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Abbreviations

AAQO	Ambient Air Quality Objective
ACPI	Air Contaminants of Potential Interest
ANFO	ammonium nitrate fuel oil
AQMP	Air Quality Management Plan
ARM2	ambient ratio method
BC	British Columbia
BIPR	Bathurst Inlet Port and Road
BMPs	best management practices
CAAQS	Canadian Ambient Air Quality Standards
CCME	Canadian Council of Ministers of the Environment
CO	carbon monoxide
DEIS	Draft Environmental Impact Statement
DPM	diesel particulate matter
ECCC	Environment and Climate Change Canada
EIS	Environmental Impact Statement
ENVP	British Columbia Ministry of Environment and Parks, formerly Ministry of Environment and Climate Change Strategy
FEIS	Final Environmental Impact Statement
GN	Government of Nunavut
GN-DOE	Government of Nunavut Department of Environment
GNWT	Government of Northwest Territories
H	Hydrogen
IAG	Inuit Advisory Group
IAG	Inuit Advisory Group
ICP	Izok Corridor Project
IS	Impact Statement
LAA	Local Assessment Area
LTO	landing and takeoff
MECP	Ontario Ministry of the Environment, Conservation, and Parks

**Grays Bay Road and Port Project
Air Quality Technical Modelling Report**

Abbreviations
March 2026

MLA	Marine Laydown Area
MMG	Minerals and Metals Group
MMIF	Mesoscale Model Interface Program
MOVES3	Motor Vehicle Emission Simulator Model version 3
N	nitrogen
NAAQS	Nunavut Ambient Air Quality Standards
NIRB	Nunavut Impact Review Board
NO	nitrogen oxide
NO ₂	nitrogen dioxide
NO ₃ ⁻	nitrate anion
NPI	National Pollutant Inventory
NPRI	National Pollutant Release Inventory
NRC	National Research Council
NTKP	Naonaiyaotit Traditional Knowledge Project
NWT	Northwest Territories
PAH	Polycyclic aromatic hydrocarbons
PAI	Potential Acid Input
PCO	Pollution Control Objectives
PDA	Project Development Area
PM	particulate matter
PM ₁₀	inhalable particulate matter with an aerodynamic diameter less than 10 micrometres
PM _{2.5}	respirable particulate matter with an aerodynamic diameter less than 2.5 micrometres
RAA	regional assessment area
SO ₂	sulphur dioxide
SO ₄ ²⁻	sulphate anion
SOGs	standards, objectives and guidelines
TCEQ	Texas Commission on Environmental Quality
TCWR	Tibbitt to Contwoyto Winter Road
TSP	total suspended particulate
U.S. EPA	United States Environmental Protection Agency
VC	Valued Component

VOC..... volatile organic compounds
WKR..... West Kitikmeot Resources Corporation
WRAP..... Western Regional Air Partnership

Symbols and Units of Measure

% percent
°C degrees Celsius
 $\mu\text{g}/\text{m}^3$ microgram per cubic metre
 μm micrometre
cm..... centimetre
 $\text{keq H}^+ \text{ha}^{-1} \text{y}^{-1}$ kiloequivalents of hydrogen ion per hectare per year
 $\text{kg ha}^{-1} \text{yr}^{-1}$ kilogram per hectare per year
km..... kilometre
 km^2 square kilometre
m metre
 $\text{mg}/\text{dm}^2/\text{day}$ milligram per square decimetre per day
 $\text{mg}/\text{m}^2/\text{y}$ milligram per square metre per year
mm millimetre
MW megawatts
Year..... Project Year (i.e., project phase year, not calendar year)

1 Introduction

West Kitikmeot Resources Corp. (WKR) is an Inuit-owned, Inuit-led company focused on the advancement of the Grays Bay Road and Port Project (the “Project”) in the Kitikmeot Region of Nunavut. WKR’s largest shareholder is a wholly-owned subsidiary of the Kitikmeot Inuit Association. The Project is proposed as multi-user, multi-use transportation infrastructure to be located on a combination of Inuit Owned Land and Crown land in the Kitikmeot Region of western Nunavut. Subject to approval, the Project would result in the establishment of the first deep-water port in the Canadian Central Arctic at Grays Bay, as well as a 230 kilometre (km) all-season access road between Grays Bay and Jericho Station near Contwoyto Lake. The Project will connect to the already approved Tibbitt to Contwoyto Winter Road (TCWR). The multi-user, multi-use project would allow for the establishment of shared infrastructure with many potential users including the federal and territorial governments, communities, community members, resource companies, and defence agencies.

The Project is a transformational nation-building transportation infrastructure project with significant benefits to Indigenous, Nunavummiut and all Canadians. This infrastructure will support economic development and provide various benefits, including food security, employment opportunities, a more resilient supply chain between Nunavut, the Northwest Territories, and southern Canada, enhanced sovereignty over the Northwest Passage, and support critical minerals development. The Project has the potential to positively transform this remote area of Canada that is struggling with high levels of poverty, pervasive food insecurity, low-income levels, high unemployment, housing shortages and an expensive cost of living.

An air quality assessment has been completed to determine the potential changes to ambient air quality as a result of the project activities. The air quality assessment estimates emissions of Air Contaminants of Potential Interest (ACPI) from the planned project activities and uses an air dispersion model to predict the potential changes in ambient air quality associated with project emissions. The air quality assessment focused on the Construction phase (including pre-construction activities), and the Operations and Maintenance phase, given that there is no reclamation or closure phase.

The air quality assessment considers ACPI for which there are applicable ambient air quality standards and guidelines adopted by the Government of Nunavut Department of Environment (GN-DOE), and other jurisdictions in Canada such as the British Columbia Ministry of Environment and Parks (ENVP), and Environment and Climate Change Canada (ECCC). The predicted air quality changes are assessed relative to these criteria, which are presented in Section 2.1.

The primary pathway for ACPI to reach human and ecological receptors is via airborne dispersion and deposition during project activities. As a result, a key objective of the air quality assessment is to inform the assessments of the following Valued Components (VC) of the Application:

- Human Health and Community Wellbeing – project emissions and the associated ambient concentrations may increase exposure of humans to ACPI and affect health.
- Water resources – project emissions and the deposition of these emissions may affect water quality of surrounding lakes and streams.

- Vegetation - project fugitive dust emissions and the deposition of these emissions on surrounding native plant communities may affect plant species diversity and community diversity.
- Wildlife and wildlife habitat – project emissions and the associated ambient concentrations and deposition may increase the exposure of wildlife to ACPI and affect wildlife health.

This report is presented in 10 sections. The purpose of the air quality assessment is provided in Section 1, along with a description of the air ACPI of interest and assessment boundaries. The regulatory criteria used in the assessment are discussed in Section 2 and an overview of the regional setting and existing conditions is provided in Section 3. Project air emissions are discussed in Section 4. Section 5 contains environmental control and management procedures. Sections 6 and 7 present the assessment approach and dispersion modelling results, respectively. Model prediction uncertainty is discussed in Section 8 and concluding remarks are provided in Section 9. Lastly, references cited in the report are listed in Section 10.

1.1 Inuit Knowledge, Traditional Knowledge, and Community Knowledge

A considerable volume of Inuit Knowledge has been documented for the Project, which has substantially informed WKR's understanding of baseline environmental and socio-economic conditions in the Project Development Area (PDA). For the purposes of the Impact Statement (IS), focus is placed on Inuit of the Kitikmeot Region, or Kitikmeot. The Project is located wholly within the Kitikmeot Region; as such, the Region and its people are where key project interactions and effects are most likely to occur.

Verified Inuit Knowledge and perspectives considered and integrated in the IS were shared through two primary project-specific sources:

1. **Naonaiyaotit Traditional Knowledge Project (NTKP):** The Kitikmeot Inuit Association maintains a repository of Inuit Knowledge for the Kitikmeot Region within a Geographic Information System-based database called the NTKP. The NTKP contains the collective body of documented and verified Inuit Knowledge of the Kitikmeot Region, including but not limited to knowledge of birds, fish, terrestrial and marine mammals, water quality, travel routes, gathering places, and heritage. The Kitikmeot Inuit Association compiled a project-specific report called *Kitikmeot Knowledge of the Proposed Koglokoakyok (Grays Bay) Port and Road Project* (Banci and Spicker 2024), which provides the majority of the Inuit Knowledge shared and integrated in the IS.
2. **Inuit Advisory Group (IAG):** Initiated in 2018 by the previous project proponent, WKR re-initiated the IAG in 2025. Through a series of IAG workshops, WKR and Inuit land users, Elders, and Knowledge Holders have met to discuss and document feedback and advice about the Project, including but not limited to dialogue about wildlife, fisheries, land use, archaeology, water, air quality, and access management. Through the IAG, multiple perspectives have been shared, allowing for the integration of knowledge systems (both Inuit Knowledge and western science), resulting in a more informed and sustainable project. At the time of filing, four IAG workshops had occurred (GBEEC 2018a; GBEEC 2018b; IAG 2025a; IAG 2025b), with additional workshops planned.

Pertinent baseline information from these sources of Inuit Knowledge is not presented further here; rather, this information is provided in the above-noted reports themselves, the 'Baseline Conditions'

sections of each assessment section, and integrated in the Air Quality sections where appropriate (i.e., the consideration and assessment of particulate matter and dustfall). The same process was applied when integrating baseline information associated with applicable Traditional Knowledge and Community Knowledge shared in publicly available literature and through the project-specific engagement program.

1.2 Air Contaminants of Potential Interest

The air quality assessment considers ACPI for which there are applicable ambient air quality standards and guidelines adopted by ENV, ENVP and ECCC (see Section 2.1). The air quality assessment includes the following ACPI:

- Total suspended particulate matter (PM) with an aerodynamic diameter less than 30 micrometres (μm) total suspended particulate (TSP)
- Respirable particulate matter with an aerodynamic diameter less than 10 μm (PM_{10})
- Fine particulate matter with an aerodynamic diameter less than 2.5 μm ($\text{PM}_{2.5}$)
- Nitrogen dioxide (NO_2)
- Sulphur dioxide (SO_2)
- Carbon monoxide (CO)

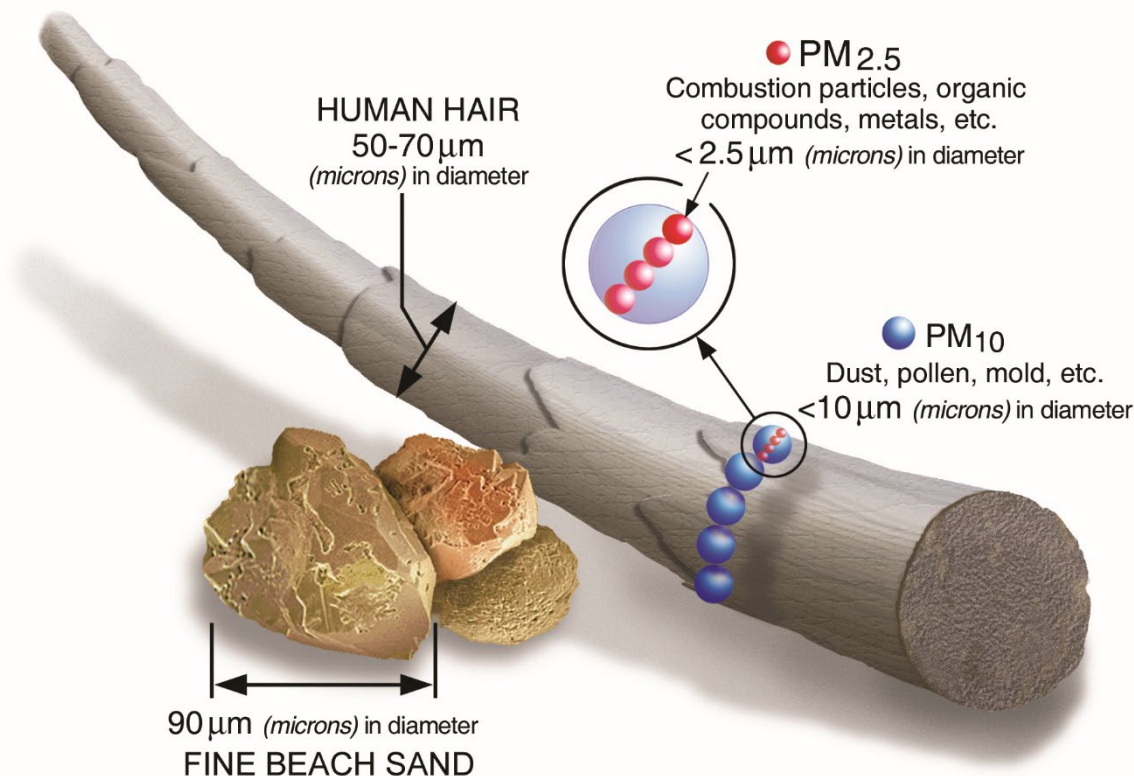
Total particulate deposition (dustfall) is another ACPI and refers to the settling of airborne particulate matter, specifically the portion that falls out of the atmosphere due to gravity. It is expressed in terms of milligram per square decimetre per day ($\text{mg}/\text{dm}^2/\text{day}$).

Potential Acid Input (PAI) is another ACPI and is defined as the difference between deposited acidic anions and basic cations. It is expressed in terms of kiloequivalents of hydrogen ion per hectare per year ($\text{keq H}^+ \text{ha}^{-1} \text{y}^{-1}$).

1.2.1 Particulate Matter

Particulate matter is a general term to describe many types of “dust” that have a wide variety of particle diameters. As defined by the British Columbia (BC) ENVP, Environment Canada and Climate Change (ECCC) and the United States Environmental Protection Agency (U.S. EPA), PM is comprised of solid particles and aerosols ranging in size from visible particles to microscopic particles with an aerodynamic diameter less than 1 μm (BC ENVP 2024a; ECCC 2013a; U.S. EPA 2023a). Figure 1.1 shows the range of PM in comparison to a human hair. Larger particles tend to deposit close to the source of the emissions and are primarily associated with visible dust generated by movement of geological materials during excavation, earthworks, blasting, road dust, and other activities during construction or from wind erosion of exposed soils. The larger dust particles are removed near the disturbance area by gravitational settling and are the main contributor to dustfall. Smaller particles from a source can be suspended in the air and transported downwind from several meters to several kilometers for the smallest particles. These finer particles are typically associated with combustion sources like construction equipment exhausts, generators, boilers, burning of materials, and wildfires. The particles with aerodynamic diameters less than 10 μm are small enough to enter the human lungs and have been linked to cardiac and respiratory diseases (ECCC 2013a).

Figure 1.1 Comparison of Particulate Matter Sizes to Human Hair



Source: (U.S. EPA 2023a)

The common PM size ranges that are most relevant to ambient air quality are:

- Fine Particulate Matter (PM_{2.5}) – PM that is less than 2.5 µm in aerodynamic diameter.
- Respirable Particulate Matter (PM₁₀) – PM that is less than 10 µm in aerodynamic diameter (includes PM_{2.5}).
- Total Suspended Particulate (TSP) – PM that is less than 30 µm in aerodynamic diameter (includes PM_{2.5} and PM₁₀).

1.2.2 Nitrogen Dioxide

Oxides of Nitrogen (NO_x) are almost entirely made up of nitrogen oxide (NO) and nitrogen dioxide (NO₂) and are produced in most combustion processes (ECCC 2013b; BC ENVP 2024b; U.S. EPA 2023b). In the atmosphere, NO is quickly oxidized with ground level ozone (O₃), and other oxidants to form NO₂. Because NO is short lived and NO₂ is considered a respiratory irritant, a regulatory ambient air quality objective exists for NO₂ but not for NO or NO_x (Alberta Environment 2007).

NO₂ is an orange to brown gas that is corrosive and irritating at high concentrations (Alberta Environment 2011). NO₂ will dissolve in atmospheric water to form nitric acid (acid rain) or react with other gases and particles to form nitrates and secondary PM_{2.5}. NO_x, in combination with volatile organic compounds and sunlight, form ground-level ozone, which is commonly known as smog. Exposure to NO₂ by humans can cause short-term respiratory symptoms and airway inflammation with long term exposures linked to asthma, allergic responses, respiratory infections, and potential harm to the cardiovascular and reproductive systems (BC ENVP 2024b).

1.2.3 Sulphur Dioxide

Sulphur dioxide (SO₂) is an invisible gas that smells like burnt matches. It is produced when fuels containing sulphur (a natural element) or some types of garbage are burned. SO₂ can form acids, which can damage lakes, streams, and vegetation. SO₂ can also contribute to levels of Fine Particulate Matter in the air and is a major component of urban smog. Exposure to high levels of sulphur dioxide can cause breathing problems and worsen existing respiratory or cardiovascular conditions.

1.2.4 Carbon Monoxide

Carbon monoxide (CO) is produced by the incomplete combustion of fuels containing carbon. At very high concentrations, CO is acutely toxic, and immediately dangerous to health. Long-term exposure to low concentrations of CO may cause adverse effects in people suffering from cardiovascular disease. The major sources of CO in urban areas are passenger vehicles and non-road equipment. The most substantial natural sources of CO are wildfires and biomass burning, photochemical reactions (breakdown of volatile organic compounds, VOCs), and microbial processes.

1.2.5 Other Air Contaminants

Volatile organic compounds (VOCs) are compounds that have a high vapor pressure and low water solubility. Many VOCs are human-made chemicals that are used and produced in the manufacture of paints, pharmaceuticals, and refrigerants. VOCs typically are industrial solvents, such as trichloroethylene; fuel oxygenates, such as methyl tert-butyl ether; or by-products produced by chlorination in water treatment, such as chloroform. VOCs are often components of petroleum fuels, hydraulic fluids, paint thinners, and dry cleaning agents. VOCs are emitted as gases from certain solids or liquids. VOCs include a variety of chemicals, some of which may have short- and long-term adverse health effects. Concentrations of many VOCs are consistently higher indoors (up to ten times higher) than outdoors.

Polycyclic aromatic hydrocarbons (PAHs) are a class of chemicals that occur naturally in coal, crude oil, and gasoline. They also are produced when coal, oil, gas, wood, garbage, and tobacco are burned. PAHs generated from these sources can bind to or form small particles in the air. People are usually exposed to mixtures of PAHs. Breathing air contaminated with motor vehicle exhaust, cigarette smoke, wood smoke, or fumes from asphalt roads are common ways exposure occurs.

Diesel particulate matter (DPM) is defined as a component of diesel exhaust, primarily composed of elemental carbon particles and adsorbed organic compounds. It is the most frequently determined measure of diesel emissions and is reported in toxicological studies of diesel engine exhaust. DPM contains hundreds of different chemicals, many of which are harmful to health.

The consideration of potential adverse health effects from exposure to VOCs, PAHs, and DPM are described in the Human Health Risk Assessment Report (IS Volume 9, Appendix 26A, Section 4.1.2).

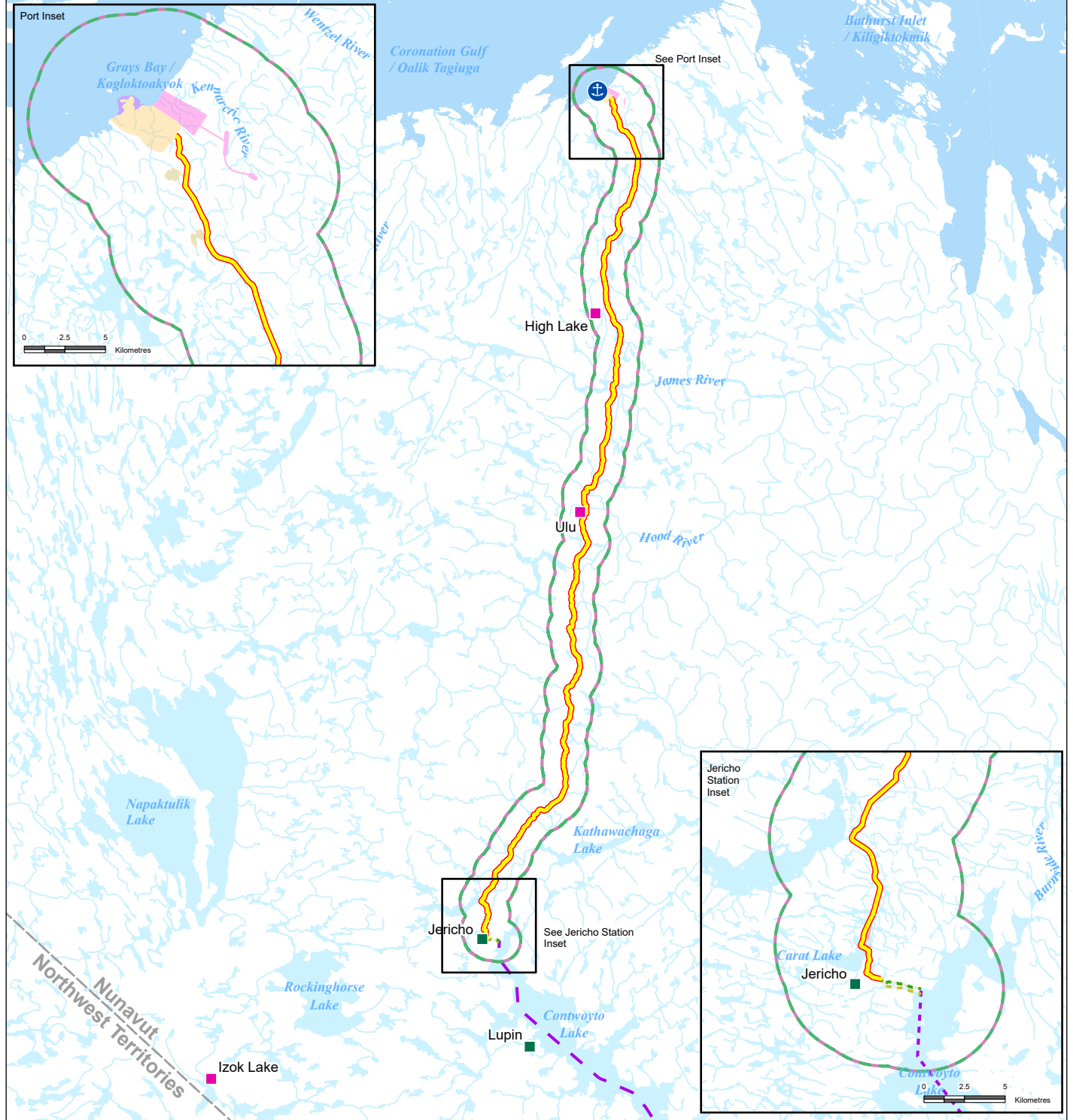
1.3 Assessment Boundaries

The following sections present the spatial and temporal boundaries for the Project.

1.3.1 Spatial Boundaries

1.3.1.1 Project Development Area

The PDA encompasses the physical footprint of all project components, including both permanent and temporary disturbances (e.g., extent of project infrastructure, planned clearing, and laydown areas). The PDA includes six sub-areas based on the types of components to be developed: the Port (which is further divided into marine and landside infrastructure), Road, Aerodrome, Jericho Station, and Winter Road PDAs. The boundaries of the PDAs were created by applying buffers around where the project components will be sited and varies by each of the sub-areas depending on necessary flexibility for final siting of certain project components based on conditions on the ground. For the Road PDA and Winter Road PDA, a 75 m buffer was applied to the roads centreline, for the Port PDA and the Aerodrome PDA, the areas were subdivided based on the conceptual project component locations and then buffered approximately 1,000 m for the landside Port PDA, approximately 300 m for the marine Port PDA, and 500 m for the Aerodrome PDA. The Jericho Station PDA was buffered based on the existing development from the old Jericho Mine site that will be used for the Project and the need for additional space to accommodate the project components that will be developed as part of the Project for this location. The Winter Road PDA will only exist annually between the beginning of February and end of March, will be built on land where the existing Jericho Station road ends, at the southeastern portion of Jericho Station, to the shoreline of Contwoyto Lake where it will connect to the TCWR. For the purposes of the impact assessment, the PDA is the same as the Site Study Area identified in the IS Guidelines. The air quality assessment areas, including the PDA, are shown in Figure 1.2.



Notes
 1. Coordinate System: WGS 1984 UTM Zone 12N
 2. Data Sources: Governments of Nunavut and Canada, Stantec

Local Assessment Area	Advanced Mineral Exploration Site
Regional Assessment Area	Closed Mine Site
Grays Bay Port	Territorial Boundary
Grays Bay Road	Tibbitt to Contwoyto Winter Road
Grays Bay Winter Road	Watercourse
Grays Bay Winter Road Optional Alignment	Ocean
Aerodrome	Waterbody
Jericho Station	
Port (Landside Infrastructure)	
Port (Marine-based Infrastructure)	

0 10 20 Kilometres
 (At original document size of 8.5x11) 1:1,350,000



Project Location
 Kitikmeot Region, Nunavut

Prepared by DSPRY on 2026-02-02
 TR by SL on 2026-02-02

Client/Project

West Kitikmeot Resources Corp
 Grays Bay Road and Port

123514888_071

Figure No.

1.2

Title

Air Quality Assessment Area

1.3.1.2 Local Assessment Area

Local Assessment Areas (LAAs) have been developed for each VC to represent the maximum area within which project environmental effects, both direct and indirect, can be predicted or measured with a reasonable degree of accuracy and confidence. The LAA includes the PDA and adjacent areas where environmental effects may reasonably be expected to occur. The LAA typically varies from one VC to another, depending on factors such as local conditions, species abundance, socioeconomic factors, and cultural values.

The LAA for air quality was defined as a 5 km buffer around the PDA and was established to comply with regulatory requirements and to capture air quality effects of the specific components being assessed. The LAA is the maximum area where project-specific environmental effects on air quality can be qualitatively estimated with a reasonable degree of accuracy and confidence. The LAA is large enough to qualitatively discuss the extents of the influence of the ACPI emissions from the project activities. project-related air quality effects may be present within the LAA; outside the LAA, air quality effects are expected to be small due to natural atmospheric attenuation (natural dilution due to atmospheric mixing). project residual air quality effects are not expected to extend beyond the LAA.

1.3.1.3 Regional Assessment Area

Regional Assessment Areas (RAAs) have been developed to represent the areas that provides context to the changes occurring in the LAA for each VC. For example, this could include the area occupied by the VC population, so that effects to the VC can be characterized or quantified. The RAA is also the area within which the project's environmental effects to a VC may interact or accumulate with the environmental effects of other projects or activities that have been or will be carried out such that cumulative environmental effects may potentially occur. The RAA for each VC depends on physical and biological conditions and the type and location of other past, present, or reasonably foreseeable projects or activities that have been or will be carried out.

The RAA represents the area within which cumulative effects on air quality are likely to occur, depending on the location of other past, present, or likely future projects or activities. The RAA for air quality was defined as a 5 km buffer around the PDA and was established to comply with regulatory requirements and to capture air quality effects of the specific components being assessed. The RAA is the same size as the LAA because the cumulative air quality effects attributable to other projects (past, present or reasonably foreseeable) were expected to be negligible beyond the LAA due to natural atmospheric attenuation (e.g., natural dilution due to atmospheric mixing) of the project's ACPI emissions.

1.3.2 Temporal Boundaries

The Project phases and the worst-case years for emissions from construction and operations and maintenance are discussed in the following sections.

1.3.2.1 Project Phases

The temporal boundaries for the assessment are based on the timing and duration of project activities and the nature of the interactions with each VC. The purpose of a temporal boundary is to identify when an environmental effect may occur in relation to specific project phases and activities. Temporal boundaries for the Project include the Construction and Operations and Maintenance phases. The Nunavut Impact Review Board (NIRB) Impact Statement Guidelines (NIRB 2026) also state that temporal boundaries should also include:

“temporary closure (care and maintenance), final closure (decommission and reclamation) and post-closure periods, including planned activities to be undertaken in conjunction with the proposed project. The temporary closure period (or care and maintenance) covers the period of untimely closure of the proposed project and includes care and maintenance activities. The final closure period covers decommission and reclamation activities. The post-closure period covers the period after the proposed project has been decommissioned and abandoned and ends when the footprint has been reclaimed and returned as much as possible to its natural state”

Assuming that all regulatory environmental approvals are in place, onsite works for the Project are scheduled to begin in 2029, with major construction commencing in 2030. The major construction activities are anticipated to span approximately five years. Operations and maintenance is anticipated to commence in 2035 and continue indefinitely, as the project components are considered permanent infrastructure with a design life of 75 years. As the project facilities are designed as being permanent, there are no plans for closure and reclamation other than areas used solely for pre-construction/construction activities that are not required for ongoing operations and maintenance. Further details associated with these project phases are outlined in Section 2.6 of IS Volume 2 (Introduction, Project Description and Alternatives).

1.3.2.2 Selected Worst-Case Years for Project Construction and Operations Phases

The worst-case years for Construction and Operation and Maintenance phases were assessed for air quality with the understanding that other years will have a lower level of potential residual effects on air quality. The worst-case years of construction and operation coincide with the peak construction and operation rates, respectively, that will result in the highest emissions of ACPI. The worst-case year of construction was selected based on the most overlapping (e.g., concurrent) construction activities, the largest number of construction equipment units and the greatest construction material movement. The worst-case Construction phase year for emissions is Year 2. The following emissions due to construction activities were estimated for Year 2:

- Fugitive dust emissions from drilling and blasting
- Explosives detonation emissions from blasting

- Fugitive dust emissions from quarrying activities (primary and secondary crushing, screening, material transfer, and stacking)
- Fugitive dust emissions from site preparation (i.e., earth moving)
- Mechanically generated dust by the movement of non-road equipment and on-road vehicles along unpaved roads
- Diesel combustion exhaust emissions from non-road construction equipment and on-road vehicles
- Diesel combustion emissions from diesel-fueled, power generation facilities at the Port and Jericho Station
- Incineration of domestic waste at the Port and Jericho Station
- Jet-A combustion exhaust emissions from small cargo planes at the Port airstrip and Jericho Station
- Marine diesel combustion emissions from the slow cruise, maneuvering, and hoteling/docking of shipping vessels

Construction phase emissions were conservatively estimated, assuming that all construction equipment operates at maximum rates at the same time and construction at all construction areas occurs simultaneously.

The worst-case year for the Operations and Maintenance phase was selected based on the highest operation rate, largest number of equipment units and highest volume of equipment movement. Year 7 was determined to be the worst-case year of operations and maintenance. Emissions for Year 7 were estimated for the following emission sources:

- Fugitive dust emissions from drilling and blasting
- Explosives detonation emissions from blasting
- Fugitive dust emissions from quarrying activities (primary and secondary crushing, screening, material transfer, and stacking)
- Mechanically generated dust by the movement of non-road equipment and on-road vehicles along unpaved roads
- Diesel combustion exhaust emissions from maintenance non-road equipment and on-road vehicles
- Diesel combustion emissions from diesel-fueled, power generation facilities at the Port and Jericho Station
- Incineration of domestic waste at the Port and Jericho Station
- Jet-A combustion exhaust emissions from small cargo planes
- Marine diesel combustion emissions from the slow cruise, maneuvering, and hoteling of shipping vessels

Operations and Maintenance phase emissions were conservatively estimated assuming that all on-road and non-road mobile equipment¹ operates at maximum rates concurrently and operate in all areas simultaneously.

¹ Non-road mobile equipment refers to powered vehicles, either wheeled or tracked, designed for movement and operation on undeveloped or rough terrain, rather than public roads. Sometimes referred to as off-road mobile equipment.

2 Regulatory Criteria

2.1 Ambient Air Quality Standards, Objectives and Guidelines

The air quality assessment incorporates the Nunavut Ambient Air Quality Standards (NAAQS) outlined in the Nunavut Environmental Guideline for Ambient Air Quality (GN 2023a; GN 2011). The Nunavut Department of Environment issued an updated Guideline in 2023 that supersedes the 2011 version and contains updated objectives for NO₂ and removed the standards for TSP. This report utilizes the updated NO₂ objectives but continues to compare TSP to the standards in the 2011 Guideline for consistency.

The Government of Nunavut Department of Environment (GN-DOE) has adopted the Canadian Council of Ministers of the Environment (CCME) Canadian Ambient Air Quality Standards (CAAQS; CCME 2025) for NO₂, SO₂ and PM_{2.5} for use in Nunavut. The CAAQS have been developed as non-regulatory health and environmentally based ambient air objectives to assess general air quality in air zones and reflect desirable concentrations of contaminants in air from all sources (Ontario Ministry of the Environment Conservation and Parks (MECP) 2024). The CAAQS were not intended to assess compliance at a facility's property line or at specific locations but rather to assess and improve regional air quality. Therefore, the CAAQS have to be interpreted as conservative benchmarks for evaluating the project's air quality effects.

Nunavut does not have Guidelines or Standards for some of the ACPI. In these cases, a review of ambient air quality criteria from Alberta, British Columbia, Northwest Territories (NWT), Saskatchewan, and the Yukon territory was conducted. In most cases the criteria were similar between jurisdictions with BC having slightly more stringent criteria. Therefore, Guidelines, Objectives, or Standards from the Province of British Columbia (BC) (ENVP 2021), referred to as Ambient Air Quality Objectives (AAQO), have been used for these ACPI.

The BC Pollution Control Objectives (PCO) for dustfall have been revoked with the rationale that dustfall monitoring cannot be used for adaptive management of dust emissions because the 30-day averaging period is too long for taking adaptive actions, and if the objective of the monitoring is to protect human health, ambient air monitoring of PM_{2.5} and PM₁₀ is more appropriate (ENVP 2020). However, the PCO for dustfall were nonetheless used as reference values in the assessment to provide context for the magnitude and spatial extent of dustfall due to the project activities.

The ambient air quality standards, objectives and guidelines (SOGs) that are used in the air quality assessment are summarized in Table 2.1.

Table 2.1 Applicable Regulatory Criteria

ACPI	Averaging Period	NAAQS ^a (µg/m ³)	CAAQS ^b (µg/m ³)	BC AAQO (µg/m ³)
TSP	24-hour	120	-	-
	Annual ^c	60	-	-
PM ₁₀	24-hour	-	-	50
PM _{2.5}	24-hour ^d	27	27	-
	Annual ^e	8.8	8.8	-
NO ₂	1-hour ^f	79	79	-
	Annual ^g	23	23	-
SO ₂	1-hour ^h	170	170	-
	Annual ⁱ	10	10	-
CO	1-hour ^j	-	-	14,300
	8-hour	-	-	5,500
Dustfall ^k	30-day (residential/parkland)	-	-	1.75 mg/dm ² /day
	30-day (industrial/other)	-	-	2.90 mg/dm ² /day

Notes:

^a Government of Nunavut 2023 (2011 version for TSP)

^b CAAQS (CCME 2025)

^c Expressed as the geometric mean

^d The 24-hour PM_{2.5} is based on the annual 98th percentile (8th highest) of daily average concentrations, averaged over three consecutive years

^e The annual PM_{2.5} is based on the three-year average of the annual average of the daily 24-hour average concentrations

^f The 1-hour NO₂ is based on the annual 98th percentile (8th highest) of daily maximum 1-hour average concentrations, averaged over three consecutive years.

^g The annual NO₂ is based on the average of all 1-hour average concentrations over one year

^h The 1-hour SO₂ is based on the annual 99th percentile (4th highest) of daily maximum 1-hour average concentrations, averaged over three consecutive years.

ⁱ The annual SO₂ is based on the average of all 1-hour concentrations over one year

^j The 1-hour CO based on 9th highest of all 1-hour concentrations.

^k Dustfall PCOs for the mining, smelting and related industries, corresponding to residential/parkland and industrial/other areas (ENVP 2020). The dustfall PCOs have been rescinded and are for reference only.

µg/m³ - micrograms per cubic metre

2.2 Interpretation of Predicted Concentrations and Dust Deposition

The SOGs are developed for a time averaging period (e.g., 1-hour, 24-hour) and have a specific statistical form referred to as a “metric” (e.g., 98th percentile, 99.9th percentile).

Based on the Government of Nunavut (GN) definition (GN 2023a), compliance with the 24-hour SOG for PM_{2.5} is based on the three-year average of the 98th percentile annual value, which allows the highest seven predicted 24-hour average PM_{2.5} concentrations in a year to be disregarded. For this assessment, and following the guideline (GN 2023a), the 8th highest 24-hour average PM_{2.5} concentrations (equal to the 98th percentile) for each year at a modelled receptor are averaged over three years and the maximum of the three-year averages is compared to the 24-hour SOG to determine compliance.

Similarly, the 1-hour SOG for NO₂ and SO₂ are based on the three-year average of the 98th percentile and 99th percentile, respectively, of the daily maximum 1-hour concentrations, which allows the highest seven and three predicted daily maximum 1-hour average concentrations in a year, respectively, to be disregarded. For this assessment, the 8th highest daily 1-hour average NO₂ concentrations (equal to the 98th percentile) for each year at a given location are used to determine compliance with the 1-hour NO₂ SOG. The 4th highest daily 1-hour average SO₂ concentrations (equal to the 99th percentile) for each year at a given location are used to determine compliance with the 1-hour SO₂ SOG.

Compliance with the 24-hour TSP and PM₁₀ is based on the maximum (1st highest) 24-hour average concentration in a year. Similarly, the 1-hour and 8-hour SOG for CO are based on the maximum (1st highest) 1-hour and 8-hour average concentration, respectively.

The model-predicted dustfall from the Project is compared to the BC PCOs for residential/parkland and industrial areas. The 30-day dustfall PCO is expressed as an accumulated deposition over a day (mg/dm²/day [milligrams per square decimetre per day]). The average 30-day dustfall from the modelled years is compared to the dustfall PCO.

The air quality assessment focuses on areas that are located outside industrial facility boundaries. A facility boundary indicates the region where public access may be controlled or restricted. Ambient air quality objectives are only applied to areas where there is public access (i.e., on and beyond the facility boundary). For this assessment, a "Project boundary" was used to better represent the potential for public exposure and compliance with the SOGs. The Project boundary for the air quality assessment for the most part coincides with the PDA boundary as defined in Section 1.3.1.1. However, for marine sources, a Project boundary buffer of 1-km was applied in alignment with a typical exclusion zone around a project for public safety.

3 Regional Setting

3.1 Geographical Setting

The Kitikmeot Region is the westernmost region of Nunavut. It encompasses 447,727 km² of the central Arctic, which is approximately 4.5% of Canada's land mass – an area larger than the Province of Newfoundland and Labrador. The Kitikmeot Region borders the Northwest Territories (NWT) to the west and contains the southern and eastern parts of Victoria Island, the adjacent part of the mainland to the Boothia Peninsula, King William Island, and the southern portion of Prince of Wales Island. The Kitikmeot Region is the most isolated from the territory's capital of Iqaluit. Kitikmeot primarily reside in five incorporated hamlets: Cambridge Bay (*Ekaluktutiak*), Kugluktuk, Gjoa Haven, Taloyoak, and Kugaaruk. The region is also home to two unincorporated communities, Bathurst Inlet (*Kiligiktokmik*) and Bay Chimo (Omingmaktok), where the populations have dwindled to the point where they are generally inhabited on a seasonal basis only. The Kitikmeot communities are accessible only by air, or by sea during the short open-water season. At present, there are no permanent roads between communities or connecting the communities in the region to southern Canada.

The Project spans from Kogloktokkyok (Grays Bay) in the north, to Jericho Station, northwest of Tahikyoak (Contwoyto Lake) in the south. From south to north, the Project crosses four watersheds, which are associated with the following main rivers: the Ayapaktokvik (Burnside River), the Hivogahik (Hood River), the Hannigayok (James River) and the Kogloktokkyok (Kennarctic River). Hydrological information for each of these watersheds is available from the Grays Bay Road and Port Project Hydrology Baseline Report (see Volume 7, Appendix 19A).

Both the LAA and RAA are located on the Canadian Shield, Kazan region, Bear-Slave Upland subdivision. The physiographic region is characterized by homogenous large areas of bare and massive rocks, forming broad treeless uplands, plateaus, and lowlands (Government of Canada 2019). The topography of the region is described as undulating to moderately rugged. The PDA, LAA and RAA cross undulating bedrock, canyons, steep cliffs, valley bottoms and numerous lakes. Overall, the topography is fairly subdued, with most bedrock-controlled hills generally showing under 100 m of total elevation gain/loss. For more information, refer to Volume 6 (Terrestrial Environment).

3.2 Climate and Meteorology

The Koppen-Geiger climate classification indicates that the RAA is mainly in the boreal climate zone, characterized by a snow climate, fully humid precipitation, and cool summers (Kottek et al. 2006). The northern section is in the polar tundra climate zone. ECCC operates meteorological stations with long-term records in Lupin² and Kugluktuk³. Lupin is 30 km southeast of Jericho Station while Kugluktuk is located on the Nunavut coast 180 km west of the proposed Grays Bay Port. BGS Engineering Inc. (BGC 2013) compared air temperatures from the short and sporadic records from Izok Lake, High Lake, and Grays Bay with the ECCC stations and determined the Lupin record is closest in average daily air temperatures and provides a good approximation of historical air temperature for the RAA.

For the most recent Climate Normals period, 1991–2020, the mean annual air temperature in Lupin was 10.3°C. Mean monthly air temperatures are below 0°C for eight months (October – May), with the coldest mean monthly air temperatures of -28.9°C and -28.3°C recorded in January and February, respectively. During the summer, the warmest mean monthly air temperature of 12.0°C was recorded in July. In the 1982–2025 station record, extreme temperature ranges for Lupin from -49.0°C to 31.0°C. During the 1991–2020 period, the average number of freezing degree days and thawing degree days in Lupin were 4741.1 and 973.2, respectively.

Mean total annual precipitation (rain + snow) in Lupin was 303.5 mm (water equivalent) during the 1991–2020 period, with 160.5 mm of rainfall and 143.3 cm of snowfall. Rainfall accounts for the majority (approximately 88 to 97%) of the precipitation recorded during the summer months (June – August) with snowfall accounting for the majority or all the precipitation recorded October to April (approximately 97 to 100%); May and September precipitation is a mix of rainfall and snowfall. The largest mean monthly total rainfall of 35.4 mm was recorded in August while the largest mean monthly total snowfall of 29.0 cm was recorded in October. In the 1982–2025 station record, extreme daily precipitation records for Lupin are 41.8 mm of rainfall and 31.8 cm of snowfall.

Table 3.1 and Figure 3.1 present 1991–2020 temperature and precipitation Climate Normals values for Lupin.

² ECCC 1982–2025 composite Lupin record developed using the Lupin A (ID: 23026HN) and Lupin CS (ID: 230N002) stations.

³ ECCC 1977–2025 composite Kugluktuk record developed using the Kugluktuk A (ID: 2300902), Kugluktuk A (ID: 2300903), and Kugluktuk Climate (ID: 2300904) stations.

**Grays Bay Road and Port Project
Air Quality Technical Modelling Report**

Section 3: Regional Setting
March 2026

Table 3.1 Temperature and Precipitation Climate Normals for Lupin (1991 – 2020)

1991–2020 Climate Normals for Lupin	Daily Mean Air Temperature (°C)	Daily Maximum Air Temperature (°C)	Daily Minimum Air Temperature (°C)	Total Precipitation (mm)	Total Rainfall (mm)	Total Snowfall (cm)
Annual						
Annual	-10.3	-6.5	-14.0	303.5	160.5	143.3
Seasonal*						
Winter	-27.6	-24.1	-30.9	29.7	0.0	30.1
Spring	-15.0	-10.8	-19.0	48.1	5.4	42.7
Summer	9.5	14.1	4.9	134.3	128.6	5.9
Fall	-8.1	-5.1	-11.0	91.4	26.6	64.7
Monthly						
January	-28.9	-25.3	-32.4	8.0	0.0	8.0
February	-28.3	-24.7	-31.3	7.5	0.0	7.9
March	-24.2	-20.3	-28.0	14.0	0.0	14.0
April	-15.7	-11.3	-20.4	15.4	0.6	14.9
May	-5.0	-0.9	-8.6	18.7	4.8	13.8
June	7.1	11.9	2.4	28.7	25.1	3.7
July	12.0	17.1	7.0	38.4	38.1	0.3
August	9.3	13.3	5.4	67.2	65.4	1.9
September	2.6	5.5	-0.3	43.7	25.7	17.9
October	-7.7	-5.2	-10.1	29.9	0.9	29.0
November	-19.1	-15.7	-22.5	17.8	0.0	17.8
December	-25.7	-22.3	-29.1	14.2	0.0	14.2

Notes:

* Meteorological season values presented:

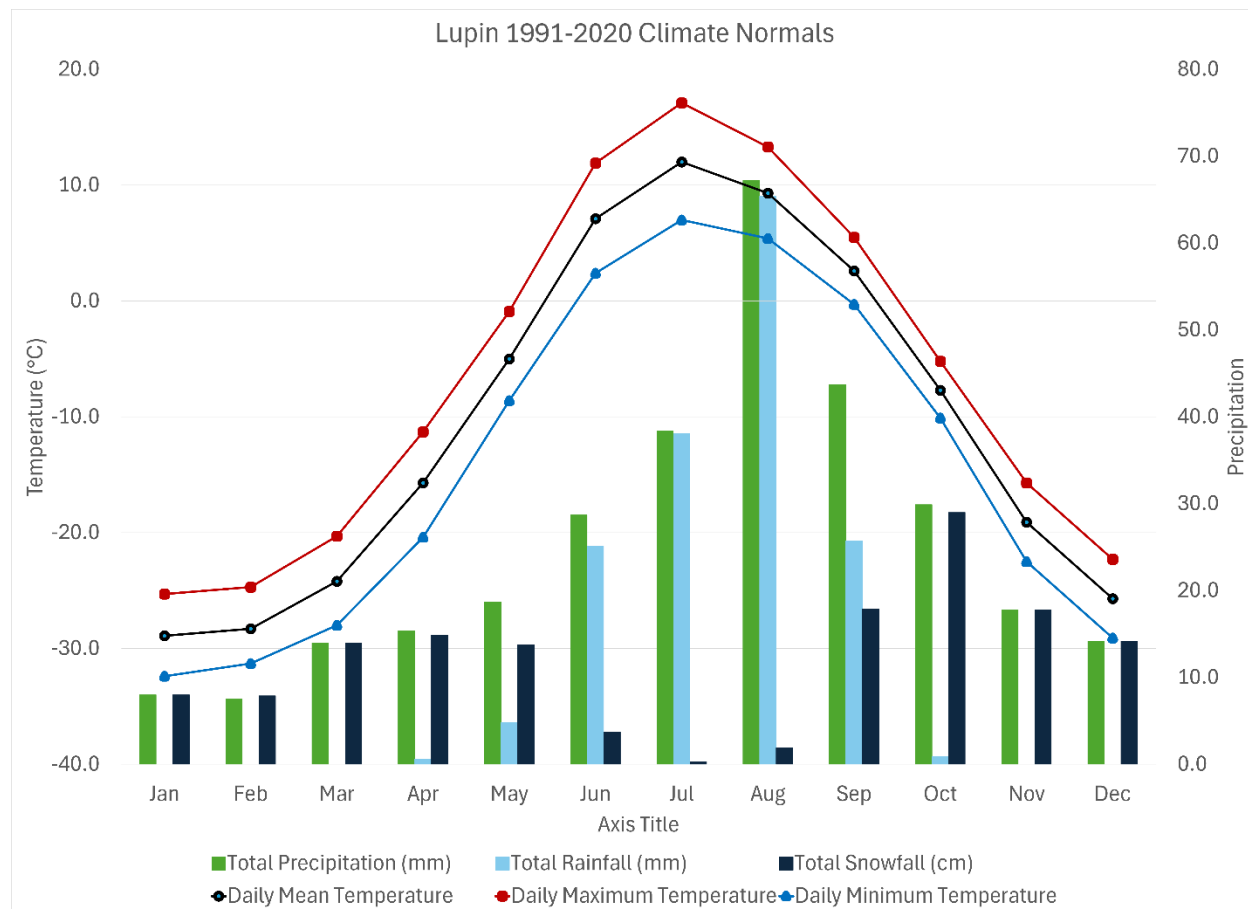
Winter = December, January, February

Spring = March, April, May

Summer = June, July, August

Fall = September, October, November

Figure 3.1 1991–2020 Temperature and Precipitation Climate Normals for Lupin



3.3 Baseline Ambient Air Quality

The air quality in the Kitikmeot region can generally be classified as pristine due to the limited number of significant sources of ACPI. There are limited continuous emission sources within the air quality LAA. Local air emissions consist of stationary (e.g., power generators, heating) and mobile sources (e.g., trucks, snowmobiles, ATVs), while marine vessel traffic also impacts local air quality during the open-water season. Long-range transport of ACPI can also play a significant role influencing air quality in the Kitikmeot region.

3.3.1 Data Sources and Application

Ambient air quality data is limited within Nunavut as there is only one National Air Pollution Surveillance station in Iqaluit operated by ECCC. Measurements from this station, however, would not be representative of the pristine air found in the Kitikmeot region, due to the urban influence of the Iqaluit community. Furthermore, the station is located approximately 2,000 km from the proposed Grays Bay port.

The Government of Northwest Territories (GNWT) operates long-term air quality monitoring stations throughout the territory, including stations at Yellowknife, Ford Liard, Norman Wells and Inuvik. However, as with the station in Iqaluit, many of these stations are located near communities that will impact the ACPI concentrations through local emissions. Furthermore, some of these stations are located upwards of 1,000 km from the proposed Grays Bay port. Thus, these sites may not be representative of the pristine air quality of the Kitikmeot region.

Therefore, a review of recent Environmental Impact Statements (EIS) and Project Proposals submitted to the NIRB was performed to determine appropriate baseline ACPI levels. Priority was given to projects being proposed within the Kitikmeot region of Nunavut. This review was completed to determine acceptable baseline data to NIRB.

3.3.2 Bathurst Inlet Port and Road Project

The proposed Bathurst Inlet Port and Road (BIPR) Project includes the construction of a port and dock that will be located on the west side of Bathurst Inlet. The port will be located about 40 km south of the community of Bathurst Inlet. The project also includes a road that will connect the port to a camp and the existing winter ice road on Contwoyto Lake, which is located 211 km to the southwest.

The Air Quality Effects Assessment (Rescan 2007a) was provided as Appendix B-2 to the Draft Environmental Impact Statements (DEIS) and assessed baseline air quality for the Bathurst Inlet region of Nunavut. The Air Quality Modelling Study (Rescan 2007b) was provided as Appendix B-4 to the DEIS and provides further insight into the baseline air quality for the Bathurst Inlet region. ACPI considered for the project include TSP, PM_{2.5}, NO₂, SO₂, CO, and dustfall. The determination of baseline air quality values included a review and analysis of ambient air quality data collected by the GNWT at various sites throughout the territory, as well as a seasonal station at Daring Lake, NWT that measures PM_{2.5}. The following excerpts from the DEIS highlight the findings of analysis.

- PM_{2.5}:
 - “Twenty-four hour average concentrations of PM_{2.5} ranged from 0 to 5 µg/m³ for the 16 measurements taken at Daring Lake during the summer of 2006.”
 - “At Inuvik, which has a coastal location similar to Bathurst Inlet, the annual average PM_{2.5} concentration was 2 µg/m³, with monthly 24-hour maximum concentrations ranging from 3 to 6 µg/m³ in the summer to 7 to 12 µg/m³ in the winter.”
- NO₂: “The only air contaminant that showed concentrations above background levels was nitrogen oxide (NO₂) with hourly maximum concentrations as high as 60 µg/m³. However, since the main source of contamination was localized vehicle idling, these results cannot be used to estimate background concentrations at remote sites like Bathurst Inlet.”
- SO₂: “The annual average sulphur dioxide (SO₂) concentration was 2 µg/m³, with a 24-hour maximum concentration of 14 µg/m³ measured in February.”

Table 3.2 shows the assumed background concentrations for the BIPR air quality modelling study. Where not explicitly stated in the DEIS (e.g., TSP, CO, dustfall), the contaminant values used were chosen to “represent medium to upper range of observed concentrations in the Northwest Territories and Nunavut”.

Table 3.2 BIPR Project Assumed Background Air Contaminant Concentrations

ACPI	Assumed Background Concentration (µg/m³)	Averaging Period
TSP	7.5	24-hour
PM _{2.5}	5	24-hour
NO ₂	9.4	1-hour; 24-hour
SO ₂	7	1-hour; 24-hour
CO	100	1-hour; 8-hour
Dustfall (g/m²/year)	0.8	Annual

The DEIS does not assess an annual averaging period for PM_{2.5}. However, an annual value of 2 µg/m³ was chosen for comparison with other projects based on the information provided in the BIPR Project DEIS.

3.3.3 Mary River Project

Baffinland’s Mary River Mine is an iron ore mine and associated facilities located on North Baffin Island, in the Qikiqtani Region of Nunavut. The project involves the construction, operation, closure, and reclamation of an 18 million tonne-per-annum open pit mine. The Mary River Project was assessed by the NIRB from 2008 – 2012. It was approved to proceed on December 28, 2012.

Volume 5 of the Mary River Project Final Environmental Impact Statement (FEIS) (Baffinland 2012) outlines the Atmospheric Environment study conducted for the project, including the Air Quality Baseline Study (RWDI 2008). As part of the Air Quality Baseline Study for the Mary River Project, RWDI conducted ambient air quality monitoring for TSP, PM₁₀, SO₂, NO₂, and dustfall. The monitoring program consisted of an active monitoring program for TSP and PM₁₀, and a passive monitoring program for dustfall, SO₂, and NO₂. Both programs were conducted in July 2007. The following excerpts from the FEIS highlight the findings of analysis.

- TSP: “The background levels of 3.0 to 7.0 µg/m³ measured in the Mary River area represent low, pristine levels that can be viewed as typical for remote Arctic areas.”
- PM₁₀: “The background levels of 1.5 to 3.8 µg/m³ measured in the Mary River area represent low, pristine levels that can be viewed as typical for remote Arctic areas.”
- NO₂/SO₂: “The area’s limited human activity means that ambient concentrations of SO₂ and NO₂ are likely to vary less over time than is typically the case in less remote sites. As a result, their respective 1-h, 24-h and annual average concentrations will be relatively similar to each other.”

Table 11 of the Air Quality Baseline Study (RWDI 2008) lists the results of the SO₂ and NO₂ concentrations for the monitoring program. SO₂ values were found to be less than or equal to 0.262 µg/m³, while NO₂ concentrations were less than or equal to 0.188 µg/m³. The study also found that dustfall ranged from 0.135 to 0.398 mg/100cm²/30 days.

Table 3.3 shows the assumed background concentrations for the Mary River Project air quality modelling study.

Table 3.3 Mary River Project Measured Baseline Concentrations

ACPI	Assumed Background Concentration (µg/m ³)	Averaging Period
TSP	7.0	24-hour
PM ₁₀	3.8	24-hour
NO ₂	0.188	1-hour; 24-hour; Annual
SO ₂	0.262	1-hour; 24-hour; Annual
Dustfall (mg/100cm ² /30 days)	0.398	30-days

3.3.4 The Back River Project

The Back River Project is a gold project owned by Sabina Gold and Silver Corp. located in the West Kitikmeot region of Nunavut. The project includes two main development areas with a winter ice road interconnecting the Goose Property with the Marine Laydown Area (MLA) located at Bathurst Inlet. The Back River Project was assessed by the NIRB from 2012-2017. The project was approved to proceed on December 19, 2017.

Volume 4 of the Back River Project FEIS outlines the Atmospheric Environment study (Sabina 2015) conducted for the project, including the 2011-2013 Air Quality Baseline Report (Rescan 2014). The 2011-2013 Air Quality Baseline Report includes results from 2011, 2012, and 2013 air quality monitoring programs, which included measurements of TSP, PM₁₀, SO₂, NO₂, and dustfall. Baseline field programs began in 2011 at the Goose Property Area and were expanded in 2012 to include the George Property Area and MLA.

- TSP: “At the Goose Property Area the TSP and PM_{2.5} results were both below the detection limit (2.1 µg/m³).” (Rescan 2014)
- PM₁₀: “At the George Property Area the PM₁₀ results were below the detection limit (2.1 µg/m³) during both monitoring periods (May and June)” (Rescan 2014)
- PM_{2.5}: “the PM_{2.5} results were below the detection limit (2.1 µg/m³) on May 27 and 2.9 µg/m³ on May 28” (Rescan 2014)
- Particulate Matter: “At the Goose Property Area the TSP and PM_{2.5} results were both below the detection limit (2.1 µg/m³); therefore, values from a proposed iron mine in Nunavut were used (Baffinland Iron Mines Corporation 2012).” (Sabina 2015)

- NO₂:
 - “In 2013 the highest average 30-day NO₂ concentration was 1.4 µg/m³, measured at DF11/PASS3 within the MLA. In 2011 and 2012, the highest NO₂ concentrations were 0.6 µg/m³ measured at the Goose Property and 1.1 µg/m³ measured at the George Property, respectively.” (Rescan 2014)
 - “The highest NO₂ value within the Goose Property Area was measured at 0.61 µg/m³ in 2011 and 0.1 µg/m³ in 2012.” (Sabina 2015)
- SO₂:
 - “In 2013 the highest average 30-day SO₂ concentration was 0.8 µg/m³, measured at DF10/PASS2 within the George Property. In 2011 and 2012, the highest SO₂ concentrations were 1.0 µg/m³ and 1.3 µg/m³ respectively, both measured within the Goose Property.” (Rescan 2014)
 - “The highest average 30-day SO₂ concentrations in 2012 of 1.3 µg/m³ and 0.1 µg/m³ were measured at PASS1 within the Goose Property Area and at PASS3 within the MLA, respectively.” (Sabina 2015)
- CO: “There are no site-specific background concentrations available for CO, therefore the values used for a nearby project in the West Kitikmeot have been used. The background annual average concentration of CO was assumed to be 100 µg/m³ (Rescan 2013b).” (Sabina 2015)
- Dustfall:
 - “The monthly dustfall results in 2013 ranged from less than 0.14 to 1.67 mg/dm²/day. In 2012, the monthly values ranged from less than 0.10 to 0.57 mg/dm²/day and in 2011 the results ranged from less than 0.10 to 1.13 mg/dm²/day.” (Rescan 2014)
 - “The average dustfall results over all sampling locations ranged from 0.16 to 0.32 mg/dm²/day for dustfall locations in the Goose Property Area in 2012, and 0.29 to 0.53 mg/dm²/day in 2011. In 2011, the maximum dustfall deposition rate of 1.13 mg/dm²/day was observed in July at station DF3 located within the Goose Property Area. In 2012, the maximum dustfall deposition rate of 0.57 mg/dm²/day was also observed in July within the Goose Property Area.” (Sabina 2015)

Table 3.4 shows the assumed background concentrations for the Back River Project air quality modelling study.

Table 3.4 Back River Project Assumed Background Air Contaminant Concentrations

ACPI	Assumed Background Concentration ($\mu\text{g}/\text{m}^3$)	Averaging Period
TSP	7	24-hour
	1.4	Annual
PM ₁₀	3.8	24-hour
PM _{2.5}	3.8	24-hour
	0.76	Annual
NO ₂	7.5	1-hour
	3	24-hour
	0.6	Annual
SO ₂	16.25	1-hour
	6.5	24-hour
	1.3	Annual
CO	1250	1-hour
	875	8-hour
Dustfall (mg/dm ² /day)	1.13	30-day

Note:

Italicized values noted in the reference document as being scaled from measured values.

3.3.5 High Lake Project

The proposed High Lake Project consists of a mine site and processing facility at High Lake in the Kitikmeot Region of Nunavut. The project will mine copper, zinc, gold and silver over a period of fourteen years, and process the minerals using conventional methods to separate them from mined rock. The design production rate of the facility is 4,000 tonnes of ore per day. The High Lake Project was screened by the NIRB from 2006-2007.

Baseline air quality concentrations were provided in Volume 4, Section 2 of the DEIS. Given the remote location of the High Lake Project site and lack of regional emissions sources, an analysis of ambient air quality data obtained from northern communities was performed to determine relevant baseline levels. Data from Yellowknife, Fort Liard, Norman Wells, Inuvik, Daring Lake and Fort Simpson monitoring stations were used in the analysis. Data from these stations were analyzed for a five-year period from 2000 to 2004. In addition to these monitoring sites, data from other nearby sites (e.g., Diavik diamond mine) were also examined. The following excerpts from the DEIS highlight the findings of analysis.

- TSP:
 - “Measurements from the Diavik site indicated that ambient concentrations of particulate (TSP) are less than 10 $\mu\text{g}/\text{m}^3$.”
 - “On-site ambient monitoring was conducted at the Doris North site from May to August, 2003. Three 24 hour TSP measurements were collected using a high-volume sampler. The 24 hour TSP concentrations ranged from 3.9 to 5.5 $\mu\text{g}/\text{m}^3$ (Golder 2003).”

- “the annual average concentration of $7 \mu\text{g}/\text{m}^3$ is considered to represent 24 hour concentrations at the Project site; this value is consistent with background measurements taken at the Diavik and Doris North sites (Levelton, 2002; Golder, 2003).”
- $\text{PM}_{2.5}$: “Annual average $\text{PM}_{2.5}$ concentrations have ranged from 2 to $12 \mu\text{g}/\text{m}^3$. Given the remoteness of the High Lake Project and lack of nearby source, the annual average concentration of $7 \mu\text{g}/\text{m}^3$ was assumed to represent 24 hour concentrations at the Project site.”
- NO_2 :
 - “Maximum 1 hour NO_2 concentrations measured at [Yellowknife and Inuvik] ranged from 50 to $89 \mu\text{g}/\text{m}^3$, respectively. Corresponding annual average concentrations ranged from 5 to $12 \mu\text{g}/\text{m}^3$, respectively. These levels, however, are likely attributable to combustion sources near the monitoring stations (e.g., vehicles, residential heating etc).”
 - “As there are no existing combustion sources in the vicinity of the Project site, the NO_2 concentration of $6 \mu\text{g}/\text{m}^3$ was selected to represent the 1 hour, 24 hour and annual average NO_2 concentrations at the Project site.”
- SO_2 :
 - “The recent measurements indicate that background maximum 1 hour SO_2 concentrations have ranged from 11 to $16 \mu\text{g}/\text{m}^3$. Similarly, the annual average SO_2 concentrations range from 1 to $5 \mu\text{g}/\text{m}^3$.”
 - “The SO_2 concentration of $3 \mu\text{g}/\text{m}^3$ was selected to represent the 24 hour and annual average SO_2 concentrations at the Project site.”
- CO: “CO is measured continuously at Yellowknife. The maximum measured 1 hour CO concentration was $2,000 \mu\text{g}/\text{m}^3$. Most of the hourly concentrations are less than $200 \mu\text{g}/\text{m}^3$. Given the pristine nature of the Project site, the CO concentration of $200 \mu\text{g}/\text{m}^3$ was selected to represent 1 hour and 8 hour CO concentrations.”

Table 3.5 shows the assumed background concentrations for the High Lake air quality modelling study.

Table 3.5 High Lake Project Assumed Background Air Contaminant Concentrations

ACPI	Assumed Background Concentration ($\mu\text{g}/\text{m}^3$)	Averaging Period
TSP	7	24-hour
	7	Annual
$\text{PM}_{2.5}$	7	24-hour
NO_2	6	1-hour
	6	24-hour
	6	Annual
SO_2	16	1-hour
	3	24-hour
	3	Annual
CO	200	1-hour
	200	8-hour

3.3.6 Izok Corridor Project

The Izok Corridor Project (ICP) is a proposed zinc mine and milling project that will consist of two mine sites, an all-season access road and a port facility. The project is located in the Kitikmeot region of Nunavut and is being developed by Minerals and Metals Group (MMG). MMG originally submitted the ICP Proposal to the NIRB in September of 2012 to fulfill the requirements outlined in the NIRB Screening Part 2 Form.

Baseline air quality concentrations were provided in Section 5 (Existing Biophysical Environment) of the Project Proposal (MMG 2012). Like other projects in the Kitikmeot region, an analysis of ambient air quality data obtained from northern communities (Yellowknife, Fort Liard, Norman Wells, and Inuvik) was performed to determine relevant baseline levels. Data from these stations were analyzed for the period of 2000 to 2006. This data was supplemented with PM_{2.5} measurements conducted at the site, as well as at Daring Lake from 2002 to 2006. The following excerpts from the Project Proposal (MMG 2012) highlight the findings of analysis.

- Particulate Matter:
 - *“Measurements of hourly PM_{2.5} were conducted at Izok Lake from 9 to 28 September 2008, resulting in 336 h of valid data. Measurement statistics indicate that most reported concentrations were less than 1 µg/m³ (the median value was zero and the 90th percentile value was 1 µg/m³).”*
 - *“The median PM_{2.5} concentration was 2 µg/m³, and the 90th percentile ranged from 2.8 to 14 µg/m³ over the years 2002 to 2006.”* (in reference to measurements at Daring Lake)
- NO₂: *“NO₂ is measured continuously at Yellowknife and Inuvik. Maximum 1-h NO₂ concentrations measured at the two sites were 50 µg/m³ and 89 µg/m³, respectively. Corresponding annual average concentrations ranged from 5 µg/m³ to 12 µg/m³, respectively. These levels, however, are likely attributable to combustion sources near the monitoring stations (e.g., vehicles, residential heating).”*
- SO₂: *“Recent measurements indicate that background maximum 1-h SO₂ concentrations have ranged from 11 µg/m³ to 16 µg/m³. Similarly, the annual average SO₂ concentration ranges from 1 µg/m³ to 5 µg/m³. Expected background concentrations on site are likely to be lower.”*
- CO: *“CO is measure continuously at Yellowknife. The maximum measured 1-h CO concentration was 2,000 µg/m³. Most of the hourly concentrations are less than 200 µg/m³.”*

Given the monitoring locations for both NO₂ and CO, these measurements were excluded from the current analysis for the Project, as they are not anticipated to be representative of values found in the Kitikmeot region of Nunavut. Similarly, SO₂ values near the Project are expected to be lower than those listed in the ICP Project Proposal. However, the SO₂ values are of similar order found in some of the other studies listed above. Therefore, they are considered relevant for the Project analysis. PM_{2.5} values from Izok and Daring Lakes were anticipated to be representative of concentrations found in the ICP region and are used in the current analysis.

Table 3.6 Izok Corridor Project Assumed Background Air Contaminant Concentrations

ACPI	Assumed Background Concentration ($\mu\text{g}/\text{m}^3$)	Averaging Period
PM _{2.5}	1	24-hour
SO ₂	16	1-hour
	5	Annual

3.3.7 Potential Acid Input

Nitrogen (N) and Sulfur (S) deposition are monitored at a few locations in the north. The monitoring sites closest to the Project are located in Alaska. Typically, long-term acid deposition sites only measure wet deposition and estimate or model the dry component. There are some peer-reviewed “measurement - model fusion” studies that blend measurements and global transport / chemistry / deposition model predictions to generate isopleth style estimates of total global deposition (Rubin et al., 2023).

Data from Rubin et al. (2023) suggest that total nitrogen deposition is around 50 mg/m²/y (as N) and total sulphur is around 100 mg/m²/y (as S) in Nunavut. These values represent the sum of deposition of N species (NO₃, NH₄, NH₃, HNO₃, NO_x) and S species (SO₂ and SO₄), respectively, and include both dry and wet deposition. In equivalents, these values are approximately 0.036 keq H⁺ ha⁻¹ y⁻¹ for nitrogen and 0.031 keq H⁺ ha⁻¹ y⁻¹ for sulphur. These values would be representative of background acid deposition across the entire RAA and are equivalent to a total potential acid input of 0.00123 keq H⁺ ha⁻¹ y⁻¹.

3.3.8 Baseline Summary

The maximum ACPI concentration values across the reviewed projects were used as a conservative estimate of background levels for this assessment. Furthermore, all reported dustfall values were converted to units of mg/dm²/day for comparison to the BC PCO. Table 3.7 summarizes the findings of the review of recent studies submitted to the NIRB. Table 3.8 indicates the values chosen for the assessment of the Project. Bolded values indicate maximum values across all studies.

Table 3.7 Summary of Monitoring Stations Locations and ACPI Monitored

Monitoring Station	Data Period	ACPI Monitored						
		TSP	PM ₁₀	PM _{2.5}	NO ₂	SO ₂	CO	Dustfall
Bathurst Inlet Port and Road Project	2003 to 2006	X	-	X	X	X	X	X
Mary River Project	2007	X	X	-	X	X	-	X
The Back River Project	2011 to 2013	X	X	X	X	X	X	X
High Lake Project	2000 to 2004	X	-	X	X	X	X	-
Izok Corridor Project	2000 to 2006	-	-	X	X	X	X	-

Table 3.8 Summary Statistics for Baseline Ambient Air Quality

Parameter	Project (date)					Project SOGs (ug/m ³)
	Bathurst Inlet Port and Road Project (2007) (ug/m ³)	Mary River Project (2012) (ug/m ³)	The Back River Project (2015) (ug/m ³)	High Lake (2015) (ug/m ³)	Izok Corridor Project (2015) (ug/m ³)	
24-hour TSP	<u>7.5</u>	7.0	7	7	--	120 ^a
Annual TSP	<u>7.5</u>	--	--	7	--	60 ^a
24-hour PM ₁₀	--	3.8	<u>3.8</u>	--	--	50 ^b
24-hour PM _{2.5}	5	--	3.8	<u>7</u>	1	27 ^a
Annual PM _{2.5}	<u>2</u>	--	0.76	--	--	8 ^a
1-hour NO ₂	<u>9.4</u>	0.19	7.5	6	--	79 ^a
Annual NO ₂	--	0.19	0.6	<u>6</u>	--	23 ^a
1-hour SO ₂	7	0.26	<u>16.3</u>	16	16	170 ^a
Annual SO ₂	2	0.26	1.3	3	<u>5</u>	10 ^a
1-hour CO	100	--	<u>1250</u>	200	--	14,300 ^b
8-hour CO	100	--	<u>875</u>	200	--	5,500 ^b
Dustfall (mg/dm ² /day)	0.02	0.01	<u>1.1</u>	--	--	1.75 ^c

Notes:

^a Government of Nunavut Environmental Guideline for Ambient Air Quality (GN 2023a; GN 2011)

^b BC AAQO (ENVP 2021)

^c BC PCO (ENVP 2020)

^d Values in **BOLD** and highlighted cells represent the selected representative baseline concentrations for the Project. All presented values are maxima other than the Izok PM_{2.5} background concentration, which is a 90th percentile.

Summary of Baseline Concentrations

The baseline ambient air quality concentrations used in the air quality assessment are summarized in Table 3.9 and compared to the project SOGs. Table 3.9 indicates that the baseline concentrations are less than the project SOGs. The baseline particulate matter concentrations (TSP, PM₁₀, PM_{2.5}) range from 6% to 26% of the SOGs with the highest percentages associated with ambient PM_{2.5} concentrations. The baseline gaseous concentrations (NO₂, SO₂ and CO) range from 9% to 50% of the SOGs with the highest percentages associated with SO₂ concentrations. The baseline dustfall value is 65% of the SOG and represents the ACPI closest to the relevant SOG. Overall, the existing air quality in the LAA is expected to be good and the baseline values summarized in Table 3.9 are considered conservative of the existing conditions.

Table 3.9 Summary of Baseline Concentrations Used in the Air Quality Assessment

ACPI	Averaging Period	Baseline Concentration ($\mu\text{g}/\text{m}^3$)	SOG	Percent of SOG (%)
TSP	24-hour	7.5	120 ^a	6%
	Annual	7.5	60 ^a	13%
PM ₁₀	24-hour	3.8	50 ^b	8%
PM _{2.5}	24-hour	7	27 ^a	26%
	Annual	2	8.8 ^a	25%
NO ₂	1-hour	9.4	79 ^a	12%
	Annual	6	23 ^a	26%
SO ₂	1-hour	16.3	170 ^a	10%
	Annual	5	10 ^a	50%
CO	1-hour	1,250	14,300 ^b	9%
	8-hour	875	5,500 ^b	16%
Dustfall (mg/dm ² /day)	30-day	1.13	1.75 / 2.9 ^c	63% / 38%
Potential Acid Input (keq H ⁺ ha ⁻¹ y ⁻¹)	Annual	0.00123	-	-

Notes:

^a Government of Nunavut Environmental Guideline for Ambient Air Quality (GN 2023a; GN 2011)

^b BC AAQO (ENVP 2021)

^c BC PCO (ENVP 2020)

4 Project Emissions

4.1 Overview

The Project has two primary components: the development and operation of a deep water port at Grays Bay on the Coronation Gulf, referred to as Grays Bay Port; and the construction and operation of an all-season controlled access road, referred to as the Grays Bay Road, that will connect the port to the northern terminus of the TCWR.

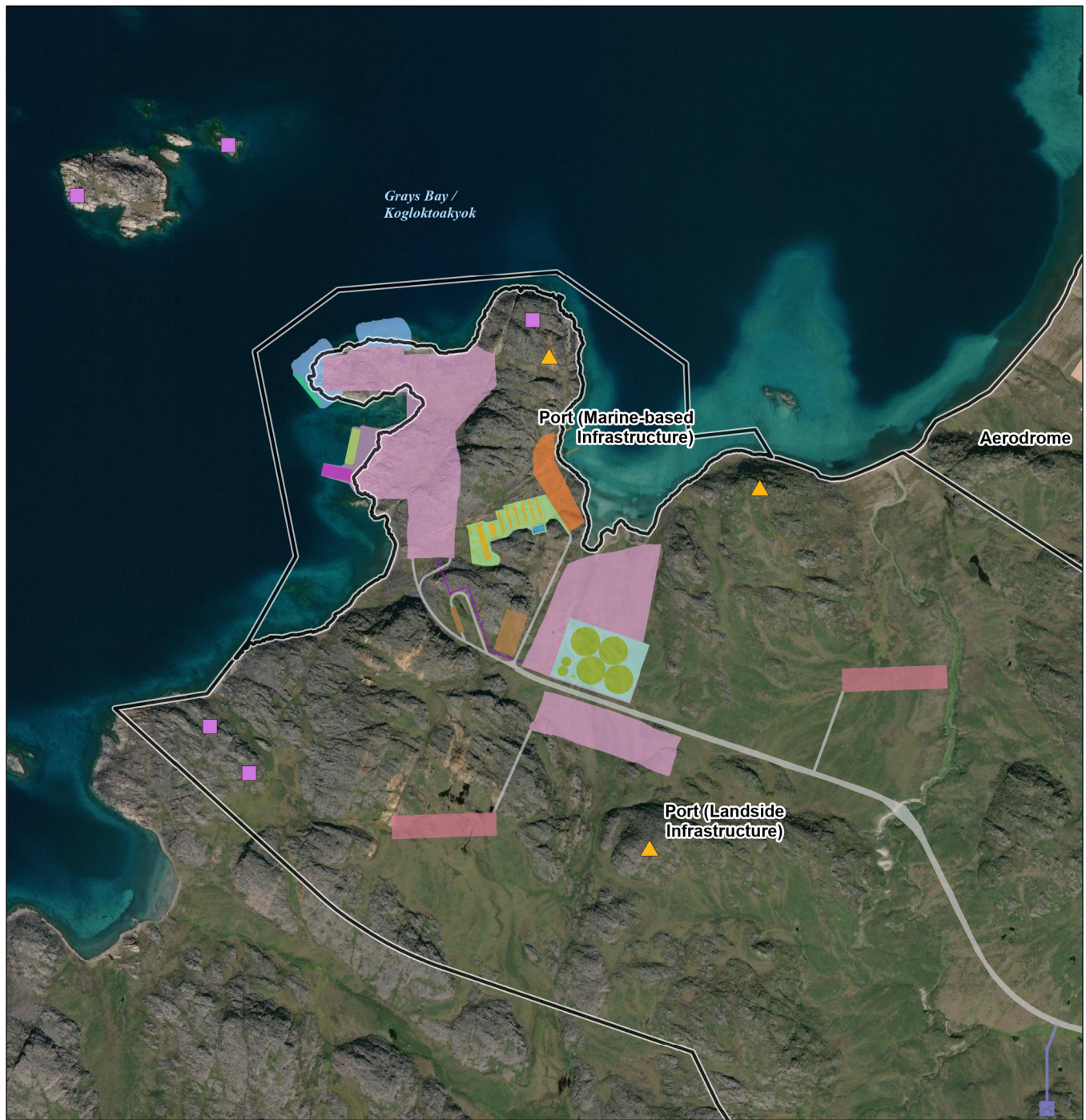
4.1.1 Grays Bay Port

The Grays Bay Port is comprised of marine-based infrastructure and landside infrastructure (see Volume 2, Table 2.8), with the size and configuration designed according to intended use and informed by input from anticipated industrial, government, and Inuit users. The Grays Bay Port is intended to:

- Support the staging, storage, loading, and offloading of inbound and outbound materials, supplies, commodities, fuel, goods and equipment for third-party users such as mining, exploration, community re-supply and other industrial or government operations
- Provide accommodations for a permanent workforce, and temporary commercial accommodations
- Provide moorage and support for all manner of commercial and government vessels on transarctic routes
- Provide a safe harbour for small vessels
- Provide refuge for community-based travelers
- Provide landing facilities for aircraft
- Set aside areas for future third-party use

A conceptual port layout is presented in Figure 4.1. These facilities consider the needs of immediate users, such as community resupply vessels, government vessels and the public. The conceptual layout is also configured to support potential future needs of proposed commercial operations, including potential for third-party use areas, which are depicted in Figure 4.1.

Construction of landside infrastructure is expected to take place year-round, whereas nearshore facilities are most likely to be constructed during the open-water season. The siting of facilities will be determined during final design, as informed by the environmental assessment process, Inuit Knowledge, site geotechnical, oceanographic, hydrology, meteorological, environmental and regulatory conditions, and further engagement with interested parties.



Notes
1. Coordinate System: WGS 1984 UTM Zone 12N
2. Data Sources: Government of Canada, Stantec, Vantor

Port Footprint

- Admin Office and Accommodation Area
- Admin Office and Accommodation Buildings
- Aerodrome
- Ancillary Support Area
- Barge Ramp
- Barge Wharf
- Explosives Storage
- Fuel Pipeline
- Fuel Storage
- Landside Port

- Large Vessel Wharf
 - Medium Vessel Wharf
 - Public Use Area
 - Road
 - Secondary Containment Area
 - Service Vehicle Garage
 - Solar Array
- #### Port Locations
- Fixed Navigation Aid
 - Potential Wind Turbine
 - Project Development Area (PDA)

0 150 300 Metres
(At original document size of 8.5x11) 1:20,000



Project Location
West Kitikmeot Region
Nunavut

Prepared by SL on 2025-12-15
TR by BL on 2025-12-15

Client/Project 123514868_173

West Kitikmeot Resources Corp
Grays Bay Road and Port

Figure No.
4.1

Title
Grays Bay Port Components

4.1.2 Grays Bay Road and Corridor

The Project includes development and operation of an all-season controlled access road, to be located within a transportation and utilities corridor. WKR anticipates that the presence of the road will facilitate consideration of potential additional utilities, such as power and communications, and additional road width in the future. While construction of these potential future developments is not part of this Project, an undeveloped transportation and utilities corridor, which is wider than the roadway itself, is part of the scope of the Project. The transportation and utilities corridor is approximately 150 m-wide and is centered on the road's current location (route).

The road's principal purpose is to create infrastructure that will facilitate economic development in the Kitikmeot Region by connecting its lands and waters to existing transportation networks. None of these activities is intended to have a limited economic life. Both the road and port are considered permanent infrastructure. Therefore, there are no plans for closure and reclamation.

4.1.3 Jericho Station

Jericho Station, at the southern terminus of the Grays Bay Road and principal interconnection with the TCWR, will be located at or near the former Jericho Mine site, that was declared abandoned in 2014. Existing infrastructure at the former mine site includes a gravel airstrip and apron, the condition of which will be assessed, but is anticipated to be retained in operable condition. Jericho Station will serve as a permanent truck stop, and check-in point to control access for north- and south-bound vehicles traveling the Grays Bay Road. The Jericho Station is intended to:

- Provide permanent accommodations and associated infrastructure
- Maintain the existing airstrip and apron in operable condition
- Provide fuel storage and refueling facilities
- Provide laydown areas for loading, unloading and storage of containerized or breakbulk cargo

During construction, Jericho Station may be used as a transshipment facility, temporary construction camp and laydown area for construction equipment and materials.

Connection from Jericho Station to Contwoyto Lake may use the historic winter road access location and route, or may incorporate an alternate winter access road location, or all-season road within the alignment routing corridor.

The exact location and configuration of Jericho Station will be determined as design progresses, and this will be based on site investigations, safety considerations, and input of landowners and land users.

4.2 Emission Sources

The sources of air emissions during the Construction phase (including pre-construction activities), and the Operations and Maintenance phase of the Project result from the following sources:

- Fugitive dust emissions from activities such as drilling, blasting, quarrying activities (inclusive of, primary and secondary crushing, screening, stacking and material transfer of aggregate material), vehicle movement of both on-road and non-road mobile equipment⁴ on unpaved roads at the Port and Jericho Station and along the road construction segments. These activities result in particulate matter (PM) emissions of various size ranges (e.g., TSP, PM₁₀ and PM_{2.5}) that can be deposited outside the PDA onto the ground and water surfaces (i.e., dustfall). Larger dust particles are removed near the disturbance area by gravitational settling and are the main contributor to dustfall. TSP, PM₁₀ and PM_{2.5} emissions are carried outside the PDA by the wind, with the smaller PM_{2.5} and PM₁₀ fractions tending to be transported further downwind.
- Diesel combustion exhaust (tailpipe) emissions from non-road equipment (e.g., haul trucks, excavators, loaders, bulldozers, graders) and on-road trucks and light duty vehicles. The exhaust emissions contain by-products of diesel fuel combustion that include ACPI (as listed in Section 1.2).
- Diesel combustion emissions from diesel-fueled power generation facilities at the Port and Jericho Station. The exhaust emissions contain by-products of diesel fuel combustion that include ACPI (as listed in Section 1.2).
- Explosives detonation emissions from blasting. Blasting emissions include NO_x, SO₂ and CO from the detonation of ammonium nitrate fuel oil (ANFO) explosives.
- Incineration of domestic waste at the Port and Jericho Station. The expected emissions include NO_x, SO₂, CO, TSP, PM₁₀, PM_{2.5} and negligible trace amounts of dioxins and furans.
- Jet-A fuel combustion exhaust during the landing and take-off flight phases of small cargo planes at the Port aerodrome and at Jericho Station. The exhaust emissions contain by-products of Jet-A fuel combustion that include NO_x, SO₂, CO, TSP, PM₁₀ and PM_{2.5}.
- Shipping vessel fuel combustion exhaust during vessel cruising, maneuvering, and hoteling. The exhaust emissions contain by-products of marine diesel fuel combustion that include NO_x, SO₂, CO, TSP, PM₁₀ and PM_{2.5}.

The Project will be powered via diesel-fueled, power generation facilities, with the potential to be augmented by wind and/or solar power in the future.

The consideration of potential adverse health effects from exposure to volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), and diesel particulate matter (DPM) are described in the Human Health Risk Assessment Report (IS Volume 9, Appendix 26A, Section 4.1.2).

⁴ Non-road mobile equipment refers to powered vehicles, either wheeled or tracked, designed for movement and operation on undeveloped or rough terrain, rather than public roads. Sometimes referred to as off-road mobile equipment.

Dioxins and furans from waste incineration were not considered in this assessment as the waste incinerators and associated building will be designed in accordance with ECCC Technical Document for Batch Incineration (ECCC 2010), including:

- Incinerators with controlled air dual chambers with a residence time of at least one (1) second and a temperature higher than 1000 °C.
- The incinerators being installed inside a building that will be equipped with sufficient fresh air inlet capacity for the incinerator.
- Stack gases will be released the atmosphere at a temperature higher than 700 °C to reduce the chances of the inadvertent formation of dioxins and furans through the de novo synthesis process.

With the implementation of the items above and the recommended operational considerations, the emissions from the waste incinerator are expected to be less than the Canada-wide Standards for dioxins and furans (CCME 2001).

Appreciable ozone formation that can result in elevated concentrations is not anticipated because ozone concentrations in the arctic are lower on average than in southern latitudes. Measured ozone concentrations in the arctic are consistently much lower than the CAAQS. Ozone production requires the presence of nitrogen oxides (NO_x) and volatile organic compounds (VOC) and conducive meteorological conditions. While photochemical modelling studies and ambient measurements have shown that marine shipping has been demonstrated to increase ozone concentrations, these increases are small (typically less than 5 ppb) and generally occur when background ozone concentrations are low (Raut et al. 2022). The absence of industrial activity significantly limits the potential for anthropogenic ozone production. The increases to regional and project NO_x and VOC emissions are not anticipated to materially affect ozone levels which are expected to remain much less than the CAAQS (Aliabadi et al. 2015, ECCC 2018).

4.3 Emission Inventory

The emissions inventory for project activities during the Construction phase (including pre-construction activities) and the Operations and Maintenance phase are described separately in the following sections. Project emissions were estimated using project information provided by WKR, as well as published emission factors.

The non-road equipment is not used 100% of the time and some construction activities are not constant with time; therefore, emission rates are estimated considering the actual operating hours per day for each equipment and construction activity, as available. The assumptions used to estimate the emission rates for different activities are provided in Appendix A.

4.3.1 Construction Emissions

The Construction phase is planned to start in Year 1 and continue for five years. Construction is anticipated to proceed year-round, with work advancing simultaneously from both the northern (Grays Bay Port) and southern (Jericho Station) ends of the Project. Therefore, the PDA has been divided into two sections: the Northern Domain consisting of the Port, Aerodrome, and the Northern Road and the Southern Domain consisting of Jericho Station and the Southern Road.

The emissions during construction are associated with drilling, blasting, quarrying activities, the operation of the non-road construction equipment and on-road vehicles for the construction of the major components of the Project, power generation, incineration of domestic waste and the operation of airplanes and shipping vessels. Emissions from the Construction phase are estimated for the worst-case year of construction that will result in the highest air emissions. The worst-case year of Construction phase emissions was selected based on the greatest intensity of concurrent (simultaneous) construction activities resulting in the highest total annual emissions.

Construction phase emissions were conservatively estimated assuming that all construction equipment operates at their maximum rates at the same time and construction at all construction areas occurs simultaneously. Detailed emissions calculations, inclusive of assumptions for Project construction, are provided in Appendix A. Where feasible, emission sources are categorized into sub-groups. This enables a more detailed analysis of operations and sources, helping to identify which ones contribute to potential environmental effects.

4.3.1.1 Emission Sources during Project Construction and Operations and Maintenance

Incineration of Domestic Waste

For each advancing construction stage (heading), two mobile camps and one stationary camp are anticipated. For the south-bound heading stage starting from the Port site, the stationary camp will be at the Port site. For the north-bound heading stage, the stationary camp will be in the area of Jericho Station. Two mobile camps will be moved as each of the road headings progresses in a “leapfrog” pattern where one camp will be moved ahead of the other, then the process is repeated. Camps are expected to be relocated approximately every three months, and their locations will be combined with other components (e.g., quarries) to reduce the total footprint of the Project. Camps will accommodate up to approximately 80 people.

During construction, domestic waste from the mobile camps will be transported to the permanent construction camps at the Port and Jericho Station for incineration in two (2) waste incinerators. NO_x, SO₂, CO, TSP, PM₁₀ and PM_{2.5} are the emissions assessed from the incinerators. These emissions were estimated using worker camp capacities, waste generation rates, and acceptable in-stack emissions levels from the MECP Guideline A-7: Air Pollution Control, Design and Operation Guidelines for Municipal Waste Thermal Treatment Facilities, Table 1 (MECP 2016).

Drilling and Blasting Activities

Holes are drilled and used for placing explosives for blasting. Drilling of holes can occur throughout the workday. Emissions from drilling include particulate emissions (TSP, PM₁₀, PM_{2.5}). Drilling emissions were estimated using the typical blasting area from the United State Environmental Protection Agency (U.S. EPA) AP-42, Chapter 11.9, Table 11.9-3 (Western Surface Coal Mining) (U.S. EPA 1998) and emission factors for particulates for boring/blast hole drilling from ECCC National Pollutant Release Inventory (NPRI) Pits and Quarries Reporting Guide (ECCC 2017).

Blasting occurs to provide aggregate for the construction activities at the port, Northern and Southern road segments, and Jericho Station. Blasting emissions include fugitive dust (TSP, PM₁₀, and PM_{2.5}) generated from the blast, and explosives emissions (NO_x, SO₂, and CO) from the detonation of ANFO explosives. Fugitive dust emissions from blasting activities were estimated using the typical blasting area from U.S. EPA AP-42, Chapter 11.9, Table 11.9-3 (Western Surface Coal Mining) (U.S. EPA 1998) and particulate emission factors for blasting from the ECCC NPRI Pits and Quarries Reporting Guide (ECCC 2017). Explosives gaseous emissions were estimated using emission factors from the ECCC NPRI Pits and Quarries Reporting Guide, Table 1 (Blasting Explosives) (ECCC 2017). Blasting emissions were estimated based on approximately 104 blasts per year for the Port and Jericho Station (each) and approximately 208 blasts per year for the Northern and Southern Roads (each).

Quarrying Activities

Quarrying activities generate particulate matter emissions from drilling, material handling, crushing and screening aggregate rock. The following sources are considered:

- Drilling of unfragmented rock/aggregate after blasting but before crushing activities. TSP, PM₁₀, and PM_{2.5} are the expected emissions. Particulate emissions for wet drilling were estimated using emission factors in U.S. EPA AP-42, Chapter 11.19.2 (Crushed Stone Processing and Pulverized Mineral Processing) Table 11.19.2-1 (U.S. EPA 2004a).
- Material transfers of aggregate to and from the crushers, screener and stacker. TSP, PM₁₀, and PM_{2.5} are the expected emissions from these operations. Particulate emissions for material unloading/dropping were estimated using Equation (1) in U.S. EPA AP-42, Chapter 13.2.4 (Aggregate Handling and Storage Piles) (U.S. EPA 2006a). A 50% mitigation effectiveness for particulate matter was utilized, assuming drop points are partially enclosed. The Western Regional Air Partnership Report (WRAP 2006) notes a mitigation efficiency of 75% for partial (3-sided) enclosure – the 50% value used is expected to be conservative.
- Primary crushing (using a jaw crusher), secondary crushing (using a cone crusher) and screening of aggregate. TSP, PM₁₀, and PM_{2.5} are the expected emissions from these operations. Particulate emissions for crushing and screening were estimated using emission factors in U.S. EPA AP-42, Chapter 11.19.2 (Crushed Stone Processing and Pulverized Mineral Processing) Table 11.19.2-1 (U.S. EPA 2004a). An 86% control for particulate matter was utilized, assuming the crushing operations are partially enclosed (Texas Commission on Environmental Quality (TCEQ) 2002).

Site Preparation

Site preparation activities will generate particulate matter emissions from overburden removal and grading. The following sources are considered:

- Overburden removal from the Port, Jericho Station and the Northern and Southern road construction segments (using bulldozers and/or front-end loaders). TSP, PM₁₀, and PM_{2.5} are the expected emissions. Particulate emissions were estimated using emission factors in U.S. EPA AP-42, Chapter 11.9, Table 11.9-2 (Western Surface Coal Mining) (U.S. EPA 1998). No controls were assumed on the removal of overburden.
- Grading of the sites after overburden removal for the efficient operation of construction and equipment and maintaining of road surfaces. TSP, PM₁₀, and PM_{2.5} are the expected emissions. Particulate emissions for grading were estimated using emission factors in U.S. EPA AP-42, Chapter 11.9, Table 11.9-2 (Western Surface Coal Mining) (U.S. EPA 1998). During the summer months a 70% control (i.e., reduction) was used, assuming that grading occurs on roads that have been treated with water.

Diesel Combustion in Non-Road Equipment and On-Road Vehicles

The construction fleet will consist of heavy equipment units including excavators, wheeled loaders, haul trucks, drills, wheeled and tracked dozers, graders, and other support vehicles. Diesel combustion in non-road equipment and on-road vehicles within the PDA will generate NO_x, SO₂, CO, TSP, PM₁₀, and PM_{2.5} emissions. Vehicle tailpipe emissions for on-road vehicle emissions were estimated using the U.S. EPA's Motor Vehicle Emission Simulator Model version 3 (MOVES3) (U.S. EPA 2021). For the MOVES3 model, it was conservatively assumed that the mobile equipment will be older, Tier 3 equipment, manufactured between 2007 and 2014, which results in higher emissions. The emission factors generated by the model are based on the horsepower of the vehicle and will vary based on the contaminant and the vehicle horsepower. For a worst-case scenario, it was assumed that all the equipment would be operating simultaneously.

Diesel Combustion for Power Generation

Electrical power for the Port will be provided by a diesel power plant that will include four (4) generator units with a capacity of approximately 6 MW. Demand is not anticipated to regularly exceed 4 MW based on the Project Description (see Volume 2). Two of the units will operate regularly to meet routine demand, and two will be on standby for occasional peaks and emergency use.

A diesel power plant at Jericho Station will include two (2) generator units with a capacity of approximately 3 MW. Demand is not anticipated to regularly exceed 1 MW. One of the units will operate regularly to meet routine demand, and one will be on standby for occasional peaks and emergency use.

The power plants will be constructed in a location to reduce the length of transmission and fuel lines. Location of the power plants and associated infrastructure will be confirmed during detailed design of the Project.

Generator emissions were estimated for an assumed diesel generator model CAT 3516C with a continuous power of 1,825 kW, compliant with Tier 2 off-road diesel engine emission standards.

The Off-road Compression Ignition (Mobile and Stationary) and Large Spark-Ignition Engine Emission Regulations (SOR/2020-258) require new off-road and stationary diesel engines to meet US EPA Tier 4 emission standards. However, Section 12(1) of SOR/2020-258 allows diesel engines that are to be used exclusively to provide a primary source of electrical power in a remote location to meet Tier 2 emission standards that are less stringent than Tier 4 standards. A "remote location" is defined in the Regulation as geographic areas that are serviced neither by an electrical distribution network nor a natural gas distribution network. The Project meets the definition of "remote location" for the purpose of the Regulation.

Diesel combustion from the diesel power generators will generate NO_x, SO₂, CO, TSP, PM₁₀, and PM_{2.5} emissions. Emissions were estimated for two (2) 1,825 kW continuously operating diesel generators at the Port and one (1) 1,825 kW continuously operating diesel generator at Jericho Station. These emissions were estimated using emission factors from the manufacturer's specifications for NO_x, CO and PM (Caterpillar 2025). It was assumed that the PM consists 100% of the PM_{2.5} fraction. SO₂ emissions were estimated based on 15 mg/kg sulphur limit in off-road diesel fuel as required by the Sulphur in Diesel Fuel Regulations (SOR/202-254).

Unpaved Road Dust

Non-road equipment (e.g., haul trucks, excavators, loaders, bulldozers, graders) and on-road trucks and light duty vehicles will travel within the PDA via unpaved roads. Particulate matter (TSP, PM₁₀, PM_{2.5}) emissions were estimated using Equation (1) in U.S. EPA AP-42, Chapter 13.2.2 (Unpaved Roads) (U.S. EPA 2006b). The amount of dust emissions from an unpaved road is directly related to the speed and type of vehicle using the road, with emissions varying linearly with vehicle speed (Figure 3-3, Federation of Canadian Municipalities and National Research Council, 2005). Equation (1) in U.S. EPA AP-42, Chapter 13.2.2 assumes vehicles travel at 72 km/h; therefore, the emission factors were scaled based on the average speed in the construction areas of 15 km/hr. A control efficiency of 75% was assumed for the use of watering and chemical dust suppressants for summer operations (May to September) (WRAP 2006), while a 95% control efficiency was assumed for snow cover in winter (October to April) (Golder 2012). Given that unpaved road dust is the largest source of particulate matter (TSP and PM₁₀) emissions, more frequent road watering or the application of a dust suppressant will be implemented if required. During meteorological and seasonal conditions that can result in increased fugitive dust emissions, the frequency of water applications to roads and work surfaces can be increased and/or different types and dosage of dust control agents can be applied to achieve the required level of control.

Jet-A Fuel Combustion

Small cargo planes using Jet-A fuel will be used to transport goods to and from the Port and Jericho Station airstrips during the Construction phase of the Project. The expected emissions are NO_x, SO₂, CO, TSP, PM₁₀, and PM_{2.5}. Emissions were estimated using emission factors for the landing and take-off (LTO) flight phases provided in Appendix B.1 of the *National Pollutant Inventory: Emission Estimation Technique Manual for Airports* (Australian Government Department of the Environment, Water, Heritage and the Arts 2008). Emissions were estimated assuming one LTO per day at each airstrip.

Shipping Vessels

Emissions from marine shipping vessels travelling to and from Gray's Bay Port were calculated for hoteling, maneuvering, and slow cruising using published emission factors and calculation methodology for marine vessels from the Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data (U.S. EPA 2000). Modelling was completed for one berthed vessel and another waiting for a berth within approximately a 27 km radius of the port which is the approximate distance of the shipping route that is located within the 30 km by 30 km model domain.

Assumptions used for the inventory include:

- Shipping vessels will be docked at Gray's Bay Port only during the open water season August to October.
- Each shipping vessel will stay docked and undertake hoteling operations at the Gray's Bay Port for a period of four (4) days.
- A shipping vessel will take 1 hour to maneuver into or out of the Gray's Bay Port and take 1 hour to travel at slow cruise speed outside of Gray's Bay.
- Only one (1) shipping vessel will be within the Gray's Bay area at a time.

4.3.1.2 Emissions Summary

A summary of annual emissions during the worst-case year of construction (Year 2) for the Northern Domain is provided in Table 4.1 and for the Southern Domain is provided in Table 4.2. The summary for the Northern Domain (Table 4.1) indicates that:

- The main source of TSP, PM₁₀ and PM_{2.5} emissions for the Northern Domain during construction is movement of non-road equipment and on-road vehicles on unpaved roads, followed by quarry activities (drilling, material transfer, crushing and screening).
- The main source of NO_x emissions is diesel combustion from power generation and non-road equipment and on-road vehicles (tailpipe exhaust).
- The main sources of SO₂ emissions are waste incineration and blasting operations.
- The main source of CO emissions is diesel combustion from non-road equipment and on-road vehicles (tailpipe exhaust), followed by power generation and blasting operations.

The summary for the Southern Domain (Table 4.2) indicates that:

- The main source of TSP, PM₁₀ and PM_{2.5} emissions for the Southern Domain during construction is movement of non-road equipment and on-road vehicles on unpaved roads, followed by quarry activities (drilling, material transfer, crushing and screening).
- The main sources of NO_x emissions are diesel combustion from power generation and non-road equipment and on-road vehicles (tailpipe exhaust).
- The main sources of SO₂ emissions are waste incineration and blasting operations.
- The main source of CO emissions is diesel combustion from non-road equipment and on-road vehicles (tailpipe exhaust) followed by power generation and blasting operations.

Table 4.1 Northern Domain Annual Construction Emissions (Year 2)

Project Emission Source	Northern Domain Construction Phase Emissions (tonnes/year)					
	TSP	PM ₁₀	PM _{2.5}	NO _x	SO ₂	CO
Northern Domain (Grays Bay Port and Grays Bay Road Segment)						
Grays Bay Port						
Waste incineration	0.39	0.39	0.39	5.6	1.6	1.1
Blasting ^a	1.5	0.75	0.04	5.0	0.60	21
Quarrying Activities – drilling, material handling, crushing and screening	26	12	5.3	-	-	-
Site Preparation (e.g., overburden removal, grading)	15	3.3	1.4	-	-	-
Diesel Combustion in Non-Road Equipment and On-Road Vehicles	4.8	4.8	4.6	88	0.11	31
Diesel Combustion from Power Generation	1.7	1.7	1.7	261	0.21	21
Unpaved Road Dust Emissions from Non-Road Equipment and On-Road Vehicle Movement on unpaved roads within the Port	86	24	2.4	-	-	-
Jet-A Fuel Combustion	0.0022	0.0022	0.0022	0.031	0.0021	0.285
Shipping Vessels (hoteling, maneuvering, cruising)	0.13	0.13	0.12	5.3	0.26	0.46
Grays Bay Port Total Emissions:	135	48	16	364	2.8	75
Northern Grays Bay Road Segment (115 km) ^b						
Blasting ^c	2.9	1.5	0.09	8.9	1.1	37.7
Quarrying Activities – drilling, material handling, crushing and screening	30	14	7.4	-	-	-
Site Preparation (e.g., overburden removal, grading)	15	3.2	1.5	-	-	-
Diesel Combustion in Non-Road Equipment and On-Road Vehicles	6.0	6.0	5.8	117	0.15	39
Unpaved Road Dust Emissions from Non-Road Equipment and On-Road Vehicle Movement on unpaved roads on the Northern Road	124	35	3.5	-	-	-
Northern Grays Bay Road Segment Total Emissions:	178	60	18	126	1.3	76
Northern Domain Total Emissions:	313	107	34	490	4.0	151

Notes:

^a Blasting for the Grays Bay Port occurs once per day, approximately 104 days per year

^b Emissions are estimated for the Northern Segment of the Grays Bay Road (approximately 115 km)

^c Blasting for the Northern Road occurs once per day, approximately 208 days per year

Table 4.2 Southern Domain Annual Construction Emissions (Year 2)

Project Emission Source	Southern Domain Construction Phase Emissions (tonnes/year)					
	TSP	PM ₁₀	PM _{2.5}	NO _x	SO ₂	CO
Southern Domain (Jericho Station and Grays Bay Road Segment)						
Jericho Station						
Waste incineration	0.39	0.39	0.39	5.6	1.6	1.1
Blasting ^a	1.5	0.75	0.04	0.5	0.06	2.1
Quarrying Activities – drilling, material handling, crushing and screening	13	6.4	3.5	-	-	-
Site Preparation (e.g., mucking, grading)	4.0	0.76	0.42	-	-	-
Diesel Combustion in Non-Road Equipment and On-Road Vehicles	1.2	1.2	1.2	19	0.03	8.1
Diesel Combustion from Power Generation	0.86	0.86	0.86	130	0.10	11
Jet-A Fuel Combustion	0.0018	0.0018	0.0018	0.024	0.0017	0.224
Unpaved Road Dust Emissions from Non-Road Equipment and On-Road Vehicle Movement on unpaved roads in Jericho Station	27	6.5	0.78	-	-	-
Jericho Station Total Emissions:	49	17	7.1	155	1.8	22
Percent Jericho Station Construction Emissions from Port Emissions:	36%	35%	44%	43%	64%	29%
Southern Grays Bay Road Segment (115 km) ^b						
Blasting ^c	2.9	1.5	0.09	5.5	0.68	23
Quarrying Activities – drilling, material handling, crushing and screening	17	8.5	5.5	-	-	-
Site Preparation (e.g., mucking, grading)	15	3.2	1.5	-	-	-
Diesel Combustion in Non-Road Equipment and On-Road Vehicles	7.0	7.0	6.8	143	0.18	45
Unpaved Road Dust Emissions from Non-Road Equipment and On-Road Vehicle Movement on unpaved roads on the Southern Road	144	41	4.1	-	-	-
Southern Grays Bay Road Segment Total Emissions:	186	61	18	148	0.9	68
Southern Domain Total Emissions:	235	78	25	303	2.6	90

Notes:

^a Blasting for Jericho Station occurs once per day, approximately 104 days per year

^b Emissions are estimated for the Southern Segment of the Grays Bay Road (approximately 115 km)

^c Blasting for the Southern Road occurs once per day, approximately 208 days per year

4.3.2 Operations and Maintenance Phase Emissions

The Operations and Maintenance phase is anticipated to commence in 2035 (start in Year 6) and continue indefinitely (75-year design life).

Similar to the Construction phase, emissions during the Operations and Maintenance phase of the Project are associated with drilling, blasting, quarrying activities, the operation of non-road construction equipment and on-road vehicles, power generation, incineration of domestic waste and the operation of airplanes and shipping vessels. Emissions were estimated for the worst-case year of operation that will result in the highest air emissions. The worst-case year of operations and maintenance is selected based on the greatest intensity of concurrent (simultaneous) activities resulting in the highest annual total emissions.

Operations and Maintenance phase emissions were conservatively estimated assuming that all sources are being operated at their maximum rates at the same time and all operational activities occur simultaneously. Detailed emissions calculations inclusive of assumptions for Project Operations and Maintenance phase are provided in Appendix B.

4.3.2.1 Incineration of Domestic Waste

During operations and maintenance, workers will be housed at two (2) worker accommodation camps: one (1) at the Port, and one (1) at Jericho Station. Approximately 10 to 20 permanent staff will be located at Grays Bay Port to operate and maintain the port facilities. Approximately 12 staff will be located at Jericho Station. Jericho Station will be open when the connection to the TCWR is open, and when required for road operations or maintenance.

The domestic waste generated at these camps will be incinerated in two (2) waste incinerators. NO_x, SO₂, CO, TSP, PM₁₀, and PM_{2.5} are the emissions assessed from the incinerators. These emissions were estimated using the worker camp capacities, waste generation rates, and allowable in-stack emissions levels from MECP Guideline A-7: Air Pollution Control, Design and Operation Guidelines for Municipal Waste Thermal Treatment Facilities, Table 1 (MECP 2016).

4.3.2.2 Blasting Activities

Drilling

Holes are drilled and used for placing explosives for blasting. For operations and maintenance it is estimated that there will be 44 blasts required per year, so there will be considerably less drilling relative to the Construction phase. Drilling of holes can occur throughout the workday. Emissions from drilling include TSP, PM₁₀, PM_{2.5}. Drilling emissions were estimated using the typical blasting area from U.S. EPA AP-42, Chapter 11.9, Table 11.9-3 (Western Surface Coal Mining) (U.S. EPA 1998) and emission factors for particulates for boring/blast hole drilling from ECCC NPRI Pits and Quarries Reporting Guide (ECCC 2017).

Blasting

Blasting occurs to provide aggregate for the maintenance of the all-season access road. During operations and maintenance, there will be approximately 44 blasts per year to produce the annual aggregate needed to operate and maintain the Project, spread across all active quarries. Blasting emissions include fugitive dust (TSP, PM₁₀, and PM_{2.5}) generated from the blast and gaseous emissions (NO_x, SO₂, and CO) from the detonation of ANFO explosives. Fugitive dust emissions from blasting activities were estimated using the typical blasting area from U.S. EPA AP-42, Chapter 11.9, Table 11.9-3 (Western Surface Coal Mining) (U.S. EPA 1998) and emission factors for particulates for blasting from ECCC NPRI Pits and Quarries Reporting Guide. Explosives gaseous emissions were estimated using emission factors from the ECCC NPRI Pits and Quarries Reporting Guide, Table 1 (Blasting Explosives) (ECCC 2017). Blasting emissions were estimated based on roughly 44 blasts per year (each) for maintenance of the Northern Road and Southern Road.

4.3.2.3 Quarrying Activities

Quarrying activities generate particulate matter emissions from drilling, material handling, crushing and screening rock. During the Operations and Maintenance phase, quarrying is only conducted to generate aggregate for maintenance of the all-season access road. The following sources are considered:

- Drilling of unfragmented rock/aggregate after blasting but before crushing activities. TSP, PM₁₀, PM_{2.5}, are the expected emissions. Particulate emissions for drilling were estimated using emission factors for wet drilling in U.S. EPA AP-42, Chapter 11.19.2 (Crushed Stone Processing and Pulverized Mineral Processing) Table 11.19.2-1 (U.S. EPA 2004a).
- Material transfers of aggregate to and from the crushers, screener and stacker. TSP, PM₁₀, PM_{2.5}, are the expected emissions from these operations. Particulate emissions for material unloading/dropping were estimated using Equation (1) in U.S. EPA AP-42, Chapter 13.2.4 (Aggregate Handling and Storage Piles) (U.S. EPA 2006a). A 50% mitigation effectiveness for particulate matter was utilized, assuming drop points are partially enclosed. The Western Regional Air Partnership Report (WRAP 2006) notes a mitigation efficiency of 75% for partial (3-sided) enclosure – the 50% value used is expected to be conservative.
- Primary crushing (using a jaw crusher), secondary crushing (using a cone crusher) and screening of aggregate. TSP, PM₁₀, PM_{2.5}, are the expected emissions from these operations. Particulate emissions for crushing and screening were estimated using emission factors in U.S. EPA AP-42, Chapter 11.19.2 (Crushed Stone Processing and Pulverized Mineral Processing) Table 11.19.2-1 (U.S. EPA 2004a). An 86% control for particulate matter was utilized, assuming the crushing operations are partially enclosed (TCEQ 2002).

4.3.2.4 Diesel Combustion

Diesel Combustion in Non-Road Equipment and On-Road Vehicles

The operations and maintenance fleet will consist of heavy equipment units including excavators, wheeled loaders, haul trucks, drills, wheeled and tracked dozers, graders, and other support vehicles. Diesel combustion in non-road equipment and on-road vehicles within the PDA will generate NO_x, SO₂, CO, TSP, PM₁₀, and PM_{2.5} emissions. Vehicle tailpipe emissions for on-road vehicle emissions were estimated using the U.S. EPA's Motor Vehicle Emission Simulator Model version 3 (MOVES3) (U.S. EPA 2021). For the MOVES3 model it was conservatively assumed that the mobile equipment will be older, Tier 3 equipment, manufactured between 2007 and 2014, which results in higher emissions. The emission factors generated by the model are based on the horsepower of the vehicle and will vary based on the contaminant and the vehicle horsepower. For a worst-case scenario, it was assumed that all of the equipment would be operating simultaneously.

Diesel Combustion for Power Generation

Electrical power for the Port will be provided by a diesel power plant that will include four (4) generator units with a capacity of approximately 6 megawatts (MW). Demand is not anticipated to regularly exceed 4 MW based on the Project Description (see Volume 2). Two of the units will operate regularly to meet routine demand, and two will be on standby for occasional peaks and emergency use.

A diesel power plant at Jericho Station will include two (2) generator units with a capacity of approximately 3 MW. Demand is not anticipated to regularly exceed 1 MW. One of the units will operate regularly to meet routine demand, and one will be on standby for occasional peaks and emergency use.

Generator emissions were estimated for an assumed diesel generator model CAT 3516C with a continuous power of 1,825 kW, compliant with Tier 2 off-road diesel engine emission standards. As discussed in Section 4.3.1.1, the Project is in a remote location, and the diesel generators are allowed to comply with Tier 2 emission standards.

Diesel combustion from the diesel power generators will generate NO_x, SO₂, CO, TSP, PM₁₀, and PM_{2.5} emissions. Emissions were estimated for two (2) 1,825 kW continuously operating diesel generators at the Port and one (1) 1,825 kW continuously operating diesel generator at Jericho Station. These emissions were estimated using emission factors from the manufacturer's specifications for NO_x, CO and PM (Caterpillar 2025). It was assumed that the PM consists 100% of the PM_{2.5} fraction. SO₂ emissions were estimated based on 15 mg/kg sulphur limit in off-road diesel fuel as required by the Sulphur in Diesel Fuel Regulations (SOR/202-254).

4.3.2.5 *Unpaved Road Dust*

Non-road equipment (e.g., haul trucks, excavators, loaders, bulldozers, graders) and on-road trucks and light duty vehicles travel within the PDA via unpaved roads. Particulate matter (TSP, PM₁₀, PM_{2.5}) emissions were estimated using Equation (1) in U.S. EPA AP-42, Chapter 13.2.2 (Unpaved Roads) (U.S. EPA 2006b). The amount of dust emissions from an unpaved road is directly related to the speed and type of vehicle using the road, with emissions varying linearly with vehicle speed (Figure 3-3, NRC 2005). Equation (1) in U.S. EPA AP-42, Chapter 13.2.2 assumes that vehicles travel at 72 km/h; therefore, the emission factors were scaled based on the average speed of the maintenance off-road equipment of 15 km/hr. A control efficiency of 75% was assumed for the use of watering and chemical dust suppressants for summer operations (May to September) (WRAP 2006), while a 95% control efficiency was assumed for snow cover in winter (October to April) (Golder 2012).

4.3.2.6 *Jet-A Fuel Combustion*

Small cargo planes using Jet-A fuel will be used to transport goods to and from the Port and Jericho Station airstrips during the Operations and Maintenance phase of the Project. The expected emissions are NO_x, SO₂, CO, TSP, PM₁₀, and PM_{2.5}. Emissions were estimated using emission factors for landing and take-off (LTO) flight phases from the Australian Government, Department of the Environment's NPI Emission Estimation Technique Manual for Airports, Appendix B.1 (A.G. DOE, 2008). Emissions were estimated assuming one LTO per day at each airstrip.

4.3.2.7 *Shipping Vessels*

Emissions from marine shipping vessels travelling to and from Gray's Bay Port were calculated for hoteling, maneuvering, and slow cruising using published emission factors and the calculation methodology for marine vessels from the document Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data (U.S. EPA 2000). Modelling was completed for one berthed vessel and another waiting for a berth within approximately a 27 km radius of the port, which is the approximate distance of the shipping route that is located within the 30 km by 30 km model domain.

Assumptions used for the inventory include:

- Shipping vessels will be docked at Gray's Bay Port only during the open water season. The open water season typically extends from late June through October, with annual variability. For the air dispersion modelling, it was assumed that shipping vessels will be docked at the Port August to October.
- Each shipping vessel will stay docked and undertake hoteling operations at the Gray's Bay Port for a period of four (4) days.
- A shipping vessel will take 1 hour to maneuver into or out of the Gray's Bay Port and take 1 hour to travel at slow cruise speed outside of Gray's Bay.
- Only one (1) shipping vessel will be within the Gray's Bay area at a time.

4.3.2.8 *Emissions Summary*

A summary of annual emissions during the worst-case year of operations and maintenance (Year 7) for the Northern Domain is provided in Table 4.3 and for the Southern Domain in Table 4.4. The summary for the Northern Domain (Table 4.3) indicates that:

- The main source of TSP, PM₁₀ and PM_{2.5} emissions for the Northern Domain during operations and maintenance is movement of non-road equipment and on-road vehicles on unpaved roads, followed by quarry activities (drilling, material transfer, crushing and screening).
- The main source of NO_x emissions is diesel combustion from power generation, followed by non-road equipment and on-road vehicles (tailpipe exhaust).
- The main source of SO₂ emissions is waste incineration.
- The main sources of CO emissions are diesel combustion from power generation and non-road equipment and on-road vehicles (tailpipe exhaust).

The summary for the Southern Domain (Table 4.4) indicates that:

- The main source of TSP, PM₁₀ and PM_{2.5} emissions for the Southern Domain during operations and maintenance is movement of non-road equipment and on-road vehicles on unpaved roads, followed by quarry activities (drilling, material transfer, crushing and screening).
- The main source of NO_x emissions are diesel combustion from power generation, followed by non-road equipment and on-road vehicles (tailpipe exhaust).
- The main source of SO₂ emissions is waste incineration.
- The main sources of CO emissions are diesel combustion from power generation and non-road equipment and on-road vehicles (tailpipe exhaust).

Table 4.3 Northern Domain Annual Operations and Maintenance Emissions (Year 7)

Project Emission Source	Northern Domain Operations and Maintenance Phase Emissions (tonnes/year)					
	TSP	PM ₁₀	PM _{2.5}	NO _x	SO ₂	CO
Northern Domain (Grays Bay Port and Grays Bay Road Segment)						
Grays Bay Port						
Waste incineration	0.39	0.39	0.39	5.6	1.6	1.1
Blasting ^a	0.61	0.32	0.02	0.72	0.09	3.0
Quarrying Activities – drilling, material handling, crushing and screening	3.9	1.9	1.2	-	-	-
Diesel Combustion in Non-Road Equipment and On-Road Vehicles	1.6	1.6	1.6	25	0.04	11
Diesel Combustion from Power Generation	1.7	1.7	1.7	261	0.21	21
Unpaved Road Dust Emissions from Non-Road Equipment and On-Road Vehicle Movement on unpaved roads within the Port	29	8.3	0.83	-	-	-
Jet-A Fuel Combustion	0.0024	0.0024	0.0024	0.032	0.0023	0.320
Shipping Vessels (hoteling, maneuvering, cruising)	0.19	0.18	0.17	7.5	0.37	0.65
Grays Bay Port Total Emissions:	38	14	5.9	299	2.3	37
Northern Grays Bay Road Segment (115 km) ^b						
Diesel Combustion in Non-Road Equipment and On-Road Vehicles	2.4	2.4	2.3	39	0.06	15
Unpaved Road Dust Emissions from Non-Road Equipment and On-Road Vehicle Movement on unpaved roads on the Northern Road	49	14	1.4	-	-	-
Northern Grays Bay Road Segment Total Emissions:	51	16	3.7	39	0.06	15
Northern Domain Total Emissions:	89	31	10	338	2.3	53

Notes:

^a Blasting for maintenance of the Northern Segment of the Grays Bay Road occurs once per day, approximately 44 days per year.

^b Emissions are estimated for the Northern Segment of the Grays Bay Road (approximately 115 km)

Table 4.4 Southern Domain Annual Operations and Maintenance Emissions (Year 7)

Project Emission Source	Southern Domain Operations and Maintenance Phase Emissions (tonnes/year)					
	TSP	PM ₁₀	PM _{2.5}	NO _x	SO ₂	CO
Southern Domain (Jericho Station and Grays Bay Road Segment)						
Jericho Station						
Waste incineration	0.39	0.39	0.39	5.6	1.6	1.1
Blasting ^a	0.61	0.32	0.02	0.72	0.09	3.0
Quarrying Activities – drilling, material handling, crushing and screening	3.9	1.9	1.2	-	-	-
Diesel Combustion in Non-Road Equipment and On-Road Vehicles	1.2	1.2	1.2	19	0.03	8.1
Diesel Combustion from Power Generation	0.86	0.86	0.86	130	0.10	11
Jet-A Fuel Combustion	0.0018	0.0018	0.0018	0.0243	0.0017	0.224
Unpaved Road Dust Emissions from Non-Road Equipment and On-Road Vehicle Movement on unpaved roads in Jericho Station	27	6.5	0.78	-	-	-
Jericho Station Total Emissions:	34	11	4.4	155	1.8	23
Percent Jericho Station Operation Emissions from Port Emissions:	91%	77%	75%	52%	79%	62%
Southern Grays Bay Road Segment (115 km) ^b						
Diesel Combustion in Non-Road Equipment and On-Road Vehicles	2.4	2.4	2.3	39	0.06	15
Unpaved Road Dust Emissions from Non-Road Equipment and On-Road Vehicle Movement on unpaved roads on the Southern Road	49	14	1.4	-	-	-
Southern Grays Bay Road Segment Total Emissions:	51	16	3.7	39	0.1	15
Southern Domain Total Emissions:	86	27	8.1	194	1.9	38

Notes:

^a Blasting for maintenance of the Southern Segment of the Grays Bay Road occurs once per day, approximately 44 days per year.

^b Emissions are estimated for the Southern Segment of the Grays Bay Road (approximately 115 km)

4.4 Summary

The PDA has been divided into two sections:

1. The Northern Domain, including:
 - the Grays Bay Port with marine-based and land-based infrastructure
 - an Aerodrome
 - the Northern segment of the Grays Bay Road connected to the Port (assumed half of the Grays Bay Road length, approximately 115 km)
2. The Southern Domain, including:
 - the Jericho Station, including gravel airstrip
 - the Southern segment of the Grays Bay Road connected to the Jericho Station (assumed half of the Grays Bay Road length, approximately 115 km).

As evident from Table 4.1 and Table 4.2, the Jericho Station emissions during construction are less than half of the construction emissions from the Port (36% for TSP emissions and 43% for NO_x emissions), and the emissions from the Southern segment of Grays Bay Road are approximately the same as the emissions from the Northern segment of the road. Therefore, the air quality effects (and model-predicted concentrations) from the Southern Domain will be less than the Northern Domain and subsequently, the Southern Domain was not modelled. Since the emissions along the Northern and Southern segments of the Grays Bay Road are similar in magnitude, the model-predicted concentrations along the Northern segment of the road are expected to be representative of the magnitude and spatial distribution of concentrations along the Southern segment of the road.

During the Operations and Maintenance phase, the TSP emissions from Jericho Station are estimated to be similar to the emissions from the Port (91%), while the NO_x emissions are approximately half of the emissions from the Port (52%) (Table 4.3 and Table 4.4). Similar to the Construction phase, the emissions from the Southern segment of Grays Bay Road are approximately the same as the emissions from the Northern segment of the road. Therefore, the effects on air quality from the Southern Domain during Operations and Maintenance are expected to be less than the Northern Domain and the Southern Domain emissions were not modelled. Since the emissions along the Northern and Southern segments of the Grays Bay Road are similar in magnitude, the model-predicted concentrations along the Northern segment of the road during operations and maintenance are expected to be representative of the magnitude and spatial distribution of concentrations along the Southern segment of the road.

5 Environmental Control and Management Procedures

Mitigation measures will be implemented to manage and reduce project emissions during all project phases. Meteorological conditions are currently measured by an onsite meteorological tower located at the Grays Bay Port Site (Grays Bay Meteorology Station; UTM Zone 12W, 505916 m E, 7520765 m N). Air temperature, relative humidity, wind speed and direction, barometric pressure, solar radiation, and snow depth data have been measured since late August 2024. Ambient air quality monitoring for particulate matter (TSP, PM₁₀, PM_{2.5}) will be implemented to provide an understanding of site ambient concentrations, and to determine the need for additional mitigation. Based on the measured wind conditions and ambient concentration levels, appropriate mitigation options will be considered to reduce project emissions.

5.1 Mitigation by Project Design

Mitigation measures that are incorporated in the Project design to reduce ACPI emissions include:

- Waste incinerators will be designed and operated in accordance with ECCC Technical Document for Batch Waste Incineration: Executive Summary and Overview of the Six-Step Process for Batch Waste Incineration (ECCC 2010).
- Quarry crushing and screening operations will incorporate standard emissions control measures (e.g. partial enclosure).

5.2 Best Management Practices

Emissions during all phases of the Project will be managed and reduced following standard best management practices (BMPs) for the reduction of air emissions from construction activities (ECCC 2005; EMLI and ENVP 2023) and mining activities (The Centre for Excellence in Mining Innovation 2010).

The following BMPs will be implemented for the management and reduction of diesel exhaust emissions and associated ACPI from non-road equipment and vehicles during all phases of the Project:

- Engines and exhaust systems will be properly maintained to keep construction and mining equipment in good working condition.
- Mobile equipment speed will be limited to the posted speed limits on project road surfaces.
- Manage vehicle and equipment emissions by conducting regular maintenance of engines and exhaust systems.
- Cold starts of equipment will be limited to the extent possible.
- Contractors will be encouraged to use multi-passenger vehicles (e.g., passenger van or bus) to move crews.

- Vehicles and equipment will be maintained regularly and in good working order.
- Construction contractors will be encouraged to use newer equipment that meets Tier 4 emission standards and are no older than 13-years (built in or after 2012), where possible.

The following BMPs will be implemented for the management and reduction of fugitive dust emissions during all phases of the Project:

- A dust control program using water will be implemented, and where applicable, dust suppression will follow the Nunavut Environmental Guideline: Dust Suppressants (GN 2023b).
- Storage areas will be kept in a condition that minimizes dust emissions.

The following BMPs will be implemented for the management and reduction of emissions and associated ACPI from incinerator processes during all phases of the Project:

- Incinerators will be operated in accordance with manufacturer's specifications, will comply with Nunavut standards, and emissions will meet MECP Guideline A-7: Air Pollution Control, Design and Operation Guidelines for Municipal Waste Thermal Treatment Facilities (MECP 2016).
- Details of management and operation of incinerators will be included in the Waste Management Plan.

Additional mitigation measures can be implemented on an as-required basis.

5.3 Air Quality Monitoring

An Air Quality Management Plan (AQMP) will be developed and implemented for all phases of the Project after submission of the IS. The AQMP will specify the mitigation measures for the management and reduction of emissions during all project phases, the ambient air quality and meteorology monitoring program, and the reporting requirements of monitoring results to GN-DOE.

Ambient air quality and meteorology monitoring will include:

- Meteorological monitoring (temperature, wind speed, wind direction, relative humidity, solar radiation and rainfall)
- Ambient PM monitoring

Visual inspection and the results of the ambient PM monitoring will be used to assess the effectiveness of the dust mitigation measures and to evaluate the need for more rigorous dust mitigation.

Monitoring requirements will be reviewed on a case-by-case basis should any complaints related to air quality occur from Kitikmiut, other Indigenous groups, and other affected parties because of project activities.

6 Assessment Approach

The effects of project emissions on ambient air quality are evaluated by using a numerical atmospheric dispersion model. Atmospheric dispersion models simulate the transport, dispersion, transformation, and deposition of emissions in the atmosphere. Dispersion models are used to predict ambient concentrations for a wide range of meteorological conditions and account for terrain influences. In the absence of Nunavut dispersion modelling guidance, the modelling approach was based on the British Columbia Air Quality Dispersion Modeling Guideline (ENVP 2022), the Alberta Air Quality Model Guideline (AEP 2021), and professional judgement and experience.

6.1 AERMOD Dispersion Model

AERMOD is a multi-source, steady-state plume model that was developed by the U.S. EPA (U.S. EPA 2004b), in collaboration with the American Meteorological Society, and is the U.S. EPA's regulatory air dispersion model. According to the British Columbia Air Quality Dispersion Modeling Guideline (ENVP 2022), AERMOD is suitable for use in the following situations, all of which apply to the Project:

- sources in an industrial complex with multiple sources
- surface and elevated releases
- non-complex air flow, where the steady-state model applies
- single or multiple buildings with or without building downwash
- gas and particle depositions
- constant or time-varying emissions
- rural and urban areas
- flat and complex terrain
- transport distances less than 50 km (depends on terrain)
- concentration estimates for all terrain locations, except in areas located on the lee-side of the topographic features

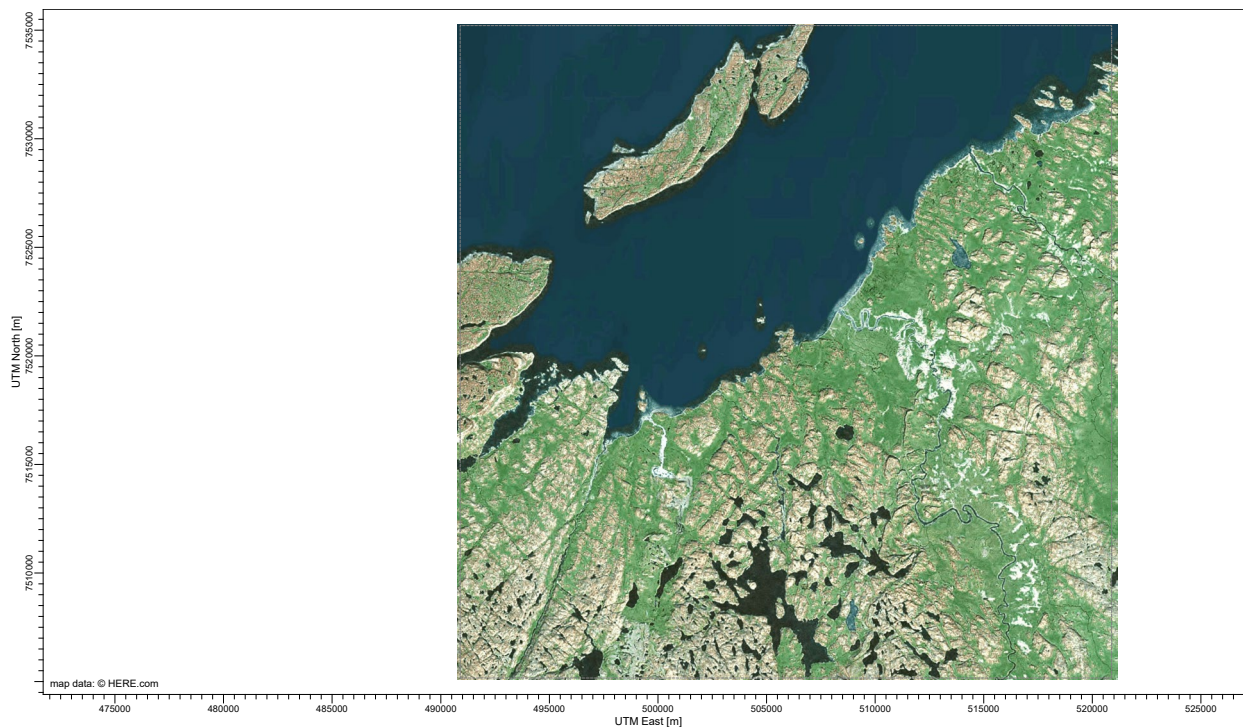
The AERMOD modelling system was used to simulate the transport, dispersion and deposition of emissions from the Northern Domain during construction and operations and maintenance. As discussed in Section 4.4, emissions from the Southern Domain (Jericho Station and Southern Segment of the Grays Bay Road) were not modelled as emissions in the Southern Domain are less than emissions in the Northern Domain and therefore, the effects on air quality are expected to be less than the predictions for the Northern Domain.

The AERMOD modelling system includes the AERMOD dispersion model, the AERMET meteorological pre-processor and the AERMAP terrain pre-processor. The following approved dispersion model and pre-processors were used in the assessment:

- AERMOD dispersion model (v. 24142)
- AERMAP surface pre-processor (v. 18081), and
- BPIP building downwash pre-processor (v. 04274).

The AERMOD model domain for the Northern Domain is a 30 km by 30 km area centered on the Grays Bay Port and encompasses Grays Bay Port, the aerodrome, and approximately 15 km segment of the Grays Bay Road connected to the Port. The modelling domain is shown in Figure 6.1.

Figure 6.1 AERMOD Model Domain



6.1.1 Meteorological Data

A five-year (2020 – 2024) regional meteorological dataset was prepared for AERMOD using the most recent version of the U.S. EPA AERMET meteorological pre-processor executable (Version 24142) from prognostic meteorological modelled data (i.e., weather data that is forecasted using numerical weather prediction model) that was obtained from Lakes Environmental Consultants Inc. The data was supplied as AERMET/AERMOD-ready formats for direct use in AERMOD. The modelled data was centered at 67.797°N, 110.860°W, which is located at the Port. The meteorological files were created by processing the prognostic meteorological model output fields by the U.S. EPA Mesoscale Model Interface Program (MMIF). This includes use of the MMIF-generated AERSURFACE output file which contains the surface characteristics (albedo, Bowen ratio, and surface roughness length) of the modelling domain.

The AERMOD-ready five-year meteorological data (2020 – 2024) is viewed as being representative of the wide range of weather conditions that could occur in the region. The wind rose derived from the 2020 – 2024 AERMET data indicates dominant winds from the west and west-southwest, with a minor component from the south (Figure 6.2), which is in reasonable agreement with the measured winds at the Grays Bay meteorological station (Figure 6.3). It should be noted that at the time of preparation of this assessment report, data from the on-site meteorological station was only available from August 19, 2024 to November 5, 2024.

Figure 6.2 Windrose Derived from the AERMET 5-Year Meteorological Data

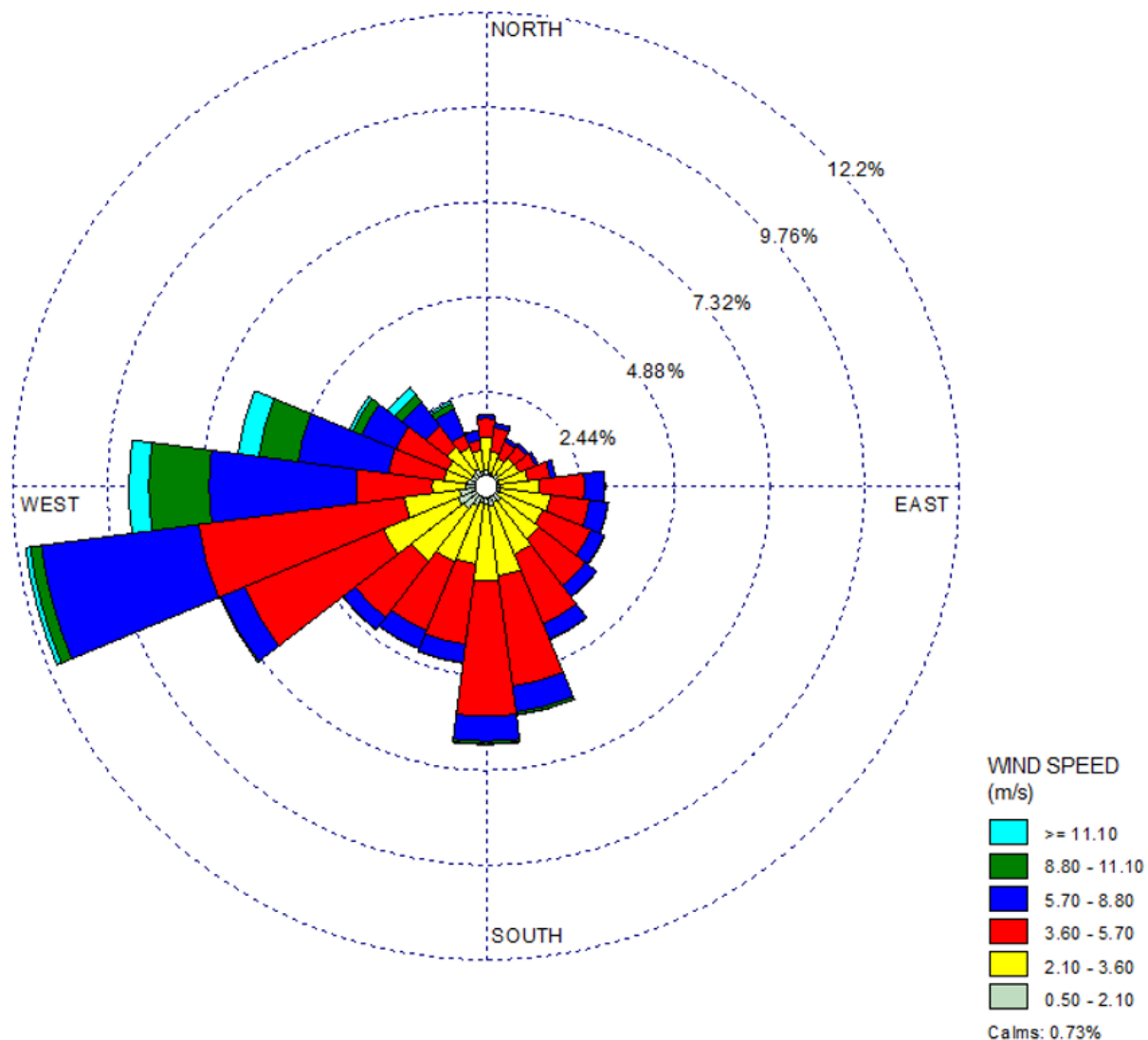
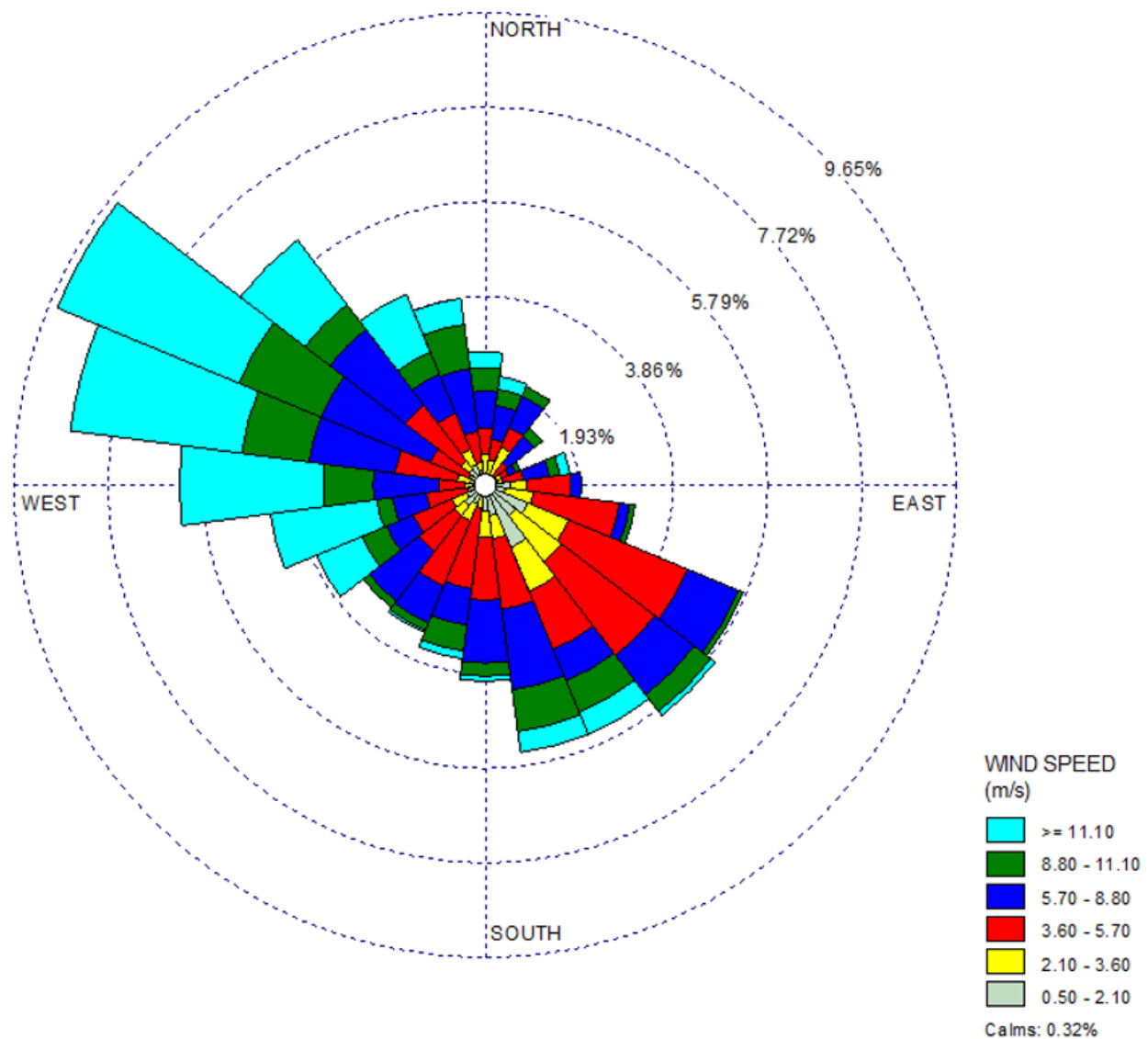


Figure 6.3 Windrose Derived from Grays Bay Meteorological Station Data (August 19, 2024 to November 5, 2024)



6.1.2 Model Sources

Emission sources from Construction and Operation and Maintenance phases were modelled in AERMOD as one of the following types depending on the nature of the source and the emission release to the atmosphere. Different input parameters are used to represent the different source types:

- **Point source:** emissions from an industrial stack; parameters required for each stack include stack height, stack diameter, stack gas exit temperature and stack gas exit velocity.
- **Area source:** emission distributed over an area; parameters required for each area source include release height and initial vertical dimension (σ_z), which accounts for the initial vertical dispersion of the plume.
- **Line Area source:** emissions distributed along a line; parameters required for each road source include release height, and initial vertical (σ_z) and horizontal dimension (σ_y), which account for the initial vertical and horizontal dispersion of the plume. Emission rates are specified per metre of road length.
- **Line Volume source:** emissions distributed along a line with elevated release; parameters required for each line volume source release height, and initial vertical (σ_z) and horizontal dimension (σ_y), which account for the initial vertical and horizontal dispersion of the plume.

6.1.2.1 Project Construction

The waste incinerator was modelled as a point source, with stack design parameters included in the air dispersion model. Stack design parameters were based on a similar capacity incinerator from a mine project.

Port construction and quarry operations were modelled as area sources. The emission sources for Port construction include diesel combustion in non-road equipment and on-road vehicles, fugitive dust emissions from bulldozing, grading, and non-road equipment movement. The Port area source was defined as the size of the Port. The emission sources for quarry operations include fugitive dust emissions from drilling, blasting (including ANFO combustion), and material handling (e.g., screening, crushing, stacking). Based on the proposed equipment for use within the quarry, the quarry was modeled as an area source with a radius of 50 m. Summer, and winter control factors were applied to fugitive dust emissions using AERMOD's variable emissions option.

The power generators at the Port were modeled as two point sources, located within the Port area source. Stack parameters for the generators were taken from manufacturer specifications provided in Appendix B.

Aerodrome emissions were modelled as an area source. The size of the area source was based on the design length of the gravel landing strip (i.e., 6,000 ft [1,828.8 m] in length, 50 m wide).

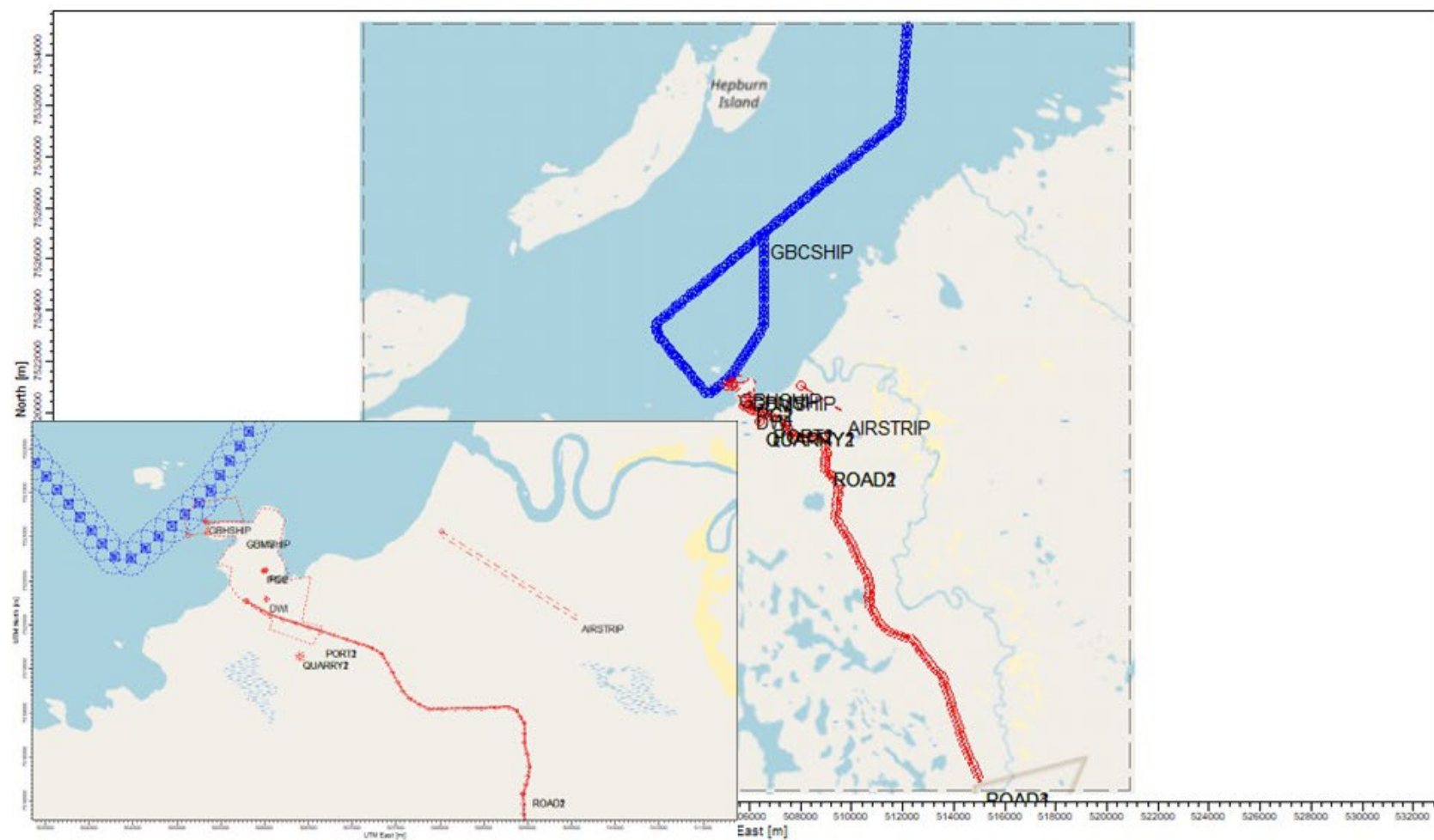
Emissions associated with road construction were modelled as a line area source. The source was defined as a 19 km strip of road exiting the Port. To scale the annual, daily and hourly emissions for the Construction phase to each segment of the road, the mass emission rate for each averaging period was divided by the area of the road, assuming that Northern Road construction would proceed at 38.34 km per year.

Shipping sources were modeled as a point source (vessel hoteling emissions), an area source (vessel maneuvering emissions), and a line volume source (vessel cruising emissions).

In total, fifteen (15) model sources were created in AERMOD to model the project emissions. Detailed information about the modelled sources and source parameters is provided in Appendix A. The modelled emission sources at the Port during construction are shown on Figure 6.4 (Lakes Environmental Software 2025). These sources include:

- One (1) point source representing the incinerator (DWI)
- Area source representing Port construction (diesel combustion tailpipe exhaust emissions from non-road equipment and on-road vehicles during site preparation, and unpaved road dust emissions from non-road equipment and on-road vehicles).
- Two (2) point sources representing the two diesel-powered generators (PG1 and PG2)
- One (1) area source representing aerodrome operations during construction (AIRSTRIP).
- Line area sources representing emissions along the road leading out of the Port:
 - ROAD1 – on-road vehicle movement on unpaved roads in Port (both tailpipe exhaust emissions and unpaved road dust)
 - ROAD2 – on-road vehicle movement on unpaved roads outside Port (both tailpipe exhaust emissions and unpaved road dust)
- Area source representing quarry operations – blasting, and quarrying activities (drilling, material handling, crushing and screening – during construction).
- Three (3) sources were defined to represent shipping vessel activities:
 - GBHSHIP – a point source representing a shipping vessel hoteling,
 - GBMSHIP – an area source representing a shipping vessel maneuvering, and
 - GBCSHIP – a line volume source representing a shipping vessel cruising.

Figure 6.4 AERMOD Source Distribution



6.1.2.2 *Project Operations and Maintenance*

The same fifteen sources listed in Section 6.1.2.1 were used to model the Operations and Maintenance phase. The main difference in source characterization is that PORT1 no longer includes site preparation activities. The modelled emission sources at the Port during operations are the same as those shown on Figure 6.4 (Lakes Environmental Software 2025).

6.1.3 Receptors and Terrain

Ambient ground level concentration and deposition patterns were predicted at modelled receptor locations within the AERMOD model domain and outside the PDA boundary. The grid receptors and sensitive receptors modelled in AERMOD are described in the following sections.

6.1.3.1 *Grid Receptors*

Grid receptors were chosen based on recommendations provided in Section 7.2 of the BC Air Quality Dispersion Modelling Guideline (ENVP 2022). A 30 km by 30 km nested receptor grid, centered on the emission sources, was placed as follows:

- a) 20 m spacing along the PDA boundary
- b) 50 m spacing, within an area of 6,000 m by 6,000 m
- c) 250 m spacing, within an area of 8,500 m by 8,500 m surrounding the area described in (a)
- d) 1,000 m spacing, within an area of 14,000 m by 14,000 m surrounding the area described in (b), and
- e) 2,000 m spacing, within an area of 30,000 m by 30,000 m surrounding the area described in (c).

The nested receptor grid locations are shown as red cross symbols and the receptors along the PDA boundary are shown as yellow cross symbols in Figure 6.5 (Lakes Environmental Software 2025). The receptor grid consists of 11,691 gridded receptor points.

Receptor locations within 1-km of the shipping vessel cruising route were excluded from the assessment. This distance was used to be consistent with the public safety buffer zone around the Project.

Terrain elevations were applied to the receptor locations using the GTOPO30 global digital elevation model with spatial resolution of 30 arc seconds in the south-north direction and 30 arc seconds in the west-east direction, specific for the latitude of the Project. The terrain elevations are shown on Figure 6.6 (Lakes Environmental Software 2025).

Figure 6.5 AERMOD Receptor Grid

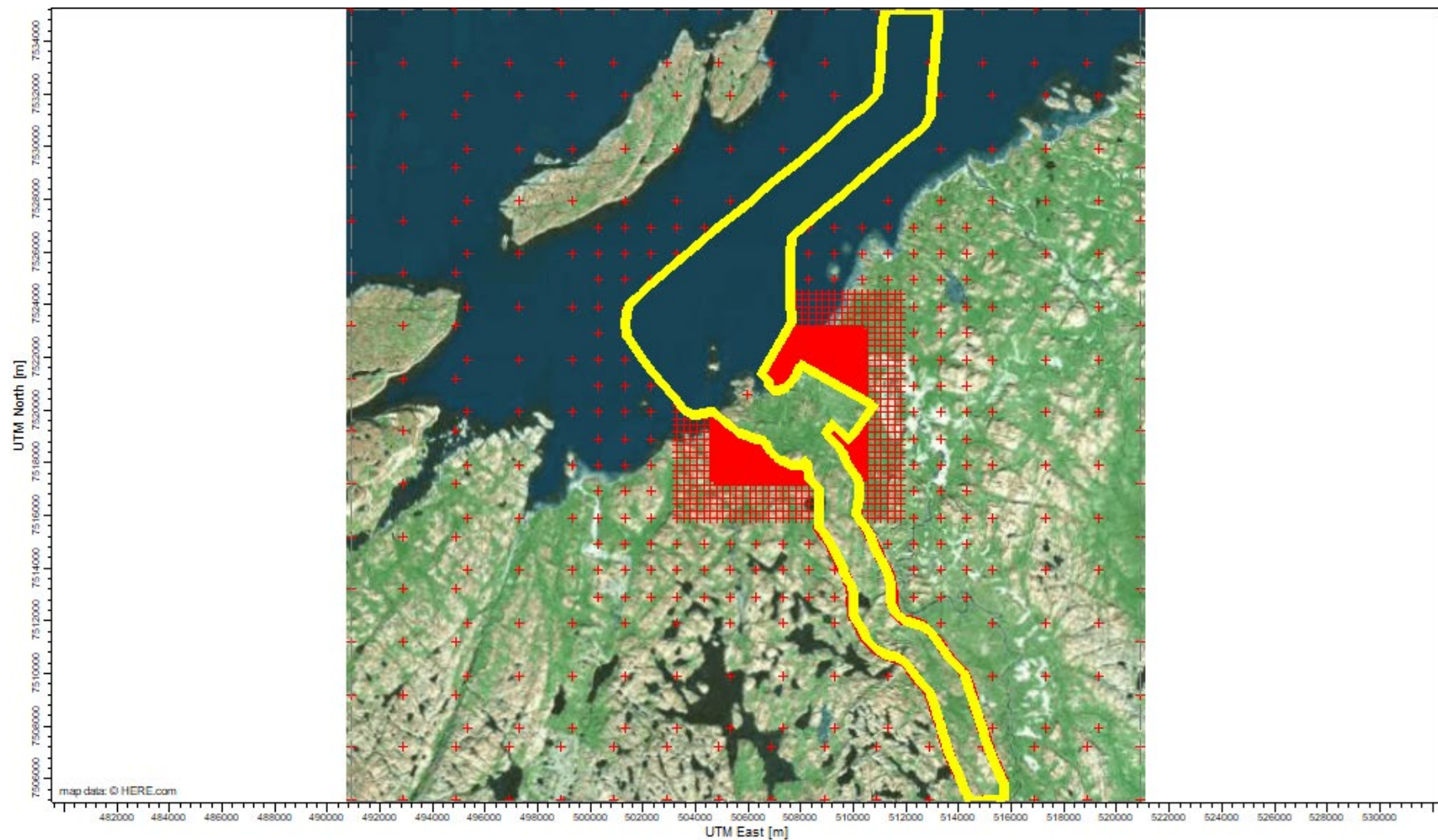
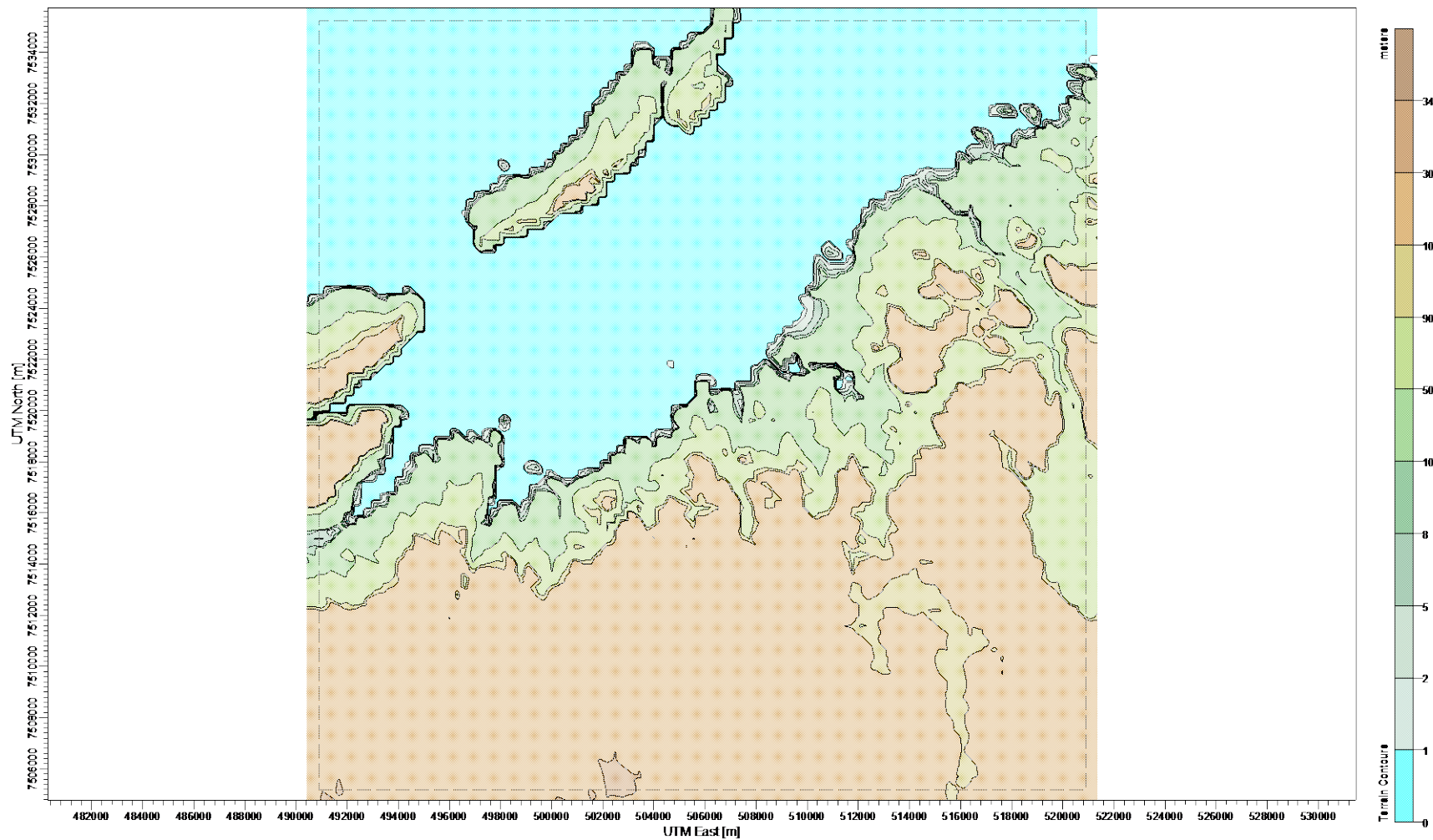


Figure 6.6 AERMOD Terrain Elevations



6.1.3.2 Sensitive Receptors

Local communities and areas of interest located within the RAA were reviewed for potential identification as sensitive receptors. That review indicated two potential sensitive receptors: the High Lake Mineral Exploration camp and the Ulu Mineral Exploration camp. The Ulu Mineral Exploration camp is located approximately 43 km south of Grays Bay Port and 1,000 m west from the proposed road. The High Lake Mineral Exploration camp is located approximately 100 km south of Grays Bay Port and 730 m to the west of the proposed road. The camp will open in 2027 and be open yearly between May to October.

To estimate air quality effects at the High Lake Mineral Exploration camp, emissions from road construction activities were modelled over the full five-year regional meteorological dataset. Model receptors were placed at a distance of 700 m to 800 m from the road south of the Port. To conservatively estimate potential effects at the High Lake Mineral Exploration camp, the maximum value of each ACPI (based on the relevant statistical form) over these model receptors was assumed to occur at the High Lake Mineral Exploration camp. The potential human health effects from the project's ACPI emissions at the High Lake and Ulu Mineral Exploration camps are summarized in the Human Health Risk Assessment (Volume 9, Appendix 26A of the IS).

6.1.4 Building Downwash Effects

Buildings or other solid structures may affect air flow near a source and cause building downwash effects (e.g., eddies on the downwind side), which have the potential to reduce plume rise and affect atmospheric dispersion. Building downwash effects may occur if the height of the stack is less than 2.5 times the height of an adjacent building. Adjacent buildings may also affect the stack if the stack is located in the building's region of influence defined as a distance of five times the lesser of the width or height of the crosswind face of the building.

Building downwash effects were considered for the two generator stacks at the Port. It was assumed that the power plant is enclosed in a 40 m by 50 m building with a 6 m height, and the generator stacks are 8 m tall.

6.1.5 Particulate Matter Deposition

Dry deposition of PM is the process of particles settling from the air to the ground due to gravity and micro meteorological and atmospheric processes. Wet deposition is the depletion of particles from the atmosphere by rain or snow. Total deposition (dry and wet deposition) of total PM was modelled in AERMOD. PM deposition is also referred to as dustfall.

Different physical processes govern the settling of PM of different sizes. For larger PM (greater than 20 µm), dry deposition is caused mainly by gravitational settling, while deposition of smaller PM is caused by micro meteorological and atmospheric processes. Wet deposition is proportional to the precipitation rate and a scavenging coefficient that depends on the particle size.

For deposition modelling, total PM is represented with a particle size distribution consisting of the following particle size categories:

- Particles with aerodynamic diameter smaller than 2.5 µm represented with a mass mean particle diameter of 2.5 µm.
- Particles with aerodynamic diameter between 2.5 µm and 10 µm represented with a mass mean particle diameter of 10 µm.
- Particles with aerodynamic diameter between 10 µm and 30 µm represented with a mass mean particle diameter of 30 µm.

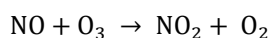
Particle size distributions for each particle size category are derived from particle size specific emission factors representative of the various construction and operational activities.

Total dustfall is estimated as the sum of the predicted dry and wet deposition for each particle size category.

Dustfall was assessed for consideration in other VCs (see Section 1), but not Community Health and Well-being. Therefore, total dustfall was not predicted for the High Lake Mineral Exploration camp.

6.1.6 Conversion of Nitric Oxide to Nitrogen Dioxide

Nitrogen oxides or NO_x is composed of nitric oxide (NO) and nitrogen dioxide (NO₂). However, only NO₂ has an ambient air quality criterion against which to evaluate the Project's model predicted ground level concentrations in ambient air. In combustion emissions, typically most of the NO_x emissions are NO and only a small percentage are NO₂. Once in the ambient air, NO is oxidized by ground level O₃ to produce NO₂ as follows:



The following lists different conversion treatments recommended by the U.S. EPA:

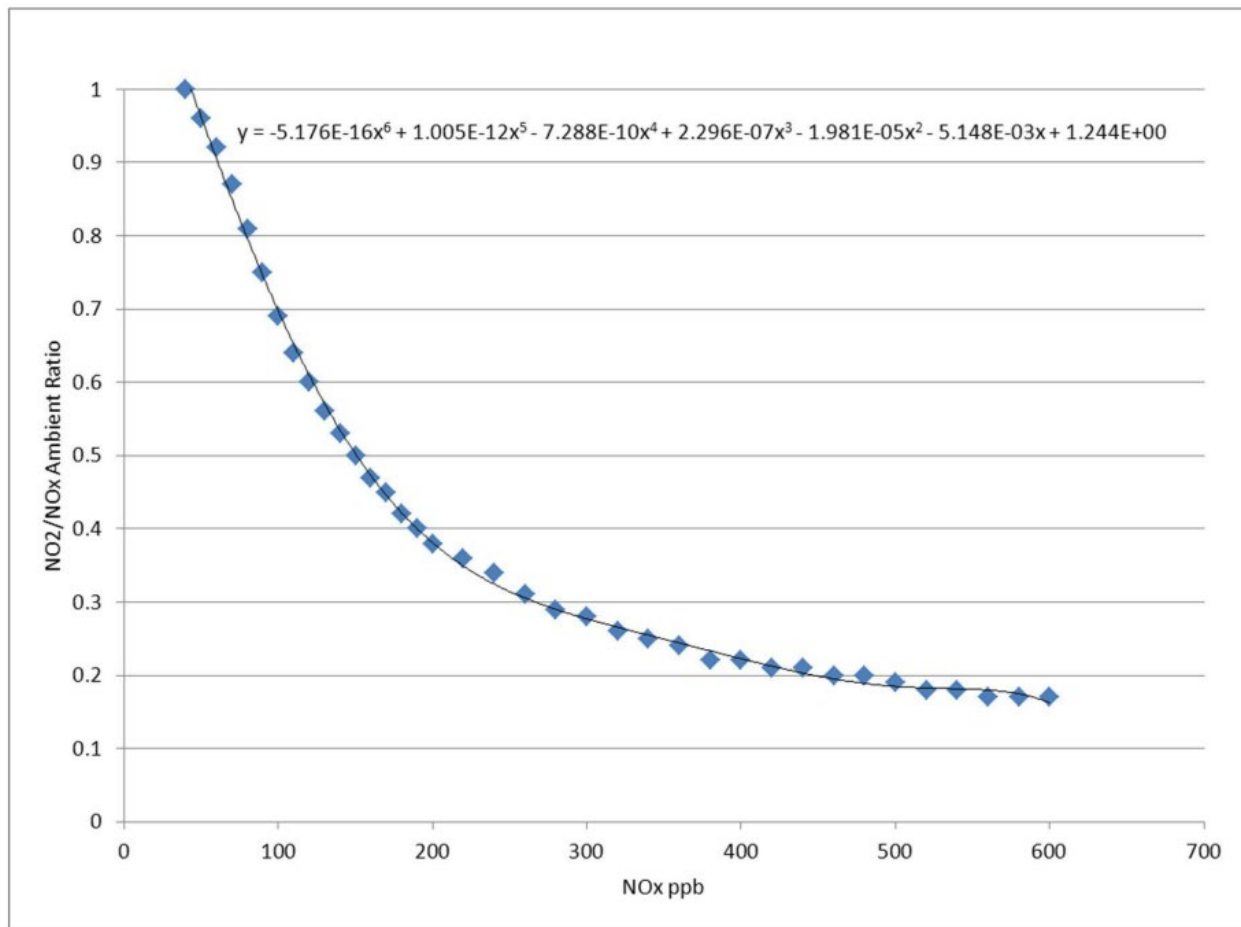
- Tier 1 - 100% of emitted NO_x converts to NO₂
- Tier 2 - Ambient Ratio Method (ARM2)
- Tier 3 - Ozone Limiting Method or Plume Volume Molar Ratio Method

In this assessment, the Ambient Ratio Method (ARM2) method was used to predict ambient NO₂ concentrations. The ARM2 module is built into the AERMOD model. This module applies a varying ambient ratio of NO₂ to total NO_x in the atmosphere to calculate NO₂ concentrations based on modelled NO_x concentrations (the ratio decreases with increasing NO_x concentrations). In the application of ARM2, the ratios assume that all NO_x/NO₂ concentrations are expressed in parts per billion (ppb) using the following equation from the British Columbia Ministry of Environment and Climate Change Strategy (BCMECCS 2022):

$$\mu\text{g}/\text{m}^3 = \text{ppb} * 1.88$$

Figure 6.7 presents the ambient ratios and the ARM2 equation (RTP 2013).

Figure 6.7 Ambient NO₂/NO_x Ratios and ARM2 Equation



The ratios applied in this study were constrained to a maximum of 0.90 and a minimum value of 0.10, based on the current U.S. EPA in-stack ratio database (U.S. EPA 2025) and consistent with diesel engines in-stack ratios.

6.1.7 Atmospheric Chemistry and Formation of Secondary PM_{2.5}

Atmospheric chemistry is not simulated in AERMOD. Thus, secondary formation of fine particulate matter (PM_{2.5}) from nitrates and sulphates is not modelled. The formation of secondary PM_{2.5} is not considered substantial compared to the amount of fugitive dust generated from the various construction activities.

6.1.8 Acid Deposition

As outlined in Section 1.2, PAI is defined as the difference between deposited acidic anions and basic cations. It is expressed in terms of kiloequivalents of hydrogen ion per hectare per year ($\text{keq H}^+ \text{ha}^{-1} \text{yr}^{-1}$). Anion deposition is comprised of total sulphate (SO_4^{2-}) and nitrate (NO_3^-) equivalents, which are calculated by considering the total deposition of all modelled sulphur and nitrogen species as follows:

$$\begin{aligned} [\text{SO}_4^{2-}]_{\text{dep.equiv}} &= 1.5 [\text{SO}_2]_{\text{dep}} + 1.0 [\text{SO}_4^{2-}]_{\text{dep}} \\ [\text{NO}_3^-]_{\text{dep.equiv}} &= 2.07 [\text{NO}]_{\text{dep}} + 1.35 [\text{NO}_2]_{\text{dep}} + 0.98 [\text{HNO}_3]_{\text{dep}} + 1.0 [\text{NO}_3^-]_{\text{dep}} \end{aligned}$$

where the deposition equivalents in the above equations are expressed in units of kilogram per hectare per year ($\text{kg ha}^{-1} \text{yr}^{-1}$), and the leading constants are the respective ratios of the molecular mass of sulphate/nitrate to that of the species associated with the constant.

The PAI can then be calculated from the sulphur and nitrogen deposition rates according to the following equation:

$$\text{PAI} = \frac{[\text{SO}_4^{2-}]_{\text{dep.equiv}}}{48} + \frac{[\text{NO}_3^-]_{\text{dep.equiv}}}{62}$$

For this study, PAI were calculated using yearly sulphur and nitrogen deposition fluxes conservatively predicted by AERMOD for each scenario. The sulphur deposition flux was estimated by assuming that either there was no chemical transformation of SO_2 to SO_4^{2-} or there was 100% transformation and the SO_4^{2-} deposition flux was predicted assuming that all SO_4^{2-} was particulate in the $\text{PM}_{2.5}$ size range. The larger of these two alternatives was used to conservatively estimate the SO_4^{2-} deposition equivalent. Likewise, the NO_3^- deposition equivalent was conservatively estimated by assuming no chemical transformation to nitrates (NO and NO_2 estimated by running AERMOD with and without the ARM2 option) or or there was 100% transformation and the NO_3^- deposition flux was predicted assuming that all NO_3^- was particulate in the $\text{PM}_{2.5}$ size range. The larger of these two alternatives was used to conservatively estimate the NO_3^- deposition equivalent. PAI was assessed for consideration in other VCs (see Section 1.2), but not Community Health and Well-being. Therefore, PAI was not predicted for the High Lake Mineral Exploration camp.

7 Dispersion Model Results

Maximum predicted ambient concentrations and dustfall for the ACPI are predicted for the worst-case year of construction (Year 2) and the worst-case year for operations and maintenance (Year 7) within the 30 km by 30 km Northern model domain.

Existing air quality conditions are represented by the baseline concentrations. The baseline concentrations are added to the model-predicted maximum concentrations for each project phase to account for other existing emission sources (natural and anthropogenic) that have not been directly included in the model simulation. The model predicted maximum concentrations, including the baseline contribution, are compared to the SOGs. The maximum predicted concentrations within the 30 km x 30 km model domain are based on areas along and outside the project boundary (i.e., locations where public access is not restricted).

The maximum predicted concentrations and dustfall results are discussed for the Construction and Operations and Maintenance phases in the following sections.

7.1 Project Construction Phase

Summaries of the maximum predicted ACPI concentrations in the 30 km x 30 km model domain and at the High Lake Mineral Exploration Camp during project construction are provided in Table 7.1 and Table 7.2, respectively. The maximum predicted concentrations for the ACPI are compared to the applicable SOGs for each averaging period. Concentration contour maps for project construction are presented in Appendix C. Detailed discussion of the dispersion model predictions for each assessed ACPI is provided below.

7.1.1 Maximum TSP Concentrations

The maximum predicted 24-hour average TSP concentration including baseline is 229 $\mu\text{g}/\text{m}^3$ and is greater than the SOG of 120 $\mu\text{g}/\text{m}^3$. The maximum annual average TSP concentration including baseline is 24.2 $\mu\text{g}/\text{m}^3$, which is less than the SOG of 60 $\mu\text{g}/\text{m}^3$.

The maximum predicted 24-hour and annual TSP concentrations occur on the northeast PDA boundary at the Port (Appendix C, Figure C.1 and Figure C.3). TSP concentrations greater than the 24-hour SOG (120 $\mu\text{g}/\text{m}^3$) are predicted to occur infrequently (5 days/year) and are limited to areas immediately around the PDA boundary (Appendix C, Figure C.2).

Table 7.1 Project Construction Phase – Maximum Predicted Concentrations

ACPI	Averaging Period	Baseline Concentration (µg/m³)	Maximum Predicted Concentration in the LAA (µg/m³)	Maximum Predicted Concentration Including Baseline Concentration (µg/m³)	Maximum Frequency Above SOG (d/y)	SOG ^a (µg/m³)	CAAQS ^b (µg/m³)	% Max. Value of SOG	% Max. Value of CAAQS
TSP	24-hour ^c	7.5	221	229	5	120	-	190%	-
	Annual ^d	7.5	16.7	24.2	-	60	-	40%	-
PM ₁₀	24-hour ^c	3.8	107	111	4	50 ^e	-	221%	-
PM _{2.5}	24-hour ^f	7.0	12.3	19.3	-	27	27	71%	71%
	Annual ^g	2.0	2.13	4.13	-	8.8	8.8	47%	47%
NO ₂	1-hour ^h	9.4	148	158	127 ⁿ	79	79	199%	199%
	Annual ⁱ	6.0	17.3	23.3	-	23	23	101%	101%
SO ₂	1-hour ^j	16.3	45.7	62.0	-	170	170	36%	36%
	Annual ⁱ	5.0	0.162	5.16	-	10	10	52%	52%
CO	1-hour ^k	1,250	605	1,855	-	14,300 ^e	-	13%	-
	8-hour ^c	875	3,461	4,336	-	5,500 ^e	-	79%	-
Dustfall (mg/dm²/day)	30-day	1.13	0.49	1.62	-	1.75 ^l / 2.9 ^m	-	93% / 56%	-
Potential Acid Input (keq H ⁺ /ha/y)	Annual	0.00123	0.0782	0.0794	-	-	-	-	-

Notes:

- ^a Values based on Government of Nunavut 2023 (2011 version for TSP) unless otherwise indicated
- ^b CAAQS (CCME 2025)
- ^c The maximum (1st highest) concentration
- ^d Expressed as the geometric mean
- ^e BC AAQO (ENVP 2021)
- ^f The annual 98th percentile (8th highest) of daily average concentrations, averaged over three consecutive years
- ^g The three-year average of the annual average of the daily 24-hour average concentrations
- ^h The annual 98th percentile (8th highest) of the daily maximum 1-hour average concentrations, averaged over three consecutive years
- ⁱ The annual average of 1-hour average concentrations, averaged over one year
- ^j The annual 99th percentile (4th highest) of the daily maximum 1-hour concentrations, averaged over three consecutive years
- ^k Determination of 1-hour CO concentration based on 9th highest of all 1-hour concentrations
- ^l Dustfall PCO for residential/parkland areas (ENVP 2020)
- ^m Dustfall PCO for industrial/other areas (ENVP 2020)
- ⁿ Seven (7) days of exceedance were removed from the maximum days of exceedance per day to be consistent with the 1-hour NO₂ CAAQS metric
- d/y – days per year

Baseline Concentrations provided as maximum over the relevant averaging period.

Bold values are greater than the applicable regulatory criteria.

Table 7.2 Project Construction Phase – Maximum Predicted Concentrations at High Lake Mineral Exploration Camp

ACPI	Averaging Period	Baseline Concentration (µg/m³)	Maximum Predicted Concentration at the Camp (µg/m³)	Maximum Predicted Concentration Including Baseline Concentration (µg/m³)	SOG ^a (µg/m³)	CAAQS ^b (µg/m³)	% Max. Value of SOG	% Max. Value of CAAQS
TSP	24-hour ^c	7.5	8.99	16.5	120	-	14%	-
	Annual ^d	7.5	1.0	8.5	60	-	14%	-
PM ₁₀	24-hour ^c	3.8	2.7	6.5	50 ^e	-	13%	-
PM _{2.5}	24-hour ^f	7.0	0.36	7.4	27	27	27%	27%
	Annual ^g	2.0	0.090	2.1	8.8	8.8	24%	24%
NO ₂	1-hour ^h	9.4	22	31	79	79	40%	40%
	Annual ⁱ	6.0	0.89	6.9	23	23	30%	30%
SO ₂	1-hour ^j	16.3	0.0385	16.3	170	170	9.6%	9.6%
	Annual ⁱ	5.0	0.0013	5.0	10	10	50%	50%
CO	1-hour ^k	1,250	8.87	1,259	14,300 ^e	-	8.8%	-
	8-hour ^c	875	5.2	880	5,500 ^e	-	16%	-

Notes:

- ^a Values based on Government of Nunavut 2023 (2011 version for TSP) unless otherwise indicated
 - ^b CAAQS (CCME 2025)
 - ^c The maximum (1st highest) concentration
 - ^d Expressed as the geometric mean
 - ^e BC AAQO (ENVP 2021)
 - ^f The annual 98th percentile (8th highest) of daily average concentrations, averaged over three consecutive years
 - ^g The three-year average of the annual average of the daily 24-hour average concentrations
 - ^h The annual 98th percentile (8th highest) of the daily maximum 1-hour average concentrations, averaged over three consecutive years
 - ⁱ The annual average of 1-hour average concentrations, averaged over one year
 - ^j The annual 99th percentile (4th highest) of the daily maximum 1-hour concentrations, averaged over three consecutive years
 - ^k Achievement for 1-hour CO based on 9th highest of all 1-hour concentrations
- Baseline Concentrations provided as maximum over the relevant averaging period.

7.1.2 Maximum PM₁₀ Concentrations

The maximum predicted 24-hour average PM₁₀ concentration including baseline is 111 µg/m³, which is greater than the SOG (50 µg/m³).

The maximum predicted 24-hour PM₁₀ concentration occurs on the northeast Port PDA boundary at the Port (Appendix C, Figure C.4). PM₁₀ concentrations greater than the 24-hour SOG (50 µg/m³) are predicted to occur infrequently (4 days/year) and are limited to areas immediately around the PDA boundary (Appendix C, Figure C.5).

7.1.3 Maximum PM_{2.5} Concentrations

The maximum predicted 24-hour and annual average PM_{2.5} concentrations including baseline are 19.3 µg/m³ and 4.13 µg/m³, respectively, and are less than the respective SOG/CAAQS.

The maximum predicted 24-hour and annual PM_{2.5} concentrations occur on the northeast PDA boundary at the Port (Appendix C, Figure C.6 and Figure C.7).

7.1.4 Maximum NO₂ Concentrations

The maximum predicted 1-hour average NO₂ concentration in the metric of the CAAQS, including baseline, is 158 µg/m³ and is greater than the 1-hour CAAQS (79 µg/m³). The maximum predicted annual average NO₂ concentration, including baseline, is 23.3 µg/m³ and is at the annual CAAQS (23 µg/m³).

The maximum predicted 1-hour and annual NO₂ concentrations occur on the northeast PDA boundary at the Port (Appendix C, Figure C.8 and Figure C.10). Predicted NO₂ concentrations greater than the 1-hour CAAQS (79 µg/m³) extend up to 2 km from the PDA boundary along the shoreline and 6 km over Grays Bay (Appendix C, Figure C.9). The maximum predicted exceedances along the northeast PDA boundary are 127 days/year. NO₂ exceedances decrease with distance, dropping to fewer than 30 days/year within 1.5 km along the shoreline from the PDA boundary.

7.1.5 Maximum SO₂ Concentrations

The maximum predicted 1-hour and annual average SO₂ concentrations including baseline are 62.0 µg/m³ and 5.16 µg/m³, respectively, and are less than the respective CAAQS.

The maximum predicted 1-hour and annual SO₂ concentrations occur on the northeast PDA boundary at the Port (Appendix C, Figure C.11 and Figure C.12).

7.1.6 Maximum CO Concentrations

The maximum predicted 1-hour (9th highest) and 8-hour average CO concentrations including baseline are 1,855 µg/m³ and 4,336 µg/m³, respectively, and are less than the respective SOGs.

The maximum predicted 1-hour (9th highest) CO concentration occurs on the southwest PDA boundary at the Port (Appendix C, Figure C.13). The maximum predicted 8-hour CO concentration occurs on the northeast PDA boundary at the Port (Appendix C, Figure C.14).

7.1.7 Maximum Dustfall

The maximum predicted 30-day average dustfall including baseline is 1.62 mg/dm²/day and is less than the BC PCO for residential/parkland areas (1.75 mg/dm²/day) and industrial/other areas (2.9 mg/dm²/day).

The maximum predicted dustfall occurs on the northeast PDA boundary at the Port (Appendix C, Figure C.15).

7.1.8 Maximum Potential Acid Input

The maximum predicted annual PAI including baseline is 0.0794 keq H⁺ /ha/y.

7.1.9 Model Predictions at High Lake Mineral Exploration Camp

The ACPI were assessed at the High Lake Mineral Exploration Camp, the nearest sensitive receptor to the Project. The maximum predicted concentrations of all ACPI at the High Lake Mineral Exploration Camp are below their relevant SOGs.

7.2 Project Operations and Maintenance Phase

Summaries of the maximum predicted ACPI concentrations in the 30 km x 30 km model domain and at the High Lake Mineral Exploration Camp during operations and maintenance are provided in Table 7.3 and Table 7.4, respectively. The maximum predicted concentrations for the ACPI are compared to the applicable SOGs for each averaging period. Concentration contour maps for operations and maintenance are presented in Appendix D. Detailed discussion of the dispersion model predictions for each assessed ACPI is provided below.

7.2.1 Maximum TSP Concentrations

The maximum predicted 24-hour and annual average TSP concentrations including baseline are 59.0 µg/m³ and 10.3 µg/m³, respectively, and are less than the relevant SOGs.

The maximum predicted 24-hour and annual TSP concentrations occur on the northeast PDA boundary at the Port (Appendix D, Figure D.1 and Figure D.2).

7.2.2 Maximum PM₁₀ Concentrations

The maximum predicted 24-hour average PM₁₀ concentration including baseline is 30.2 µg/m³ and is less than the SOG (50 µg/m³).

The maximum predicted 24-hour PM₁₀ concentration occurs on the northeast Port PDA boundary at the Port (Appendix D, Figure D.3).

Table 7.3 Project Operations and Maintenance Phase – Maximum Predicted Concentrations

Substance	Averaging Period	Baseline Concentration (µg/m³)	Maximum Predicted Concentration in the LAA (µg/m³)	Maximum Predicted Concentrations Including Baseline Concentration (µg/m³)	Maximum Frequency Above SOG (d/y)	SOG ^a (µg/m³)	CAAQS ^b (µg/m³)	% Max. Value of SOG	% Max. Value of CAAQS
TSP	24-hour ^c	7.5	51.5	59.0	-	120	-	49%	-
	Annual ^d	7.5	2.77	10.3	-	60	-	17%	-
PM ₁₀	24-hour ^c	3.8	26.4	30.2	-	50 ^e	-	60%	-
PM _{2.5}	24-hour ^f	7.0	2.19	9.19	-	27	27	34%	34%
	Annual ^g	2.0	0.434	2.43	-	8.8	8.8	28%	28%
NO ₂	1-hour ^h	9.4	108	117	14 ⁿ	79	79	149%	149%
	Annual ⁱ	6.0	5.88	11.9	-	23	23	52%	52%
SO ₂	1-hour ^j	16.3	8.65	25.0	-	170	170	15%	15%
	Annual ⁱ	5.0	0.051	5.05	-	10	10	51%	51%
CO	1-hour ^k	1,250	261	1,511	-	14,300 ^e	-	11%	-
	8-hour ^c	875	622	1,497	-	5,500 ^e	-	27%	-
Dustfall (mg/dm²/day)	30-day	1.13	0.13	1.26	-	1.75 ^l / 2.9 ^m	-	72% / 43%	-
Potential Acid Input (keq H ⁺ /ha/y)	Annual	0.00123	0.0662	0.0674	-	-	-	-	-

Notes:

- ^a Values based on Government of Nunavut 2023 (2011 version for TSP) unless otherwise indicated
- ^b CAAQS (CCME 2025)
- ^c The maximum (1st highest) concentration
- ^d Expressed as the geometric mean
- ^e BC AAQO (ENVP 2021)
- ^f The annual 98th percentile (8th highest) of daily average concentrations, averaged over three consecutive years
- ^g The three-year average of the annual average of the daily 24-hour average concentrations
- ^h The annual 98th percentile (8th highest) of the daily maximum 1-hour average concentrations, averaged over three consecutive years
- ⁱ The annual average of 1-hour average concentrations, averaged over one year
- ^j The annual 99th percentile (4th highest) of the daily maximum 1-hour concentrations, averaged over three consecutive years
- ^k The 1-hour CO based on 9th highest of all 1-hour concentrations
- ^l Dustfall PCO for residential/parkland areas (ENVP 2020)
- ^m Dustfall PCO for industrial/other areas (ENVP 2020)
- ⁿ Seven (7) days of exceedance were removed from the maximum days of exceedance per day to be consistent with the 1-hour NO₂ CAAQS metric
- d/y – days per year

Baseline Concentrations provided as maximum over the relevant averaging period.

Bold values are greater than the applicable regulatory criteria.

Table 7.4 Project Operations and Maintenance Phase – Maximum Predicted Concentrations at High Lake Mineral Exploration Camp

Substance	Averaging Period	Baseline Concentration (µg/m³)	Maximum Predicted Concentration at the Camp (µg/m³)	Maximum Predicted Concentrations Including Baseline Concentration (µg/m³)	SOG ^a (µg/m³)	CAAQS ^b (µg/m³)	% Max. Value of SOG	% Max. Value of CAAQS
TSP	24-hour ^c	7.5	0.49	8.0	120	-	6.7%	-
	Annual ^d	7.5	0.044	7.5	60	-	13%	-
PM ₁₀	24-hour ^c	3.8	0.16	4.0	50 ^e	-	7.9%	-
PM _{2.5}	24-hour ^f	7.0	0.024	7.0	27	27	26%	26%
	Annual ^g	2.0	0.0061	2.0	8.8	8.8	23%	23%
NO ₂	1-hour ^h	9.4	2.1	11	79	79	15%	15%
	Annual ⁱ	6.0	0.085	6.1	23	23	26%	26%
SO ₂	1-hour ^j	16.3	0.010	16.3	170	170	9.6%	9.6%
	Annual ⁱ	5.0	0.00034	5.0	10	10	50%	50%
CO	1-hour ^k	1,250	0.919	1,251	14,300 ^e	-	8.7%	-
	8-hour ^c	875	0.55	876	5,500 ^e	-	16%	-

Notes:

- ^a Values based on Government of Nunavut 2023 (2011 version for TSP) unless otherwise indicated
- ^b CAAQS (CCME 2025)
- ^c The maximum (1st highest) concentration
- ^d Expressed as the geometric mean
- ^e BC AAQO (ENVP 2021)
- ^f The annual 98th percentile (8th highest) of daily average concentrations, averaged over three consecutive years
- ^g The three-year average of the annual average of the daily 24-hour average concentrations
- ^h The annual 98th percentile (8th highest) of the daily maximum 1-hour average concentrations, averaged over three consecutive years
- ⁱ The annual average of 1-hour average concentrations, averaged over one year
- ^j The annual 99th percentile (4th highest) of the daily maximum 1-hour concentrations, averaged over three consecutive years
- ^k Achievement for 1-hour CO based on 9th highest of all 1-hour concentrations

Baseline Concentrations provided as maximum over the relevant averaging period.

7.2.3 Maximum PM_{2.5} Concentrations

The maximum predicted 24-hour and annual average PM_{2.5} concentrations including baseline are 9.19 µg/m³ and 2.43 µg/m³, respectively, and are less than the respective SOG/CAAQS.

The maximum predicted 24-hour and annual PM_{2.5} concentrations occur on the northeast PDA boundary at the Port (Appendix D, Figure D.4 and Figure D.5).

7.2.4 Maximum NO₂ Concentrations

The maximum predicted 1-hour average NO₂ concentration in the metric of the CAAQS, including baseline, is 117 µg/m³ and is greater than the 1-hour CAAQS (79 µg/m³). The maximum predicted annual average NO₂ concentration, including baseline, is 11.9 µg/m³ and is less than the annual CAAQS (23 µg/m³).

The maximum predicted 1-hour and annual NO₂ concentrations occur on the northeast PDA boundary at the Port (Appendix D, Figure D.6 and Figure D.8). NO₂ concentrations greater than the 1-hour CAAQS (79 µg/m³) are predicted to occur infrequently (14 days/year) and are limited to areas immediately around the PDA boundary (Appendix D, Figure D.7).

7.2.5 Maximum SO₂ Concentrations

The maximum predicted 1-hour and annual average SO₂ concentrations including baseline are 25.0 µg/m³ and 5.05 µg/m³, respectively, and are less than the respective CAAQS.

The maximum predicted 1-hour and annual SO₂ concentrations occur on the northeast PDA boundary at the Port (Appendix D, Figure D.9 and Figure D.10).

7.2.6 Maximum CO Concentrations

The maximum predicted 1-hour (9th highest) and 8-hour average CO concentrations including baseline are 1,511 µg/m³ and 1,497 µg/m³, respectively, and are less than the respective SOGs.

The maximum predicted 1-hour (9th highest) and 8-hour CO concentrations occur on the northeast PDA boundary at the Port (Appendix D, Figure D.11 and Figure D.12).

7.2.7 Maximum Dustfall

The maximum predicted 30-day average dustfall including baseline is 1.26 mg/dm²/day and is less than the BC PCO for residential/parkland areas (1.75 mg/dm²/day) and industrial/other areas (2.9 mg/dm²/day).

The maximum predicted dustfall occurs on the northeast PDA boundary at the Port (Appendix D, Figure D.13).

7.2.8 Maximum Potential Acid Input

The maximum predicted annual PAI including baseline is 0.0794 keq H⁺ /ha/y.

7.2.9 Model Predictions at High Lake Mineral Exploration Camp

The ACPI were assessed at the High Lake Mineral Exploration Camp, the nearest sensitive receptor to the Project. The maximum predicted concentrations of all ACPI at the High Lake Mineral Exploration Camp are below their relevant SOGs.

8 Model Prediction Uncertainty

The air quality assessment depends on air quality simulation models to link emissions to air quality changes, and the model predictions depend on the representativeness of the source and emission inventory, the meteorological conditions used in the model, and the algorithms used to represent atmospheric physics and chemistry processes in the models.

8.1 Emission Uncertainty

Diesel exhaust emissions from construction non-road and non-road equipment were based on emission factors generated by the U.S. EPA's Motor Vehicle Emission Simulator Model version 3 (MOVES3) (U.S. EPA 2021). Therefore, the level of confidence associated with the estimation of gaseous ACPI emissions (e.g., NO_x, SO₂, and CO) and PM from these sources is moderate to high.

Diesel exhaust emissions from power generation were based on manufacturer specifications and therefore, the level of confidence associated with the estimation of ACPI emissions (e.g., NO_x, SO₂, CO and PM) from these sources is moderate to high.

Aircraft exhaust emissions were estimated using emission factors based on aircraft category without a provided rating. Therefore, the level of confidence associated with the estimation of ACPI emissions (e.g., NO_x, SO₂, and CO) and PM from these sources is low.

Fugitive NO₂ emissions due to blasting operations are estimated using algorithms developed by the U.S. EPA that have a low emission factor rating. Consequently, the level of confidence associated with the estimation of NO₂ from blasting operations is low.

Fugitive PM (i.e., blasting operations, earth moving operations, quarrying activities, movement of non-road equipment and on-road vehicles along unpaved roads) (and associated TSP, PM₁₀ and PM_{2.5}) emission rates depend on the properties of the surface material, the occurrence and history of surface disturbances, and meteorological conditions. While the air quality assessment uses emission estimation algorithms developed by the U.S. EPA, there is uncertainty associated with estimating these emissions. Particularly, fugitive road dust emissions estimated with the U.S. EPA emission factors have been found to substantially overpredict PM emissions. This emissions overprediction results in overprediction of the associated ambient TSP, PM₁₀ and PM_{2.5} concentrations and dustfall deposition. Multiple investigators have found consistent overpredictions when comparing the predicted fugitive PM concentrations from air quality models to measured PM concentrations, typically by a factor of 2 to 6 (Pace 2005; Countess 2007; Pouliot et al. 2010).

Pace (2005) states that "Most experts agree that this overestimation is due to a combination of shortcomings in the inventory modelling process: 1) the multiplier used to "scale" or infer PM_{2.5} from PM₁₀ emissions in the inventory, 2) faulty emission factor algorithms, 3) imprecise or difficult to obtain activity data to apply these algorithms (including inability to account for the effect of actual meteorological conditions on emissions), and 4) modelling deficiencies (especially in the treatment of particles near their point of emissions)".

Practitioners often reduce particulate matter emission rates by a factor between 2 and 6 to account for these issues. In this assessment, fugitive dust emissions estimated using the U.S. EPA approach were used without reduction to obtain a first order understanding of potential magnitude, geographic extent, and frequency of the maximum concentrations in the LAA due to the Project. Therefore, the PM concentration and deposition predictions are expected to be conservative and overstated.

8.2 Meteorology Uncertainty

The application of five years of hourly meteorological data includes a wide range of conditions, which reduces the level of uncertainty related to meteorology. The use of five years of meteorological data is consistent with the recommendations provided in the BC Air Quality Dispersion Modeling Guideline (ENVP 2022). The level of confidence related to the meteorological data is rated as moderate to high.

8.3 Model Uncertainty

In terms of the air quality model algorithms, the U.S. EPA (2005) states:

“Models are reasonably reliable in estimating the magnitude of highest concentrations occurring sometime, somewhere within an area. For example, errors in highest estimated concentrations of ± 10 to $\pm 40\%$ are found to be typical, i.e., certainly well within the often quoted factor of two accuracy that has long been recognized for these models.”

In addition, they also state,

“it is desirable to quantify the accuracy or uncertainty associated with concentration estimates used in decision making. Communications between modelers and decision makers must be fostered and further developed.”

The U.S. EPA (2005) indicates that the application of regulatory dispersion models is viewed as a best estimate approach and that this approach should be viewed as acceptable to the decision maker. The model approach that was used for this assessment is viewed as being a best practice approach. The level of confidence related to the air dispersion model is rated as moderate to high.

8.4 Overall Prediction Confidence for Changes in Air Quality

The level of confidence is high for the estimated combustion emissions, the representativeness of the meteorological data, the selected model approach, and the overall effectiveness of the proposed mitigation measures. The prediction confidence associated with the estimation of fugitive dust emissions is medium to low. For this reason, an ambient air quality and meteorology monitoring program is recommended during construction and operations and maintenance to confirm the model predictions and determine the effectiveness of fugitive dust mitigation (Section 5.3).

9 Summary and Conclusions

An air quality assessment of the effects of TSP, PM₁₀, PM_{2.5}, NO₂, SO₂ and CO emissions from the Project was conducted.

The baseline ambient concentrations were determined based on a review of other recent EIS and Project Proposals submitted to the NIRB. The baseline review indicates that baseline air quality in the LAA is very good. The representative baseline air quality concentrations established for the Project are less than 6% to 63% of the corresponding SOGs.

Potential effects on ambient air quality associated with the Construction phase and the Operations and Maintenance phase at the Project Northern Domain (Grays Bay Port, Aerodrome and the northern segment of Grays Bay Road) were evaluated using the AERMOD atmospheric dispersion model and the air quality assessment was completed in accordance with industry best practices and additional guidance from the British Columbia Air Quality Dispersion Modelling Guideline (ENVP 2022). The Project Southern Domain (Jericho Station and the southern segment of Grays Bay Road) was not modelled because the Southern Domain emissions during the worst-case year of construction (Year 2) and the worst-year of operations and maintenance (Year 7) are less than the worst-case year emissions from the Northern Domain. The Jericho Station emissions during construction are less than half of the construction emissions from the Port (36% for TSP emissions and 43% for NO_x emissions). During operations and maintenance, the TSP emissions from Jericho Station are estimated to be similar to the emissions from the Port (91%), while the NO_x emissions are approximately half of the emissions from the Port (52%). Therefore, the effects of the Southern Domain emissions on air quality will be less than the Northern Domain.

During the Construction phase, the Project is predicted to increase ACPI concentrations above baseline, with some ACPI (TSP, PM₁₀ and NO₂) having maximum predicted concentrations within the LAA outside the PDA boundary greater than their applicable SOGs. The TSP and PM₁₀ exceedances during construction are infrequent (fewer than 5 days/year) and limited to areas immediately around the PDA boundary. The predicted maximum 1-hour NO₂ concentrations above the CAAQS extend up to 2 km along the shoreline and 6 km over Grays Bay, with the highest frequency of exceedance along the PDA boundary (up to 127 days/year). NO₂ exceedances decrease with distance, dropping to fewer than 30 days/year within 1.5 km of the PDA boundary along the shoreline. All predicted ACPI concentrations at the High Lake Mineral Exploration Camp during construction remain below applicable SOGs.

During the Operations and Maintenance phase, the Project is predicted to increase ACPI concentrations above baseline, with only NO₂ having a maximum predicted concentration within the LAA outside the PDA boundary greater than the CAAQS. The predicted NO₂ exceedances during operations and maintenance are infrequent (fewer than 14 days/year) and limited to areas immediately surrounding the PDA boundary. All predicted ACPI concentrations at the High Lake Mineral Exploration Camp during operations and maintenance remain below applicable SOGs.

The maximum predicted NO₂ concentrations at the Port camp are primarily influenced by diesel combustion from the power plant and diesel combustion exhaust from non-road equipment and on-road vehicles at the Port (Section 4.3.2.8).

An AQMP will be developed for project construction and operations and maintenance to monitor and manage the ambient air quality near the Project. The AQMP will include adaptive management recommendations to reduce fugitive dust emissions and evaluate the need for more rigorous dust mitigation. An AQMP will be developed after submission of the IS Monitoring will include meteorological monitoring (wind speed and direction, air temperature and relative humidity and rain precipitation) and ambient particulate monitoring for TSP and PM₁₀. If the monitoring program indicates that ground level TSP and PM₁₀ concentrations are greater than the relevant ambient criteria, additional mitigation measures to reduce particulate emissions will be implemented.

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Appendix A Construction Phase Emissions

CAC Emissions from Domestic Waste Incinerator

	entered data
	formula

Assumptions:		Construction	Operation	Sources
Work camp capacity	# people / site	30	40	Table 2.1 (Summary of Anticipated Project Requirements) of Project Proposal
# of campsites		4	2	Table 2.1 (Summary of Anticipated Project Requirements) of Project Proposal
Waste per person	kg/person/year	938	938	https://www.epa.gov/landmanagement/land-use-change-impact-assessment-report
	kg/person/day	2.5	2.5	approximated from BCCAC data
Domestic Waste	kg/d	800	200	

[illegible]

NOTES:

1. CAC emission factors (mg/Sm³ exhaust) based on Ontario Guideline A-7: Air Pollution Control, Design and Operation Guidelines for Municipal Waste Thermal Treatment Facilities (2010).

Standard Conditions (Ontario Guideline A-7):

- Temperature 25 °C
 - Pressure 101.325 kPa
 - Oxygen content 11 %
 - Water content nil (dry conditions)
2. Assume incinerators operate 24/7, 365 days per year
 3. Incinerator stack parameters based on similar capacity incinerator from another mine project.
 4. Incinerator exhaust temperature set to minimum required exhaust temperature (1,000 °C) in Ontario Guideline A-7 (2010)
 5. Assume two (2) incinerators to accommodate 800 kg/d waste during construction.

Emissions for Quarry Blasting Activities

SOURCE: Pits and quarries reporting guide (Environment and Climate Change Canada)

<https://www.canada.ca/en/environment-climate-change/services/national-pollutant-release-inventory/report/pits-quarries-guide.html>

Blasting Explosives for Construction

Activity	Emission Factor (kg/tonne explosive) ^a		
	CO	NOx	SO ₂
Explosive Detonation (Ammonium Nitrate Fuel Oil Mixtures) ^b	34	8	1

Reference: NPRI Blasting section 8.3 (Table 1)

Note: ^a US EPA AP-42 emission factor rating D

Note: ^b Explosives to be used will be primarily ammonium nitrate and diesel fuel (ANFO), according to Project Proposal.

Note: No VOC for blasting

Legend

entered data
formula

Blasts per week (Port/Jericho):	2 days/week
Operating Days/Year:	104 days
Operating Hours/Day:	1 hrs
Blasts per week (Road)	4 days/week
Operating Days/Year:	208 days
Operating Hours/Day:	1 hrs

Financial Year	CY30	CY31	CY32	CY33	CY34
Period From	1 Jan 30	1 Jan 31	1 Jan 32	1 Jan 33	1 Jan 34
Period To	31 Dec 30	31 Dec 31	31 Dec 32	31 Dec 33	31 Dec 34
Period Number	9	10	11	12	13
Days in Period	365	365	366	365	365

Unit

Quarrying Requirements for Port

Cubic Meters of Material	M ³	625,590	625,590	625,590	625,590
Explosives needed	Tonnes/year	626	626	626	626
CO	kg/year	21,270.06	21,270.06	21,270.06	21,270.06
NOx	kg/year	5,004.72	5,004.72	5,004.72	5,004.72
SO ₂	kg/year	625.59	625.59	625.59	625.59
CO	kg/day	204.52	204.52	204.52	204.52
NOx	kg/day	48.12	48.12	48.12	48.12
SO ₂	kg/day	6.02	6.02	6.02	6.02
CO	kg/hr	204.52	204.52	204.52	204.52
NOx	kg/hr	48.12	48.12	48.12	48.12
SO ₂	kg/hr	6.02	6.02	6.02	6.02

Quarrying Requirements for North Road

Cubic Meters of Material	M ³	1,109,219	1,109,219	1,109,219
Blasting material needed	Tonnes/year	1,109	1,109	1,109
CO	kg/year	37,713.44	37,713.44	37,713.44
NOx	kg/year	8,873.75	8,873.75	8,873.75
SO ₂	kg/year	1,109.22	1,109.22	1,109.22
CO	kg/day	181.31	181.31	181.31
NOx	kg/day	42.66	42.66	42.66
SO ₂	kg/day	5.33	5.33	5.33
CO	kg/hr	181.31	181.31	181.31
NOx	kg/hr	42.66	42.66	42.66
SO ₂	kg/hr	5.33	5.33	5.33

Quarrying Requirements for South Road

Cubic Meters of Material	M ³	684,293	684,293	684,293
Blasting material needed	Tonnes	684	684	684
CO	kg/year	23,265.95	23,265.95	23,265.95
NOx	kg/year	5,474.34	5,474.34	5,474.34
SO ₂	kg/year	684.29	684.29	684.29
CO	kg/day	111.86	111.86	111.86
NOx	kg/day	26.32	26.32	26.32
SO ₂	kg/day	3.29	3.29	3.29
CO	kg/hr	111.86	111.86	111.86
NOx	kg/hr	26.32	26.32	26.32
SO ₂	kg/hr	3.29	3.29	3.29

Quarrying Requirements for Jericho

Cubic Meters of Material	M ³	62,559	62,559
Blasting material needed	Tonnes	63	63
CO	kg/year	2,127.01	2,127.01
NOx	kg/year	500.47	500.47
SO ₂	kg/year	62.56	62.56
CO	kg/day	20.45	20.45
NOx	kg/day	4.81	4.81
SO ₂	kg/day	0.60	0.60
CO	kg/hr	20.45	20.45
NOx	kg/hr	4.81	4.81
SO ₂	kg/hr	0.60	0.60

Emissions for Quarry Blasting Activities

SOURCE: Pits and quarries reporting guide (Environment and Climate Change Canada)

<https://www.canada.ca/en/environment-climate-change/services/national-pollutant-release-inventory/report/pits-quarries-guide.html>

Boring/blast Hole Drilling for Construction

Parameter	Value	Source
Area of blasting (m ²)	1590	AP-42 Table 11.9-3 (Blasting Geometric Mean)
One blast hole (m ² /blast)	25	Based on open pit mine blasting from previous mining projects
Number of blast holes = Area / (blast per hole)	64	

Activity	Emission Factor (kg/hole) ¹		
	TSP	PM ₁₀	PM _{2.5}
Emission Factor (kg/hole)	0.59	0.32	0.31

Operating Time ²

Days per year	365 days/year
Hours per day	24 hours/day

Notes:

1. Reference: NPRI Blasting section 8.3

2. Assuming that drilling continuous throughout the day and is not dependent on the number of blasts

Financial Year	CY30	CY31	CY32	CY33	CY34
Period From	1 Jan 30	1 Jan 31	1 Jan 32	1 Jan 33	1 Jan 34
Period To	31 Dec 30	31 Dec 31	31 Dec 32	31 Dec 33	31 Dec 34
Period Number	9	10	11	12	13
Days in Period	365	365	366	365	365

Unit

Quarrying Requirements for Port

Number of blasts per year		104	104	104	104
Number of blasts per day		1	1	1	1
TSP	kg/year	3,902.50	3,902.50	3,902.50	3,902.50
PM ₁₀	kg/year	2,116.61	2,116.61	2,116.61	2,116.61
PM _{2.5}	kg/year	2,050.46	2,050.46	2,050.46	2,050.46
TSP	kg/day	10.69	10.66	10.69	10.69
PM ₁₀	kg/day	5.80	5.78	5.80	5.80
PM _{2.5}	kg/day	5.62	5.60	5.62	5.62
TSP	kg/hr	0.45	0.44	0.45	0.45
PM ₁₀	kg/hr	0.24	0.24	0.24	0.24
PM _{2.5}	kg/hr	0.23	0.23	0.23	0.23

Quarrying Requirements for North Road

Number of blasts per year		208	208	208
Number of blasts per day		1	1	1
TSP	kg/year	7,804.99	7,804.99	7,804.99
PM ₁₀	kg/year	4,233.22	4,233.22	4,233.22
PM _{2.5}	kg/year	4,100.93	4,100.93	4,100.93
TSP	kg/day	21.33	21.38	21.38
PM ₁₀	kg/day	11.57	11.60	11.60
PM _{2.5}	kg/day	11.20	11.24	11.24
TSP	kg/hr	0.89	0.89	0.89
PM ₁₀	kg/hr	0.48	0.48	0.48
PM _{2.5}	kg/hr	0.47	0.47	0.47

Quarrying Requirements for South Road

Number of blasts per year		208	208	208
Number of blasts per day		1	1	1
TSP	kg/year	7,804.99	7,804.99	7,804.99
PM ₁₀	kg/year	4,233.22	4,233.22	4,233.22
PM _{2.5}	kg/year	4,100.93	4,100.93	4,100.93
TSP	kg/day	21.33	21.38	21.38
PM ₁₀	kg/day	11.57	11.60	11.60
PM _{2.5}	kg/day	11.20	11.24	11.24
TSP	kg/hr	0.89	0.89	0.89
PM ₁₀	kg/hr	0.48	0.48	0.48
PM _{2.5}	kg/hr	0.47	0.47	0.47

Quarrying Requirements for Jericho

Number of blasts per year		104	104
Number of blasts per day		1	1
TSP	kg/year	3,902.50	3,902.50
PM ₁₀	kg/year	2,116.61	2,116.61
PM _{2.5}	kg/year	2,050.46	2,050.46
TSP	kg/day	10.69	10.66
PM ₁₀	kg/day	5.80	5.78
PM _{2.5}	kg/day	5.62	5.60
TSP	kg/hr	0.45	0.44
PM ₁₀	kg/hr	0.24	0.24
PM _{2.5}	kg/hr	0.23	0.23

Emissions for Quarry Blasting Activities

SOURCE: Pits and quarries reporting guide (Environment and Climate Change Canada)

<https://www.canada.ca/en/environment-climate-change/services/national-pollutant-release-inventory/report/pits-quarries-guide.html>

Blasting for Construction

Parameter	Value	Source
Area of blasting (m ²)	1590	AP-42 Table 11.9-3 (Blasting Geometric Mean)

Activity	Emission Factor (kg/blast)		
	TSP	PM ₁₀	PM _{2.5}
Emission Factor (kg/blast)	13.95	7.25	0.42

Reference: NPRI Blasting section 8.2

Financial Year	CY30	CY31	CY32	CY33	CY34
Period From	1 Jan 30	1 Jan 31	1 Jan 32	1 Jan 33	1 Jan 34
Period To	31 Dec 30	31 Dec 31	31 Dec 32	31 Dec 33	31 Dec 34
Period Number	9	10	11	12	13
Days in Period	365	365	366	365	365

Unit					
Quarrying Requirements for Port					
Number of blasts per year		104	104	104	104
Number of blasts per day		1	1	1	1
TSP	kg/year	1,450.61	1,450.61	1,450.61	1,450.61
PM ₁₀	kg/year	754.32	754.32	754.32	754.32
PM _{2.5}	kg/year	43.52	43.52	43.52	43.52
TSP	kg/day	13.95	13.95	13.95	13.95
PM ₁₀	kg/day	7.25	7.25	7.25	7.25
PM _{2.5}	kg/day	0.42	0.42	0.42	0.42
TSP	kg/hr	13.95	13.95	13.95	13.95
PM ₁₀	kg/hr	7.25	7.25	7.25	7.25
PM _{2.5}	kg/hr	0.42	0.42	0.42	0.42
Quarrying Requirements for North Road					
Number of blasts per year		208	208	208	
Number of blasts per day		1	1	1	
TSP	kg/year	2,901.23	2,901.23	2,901.23	
PM ₁₀	kg/year	1,508.64	1,508.64	1,508.64	
PM _{2.5}	kg/year	87.04	87.04	87.04	
TSP	kg/day	13.95	13.95	13.95	
PM ₁₀	kg/day	7.25	7.25	7.25	
PM _{2.5}	kg/day	0.42	0.42	0.42	
TSP	kg/hr	13.95	13.95	13.95	
PM ₁₀	kg/hr	7.25	7.25	7.25	
PM _{2.5}	kg/hr	0.42	0.42	0.42	
Quarrying Requirements for South Road					
Number of blasts per year		208	208	208	
Number of blasts per day		1	1	1	
TSP	kg/year	2,901.23	2,901.23	2,901.23	
PM ₁₀	kg/year	1,508.64	1,508.64	1,508.64	
PM _{2.5}	kg/year	87.04	87.04	87.04	
TSP	kg/day	13.95	13.95	13.95	
PM ₁₀	kg/day	7.25	7.25	7.25	
PM _{2.5}	kg/day	0.42	0.42	0.42	
TSP	kg/hr	13.95	13.95	13.95	
PM ₁₀	kg/hr	7.25	7.25	7.25	
PM _{2.5}	kg/hr	0.42	0.42	0.42	
Quarrying Requirements for Jericho					
Number of blasts per year		104	104		
Number of blasts per day		1	1		
TSP	kg/year	1,450.61	1,450.61		
PM ₁₀	kg/year	754.32	754.32		
PM _{2.5}	kg/year	43.52	43.52		
TSP	kg/day	13.95	13.95		
PM ₁₀	kg/day	7.25	7.25		
PM _{2.5}	kg/day	0.42	0.42		
TSP	kg/hr	13.95	13.95		
PM ₁₀	kg/hr	7.25	7.25		
PM _{2.5}	kg/hr	0.42	0.42		

Emissions from Quarry Aggregate Handling Activities
Emissions from the crushing activities within the quarries (one quarry for PurisNorth Road and one Quarry for Jericho/South Road) include the following:
1) Drilling of rocks (DR-1 and DR-2)
2) Material drop in and from:
i) primary crusher (PC-1H, PC-1C, PC-2H, PC-2C),
ii) secondary crusher (SC-1H, SC-1C, SC-2H, SC-2C),
iii) screener (SCR-1H, SCR-1C, SCR-2H, SCR-2C), and
iv) stacker (ST-1H, ST-1C, ST-2H, ST-2C)
3) Primary Crushing (Jaw Crusher) (PC-1, PC-2)
4) Secondary Crushing (SC-1, SC-2)
5) Screening (SCR-1, SCR-2)

Assume Quarry Dimension: 50 m x 50 m							
Cubic Meters of Material	Unit		CY30	CY31	CY32	CY33	CY34
Crust	m³/year		0	625,500	625,500	625,500	625,500
North Road	m³/year		0	1,109,210	1,109,210	1,109,210	1,109,210
South Road	m³/year		0	0	684,293	684,293	684,293
Mining	m³/year		0	62,500	62,500	0	0
Operation days/year			365	365	365	365	365

Operating hours/day 24
Source: Drilling at Quarry 1 (DR-1) and Quarry 2 (DR-2)

Description:
Drilling of rocks

Contaminants of Concern:
TSP, PM₁₀, and PM_{2.5} emissions.

Methodology: Emission Factor (EF)
Emission factors for activities were based on US EPA AP-42 document Chapter 11.19.2 (Crushed Stone Processing and Pulverized Mineral Processing) Table 11.19.2-1 Emission Factors for Crushed Stone Processing Operations.

Quarry 1 (Port & North Road) Drilling - DR-1								
Parameter	Unit		CY30	CY31	CY32	CY33	CY34	Data Source
Cubic meters of material	m³/year		0	525,500	1,734,809	1,734,809	1,734,809	WYH Integrated Model
bulk density	tonnes/m³		2.5	2.5	2.5	2.5	2.5	assumed
crushed material rate	tonnes/year		0	1,313,750	4,337,022	4,337,022	4,337,022	calculated
TSP Emission Factor¹	kg/tonne		4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	see table 1
PM10 Emission Factor¹	kg/tonne		4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	see table 1
PM2.5 Emission Factor¹	kg/tonne		4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	see table 1
TSP Emissions	kg/year		0	62.6	173	173	173	calculated
PM10 Emissions	kg/year		0	62.6	173	173	173	calculated
PM2.5 Emissions	kg/year		0	62.6	173	173	173	calculated
TSP Emissions	kg/day		0	0.17	0.47	0.48	0.48	calculated
PM10 Emissions	kg/day		0	0.17	0.47	0.48	0.48	calculated
PM2.5 Emissions	kg/day		0	0.17	0.47	0.48	0.48	calculated
TSP Emissions	kg/hr		0	0.007	0.020	0.020	0.020	calculated
PM10 Emissions	kg/hr		0	0.007	0.020	0.020	0.020	calculated
PM2.5 Emissions	kg/hr		0	0.007	0.020	0.020	0.020	calculated

Notes:
1. Emission factors are from US EPA AP-42 document Chapter 11.19.2 (Crushed Stone Processing and Pulverized Mineral Processing) Table 11.19.2-1 Emission Factors for Crushed Stone Processing Operations - emission factors for wet drilling. No emission factors for TSP or PM_{2.5}, used the PM₁₀ emission factor for both.

Quarry 2 (Jericho & South Road) Drilling - DR-2								
Parameter	Unit		CY30	CY31	CY32	CY33	CY34	Data Source
Cubic meters of material	m³/year		0	62,500	746,852	684,293	684,293	WYH Integrated Model
bulk density	tonnes/m³		2.5	2.5	2.5	2.5	2.5	assumed
crushed material rate	tonnes/year		0	156,250	1,867,130	1,710,733	1,710,733	calculated
TSP Emission Factor¹	kg/tonne		4.00E-04	4.00E-04	4.00E-04	4.00E-04	4.00E-04	see table 1
PM10 Emission Factor¹	kg/tonne		4.00E-04	4.00E-04	4.00E-04	4.00E-04	4.00E-04	see table 1
PM2.5 Emission Factor¹	kg/tonne		4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	see table 1
TSP Emissions	kg/year		0	0.26	29.7	28.6	28.6	calculated
PM10 Emissions	kg/year		0	0.26	29.7	28.6	28.6	calculated
PM2.5 Emissions	kg/year		0	0.027	0.20	0.19	0.19	calculated
TSP Emissions	kg/day		0	0.001	0.08	0.08	0.08	calculated
PM10 Emissions	kg/day		0	0.001	0.08	0.08	0.08	calculated
PM2.5 Emissions	kg/day		0	0.0001	0.002	0.002	0.002	calculated
TSP Emissions	kg/hr		0	7.14E-04	0.009	0.008	0.008	calculated
PM10 Emissions	kg/hr		0	7.14E-04	0.009	0.008	0.008	calculated
PM2.5 Emissions	kg/hr		0	2.84E-05	0.0003	0.0003	0.0003	calculated

Notes:
1. Emission factors are from US EPA AP-42 document Chapter 11.19 (Crushed Stone Processing and Pulverized Mineral Processing) Table 11.19.2-1 Emission Factors for Crushed Stone Processing Operations - emission factors for wet drilling. No emission factors for TSP or PM_{2.5}, used the PM₁₀ emission factor for both.

Assume Quarry Dimension: Q = 50 x 50 m					
Cubic Metres of Material	CV30	CV21	CV20	CV23	CV34
East	m ³ /year	0	825,590	825,590	825,590
North Road	m ³ /year	0	1,109,219	1,109,219	1,109,219
South Road	m ³ /year	0	684,293	684,293	684,293
Aviation	m ³ /year	0	82,590	82,590	82,590
Operating days/year	365	365	365	365	365

Operating hours/day 24

Decision:

material drops to hoppers and from conveyors of the primary crusher, secondary crusher, screener and stacker

Contaminant(s) of Concern:
TSP, PM₁₀, and PM_{2.5} emissions are the contaminants of concern.

Methodology: Emission Factor (EF)
Emission factor for material unloading/dropping was calculated using Equation (1) in the US EPA AP-42 document Chapter 13.2.4 (Aggregate Handling and Storage Piles). The equation is:

$$E = k(0.0016) \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \text{ (kg/megagram [Mg])}$$

where:
E = emission factor
k = particle size multiplier (dimensionless)
U = mean wind speed, meters per second

The particle size multiplier in the equation, k , varies with aerodynamic particle size range, as follows:		
Aerodynamic Particle Size Multiplier (k)	< 10 μm	0.74
For Equation 1 (US EPA AP-42 document Chapter 13.2.2)	< 10 μm	0.35
	< 7.5 μm	0.053

Note: It is assumed that $k=0.74$ for total particulate matter (<10 μm) consistent with the assumption in U.S. EPA AP-42 Chapter 13.2.2

[illegible][illegible]

Emissions for Quarry Aggregate Handling Activities
Emissions from the crushing activities within the quarries (one quarry for PurisNorth Road and one Quarry for Jaricho/South Road) include the following:
1) Drilling of rocks (DR-1 and DR-2)
2) Material drop in and from:
i) primary crusher (PC-1H, PC-1C, PC-2H, PC-2C),
ii) secondary crusher (SC-1H, SC-1C, SC-2H, SC-2C),
iii) screener (SCR-1H, SCR-1C, SCR-2H, SCR-2C), and
iv) stacker (ST-1H, ST-1C, ST-2H, ST-2C)
3) Primary Crushing (Jaw Crusher) (PC-1, PC-2)
4) Secondary Crushing (SC-1, SC-2)
5) Screening (SCR-1, SCR-2)

Assume Quarry Dimension: 50 m x 50 m

Cubic Meters of Material	Unit		CY30	CY31	CY32	CY33	CY34
Drill	m ³ /year		0	825,590	825,590	825,590	825,590
North Road	m ³ /year		0	1,109,215	1,109,215	1,109,215	1,109,215
South Road	m ³ /year		0	0	684,293	684,293	684,293
Material	m ³ /year		0	82,559	82,559	0	0
Operation/stacker	m ³ /year		365	365	365	365	365

Operator hours/day: 24
Source 1 (Primary crushing (Jaw crusher) at Quarry 1 and Quarry 2 (PC-1 and PC-2)

Description:
Primary crushing of aggregate using a jaw crusher
Contaminant(s) of Concern:
PM₁₀, PM_{2.5}, and PM_{10-2.5} emissions.
Methodology: Emission Factor (EF)
Emission factors for screening were based on US EPA AP-42 document Chapter 11.10.2 (Crushed Stone Processing and Pulverized Mineral Processing) Table 11.10.2-1 Emission Factors for Crushed Stone Processing Operations.

Quarry 1 (Port & North Road) Primary Crusher - PC-1

Parameter	Unit		CY30	CY31	CY32	CY33	CY34	Data Source
Cubic meters of material	m ³ /year		0	825,590	1,734,809	1,734,809	1,734,809	WQIA Interpolated Model
Drill density	m ³ /year	2.4	2.4	2.4	2.4	2.4	2.4	Measured
material handling rate	m ³ /year	0	1,051,275	4,317,722	4,317,722	4,317,722	4,317,722	calculated
TFP Emission Factor ¹	kg/dry ton	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	See note 1
PM ₁₀ Emission Factor ¹	kg/dry ton	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	See note 1
PM _{2.5} Emission Factor ¹	kg/dry ton	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	See note 1
Control Efficiency	%	80	80	80	80	80	80	Control Efficiency - TCEM Rock Crushing Plants (Feb 2002)
TFP Emissions	kg/day	0	285	1,438	1,438	1,438	1,438	calculated
PM ₁₀ Emissions	kg/day	0	283	129	129	129	129	calculated
PM _{2.5} Emissions	kg/day	0	283	729	729	729	729	calculated
TFP Emissions	kg/day	0	1.82	4	4	4	4	calculated
PM ₁₀ Emissions	kg/day	0	0.72	0.00	0.00	0.00	0.00	calculated
PM _{2.5} Emissions	kg/day	0	0.72	0.00	0.00	0.00	0.00	calculated
PM _{10-2.5} Emissions	kg/day	0	0.07	0.00	0.00	0.00	0.00	calculated
PM _{2.5} Emissions	kg/day	0	0.05	0.08	0.08	0.08	0.08	calculated
PM _{10-2.5} Emissions	kg/day	0	0.05	0.00	0.00	0.00	0.00	calculated

Notes:
1. Emission factors are from US EPA AP-42 document Chapter 11.10 (Crushed Stone Processing and Pulverized Mineral Processing) Table 11.10.2-1 Emission Factors for Crushed Stone Processing Operations. Based on note n of Table 11.10.2-1 Tertiary Crushing Emission factors can be used as the upper limit for primary and secondary crushing. No PM_{2.5} emission factor, as such conservatively assumed to be the same as PM₁₀

Quarry 2 (Jaricho & South Road) Primary Crusher - PC-2

Parameter	Unit		CY30	CY31	CY32	CY33	CY34	Data Source
Cubic meters of material	m ³ /year		0	82,559	749,852	684,293	684,293	WQIA Interpolated Model
Drill density	m ³ /year	2.4	2.4	2.4	2.4	2.4	2.4	Measured
material handling rate	m ³ /year	0	104,309	1,067,119	1,734,729	1,734,729	1,734,729	calculated
TFP Emission Factor ¹	kg/dry ton	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	See note 1
PM ₁₀ Emission Factor ¹	kg/dry ton	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	See note 1
PM _{2.5} Emission Factor ¹	kg/dry ton	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	See note 1
Control Efficiency	%	80	80	80	80	80	80	Control Efficiency - TCEM Rock Crushing Plants (Feb 2002)
TFP Emissions	kg/day	0	32	729	617	617	617	calculated
PM ₁₀ Emissions	kg/day	0	32	114	287	287	287	calculated
PM _{2.5} Emissions	kg/day	0	32	114	287	287	287	calculated
TFP Emissions	kg/day	0	0.08	0.00	0.00	0.00	0.00	calculated
PM ₁₀ Emissions	kg/day	0	0.07	0.00	0.00	0.00	0.00	calculated
PM _{2.5} Emissions	kg/day	0	0.07	0.00	0.00	0.00	0.00	calculated
PM _{10-2.5} Emissions	kg/day	0	0.05	0.00	0.00	0.00	0.00	calculated
PM _{2.5} Emissions	kg/day	0	0.00	0.04	0.04	0.04	0.04	calculated

Notes:
1. Emission factors are from US EPA AP-42 document Chapter 11.10 (Crushed Stone Processing and Pulverized Mineral Processing) Table 11.10.2-1 Emission Factors for Crushed Stone Processing Operations. Based on note n of Table 11.10.2-1 Tertiary Crushing Emission factors can be used as the upper limit for primary and secondary crushing. No PM_{2.5} emission factor, as such conservatively assumed to be the same as PM₁₀

Emissions for Quarry Aggregate Handling Activities
Emissions from the crushing activities within the quarries (one quarry for PurisNorth Road and one quarry for Jaricho/South Road) include the following:
1) Drilling of rocks (DR-1 and DR-2)
2) Material drop in and from:
i) primary crusher (PC-1H, PC-1C, PC-2H, PC-2C),
ii) secondary crusher (SC-1H, SC-1C, SC-2H, SC-2C),
iii) screener (SCR-1H, SCR-1C, SCR-2H, SCR-2C), and
iv) stacker (ST-1H, ST-1C, ST-2H, ST-2C)
3) Primary Crushing (one Crusher) (PC-1, PC-2)
4) Secondary Crushing (SC-1, SC-2)
5) Screening (SCR-1, SCR-2)

Assume Quarry Dimension: 50 m x 50 m

Cubic Meters of Material	Unit		CV30	CV31	CV32	CV33	CV34
Port	m ³ /hour		0	625,599	625,599	625,599	625,599
North Road	m ³ /hour		0	1,109,215	1,109,215	1,109,215	1,109,215
South Road	m ³ /hour		0	0	684,293	684,293	684,293
Material	m ³ /hour		0	62,559	62,559	0	0
Operating hours/year			365	365	365	365	365

Operating hours/year: 24
Source: Secondary crushing at Quarry 1 (SC-1) and Quarry 2 (SC-2)

Description:
Secondary crushing (stone crusher) of aggregate

Contaminants of Concern:
PM₁₀, PM_{2.5}, and PM_{10-2.5} emissions.

Methodology: Emission Factor (EF)
Emission factors for scenarios were based on US EPA AP-42 document Chapter 11.19.2 (Crushed Stone Processing) and Pulverized Mineral Processing) Table 11.19.2-1 Emission Factors for Crushed Stone Processing Operations.

Quarry 1 (Port & North Road) Secondary Crusher - SC-1							
Parameter	Unit		CV30	CV31	CV32	CV33	CV34
Cubic meters of material	m ³ /hour		0	625,599	1,734,809	1,734,809	1,734,809
Dust density	kg/m ³		2.5	2.5	2.5	2.5	2.5
Crushed material rate	kg/hour		0	1,563,975	4,337,022	4,337,022	4,337,022
TSP Emission Factor ¹	kg/hour		0.0007	0.0007	0.0007	0.0007	0.0007
PM ₁₀ Emission Factor ¹	kg/hour		0.0012	0.0012	0.0012	0.0012	0.0012
PM _{2.5} Emission Factor ¹	kg/hour		0.0012	0.0012	0.0012	0.0012	0.0012
Crusher Efficiency	%		80%	80%	80%	80%	80%
TSP Emissions	kg		0	583	1,839	1,839	1,839
PM ₁₀ Emissions	kg		0	583	729	729	729
PM _{2.5} Emissions	kg		0	283	729	729	729
TSP Emissions	kg/day		0	6.98	6	6	6
PM ₁₀ Emissions	kg/day		0	6.97	2.80	2.80	2.80
PM _{2.5} Emissions	kg/day		0	6.97	2.80	2.80	2.80
TSP Emissions	kg/yr		0	2,557	6,669	6,669	6,669
PM ₁₀ Emissions	kg/yr		0	2,557	2,688	2,688	2,688
PM _{2.5} Emissions	kg/yr		0	2,557	2,688	2,688	2,688

Notes:
1. Emission factors are from US EPA AP-42 document Chapter 11.19 (Crushed Stone Processing and Pulverized Mineral Processing) Table 11.19.2-1 Emission Factors for Crushed Stone Processing Operations. Based on note n of Table 11.19.1-1 Tertiary Crushing Emission factors can be used as the upper limit for primary and secondary crushing. No PM_{2.5} emission factor, as such conservatively assumed to be the same as PM₁₀

Quarry 2 (Jaricho & South Road) Secondary Crusher - SC-2							
Parameter	Unit		CV30	CV31	CV32	CV33	CV34
Cubic meters of material	m ³ /hour		0	62,559	749,852	684,293	684,293
Dust density	kg/m ³		2.5	2.5	2.5	2.5	2.5
Crushed material rate	kg/hour		0	156,398	1,887,429	1,736,736	1,736,736
TSP Emission Factor ¹	kg/hour		0.0007	0.0007	0.0007	0.0007	0.0007
PM ₁₀ Emission Factor ¹	kg/hour		0.0012	0.0012	0.0012	0.0012	0.0012
PM _{2.5} Emission Factor ¹	kg/hour		0.0012	0.0012	0.0012	0.0012	0.0012
Crusher Efficiency	%		80%	80%	80%	80%	80%
TSP Emissions	kg		0	59	759	557	557
PM ₁₀ Emissions	kg		0	28	314	287	287
PM _{2.5} Emissions	kg		0	28	314	287	287
TSP Emissions	kg/day		0	1.36	1.97	1.47	1.47
PM ₁₀ Emissions	kg/day		0	0.87	0.89	0.79	0.79
PM _{2.5} Emissions	kg/day		0	0.87	0.89	0.79	0.79
TSP Emissions	kg/yr		0	495	719	537	537
PM ₁₀ Emissions	kg/yr		0	316	334	291	291
PM _{2.5} Emissions	kg/yr		0	316	334	291	291

Notes:
1. Emission factors are from US EPA AP-42 document Chapter 11.19 (Crushed Stone Processing and Pulverized Mineral Processing) Table 11.19.2-1 Emission Factors for Crushed Stone Processing Operations. Based on note n of Table 11.19.1-1 Tertiary Crushing Emission factors can be used as the upper limit for primary and secondary crushing. No PM_{2.5} emission factor, as such conservatively assumed to be the same as PM₁₀

Emissions from Quarry Aggregate Handling Activities
Emissions from the crushing activities within the quarries (one quarry for PurisNorth Road and one Quarry for Jaricho/South Road) include the following:
1) Drilling of rocks (DR-1 and DR-2)
2) Material drop in and from:
i) primary crusher (PC-1H, PC-1C, PC-2H, PC-2C),
ii) secondary crusher (SC-1H, SC-1C, SC-2H, SC-2C),
iii) screener (SCR-1H, SCR-1C, SCR-2H, SCR-2C), and
iv) stacker (ST-1H, ST-1C, ST-2H, ST-2C)
3) Primary Crushing (see Crusher) (PC-1, PC-2)
4) Secondary Crushing (SC-1, SC-2)
5) Screening (SCR-1, SCR-2)

Assume Quarry Dimension: 50 m x 50 m

Cubic Meters of Material	Unit		CY30	CY31	CY32	CY33	CY34
Crust	m³/year		0	825,590	825,590	825,590	825,590
North Road	m³/year		0	1,109,215	1,109,215	1,109,215	1,109,215
South Road	m³/year		0	884,293	884,293	884,293	884,293
Material	m³/year		0	82,590	82,590	0	0
Operation/stacker			365	365	365	365	365

Operative hours/day: 24
Source: Screening at Quarry 1 (SCR-1) and Quarry 2 (SCR-2)

Description:
Screening of aggregate after the secondary crusher

Contaminant(s) of Concern:
PM₁₀, PM_{2.5}, and PM_{2.5}-equivalents

Methodology: Emission Factor (EF)
Emission factors for screening were based on US EPA AP-42 document Chapter 11.19.2 (Crushed Stone Processing and Pulverized Mineral Processing) Table 11.19.2-1 Emission Factors for Crushed Stone Processing Operations.

Quarry 1 (Port & North Road) Screener (SCR-1)

Parameter	Unit		CY30	CY31	CY32	CY33	CY34	Data Source
cubic meters of material	m³/year		0	825,590	1,734,809	1,734,809	1,734,809	WQI, Unattended Model
bulk density	kg/m³		2.4	2.4	2.4	2.4	2.4	WQI/4
material handling rate	tonnes/hour		0	1,963,976	4,337,632	4,337,632	4,337,632	calculated
TFP Emission Factor ¹	kg/tonne		0.0026	0.0026	0.0026	0.0026	0.0026	see note 1
PM ₁₀ Emission Factor ¹	kg/tonne		0.0043	0.0043	0.0043	0.0043	0.0043	see note 1
PM _{2.5} Emission Factor ¹	kg/tonne		0.0043	0.0043	0.0043	0.0043	0.0043	see note 1
Control Efficiency	%		80%	80%	80%	80%	80%	Control Efficiency - TCEM Book Contains Details of job 2009
TFP Emissions	kg/year		0	2,426	7,086	7,086	7,086	calculated
PM ₁₀ Emissions	kg/year		0	845	2,611	2,611	2,611	calculated
PM _{2.5} Emissions	kg/year		0	845	2,611	2,611	2,611	calculated
TFP Emissions	kg/day		0	7	21	21	21	calculated
PM ₁₀ Emissions	kg/day		0	3	7	7	7	calculated
PM _{2.5} Emissions	kg/day		0	3	7	7	7	calculated
TFP Emissions	kg/hr		0	0.16	0.87	0.87	0.87	calculated
PM ₁₀ Emissions	kg/hr		0	0.11	0.30	0.30	0.30	calculated
PM _{2.5} Emissions	kg/hr		0	0.11	0.30	0.30	0.30	calculated

Notes:
1. Emission factors are from US EPA AP-42 document Chapter 11.19 (Crushed Stone Processing and Pulverized Mineral Processing) Table 11.19.2-1 Emission Factors for Crushed Stone Processing Operations for unattended screening. No PM_{2.5} emission factor, conservatively assumed to be the same as PM₁₀.

Quarry 2 (Jaricho & South Road) Screener (SCR-2)

Parameter	Unit		CY30	CY31	CY32	CY33	CY34	Data Source
cubic meters of material	m³/year		0	884,293	1,691,854	884,293	884,293	WQI, Unattended Model
bulk density	kg/m³		2.4	2.4	2.4	2.4	2.4	WQI/4
material handling rate	tonnes/hour		0	1,043,906	1,691,129	1,730,732	1,730,732	calculated
TFP Emission Factor ¹	kg/tonne		0.0026	0.0026	0.0026	0.0026	0.0026	see note 1
PM ₁₀ Emission Factor ¹	kg/tonne		0.0043	0.0043	0.0043	0.0043	0.0043	see note 1
PM _{2.5} Emission Factor ¹	kg/tonne		0.0043	0.0043	0.0043	0.0043	0.0043	see note 1
Control Efficiency	%		80%	80%	80%	80%	80%	Control Efficiency - TCEM Book Contains Details of job 2009
TFP Emissions	kg/year		0	2,216	2,292	2,292	2,292	calculated
PM ₁₀ Emissions	kg/year		0	86	1,132	1,030	1,030	calculated
PM _{2.5} Emissions	kg/year		0	86	1,132	1,030	1,030	calculated
TFP Emissions	kg/day		0	6	6	6	6	calculated
PM ₁₀ Emissions	kg/day		0	0.28	3	3	3	calculated
PM _{2.5} Emissions	kg/day		0	0.28	3	3	3	calculated
TFP Emissions	kg/hr		0	0.02	0.37	0.34	0.34	calculated
PM ₁₀ Emissions	kg/hr		0	0.02	0.12	0.12	0.12	calculated
PM _{2.5} Emissions	kg/hr		0	0.02	0.12	0.12	0.12	calculated

Notes:
1. Emission factors are from US EPA AP-42 document Chapter 11.19 (Crushed Stone Processing and Pulverized Mineral Processing) Table 11.19.2-1 Emission Factors for Crushed Stone Processing Operations for unattended screening. No PM_{2.5} emission factor, conservatively assumed to be the same as PM₁₀.

Emissions from Overburden Removal

Overburden will be removed from the port, north road, south road and jericho station during construction. Emissions include
1) Emissions from Overburden Removal (bulldozing/front end loaders) (OB_P1, OB_NR1, OB_J1, OB_SR1)
2) Grading (OB_P2, OB_NR2, OB_J2, OB_SR2)

	entered data
	formula

Source: Overburden Removal

Description:

Overburden is moved with bulldozers or front end loaders

Contaminant(s) of Concern:

PM, PM₁₀, PM_{2.5}, NO_x, CO and SO₂ emissions are the contaminants of concern. Tailpipe emissions such as NO_x, CO and SO₂ are calculated in the "CAC_EF_Diesel" sheet.

Methodology: Emission Factor (EF)

Emission factor for buldozing of material other than coal in the US EPA AP-42 document Chapter 11.9 (Western Surface Coal Mining) Table 11.9-2 was used to estimate the dust emissions.

The emission calculation equation in the table is:

$$E_{TSP} = 2.6 \times s^{1.2} / M^{1.3}$$

where:

E_{TSP} = emission factor (kg/h) for TSP (<=30um)

s = material silt content (%)

M = material moisture content (%)

The emission calculation is listed in the following table.

$$E_{PM15} = 0.45 \times s^{1.5} / M^{1.4}$$

where:

E_{PM15} = emission factor (kg/h) for PM (<=15 um)

s = material silt content (%)

M = material moisture content (%)

Scaling Factors - from Table 11.9-2 for buldozing overburden

PM ₁₀	0.75	Multiply the E _{PM15} equation by this fraction to determine emissions
PM _{2.5}	0.105	Multiply the E _{TSP} equation by this fraction to determine emissions

Operating days/year	365
Operating hours/day	24

Port/Camp (OB_P1)

Parameter	Units	CY30	CY31	CY32	CY33	CY34	Reference
Material Moisture content (M) ¹	%	7.9	7.9	7.9	7.9	7.9	US EPA Table 11.9.3
Material silt content (s) ¹	%	6.9	6.9	6.9	6.9	6.9	US EPA Table 11.9.3
TSP Calculated emission factor (E)	kg/hr	1.80	1.80	1.80	1.80	1.80	calculated
PM ₁₅ Calculated emission factor (E)	kg/hr	0.452	0.452	0.452	0.452	0.452	calculated
Operating hours per year	hrs/year	-	6,700.5	6,700.5	6,700.5	6,700.5	Provided by WKR
Control Efficiency	%	-	-	-	-	-	Assumed uncontrolled
TSP	kg/year	-	12,044.37	12,044.37	12,044.37	12,044.37	
PM ₁₀	kg/year	-	2,269.74	2,269.74	2,269.74	2,269.74	
PM _{2.5}	kg/year	-	1,264.66	1,264.66	1,264.66	1,264.66	
TSP	kg/day	-	43.14	43.14	43.14	43.14	Assume constant 24 hour operations
PM ₁₀	kg/day	-	8.13	8.13	8.13	8.13	Assume constant 24 hour operations
PM _{2.5}	kg/day	-	4.53	4.53	4.53	4.53	Assume constant 24 hour operations
TSP	kg/hr	-	1.80	1.80	1.80	1.80	Assume constant 1 hour operation
PM ₁₀	kg/hr	-	0.34	0.34	0.34	0.34	Assume constant 1 hour operation
PM _{2.5}	kg/hr	-	0.19	0.19	0.19	0.19	Assume constant 1 hour operation

Notes:

¹ Moisture and silt content for Overburden taken from Table 11.9.3 (Typical values for Correction Factors Applicable to the Predictive Emission Factor Equations)

North Road (OB_NR1)

Parameter	Units	CY30	CY31	CY32	CY33	CY34	Reference
Material Moisture content (M) ¹	%	7.9	7.9	7.9	7.9	7.9	US EPA Table 11.9.3
Material silt content (s) ¹	%	6.9	6.9	6.9	6.9	6.9	US EPA Table 11.9.3
TSP Calculated emission factor (E)	kg/hr	1.80	1.80	1.80	1.80	1.80	calculated
PM ₁₅ Calculated emission factor (E)	kg/hr	0.452	0.452	0.452	0.452	0.452	calculated
Operating hours per year	hrs/year	-	-	7,445.0	7,445.0	7,445.0	Provided by WKR
Control Efficiency	%	-	-	-	-	-	Assumed uncontrolled
TSP	kg/year	-	-	13,382.64	13,382.64	13,382.64	
PM ₁₀	kg/year	-	-	2,521.94	2,521.94	2,521.94	
PM _{2.5}	kg/year	-	-	1,405.18	1,405.18	1,405.18	
TSP	kg/day	-	-	43.14	43.14	43.14	Assume constant 24 hour operations
PM ₁₀	kg/day	-	-	8.13	8.13	8.13	Assume constant 24 hour operations
PM _{2.5}	kg/day	-	-	4.53	4.53	4.53	Assume constant 24 hour operations
TSP	kg/hr	-	-	1.80	1.80	1.80	Assume constant 1 hour operation
PM ₁₀	kg/hr	-	-	0.34	0.34	0.34	Assume constant 1 hour operation
PM _{2.5}	kg/hr	-	-	0.19	0.19	0.19	Assume constant 1 hour operation

Notes:

¹ Moisture and silt content for Overburden taken from Table 11.9.3 (Typical values for Correction Factors Applicable to the Predictive Emission Factor Equations)

Jericho Station (OB_J1)

Parameter	Units	CY30	CY31	CY32	CY33	CY34	Reference
Material Moisture content (M) ¹	%	7.9	7.9	7.9	7.9	7.9	US EPA Table 11.9.3
Material silt content (s) ¹	%	6.9	6.9	6.9	6.9	6.9	US EPA Table 11.9.3
TSP Calculated emission factor (E)	kg/hr	1.80	1.80	1.80	1.80	1.80	calculated
PM ₁₅ Calculated emission factor (E)	kg/hr	0.452	0.452	0.452	0.452	0.452	calculated
Operating hours per year	hrs/yr	-	2,233.5	2,233.5	-	-	Provided by WKR
Control Efficiency	%	-	-	-	-	-	Assumed uncontrolled
TSP	kg/year	-	4,014.79	4,014.79	-	-	
PM ₁₀	kg/year	-	756.58	756.58	-	-	
PM _{2.5}	kg/year	-	421.55	421.55	-	-	
TSP	kg/day	-	43.14	43.14	-	-	Assume constant 24 hour operations
PM ₁₀	kg/day	-	8.13	8.13	-	-	Assume constant 24 hour operations
PM _{2.5}	kg/day	-	4.53	4.53	-	-	Assume constant 24 hour operations
TSP	kg/hr	-	1.80	1.80	-	-	Assume constant 1 hour operation
PM ₁₀	kg/hr	-	0.34	0.34	-	-	Assume constant 1 hour operation
PM _{2.5}	kg/hr	-	0.19	0.19	-	-	Assume constant 1 hour operation

Notes:

¹ Moisture and silt content for Overburden taken from Table 11.9.3 (Typical values for Correction Factors Applicable to the Predictive Emission Factor Equations)

South Road (OB_SR1)

Parameter	Units	CY30	CY31	CY32	CY33	CY34	Reference
Material Moisture content (M) ¹	%	7.9	7.9	7.9	7.9	7.9	US EPA Table 11.9.3
Material silt content (s) ¹	%	6.9	6.9	6.9	6.9	6.9	US EPA Table 11.9.3
TSP Calculated emission factor (E)	kg/hr	1.80	1.80	1.80	1.80	1.80	calculated
PM ₁₅ Calculated emission factor (E)	kg/hr	0.452	0.452	0.452	0.452	0.452	calculated
Operating hours per year	hrs/yr	-	-	7,445.0	7,445.0	7,445.0	Provided by WKR
Control Efficiency	%	-	-	-	-	-	Assumed uncontrolled
TSP	kg/year	-	-	13,382.64	13,382.64	13,382.64	
PM ₁₀	kg/year	-	-	2,521.94	2,521.94	2,521.94	
PM _{2.5}	kg/year	-	-	1,405.18	1,405.18	1,405.18	
TSP	kg/day	-	-	43.14	43.14	43.14	Assume constant 24 hour operations
PM ₁₀	kg/day	-	-	8.13	8.13	8.13	Assume constant 24 hour operations
PM _{2.5}	kg/day	-	-	4.53	4.53	4.53	Assume constant 24 hour operations
TSP	kg/hr	-	-	1.80	1.80	1.80	Assume constant 1 hour operation
PM ₁₀	kg/hr	-	-	0.34	0.34	0.34	Assume constant 1 hour operation
PM _{2.5}	kg/hr	-	-	0.19	0.19	0.19	Assume constant 1 hour operation

Notes:

¹ Moisture and silt content for Overburden taken from Table 11.9.3 (Typical values for Correction Factors Applicable to the Predictive Emission Factor Equations)

Emissions from Overburden Removal

Overburden will be removed from the port, north road, south road and jericho station during construction. Emissions include
1) Emissions from Overburden Removal (bulldozing/front end loaders) (OB_P1, OB_NR1, OB_J1, OB_SR1)
2) Grading (OB_P2, OB_NR2, OB_J2, OB_SR2)

	entered data
	formula

Source: Grading (CL2B)

Description:

A grader maintains the routes on the construction site for efficient operation of construction equipment, as well as grading the road surface.

Contaminant(s) of Concern:

PM, PM₁₀, PM_{2.5}, NO_x, CO and SO₂ emissions are the contaminants of concern. Tailpipe emissions such as NO_x, CO and SO₂ are calculated in the "CAC_EF_Diesel" sheet.

Methodology: Emission Factor (EF)

Emission factor for grading operations are found in the US EPA AP-42 document Chapter 11.9 (Western Surface Coal Mining) Table 11.9-2

$$E_{TSP} = 0.0034(S)^{2.5}$$

$$E_{PM_{2.5}} = 0.0056(S)^{2.0}$$

where:

E_{TSP} = emission factor (kg/VKT) for TSP (<=30um)

S = mean vehicle speed (km/hr)

where:

$E_{PM_{2.5}}$ = emission factor (kg/VKT) for PM (<=15um)

S = mean vehicle speed (km/hr)

Scaling Factors - from Table 11.9-2 for grading

PM ₁₀	0.6	Multiply the $E_{PM_{10}}$ equation by this fraction to determine emissions
PM _{2.5}	0.031	Multiply the E_{TSP} equation by this fraction to determine emissions

Port/Camp (OB_P2)

Parameter	Units	CY30	CY31	CY32	CY33	CY34	Reference
Grader speed	km/hr	8.0	8.0	8.0	8.0	8.0	US EPA - Gravel Roads - Maintenance and Design Manual. Max speed for road grading = 5 mph (8 km/hr). https://www.epa.gov/sites/production/files/2015-10/documents/2003_07_24_nps_gravelroads_sec1_1.pdf
TSP Calculated emission factor (E)	kg/VKT	0.615	0.615	0.615	0.615	0.615	calculated
PM ₁₀ Calculated emission factor (E)	kg/VKT	0.358	0.358	0.358	0.358	0.358	calculated
Operating hours per year for all graders	hrs/yr	-	1,983.2	1,983.2	1,983.2	1,983.2	Provided by WKR
Total route graded per year	VKT/yr	-	15,865.60	15,865.60	15,865.60	15,865.60	calculated
Control efficiency	%	70%	70%	70%	70%	70%	Assumed grading roads that have been treated with water
TSP	kg/year	-	2,929.42	2,929.42	2,929.42	2,929.42	
PM ₁₀	kg/year	-	1,023.52	1,023.52	1,023.52	1,023.52	
PM _{2.5}	kg/year	-	90.81	90.81	90.81	90.81	
TSP	kg/day	-	35.45	35.45	35.45	35.45	Assume constant 24 hour operations
PM ₁₀	kg/day	-	12.39	12.39	12.39	12.39	Assume constant 24 hour operations
PM _{2.5}	kg/day	-	1.10	1.10	1.10	1.10	Assume constant 24 hour operations
TSP	kg/hr	-	1.48	1.48	1.48	1.48	Assume constant 1 hour operation
PM ₁₀	kg/hr	-	0.52	0.52	0.52	0.52	Assume constant 1 hour operation
PM _{2.5}	kg/hr	-	0.05	0.05	0.05	0.05	Assume constant 1 hour operation

North Road (OB_NR2)

Parameter	Units	CY30	CY31	CY32	CY33	CY34	Reference
Grader speed	km/hr	8.0	8.0	8.0	8.0	8.0	US EPA - Gravel Roads - Maintenance and Design Manual. Max speed for road grading = 5 mph (8 km/hr). https://www.epa.gov/sites/production/files/2015-10/documents/2003_07_24_nps_gravelroads_sec1_1.pdf
TSP Calculated emission factor (E)	kg/VKT	0.615	0.615	0.615	0.615	0.615	calculated
PM ₁₀ Calculated emission factor (E)	kg/VKT	0.358	0.358	0.358	0.358	0.358	calculated
Operating hours per year for all graders	hrs/yr	-	-	1,322.1	1,322.1	1,322.1	Provided by WKR
Total route graded per year	VKT/yr	-	-	10,577.07	10,577.07	10,577.07	calculated
Control efficiency	%	70%	70%	70%	70%	70%	Assumed grading roads that have been treated with water
TSP	kg/year	-	-	1,952.95	1,952.95	1,952.95	
PM ₁₀	kg/year	-	-	682.35	682.35	682.35	
PM _{2.5}	kg/year	-	-	60.54	60.54	60.54	
TSP	kg/day	-	-	35.45	35.45	35.45	Assume constant 24 hour operations
PM ₁₀	kg/day	-	-	12.39	12.39	12.39	Assume constant 24 hour operations
PM _{2.5}	kg/day	-	-	1.10	1.10	1.10	Assume constant 24 hour operations
TSP	kg/hr	-	-	1.48	1.48	1.48	Assume constant 1 hour operation
PM ₁₀	kg/hr	-	-	0.52	0.52	0.52	Assume constant 1 hour operation
PM _{2.5}	kg/hr	-	-	0.05	0.05	0.05	Assume constant 1 hour operation

Jericho Station (OB_J2)

Parameter	Units	CY30	CY31	CY32	CY33	CY34	Reference
Grader speed	km/hr	8.0	8.0	8.0	8.0	8.0	US EPA - Gravel Roads - Maintenance and Design Manual. Max speed for road grading = 5 mph (8 km/hr). https://www.epa.gov/sites/production/files/2015-10/documents/2003_07_24_nps_gravelroads_sec1_1.pdf
TSP Calculated emission factor (E)	kg/VKT	0.615	0.615	0.615	0.615	0.615	calculated
PM ₁₀ Calculated emission factor (E)	kg/VKT	0.358	0.358	0.358	0.358	0.358	calculated
Operating hours per year for all graders	hrs/yr	-	-	-	-	-	Provided by WKR - no grader located at Jericho Station
Total route graded per year	VKT/yr	-	-	-	-	-	calculated
Control efficiency	%	70%	70%	70%	70%	70%	Assumed grading roads that have been treated with water
TSP	kg/year	-	-	-	-	-	
PM ₁₀	kg/year	-	-	-	-	-	
PM _{2.5}	kg/year	-	-	-	-	-	
TSP	kg/day	-	-	-	-	-	
PM ₁₀	kg/day	-	-	-	-	-	
PM _{2.5}	kg/day	-	-	-	-	-	
TSP	kg/hr	-	-	-	-	-	
PM ₁₀	kg/hr	-	-	-	-	-	
PM _{2.5}	kg/hr	-	-	-	-	-	

South Road (OB_SR2)

Parameter	Units	CY30	CY31	CY32	CY33	CY34	Reference
Grader speed	km/hr	8.0	8.0	8.0	8.0	8.0	US EPA - Gravel Roads - Maintenance and Design Manual. Max speed for road grading = 5 mph (8 km/hr). https://www.epa.gov/sites/production/files/2015-10/documents/2003_07_24_nps_gravelroads_sec1_1.pdf
TSP Calculated emission factor (E)	kg/VKT	0.615	0.615	0.615	0.615	0.615	calculated
PM ₁₀ Calculated emission factor (E)	kg/VKT	0.358	0.358	0.358	0.358	0.358	calculated
Operating hours per year for all graders	hrs/yr	-	-	1,322.1	1,322.1	1,322.1	Provided by WKR
Total route graded per year	VKT/yr	-	-	10,577.07	10,577.07	10,577.07	calculated
Control efficiency	%	70%	70%	70%	70%	70%	Assumed grading roads that have been treated with water
TSP	kg/year	-	-	1,952.95	1,952.95	1,952.95	
PM ₁₀	kg/year	-	-	682.35	682.35	682.35	
PM _{2.5}	kg/year	-	-	60.54	60.54	60.54	
TSP	kg/day	-	-	35.45	35.45	35.45	Assume constant 24 hour operations
PM ₁₀	kg/day	-	-	12.39	12.39	12.39	Assume constant 24 hour operations
PM _{2.5}	kg/day	-	-	1.10	1.10	1.10	Assume constant 24 hour operations
TSP	kg/hr	-	-	1.48	1.48	1.48	Assume constant 1 hour operation
PM ₁₀	kg/hr	-	-	0.52	0.52	0.52	Assume constant 1 hour operation
PM _{2.5}	kg/hr	-	-	0.05	0.05	0.05	Assume constant 1 hour operation

Combustion emissions from operating equipment and vehicles

Emission changes (Inna, Dec 2025)

Description:
Tailpipe emissions from vehicles and Non-road equipment driving on unpaved roads and operating in the PDA.

Contaminant(s) of Concern:
CO, SO₂, NOx, PM, PM₁₀ and PM_{2.5} emissions are the contaminants of concern.

Methodology: Emission Factor (EF)
US EPA Motor Vehicle Emissions Simulator (MOVES3) Non-Road Modelling was used to generate emission factors for non-road equipment in g/hp-hr.

Financial Year	CY30	CY31	CY32	CY33	CY34
Period From	1 Jan 30	1 Jan 31	1 Jan 32	1 Jan 33	1 Jan 34
Period To	31 Dec 30	31 Dec 31	31 Dec 32	31 Dec 33	31 Dec 34
Period Number	9	10	11	12	13
Days in Period	365	365	366	365	365

Port/Camp Construction Equipment

MOVES Equipment ID	Type of Equipment	Number of Units	Horsepower (hp)	MOVES hpID	Operating Hours per Day	Annual Operating Hours	Load/Utilization Factor (%)	Emission Factors (g/hp-hr)					Annual Emission Rates (kg/year)					Daily Emission Rates (kg/day)					Hourly Emission Rates (kg/hr)								
								CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}	CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}	CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}	CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}
17	Crane - Eg 75 ton class	1	267	300	4	1,278	70%	0.853	4.279	0.005	0.184	0.184	0.179	204	1,022	1	44	44	43	0.56	2.80	0.00	0.12	0.12	0.12	0.16	0.80	0.00	0.03	0.03	0.03
20	Loader - Eg Cat 966	7	321	600	5	13,500	70%	1.733	4.426	0.005	0.224	0.224	0.217	5,258	13,426	15	679	679	659	14.41	36.78	0.04	1.86	1.86	1.80	2.73	6.96	0.01	0.35	0.35	0.34
79	Haul Truck - Eg Cat 773	5	760	1000	9	15,744	70%	1.071	4.458	0.005	0.182	0.182	0.176	8,968	37,343	39	1,520	1,520	1,475	24.57	102.31	0.11	4.17	4.17	4.04	2.85	11.86	0.01	0.48	0.48	0.47
79	Winch Tractor Trailer	1	360	600	5	1,792	70%	1.193	2.934	0.005	0.178	0.178	0.172	539	1,325	2	80	80	78	1.48	3.63	0.01	0.22	0.22	0.21	0.30	0.74	0.00	0.04	0.04	0.04
81	Dozer - Eg Cat D6 / D8	3	198	300	6	6,701	70%	1.117	3.402	0.005	0.215	0.215	0.208	1,037	3,159	4	199	199	193	2.84	8.65	0.01	0.55	0.55	0.53	0.46	1.41	0.00	0.09	0.09	0.09
77	Excavator - Eg Cat 349	2	425	600	3	2,400	70%	1.568	4.046	0.005	0.208	0.208	0.202	1,119	2,889	4	149	149	144	3.07	7.92	0.01	0.41	0.41	0.40	0.93	2.41	0.00	0.12	0.12	0.12
79	Rock Truck - Eg Cat 740	4	452	600	5	7,012	70%	1.193	2.934	0.005	0.178	0.178	0.172	2,646	6,510	10	394	394	382	7.25	17.84	0.03	1.08	1.08	1.05	1.51	3.71	0.01	0.22	0.22	0.22
79	Plow / Sand / Gravel / Water Truck	1	360	600	3	1,200	70%	1.193	2.934	0.005	0.178	0.178	0.172	361	887	1	54	54	52	0.99	2.43	0.00	0.15	0.15	0.14	0.30	0.74	0.00	0.04	0.04	0.04
9	Packer - Eg CS563	1	145	175	6	2,262	70%	1.503	4.302	0.005	0.317	0.317	0.307	345	988	1	73	73	71	0.95	2.71	0.00	0.20	0.20	0.19	0.15	0.44	0.00	0.03	0.03	0.03
78	Grader - Cat 14	1	238	300	5	1,983	70%	1.100	3.333	0.005	0.211	0.211	0.205	363	1,101	2	70	70	68	1.00	3.02	0.00	0.19	0.19	0.19	0.18	0.56	0.00	0.04	0.04	0.03
22	Skidsteer / Bobcat	2	98	100	6	4,379	70%	7.528	6.499	0.006	1.065	1.065	1.033	2,261	1,952	2	320	320	310	6.20	5.35	0.01	0.88	0.88	0.85	1.03	0.89	0.00	0.15	0.15	0.14
25	Manlift - 60' / 80' Boom	2	74	75	7	4,800	70%	6.538	7.052	0.006	1.031	1.031	1.000	1,626	1,753	2	256	256	249	4.45	4.80	0.00	0.70	0.70	0.68	0.68	0.73	0.00	0.11	0.11	0.10
79	Light Vehicle - EG F-350	15	500	600	3	15,000	70%	1.193	2.934	0.005	0.178	0.178	0.172	6,262	15,405	24	933	933	905	17.16	42.21	0.07	2.56	2.56	2.48	6.26	15.41	0.02	0.93	0.93	0.90

CO	kg/year	30,989	30,989	30,989	30,989
NOx	kg/year	87,761	87,761	87,761	87,761
SO ₂	kg/year	107	107	107	107
TSP	kg/year	4,771	4,771	4,771	4,771
PM ₁₀	kg/year	4,771	4,771	4,771	4,771
PM _{2.5}	kg/year	4,628	4,628	4,628	4,628
CO	kg/day	85	85	85	85
NOx	kg/day	240	240	240	240
SO ₂	kg/day	0.29	0.29	0.29	0.29
TSP	kg/day	13	13	13	13
PM ₁₀	kg/day	13	13	13	13
PM _{2.5}	kg/day	13	13	13	13
CO	kg/hr	17.6	17.6	17.6	17.6
NOx	kg/hr	47	47	47	47
SO ₂	kg/hr	6.12E-02	6.12E-02	6.12E-02	6.12E-02
TSP	kg/hr	2.6	2.6	2.6	2.6
PM ₁₀	kg/hr	2.6	2.6	2.6	2.6
PM _{2.5}	kg/hr	2.6	2.6	2.6	2.6

Northern Road Construction Equipment

MOVES		Number of Units	Horsepower (hp)	MOVES hpID	Operating Hours per Day	Annual Operating Hours	Load/Utilization Factor (%)	Emission Factors (g/hp-hr)					Annual Emission Rates (kg/year)					Daily Emission Rates (kg/day)					Hourly Emission Rates (kg/hr)								
Equipment ID	Type of Equipment							CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}	CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}	CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}	CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}
81	Dozer - Eg Cat D6 / D8	5	198	300	4	7,445	70%	1.117	3.402	0.005	0.215	0.215	0.208	1,152	3,510	5	222	222	215	3.16	9.62	0.01	0.61	0.61	0.59	0.77	2.36	0.00	0.15	0.15	0.14
77	Excavator - Eg Cat 349	6	425	600	4	8,000	70%	1.568	4.046	0.005	0.208	0.208	0.202	3,731	9,630	12	496	496	481	10.22	26.38	0.03	1.36	1.36	1.32	2.80	7.22	0.01	0.37	0.37	0.36
79	Haul Truck - Eg Cat 773	10	760	1000	6	20,992	70%	1.071	4.458	0.005	0.182	0.182	0.176	11,957	49,790	52	2,027	2,027	1,966	32.76	136.41	0.14	5.55	5.55	5.39	5.70	23.72	0.02	0.97	0.97	0.94
20	Loader - Eg Cat 966	5	321	600	4	6,428	70%	1.733	4.426	0.005	0.224	0.224	0.217	2,504	6,393	7	323	323	314	6.86	17.52	0.02	0.89	0.89	0.86	1.95	4.97	0.01	0.25	0.25	0.24
78	Grader - Cat 14	1	238	300	4	1,322	70%	1.100	3.333	0.005	0.211	0.211	0.205	242	734	1	47	47	45	0.66	2.01	0.00	0.13	0.13	0.12	0.18	0.56	0.00	0.04	0.04	0.03
9	Packer - Eg CS563	1	145	175	4	1,508	70%	1.503	4.302	0.005	0.317	0.317	0.307	230	658	1	48	48	47	0.63	1.80	0.00	0.13	0.13	0.13	0.15	0.44	0.00	0.03	0.03	0.03
79	Water/ Sand/ Gravel Truck	2	360	600	2	1,600	70%	1.193	2.934	0.005	0.178	0.178	0.172	481	1,183	2	72	72	69	1.32	3.24	0.01	0.20	0.20	0.19	0.60	1.48	0.00	0.09	0.09	0.09
79	Fuel / Fuel Lube Truck	6	360	600	4	8,750	70%	1.193	2.934	0.005	0.178	0.178	0.172	2,630	6,470	10	392	392	380	7.21	17.73	0.03	1.07	1.07	1.04	1.80	4.44	0.01	0.27	0.27	0.26
79	Light Vehicle - EG F-350	25	500	600	4	37,500	70%	1.193	2.934	0.005	0.178	0.178	0.172	15,656	38,513	61	2,332	2,332	2,262	42.89	105.52	0.17	6.39	6.39	6.20	10.44	25.68	0.04	1.55	1.55	1.51

CO	kg/year	38,583	38,583	38,583
NOx	kg/year	116,883	116,883	116,883
SO ₂	kg/year	150	150	150
TSP	kg/year	5,958	5,958	5,958
PM ₁₀	kg/year	5,958	5,958	5,958
PM _{2.5}	kg/year	5,779	5,779	5,779
CO	kg/day	106	106	106
NOx	kg/day	320	320	320
SO ₂	kg/day	0.41	0.41	0.41
TSP	kg/day	16.3	16.3	16.3
PM ₁₀	kg/day	16.3	16.3	16.3
PM _{2.5}	kg/day	15.8	15.8	15.8
CO	kg/hr	24.4	24.4	24.4
NOx	kg/hr	70.9	70.9	70.9
SO ₂	kg/hr	9.34E-02	9.34E-02	9.34E-02
TSP	kg/hr	3.7	3.7	3.7
PM ₁₀	kg/hr	3.7	3.7	3.7
PM _{2.5}	kg/hr	3.6	3.6	3.6

Combustion emissions from operating equipment and vehicles

Emission changes (Inna, Dec 2025)

Description:
Tailpipe emissions from vehicles and Non-road equipment driving on unpaved roads and operating in the PDA.

Contaminant(s) of Concern:
CO, SO₂, NOx, PM, PM₁₀ and PM_{2.5} emissions are the contaminants of concern.

Methodology: Emission Factor (EF)
US EPA Motor Vehicle Emissions Simulator (MOVES3) Non-Road Modelling was used to generate emission factors for non-road equipment in g/hp-hr.

Financial Year	CY30	CY31	CY32	CY33	CY34
Period From	1 Jan 30	1 Jan 31	1 Jan 32	1 Jan 33	1 Jan 34
Period To	31 Dec 30	31 Dec 31	31 Dec 32	31 Dec 33	31 Dec 34
Period Number	9	10	11	12	13
Days in Period	365	365	366	365	365

Jericho/Camp Construction Equipment

MOVES Equipment ID	Type of Equipment	Number of Units	Horsepower (hp)	MOVES hpID	Operating Hours per Day	Annual Operating Hours	Load/Utilization Factor (%)	Emission Factors (g/hp-hr)						Annual Emission Rates (kg/year)						Daily Emission Rates (kg/day)						Hourly Emission Rates (kg/hr)					
								CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}	CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}	CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}	CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}
17	Crane - Eg 75 ton class	1	267	300	4	1,278	70%	0.853	4.279	0.005	0.184	0.184	0.179	204	1,022	1	44	44	43	0.56	2.80	0.00	0.12	0.12	0.12	0.16	0.80	0.00	0.03	0.03	0.03
20	Loader - Eg Cat 966	1	321	600	5	1,929	70%	1.733	4.426	0.005	0.224	0.224	0.217	751	1,918	2	97	97	94	2.06	5.25	0.01	0.27	0.27	0.26	0.39	0.99	0.00	0.05	0.05	0.05
79	Winch Tractor Trailer	1	360	600	5	1,792	70%	1.193	2.934	0.005	0.178	0.178	0.172	539	1,325	2	80	80	78	1.48	3.63	0.01	0.22	0.22	0.21	0.30	0.74	0.00	0.04	0.04	0.04
79	Plow / Sand / Gravel / Water Truck	1	360	600	3	1,200	70%	1.193	2.934	0.005	0.178	0.178	0.172	361	887	1	54	54	52	0.99	2.43	0.00	0.15	0.15	0.14	0.30	0.74	0.00	0.04	0.04	0.04
81	Dozer - Eg Cat D6 / D8	1	198	300	6	2,234	70%	1.117	3.402	0.005	0.215	0.215	0.208	346	1,053	1	66	66	64	0.95	2.88	0.00	0.18	0.18	0.18	0.15	0.47	0.00	0.03	0.03	0.03
79	Rock Truck - Eg Cat 740	4	452	600	5	7,012	70%	1.193	2.934	0.005	0.178	0.178	0.172	2,646	6,510	10	394	394	382	7.25	17.84	0.03	1.08	1.08	1.05	1.51	3.71	0.01	0.22	0.22	0.22
22	Skidsteer / Bobcat	1	98	100	6	2,190	70%	7.528	6.499	0.006	1.065	1.065	1.033	1,131	976	1	160	160	155	3.10	2.67	0.00	0.44	0.44	0.43	0.52	0.45	0.00	0.07	0.07	0.07
79	Light Vehicle - EG F-350	5	500	600	3	5,000	70%	1.193	2.934	0.005	0.178	0.178	0.172	2,087	5,135	8	311	311	302	5.72	14.07	0.02	0.85	0.85	0.83	2.09	5.14	0.01	0.31	0.31	0.30

CO	kg/year	8,065	8,065
NOx	kg/year	18,827	18,827
SO ₂	kg/year	28	28
TSP	kg/year	1,206	1,206
PM ₁₀	kg/year	1,206	1,206
PM _{2.5}	kg/year	1,170	1,170
CO	kg/day	22	22
NOx	kg/day	52	52
SO ₂	kg/day	0.1	0.1
TSP	kg/day	3.3	3.3
PM ₁₀	kg/day	3.3	3.3
PM _{2.5}	kg/day	3.2	3.2
CO	kg/hr	5.4	5.4
NOx	kg/hr	13.0	13.0
SO ₂	kg/hr	1.94E-02	1.94E-02
TSP	kg/hr	0.81	0.81
PM ₁₀	kg/hr	0.81	0.81
PM _{2.5}	kg/hr	0.79	0.79

Southern Road Construction Equipment

MOVES Equipment ID	Type of Equipment	Number of Units	Horsepower (hp)	MOVES hpID	Operating Hours per Day	Annual Operating Hours	Load/Utilization Factor (%)	Emission Factors (g/hp-hr)					Annual Emission Rates (kg/year)					Daily Emission Rates (kg/day)					Hourly Emission Rates (kg/hr)								
								CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}	CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}	CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}	CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}
81	Dozer - Eg Cat D6 / D8	5	198	300	4	7,445	70%	1.117	3.402	0.005	0.215	0.215	0.208	1,152	3,510	5	222	222	215	3.16	9.62	0.01	0.61	0.61	0.59	0.77	2.36	0.00	0.15	0.15	0.14
77	Excavator - Eg Cat 349	4	425	600	4	5,649	70%	1.568	4.046	0.005	0.208	0.208	0.202	2,635	6,801	8	350	350	340	7.22	18.63	0.02	0.96	0.96	0.93	1.87	4.82	0.01	0.25	0.25	0.24
79	Haul Truck - Eg Cat 773	15	760	1000	6	31,488	70%	1.071	4.458	0.005	0.182	0.182	0.176	17,935	74,685	78	3,041	3,041	2,950	49.14	204.62	0.21	8.33	8.33	8.08	8.54	35.58	0.04	1.45	1.45	1.41
20	Loader - Eg Cat 966	8	321	600	4	10,285	70%	1.733	4.426	0.005	0.224	0.224	0.217	4,006	10,229	11	517	517	502	10.98	28.03	0.03	1.42	1.42	1.38	3.12	7.96	0.01	0.40	0.40	0.39
78	Grader - Cat 14	1	238	300	4	1,322	70%	1.100	3.333	0.005	0.211	0.211	0.205	242	734	1	47	47	45	0.66	2.01	0.00	0.13	0.13	0.12	0.18	0.56	0.00	0.04	0.04	0.03
9	Packer - Eg CS563	1	145	175	4	1,508	70%	1.503	4.302	0.005	0.317	0.317	0.307	230	658	1	48	48	47	0.63	1.80	0.00	0.13	0.13	0.13	0.15	0.44	0.00	0.03	0.03	0.03
79	Water/ Sand/ Gravel Truck	2	360	600	2	1,600	70%	1.193	2.934	0.005	0.178	0.178	0.172	481	1,183	2	72	72	69	1.32	3.24	0.01	0.20	0.20	0.19	0.60	1.48	0.00	0.09	0.09	0.09
79	Fuel / Fuel Lube Truck	6	360	600	4	8,750	70%	1.193	2.934	0.005	0.178	0.178	0.172	2,630	6,470	10	392	392	380	7.21	17.73	0.03	1.07	1.07	1.04	1.80	4.44	0.01	0.27	0.27	0.26
79	Light Vehicle - EG F-350	25	500	600	4	37,500	70%	1.193	2.934	0.005	0.178	0.178	0.172	15,656	38,513	61	2,332	2,332	2,262	42.89	105.52	0.17	6.39	6.39	6.20	10.44	25.68	0.04	1.55	1.55	1.51

CO	kg/year	44,968	44,968	44,968
NOx	kg/year	142,785	142,785	142,785
SO ₂	kg/year	177	177	177
TSP	kg/year	7,020	7,020	7,020
PM ₁₀	kg/year	7,020	7,020	7,020
PM _{2.5}	kg/year	6,809	6,809	6,809
CO	kg/day	123	123	123
NOx	kg/day	391	391	391
SO ₂	kg/day	0.5	0.5	0.5
TSP	kg/day	19.2	19.2	19.2
PM ₁₀	kg/day	19.2	19.2	19.2
PM _{2.5}	kg/day	18.7	18.7	18.7
CO	kg/hr	27.5	27.5	27.5
NOx	kg/hr	83.3	83.3	83.3
SO ₂	kg/hr	1.06E-01	1.06E-01	1.06E-01
TSP	kg/hr	4.2	4.2	4.2
PM ₁₀	kg/hr	4.2	4.2	4.2
PM _{2.5}	kg/hr	4.1	4.1	4.1

Emissions for Diesel Fuel Usage for Power Generation

The below calculations assume that the Port is powered by two continuous and two standby 1.825 MW diesel-fired generators. This would meet the required installed capacity of 6 MW and power demand rarely exceeds 4 MW as outlined in the Project Description.

The below calculations assume that the Jericho Station is powered by one continuous and one standby 1.825 MW diesel generator. This would meet the required installed capacity of 3 MW and power demand rarely exceeds 1 MW as outlined in the Project Description.

Generator assumed for use is the Cat 3516C Diesel Generator Set with 1825 kW power, Tier 2 compliant.

Generator emission specifications were taken from: https://www.cat.com/en_US/products/new/power-systems/electric-power/diesel-generator-sets/1000028912.html

Operation Mode:	Continuous	
Rated Engine Power:	1825	ekW
	2447	bhp
Rated Generator Power:	1825	ekW
Required Generator Power:	1825	ekW
Assessed Engine Power:	1825	ekW
	2447	bhp
Assume Engine Load:	100%	

EFs for Power Generation

Source	Substance	Units	CO	NOx	SO ₂	PM ₁₀
Manufacturer Specifications ¹	Emission Factor	(g/hp-hr) (power output)	0.49	6.06	-	0.04
Sulphur in Diesel Fuel Regulations ²		(g/L diesel consumption)	-	-	0.0255	-
Diesel Consumption ³		(L/hr)	465.6			

¹ Emission rates accounting for potential site variations. Source: https://www.cat.com/en_US/products/new/power-systems/electric-power/diesel-generator-sets/1000028912.html

² SO₂ emission rate based on 15 mg/kg sulphur (S) content in diesel fuel. Source: Sulphur in Diesel Fuel Regulations. SOR/2002-254 (Government of Canada 2002). Available at: <https://laws-lois.justice.gc.ca/PDF/SOR-2002-254.pdf>.

³ Conversion from mg S/kg diesel to g S/L diesel = mg/kg x 0.85 kg/L (diesel density) x 1000 mg/g

Operating Hours/Day:

24 hrs

Financial Year	CY30	CY31	CY32	CY33	CY34
Period From	1 Jan 30	1 Jan 31	1 Jan 32	1 Jan 33	1 Jan 34
Period To	31 Dec 30	31 Dec 31	31 Dec 32	31 Dec 33	31 Dec 34
Period Number	9	10	11	12	13
Days in Period	365	365	366	365	365

Diesel Fuel Consumption For Construction

	Unit				
<i>Diesel Fuel Consumption Port</i>					
Number of Generators	#		2	2	2
Operating Hours	HR		17,520	17,568	17,520
CO	kg/year		21,010.14	21,067.70	21,010.14
NOx	kg/year		259,839.69	260,551.58	259,839.69
SO ₂	kg/year		208.01	208.58	208.01
TSP	kg/year		1,715.11	1,719.81	1,715.11
PM ₁₀	kg/year		1,715.11	1,719.81	1,715.11
PM _{2.5}	kg/year		1,715.11	1,719.81	1,715.11
CO	kg/day		57.56	57.56	57.56
NOx	kg/day		711.89	711.89	711.89
SO ₂	kg/day		0.57	0.57	0.57
TSP	kg/day		4.70	4.70	4.70
PM ₁₀	kg/day		4.70	4.70	4.70
PM _{2.5}	kg/day		4.70	4.70	4.70
CO	kg/hr		2.40	2.40	2.40
NOx	kg/hr		29.66	29.66	29.66
SO ₂	kg/hr		0.024	0.024	0.024
TSP	kg/hr		0.20	0.20	0.20
PM ₁₀	kg/hr		0.20	0.20	0.20
PM _{2.5}	kg/hr		0.20	0.20	0.20

Diesel Fuel Consumption Jericho

	#		1	1
Number of Generators			1	1
Operating Hours	HR		8,760	8,784
CO	kg/year		10,505.07	10,533.85
NOx	kg/year		129,919.85	130,275.79
SO ₂	kg/year		104.01	104.29
TSP	kg/year		857.56	859.91
PM ₁₀	kg/year		857.56	859.91
PM _{2.5}	kg/year		857.56	859.91
CO	kg/day		28.78	28.78
NOx	kg/day		355.94	355.94
SO ₂	kg/day		0.28	0.28
TSP	kg/day		2.35	2.35
PM ₁₀	kg/day		2.35	2.35
PM _{2.5}	kg/day		2.35	2.35
CO	kg/hr		1.20	1.20
NOx	kg/hr		14.83	14.83
SO ₂	kg/hr		0.01	0.01
TSP	kg/hr		0.10	0.10
PM ₁₀	kg/hr		0.10	0.10
PM _{2.5}	kg/hr		0.10	0.10

Emissions from Unpaved Road Operations

Description:

Particulate emissions from vehicles driving on unpaved roads causing the resuspension of loose particulate matter on the road surface.

Contaminant(s) of Concern:

PM, PM₁₀ and PM_{2.5} emissions are the contaminants of concern.

Methodology: Emission Factor (EF)

Emission factor for unpaved roads was calculated using Equation (1a) in the US EPA AP-42 document Chapter 13.2.2 (Unpaved Roads). The equation is:

$$E = k (s/12)^b (W/3)^b$$

Where:

E = emission factor

s = surface material silt content (%)

W = mean vehicle weight

k, a, and b = empirical constants

Source

AP 42, Fifth Edition, Volume I, Chapter 13.2.2 Unpaved Roads

Link

[AP42, Section 13.2.2 Unpaved Roads - Updated November 2006](#)

Table 13.2.2-2. CONSTANTS FOR EQUATIONS 1a

Constant	Industrial Roads (Equation 1a)		
	PM-2.5	PM-10	PM-30*
k (lb/VMT)	0.15	1.5	4.9
a	0.90	0.9	0.7
b	0.45	0.5	0.5
Rating	B	B	B

*Assumed equivalent to total suspended particulate matter (TSP)

Input Values

Parameter	Value	Unit	Reference
Surface Silt Content	8.3	%	Table 13.2.2-1. (Stone quarrying and processing)
Operating Speed (General)	15	km/hr	assumption
Operating Speed (Loader/Skidsteer)	5	km/hr	assumption
Operating Speed (Packer/Grader)	10	km/hr	assumption
Operating Days/Year	365	days	provided by client
Operating Hours/Day	24	hrs	provided by client
Combined Water and Speed Limit	95%	summer	https://www.env.nm.gov/wp-content/uploads/sites/2/2017/02/WRAP_FDHandbook_Rev_06.pdf
Control Efficiency :	99%	winter	Natural mitigation in the winter (October to April)

Financial Year

CY30

CY31

CY32

CY33

CY34

Period From

1 Jan 30

1 Jan 31

1 Jan 32

1 Jan 33

1 Jan 34

Period To

31 Dec 30

31 Dec 31

31 Dec 32

31 Dec 33

31 Dec 34

Period Number

9

10

11

12

13

Days in Period

365

365

366

365

365

Port/Camp Construction Equipment (assuming Summer Control Efficiency)

Vehicle	Quantity	Travelling Hours	Mean Vehicle Weight (ton)	Annual Travel Distance (VKT/yr)	Mean Weight x Annual Distance (ton.VKT/year)	Weighted Mean Vehicle Weight (ton)	Data Source
Crane - Eg 75 ton class	1	365.00	24.98	5,475.00	136,765.50	32.63	https://www.sterlincrane.com/wp-content/uploads/2020/09/trGR750XL-2.pdf
Loader - Eg Cat 966	7	9,449.65	25.56	47,248.25	1,207,759.77		https://www.cat.com/en_US/products/new/equipment/wheel-loaders/medium-wheel-loaders/cat-966.html
Haul Truck - Eg Cat 773	5	11,020.59	54.73	165,308.85	9,047,353.36		https://www.cat.com/en_IN/products/new/equipment/off-highway-trucks/off-highway-trucks/cat-773.html
Winch Tractor Trailer	1	1,254.33	20.00	18,814.95	376,299.00		Assumed
Dozer - Eg Cat D6 / D8	3	-	31.96	-	-		https://www.cat.com/en_IN/products/new/equipment/dozers/medium-wheel-loaders/cat-d6-d8.html
Excavator - Eg Cat 349	2	365.00	54.45	5,475.00	298,113.75		https://www.cat.com/en_US/news/machine-press-releases/new-generation-cat-349.html
Rock Truck - Eg Cat 740	4	4,908.40	56.29	73,626.00	4,144,370.73		https://www.cat.com/en_US/products/new/equipment/articulated-trucks/three-axle.html
Plow / Sand / Gravel / Water Truck	1	840.08	20.00	12,601.26	252,025.20		Assumed
Packer - Eg CS563	1	1,583.40	45.00	15,834.00	712,530.00		https://www.ritchiespecs.com/model/caterpillar-cs563-vibratory-smooth-drum-roller
Grader - Cat 14	1	1,388.24	28.63	13,882.40	397,453.11		https://www.cat.com/en_US/products/new/equipment/motor-graders/motor-graders/cat-14.html
Skidsteer / Bobcat	2	2,189.50	4.57	10,947.50	50,030.08		https://www.cat.com/en_US/products/new/equipment/skid-steer-and-compact-track-loaders/skid-steer-and-compact-track-loaders/cat-14.html
Manlift - 60' / 80' Boom	2	365.00	19.00	5,475.00	104,025.00		https://www.genielift.com/docs/default-source/product-specifications/articulated-boom-lifts/genie-boom-lifts.pdf
Light Vehicle - EG F-350	15	10,500.00	4.07	157,500.00	641,025.00		https://www.ford.ca/trucks/super-duty/models/f350-4x4/
Total				532,188.21	17,367,750.49		

total km travelled

VKT/year

532,188

532,188

532,188

532,188

VKT/day

1,458.05

1,458.05

1,458.05

1,458.05

VKT/hr

60.75

60.75

60.75

60.75

mean vehicle weight, W

tons

32.63

32.63

32.63

32.63

TSP

3,123.70

3,123.70

3,123.70

3,123.70

PM₁₀

888.27

888.27

888.27

888.27

PM_{2.5}

88.83

88.83

88.83

88.83

TSP

86,045.42

86,045.42

86,045.42

86,045.42

PM₁₀

24,468.22

24,468.22

24,468.22

24,468.22

PM_{2.5}

2,446.82

2,446.82

2,446.82

2,446.82

TSP

235.74

235.74

235.74

235.74

PM₁₀

67.04

67.04

67.04

67.04

PM_{2.5}

6.70

6.70

6.70

6.70

TSP

9.82

9.82

9.82

9.82

PM₁₀

2.79

2.79

2.79

2.79

PM_{2.5}

0.28

0.28

0.28

0.28

Emissions from Unpaved Road Operations

Description:

Particulate emissions from vehicles driving on unpaved roads causing the resuspension of loose particulate matter on the road surface.

Contaminant(s) of Concern:

PM, PM₁₀ and PM_{2.5} emissions are the contaminants of concern.

Methodology: Emission Factor (EF)

Emission factor for unpaved roads was calculated using Equation (1a) in the US EPA AP-42 document Chapter 13.2.2 (Unpaved Roads). The equation is:

$$E = k (s/12)^b (W/3)^a$$

Where:

E = emission factor

s = surface material silt content (%)

W = mean vehicle weight

k, a, and b = empirical constants

Source

AP 42, Fifth Edition, Volume I, Chapter 13.2.2 Unpaved Roads

Link

[AP42, Section 13.2.2 Unpaved Roads - Updated November 2006](#)

Table 13.2.2-2. CONSTANTS FOR EQUATIONS 1a

Constant	Industrial Roads (Equation 1a)		
	PM-2.5	PM-10	PM-30*
k (lb/VMT)	0.15	1.5	4.9
a	0.90	0.9	0.7
b	0.45	0.5	0.5
Rating	B	B	B

*Assumed equivalent to total suspended particulate matter (TSP)

Input Values

Parameter	Value	Unit	Reference
Surface Silt Content	8.3	%	Table 13.2.2-1. (Stone quarrying and processing)
Operating Speed (General)	15	km/hr	assumption
Operating Speed (Loader/Skidsteer)	5	km/hr	assumption
Operating Speed (Packer/Grader)	10	km/hr	assumption
Operating Days/Year	365	days	provided by client
Operating Hours/Day	24	hrs	provided by client
Combined Water and Speed Limit	95%	summer	https://www.env.nm.gov/wp-content/uploads/sites/2/2017/02/WRAP_FDHandbook_Rev_06.pdf
Control Efficiency :	99%	winter	Natural mitigation in the winter (October to April)

Financial Year

CY30

CY31

CY32

CY33

CY34

Period From

1 Jan 30

1 Jan 31

1 Jan 32

1 Jan 33

1 Jan 34

Period To

31 Dec 30

31 Dec 31

31 Dec 32

31 Dec 33

31 Dec 34

Period Number

9

10

11

12

13

Days in Period

365

365

366

365

365

Jericho/Camp Construction Equipment (assuming Summer Control Efficiency)

Vehicle	Quantity	Travelling Hours	Mean Vehicle Weight (ton)	Annual Travel Distance (VKT/yr)	Mean Weight x Annual Distance (ton.VKT/year)	Weighted Mean Vehicle Weight (ton)	Data Source
Crane - Eg 75 ton class	1	365.00	24.98	5,475.00	136,765.50	30.36	https://www.sterlingcrane.com/wp-content/uploads/2020/09/trGR750XL-2.pdf
Loader - Eg Cat 966	1	1,349.95	25.56	6,749.75	172,537.11		https://www.cat.com/en_US/products/new/equipment/wheel-loaders/medium-wheel-loaders/cat-966
Winch Tractor Trailer	1	1,254.33	20.00	18,814.95	376,299.00		Assumed
Plow / Sand / Gravel / Water Truck	1	840.08	20.00	12,601.26	252,025.20		Assumed
Dozer - Eg Cat D6 / D8	1		31.96				https://www.cat.com/en_IN/products/new/equipment/dozers/medium-dozers/cat-d6-d8
Rock Truck - Eg Cat 740	4	4,908.40	56.29	73,626.00	4,144,370.73		https://www.cat.com/en_US/products/new/equipment/articulated-trucks/three-axle-articulated-trucks/cat-740
Skidsteer / Bobcat	1	1,094.83	4.57	5,474.13	25,016.75		https://www.cat.com/en_AI/products/new/equipment/skid-steer-end-compact-track-loaders/cat-bobcat
Light Vehicle - EG F-350	5	3,500.00	4.07	52,500.00	213,675.00		https://www.ford.ca/trucks/super-duty/models/f350-xl/
Total				175,241.09	5,320,689.29		

total km travelled

VKT/year

175,241

175,241

VKT/day

480.11

480.11

VKT/hr

20.00

20.00

mean vehicle weight, W

tons

30.36

30.36

TSP

g/VKT

3,023.87

3,023.87

PM₁₀

g/VKT

712.69

712.69

PM_{2.5}

g/VKT

85.99

85.99

TSP

kg/yr

27,427.90

27,427.90

PM₁₀

kg/yr

6,464.38

6,464.38

PM_{2.5}

kg/yr

779.95

779.95

TSP

kg/day

75.14

75.14

PM₁₀

kg/day

17.71

17.71

PM_{2.5}

kg/day

2.14

2.14

TSP

kg/hr

3.13

3.13

PM₁₀

kg/hr

0.74

0.74

PM_{2.5}

kg/hr

0.089

0.089

Northern Road Construction Equipment (assuming Summer Control Efficiency)

Vehicle	Quantity	Travelling Hours	Mean Vehicle Weight (ton)	Annual Travel Distance (VKT/yr)	Mean Weight x Annual Distance (ton.VKT/year)	Weighted Mean Vehicle Weight (ton)	Data Source
Dozer - Eg Cat D6 / D8	5	-	31.96	-	-	25.60	https://www.cat.com/en_IN/products/new/equipment/dozers/medium-dozers/cat-d6-d8
Excavator - Eg Cat 349	6	5,600.00	54.45	84,000.00	4,573,800.00		https://www.cat.com/en_US/news/machine-press-releases/new-generation-cat-349-excavator
Haul Truck - Eg Cat 773	10	14,694.17	54.73	220,412.50	12,063,176.13		https://www.cat.com/en_IN/products/new/equipment/off-highway-trucks/off-highway-trucks/cat-773
Loader - Eg Cat 966	5	4,499.83	25.56	22,499.17	575,123.70		https://www.cat.com/en_US/products/new/equipment/wheel-loaders/medium-wheel-loaders/cat-966
Grader - Cat 14	1	1,322.13	28.63	13,221.33	378,526.77		https://www.cat.com/en_US/products/new/equipment/motor-graders/motor-graders/cat-14
Packer - Eg CS563	1	1,055.60	45.00	10,556.00	475,020.00		https://www.ritchiespecs.com/model/caterpillar-cs563-vibratory-smooth-drum-roller
Water/ Sand/ Gravel Truck	2	1,120.11	20.00	16,801.68	336,033.60		Assumed
Fuel / Fuel Lube Truck	6	6,125.00	20.00	91,875.00	1,837,500.00		Assumed
Light Vehicle - EG F-350	25	26,250.00	4.07	393,750.00	1,602,562.50		https://www.ford.ca/trucks/super-duty/models/f350-xl/
Total				853,115.68	21,841,742.70		

total km travelled

VKT/year

853,116

853,116

853,116

VKT/day

2,337

2,337

2,337

VKT/hr

97

97

97

mean vehicle weight, W

tons

25.60

25.60

25.60

TSP

g/VKT

2,800.53

2,800.53

2,800.53

PM₁₀

g/VKT

796.37

796.37

796.37

PM_{2.5}

g/VKT

79.64

79.64

79.64

TSP

kg/yr

123,663

123,663

123,663

PM₁₀

kg/yr

35,165

35,165

35,165

PM_{2.5}

kg/yr

3,517

3,517

3,517

TSP

kg/day

339

339

339

PM₁₀

kg/day

96

96

96

PM_{2.5}

kg/day

9.6

9.6

9.6

TSP

kg/hr

14

14

14

PM₁₀

kg/hr

4.0

4.0

4.0

PM_{2.5}

kg/hr

0.40

0.40

0.40

Emissions from Unpaved Road Operations

Description:

Particulate emissions from vehicles driving on unpaved roads causing the resuspension of loose particulate matter on the road surface.

Contaminant(s) of Concern:

PM, PM₁₀ and PM_{2.5} emissions are the contaminants of concern.

Methodology: Emission Factor (EF)

Emission factor for unpaved roads was calculated using Equation (1a) in the US EPA AP-42 document Chapter 13.2.2 (Unpaved Roads). The equation is:

$$E = k (s/12)^a (W/3)^b$$

Where:

E = emission factor

s = surface material silt content (%)

W = mean vehicle weight

k, a, and b = empirical constants

Source

AP 42, Fifth Edition, Volume I, Chapter 13.2.2 Unpaved Roads

Link

[AP42, Section 13.2.2 Unpaved Roads - Updated November 2006](#)

Table 13.2.2-2. CONSTANTS FOR EQUATIONS 1a

Constant	Industrial Roads (Equation 1a)		
	PM-2.5	PM-10	PM-30*
k (lb/VMT)	0.15	1.5	4.9
a	0.90	0.9	0.7
b	0.45	0.5	0.5
Rating	B	B	B

*Assumed equivalent to total suspended particulate matter (TSP)

Input Values

Parameter	Value	Unit	Reference
Surface Silt Content	8.3	%	Table 13.2.2-1. (Stone quarrying and processing)
Operating Speed (General)	15	km/hr	assumption
Operating Speed (Loader/Skidsteer)	5	km/hr	assumption
Operating Speed (Packer/Grader)	10	km/hr	assumption
Operating Days/Year	365	days	provided by client
Operating Hours/Day	24	hrs	provided by client
Combined Water and Speed Limit	95%	summer	https://www.env.nm.gov/wp-content/uploads/sites/2/2017/02/WRAP_FDHandbook_Rev_06.pdf
Control Efficiency :	99%	winter	Natural mitigation in the winter (October to April)

Financial Year	CY30	CY31	CY32	CY33	CY34
Period From	1 Jan 30	1 Jan 31	1 Jan 32	1 Jan 33	1 Jan 34
Period To	31 Dec 30	31 Dec 31	31 Dec 32	31 Dec 33	31 Dec 34
Period Number	9	10	11	12	13
Days in Period	365	365	366	365	365

Southern Road Construction Equipment (assuming Summer Control Efficiency)

Vehicle	Quantity	Operating Hours	Mean Vehicle Weight (ton)	Annual Travel Distance (VKT/yr)	Mean Weight x Annual Distance (ton.VKT/year)	Weighted Mean Vehicle Weight (ton)	Data Source
Dozer - Eq Cat D6 / D8	5	-	31.96	-	-	28.22	https://www.cat.com/en_IN/products/new/equipment/dozers/medium-
Excavator - Eq Cat 349	4	3,954.53	54.45	59,318.00	3,229,865.10		https://www.cat.com/en_US/news/machine-press-releases/new-generation-cat-349-
Haul Truck - Eq Cat 773	15	22,041.25	54.73	330,618.75	18,094,764.19		https://www.cat.com/en_IN/products/new/equipment/off-highway-trucks/off-highway-
Loader - Eq Cat 966	8	7,199.73	25.56	35,998.67	920,197.92		https://www.cat.com/en_US/products/new/equipment/wheel-loaders/medium-wheel-
Grader - Cat 14	1	925.49	28.63	9,254.93	264,968.74		https://www.cat.com/en_US/products/new/equipment/motor-grades/motor-
Packer - Eq CS563	1	1,055.60	45.00	10,556.00	475,020.00		https://www.ritchiespecs.com/modelcatalogerpillar-cs563-vibratory-smooth-drum-roller
Water/ Sand/ Gravel Truck	2	1,120.11	20.00	16,801.68	336,033.60		Assumed
Fuel / Fuel Lube Truck	6	6,125.00	20.00	91,875.00	1,837,500.00		Assumed
Light Vehicle - EG F-350	25	26,250.00	4.07	393,750.00	1,602,562.50		https://www.ford.ca/trucks/super-duty/models/f350-x/
Total				948,173.03	26,760,912.05		

total km travelled	km/year	948,173	948,173	948,173
	km/day	2,598	2,598	2,598
	km/hr	108	108	108
mean vehicle weight, W	tons	28	28	28
TSP	g/VKT	2,926	2,926	2,926
PM ₁₀	g/VKT	832	832	832
PM _{2.5}	g/VKT	83.2	83.2	83.2
TSP	kg/yr	143,605	143,605	143,605
PM ₁₀	kg/yr	40,836	40,836	40,836
PM _{2.5}	kg/yr	4,084	4,084	4,084
TSP	kg/day	393	393	393
PM ₁₀	kg/day	112	112	112
PM _{2.5}	kg/day	11.2	11.2	11.2
TSP	kg/hr	16	16	16
PM ₁₀	kg/hr	4.7	4.7	4.7
PM _{2.5}	kg/hr	0.47	0.47	0.47

Emissions for Aircraft Operations

Source Emission estimation technique manual for Airports Version 2.0 (July 2008)
Link [National Pollutant Inventory \(NPI\) emission estimation technique manual for airports - Version 2.0 - July 2008](#)

Source	Substance	Units	CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}
Civil - Cargo - Small	Emission factor	(kg/LTO) ¹	10.438	1.250	0.0832	0.0893	0.0893	0.0893
Civil - Passenger - Small	Emission factor	(kg/LTO) ¹	6.588	0.967	0.0655	0.0698	0.0698	0.0698
General - Business - Small	Emission factor	(kg/LTO) ¹	5.594	0.579	0.0381	0.0413	0.0413	0.0413
General - Other - Small	Emission factor	(kg/LTO) ¹	0.141	0.578	0.0399	0.042	0.0420	0.042
General - Passenger - Small	Emission factor	(kg/LTO) ¹	6.879	0.511	0.0354	0.0373	0.0373	0.0373
Civil - Cargo - Large	Emission factor	(kg/LTO) ¹	9.889	0.947	0.0681	0.0703	0.0703	0.0703
Civil - Passenger - Large	Emission factor	(kg/LTO) ¹	7.344	0.811	0.0580	0.0601	0.0601	0.0601
General - Other - Large	Emission factor	(kg/LTO) ¹	0.0811	3.697	0.247	0.264	0.264	0.264

¹ LTO - Landing and Take-Off flight phases: Taxi in and out, Take Off, Climb out, Approach, Landing.

CY30	CY31	CY32	CY33	CY34
1 Jan 30	1 Jan 31	1 Jan 32	1 Jan 33	1 Jan 34
31 Dec 30	31 Dec 31	31 Dec 32	31 Dec 33	31 Dec 34
9	10	11	12	13
365	365	366	365	365

Flight Data For Construction

	Unit				
Small Aircraft (AGN II) - Eg Twin Otter					
Number of Aircraft	#	26	26	26	6
Number of LTO/year	#	26	26	26	6
CO	kg/year	271	271	271	62.6
NOx	kg/year	32.5	32.5	32.5	7.50
SO ₂	kg/year	2.16	2.16	2.16	0.499
TSP	kg/year	2.32	2.32	2.32	0.536
PM ₁₀	kg/year	2.32	2.32	2.32	0.536
PM _{2.5}	kg/year	2.32	2.32	2.32	0.536
CO	kg/day	10.4	10.4	10.4	10.4
NOx	kg/day	1.25	1.25	1.25	1.25
SO ₂	kg/day	0.0832	0.0832	0.0832	0.0832
TSP	kg/day	0.0893	0.0893	0.0893	0.0893
PM ₁₀	kg/day	0.0893	0.0893	0.0893	0.0893
PM _{2.5}	kg/day	0.0893	0.0893	0.0893	0.0893
CO	kg/hr	10.4	10.4	10.4	10.4
NOx	kg/hr	1.25	1.25	1.25	1.25
SO ₂	kg/hr	0.083	0.083	0.083	0.083
TSP	kg/hr	0.089	0.089	0.089	0.089
PM ₁₀	kg/hr	0.089	0.089	0.089	0.089
PM _{2.5}	kg/hr	0.089	0.089	0.089	0.089

Medium Aircraft (AGN IIIA) - Eg Dash 7

Number of Aircraft	#	24	48	48
Number of LTO/year	#	24	48	48
CO	kg/year	237	475	475
NOx	kg/year	22.7	45.5	45.5
SO ₂	kg/year	1.63	3.27	3.27
TSP	kg/year	1.69	3.37	3.37
PM ₁₀	kg/year	1.69	3.37	3.37
PM _{2.5}	kg/year	1.69	3.37	3.37
CO	kg/day	9.89	9.89	9.89
NOx	kg/day	0.947	0.947	0.947
SO ₂	kg/day	0.0681	0.0681	0.0681
TSP	kg/day	0.0703	0.0703	0.0703
PM ₁₀	kg/day	0.0703	0.0703	0.0703
PM _{2.5}	kg/day	0.0703	0.0703	0.0703
CO	kg/hr	9.89	9.89	9.89
NOx	kg/hr	0.947	0.947	0.947
SO ₂	kg/hr	0.0681	0.0681	0.0681
TSP	kg/hr	0.0703	0.0703	0.0703
PM ₁₀	kg/hr	0.0703	0.0703	0.0703
PM _{2.5}	kg/hr	0.0703	0.0703	0.0703

Emissions for Aircraft Operations

Source Emission estimation technique manual for Airports Version 2.0 (July 2008)
Link [National Pollutant Inventory \(NPI\) emission estimation technique manual for airports - Version 2.0 - July 2008](#)

Source	Substance	Units	CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}
Civil - Cargo - Small	Emission factor	(kg/LTO) ¹	10.438	1.250	0.0832	0.0893	0.0893	0.0893
Civil - Passenger - Small	Emission factor	(kg/LTO) ¹	6.588	0.967	0.0655	0.0698	0.0698	0.0698
General - Business - Small	Emission factor	(kg/LTO) ¹	5.594	0.579	0.0381	0.0413	0.0413	0.0413
General - Other - Small	Emission factor	(kg/LTO) ¹	0.141	0.578	0.0399	0.042	0.0420	0.042
General - Passenger - Small	Emission factor	(kg/LTO) ¹	6.879	0.511	0.0354	0.0373	0.0373	0.0373
Civil - Cargo - Large	Emission factor	(kg/LTO) ¹	9.889	0.947	0.0681	0.0703	0.0703	0.0703
Civil - Passenger - Large	Emission factor	(kg/LTO) ¹	7.344	0.811	0.0580	0.0601	0.0601	0.0601
General - Other - Large	Emission factor	(kg/LTO) ¹	0.0811	3.697	0.247	0.264	0.264	0.264

¹ LTO - Landing and Take-Off flight phases: Taxi in and out, Take Off, Climb out, Approach, Landing.

CY30	CY31	CY32	CY33	CY34
1 Jan 30	1 Jan 31	1 Jan 32	1 Jan 33	1 Jan 34
31 Dec 30	31 Dec 31	31 Dec 32	31 Dec 33	31 Dec 34
9	10	11	12	13
365	365	366	365	365

Flight Data For Construction

Jet A Fuel Summary For Construction

Jet A Fuel Consumption Port

Total Operating Hours	HR	300	300	300	300
Averaged Fuel Burn	L	60,000	60,000	60,000	60,000
CO	kg/year	180.93	122.09	146.54	146.54
NOx	kg/year	21.67	13.25	14.44	14.44
SO ₂	kg/year	1.44	0.91	1.03	1.03
TSP	kg/year	1.55	0.96	1.07	1.07
PM ₁₀	kg/year	1.55	0.96	1.07	1.07
PM _{2.5}	kg/year	1.55	0.96	1.07	1.07
CO	kg/day	6.96	4.88	5.54	5.54
NOx	kg/day	0.83	0.53	0.60	0.60
SO ₂	kg/day	0.055	0.036	0.041	0.041
TSP	kg/day	0.060	0.038	0.044	0.044
PM ₁₀	kg/day	0.060	0.038	0.044	0.044
PM _{2.5}	kg/day	0.060	0.038	0.044	0.044
CO	kg/hr	6.96	4.88	5.54	5.54
NOx	kg/hr	0.83	0.53	0.60	0.60
SO ₂	kg/hr	0.055	0.036	0.041	0.041
TSP	kg/hr	0.060	0.038	0.044	0.044
PM ₁₀	kg/hr	0.060	0.038	0.044	0.044
PM _{2.5}	kg/hr	0.060	0.038	0.044	0.044

Jet A Fuel Consumption Jericho

Total Operating Hours	HR	150	150
Averaged Fuel Burn	L	30,000	30,000
CO	kg/year	90.46	61.05
NOx	kg/year	10.83	6.63
SO ₂	kg/year	0.72	0.46
TSP	kg/year	0.77	0.48
PM ₁₀	kg/year	0.77	0.48
PM _{2.5}	kg/year	0.77	0.48
CO	kg/day	3.48	2.44
NOx	kg/day	0.42	0.26
SO ₂	kg/day	0.028	0.018
TSP	kg/day	0.030	0.019
PM ₁₀	kg/day	0.030	0.019
PM _{2.5}	kg/day	0.030	0.019
CO	kg/hr	3.48	2.44
NOx	kg/hr	0.42	0.26
SO ₂	kg/hr	0.028	0.018
TSP	kg/hr	0.030	0.019
PM ₁₀	kg/hr	0.030	0.019
PM _{2.5}	kg/hr	0.030	0.019

Emissions for Aircraft Operations

Source Emission estimation technique manual for Airports Version 2.0 (July 2008)
Link [National Pollutant Inventory \(NPI\) emission estimation technique manual for airports - Version 2.0 - July 2008](#)

Source	Substance	Units	CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}
Civil - Cargo - Small	Emission factor	(kg/LTO) ¹	10.438	1.250	0.0832	0.0893	0.0893	0.0893
Civil - Passenger - Small	Emission factor	(kg/LTO) ¹	6.588	0.967	0.0655	0.0698	0.0698	0.0698
General - Business - Small	Emission factor	(kg/LTO) ¹	5.594	0.579	0.0381	0.0413	0.0413	0.0413
General - Other - Small	Emission factor	(kg/LTO) ¹	0.141	0.578	0.0399	0.042	0.0420	0.042
General - Passenger - Small	Emission factor	(kg/LTO) ¹	6.879	0.511	0.0354	0.0373	0.0373	0.0373
Civil - Cargo - Large	Emission factor	(kg/LTO) ¹	9.889	0.947	0.0681	0.0703	0.0703	0.0703
Civil - Passenger - Large	Emission factor	(kg/LTO) ¹	7.344	0.811	0.0580	0.0601	0.0601	0.0601
General - Other - Large	Emission factor	(kg/LTO) ¹	0.0811	3.697	0.247	0.264	0.264	0.264

¹ LTO - Landing and Take-Off flight phases: Taxi in and out, Take Off, Climb out, Approach, Landing.

CY30	CY31	CY32	CY33	CY34
1 Jan 30	1 Jan 31	1 Jan 32	1 Jan 33	1 Jan 34
31 Dec 30	31 Dec 31	31 Dec 32	31 Dec 33	31 Dec 34
9	10	11	12	13
365	365	366	365	365

Flight Data For Construction

Jet A Fuel Consumption Northern Road Construction

Total Operating Hours	HR	400	400	400
Averaged Fuel Burn	L	80,000	80,000	80,000
CO	kg/year	162.79	195.38	195.38
NOx	kg/year	17.67	19.26	19.26
SO ₂	kg/year	1.22	1.37	1.37
TSP	kg/year	1.28	1.42	1.42
PM ₁₀	kg/year	1.28	1.42	1.42
PM _{2.5}	kg/year	1.28	1.42	1.42
CO	kg/day	6.50	7.39	7.39
NOx	kg/day	0.70	0.80	0.80
SO ₂	kg/day	0.048	0.055	0.055
TSP	kg/day	0.051	0.058	0.058
PM ₁₀	kg/day	0.051	0.058	0.058
PM _{2.5}	kg/day	0.051	0.058	0.058
CO	kg/hr	6.50	7.39	7.39
NOx	kg/hr	0.70	0.80	0.80
SO ₂	kg/hr	0.048	0.055	0.055
TSP	kg/hr	0.051	0.058	0.058
PM ₁₀	kg/hr	0.051	0.058	0.058
PM _{2.5}	kg/hr	0.051	0.058	0.058

Jet A Fuel Consumption Southern Road Construction

Total Operating Hours	HR	400	400	400
Averaged Fuel Burn	L	80,000	80,000	80,000
CO	kg/year	162.79	195.38	195.38
NOx	kg/year	17.67	19.26	19.26
SO ₂	kg/year	1.22	1.37	1.37
TSP	kg/year	1.28	1.42	1.42
PM ₁₀	kg/year	1.28	1.42	1.42
PM _{2.5}	kg/year	1.28	1.42	1.42
CO	kg/day	6.50	7.39	7.39
NOx	kg/day	0.70	0.80	0.80
SO ₂	kg/day	0.048	0.055	0.055
TSP	kg/day	0.051	0.058	0.058
PM ₁₀	kg/day	0.051	0.058	0.058
PM _{2.5}	kg/day	0.051	0.058	0.058
CO	kg/hr	6.50	7.39	7.39
NOx	kg/hr	0.70	0.80	0.80
SO ₂	kg/hr	0.048	0.055	0.055
TSP	kg/hr	0.051	0.058	0.058
PM ₁₀	kg/hr	0.051	0.058	0.058
PM _{2.5}	kg/hr	0.051	0.058	0.058

Emissions for Marine Vessel Usage

Description:

Combustion emissions from Shipping Vessels

Contaminant(s) of Concern:

Nitrogen oxides (NOx), carbon monoxide (CO), particulate matter, sulphur dioxide (SO2) emissions are the contaminants of concern

Methodology: Emission Factor (EF)

<https://downloads.regulations.gov/EPA-HQ-OAR-2003-0045-0165/content.pdf>

TSP:PM10 and TSP:PM2.5 ratios obtained from CARB CEIDAR

Vessel Information

Vessel Type	Number of Ships					Deadweight Tonnage (tonne)
	CY30	CY31	CY32	CY33	CY34	
Barges / Tugs (e.g., Arctic Tuk)	2	2	2	1	1	4,715
Fuel Tankers	0	0	0	0	1	16,640
Cargo Ships (e.g., NEAS MV Aivig)	0	0	2	2	2	4,860
Security Vessels (e.g., Polar Icebreaker)	0	0	1	1	2	13,842

Inputs

Marine diesel fuel sulphur content	1,000	1,000	1,000	1,000	1,000	mg/kg
Diesel Per Ship	20,000,000	20,000,000	20,000,000	20,000,000	20,000,000	Litres
Diesel density	0.832	0.832	0.832	0.832	0.832	kg/L
vessels per year	2	2	5	4	6	
number of days docked per ship	4	4	4	4	4	days/vessel
Maneuver time	0.5	0.5	0.5	0.5	0.5	hour/vessel
Enter/Exit Time	1	1	1	1	1	hour/vessel
No. Ships in port	1	1	1	1	1	
Average Ship DWT	4,715	4,715	6,598	7,069	9,793	tonne

Emission Factors

Pollutant	x	b	a
PM	1.5	0.2551	0.0059
NOx	1.5	10.4496	0.1255
NO ₂	1.5	15.5247	0.18865
SO ₂	n/a	0	2.3735
CO	1	0	0.8378

Calculations:

emission rate, not SO₂, (g/kW-hr) = a * ((fractional load)^x-x) + b

emission rate, for SO₂, (g/kW-hr) = a * (fuel sulfur flow) +b

fuel sulfur flow = sulphur content * (14.12 / (fractional load) + 205.717)

fractional load = % load / 100

main engine load factors (%) for bulk carriers and tankers:

80	cruise
40	slow cruise
20	maneuvering

auxiliary loads in kW. Load factor = 100%

750	slow cruise
1250	maneuvering
1000	hotelling

CY 34

						Emission Factors (g/kW-hr)						Total Emission Rate (tonnes/yr)					
Emission Location	Description	Average Ship DWT	Max Main Engine Power (kW = (2581 + 0.719 * (DWT))/1.34102)	Main Engine Power during activity (kW)	Aux Engine Power during activity (kW)	NOx	SO ₂	CO	TSP	PM ₁₀	PM _{2.5}	NOx	SO ₂	CO	TSP	PM ₁₀	PM _{2.5}
GBRP Dock	Docked ship, hotelling	9,793.17	7,175.35		1,000.00	10.58	0.52	0.84	0.26	0.25	0.24	6.09	0.30	0.48	0.15	0.14	0.14
Gray's Bay	maneuvering ship	9,793.17	7,175.35	1,435.07	1,250.00	11.85	0.66	4.19	0.32	0.31	0.30	0.10	0.01	0.03	0.003	0.002	0.002
Gray's Bay	slow cruise ship	9,793.17	7,175.35	2,870.14	750.00	10.95	0.57	2.09	0.28	0.27	0.26	0.24	0.01	0.05	0.006	0.006	0.006
						6.42	0.32	0.56	0.16	0.15	0.15						

Emissions for Marine Vessel Usage

Description:

Combustion emissions from Shipping Vessels

Contaminant(s) of Concern:

Nitrogen oxides (NOx), carbon monoxide (CO), particulate matter, sulphur dioxide (SO2) emissions are the contaminants of concern

Methodology: Emission Factor (EF)

<https://downloads.regulations.gov/EPA-HQ-OAR-2003-0045-0165/content.pdf>

TSP:PM10 and TSP:PM2.5 ratios obtained from CARB CEIDAR

						Emission Factors (g/kW-hr)						Total Emission Rate (tonnes/yr)					
Emission Location	Description	Average Ship DWT	Max Main Engine Power (kW = (2581 + 0.719 * (DWT)))/1.34102)	Main Engine Power during activity (kW)	Aux Engine Power during activity (kW)	NOx	SO ₂	CO	TSP	PM ₁₀	PM _{2.5}	NOx	SO ₂	CO	TSP	PM ₁₀	PM _{2.5}
GBRP Dock	Docked ship, hotelling	7,069.25	5,714.90		1,000.00	10.58	0.52	0.84	0.26	0.25	0.24	4.06	0.20	0.32	0.10	0.10	0.09
Gray's Bay	maneuvering ship	7,069.25	5,714.90	1,142.98	1,250.00	11.85	0.66	4.19	0.32	0.31	0.30	0.06	0.00	0.02	0.002	0.001	0.001
Gray's Bay	slow cruise ship	7,069.25	5,714.90	2,285.96	750.00	10.95	0.57	2.09	0.28	0.27	0.26	0.13	0.01	0.03	0.003	0.003	0.003
												4.25	0.21	0.37	0.11	0.10	0.10

						Emission Factors (g/kW-hr)						Total Emission Rate (tonnes/yr)					
Emission Location	Description	Average Ship DWT	Max Main Engine Power (kW = (2581 + 0.719 * (DWT)))/1.34102)	Main Engine Power during activity (kW)	Aux Engine Power during activity (kW)	NOx	SO ₂	CO	TSP	PM ₁₀	PM _{2.5}	NOx	SO ₂	CO	TSP	PM ₁₀	PM _{2.5}
GBRP Dock	Docked ship, hotelling	6,598.40	5,462.45		1,000.00	10.58	0.52	0.84	0.26	0.25	0.24	5.08	0.25	0.40	0.13	0.12	0.12
Gray's Bay	maneuvering ship	6,598.40	5,462.45	1,092.49	1,250.00	11.85	0.66	4.19	0.32	0.31	0.30	0.07	3.84E-03	0.02	1.9E-03	1.8E-03	1.8E-03
Gray's Bay	slow cruise ship	6,598.40	5,462.45	2,184.98	750.00	10.95	0.57	2.09	0.28	0.27	0.26	0.16	0.01	0.03	4.1E-03	3.9E-03	3.8E-03
												5.31	0.26	0.46	0.13	0.13	0.12

						Emission Factors (g/kW-hr)						Total Emission Rate (tonnes/yr)					
Emission Location	Description	Average Ship DWT	Max Main Engine Power (kW = (2581 + 0.719 * (DWT)))/1.34102)	Main Engine Power during activity (kW)	Aux Engine Power during activity (kW)	NOx	SO ₂	CO	TSP	PM ₁₀	PM _{2.5}	NOx	SO ₂	CO	TSP	PM ₁₀	PM _{2.5}
GBRP Dock	Docked ship, hotelling	4,715.00	4,452.64		1,000.00	10.58	0.52	0.84	0.26	0.25	0.24	2.03	0.10	0.16	0.05	0.05	0.05
Gray's Bay	maneuvering ship	4,715.00	4,452.64	890.53	1,250.00	11.85	0.66	4.19	0.32	0.31	0.30	0.03	0.00	0.01	0.00	0.00	0.00
Gray's Bay	slow cruise ship	4,715.00	4,452.64	1,781.06	750.00	10.95	0.57	2.09	0.28	0.27	0.26	0.06	0.00	0.01	0.00	0.00	0.00
												2.11	0.10	0.18	0.05	0.05	0.05

Emissions Summary for Construction Phase

Financial Year	CY30	CY31	CY32	CY33	CY34
Period From	1 Jan 30	1 Jan 31	1 Jan 32	1 Jan 33	1 Jan 34
Period To	31 Dec 30	31 Dec 31	31 Dec 32	31 Dec 33	31 Dec 34
Period Number	9	10	11	12	13
Days in Period	365	365	366	365	365

Northern Domain (Port & Northern Road)

CO	kg/year	180.43	74,759.34	151,494.45	151,403.71	151,598.32
NOx	kg/year	2,111.20	360,324.31	489,997.31	488,232.59	490,406.59
SO ₂	kg/year	104.48	2,626.51	4,045.25	3,992.71	4,100.51
TSP	kg/year	52.21	129,109.62	312,875.71	312,845.15	312,898.98
PM ₁₀	kg/year	50.12	44,685.66	107,461.23	107,431.72	107,483.39
PM _{2.5}	kg/year	48.92	15,061.08	34,303.11	34,274.19	34,324.63
CO	kg/day	28.64	385.67	678.38	680.25	682.09
NOx	kg/day	278.33	1,294.92	1,663.83	1,665.40	1,673.52
SO ₂	kg/day	13.89	25.15	31.22	31.31	31.74
TSP	kg/day	6.92	408.10	954.00	954.14	954.35
PM ₁₀	kg/day	6.64	145.67	332.41	332.51	332.71
PM _{2.5}	kg/day	6.48	49.88	104.30	104.39	104.59
CO	kg/hr	15.11	246.66	458.49	460.46	462.91
NOx	kg/hr	63.65	189.56	310.29	312.16	322.02
SO ₂	kg/hr	3.37	9.71	15.53	15.63	16.16
TSP	kg/hr	1.65	33.90	73.25	73.31	73.57
PM ₁₀	kg/hr	1.59	16.49	34.46	34.51	34.76
PM _{2.5}	kg/hr	1.55	5.86	11.66	11.72	11.96

Southern Domain (Jericho & Southern Road)

CO	kg/year	21,915.65	90,311.31	69,557.40	69,557.40
NOx	kg/year	154,844.12	303,472.48	153,864.33	153,864.33
SO ₂	kg/year	1,774.76	2,637.05	2,442.34	2,442.34
TSP	kg/year	40,835.79	234,791.29	194,348.56	194,348.56
PM ₁₀	kg/year	13,263.68	77,857.67	64,987.04	64,987.04
PM _{2.5}	kg/year	5,956.67	25,105.74	19,542.12	19,542.12
CO	kg/day	77.90	318.42	245.54	245.54
NOx	kg/day	428.06	846.12	433.61	433.61
SO ₂	kg/day	5.32	9.13	8.16	8.16
TSP	kg/day	154.02	727.93	575.09	575.09
PM ₁₀	kg/day	47.61	239.42	192.96	192.96
PM _{2.5}	kg/day	20.02	74.26	55.39	55.39
CO	kg/hr	30.68	175.47	146.85	146.85
NOx	kg/hr	33.74	143.90	111.05	111.05
SO ₂	kg/hr	0.84	4.28	3.63	3.63
TSP	kg/hr	20.49	61.23	40.81	40.81
PM ₁₀	kg/hr	9.64	28.05	18.47	18.47
PM _{2.5}	kg/hr	1.92	7.94	6.09	6.09

Emissions Summary for Construction Phase

Financial Year	CY30	CY31	CY32	CY33	CY34
Period From	1 Jan 30	1 Jan 31	1 Jan 32	1 Jan 33	1 Jan 34
Period To	31 Dec 30	31 Dec 31	31 Dec 32	31 Dec 33	31 Dec 34
Period Number	9	10	11	12	13
Days in Period	365	365	366	365	365

Totals

CO	kg/year	180.43	96,674.99	241,805.76	220,961.11	221,155.72
NOx	kg/year	2,111.20	515,168.42	793,469.79	642,096.93	644,270.92
SO ₂	kg/year	104.48	4,401.27	6,682.30	6,435.05	6,542.86
TSP	kg/year	52.21	169,945.41	547,667.01	507,193.72	507,247.54
PM ₁₀	kg/year	50.12	57,949.34	185,318.90	172,418.76	172,470.43
PM _{2.5}	kg/year	48.92	21,017.75	59,408.84	53,816.31	53,866.75
CO	kg/day	28.64	463.57	996.80	925.79	927.63
NOx	kg/day	278.33	1,722.98	2,509.94	2,099.01	2,107.14
SO ₂	kg/day	13.89	30.47	40.35	39.47	39.90
TSP	kg/day	6.92	562.12	1,681.92	1,529.23	1,529.44
PM ₁₀	kg/day	6.64	193.28	571.83	525.46	525.67
PM _{2.5}	kg/day	6.48	69.91	178.56	159.78	159.97
CO	kg/hr	15.11	277.34	633.96	607.31	609.76
NOx	kg/hr	63.65	223.30	454.19	423.21	433.06
SO ₂	kg/hr	3.37	10.55	19.80	19.26	19.79
TSP	kg/hr	1.65	54.39	134.48	114.12	114.38
PM ₁₀	kg/hr	1.59	26.13	62.50	52.98	53.23
PM _{2.5}	kg/hr	1.55	7.78	19.60	17.80	18.05

Appendix B Operations and Maintenance Phase Emissions

CAC and GHG Emissions from Domestic Waste Incinerator

		entered data
		formula
Assumptions:		
		Construction
		Operation
		Sources
Work camp capacity	# people / site	80
# of campsites		4
Waste per person	kg/person/year	938
	kg/person/day	2.5
Domestic Waste	kg/d	800

Equipment Specifications												CAC Emission Factors						CAC Hourly Emissions						CAC Daily Emissions						CAC Annual Emissions					
Activity Description	Stage	Model	Number of Units	Capacity	Volumetric Flow Rate @ stack temp and 101.325 kPa	Stack Height	Stack Diameter	Exit Velocity	Exit Temperature	Operating Hours per Day	Operating Days per year	SO ₂	NOx	CO	TSP	PM10	PM2.5	SO ₂	NOx	CO	TSP	PM ₁₀	PM _{2.5}	SO ₂	NOx	CO	TSP	PM ₁₀	PM _{2.5}	SO ₂	NOx	CO	TSP	PM ₁₀	PM _{2.5}
				kg refuse/d	m ³ /h	m	m	m/s	K	h/d	d/y	mg/Sm ³ exhaust					kg/hour						kg/day						tonne/year						
Domestic Incinerator																																			
Domestic Waste Incinerator (port site)	Operation	—	1	200	13,753	11	0.80	7.60	1,273.15	24	365	56	198	40	14	14	14	0.180	0.638	0.129	0.045	0.045	0.045	4.329	15.304	3.092	1.082	1.082	1.082	1.580	5.586	1.129	0.395	0.395	0.395
Domestic Waste Incinerator (Jericho Station)	Operation	—	1	200	13,753	11	0.80	7.60	1,273.15	24	365	56	198	40	14	14	14	0.180	0.638	0.129	0.045	0.045	0.045	4.329	15.304	3.092	1.082	1.082	1.082	1.580	5.586	1.129	0.395	0.395	0.395

NOTES:

1. CAC emission factors (mg/Sm³ exhaust) based on Ontario Guideline A-7: Air Pollution Control, Design and Operation Guidelines for Municipal Waste Thermal Treatment Facilities (2010).

Standard Conditions (Ontario Guideline A-7):

- Temperature 25 °C
- Pressure 101.325 kPa
- Oxygen content 11 %
- Water content nil (dry conditions)

2. Assume incinerators operate 24/7, 365 days per year

3. Incinerator stack parameters based on similar capacity incinerator from another mine project.

4. Incinerator exhaust temperature set to minimum required exhaust temperature (1,000 °C) in Ontario Guideline A-7 (2010).

5. Assumed 2 incinerators to accommodate 800 kg/d waste during construction.

6. From Project Proposal: Approximately 10 to 20 permanent staff will be located at Grays Bay Port to operate and maintain port facilities

7. From Project Proposal: Around three staff will be located at Jericho Station.

Emissions for Quarry Blasting Activities
SOURCE: Pits and quarries reporting guide (Environment and Climate Change Canada)
<https://www.canada.ca/en/environment-climate-change/services/national-pollutant-release-inventory/report/pits-quarries-guide.html>

Activity	Emission Factor (kg/Mg explosive) ^a		
	CO	NOx	SO ₂
Explosive Detonation (Ammonium Nitrate Fuel Oil Mixtures) ^b	34	8	1

Reference: NPRI Blasting section 8.3 (Table 1)
Note: ^a US EPA AP-42 emission factor rating D
Note: ^b Explosives to be used will be primarily ammonium nitrate and diesel fuel (ANFO), according to Project Proposal.
Note: No VOC for blasting

Total Number of Quarries	11
Blasts per week (Road)	2 days/week
Operating Weeks/Year:	2 weeks/year
Operating Days/Year:	44 days/year
Operating Hours/Day:	1 hrs

Legend
entered data
formula

	Financial Year	CY35	CY36	CY37	CY38	CY39	CY40	CY41	CY42	CY43	CY44	CY45	CY46	CY47	CY48	CY49	CY50	CY51	CY52	CY53	CY54	CY55
		1 Jan 35	1 Jan 36	1 Jan 37	1 Jan 38	1 Jan 39	1 Jan 40	1 Jan 41	1 Jan 42	1 Jan 43	1 Jan 44	1 Jan 45	1 Jan 46	1 Jan 47	1 Jan 48	1 Jan 49	1 Jan 50	1 Jan 51	1 Jan 52	1 Jan 53	1 Jan 54	1 Jan 55
		31 Dec 35	31 Dec 36	31 Dec 37	31 Dec 38	31 Dec 39	31 Dec 40	31 Dec 41	31 Dec 42	31 Dec 43	31 Dec 44	31 Dec 45	31 Dec 46	31 Dec 47	31 Dec 48	31 Dec 49	31 Dec 50	31 Dec 51	31 Dec 52	31 Dec 53	31 Dec 54	31 Dec 55
		14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
		365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365

Unit																						
<i>Quarrying Requirements for Road</i>																						
Cubic Meters of Material	M^3	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676
Explosives needed	Tonnes	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
CO	kg/year	3,048.97	3,048.97	3,048.97	3,048.97	3,048.97	3,048.97	3,048.97	3,048.97	3,048.97	3,048.97	3,048.97	3,048.97	3,048.97	3,048.97	3,048.97	3,048.97	3,048.97	3,048.97	3,048.97	3,048.97	3,048.97
NOx	kg/year	717.40	717.40	717.40	717.40	717.40	717.40	717.40	717.40	717.40	717.40	717.40	717.40	717.40	717.40	717.40	717.40	717.40	717.40	717.40	717.40	717.40
SO ₂	kg/year	89.68	89.68	89.68	89.68	89.68	89.68	89.68	89.68	89.68	89.68	89.68	89.68	89.68	89.68	89.68	89.68	89.68	89.68	89.68	89.68	89.68
CO	kg/day	69.29	69.29	69.29	69.29	69.29	69.29	69.29	69.29	69.29	69.29	69.29	69.29	69.29	69.29	69.29	69.29	69.29	69.29	69.29	69.29	69.29
NOx	kg/day	16.30	16.30	16.30	16.30	16.30	16.30	16.30	16.30	16.30	16.30	16.30	16.30	16.30	16.30	16.30	16.30	16.30	16.30	16.30	16.30	16.30
SO ₂	kg/day	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04
CO	kg/hr	69.29	69.29	69.29	69.29	69.29	69.29	69.29	69.29	69.29	69.29	69.29	69.29	69.29	69.29	69.29	69.29	69.29	69.29	69.29	69.29	69.29
NOx	kg/hr	16.30	16.30	16.30	16.30	16.30	16.30	16.30	16.30	16.30	16.30	16.30	16.30	16.30	16.30	16.30	16.30	16.30	16.30	16.30	16.30	16.30
SO ₂	kg/hr	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04

Boring/blast Hole Drilling for Operations &		
Parameter	Value	Source
Area of blasting (m ²)	1590	AP-42 Table 11.9-3 (Blasting Geometric Mean)
One blast hole (m ² /blast)	25	Based on open pit mine blasting from previous mining projects
Number of blast holes = Area / (blast per hole)	64	

Activity	Emission Factor (kg/hole) ¹		
	TSP	PM ₁₀	PM _{2.5}
Emission Factor (kg/hole)	0.59	0.32	0.31

Operating Time ²	
Days per year	365 days/year
Hours per day	24 hours/day

Notes:
1. Reference: NPRI Blasting section 8.3
2. Assuming that drilling continuous throughout the day and is not dependent on the number of blasts

	Financial Year	CY35	CY36	CY37	CY38	CY39	CY40	CY41	CY42	CY43	CY44	CY45	CY46	CY47	CY48	CY49	CY50	CY51	CY52	CY53	CY54	CY55
		1 Jan 35	1 Jan 36	1 Jan 37	1 Jan 38	1 Jan 39	1 Jan 40	1 Jan 41	1 Jan 42	1 Jan 43	1 Jan 44	1 Jan 45	1 Jan 46	1 Jan 47	1 Jan 48	1 Jan 49	1 Jan 50	1 Jan 51	1 Jan 52	1 Jan 53	1 Jan 54	1 Jan 55
		31 Dec 35	31 Dec 36	31 Dec 37	31 Dec 38	31 Dec 39	31 Dec 40	31 Dec 41	31 Dec 42	31 Dec 43	31 Dec 44	31 Dec 45	31 Dec 46	31 Dec 47	31 Dec 48	31 Dec 49	31 Dec 50	31 Dec 51	31 Dec 52	31 Dec 53	31 Dec 54	31 Dec 55
		14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
		365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365

Unit																						
<i>Quarrying Requirements for Road</i>																						
Number of blasts per year		44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44
Number of blasts per day		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
TSP	kg/year	1,651.06	1,651.06	1,651.06	1,651.06	1,651.06	1,651.06	1,651.06	1,651.06	1,651.06	1,651.06	1,651.06	1,651.06	1,651.06	1,651.06	1,651.06	1,651.06	1,651.06	1,651.06	1,651.06	1,651.06	1,651.06
PM ₁₀	kg/year	895.49	895.49	895.49	895.49	895.49	895.49	895.49	895.49	895.49	895.49	895.49	895.49	895.49	895.49	895.49	895.49	895.49	895.49	895.49	895.49	895.49
PM _{2.5}	kg/year	867.50	867.50	867.50	867.50	867.50	867.50	867.50	867.50	867.50	867.50	867.50	867.50	867.50	867.50	867.50	867.50	867.50	867.50	867.50	867.50	867.50
TSP	kg/day	4.52	4.51	4.52	4.52	4.52	4.51	4.52	4.52	4.52	4.51	4.52	4.52	4.52	4.51	4.52	4.52	4.52	4.51	4.52	4.52	4.52
PM ₁₀	kg/day	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45
PM _{2.5}	kg/day	2.38	2.37	2.38	2.38	2.38	2.37	2.38	2.38	2.38	2.37	2.38	2.38	2.38	2.37	2.38	2.38	2.38	2.37	2.38	2.38	2.38
TSP	kg/hr	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
PM ₁₀	kg/hr	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
PM _{2.5}	kg/hr	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10

Blasting for Operations & Maintenance

Parameter	Value	Source
Area of blasting (m ²)	1590	AP-42 Table 11.9-3 (Blasting Geometric Mean)

Activity	Emission Factor (kg/blast)		
	TSP	PM ₁₀	PM _{2.5}
Emission Factor (kg/blast)	13.95	7.25	0.42

Reference: NPRI Blasting section 8.2

		Financial Year	CY35	CY36	CY37	CY38	CY39	CY40	CY41	CY42	CY43	CY44	CY45	CY46	CY47	CY48	CY49	CY50	CY51	CY52	CY53	CY54	CY55
		Period From	1 Jan 35	1 Jan 36	1 Jan 37	1 Jan 38	1 Jan 39	1 Jan 40	1 Jan 41	1 Jan 42	1 Jan 43	1 Jan 44	1 Jan 45	1 Jan 46	1 Jan 47	1 Jan 48	1 Jan 49	1 Jan 50	1 Jan 51	1 Jan 52	1 Jan 53	1 Jan 54	1 Jan 55
		Period To	31 Dec 35	31 Dec 36	31 Dec 37	31 Dec 38	31 Dec 39	31 Dec 40	31 Dec 41	31 Dec 42	31 Dec 43	31 Dec 44	31 Dec 45	31 Dec 46	31 Dec 47	31 Dec 48	31 Dec 49	31 Dec 50	31 Dec 51	31 Dec 52	31 Dec 53	31 Dec 54	31 Dec 55
		Period Number	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
		Days in Period	365	366	365	365	365	366	365	365	366	365	365	365	365	366	365	365	365	366	365	365	365
		Unit																					
Quarrying Requirements for Road																							
Number of blasts per year			44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	
Number of blasts per day			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
TSP	kg/year		613.72	613.72	613.72	613.72	613.72	613.72	613.72	613.72	613.72	613.72	613.72	613.72	613.72	613.72	613.72	613.72	613.72	613.72	613.72	613.72	
PM ₁₀	kg/year		319.13	319.13	319.13	319.13	319.13	319.13	319.13	319.13	319.13	319.13	319.13	319.13	319.13	319.13	319.13	319.13	319.13	319.13	319.13	319.13	
PM _{2.5}	kg/year		18.41	18.41	18.41	18.41	18.41	18.41	18.41	18.41	18.41	18.41	18.41	18.41	18.41	18.41	18.41	18.41	18.41	18.41	18.41	18.41	
TSP	kg/day		13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	
PM ₁₀	kg/day		7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	
PM _{2.5}	kg/day		0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	
TSP	kg/hr		13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	
PM ₁₀	kg/hr		7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	
PM _{2.5}	kg/hr		0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	

Emissions for Quarry Aggregate Handling Activities
Emissions from the drilling and crushing activities within the quarry for road operations include the following:
1) Drilling of rocks (DR-1 and DR-2)
2) Material drop to and from
 i) primary crusher (PC-1H,PC-1C),
 ii) secondary crusher (SC-1H, SC-1C),
 iii) screener (SCR-1H, SCR-1C), and
 iv) stacker (ST-1H, ST-1C)
3) Primary Crushing (Jaw Crusher) (PC-1)
4) Secondary Crushing (SC-1)
5) Screening (SCR-1)

Assume Quarry Dimension: 50 m x 50 m

Cubic Meters of Material	Unit		CY35	CY36	CY37	CY38	CY39	CY40	CY41	CY42	CY43	CY44	CY45	CY46	CY47	CY48	CY49	CY50	CY51	CY52	CY53	CY54	CY55
Road	m ³ /yr		89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676
Operating days/year			365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365

Operating hours/day 24

Source: Drilling at Ouarrv (DR-1)

Description:
Drilling of Rock

Contaminant(s) of Concern:
TSP, PM₁₀, and PM_{2.5} emissions are the contaminants of concern.

Methodology: Emission Factor (EF)
Emission factors for screening were based on US EPA AP-42 document Chapter 11.19.2 (Crushed Stone Processing and Pulverized Mineral Processing) Table 11.19.2-1 Emission Factors for Crushed Stone Processing Operations.

Parameter	Unit		CY35	CY36	CY37	CY38	CY39	CY40	CY41	CY42	CY43	CY44	CY45	CY46	CY47	CY48	CY49	CY50	CY51	CY52	CY53	CY54	CY55	Data Source
cubic meters of material	m ³ /year		89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	WKR Integrated Model
bulk density	tonnes/m ³		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	assumed
material handling rate	tonnes/year		224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	calculated
TSP Emission Factor ¹	kg/tonne		4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	see note 1
PM ₁₀ Emission Factor ¹	kg/tonne		4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	see note 1
PM _{2.5} Emission Factor ¹	kg/tonne		4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	see note 1
TSP Emissions	kg/year		8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	calculated
PM ₁₀ Emissions	kg/year		8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	calculated
PM _{2.5} Emissions	kg/year		8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	calculated
TSP Emissions	kg/day		2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	calculated
PM ₁₀ Emissions	kg/day		2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	calculated
PM _{2.5} Emissions	kg/day		2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	2.46E-02	calculated
TSP Emissions	kg/hr		1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	calculated
PM ₁₀ Emissions	kg/hr		1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	calculated
PM _{2.5} Emissions	kg/hr		1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	1.02E-03	calculated

Notes:
1. Emission factors are from US EPA AP-42 document Chapter 11.19 (Crushed Stone Processing and Pulverized Mineral Processing) Table 11.19.2-1 Emission Factors for Crushed Stone Processing Operations - emission factors for wet drilling. No emission factors for TSP or PM_{2.5} used the PM10 emission factor for both.

Source : Material Drops at Quarry

Description:
material drops to hoppers and from conveyors of the primary crusher, secondary crusher, screener and stacker.

Contaminant(s) of Concern:
TSP, PM₁₀, and PM_{2.5} emissions are the contaminants of concern.

Methodology: Emission Factor (EF)
Emission factor for material unloading/dropping was calculated using Equation (1) in the US EPA AP-42 document Chapter 13.2.4 (Aggregate Handling and Storage Piles). The equation is:

$$E = k(0.0016) \left(\frac{U}{2.2} \right)^{1.3} \left(\frac{M}{2} \right)^{1.4} \text{ (kg/megagram [Mg])}$$

where:
E = emission factor
k = particle size multiplier (dimensionless)
U = mean wind speed, meters per second (m/s)
M = material moisture content (%)

The particle size multiplier in the equation, k, varies with aerodynamic particle size range, as follows:		
Aerodynamic Particle Size Multiplier (k) For Equation 1	< 30 µm	0.74
	< 10 µm	0.35
	< 2.5 µm	0.053

Note: It is assumed that k=0.74 for total particulate matter (<30 µm) consistent with the assumption in U.S. EPA AP-42 Chapter 13.2.2

Parameter	Unit	CY35 - CY55								Data Source
		Material Drop to Primary Crusher	Material Drop from Primary Crusher	Material Drop to Secondary Crusher	Material Drop from Secondary Crusher	Material Drop to Screener Hopper	Material Drop from Screener Conveyor	Material Drop to Stacker Hopper	Material Drop from Stacker Conveyor	
		PC-1H	PC-1C	SC-1H	SC-1C	SCR-1H	SCR-1C	ST-1H	ST-1C	
cubic meters of material	m ³ /year	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	WKR Integrated Model
bulk density	tonnes/m ³	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	assumed
material handling rate	tonnes/year	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	calculated
Moisture Content	%	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	US EPA AP-42 Table 13.2.4-1 Typical Moisture content for various limestone products
Mean Wind Speed (U)	m/s	3.32	3.32	3.32	3.32	3.32	3.32	3.32	3.32	5-year average wind speed from the site-specific meteorological dataset adjusted to 1.5m height
TSP Emission Factor	kg/tonne	1.89E-03	1.89E-03	1.89E-03	1.89E-03	1.89E-03	1.89E-03	1.89E-03	1.89E-03	calculated
PM ₁₀ Emission Factor	kg/tonne	8.94E-04	8.94E-04	8.94E-04	8.94E-04	8.94E-04	8.94E-04	8.94E-04	8.94E-04	calculated
PM _{2.5} Emission Factor	kg/tonne	1.35E-04	1.35E-04	1.35E-04	1.35E-04	1.35E-04	1.35E-04	1.35E-04	1.35E-04	calculated
Operating Days per year	days	365	365	365	365	365	365	365	365	assumed
Hours of Operation per day	hours	24	24	24	24	24	24	24	24	assumed
Control Efficiency	%	50%	50%	50%	50%	50%	50%	50%	50%	Partial Enclosure of drop points
TSP Emissions	kg/year	212	212	212	212	212	212	212	212	calculated
PM ₁₀ Emissions	kg/year	100	100	100	100	100	100	100	100	calculated
PM _{2.5} Emissions	kg/year	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2	calculated
TSP Emissions	kg/day	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	calculated
PM ₁₀ Emissions	kg/day	0.274	0.274	0.274	0.274	0.274	0.274	0.274	0.274	calculated
PM _{2.5} Emissions	kg/day	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	calculated
TSP Emissions	kg/hr	2.42E-02	2.42E-02	2.42E-02	2.42E-02	2.42E-02	2.42E-02	2.42E-02	2.42E-02	calculated
PM ₁₀ Emissions	kg/hr	1.14E-02	1.14E-02	1.14E-02	1.14E-02	1.14E-02	1.14E-02	1.14E-02	1.14E-02	calculated
PM _{2.5} Emissions	kg/hr	1.73E-03	1.73E-03	1.73E-03	1.73E-03	1.73E-03	1.73E-03	1.73E-03	1.73E-03	calculated

Emissions for Quarry Aggregate Handling Activities
Emissions from the drilling and crushing activities within the quarry for road operations include the following:
1) Drilling of rocks (DR-1 and DR-2)
2) Material drop to and from
 i) primary crusher (PC-1H,PC-1C),
 ii) secondary crusher (SC-1H, SC-1C),
 iii) screener (SCR-1H, SCR-1C), and
 iv) stacker (ST-1H, ST-1C)
3) Primary Crushing (Jaw Crusher) (PC-1)
4) Secondary Crushing (SC-1)
5) Screening (SCR-1)

Assume Quarry Dimension: 50 m x 50 m

Cubic Meters of Material	Unit		CY35	CY36	CY37	CY38	CY39	CY40	CY41	CY42	CY43	CY44	CY45	CY46	CY47	CY48	CY49	CY50	CY51	CY52	CY53	CY54	CY55
Road	m ³ /yr		89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676
Operating days/year			365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365

Operating hours/day 24
Source : Primary crushing (jaw crusher) at the Quarry (PC-1)

Description:
Primary crushing of aggregate using a jaw crusher

Contaminant(s) of Concern:
TSP, PM₁₀, and PM_{2.5} emissions are the contaminants of concern.

Methodology: Emission Factor (EF)
Emission factors for screening were based on US EPA AP-42 document Chapter 11.19.2 (Crushed Stone Processing and Pulverized Mineral Processing) Table 11.19.2-1 Emission Factors for Crushed Stone Processing Operations.

Parameter	Unit		CY35	CY36	CY37	CY38	CY39	CY40	CY41	CY42	CY43	CY44	CY45	CY46	CY47	CY48	CY49	CY50	CY51	CY52	CY53	CY54	CY55	Data Source
cubic meters of material	m ³ /year		89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	WKR Integrated Model
bulk density	tonnes/m ³		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	assumed
material handling rate	tonnes/year		224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	calculated
TSP Emission Factor ¹	kg/tonne		0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	see note 1
PM ₁₀ Emission Factor ¹	kg/tonne		0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	see note 1
PM _{2.5} Emission Factor ¹	kg/tonne		0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	see note 1
Control Efficiency	%		86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	Partial Enclosure - TCEQ Rock Crushing Plants (Feb 2002)
TSP Emissions	kg/year		85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	calculated
PM ₁₀ Emissions	kg/year		38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	calculated
PM _{2.5} Emissions	kg/year		38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	calculated
TSP Emissions	kg/day		0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	calculated
PM ₁₀ Emissions	kg/day		0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	calculated
PM _{2.5} Emissions	kg/day		0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	calculated
TSP Emissions	kg/hr		9.67E-03	9.65E-03	9.67E-03	9.67E-03	9.67E-03	9.65E-03	9.67E-03	9.67E-03	9.67E-03	9.65E-03	9.67E-03	9.67E-03	9.67E-03	9.65E-03	9.67E-03	9.67E-03	9.67E-03	9.65E-03	9.67E-03	9.67E-03	9.67E-03	calculated
PM ₁₀ Emissions	kg/hr		4.30E-03	4.29E-03	4.30E-03	4.30E-03	4.30E-03	4.29E-03	4.30E-03	4.30E-03	4.30E-03	4.29E-03	4.30E-03	4.30E-03	4.30E-03	4.29E-03	4.30E-03	4.30E-03	4.30E-03	4.29E-03	4.30E-03	4.30E-03	4.30E-03	calculated
PM _{2.5} Emissions	kg/hr		4.30E-03	4.29E-03	4.30E-03	4.30E-03	4.30E-03	4.29E-03	4.30E-03	4.30E-03	4.30E-03	4.29E-03	4.30E-03	4.30E-03	4.30E-03	4.29E-03	4.30E-03	4.30E-03	4.30E-03	4.29E-03	4.30E-03	4.30E-03	4.30E-03	calculated

Notes:
1. Emission factors are from US EPA AP-42 document Chapter 11.19 (Crushed Stone Processing and Pulverized Mineral Processing) Table 11.19.2-1 Emission Factors for Crushed Stone Processing Operations. Based on note n of Table 11.19.1-1 Tertiary Crushing Emission factors cans be used as the upper limit for primary and secondary crushing. No PM2.5 emission factor, as such conservatively assumed to be the same as PM10.

Source: Secondarv crushing at Quarrv 1 (SC-1)

Description:
Secondary crushing (cone crusher) of aggregate

Contaminant(s) of Concern:
TSP, PM₁₀, and PM_{2.5} emissions are the contaminants of concern.

Methodology: Emission Factor (EF)
Emission factors for screening were based on US EPA AP-42 document Chapter 11.19.2 (Crushed Stone Processing and Pulverized Mineral Processing) Table 11.19.2-1 Emission Factors for Crushed Stone Processing Operations.

Parameter	Unit		CY35	CY36	CY37	CY38	CY39	CY40	CY41	CY42	CY43	CY44	CY45	CY46	CY47	CY48	CY49	CY50	CY51	CY52	CY53	CY54	CY55	Data Source
cubic meters of material	m ³ /year		89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	WKR Integrated Model
bulk density	tonnes/m ³		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	assumed
material handling rate	tonnes/year		224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	calculated
TSP Emission Factor ¹	kg/tonne		0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	see note 1
PM ₁₀ Emission Factor ¹	kg/tonne		0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	see note 1
PM _{2.5} Emission Factor ¹	kg/tonne		0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	see note 1
Control Efficiency	%		86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	Partial Enclosure - TCEQ Rock Crushing Plants (Feb 2002)
TSP Emissions	kg/year		85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	calculated
PM ₁₀ Emissions	kg/year		38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	calculated
PM _{2.5} Emissions	kg/year		38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	calculated
TSP Emissions	kg/day		0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	calculated
PM ₁₀ Emissions	kg/day		0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	calculated
PM _{2.5} Emissions	kg/day		0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	calculated
TSP Emissions	kg/hr		9.67E-03	9.65E-03	9.67E-03	9.67E-03	9.67E-03	9.65E-03	9.67E-03	9.67E-03	9.67E-03	9.65E-03	9.67E-03	9.67E-03	9.67E-03	9.65E-03	9.67E-03	9.67E-03	9.67E-03	9.65E-03	9.67E-03	9.67E-03	9.67E-03	calculated
PM ₁₀ Emissions	kg/hr		4.30E-03	4.29E-03	4.30E-03	4.30E-03	4.30E-03	4.29E-03	4.30E-03	4.30E-03	4.30E-03	4.29E-03	4.30E-03	4.30E-03	4.30E-03	4.29E-03	4.30E-03	4.30E-03	4.30E-03	4.29E-03	4.30E-03	4.30E-03	4.30E-03	calculated
PM _{2.5} Emissions	kg/hr		4.30E-03	4.29E-03	4.30E-03	4.30E-03	4.30E-03	4.29E-03	4.30E-03	4.30E-03	4.30E-03	4.29E-03	4.30E-03	4.30E-03	4.30E-03	4.29E-03	4.30E-03	4.30E-03	4.30E-03	4.29E-03	4.30E-03	4.30E-03	4.30E-03	calculated

Notes:
1. Emission factors are from US EPA AP-42 document Chapter 11.19 (Crushed Stone Processing and Pulverized Mineral Processing) Table 11.19.2-1 Emission Factors for Crushed Stone Processing Operations. Based on note n of Table 11.19.1-1 Tertiary Crushing Emission factors cans be used as the upper limit for primary and secondary crushing. No PM2.5 emission factor, as such conservatively assumed to be the same as PM10.

Emissions for Quarry Aggregate Handling Activities
Emissions from the drilling and crushing activities within the quarry for road operations include the following:
1) Drilling of rocks (DR-1 and DR-2)
2) Material drop to and from
 i) primary crusher (PC-1H,PC-1C),
 ii) secondary crusher (SC-1H, SC-1C),
 iii) screener (SCR-1H, SCR-1C), and
 iv) stacker (ST-1H, ST-1C)
3) Primary Crushing (Jaw Crusher) (PC-1)
4) Secondary Crushing (SC-1)
5) Screening (SCR-1)

Assume Quarry Dimension: 50 m x 50 m

Cubic Meters of Material	Unit		CY35	CY36	CY37	CY38	CY39	CY40	CY41	CY42	CY43	CY44	CY45	CY46	CY47	CY48	CY49	CY50	CY51	CY52	CY53	CY54	CY55
Road	m ³ /yr		89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676
Operating days/year			365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365

Operating hours/day 24
Source: Screening at Ouarrv 1 (SCR-1)

Description:
Screening of aggregate after the secondary crusher

Contaminant(s) of Concern:
TSP, PM₁₀, and PM_{2.5} emissions are the contaminants of concern.

Methodology: Emission Factor (EF)
Emission factors for screening were based on US EPA AP-42 document Chapter 11.19.2 (Crushed Stone Processing and Pulverized Mineral Processing) Table 11.19.2-1 Emission Factors for Crushed Stone Processing Operations.

Parameter	Unit		CY35	CY36	CY37	CY38	CY39	CY40	CY41	CY42	CY43	CY44	CY45	CY46	CY47	CY48	CY49	CY50	CY51	CY52	CY53	CY54	CY55	Data Source
cubic meters of material	m ³ /year		89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	89,676	WKR Integrated Model
bulk density	tonnes/m ³		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	assumed
material handling rate	tonnes/year		224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	224,189	calculated
TSP Emission Factor ¹	kg/tonne		0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	see note 1
PM ₁₀ Emission Factor ¹	kg/tonne		0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	see note 1
PM _{2.5} Emission Factor ¹	kg/tonne		0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	see note 1
Control Efficiency	%		86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	Partial Enclosure - TCEQ Rock Crushing Plants (Feb 2002)
TSP Emissions	kg/year		392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	calculated
PM ₁₀ Emissions	kg/year		135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	calculated
PM _{2.5} Emissions	kg/year		135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	calculated
TSP Emissions	kg/day		1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	calculated
PM ₁₀ Emissions	kg/day		0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	calculated
PM _{2.5} Emissions	kg/day		0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	calculated
TSP Emissions	kg/hr		0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	calculated
PM ₁₀ Emissions	kg/hr		0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	calculated
PM _{2.5} Emissions	kg/hr		0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	calculated

Notes:
1. Emission factors are from US EPA AP-42 document Chapter 11.19 (Crushed Stone Processing and Pulverized Mineral Processing) Table 11.19.2-1 Emission Factors for Crushed Stone Processing Operations for uncontrolled screening. No PM2.5 emission factor, conservatively assumed to be the same as PM10.

Combustion emissions from operating equipment and vehicles

Description: Emission changes (Inna, Dec 2025)
Tailpipe emissions from vehicles and Non-road equipment driving on unpaved roads and operating in the PDA.

Contaminant(s) of Concern:
CO, SO₂, NO_x, PM, PM₁₀ and PM_{2.5} emissions are the contaminants of concern.

Methodology: Emission Factor (EF)
US EPA Motor Vehicle Emissions Simulator (MOVES3) Non-Road Modelling was used to generate emission factors for non-road equipment in g/hp-hr.

Financial Year	CY35	CY36	CY37	CY38	CY39	CY40	CY41	CY42	CY43	CY44	CY45	CY46	CY47	CY48	CY49	CY50	CY51	CY52	CY53	CY54	CY55	CY56	CY57	CY58	CY59	CY60	FY61
Period From	1 Jan 35	1 Jan 36	50041	50406	50771	51136	51502	51867	52232	52597	52963	53328	53693	54058	54424	54789	55154	55519	55885	56250	56615	56980	57346	57711	58076	58441	58807
Period To	31 Dec 35	31 Dec 36	50405	50770	51135	51501	51866	52231	52596	52962	53327	53692	54057	54423	54788	55153	55518	55884	56249	56614	56979	57345	57710	58075	58440	58806	59171
Period Number	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Days in Period	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365

Port Operations & Maintenance Equipment

MOVES Equipment ID	Type of Equipment	Number of Units	Horsepower (hp)	MOVES hpID	Operating Hours per Day	Annual Operating Hours	Load/Utilization Factor (%)	Emission Factors (g/hp-hr)						Annual Emission Rates (kg/year)						Daily Emission Rates (kg/day)						Hourly Emission Rates (kg/hr)									
								CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}	CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}	CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}	CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}				
								2	3	31	100	100	110	CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}	CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}	CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}				
20	Loader - Eg Cat 966	2	321	600	5	3650	70%	1.733	4.426	0.005	0.224	0.224	0.217	1.422	3.630	4	184	184	178	3.90	9.95	0.01	0.50	0.50	0.49	0.78	1.99	0.00	0.10	0.10	0.10				
79	Winch Tractor Trailer	1	360	600	5	1825	70%	1.193	2.934	0.005	0.178	0.178	0.172	549	1,350	2	82	82	79	1.50	3.70	0.01	0.22	0.22	0.22	0.30	0.74	0.00	0.04	0.04	0.04				
79	Plow / Sand / Gravel / Water Truck	2	360	600	10	7300	70%	1.193	2.934	0.005	0.178	0.178	0.172	2,194	5,398	9	327	327	317	6.01	14.79	0.02	0.90	0.90	0.87	0.60	1.48	0.00	0.09	0.09	0.09				
78	Grader - Cat 14	1	238	300	3	1095	70%	1.100	3.333	0.005	0.211	0.211	0.205	201	608	1	39	39	37	0.55	1.67	0.00	0.11	0.11	0.10	0.18	0.56	0.00	0.04	0.04	0.03				
22	Skidsteer / Bobcat	2	98	100	5	3650	70%	7.528	6.499	0.006	1.065	1.065	1.033	1,885	1,627	2	267	267	259	5.16	4.46	0.00	0.73	0.73	0.71	1.03	0.89	0.00	0.15	0.15	0.14				
79	Light Vehicle - EG F-350	5	500	600	5	9125	70%	1.193	2.934	0.005	0.178	0.178	0.172	3,810	9,372	15	567	567	550	10.44	25.68	0.04	1.55	1.55	1.51	2.09	5.14	0.01	0.31	0.31	0.30				
79	Fuel Trucks	1	360	600	10	3650	70%	1.193	2.934	0.005	0.178	0.178	0.172	1,097	2,699	4	163	163	158	3.01	7.39	0.01	0.45	0.45	0.43	0.30	0.74	0.00	0.04	0.04	0.04				
28	Aircraft Tugs	1	74	75	0	109.5	70%	2.169	4.671	0.005	0.368	0.368	0.357	12	26	0	2	2	2	0.03	0.07	0.00	0.01	0.01	0.01	0.11	0.24	0.00	0.02	0.02	0.02				
								CO	kg/year	11,169	11,169	11,169	11,169	11,169	11,169	11,169	11,169	11,169	11,169	11,169	11,169	11,169	11,169	11,169	11,169	11,169	11,169	11,169	11,169	11,169	11,169	11,169	11,169		
								NOx	kg/year	24,710	24,710	24,710	24,710	24,710	24,710	24,710	24,710	24,710	24,710	24,710	24,710	24,710	24,710	24,710	24,710	24,710	24,710	24,710	24,710	24,710	24,710	24,710	24,710		
								SO ₂	kg/year	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	
								TSP	kg/year	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	
								PM ₁₀	kg/year	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	1,630	
								PM _{2.5}	kg/year	1,581	1,581	1,581	1,581	1,581	1,581	1,581	1,581	1,581	1,581	1,581	1,581	1,581	1,581	1,581	1,581	1,581	1,581	1,581	1,581	1,581	1,581	1,581	1,581	1,581	
								CO	kg/day	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
								NOx	kg/day	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68
								SO ₂	kg/day	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
								TSP	kg/day	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47
								PM ₁₀	kg/day	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47
								PM _{2.5}	kg/day	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33
								CO	kg/hr	5.40	5.40	5.40	5.40	5.40	5.40	5.40	5.40	5.40	5.40	5.40	5.40	5.40	5.40	5.40	5.40	5.40	5.40	5.40	5.40	5.40	5.40	5.40	5.40	5.40	5.40
								NOx	kg/hr	11.77	11.77	11.77	11.77	11.77	11.77	11.77	11.77	11.77	11.77	11.77	11.77	11.77	11.77	11.77	11.77	11.77	11.77	11.77	11.77	11.77	11.77	11.77	11.77	11.77	11.77
								SO ₂	kg/hr	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
								TSP	kg/hr	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
								PM ₁₀	kg/hr	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
								PM _{2.5}	kg/hr	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77

Road Operations & Maintenance Equipment

MOVES Equipment ID	Type of Equipment	Number of Units	Horsepower (hp)	MOVES hpID	Operating Hours per Day	Annual Operating Hours	Load/Utilization Factor (%)	Emission Factors (g/hp-hr)						Annual Emission Rates (kg/year)						Daily Emission Rates (kg/day)						Hourly Emission Rates (kg/hr)					
								CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}	CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}	CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}	CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}
								2	3	31	100	100	110	CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}	CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}	CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}
77	Excavator - Eg Cat 349	1	425	600	2	900	70%	1.568	4.046	0.005	0.208	0.208	0.202	420	1,083	1	56	56	54	1.15	2.97	0.00	0.15	0.15	0.15	0.47	1.20	0.00	0.06	0.06	0.06
79	Plow/ Sand / Gravel / Water Truck	2	360	600	10	7300	70%	1.193	2.934	0.005	0.178	0.178	0.172	2,194	5,398	9	327	327	317	6.01	14.79	0.02	0.90	0.90	0.87	0.60	1.48	0.00	0.09	0.09	0.09
78	Grader - Cat 14	2	238	300	10	7300	70%	1.100	3.333	0.005	0.211	0.211	0.205	1,337	4,053	6	257	257	249	3.66	11.11	0.02	0.70	0.70	0.68	0.37	1.11	0.00	0.07	0.07	0.07
79	Light Vehicle - EG F-350	6	500	600	10	21900	70%	1.193	2.934	0.005	0.178	0.178	0.172	9,143	22,492	35	1,362	1,362	1,321	25.05	61.62	0.10	3.73	3.73	3.62	2.50	6.16	0.01	0.37	0.37	0.36
79	Fuel Trucks	2	360	600	10	7300	70%	1.193	2.934	0.005	0.178	0.178	0.172	2,194	5,398	9	327	327	317	6.01	14.79	0.02	0.90	0.90	0.87	0.60	1.48	0.00	0.09	0.09	0.09
81	Snowcat	1	253	300	2	900	70%	1.117	3.402	0.005	0.215	0.215	0.208	178	542	1	34	34	33	0.49	1.49	0.00	0.09	0.09	0.09	0.20	0.60	0.00	0.04	0.04	0.04

Emissions for Diesel Fuel Usage for Power Generation

The below calculations assume that the Port is powered by two continuous and two standby 1.825 MW diesel-fired generators. This would meet the required installed capacity of 6 MW and power demand rarely exceeds 4 MW as outlined in the Project Description.

Generator assumed for use is the Cat 3516C Diesel Generator Set with 1825 kW power, Tier 2 compliant.
Generator emission specifications were taken from: https://www.cat.com/en_US/products/new/power-systems/electric-power/diesel-generator-sets/1000028912.html

Operation Mode:	Continuous	
Rated Engine Power:	1825	bkW
	2447	bhp
Rated Generator Power:	1825	ekW
Required Generator Power:	1825	ekW
Assessed Engine Power:	1825	bkW
	2447	bhp
Assume Engine Load:	100%	

EFs for Power Generation

Source	Substance	Units	CO	NOx	SO ₂	PM ₁₀
Manufacturer Specifications ²	Emission Factor	(g/bkWh) (power output)	0.49	6.06	-	0.04
Sulphur in Diesel Fuel Regulations ²		(g/L diesel consumption)	-	-	0.0255	-
Diesel Consumption ¹		(L/hr)	465.6			

¹ Emission rates accounting for potential site variations. Source: https://www.cat.com/en_US/products/new/power-systems/electric-power/diesel-generator-sets/1000028912.html

² SO₂ emission rate based on 15 mg/kg sulphur (S) content in diesel fuel. Source: Sulphur in Diesel Fuel Regulations. SOR/2002-254 (Government of Canada 2002). Available at: <https://laws-lois.justice.gc.ca/PDF/SOR-2002-254.pdf>.

³ Conversion from mg S/kg diesel to g S/L diesel = mg/kg x 0.85 kg/L (diesel density) x 1000 mg/g

Operating Hours/Day:

24 hrs

Financial Year	CY35	CY36	CY37	CY38	CY39	CY40	CY41	CY42	CY43	CY44	CY45	CY46	CY47	CY48	CY49	CY50	CY51	CY52	CY53	CY54	CY55
Period From	1 Jan 35	1 Jan 36	1 Jan 37	1 Jan 38	1 Jan 39	1 Jan 40	1 Jan 41	1 Jan 42	1 Jan 43	1 Jan 44	1 Jan 45	1 Jan 46	1 Jan 47	1 Jan 48	1 Jan 49	1 Jan 50	1 Jan 51	1 Jan 52	1 Jan 53	1 Jan 54	1 Jan 55
Period To	31 Dec 35	31 Dec 36	31 Dec 37	31 Dec 38	31 Dec 39	31 Dec 40	31 Dec 41	31 Dec 42	31 Dec 43	31 Dec 44	31 Dec 45	31 Dec 46	31 Dec 47	31 Dec 48	31 Dec 49	31 Dec 50	31 Dec 51	31 Dec 52	31 Dec 53	31 Dec 54	31 Dec 55
Period Number	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
Days in Period	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365

Diesel Fuel Consumption For Operations & Maintenance

Unit																						
Diesel Fuel Consumption Port	#	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
Number of Generators	HR	17,520	17,568	17,520	17,520	17,520	17,568	17,520	17,520	17,520	17,568	17,520	17,520	17,520	17,568	17,520	17,520	17,520	17,568	17,520	17,520	
Operating Hours																						
CO	kg/year	21,010.11	21,067.67	21,010.11	21,010.11	21,010.11	21,067.67	21,010.11	21,010.11	21,010.11	21,067.67	21,010.11	21,010.11	21,010.11	21,067.67	21,010.11	21,010.11	21,010.11	21,067.67	21,010.11	21,010.11	
NOx	kg/year	259,839.31	260,551.20	259,839.31	259,839.31	259,839.31	260,551.20	259,839.31	259,839.31	259,839.31	260,551.20	259,839.31	259,839.31	259,839.31	260,551.20	259,839.31	259,839.31	259,839.31	260,551.20	259,839.31	259,839.31	
SO ₂	kg/year	208.01	208.58	208.01	208.01	208.01	208.58	208.01	208.01	208.01	208.58	208.01	208.01	208.01	208.58	208.01	208.01	208.01	208.58	208.01	208.01	
TSP	kg/year	1,715.11	1,719.81	1,715.11	1,715.11	1,715.11	1,719.81	1,715.11	1,715.11	1,715.11	1,719.81	1,715.11	1,715.11	1,715.11	1,719.81	1,715.11	1,715.11	1,715.11	1,719.81	1,715.11	1,715.11	
PM ₁₀	kg/year	1,715.11	1,719.81	1,715.11	1,715.11	1,715.11	1,719.81	1,715.11	1,715.11	1,715.11	1,719.81	1,715.11	1,715.11	1,715.11	1,719.81	1,715.11	1,715.11	1,715.11	1,719.81	1,715.11	1,715.11	
PM _{2.5}	kg/year	1,715.11	1,719.81	1,715.11	1,715.11	1,715.11	1,719.81	1,715.11	1,715.11	1,715.11	1,719.81	1,715.11	1,715.11	1,715.11	1,719.81	1,715.11	1,715.11	1,715.11	1,719.81	1,715.11	1,715.11	
CO	kg/day	57.56	57.56	57.56	57.56	57.56	57.56	57.56	57.56	57.56	57.56	57.56	57.56	57.56	57.56	57.56	57.56	57.56	57.56	57.56	57.56	
NOx	kg/day	711.89	711.89	711.89	711.89	711.89	711.89	711.89	711.89	711.89	711.89	711.89	711.89	711.89	711.89	711.89	711.89	711.89	711.89	711.89	711.89	
SO ₂	kg/day	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	
TSP	kg/day	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	
PM ₁₀	kg/day	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	
PM _{2.5}	kg/day	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	
CO	kg/hr	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	
NOx	kg/hr	29.66	29.66	29.66	29.66	29.66	29.66	29.66	29.66	29.66	29.66	29.66	29.66	29.66	29.66	29.66	29.66	29.66	29.66	29.66	29.66	
SO ₂	kg/hr	0.0237	0.0237	0.0237	0.0237	0.0237	0.0237	0.0237	0.0237	0.0237	0.0237	0.0237	0.0237	0.0237	0.0237	0.0237	0.0237	0.0237	0.0237	0.0237	0.0237	
TSP	kg/hr	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	
PM ₁₀	kg/hr	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	
PM _{2.5}	kg/hr	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	

Emissions from Unpaved Road Operations & Maintenance

Description:
Particulate emissions from vehicles driving on unpaved roads causing the resuspension of loose particulate matter on the road surface.

Contaminant(s) of Concern:
PM, PM₁₀ and PM_{2.5} emissions are the contaminants of concern.

Methodology: Emission Factor (EF)
Emission factor for unpaved roads was calculated using Equation (1a) in the US EPA AP-42 document Chapter 13.2.2 (Unpaved Roads). The equation is:
$$E = k \left(\frac{s}{12} \right)^a \left(\frac{W}{3} \right)^b$$

Where:
E = emission factor
s = surface material silt content (%)
W = mean vehicle weight
k, a, and b = empirical constants

Source [AP 42, Fifth Edition, Volume I, Chapter 13.2.2 Unpaved Roads](#)
Link [AP42, Section 13.2.2 Unpaved Roads - Updated November 2006](#)

Constant	Industrial Roads (Equation 1a)		
	PM-2.5	PM-10	PM-30*
k (lb/VMT)	0.15	1.5	4.9
a	0.90	0.9	0.7
b	0.45	0.5	0.5
Rating	B	B	B

*Assumed equivalent to total suspended particulate matter (TSP)

Input Values			
Parameter	Value	Unit	Reference
Surface Silt Content	8.3	%	Table 13.2.2-1. (Stone quarrying and processing)
Operating Speed	15	km/hr	assumption
Operating Speed (Loader/Skidsteer)	5	km/hr	assumption
Operating Speed (Packer/Grader)	10	km/hr	assumption
Operating Days/Year:	365	days	provided by client
Operating Hours/Day:	24	hrs	provided by client
Combined Water and Speed Limit	95%	summer	https://www.env.nm.gov/wp-content/uploads/sites/2/2017/02/WRAP_FDHandbook_Rev_06.pdf
Control Efficiency :	99%	winter	Natural mitigation in the winter (October to April)

Financial Year	CY35	CY36	CY37	CY38	CY39	CY40	CY41	CY42	CY43	CY44	CY45	CY46	CY47	CY48	CY49	CY50	CY51	CY52	CY53	CY54	CY55
Period From	1 Jan 35	1 Jan 36	1 Jan 37	1 Jan 38	1 Jan 39	1 Jan 40	1 Jan 41	1 Jan 42	1 Jan 43	1 Jan 44	1 Jan 45	1 Jan 46	1 Jan 47	1 Jan 48	1 Jan 49	1 Jan 50	1 Jan 51	1 Jan 52	1 Jan 53	1 Jan 54	1 Jan 55
Period To	31 Dec 35	31 Dec 36	31 Dec 37	31 Dec 38	31 Dec 39	31 Dec 40	31 Dec 41	31 Dec 42	31 Dec 43	31 Dec 44	31 Dec 45	31 Dec 46	31 Dec 47	31 Dec 48	31 Dec 49	31 Dec 50	31 Dec 51	31 Dec 52	31 Dec 53	31 Dec 54	31 Dec 55
Period Number	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
Days in Period	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365

Port Operations & Maintenance Emissions Calculations (assuming Summer Control Efficiency)

Table Fug-1: Operational Data																							
Vehicle	Parameter	Unit	CY35	CY36	CY37	CY38	CY39	CY40	CY41	CY42	CY43	CY44	CY45	CY46	CY47	CY48	CY49	CY50	CY51	CY52	CY53	CY54	CY55
Loader - Eg Cat 966	Quantity	-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
	Operating Hours	hrs	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	
Grader - Cat 14	Quantity	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	Operating Hours	hrs	1095	1095	1095	1095	1095	1095	1095	1095	1095	1095	1095	1095	1095	1095	1095	1095	1095	1095	1095	1095	
Plow / Sand / Gravel / Water Truck	Quantity	-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
	Operating Hours	hrs	7300	7300	7300	7300	7300	7300	7300	7300	7300	7300	7300	7300	7300	7300	7300	7300	7300	7300	7300	7300	
Winch Tractor Trailer	Quantity	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	Operating Hours	hrs	1825	1825	1825	1825	1825	1825	1825	1825	1825	1825	1825	1825	1825	1825	1825	1825	1825	1825	1825	1825	
Fuel Trucks	Quantity	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	Operating Hours	hrs	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	
Aircraft Tugs	Quantity	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	Operating Hours	hrs	109.5	109.8	109.5	109.5	109.5	109.8	109.5	109.5	109.5	109.8	109.5	109.5	109.5	109.8	109.5	109.5	109.5	109.8	109.5	109.5	
Skidsteer / Bobcat	Quantity	-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
	Operating Hours	hrs	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	
Light Vehicle - EG F-350	Quantity	-	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
	Operating Hours	hrs	9125	9125	9125	9125	9125	9125	9125	9125	9125	9125	9125	9125	9125	9125	9125	9125	9125	9125	9125	9125	

Table Fug-2: Vehicle Weight and Travel Distance Calculation:

Non leap Year							Leap Year							Data Source
Vehicle	Quantity	Travelling Hours	Mean Vehicle Weight (ton)	Annual Travel Distance (VKT/yr)	Mean Weight x Annual Distance (ton.VKT/year)	Weighted Mean Vehicle Weight (ton)	Vehicle	Quantity	Travelling Hours	Mean Vehicle Weight (ton)	Annual Travel Distance (VKT/yr)	Mean Weight x Annual Distance (ton.VKT/year)	Weighted Mean Vehicle Weight (ton)	
Loader - Eg Cat 966	2	2,555.00	25.56	12,775.00	326,554.55	14.00	Loader - Eg Cat 966	2	2,555.00	25.56	12,775.00	326,554.55	14.00	https://www.cat.com/en_US/products/new/equipment/wheel-
Grader - Cat 14	1	766.50	28.63	7,665.00	219,448.95		Grader - Cat 14	1	766.50	28.63	7,665.00	219,448.95		https://www.cat.com/en_US/products/new/equipment/motor-
Plow / Sand / Gravel / Water Truck	2	5,110.00	20.00	76,650.00	1,533,000.00		Plow / Sand / Gravel / Water Truck	2	5,110.00	20.00	76,650.00	1,533,000.00		Assumption
Winch Tractor Trailer	1	1,277.50	20.00	19,162.50	383,250.00		Winch Tractor Trailer	1	1,277.50	20.00	19,162.50	383,250.00		Assumption
Fuel Trucks	1	2,555.00	20.00	38,325.00	766,500.00		Fuel Trucks	1	2,555.00	20.00	38,325.00	766,500.00		Assumption
Aircraft Tugs	1	76.65	20.00	1,149.75	22,995.00		Aircraft Tugs	1	76.66	20.00	1,152.90	23,058.00		GSE TUG GT35 Sell Sheet.pdf
Skidsteer / Bobcat	2	2,555.00	4.57	12,775.00	58,381.75		Skidsteer / Bobcat	2	2,555.00	4.57	12,775.00	58,381.75		https://www.cat.com/en_AU/products/new/equipment/skid-steer-and-
Light Vehicle - EG F-350	5	6,387.50	4.07	95,812.50	389,956.88		Light Vehicle - EG F-350	5	6,387.50	4.07	95,812.50	389,956.88		https://www.ford.ca/trucks/super-duty/models/f350-xl/
Total				264,314.75	3,700,087.13						264,317.90	3,700,150.13		

Table Fug-3: Unpaved Road Dust Emission Calculations

		CY35	CY36	CY37	CY38	CY39	CY40	CY41	CY42	CY43	CY44	CY45	CY46	CY47	CY48	CY49	CY50	CY51	CY52	CY53	CY54	CY55
total km travelled	VKT/year	264,314.75	264,317.90	264,314.75	264,314.75	264,314.75	264,317.90	264,314.75	264,314.75	264,314.75	264,317.90	264,314.75	264,314.75	264,314.75	264,317.90	264,314.75	264,314.75	264,314.75	264,317.90	264,314.75	264,314.75	264,314.75
	VKT/day	724.15	722.18	724.15	724.15	724.15	722.18	724.15	724.15	724.15	722.18	724.15	724.15	724.15	722.18	724.15	724.15	724.15	722.18	724.15	724.15	724.15
	VKT/hr	30.17	30.09	30.17	30.17	30.17	30.17	30.17	30.17	30.17	30.17	30.17	30.17	30.17	30.09	30.17	30.17	30.17	30.09	30.17	30.17	30.17
mean vehicle weight, W	tons	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00
TSP	g/VKT	2,134.30	2,134.30	2,134.30	2,134.30	2,134.30	2,134.30	2,134.30	2,134.30	2,134.30	2,134.30	2,134.30	2,134.30	2,134.30	2,134.30	2,134.30	2,134.30	2,134.30	2,134.30	2,134.30	2,134.30	2,134.30
PM ₁₀	g/VKT	606.92	606.92	606.92	606.92	606.92	606.92	606.92	606.92	606.92	606.92	606.92	606.92	606.92	606.92	606.92	606.92	606.92	606.92	606.92	606.92	606.92
PM _{2.5}	g/VKT	60.69	60.69	60.69	60.69	60.69	60.69	60.69	60.69	60.69	60.69	60.69	60.69	60.69	60.69	60.69	60.69	60.69	60.69	60.69	60.69	60.69
TSP	kg/yr	29,199.10	29,199.51	29,199.10	29,199.10	29,199.10	29,199.10	29,199.10	29,199.10	29,199.10	29,199.51	29,199.10	29,199.10	29,199.10	29,199.51	29,199.10	29,199.10	29,199.10	29,199.51	29,199.10	29,199.10	29,199.10
PM ₁₀	kg/yr	8,303.17	8,303.29	8,303.17	8,303.17	8,303.17	8,303.17	8,303.17	8,303.17	8,303.17	8,303.29	8,303.17	8,303.17	8,303.17	8,303.29	8,303.17	8,303.17	8,303.17	8,303.29	8,303.17	8,303.17	8,303.17
PM _{2.5}	kg/yr	830.32	830.33	830.32	830.32	830.32	830.32	830.32	830.32	830.32	830.33	830.32	830.32	830.32	830.33	830.32	830.32	830.32	830.33	830.32	830.32	830.32
TSP	kg/day	80.00	79.78	80.00	80.00	80.00	80.00	80.00	80.00	80.00	79.78	80.00	80.00	80.00	79.78	80.00	80.00	80.00	79.78	80.00	80.00	80.00
PM ₁₀	kg/day	22.75	22.69	22.75	22.75	22.75	22.75	22.75	22.75	22.75	22.69	22.75	22.75	22.75	22.69	22.75	22.75	22.75	22.69	22.75	22.75	22.75
PM _{2.5}	kg/day	2.27	2.27	2.27	2.27	2.27	2.27	2.27	2.27	2.27	2.27	2.27	2.27	2.27	2.27	2.27	2.27	2.27	2.27	2.27	2.27	2.27
TSP	kg/hr	3.33	3.32	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.32	3.33	3.33	3.33	3.32	3.33	3.33	3.33	3.32	3.33	3.33	3.33
PM ₁₀	kg/hr	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PM _{2.5}	kg/hr	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09

Emissions from Unpaved Road Operations & Maintenance

Description:
Particulate emissions from vehicles driving on unpaved roads causing the resuspension of loose particulate matter on the road surface.

Contaminant(s) of Concern:
PM, PM₁₀ and PM_{2.5} emissions are the contaminants of concern.

Methodology: Emission Factor (EF)
Emission factor for unpaved roads was calculated using Equation (1a) in the US EPA AP-42 document Chapter 13.2.2 (Unpaved Roads). The equation is:
$$E = k \left(\frac{s}{12} \right)^a \left(\frac{W}{3} \right)^b$$

Where:
E = emission factor
s = surface material silt content (%)
W = mean vehicle weight
k, a, and b = empirical constants

Source
Link [AP 42, Fifth Edition, Volume I, Chapter 13.2.2 Unpaved Roads](#)
[AP42, Section 13.2.2 Unpaved Roads - Updated November 2006](#)

Constant	Industrial Roads (Equation 1a)		
	PM-2.5	PM-10	PM-30*
k (lb/VMT)	0.15	1.5	4.9
a	0.90	0.9	0.7
b	0.45	0.5	0.5
Rating	B	B	B

*Assumed equivalent to total suspended particulate matter (TSP)

Parameter	Value	Unit	Reference
Surface Silt Content	8.3	%	Table 13.2.2-1. (Stone quarrying and processing)
Operating Speed	15	km/hr	assumption
Operating Speed (Loader/Skidsteer)	5	km/hr	assumption
Operating Speed (Packer/Grader)	10	km/hr	assumption
Operating Days/Year:	365	days	provided by client
Operating Hours/Day:	24	hrs	provided by client
Combined Water and Speed Limit	95%	summer	https://www.env.nm.gov/wp-content/uploads/sites/2/2017/02/WRAP_FDHandbook_Rev_06.pdf
Control Efficiency :	99%	winter	Natural mitigation in the winter (October to April)

Financial Year	CY35	CY36	CY37	CY38	CY39	CY40	CY41	CY42	CY43	CY44	CY45	CY46	CY47	CY48	CY49	CY50	CY51	CY52	CY53	CY54	CY55
Period From	1 Jan 35	1 Jan 36	1 Jan 37	1 Jan 38	1 Jan 39	1 Jan 40	1 Jan 41	1 Jan 42	1 Jan 43	1 Jan 44	1 Jan 45	1 Jan 46	1 Jan 47	1 Jan 48	1 Jan 49	1 Jan 50	1 Jan 51	1 Jan 52	1 Jan 53	1 Jan 54	1 Jan 55
Period To	31 Dec 35	31 Dec 36	31 Dec 37	31 Dec 38	31 Dec 39	31 Dec 40	31 Dec 41	31 Dec 42	31 Dec 43	31 Dec 44	31 Dec 45	31 Dec 46	31 Dec 47	31 Dec 48	31 Dec 49	31 Dec 50	31 Dec 51	31 Dec 52	31 Dec 53	31 Dec 54	31 Dec 55
Period Number	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
Days in Period	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365

Road Operations & Maintenance Emissions Calculations (assuming Summer Control Efficiency)

Table Fug-4: Road Operational Data																							
Vehicle	Parameter	Unit	CY35	CY36	CY37	CY38	CY39	CY40	CY41	CY42	CY43	CY44	CY45	CY46	CY47	CY48	CY49	CY50	CY51	CY52	CY53	CY54	CY55
Excavator - Eg Cat 349	Quantity	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Operating Hours	hrs	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900
Grader - Cat 14	Quantity	-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	Operating Hours	hrs	7300	7320	7300	7300	7300	7300	7320	7300	7300	7320	7300	7300	7300	7320	7300	7300	7300	7320	7300	7300	7300
Plow / Sand / Gravel / Water Truck	Quantity	-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	Operating Hours	hrs	7300	7320	7300	7300	7300	7300	7320	7300	7300	7320	7300	7300	7300	7320	7300	7300	7300	7320	7300	7300	7300
Snowcat	Quantity	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Operating Hours	hrs	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900
Fuel Trucks	Quantity	-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	Operating Hours	hrs	7300	7320	7300	7300	7300	7300	7320	7300	7300	7320	7300	7300	7300	7320	7300	7300	7300	7320	7300	7300	7300
Light Vehicle - EG F-350	Quantity	-	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	Operating Hours	hrs	21900	21960	21900	21900	21900	21900	21960	21900	21900	21960	21900	21900	21900	21960	21900	21900	21900	21960	21900	21900	21900

Table Fug-5: Vehicle Weight and Travel Distance Calculation:

Non leap Year							Leap Year							Data Source	
Vehicle	Quantity	Travelling Hours	Mean Vehicle Weight (ton)	Annual Travel Distance (VKT/yr)	Mean Weight x Annual Distance (ton.VKT/year)	Weighted Mean Vehicle Weight (ton)	Vehicle	Quantity	Travelling Hours	Mean Vehicle Weight (ton)	Annual Travel Distance (VKT/yr)	Mean Weight x Annual Distance (ton.VKT/year)	Weighted Mean Vehicle Weight (ton)		
Excavator - Eg Cat 349	1	630.00	54.45	9,450.00	514,552.50	13.34	Excavator - Eg Cat 349	1	630.00	54.45	9,450.00	514,552.50	13.34	https://www.cat.com/en_US/news/machine-press-releases/new-	
Grader - Cat 14	2	5,110.00	28.63	51,100.00	1,462,993.00		Grader - Cat 14	2	5,124.00	28.63	51,240.00	1,467,001.20		https://www.cat.com/en_US/products/new/equipment/motor-	
Plow / Sand / Gravel / Water Truck	2	5,110.00	20.00	76,650.00	1,533,000.00		Plow / Sand / Gravel / Water Truck	2	5,124.00	20.00	76,860.00	1,537,200.00		Assumption	
Snowcat	1	630.00	7.17	9,450.00	67,756.50		Snowcat	1	630.00	7.17	9,450.00	67,756.50		Technical data 100TrailPro.ppt (438×839)	
Fuel Trucks	2	5,110.00	20.00	76,650.00	1,533,000.00		Fuel Trucks	2	5,124.00	20.00	76,860.00	1,537,200.00		Assumption	
Light Vehicle - EG F-350	6	15,330.00	4.07	229,950.00	935,896.50		Light Vehicle - EG F-350	6	15,372.00	4.07	230,580.00	938,460.60		https://www.ford.ca/trucks/super-duty/models/f350-xl/	
Total				453,250.00	6,047,198.50						454,440.00	6,062,170.80			

Table Fug-6: Unpaved Road Dust Emission Calculations

		CY35	CY36	CY37	CY38	CY39	CY40	CY41	CY42	CY43	CY44	CY45	CY46	CY47	CY48	CY49	CY50	CY51	CY52	CY53	CY54	CY55
total km travelled	VKT/year	453,250.00	454,440.00	453,250.00	453,250.00	453,250.00	454,440.00	453,250.00	453,250.00	453,250.00	454,440.00	453,250.00	453,250.00	453,250.00	454,440.00	453,250.00	453,250.00	453,250.00	454,440.00	453,250.00	453,250.00	453,250.00
	VKT/day	1,241.78	1,241.64	1,241.78	1,241.78	1,241.78	1,241.64	1,241.78	1,241.78	1,241.78	1,241.64	1,241.78	1,241.78	1,241.78	1,241.64	1,241.78	1,241.78	1,241.78	1,241.64	1,241.78	1,241.78	1,241.78
	VKT/hr	51.74	51.73	51.74	51.74	51.74	51.73	51.74	51.74	51.74	51.73	51.74	51.74	51.74	51.73	51.74	51.74	51.74	51.73	51.74	51.74	51.74
mean vehicle weight, W	tons	13.34	13.34	13.34	13.34	13.34	13.34	13.34	13.34	13.34	13.34	13.34	13.34	13.34	13.34	13.34	13.34	13.34	13.34	13.34	13.34	13.34
TSP	g/VKT	2,088.63	2,088.49	2,088.63	2,088.63	2,088.63	2,088.63	2,088.49	2,088.63	2,088.63	2,088.49	2,088.63	2,088.63	2,088.63	2,088.49	2,088.63	2,088.63	2,088.63	2,088.49	2,088.63	2,088.63	2,088.63
PM ₁₀	g/VKT	593.93	593.89	593.93	593.93	593.93	593.89	593.93	593.93	593.93	593.89	593.93	593.93	593.93	593.89	593.93	593.93	593.93	593.89	593.93	593.93	593.93
PM _{2.5}	g/VKT	59.39	59.39	59.39	59.39	59.39	59.39	59.39	59.39	59.39	59.39	59.39	59.39	59.39	59.39	59.39	59.39	59.39	59.39	59.39	59.39	59.39
TSP	kg/yr	48,999.59	49,124.94	48,999.59	48,999.59	48,999.59	49,124.94	48,999.59	48,999.59	48,999.59	49,124.94	48,999.59	48,999.59	48,999.59	49,124.94	48,999.59	48,999.59	48,999.59	49,124.94	48,999.59	48,999.59	48,999.59
PM ₁₀	kg/yr	13,933.72	13,969.36	13,933.72	13,933.72	13,933.72	13,969.36	13,933.72	13,933.72	13,933.72	13,969.36	13,933.72	13,933.72	13,933.72	13,969.36	13,933.72	13,933.72	13,933.72	13,969.36	13,933.72	13,933.72	13,933.72
PM _{2.5}	kg/yr	1,393.37	1,396.94	1,393.37	1,393.37	1,393.37	1,396.94	1,393.37	1,393.37	1,393.37	1,396.94	1,393.37	1,393.37	1,393.37	1,396.94	1,393.37	1,393.37	1,393.37	1,396.94	1,393.37	1,393.37	1,393.37
TSP	kg/day	134.25	134.22	134.25	134.25	134.25	134.25	134.25	134.25	134.25	134.25	134.25	134.25	134.25	134.22	134.25	134.25	134.25	134.22	134.25	134.25	134.25
PM ₁₀	kg/day	38.17	38.17	38.17	38.17	38.17	38.17	38.17	38.17	38.17	38.17	38.17	38.17	38.17	38.17	38.17	38.17	38.17	38.17	38.17	38.17	38.17
PM _{2.5}	kg/day	3.82	3.82	3.82	3.82	3.82	3.82	3.82	3.82	3.82	3.82	3.82	3.82	3.82	3.82	3.82	3.82	3.82	3.82	3.82	3.82	3.82
TSP	kg/hr	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59
PM ₁₀	kg/hr	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59
PM _{2.5}	kg/hr	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16

Emissions for Aircraft Operations & Maintenance

Source Emission estimation technique manual for Airports Version 2.0 (July 2008)
Link [National Pollutant Inventory \(NPI\) emission estimation technique manual for airports - Version 2.0 - July 2008](#)

Source	Substance	Units	CO	NOx	SO ₂	TSP	PM ₁₀	PM _{2.5}
Civil - Cargo - Small	Emission factor	(kg/LTO) ¹	10.438	1.250	0.0832	0.0893	0.0893	0.0893
Civil - Passenger - Small	Emission factor	(kg/LTO) ¹	6.588	0.967	0.0655	0.0698	0.0698	0.0698
General - Business - Small	Emission factor	(kg/LTO) ¹	5.594	0.579	0.0381	0.0413	0.0413	0.0413
General - Other - Small	Emission factor	(kg/LTO) ¹	0.141	0.578	0.0399	0.042	0.0420	0.042
General - Passenger - Small	Emission factor	(kg/LTO) ¹	6.879	0.511	0.0354	0.0373	0.0373	0.0373
Civil - Cargo - Large	Emission factor	(kg/LTO) ¹	9.889	0.947	0.0681	0.0703	0.0703	0.0703
Civil - Passenger - Large	Emission factor	(kg/LTO) ¹	7.344	0.811	0.0580	0.0601	0.0601	0.0601
General - Other - Large	Emission factor	(kg/LTO) ¹	0.0811	3.697	0.247	0.264	0.264	0.264

¹ LTO - Landing and Take-Off flight phases: Taxi in and out, Take Off, Climb out, Approach, Landing.

CY35	CY36	CY37	CY38	CY39	CY40	CY41	CY42	CY43	CY44	CY45	CY46	CY47	CY48	CY49	CY50	CY51	CY52	CY53	CY54	CY55
1 Jan 35	1 Jan 36	1 Jan 37	1 Jan 38	1 Jan 39	1 Jan 40	1 Jan 41	1 Jan 42	1 Jan 43	1 Jan 44	1 Jan 45	1 Jan 46	1 Jan 47	1 Jan 48	1 Jan 49	1 Jan 50	1 Jan 51	1 Jan 52	1 Jan 53	1 Jan 54	1 Jan 55
31 Dec 35	31 Dec 36	31 Dec 37	31 Dec 38	31 Dec 39	31 Dec 40	31 Dec 41	31 Dec 42	31 Dec 43	31 Dec 44	31 Dec 45	31 Dec 46	31 Dec 47	31 Dec 48	31 Dec 49	31 Dec 50	31 Dec 51	31 Dec 52	31 Dec 53	31 Dec 54	31 Dec 55
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365

Flight Data For Operations & Maintenance

Small Aircraft (AGN II) - Eg Twin Otter

Number of Aircraft	#	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Number of LTO/year	#	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
CO	kg/year	62.6	62.6	62.6	62.6	62.6	62.6	62.6	62.6	62.6	62.6	62.6	62.6	62.6	62.6	62.6	62.6	62.6	62.6	62.6	62.6
NOx	kg/year	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50
SO ₂	kg/year	0.499	0.499	0.499	0.499	0.499	0.499	0.499	0.499	0.499	0.499	0.499	0.499	0.499	0.499	0.499	0.499	0.499	0.499	0.499	0.499
TSP	kg/year	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536
PM ₁₀	kg/year	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536
PM _{2.5}	kg/year	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536	0.536
CO	kg/day	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4
NOx	kg/day	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
SO ₂	kg/day	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02
TSP	kg/day	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02
PM ₁₀	kg/day	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02
PM _{2.5}	kg/day	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02
CO	kg/hr	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44
NOx	kg/hr	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
SO ₂	kg/hr	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02	8.32E-02
TSP	kg/hr	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02
PM ₁₀	kg/hr	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02
PM _{2.5}	kg/hr	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02	8.93E-02

Medium Aircraft (AGN IIIA) - Eg Dash 7

Number of Aircraft	#	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
Number of LTO/year	#	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
CO	kg/year	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257
NOx	kg/year	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6
SO ₂	kg/year	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77
TSP	kg/year	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83
PM ₁₀	kg/year	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83
PM _{2.5}	kg/year	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83
CO	kg/day	9.89	9.89	9.89	9.89	9.89	9.89	9.89	9.89	9.89	9.89	9.89	9.89	9.89	9.89	9.89	9.89	9.89	9.89	9.89	9.89
NOx	kg/day	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947
SO ₂	kg/day	0.0681	0.0681	0.0681	0.0681	0.0681	0.0681	0.0681	0.0681	0.0681	0.0681	0.0681	0.0681	0.0681	0.0681	0.0681	0.0681	0.0681	0.0681	0.0681	0.0681
TSP	kg/day	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703
PM ₁₀	kg/day	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703
PM _{2.5}	kg/day	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703	0.0703
CO	kg/hr	9.89	9.89	9.89	9.89	9.89	9.89	9.89	9.89	9.89	9.89	9.89	9.89	9.89	9.89	9.89	9.89	9.89	9.89	9.89	9.89
NOx	kg/hr	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
SO ₂	kg/hr	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
TSP	kg/hr	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
PM ₁₀	kg/hr	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
PM _{2.5}	kg/hr	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07

Emissions for Marine Vessel Usage

Description:

Combustion emissions from Shipping Vessels

Contaminant(s) of Concern:

Nitrogen oxides (NO_x), carbon monoxide (CO), particulate matter, sulphur dioxide (SO₂) emissions are the contaminants of concern

Methodology: Emission Factor (EF)

<https://downloads.regulations.gov/EPA-HQ-OAR-2003-0045-0165/content.pdf>
TSP:PM10 and TSP:PM2.5 ratios obtained from CARB CEIDAR

Vessel Information

Vessel Type	Number of Ships	Deadweight Tonnage (tonne)
Barges / Tugs (e.g., Arctic Tuk)	3	4,715
Fuel Tankers	1	16,640
Cargo Ships (e.g., NEAS MV Aiviq)	1	4,860
Security Vessels (e.g., Polar Icebreaker)	2	13,842

Inputs

Marine diesel fuel sulphur content	1.000	mg/kg
Diesel Per Ship	20,000,000	Litres
Diesel density	0.832	kg/L
vessels per year	7	
number of days docked per ship	4	days/vessel
Maneuver time	0.5	hour/vessel
Enter/Exit Time	1	hour/vessel
No. Ships in port	1	

Emission Factors

Pollutant	x	b	a
PM	1.5	0.2551	0.0059
NO _x	1.5	10.4496	0.1255
NO ₂	1.5	15.5247	0.18865
SO ₂	n/a	0	2.3735
CO	1	0	0.8378

Calculations:

emission rate, not SO₂, (g/kW-hr) = a * ((fractional load)^x) + b

emission rate, for SO₂, (g/kW-hr) = a * (fuel sulfur flow) + b

fuel sulfur flow = sulphur content * (14.12 / (fractional load) + 205.717)

fractional load = % load / 100

main engine load factors (%) for bulk carriers and tankers:

80	cruise
40	slow cruise
20	maneuvering

auxiliary loads in kW. Load factor = 100%

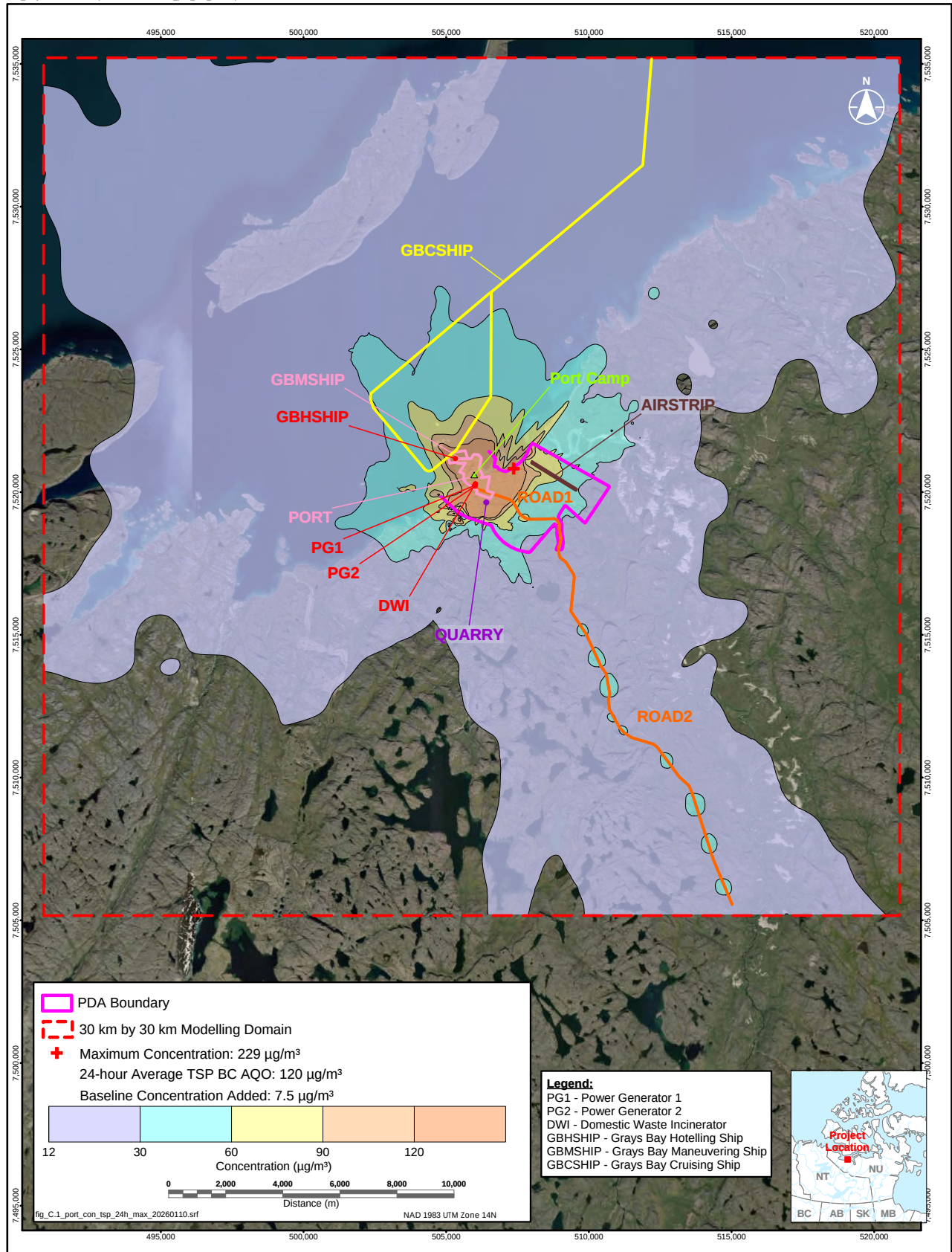
750	slow cruise
1250	maneuvering
1000	hotelling

						Emission Factors (g/kW-hr)						Total Emission Rate (tonnes/yr)					
Emission Location	Description	Average Ship DWT	Max Main Engine Power (kW = (2581 + 0.719 * (DWT))/1.34102)	Main Engine Power during activity (kW)	Aux Engine Power during activity (kW)	NO _x	SO ₂	CO	TSP	PM ₁₀	PM _{2.5}	NO _x	SO ₂	CO	TSP	PM ₁₀	PM _{2.5}
GBRP Dock	Docked ship, hotelling	9,047.00	6,775.29		1,000.00	10.58	0.52	0.84	0.26	0.25	0.24	7.11	0.35	0.56	0.18	0.17	0.16
Gray's Bay	manoeuvring ship	9,047.00	6,775.29	1,355.06	1,250.00	11.85	0.66	4.19	0.32	0.31	0.30	0.11	0.01	0.04	0.003	0.003	0.003
Gray's Bay	slow cruise ship	9,047.00	6,775.29	2,710.11	750.00	10.95	0.57	2.09	0.28	0.27	0.26	0.27	0.01	0.05	0.007	0.006	0.006
						7.48	0.37	0.65	0.19	0.18	0.17						

Emissions Summary for Operations & Maintenance Phase

Financial Year		CY35	CY36	CY37	CY38	CY39	CY40	CY41	CY42	CY43	CY44	CY45	CY46	CY47	CY48	CY49	CY50	CY51	CY52	CY53	CY54	CY55
Period From		1 Jan 35	1 Jan 36	1 Jan 37	1 Jan 38	1 Jan 39	1 Jan 40	1 Jan 41	1 Jan 42	1 Jan 43	1 Jan 44	1 Jan 45	1 Jan 46	1 Jan 47	1 Jan 48	1 Jan 49	1 Jan 50	1 Jan 51	1 Jan 52	1 Jan 53	1 Jan 54	1 Jan 55
Period To		31 Dec 35	31 Dec 36	31 Dec 37	31 Dec 38	31 Dec 39	31 Dec 40	31 Dec 41	31 Dec 42	31 Dec 43	31 Dec 44	31 Dec 45	31 Dec 46	31 Dec 47	31 Dec 48	31 Dec 49	31 Dec 50	31 Dec 51	31 Dec 52	31 Dec 53	31 Dec 54	31 Dec 55
Period Number		14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
Days in Period		365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365
Totals																						
CO	kg/year	52,794.80	52,852.37	52,794.80	52,794.80	52,794.80	52,852.37	52,794.80	52,794.80	52,794.80	52,852.37	52,794.80	52,794.80	52,794.80	52,852.37	52,794.80	52,794.80	52,794.80	52,852.37	52,794.80	52,794.80	52,794.80
NOx	kg/year	337,331.39	338,043.28	337,331.39	337,331.39	337,331.39	338,043.28	337,331.39	337,331.39	337,331.39	338,043.28	337,331.39	337,331.39	337,331.39	338,043.28	337,331.39	337,331.39	337,331.39	338,043.28	337,331.39	337,331.39	337,331.39
SO ₂	kg/year	2,346.79	2,347.36	2,346.79	2,346.79	2,346.79	2,347.36	2,346.79	2,346.79	2,346.79	2,347.36	2,346.79	2,346.79	2,346.79	2,347.36	2,346.79	2,346.79	2,346.79	2,347.36	2,346.79	2,346.79	2,346.79
TSP	kg/year	89,018.40	89,148.86	89,018.40	89,018.40	89,018.40	89,148.86	89,018.40	89,018.40	89,018.40	89,148.86	89,018.40	89,018.40	89,018.40	89,148.86	89,018.40	89,018.40	89,018.40	89,148.86	89,018.40	89,018.40	89,018.40
PM ₁₀	kg/year	30,754.52	30,794.98	30,754.52	30,754.52	30,754.52	30,794.98	30,754.52	30,754.52	30,754.52	30,794.98	30,754.52	30,754.52	30,754.52	30,794.98	30,754.52	30,754.52	30,754.52	30,794.98	30,754.52	30,754.52	30,754.52
PM _{2.5}	kg/year	9,608.54	9,616.82	9,608.54	9,608.54	9,608.54	9,616.82	9,608.54	9,608.54	9,608.54	9,616.82	9,608.54	9,608.54	9,608.54	9,616.82	9,608.54	9,608.54	9,608.54	9,616.82	9,608.54	9,608.54	9,608.54
CO	kg/day	254.80	254.80	254.80	254.80	254.80	254.80	254.80	254.80	254.80	254.80	254.80	254.80	254.80	254.80	254.80	254.80	254.80	254.80	254.80	254.80	254.80
NOx	kg/day	1,211.40	1,211.40	1,211.40	1,211.40	1,211.40	1,211.40	1,211.40	1,211.40	1,211.40	1,211.40	1,211.40	1,211.40	1,211.40	1,211.40	1,211.40	1,211.40	1,211.40	1,211.40	1,211.40	1,211.40	1,211.40
SO ₂	kg/day	21.93	21.93	21.93	21.93	21.93	21.93	21.93	21.93	21.93	21.93	21.93	21.93	21.93	21.93	21.93	21.93	21.93	21.93	21.93	21.93	21.93
TSP	kg/day	263.05	262.79	263.05	263.05	263.05	262.79	263.05	263.05	263.05	262.79	263.05	263.05	263.05	262.79	263.05	263.05	263.05	262.79	263.05	263.05	263.05
PM ₁₀	kg/day	97.27	97.19	97.27	97.27	97.27	97.19	97.27	97.27	97.27	97.19	97.27	97.27	97.27	97.19	97.27	97.27	97.27	97.19	97.27	97.27	97.27
PM _{2.5}	kg/day	33.17	33.15	33.17	33.17	33.17	33.15	33.17	33.17	33.17	33.15	33.17	33.17	33.17	33.15	33.17	33.17	33.17	33.15	33.17	33.17	33.17
CO	kg/hr	121.28	121.28	121.28	121.28	121.28	121.28	121.28	121.28	121.28	121.28	121.28	121.28	121.28	121.28	121.28	121.28	121.28	121.28	121.28	121.28	121.28
NOx	kg/hr	151.93	151.93	151.93	151.93	151.93	151.93	151.93	151.93	151.93	151.93	151.93	151.93	151.93	151.93	151.93	151.93	151.93	151.93	151.93	151.93	151.93
SO ₂	kg/hr	6.64	6.64	6.64	6.64	6.64	6.64	6.64	6.64	6.64	6.64	6.64	6.64	6.64	6.64	6.64	6.64	6.64	6.64	6.64	6.64	6.64
TSP	kg/hr	27.30	27.29	27.30	27.30	27.30	27.29	27.30	27.30	27.30	27.29	27.30	27.30	27.30	27.29	27.30	27.30	27.30	27.29	27.30	27.30	27.30
PM ₁₀	kg/hr	13.90	13.90	13.90	13.90	13.90	13.90	13.90	13.90	13.90	13.90	13.90	13.90	13.90	13.90	13.90	13.90	13.90	13.90	13.90	13.90	13.90
PM _{2.5}	kg/hr	4.61	4.61	4.61	4.61	4.61	4.61	4.61	4.61	4.61	4.61	4.61	4.61	4.61	4.61	4.61	4.61	4.61	4.61	4.61	4.61	4.61

Appendix C Concentration Contour Plots for Construction



Sources: ESRI World Imagery

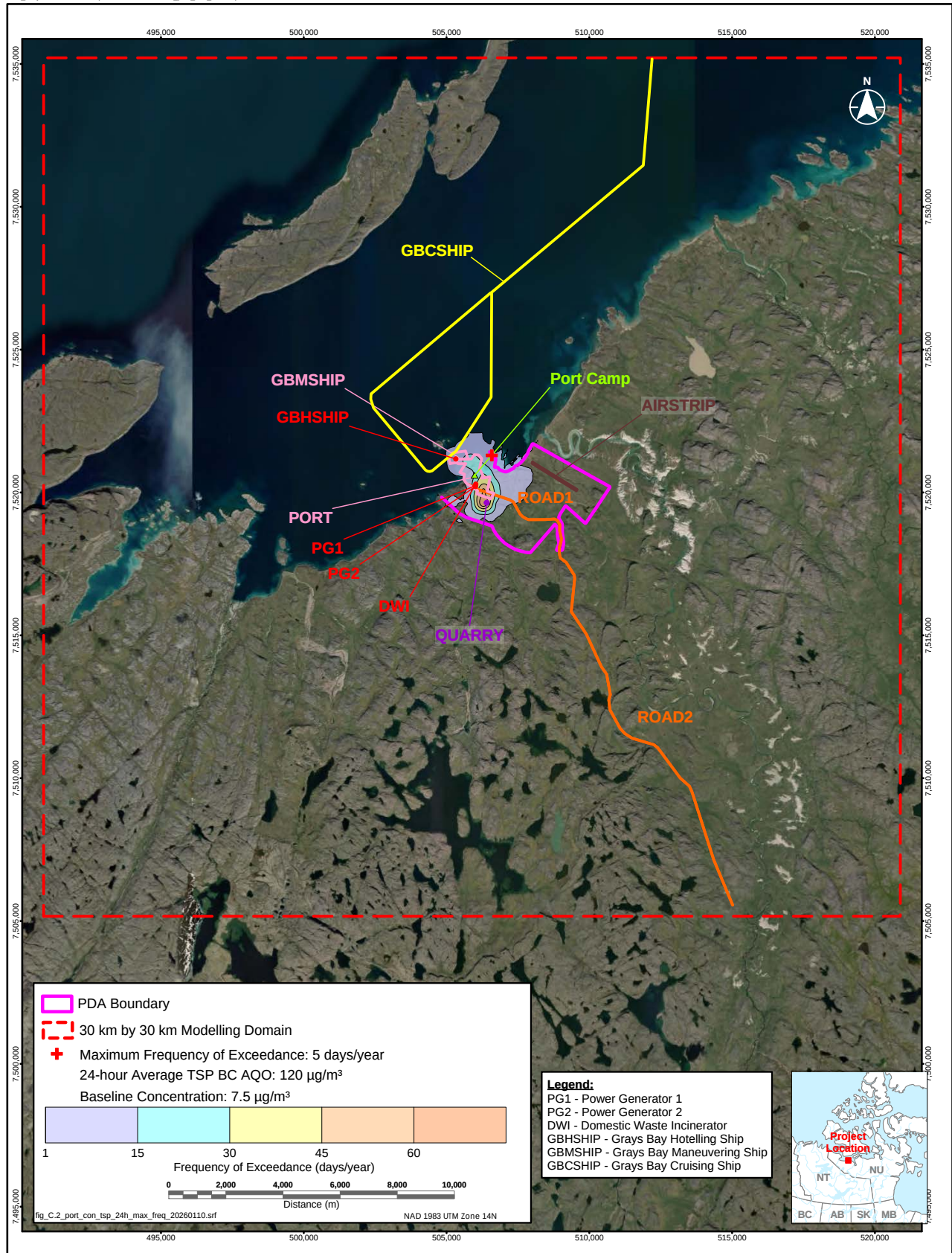
Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.



Grays Bay Road and Port Project

Predicted Maximum 24-hour Average TSP Concentrations (Project Construction)

Figure C.1



Sources: ESRI World Imagery

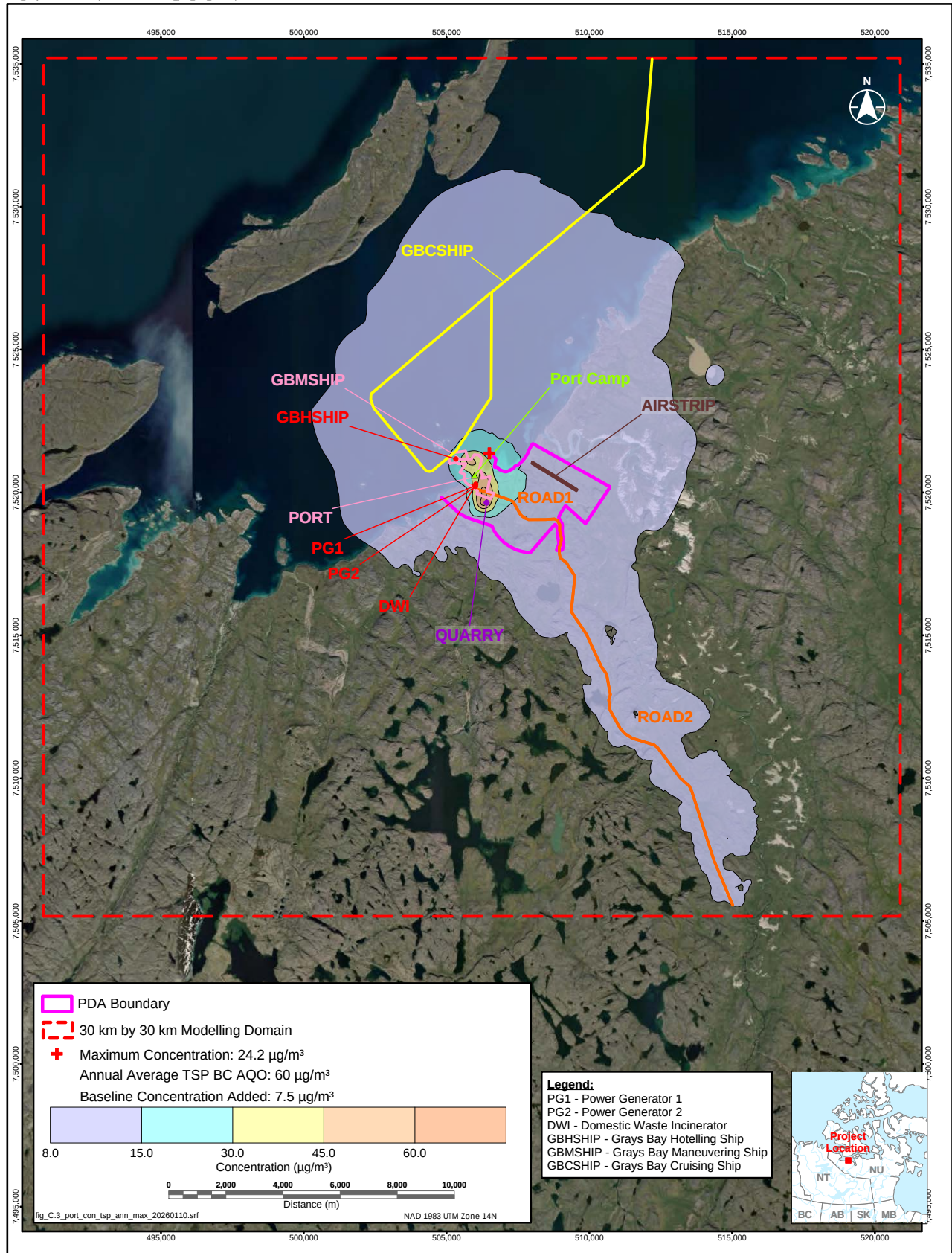
Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.



Predicted Maximum Frequency of Exceedance of the 24-hour Average TSP BC AQO (Project Construction)

Grays Bay Road and Port Project

Figure C.2



Sources: ESRI World Imagery

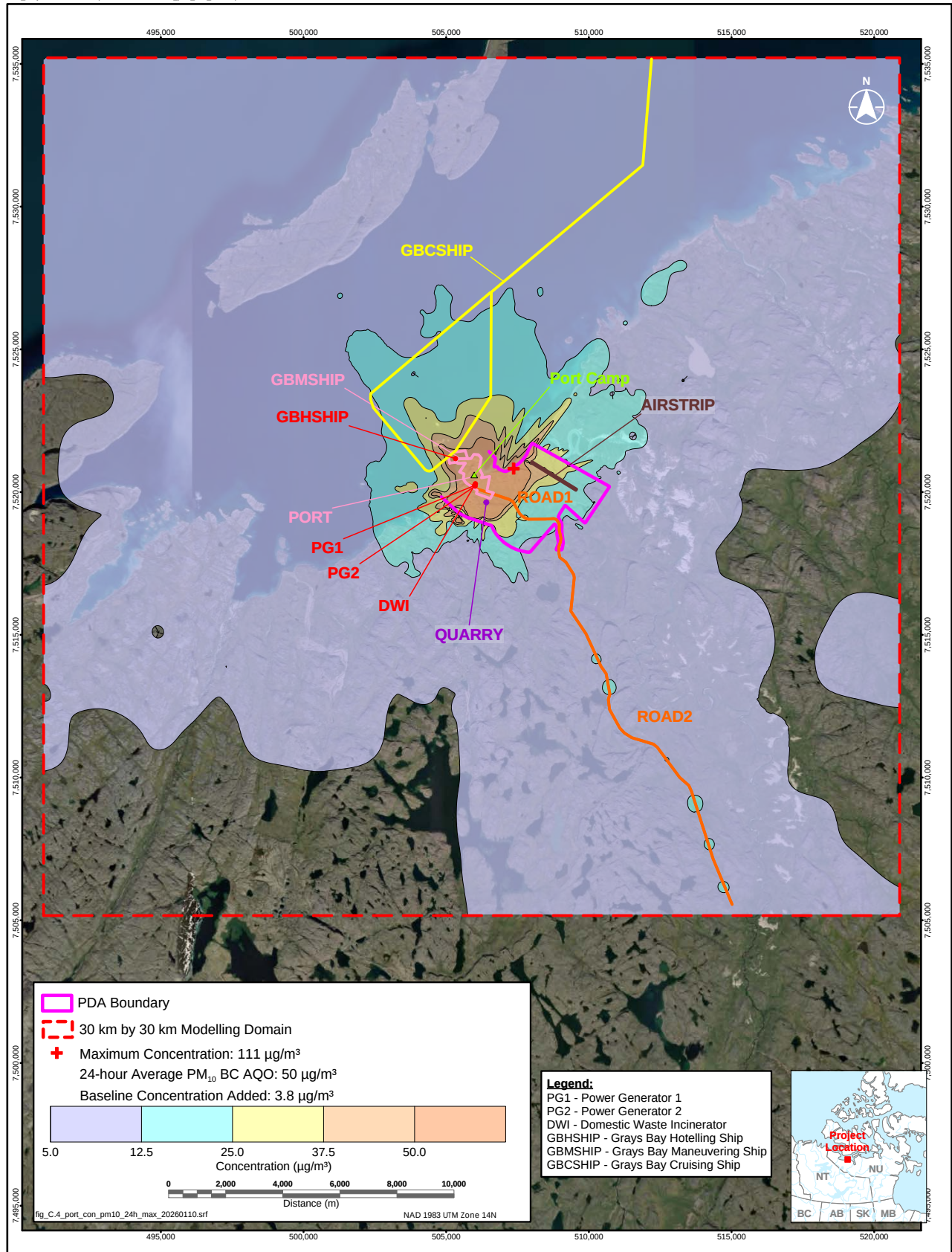
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Grays Bay Road and Port Project

Predicted Maximum Annual Average TSP Concentrations (Project Construction)

Figure C.3



Sources: ESRI World Imagery

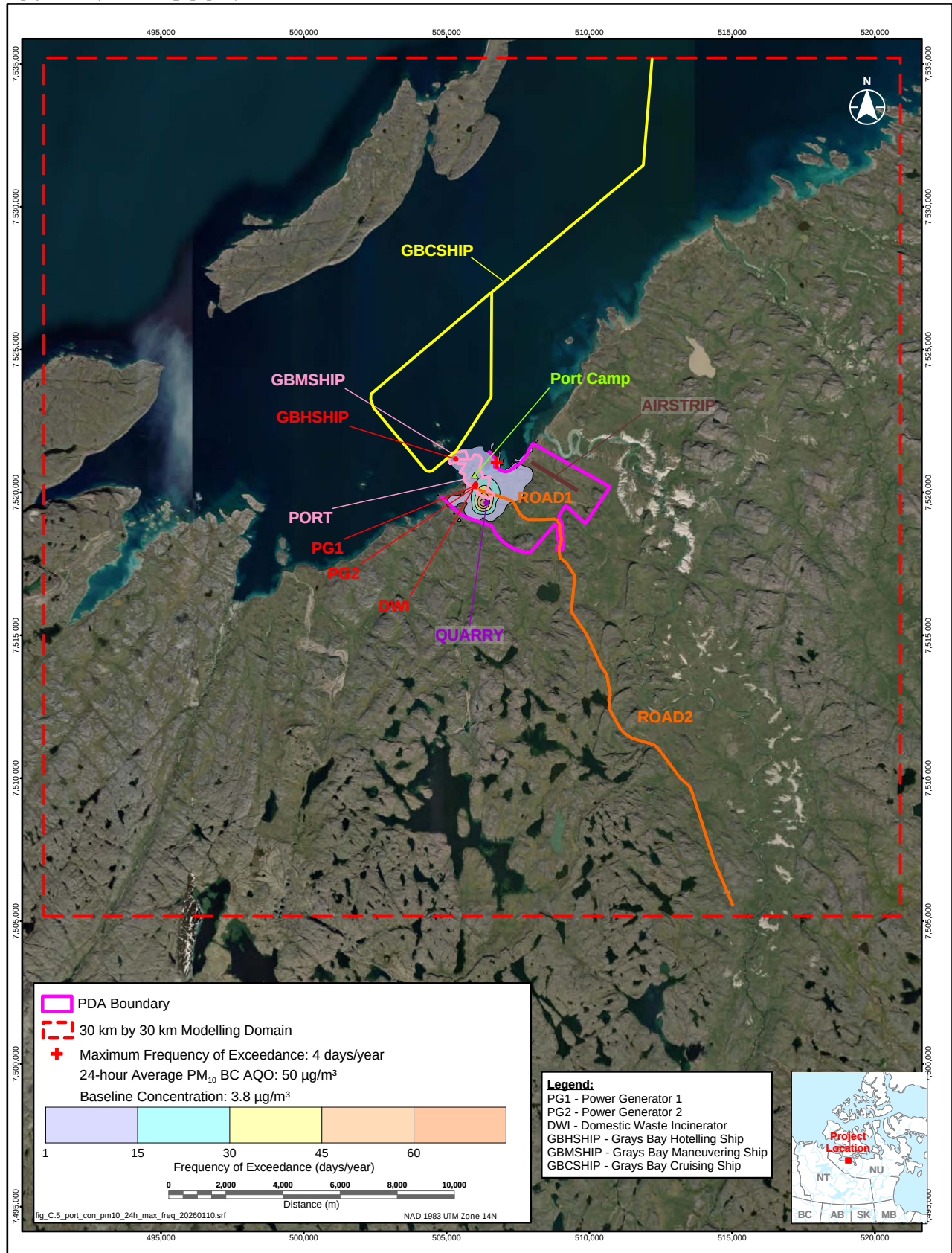
Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.



Grays Bay Road and Port Project

Predicted Maximum 24-hour Average PM₁₀ Concentrations (Project Construction)

Figure C.4



Sources: ESRI World Imagery

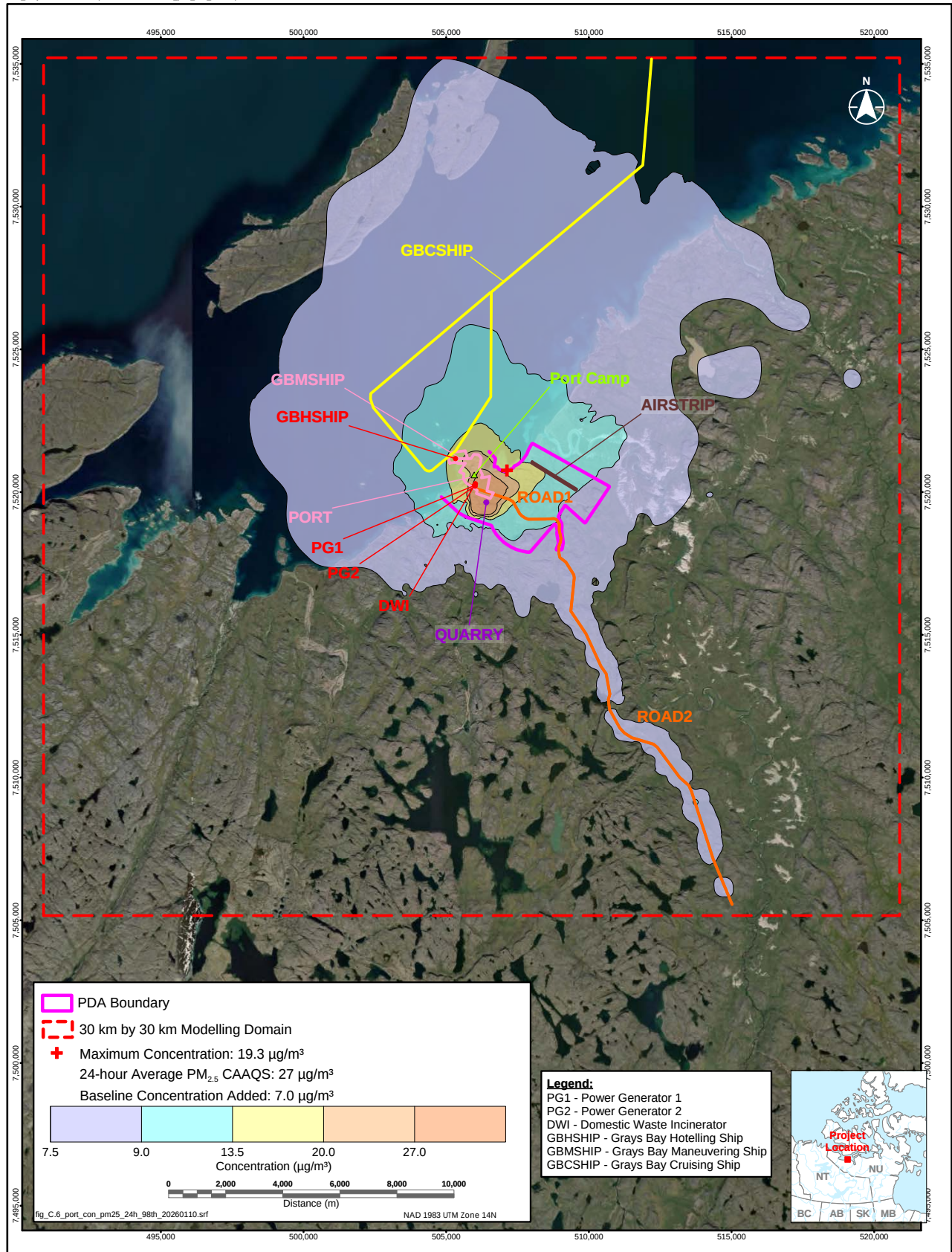
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Grays Bay Road and Port Project

Predicted Maximum Frequency of Exceedance of the 24-hour Average PM_{10} BC AQO (Project Construction)

Figure C.5



Sources: ESRI World Imagery

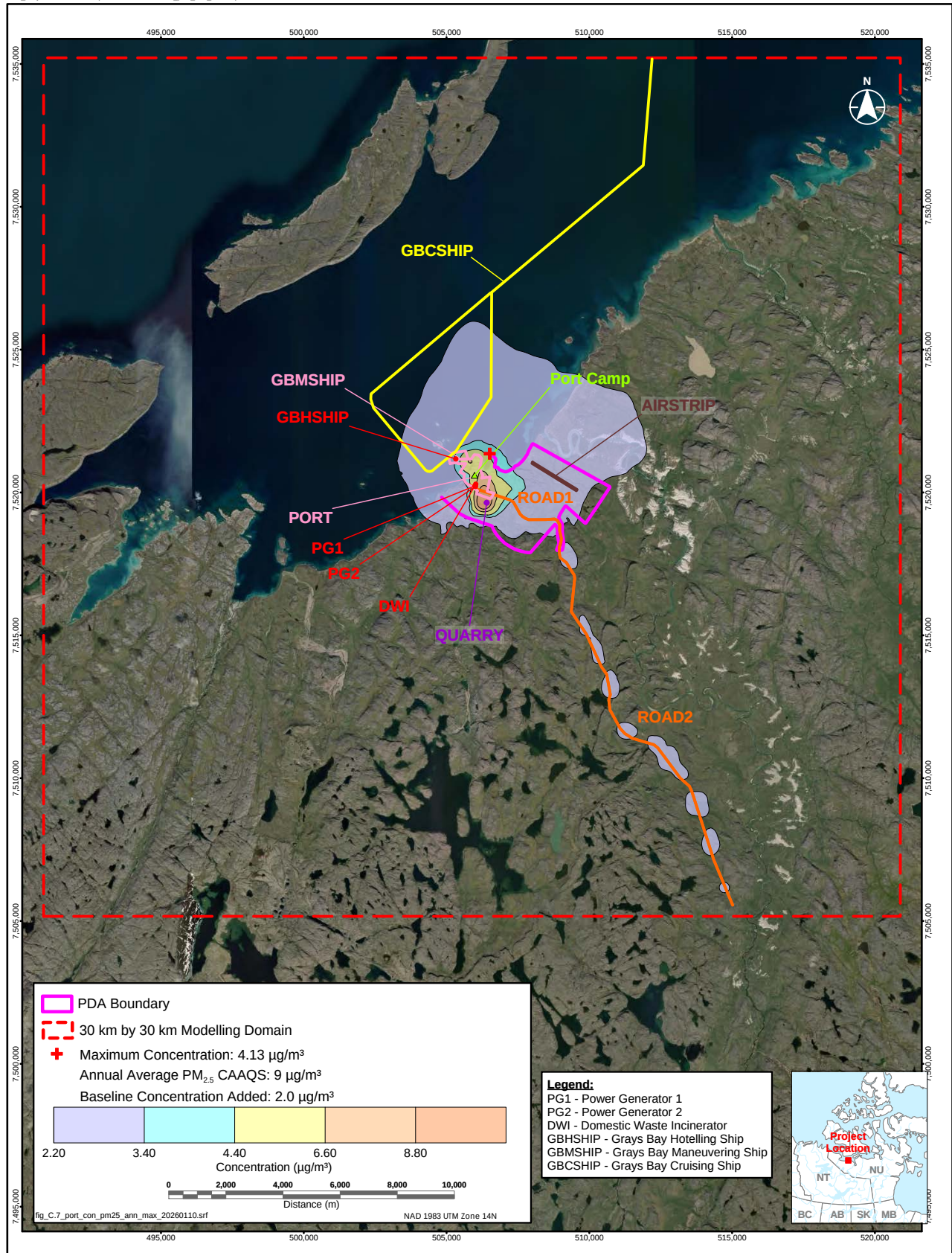
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Grays Bay Road and Port Project

Predicted 98th Percentile 24-hour Average $\text{PM}_{2.5}$ Concentrations (Project Construction)

Figure C.6



Sources: ESRI World Imagery

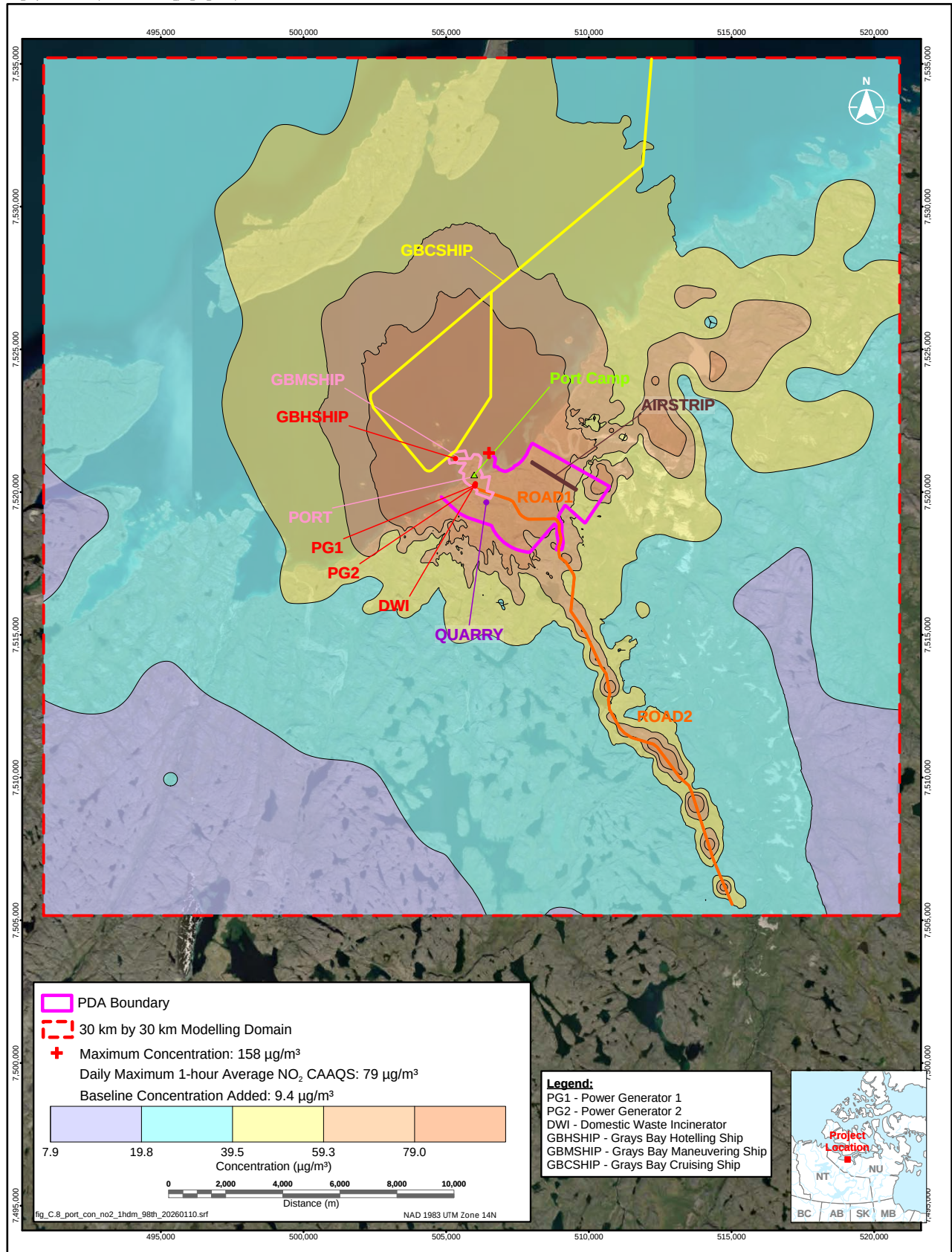
Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.



Grays Bay Road and Port Project

Predicted Maximum Annual Average PM_{2.5} Concentrations (Project Construction)

Figure C.7



Sources: ESRI World Imagery

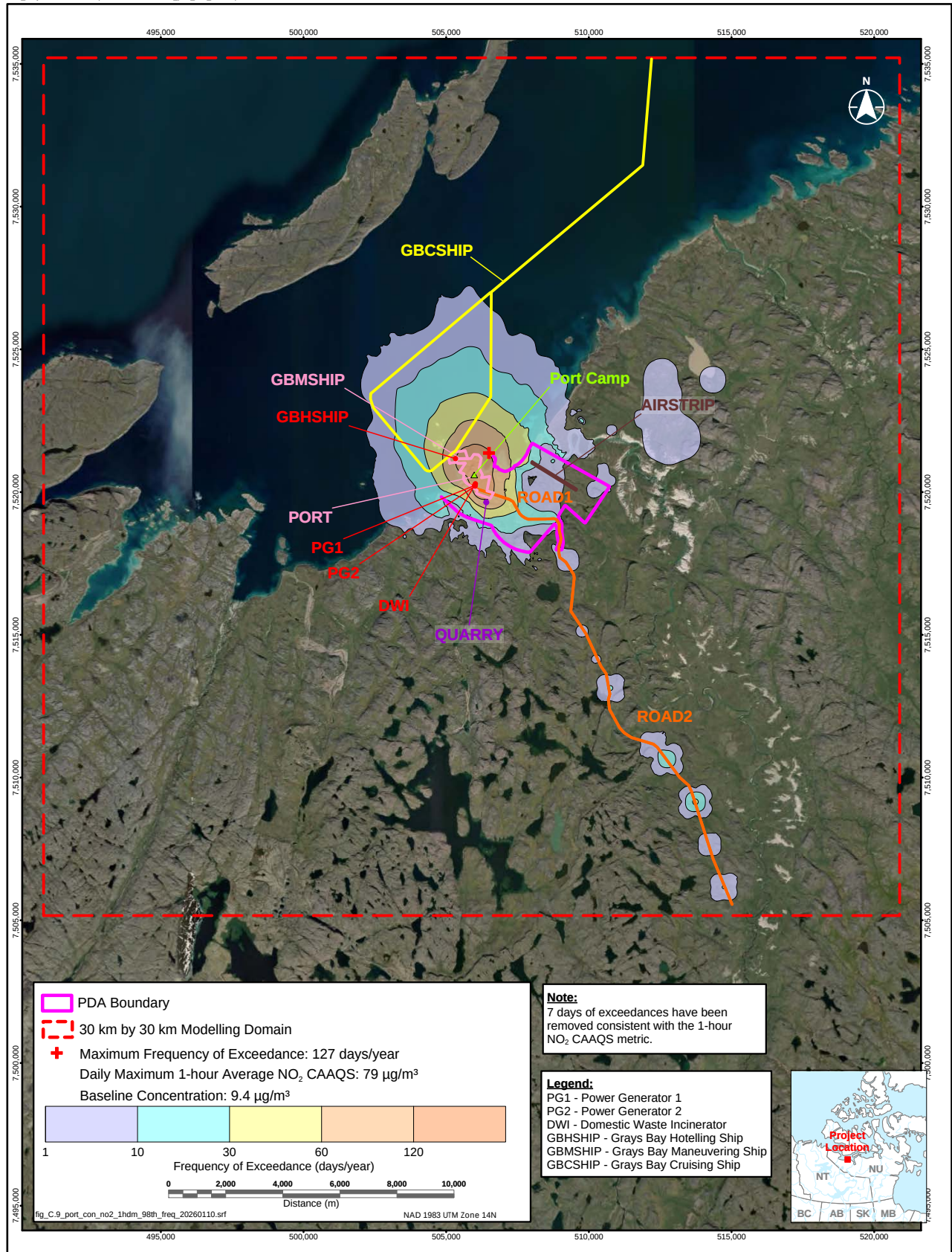
Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.



Grays Bay Road and Port Project

Predicted 98th Percentile Daily Maximum 1-hour Average NO_2 Concentrations (Project Construction)

Figure C.8

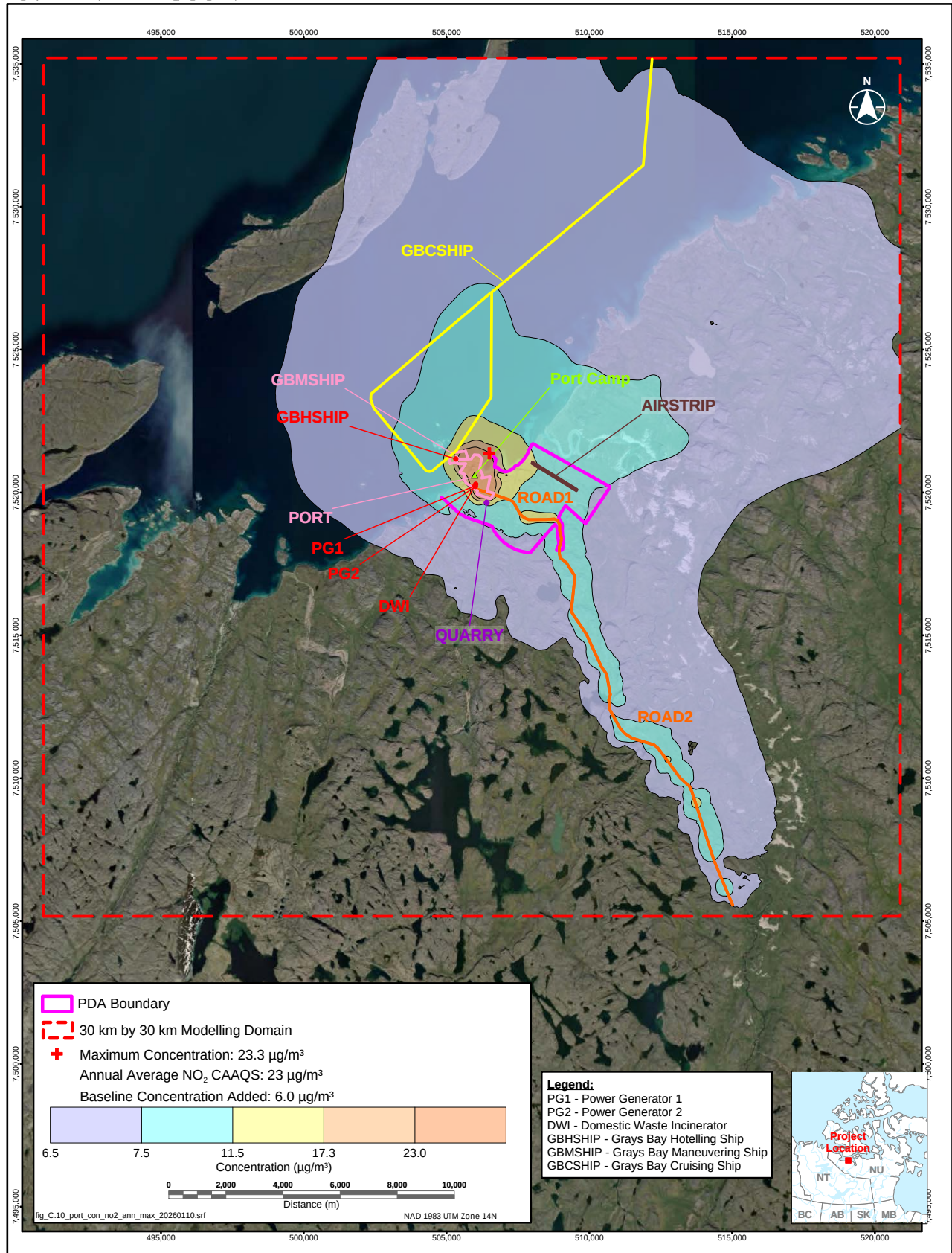


Sources: ESRI World Imagery

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Predicted Maximum Frequency of Exceedance of the 1-hour Average NO₂ CAAQS (Project Construction)





Sources: ESRI World Imagery

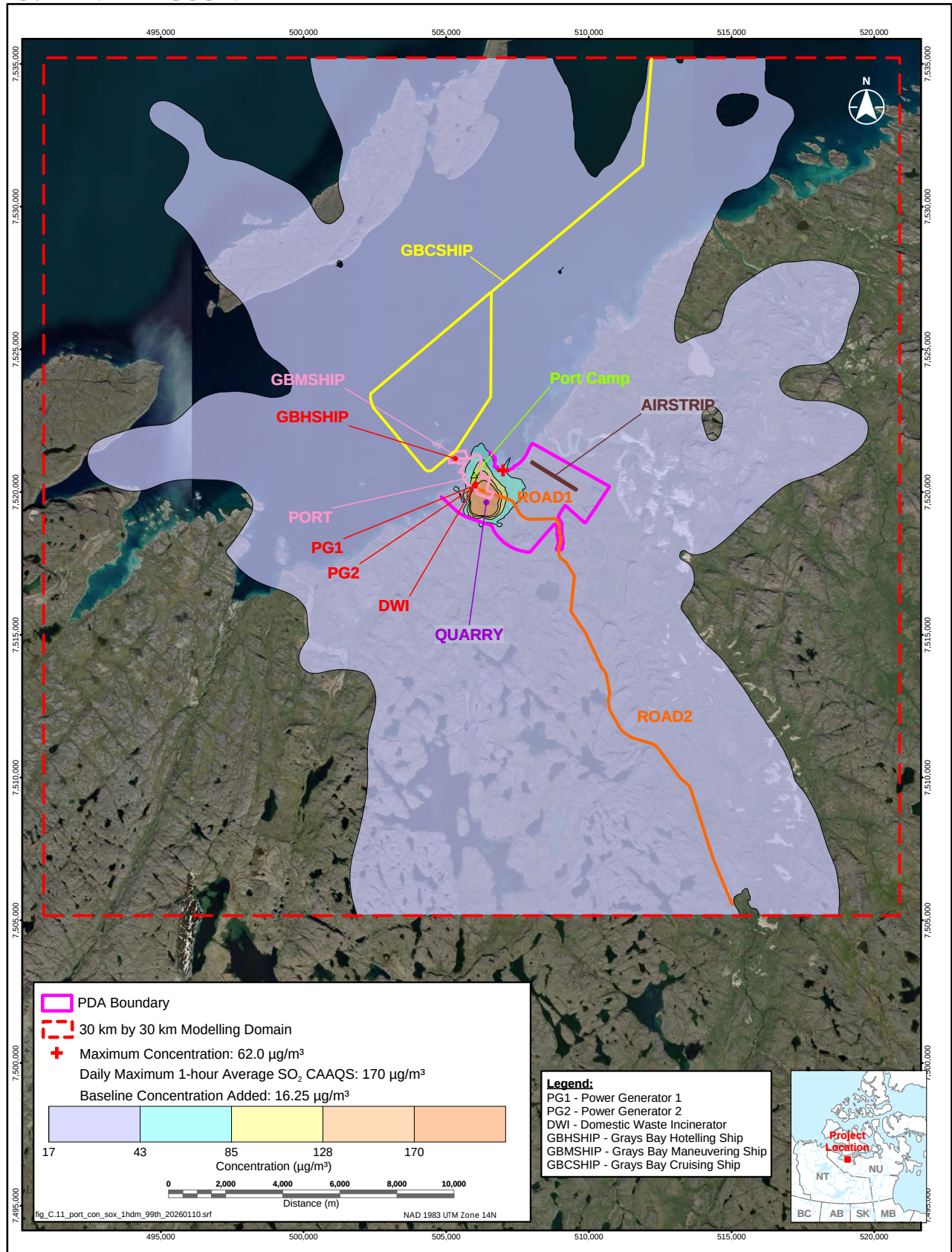
Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.



Grays Bay Road and Port Project

Predicted Maximum Annual Average NO_2 Concentrations (Project Construction)

Figure C.10



Sources: ESRI World Imagery

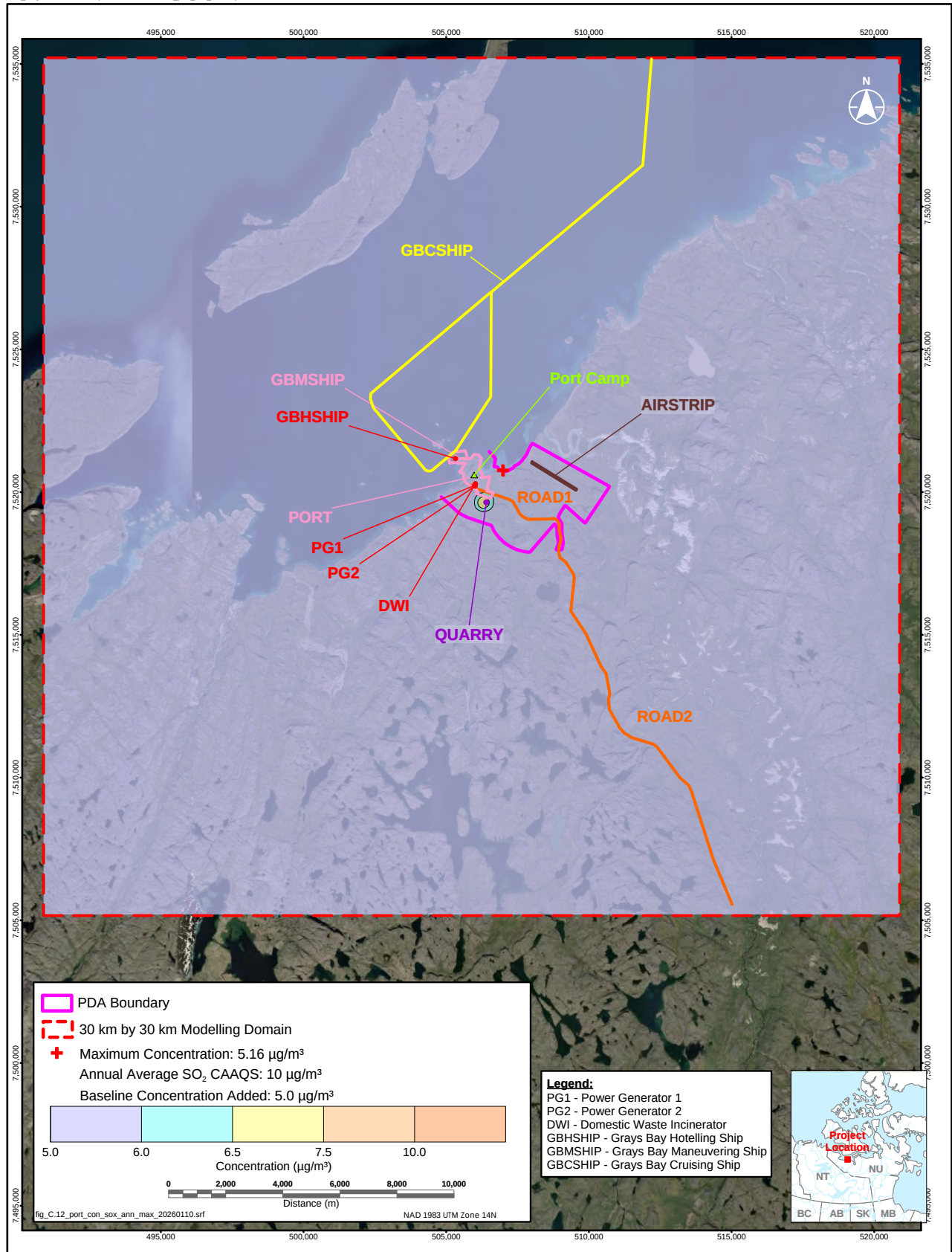
Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.



Grays Bay Road and Port Project

Predicted 99th Percentile Daily Maximum 1-hour Average SO₂ Concentrations (Project Construction)

Figure C.11

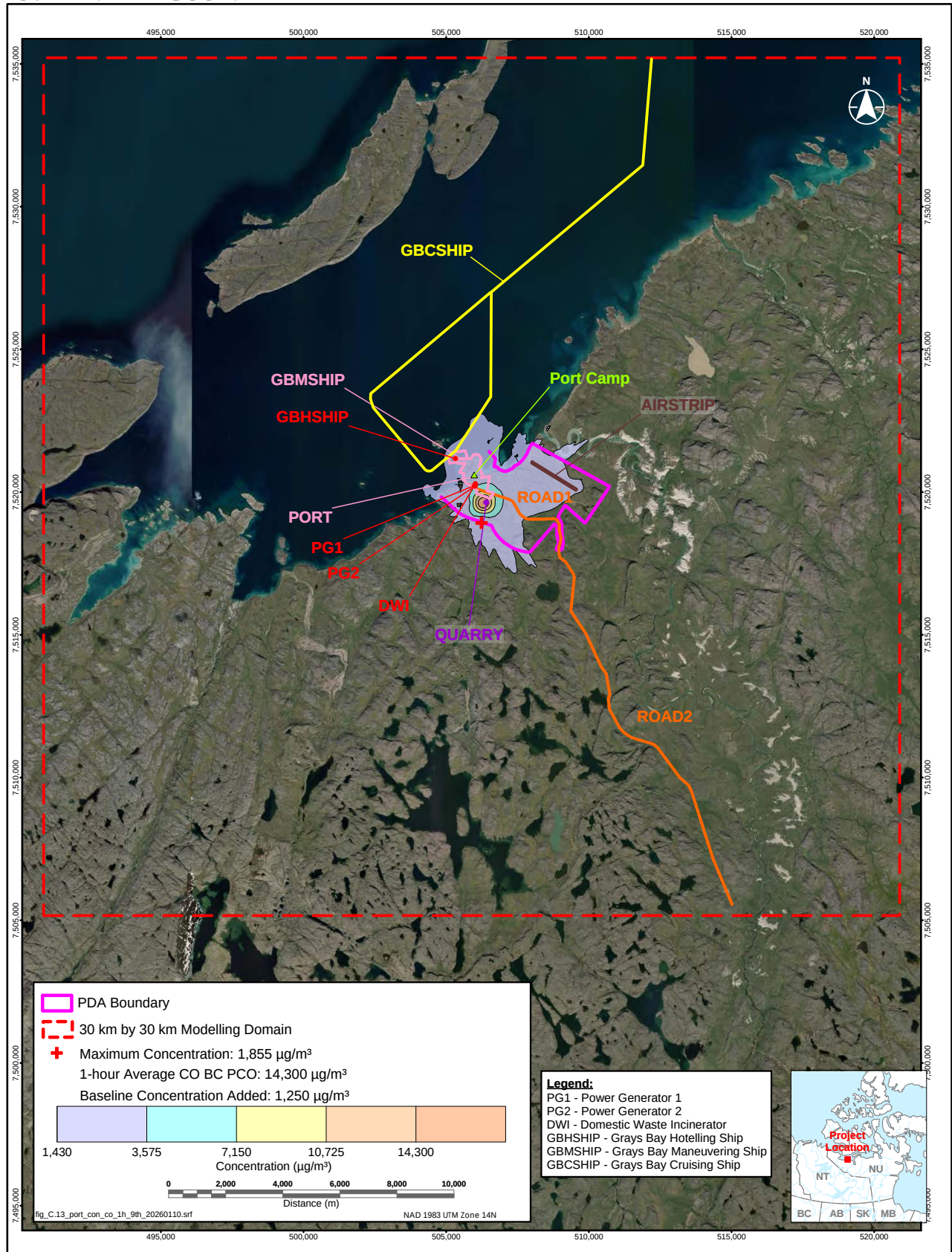


Sources: ESRI World Imagery

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

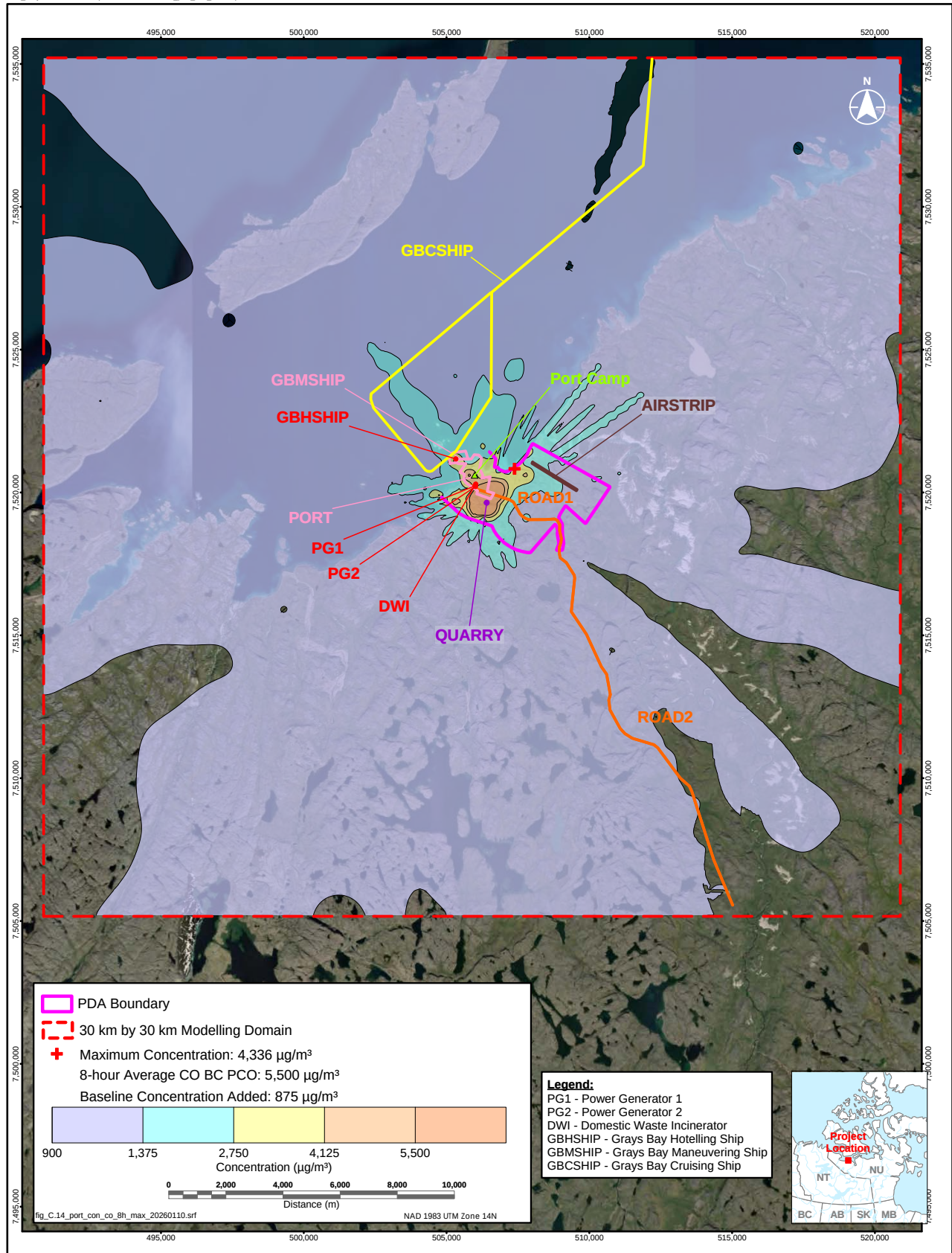


**Predicted Maximum Annual Average SO₂ Concentrations
(Project Construction)**



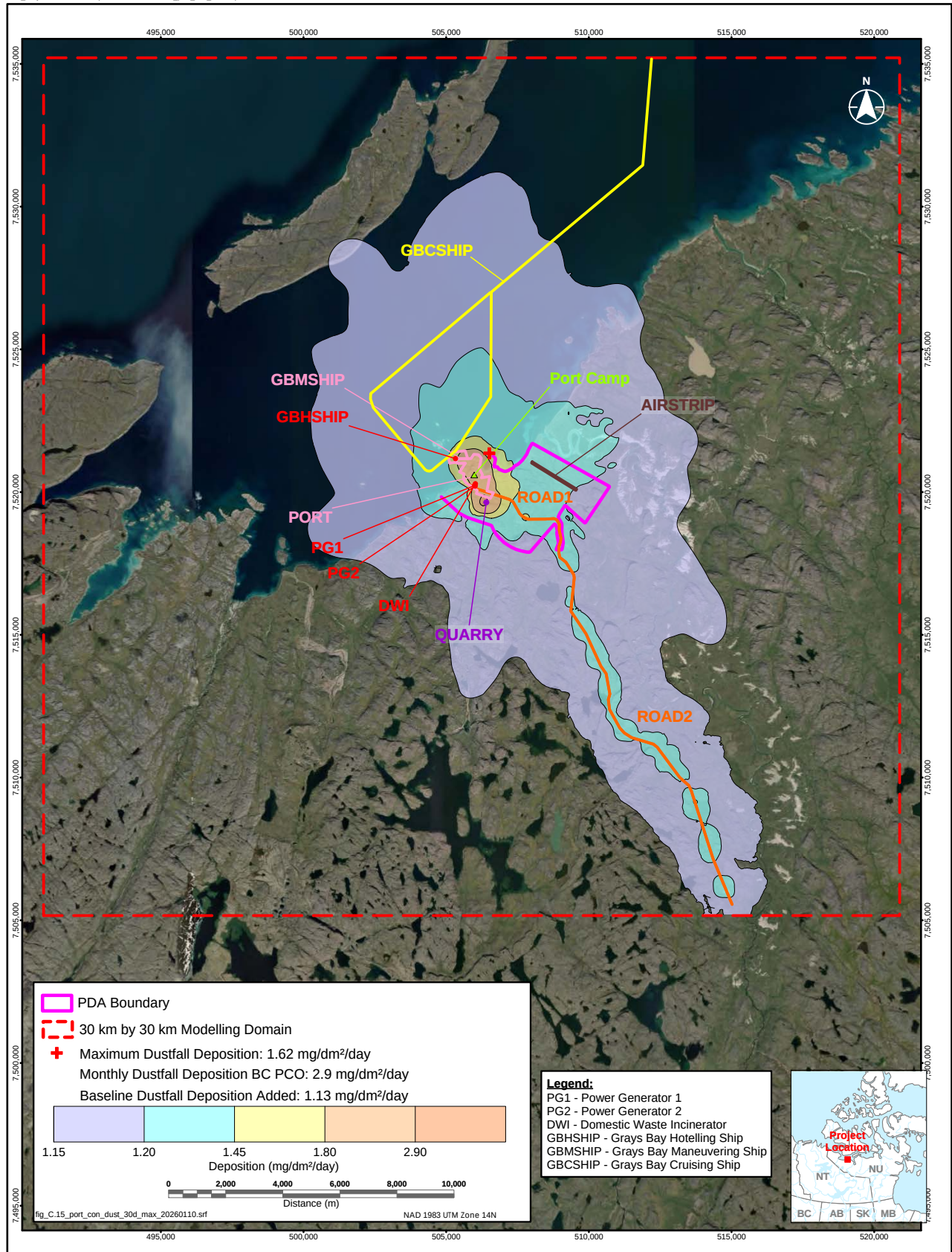
Sources: ESRI World Imagery

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.



Sources: ESRI World Imagery

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.



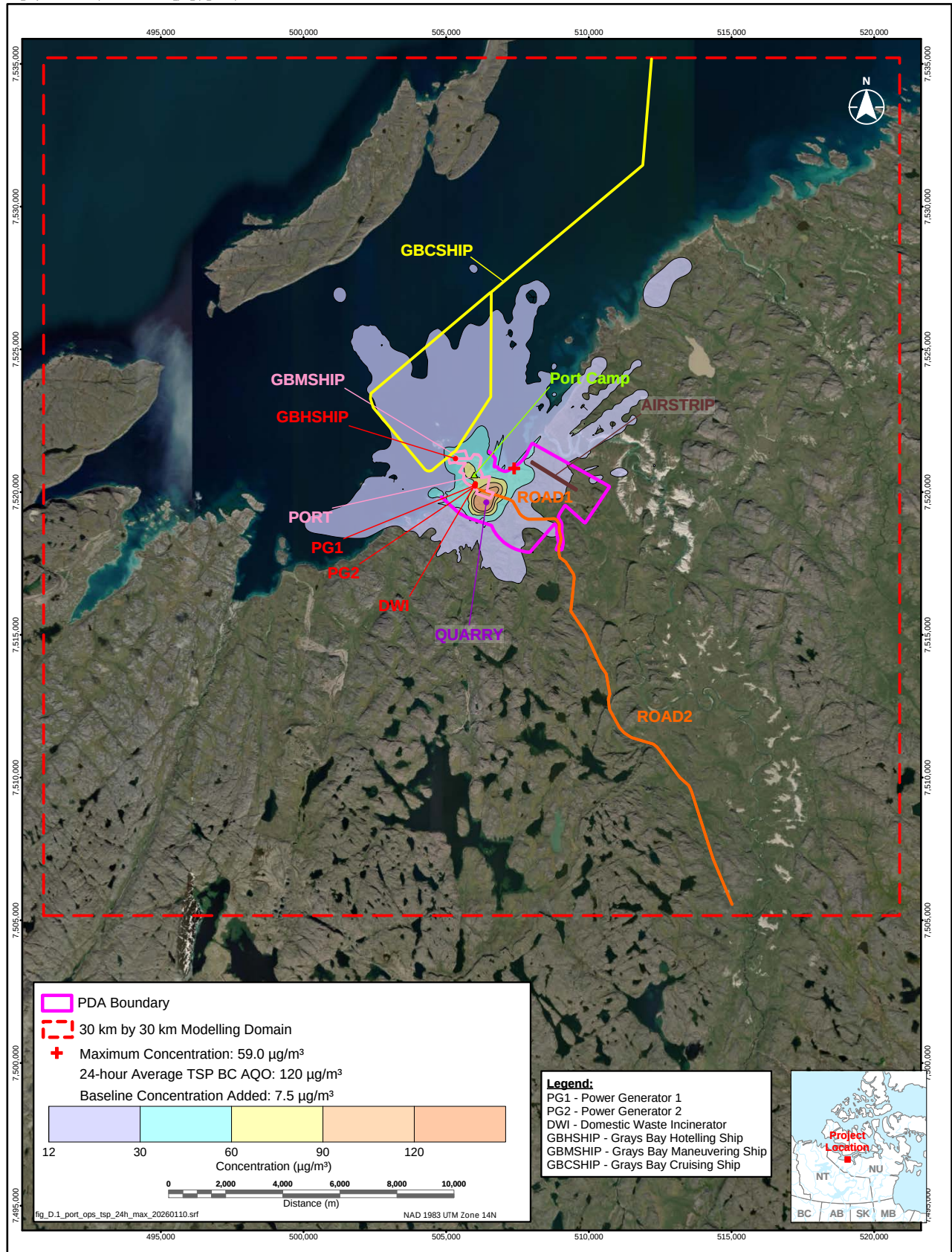
Sources: ESRI World Imagery

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.



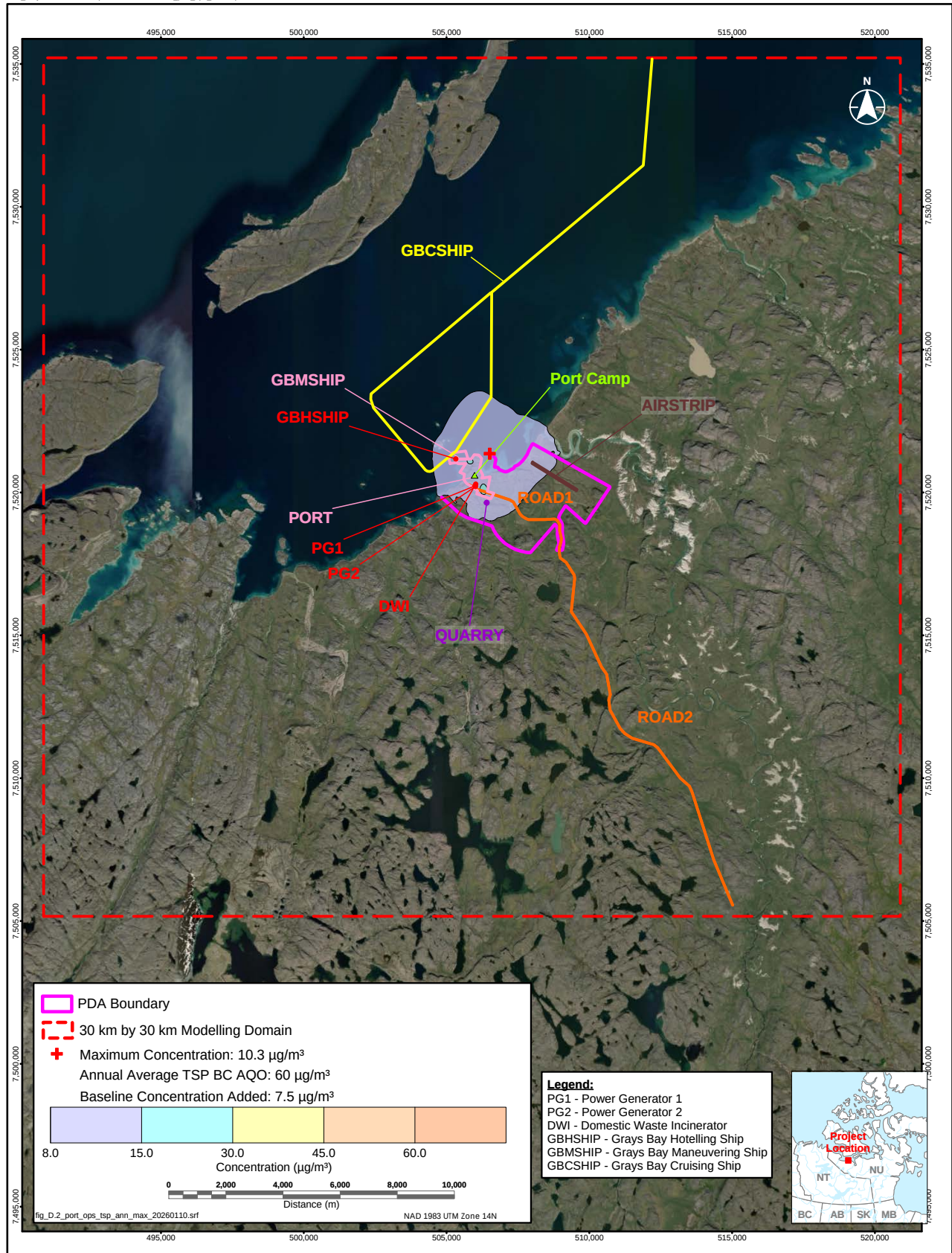
**Predicted Maximum Monthly Average Dustfall Deposition
(Project Construction)**

Appendix D Concentration Contour Plots for Operations and Maintenance



Sources: ESRI World Imagery

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.



Sources: ESRI World Imagery

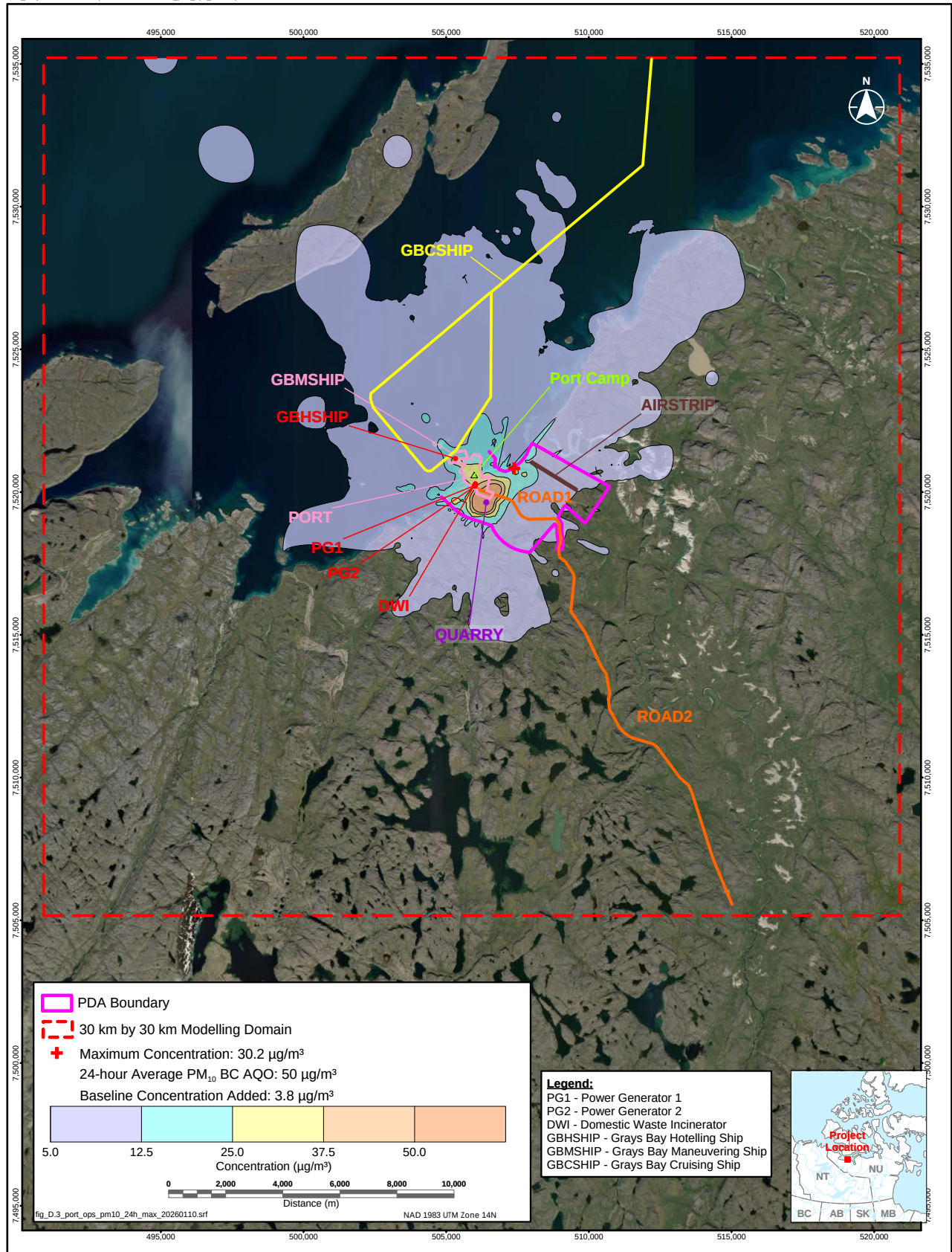
Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.



Grays Bay Road and Port Project

Predicted Maximum Annual Average TSP Concentrations (Project Operations and Maintenance)

Figure D.2



Sources: ESRI World Imagery

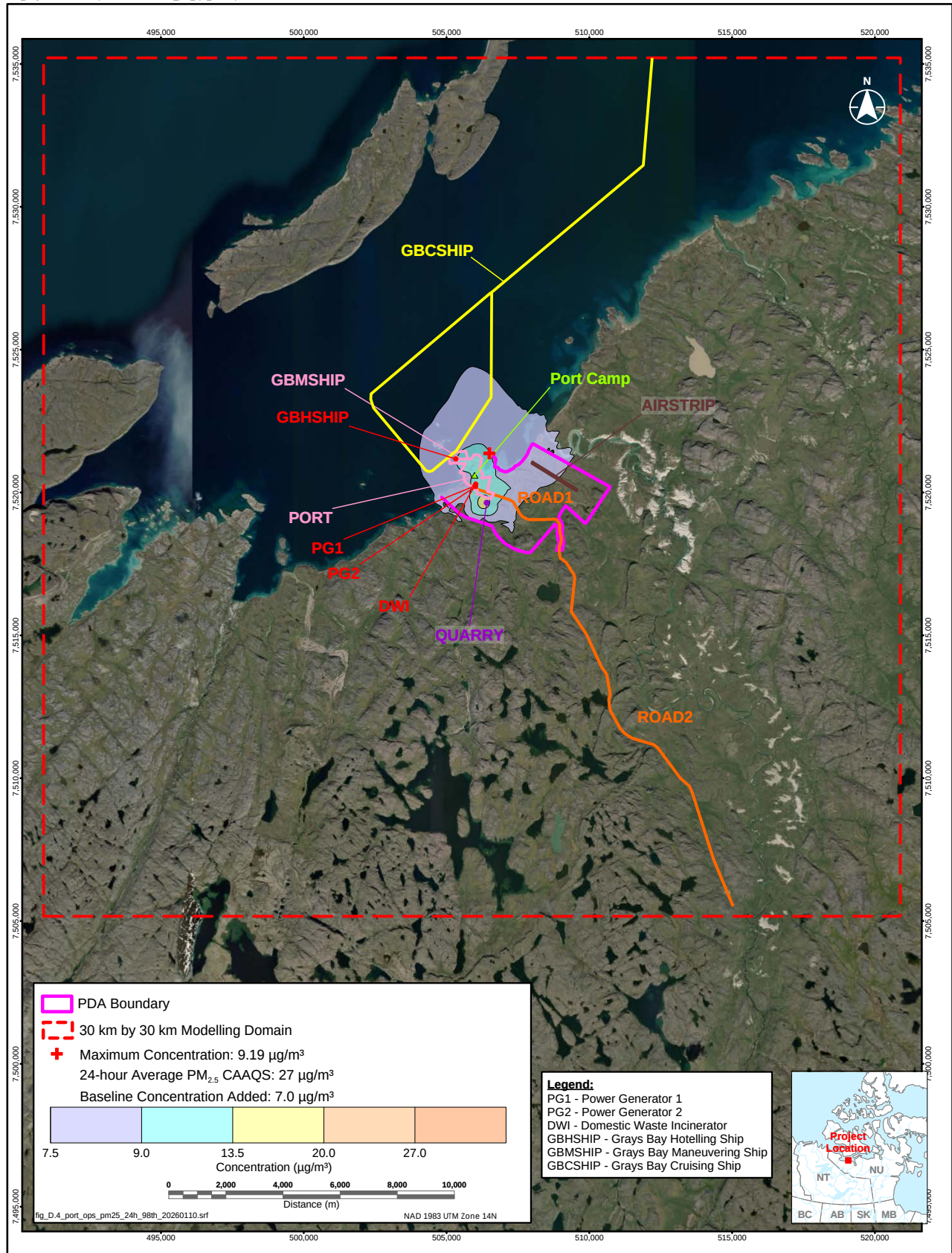
Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.



Grays Bay Road and Port Project

Predicted Maximum 24-hour Average PM_{10} Concentrations (Project Operations and Maintenance)

Figure D.3



Sources: ESRI World Imagery

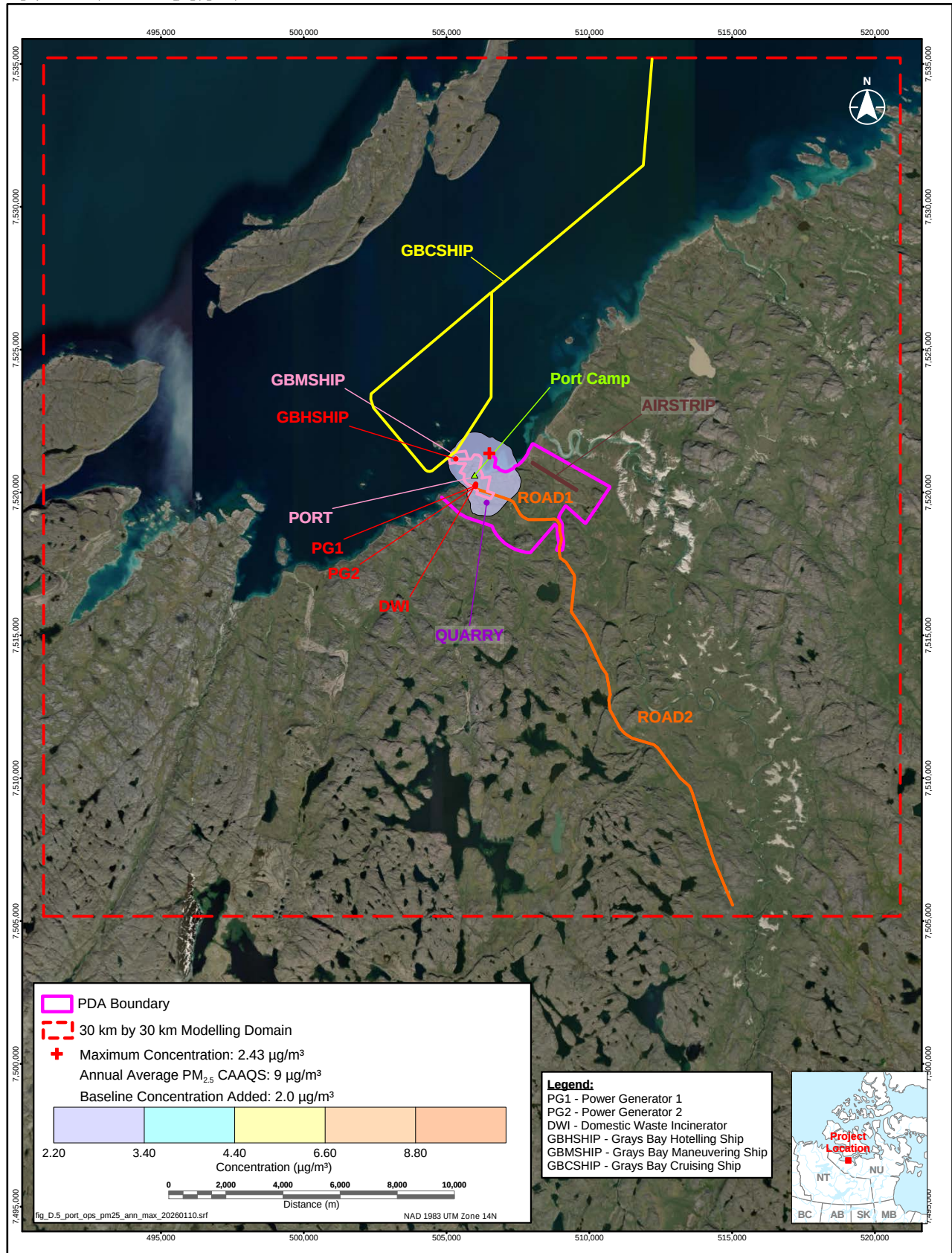
Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.



Grays Bay Road and Port Project

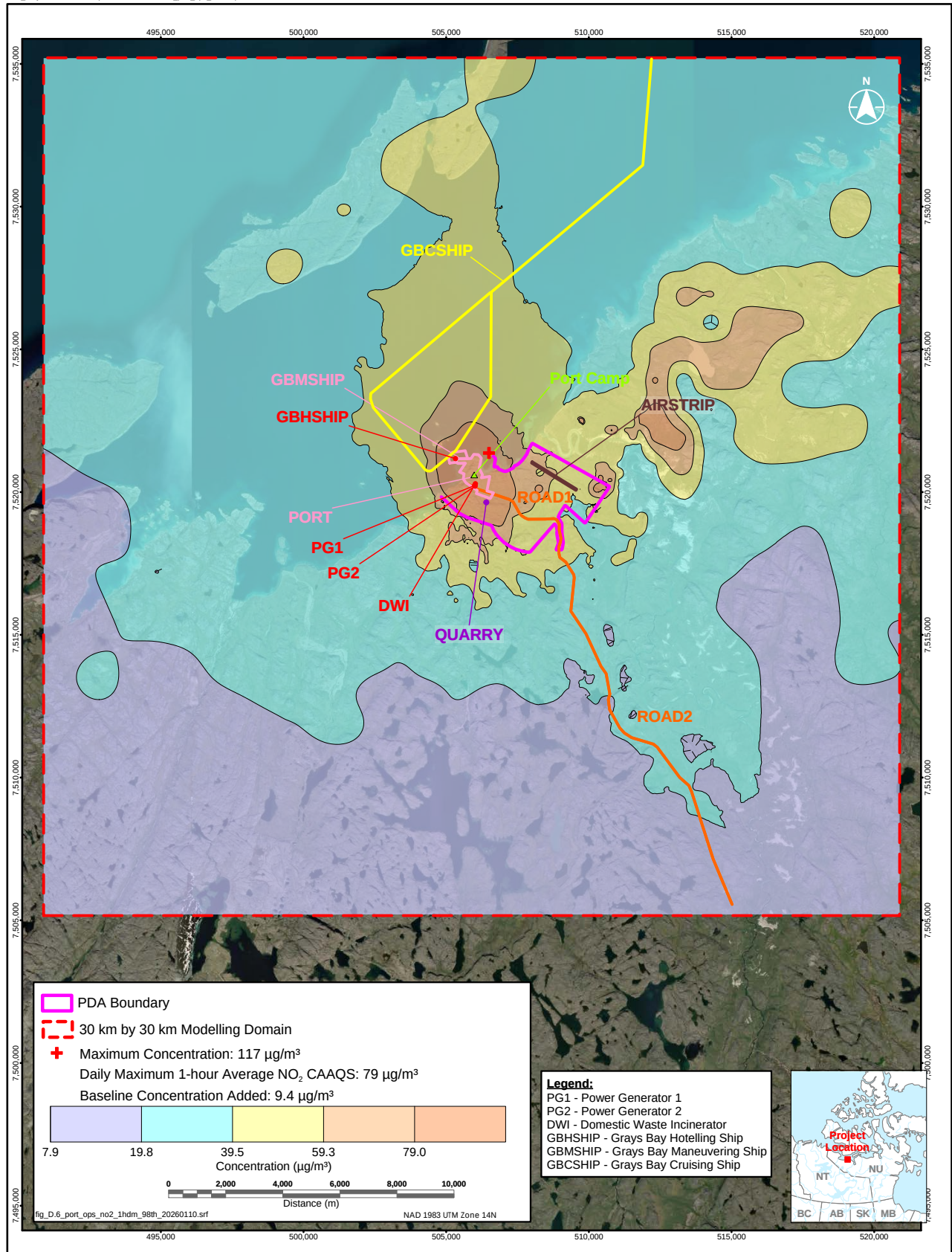
Predicted 98th Percentile 24-hour Average $\text{PM}_{2.5}$ Concentrations (Project Operations and Maintenance)

Figure D.4



Sources: ESRI World Imagery

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

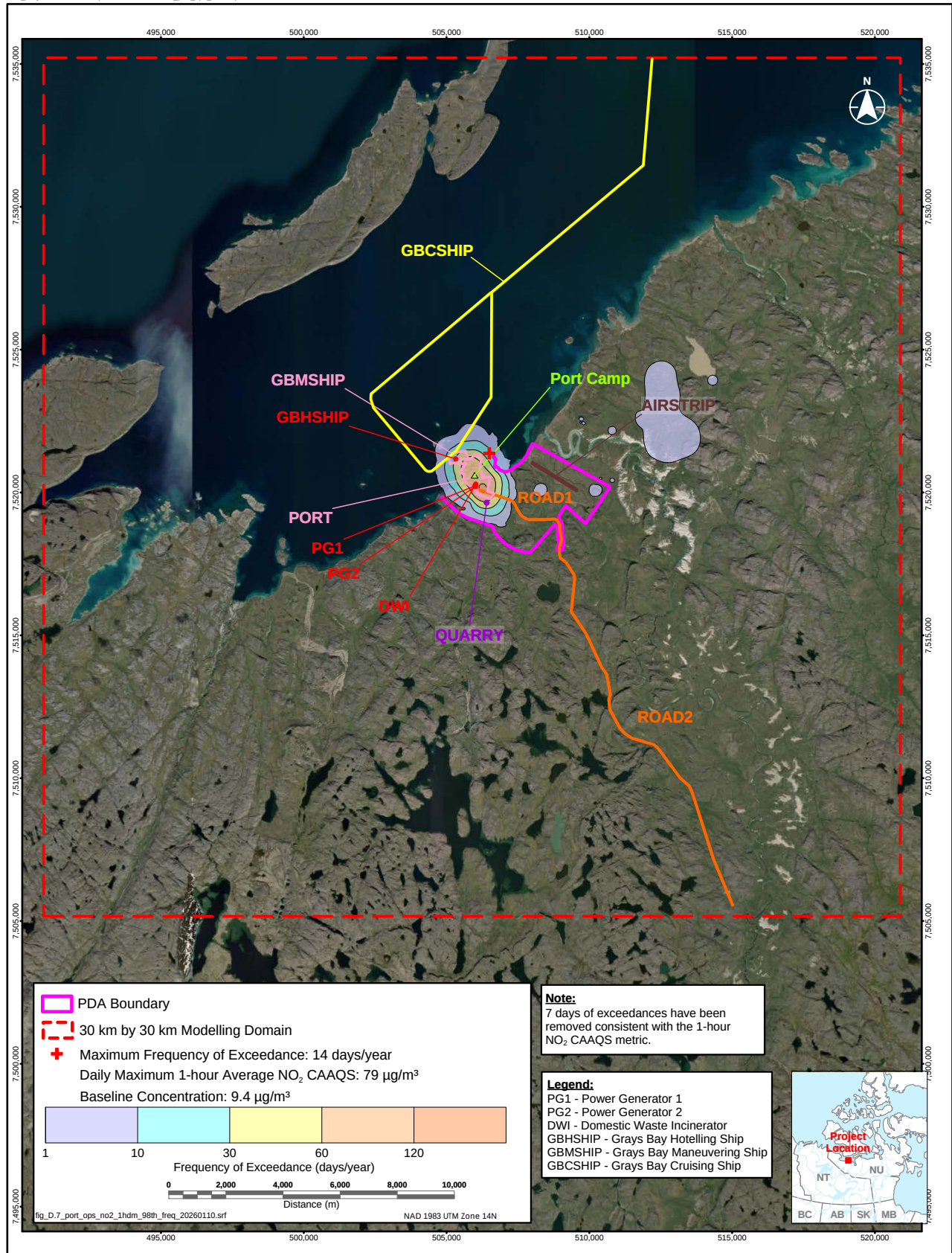


Sources: ESRI World Imagery

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.



Predicted 98th Percentile Daily Maximum 1-hour Average NO_2 Concentrations (Project Operations and Maintenance)



Sources: ESRI World Imagery

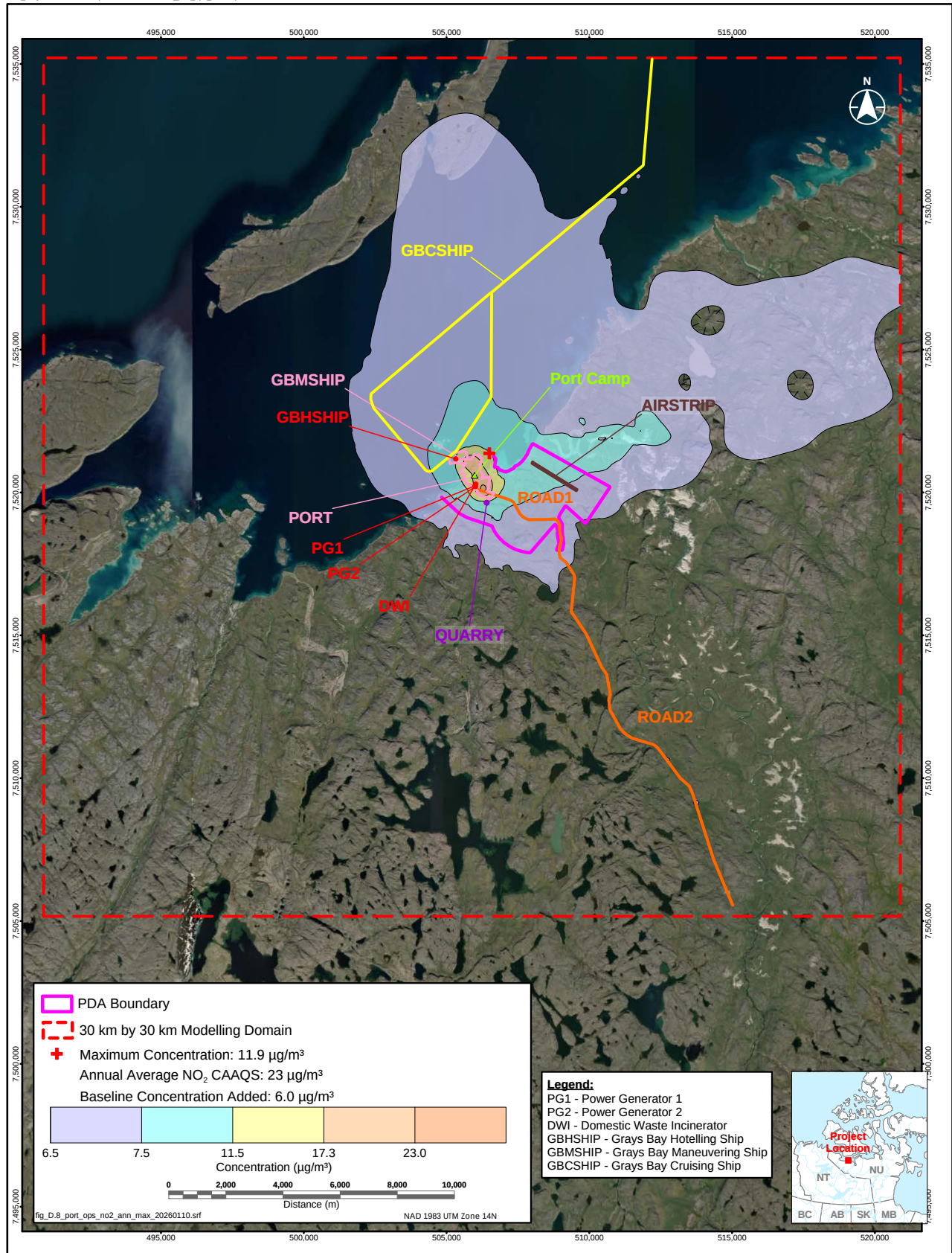
Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Predicted Maximum Frequency of Exceedance of the 1-hour Average NO₂ CAAQS (Project Operations and Maintenance)



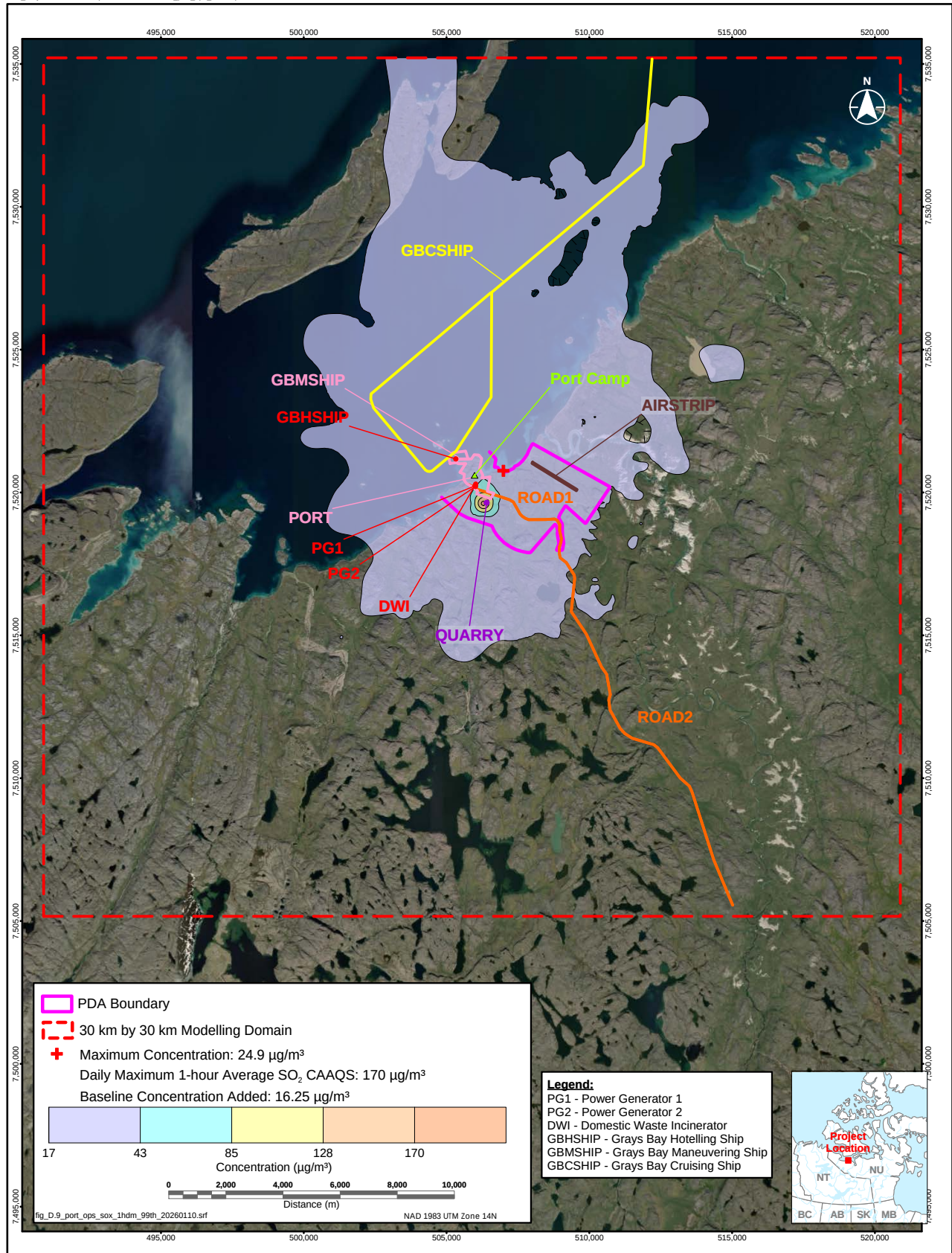
Grays Bay Road and Port Project

Figure D.7



Sources: ESRI World Imagery

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

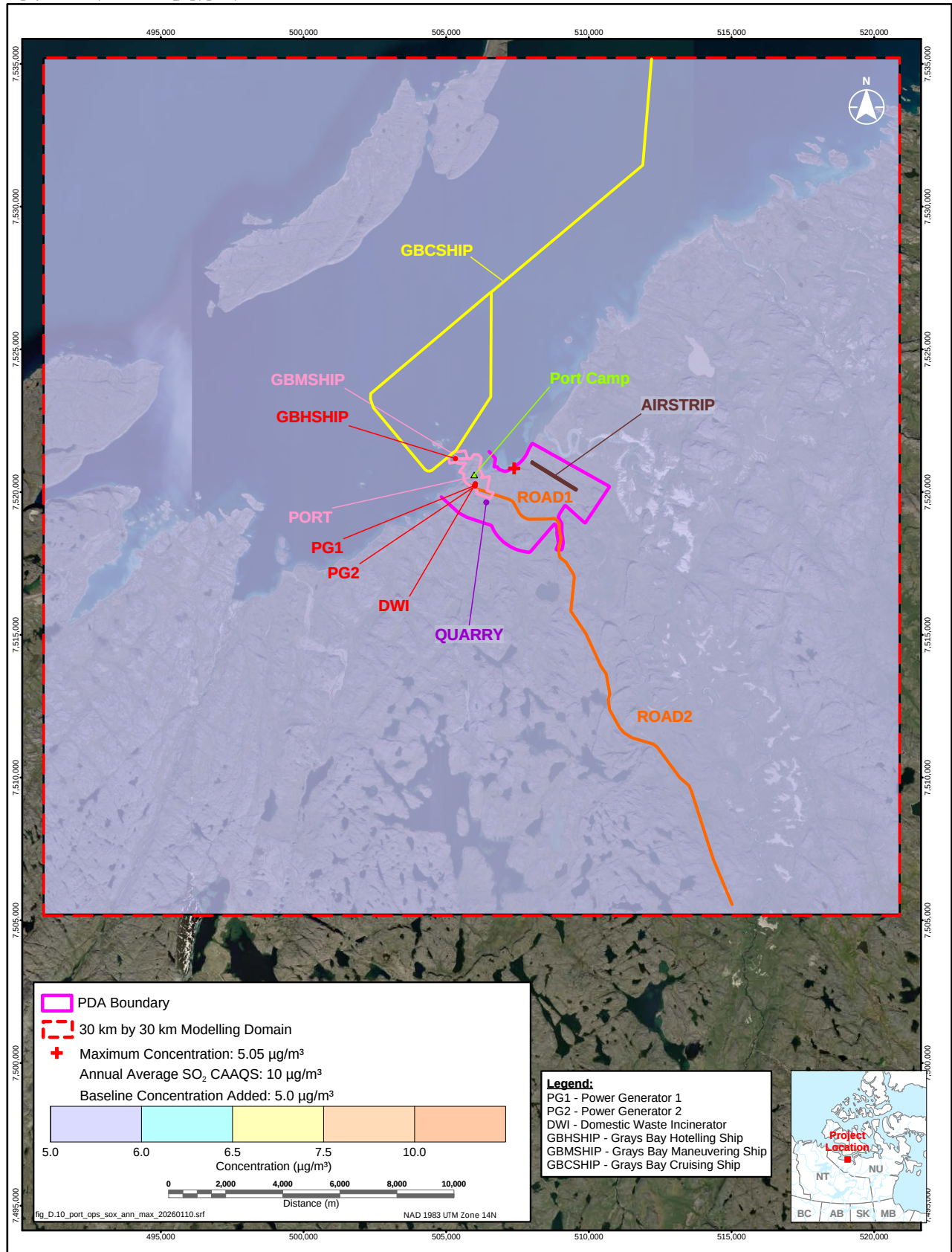


Sources: ESRI World Imagery

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

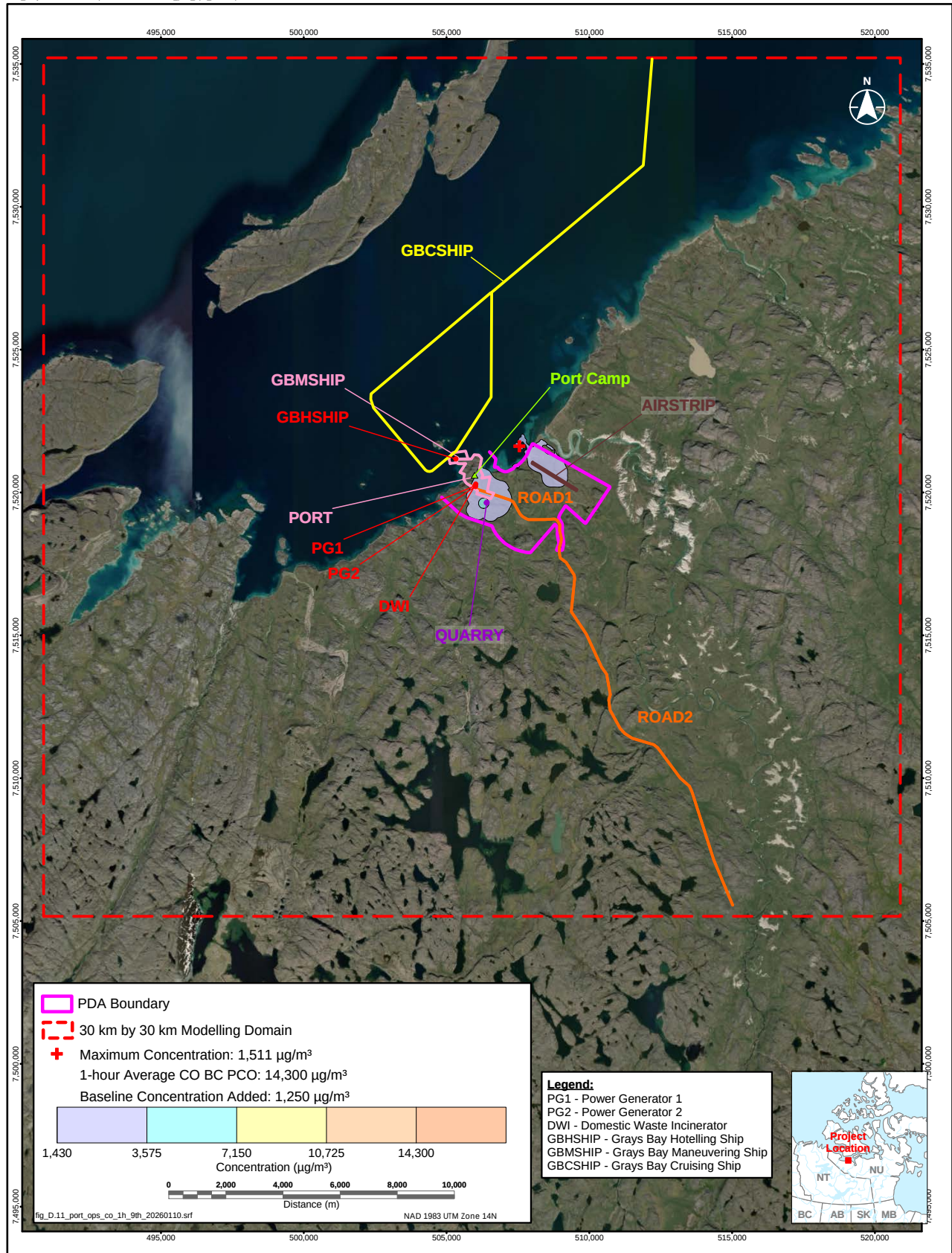


Predicted 99th Percentile Daily Maximum 1-hour Average SO_2 Concentrations (Project Operations and Maintenance)



Sources: ESRI World Imagery

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

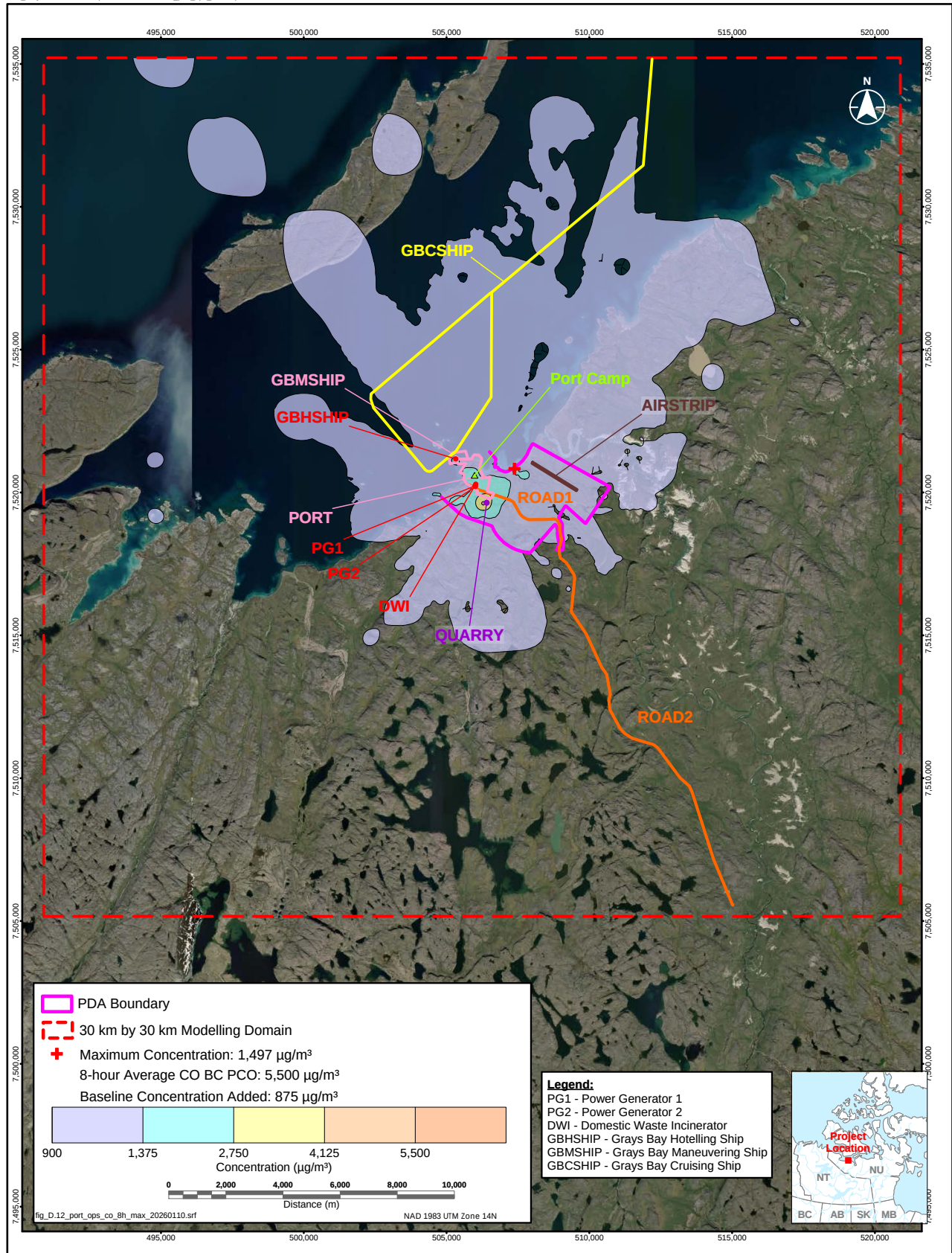


Sources: ESRI World Imagery

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

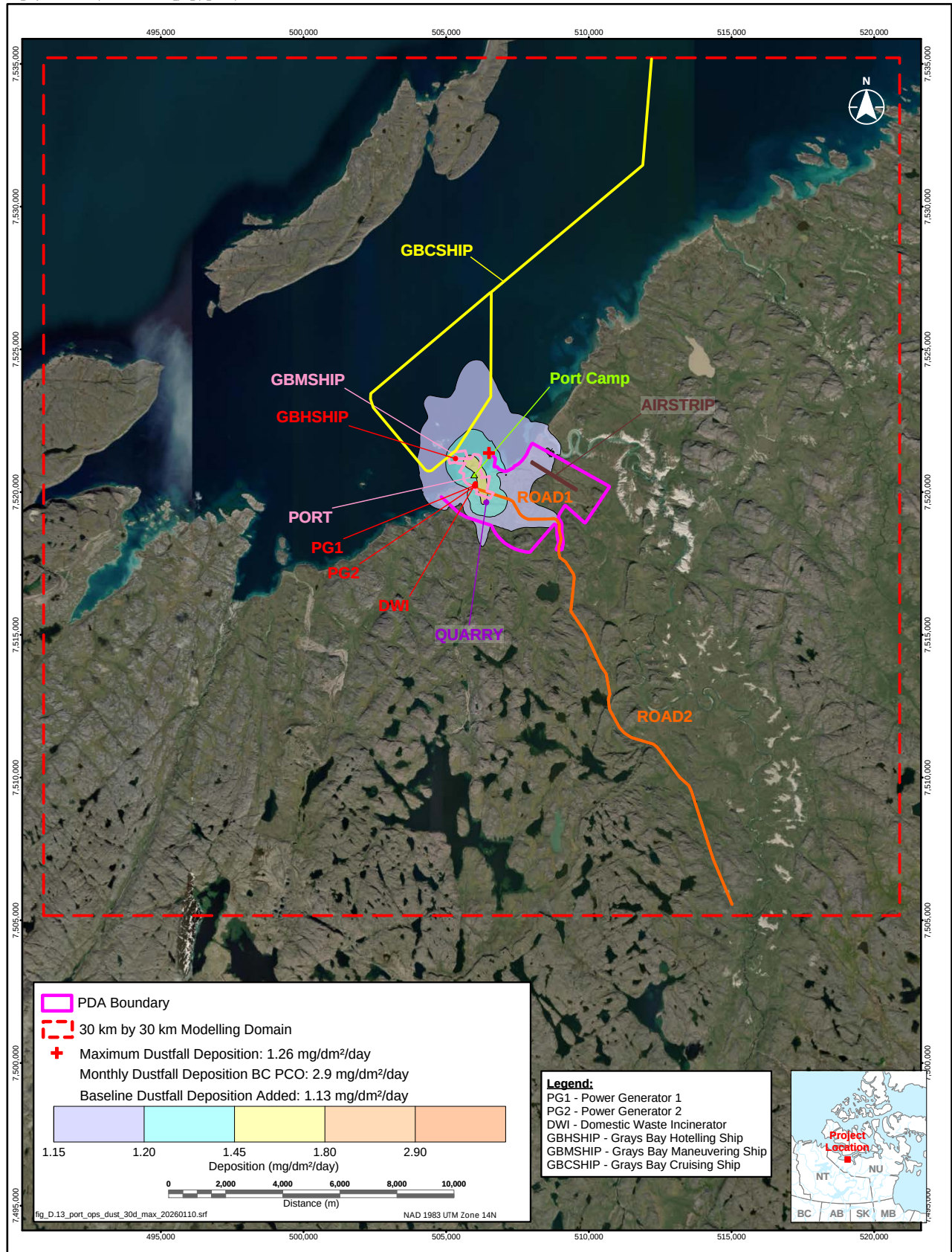


**Predicted 9th Highest 1-hour Average CO Concentrations
(Project Operations and Maintenance)**



Sources: ESRI World Imagery

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.



Sources: ESRI World Imagery

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.