



Cedar LNG Project: Application for an Amendment to the Provincial Environmental Assessment Certificate and Federal Decision Statement

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Revision: 0

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Executive Summary

Cedar LNG Partners LP, by its general partner Cedar LNG Partners (GP) Ltd. (Cedar), is constructing a liquefied natural gas (LNG) export facility within the District of Kitimat, British Columbia (BC) (the Project). The Project represents Canada's first and largest Indigenous majority-led LNG facility. The Project is located in Haisla Nation traditional territory, and was conceived, stewarded and supported by Haisla Nation for more than a decade. The Project will deliver a substantive and long-term revenue source for Haisla Nation, surrounding Indigenous nations, and the provincial and national economies. It will have one of the lowest carbon footprints of any LNG facility when it begins operations in late 2028. Indigenous values of sustainability and environmental protection have been fundamental in how the Project has been designed and it stands as a model for Indigenous economic reconciliation – values that continue to guide project development, including the proposed enhancements included in this amendment.

The Project underwent an environmental assessment from 2019 to 2023 and in March 2023 received an environmental assessment certificate (EAC) under BC's *Environmental Assessment Act* (EAC #23-01) and a positive Decision Statement under Canada's *Impact Assessment Act* (reference number 80208).

Project construction is underway, including construction of the marine terminal and transmission line. Additionally, detailed engineering and fabrication of the floating LNG (FLNG) facility is advancing in Oslo and South Korea respectively.

Through continued advancement of project planning, in particular as a result of the detailed engineering and design, Cedar has identified two potential enhancements to the FLNG that are the basis of this amendment request:

- **Worker accommodation:** Advancement of the development of the FLNG facility, including expert advice regarding the classification and regulation of FLNGs, has led to the determination that housing workers aboard the FLNG is optimal from a health, safety, and operability perspective. Originally, Cedar anticipated housing the majority of its workers within the local community. Cedar is now proposing to house up to 80 workers on the FLNG to maximize safety and efficient operations in accordance with international and national safety conventions. This proposed change does not affect the total number of workers that were approved as part of EAC #E23-01.
- **Increased liquefaction capacity:** Advancement of engineering design has identified the opportunity to increase the Project liquefaction capacity from 400 to 500 million standard cubic feet per day of natural gas. The increased capacity would be possible due to operational efficiencies, and will not alter the approved works, nor will it change the number of LNG carriers visiting the Project each year beyond the previously approved 50 carriers per year. Greenhouse gas (GHG) emissions will be consistent with those already approved. The increase in capacity is anticipated to result in an increase in revenues to Haisla Nation, the Province of British Columbia, and the Government of Canada.

Cedar conducted extensive analysis, as well as engagement with Indigenous nations, in assessing the proposed enhancements, including potential additional effects and areas of concern related to the operational enhancements. While the analysis identified potential interactions with five valued components that have potential to introduce new effects, Cedar's detailed assessment determined that the proposed changes would not alter the findings or conclusions of the Environmental Assessment Office's Assessment Report for the Project. As such, the mitigation measures already recommended by both the original EAC Application and Assessment Report remain appropriate for the amended project.



Additionally, Cedar undertook assessments for its partner, Haisla Nation. Based on the findings for relevant valued components and feedback received from Haisla Nation, Cedar has concluded the proposed changes do not alter the characterization of residual effects on Haisla Nation interests as described in the conclusions of the Assessment Report. Furthermore, the operational amendments will result in benefits to Haisla Nation, specifically improve safety for their members who will be employed aboard the FLNG, as well as increased revenues.

Key findings presented in this amendment application are as follows:

- Air Emissions – Increased LNG production will result in an incremental increase in emissions (NO_x, SO₂, PM_{2.5}, and CO emissions); however, the characterization of magnitude and extent of effects from emissions remain consistent with the EAC Application and the Assessment Report with improved confidence in modelling due to updated methods and advanced engineering.
- Noise – No material increase in noise emissions is anticipated. Residual acoustic effects remain unchanged and characterization of effects is consistent with the Assessment Report. The new accommodation block was added as a receptor and predicted sound levels comply with applicable guidelines.
- Human Health – Cedar investigated potential health effects for nearby residents and off-duty FLNG workers because of their proximity to the emissions sources. Analysis of off-duty worker exposure to noise and industrial emissions onboard the FLNG indicates minimal health risks, with emissions contributing only a small fraction of regional totals. There are no material changes to assessed health effects for residents. Noise-related impacts are below guideline thresholds. Characterization of residual health effects remains consistent with the Assessment Report and confidence in predictions has increased due to improved air and noise modelling inputs and methods.
- Freshwater fish and fish habitat – Residual effects to freshwater fish and fish habitat remain unchanged and consistent with the Assessment Report. Updated modelling shows no exceedances of critical load of acidity in lake and stream sites in connection with the anticipated incremental increases in emissions and is consistent with previous conclusions.
- Vegetation – Residual effects to vegetation remain unchanged and consistent with the Assessment Report. Updated modelling of the incremental increase in air emissions due to expanded liquefaction capacity confirms the Project remains a minor contributor to SO₂, acid, and sulphur deposition.
- There are no new projects proposed in the region and cumulative effects for all VCs are predicted to be consistent with the characterizations presented in the Assessment Report.

The objective of this amendment is to enable Cedar to proceed with Project enhancements that maximize economic and social benefits and provide the flexibility to efficiently execute the Project once designs are finalized, while continuing to responsibly manage potential adverse environmental and socioeconomic effects.

With the submission of this amendment application, Cedar is requesting the Certified Project Description in Schedule A of EAC #E23-01 and the Description of the Designated Project in Schedule 1 of the *Impact Assessment Act* Decision Statement be amended to reflect the proposed changes to the Project.



Cedar is committed to continuing to engage with Indigenous nations throughout the review of this amendment application and subsequent permitting. Cedar will respond to questions as they arise and consider inputs received during engagement activities as part of Project construction and operation.

Table ES.1 lists the requirements included in the Amendments to Environmental Assessment Certificates and Exemption Orders – Guidance for Holders (EAO 2024) and where they are addressed in the Amendment.

TABLE ES.1 CONCORDANCE WITH THE AMENDMENT APPLICATION REQUIREMENTS

Item No.	Amendment Application Requirement	Amendment Application Section
1	EAC number, Exemption Order number (if applicable), project name and current name of EAC or Exemption Order Holder.	Section 1.0 Introduction
2	Number of prior amendments and a short summary of each one.	Section 1.0 Introduction
3	A short, descriptive name for the proposed amendment (amendments will not be given a number until made).	Title page
4	The reason for the proposed amendment.	Section 2.0 Proposed Changes and Rationale
5	A short description of the substance of the proposed EAC or Exemption Order changes (not proposed EAC or exemption order wording changes). That is, what the Holder is proposing to have amended and the rationale for it, including specifics of which sentence or condition is proposed for change, if applicable.	Section 2.0 Proposed Changes and Rationale
6	If the EAC or Exemption Order was issued under a former Act, a request for conditions for the transfer of “project”, an “interest in a project”, or “a significant interest in a project” to be removed.	N/A
7	A description of potential project amendment interactions with any identified Indigenous interests.	Section 8.0 Indigenous Interests
8	The effect of the revised project on relevant VCs and Indigenous interests assessed in the project’s Environmental Assessment (EA) or exemption application and proposed mitigation measures.	Section 6.0 Valued Components Assessment Section 8.0 Indigenous Interests
9	A description of any Indigenous knowledge that was used in developing the application and confirmation that appropriate permissions are in place.	Section 8.0 Indigenous Interests
10	A table showing the VCs that have potential to be affected by the proposed amendment and required assessment materials (Section 25 of the Act). The table should include a rationale if the Holder asserts that any required assessment material is not relevant. For more information see the effects assessment policy on the EAO website.	Section 7.0 Interactions with Section 25 Assessment Matters
11	Any benefits or positive effects that would result from the revised project.	Section 2.0 Proposed Changes and Rationale
12	Any studies or assessments that would be relevant to the revised project that were submitted during the EA or exemption process.	Section 6.3.2 Existing Conditions



Item No.	Amendment Application Requirement	Amendment Application Section
13	Details of Indigenous nation, stakeholder, public and agency engagement respecting the proposed amendment. That is, with whom did the Holder engage, what did it hear, what responses were provided, and how does the Holder propose to address any issues raised?	Section 4.0 Summary of Engagement
14	Government approvals that are related to the requested amendment including any permits or licences that are expected to also need amendment.	Section 3.0 Applicable Licences, Permits and Approvals
15	Proposed timeline for supplementary submissions in support of the application, and the parties, such as Indigenous nations, that may be engaged in this work.	N/A
16	For a potential simple amendment: rationale why the change is minimal, why there is no possibility of a significant adverse effect, why public interest is unlikely to be affected and why there is limited need for Indigenous or public engagement.	N/A

List of Abbreviations

AQG	air quality guidelines
AQOs	air quality objectives
ANSI	American National Standards Institute
Assessment Report	EAO Assessment Report (EAO 2022)
BC	British Columbia
BCER	British Columbia Energy Regulator
BMP	best management practices
Cedar	Cedar LNG Partners (GP) Ltd.
CL _(A)	critical load of acidity
CO	carbon monoxide
CPD	Certified Project Description
dB	decibel
dBA	A-weighted decibel
DNV	Det Norske Veritas
EAC	Environmental Assessment Certificate
EAO	Environmental Assessment Office
EAC Application	Application for an Environmental Assessment Certificate
ENVP	Ministry of Environment and Parks
FLNG	floating liquefied natural gas
FSR	Forest Service Road
GHG	greenhouse gas
ha	hectare
IAAC	Impact Assessment Agency of Canada

IMO	International Maritime Organization
ISO	International Organization for Standardization
km	kilometre
kV	kilovolt
LAA	local assessment area
LNG	liquefied natural gas
m	metre
m ²	square metre
m ³	cubic metre
N	nitrogen
NO _x	nitrogen oxides
NO ₂	nitrogen dioxide
Pembina	Pembina Pipeline Corporation
PM _{2.5}	fine particulate
RAA	regional assessment area
S	sulphur
SO ₂	sulphur dioxide
TAC	Technical Advisory Committee
TDR	Technical Data Report
TSS	total suspended solids
VC	Valued Component
WHO	World Health Organization
%HA	percentage of people expected to be highly annoyed



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1.0 Introduction

Cedar LNG Partners LP, by its general partner Cedar LNG Partners (GP) Ltd. (Cedar), a Haisla Nation-led partnership with Pembina Pipeline Corporation (Pembina), is constructing a liquefied natural gas (LNG) export facility within the District of Kitimat, British Columbia (BC) (the Cedar LNG Project or the Project). The Project underwent an environmental assessment from 2019 to 2023 and in March 2023 received an environmental assessment certificate (EAC) under BC's *Environmental Assessment Act* (EAC #23-01) and a positive Decision Statement under Canada's *Impact Assessment Act* (reference number 80208).

Since the conclusion of the federal and provincial environmental assessment processes, Cedar has advanced the Project's engineering design, refined the capital costs, made a positive final investment decision in June 2024, and started construction in July 2024. Following submission of an amendment application in November 2024, the Environmental Assessment Office (EAO) issued an Order to amend EAC #E23-01 on April 9, 2025, and the Impact Assessment Agency of Canada (IAAC) amended the Decision Statement on May 30, 2025 to allow the following changes to the Project (jointly called Amendment #1), as shown on Figure 1.1:

- the option to relocate the 8.5-kilometre (km) long, 287 kilovolt (kV) Transmission Line Corridor
- a new 2.8 km long, 25 kV distribution power line
- expanding the Marine Terminal Area to encompass the mooring lines and anchors for the floating liquefied natural gas (FLNG) facility's catenary mooring system.

In addition, Cedar identified the opportunity to reuse previously cleared work areas along the Bish Creek Forest Service Road (FSR) for disposal of soil and organic material (e.g., mulch). IAAC amended the Decision Statement to permit this activity on July 21, 2025. Evaluation of Cedar's use of these workspaces by the EAO and BC Energy Regulator (BCER) is underway.

Through the continued advancement of project planning, in particular detailed engineering design of the FLNG facility, Cedar has identified two potential enhancements to the Project that will result in safety and economic reconciliation benefits:

- **On-site worker accommodation:** Advancement of Cedar's FLNG facility planning, which included expert advice regarding the classification and regulation of FLNGs, led to a conclusion that housing workers aboard the FLNG is optimal from a health, safety, and operability perspective. Originally, Cedar had anticipated housing most non-resident workers within the local community. Cedar is now proposing to house up to 80 workers on the FLNG to maximize safety and efficient operations in accordance with international and national safety conventions. This proposed change does not affect the total number of workers that were approved as part of EAC #E23-01 and referenced in the EAO Assessment Report (Assessment Report; EAO 2022) or Cedar's objective of filling jobs with individuals who live in and around Kitimat.



- **Increased liquefaction capacity:** Advancement of engineering design has identified the opportunity to increase the Project liquefaction capacity from 400 to 500 million standard cubic feet per day of natural gas. This represents an increase in LNG production from approximately 3.0 million tonnes per annum to 3.75 million tonnes per annum. These changes would not increase a) size or footprint of the Project's components and infrastructure or b) the number of LNG carriers visiting the Project each year beyond the previously approved 50 carriers per year. Greenhouse gas (GHG) emissions will be in line with those already approved. The increase in liquefaction capacity is anticipated to result in an increase in profits and tax revenue to Haisla Nation, the Province of British Columbia and the Government of Canada.

Safety is a paramount value to Haisla Nation and its partner Pembina. As such, any opportunity to maximize the safety of operations and protect workers, communities and the environment is taken seriously. Housing the operational workforce aboard the FLNG will address safety in the following ways:

- Additional personnel aboard the FLNG allows for quick response to automatic shutdown of equipment or systems. In the event of an incident, on-board personnel can quickly identify the reasons for a partial or total shutdown and take appropriate actions in a safe and efficient manner.
- In the unlikely event of an environmental release, availability of onboard personnel will enable a faster response and prevent further escalation.
- Housing personnel on the FLNG facility reduces the need to transport workers between accommodations off site and the FLNG, thus reducing the risk of vehicle incidents, and interference with local traffic.

Housing workers aboard the FLNG is aligned with Cedar's commitment to fostering a stable, community-based workforce in Kitimat. Due to the nascent FLNG industry in Canada, access to those with the skills and expertise required for operations are limited. As such, the initial years of the Project may require a transitional labour approach, whereby Cedar employs workers with the international expertise required to train and mentor the local workforce to take over the jobs when the skills have been developed. This approach reflects Cedar's intention to build a workforce that is integrated into and contributes meaningfully to the Kitimat community, rather than relying on a transient labour model.

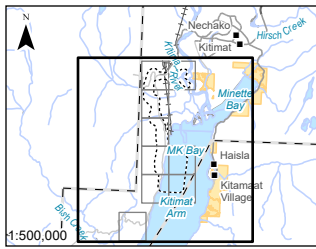
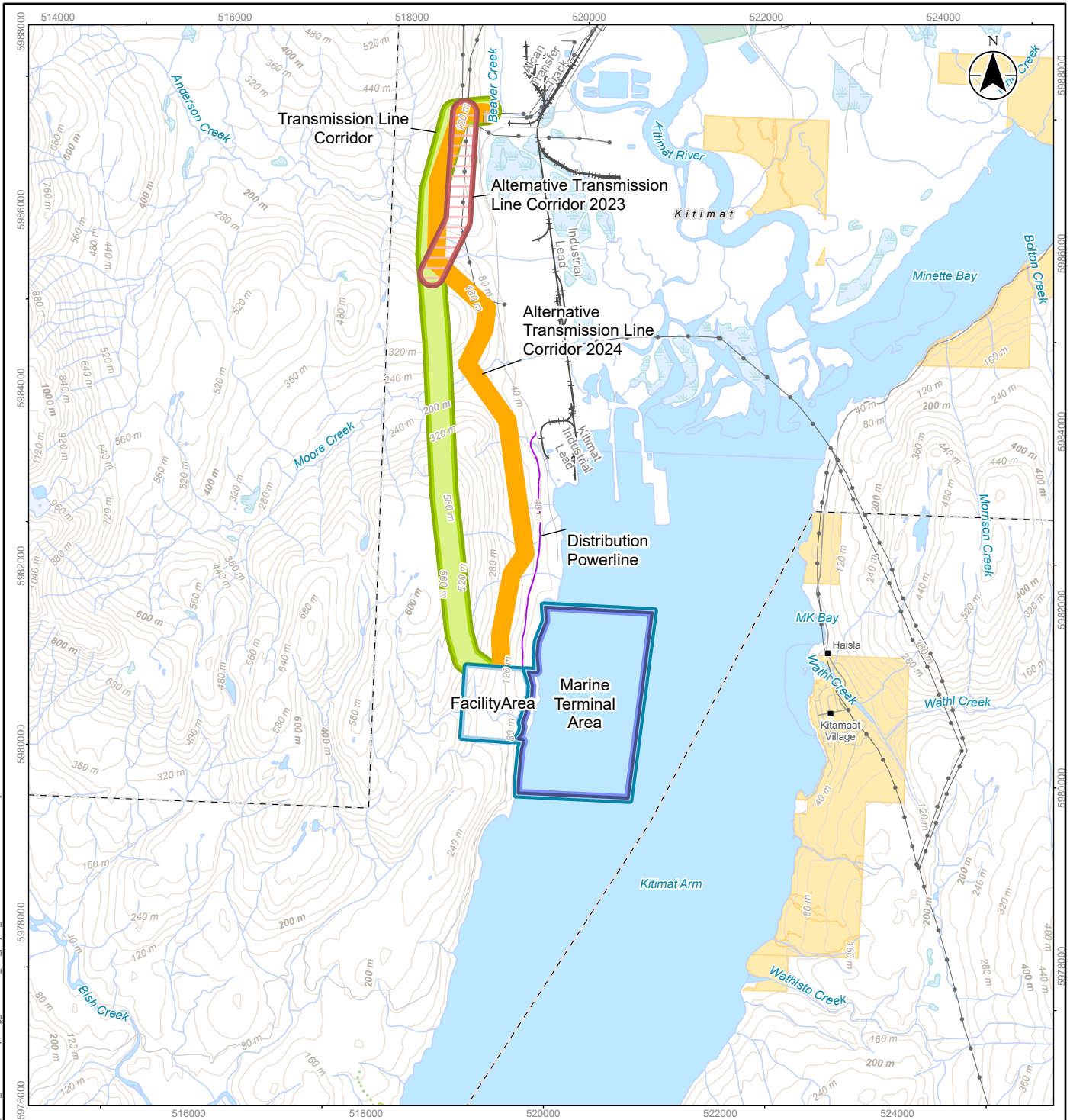
With respect to the proposed increase in liquefaction capacity, Haisla Nation are fulfilling their mandate and desire to sustainably advance economic reconciliation in their territory on their own terms, such that benefits can be realized for Haisla Nation, neighbouring First Nations, and the community as a whole. Given the current economic climate in Canada, this additional capacity helps secure Canada's position as a sustainable LNG exporter, given growing global demand.

In consideration of the benefits to the Project of these potential changes, Cedar is requesting amendments of the Certified Project Description (CPD) of EAC #E23-01 and the Description of the Designated Project in Schedule 1 of the *Impact Assessment Act* Decision Statement to reflect the changes described in this application.



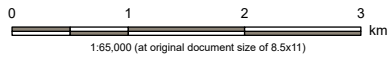
This application is the third request to amend EAC #E23-01 and *Impact Assessment Act* Decision Statement. It has been structured to address the requirements of both the provincial and federal environmental legislation and is consistent with the original scope of assessment as specified in the approved Application Information Requirements (EAO 2021). This amendment application includes:

- an overview of the proposed changes and the rationale for the requested amendment (Section 2.0)
- identification of applicable licences, permits, and approvals (Section 3.0)
- a summary of engagement with affected Indigenous nations, government agencies, and others (Section 4.0)
- an overview of the amendment process (Section 5.0)
- an assessment of potential changes to predicted effects on valued components (VCs) as a result of the proposed changes (Section 6.0)
- consideration of the other matters specified in section 25 of the *Environmental Assessment Act* (Section 7.0)
- an assessment of potential changes to effects on Indigenous interests (Section 8.0)
- an assessment of potential changes to effects within federal jurisdiction (Section 9.0).



- City, Town, Village, or District Municipality
- Transmission Line
- - - Municipal Boundary
- ⋯ Trail
- Road
- Local Street
- Resource Road
- Railway
- Watercourse
- Waterbody
- Permanent Snow and Ice
- Wetland
- Topographic Contour
- IR
- Local Greenspace
- Recreation Reserve/Site

- Transmission Line Corridor
- Alternative Transmission Line Corridor 2023
- Alternative Transmission Line Corridor 2024
- Distribution Powerline
- Marine Terminal Area
- Facility Area



Project Location: Kitimat, BC
 Project Number: 123222394
 Prepared by TCARDINAL on 20250723
 Requested by AAU on 20250723
 Checked by XXXX on 202507XX

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project
 Application to Amend EAC #23-01 and Decision Statement

Figure No. 1.1

Title: Project Overview

Notes
 1. Coordinate System: NAD 1983 BC Environment Albers
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada

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2.0 Proposed Changes and Rationale

The approved layout of the Project's components, including the FLNG, is shown in Figure 2.1. A discussion of the rationale for the proposed changes to the approved Project components is provided below.

2.1 Workforce Accommodation on the FLNG

An operational workforce of up to 100 full-time staff members was approved in EAC #E23-01 (EAO 2022). Neither EAC #23-01 nor the Decision Statement restrict the accommodation used by the operations-phase workforce.

Cedar has started preparing staffing plans and is working with Indigenous nations, in particular Haisla Nation, to develop and grow the skills required with the objective of increasing the number of local residents employed on the Project. However, non-resident workers will be required during the startup phase and the early operations period given the highly specialized nature of work and that these skills are not available in northwest BC.

Since the issuance of EAC #23-01 and the Decision Statement, Cedar has engaged international experts in FLNG design and operation and has undertaken work to verify the codes and standards applicable to the FLNG facility. Through this work, Cedar has concluded that providing accommodation for off-shift workers on the FLNG facility will enhance the capacity to respond quickly to potential incidents and improve overall safety outcomes. Accordingly, Cedar is proposing to add an accommodation block on the FLNG with capacity of up to 80 beds. The proposed change does not affect the total number of workers that were approved as part of EAC #E23-01 and the Decision Statement and provides sufficient capacity for on- and off-shift personnel aboard the FLNG.

Benefits of providing worker accommodation on the FLNG include:

- Having additional personnel onboard the FLNG facility helps Cedar to maintain compliance with the International Maritime Organization (IMO) minimum safe manning (i.e., the number of qualified and experienced crew needed to ensure safety and security of the vessel, crew and cargo) and maintain compliance with Classification and Flag State authority (i.e., compliance with international maritime laws and regulations).
- In the unlikely event of an environmental release, having onboard personnel available on the FLNG will enable a faster response and reduce the potential for further escalation.
- Housing personnel on the FLNG facility reduces the risk of vehicle accidents during personnel transport to and from camp and reduces traffic on roadways between Kitimat and the Facility Area.

The proposed accommodation block will include services typical for lodging facilities, including cafeteria, housekeeping, gym, games and TV room, laundry services, and medical facilities. Shift rotations for those staying on the FLNG will be 28 days on / 28 days off for international staff, and 14 days on / 14 days off for staff from within Canada. Staff will fly in and fly out of the Northwest Regional Airport in Terrace and Cedar will provide transportation to and from the FLNG. Depending on minimum safe manning and emergency response team requirements, local staff may not be required to stay on the FLNG. Secure



parking will be provided at the Cedar office, and local workers will be transported to the FLNG by bus from the Cedar office.

The FLNG, which includes the accommodation block, is a highly specialized vessel and is being built by FLNG experts in Korea. The FLNG is governed by the rules and framework established under the flag state authority and the selected ship classification society. The FLNG will be delivered under Marshall Islands flag, which is an internationally recognized jurisdiction commonly applied to similar offshore facilities. Further, Det Norske Veritas (DNV) has been selected as the classification society for the FLNG facility. The classification society establishes and maintains technical standards for the construction and operation of ships and offshore structures, ensuring their safety, reliability, and environmental compliance in accordance with IMO codes. As such, DNV will complete design approval, certify materials and components, and conduct audits and inspections during construction, installation, commissioning and startup, and operation to confirm compliance of the accommodation block with the general principles, procedures and legal provisions for classification as stated in DNV Rules for Classification of Floating LNG/ liquefied petroleum gas production, storage and loading units (DNV-RU-OU-0103). All standards are expected to meet or exceed Canadian construction and design standards and will be incorporated and recognized under applicable provincial and federal environmental, health and safety legislation as established in the Joint Permitting Plan (IAAC and EAO 2022) and Section 3.0 of this application.

The proposed accommodation block would be located aft on the FLNG, farthest away from the hazards of the topside facilities, with a 20 m safety zone separating the accommodation rooms from process equipment that may pose a potential hazard. Personnel working and sleeping in the accommodation block would be further protected by bulkheads rated for explosion and fire loads as well as by systems for protection against gas ingress. Emergency egress from the FLNG facility is provided both to land and sea. DNV has conducted a quantitative risk analysis for the Project as part of the suite of safety studies performed for the FLNG facility, finding that risk levels are well within thresholds defined under the *Liquefied Natural Gas Facility Regulation*, BC Reg 146/2014, including for medical, catering and lab personnel working in the accommodation block.

Sewage treatment was part of the original EAC Application as there will be both domestic wastewater and greywater generated by on-shift workers; this volume will modestly increase by roughly 10.5 m³/day with workers living on the FLNG while off-shift. For both on-shift and off-shift workers, the estimated total treated sewage volume will be approximately 12.5 m³/day. Sewage and grey water from the working and accommodation blocks will be collected into a central system and treated using the Evac Membrane Bioreactor¹. This is a biological wastewater treatment process specifically designed for vessels and turns organic material into carbon dioxide, water, and biomass by aerobic bacteria and filtration. The biomass from the process will be transferred as sludge to a holding tank and then periodically removed from the FLNG by pumping it to the bunkering manifold and transferring it through hoses to a suitable collection facility on land for disposal. Discharge of treated effluent to the marine environment will require a waste discharge authorization under the *Environmental Management Act*, which will include monitoring requirements. Marine water quality monitoring is also required under Decision Statement Condition 3.10.

1 <https://evac.com/products/evac-mbr/>



Solid waste (i.e., recycling and trash) will be collected from the accommodation block, galley, kitchen, and offices as separate waste streams of recycling and trash and consolidated in a central garbage room. Commercial composting is not currently available. Each waste stream will be compacted and stored in the garbage room before being removed from the FLNG for disposal at an approved facility.

As noted above, planned accommodation for non-resident workers during operation currently includes use of existing workforce accommodation facilities and housing supply in Kitimat, Terrace, and the Kitimat-Stikine Regional District. Adding worker accommodation to the existing FLNG facility is expected to reduce potential socio-economic impacts in Kitimat and surrounding communities, including traffic impacts. Medical facilities will be provided onsite in accordance with the approved Health and Medical Services Plan and are expected to reduce potential effects on the local health infrastructure and services during operations.

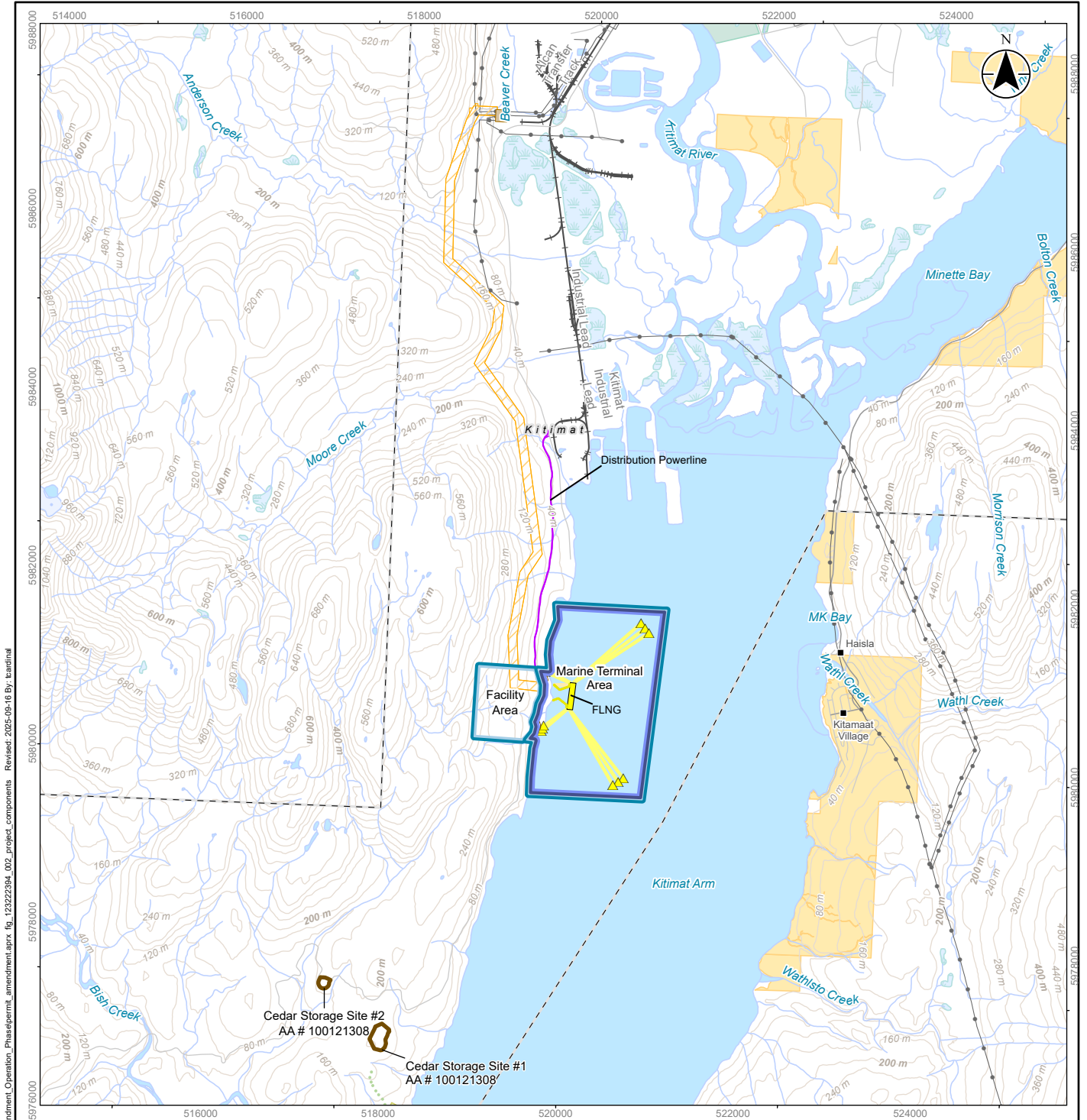
2.2 Increasing Liquefaction Capacity

The CPD in Schedule A to EAC #23-01 and Description of the Designated Project in Schedule 1 of the Decision Statement identify the Project as having the capacity to liquefy up to and including 400 million standard cubic feet per day (11.33 million standard cubic metres per day) of natural gas to produce LNG for export. Cedar is proposing to increase the liquefaction capacity of the facility up to 500 million standard cubic feet per day (14.16 million standard cubic metres per day).

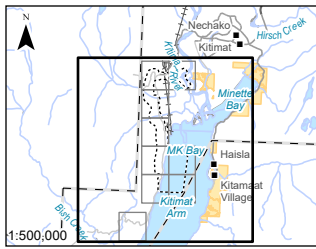
The increase in capacity will not involve changes to the equipment or facility infrastructure. It is driven by available capacity from existing pipelines and higher realized efficiencies in the detailed design. The cold winter and cool summer conditions experienced in the Kitimat area, in combination with a higher level of efficiency realized through the detailed design, allows the Project to increase the throughput without additional infrastructure.

Benefits of increased liquefaction capacity and throughput are economic in nature and include:

- the ability to achieve a higher rate of return on the investment in the Project
- better utilization of under-utilized pipeline infrastructure
- an increased diversity of markets for western Canada natural gas
- additional economic benefits to Haisla Nation
- additional tax revenue for provincial and federal governments

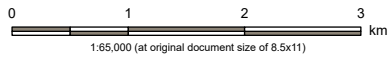


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Notes
 1. Coordinate System: NAD 1983 BC Environment Albers
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada

- Road
- Local Street
- - Resource Road
- Railway
- Transmission Line
- Topographic Contour
- Watercourse
- Waterbody
- Permanent Snow and Ice
- Wetland
- IR
- Minette Substation
- Municipal Boundary
- Local Greenspace
- Recreation Reserve/Site
- Transmission Line Corridor
- Distribution Powerline
- Facility Area
- Marine Terminal Area
- FLNG
- Floating Access
- Access
- Storage Sites #1 and #2 (AA 100121308)
- Dynamic Riser
- Mooring Line
- Mooring Anchor



Project Location: Kitimat, BC
 Project Number: 123222394
 Prepared by TCARDINAL on 20250723
 Requested by AAU on 20250723
 Checked by XXXX on 202507XX

Client/Project/Report
 Cedar LNG Partners (GP) Ltd
 Cedar LNG Project
 Application to Amend EAC #23-01 and Decision Statement

Figure No.
2.1
 Title
Project Components

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3.0 Applicable Licences, Permits and Approvals

The list of federal and provincial licences, permits and approvals outlined in the Joint Permitting / Regulatory Coordination Plan developed by the IAAC and the EAO (IAAC and EAO 2022) was reviewed in preparing this amendment. Key licences, permits, and approvals that may be required for the proposed changes, other than Cedar's requested amendment to EAC #E23-01 and the Decision Statement, are outlined in Table 3.1.

TABLE 3.1 REGULATORY APPROVALS

Approval	Description	Applicability
Provincial Approvals		
<i>Environmental Management Act</i>	The Waste Discharge Regulation defines what activities and types of waste need to be authorized under the <i>Environmental Management Act</i> . Waste under the <i>Environmental Management Act</i> includes air contaminants, effluent, garbage, and hazardous waste.	Cedar will apply for Waste Discharge Authorizations for air emissions and effluent discharge associated with the FLNG operation. The application will include the increased volume of domestic wastewater from the worker accommodation.
<i>Public Health Act</i>	Division 2 of the Act regulates activities that may cause health hazards, including sewage systems, swimming pools, personal services establishments, tanning facilities, and industrial camps. Licences and permits for regulated activities may be cancelled or varied by a health officer if the operator is causing a health hazard or contravening the Act.	As an industrial camp operation, occupation of the FLNG will require approvals/permits for services including the potable water system, sewage holding tanks, and food services prior to operating the accommodation block.

4.0 Summary of Engagement

In advance of submission, Cedar engaged with Indigenous nations and District of Kitimat to provide information regarding this amendment application, specifically the proposed changes to the Project and associated environmental effects. Engagement activities are described below. Where there is no reference to any follow-up in response to an offer to meet or provide information, there was no response to Cedar's outreach.

The information within this application is intended to address concerns raised by Indigenous nations during those meetings. As described in the sections below, discussions with Indigenous nations related primarily to changes to air quality and the associated effects to human health, water quality, and vegetation within the Kitimat Valley and Douglas Channel. Cedar is committed to working with Indigenous nations, regulatory agencies, local government, and community groups throughout the amendment application review.

4.1 Haisla Nation

As majority owners of the Project, Haisla Nation is involved in all project-related decisions, including this amendment. Haisla Nation representatives sit on the Cedar board and are responsible for setting strategic direction, monitoring progress, and managing risks.

In addition, Cedar schedules monthly meetings with Haisla Nation technical reviewers to provide updates, review upcoming and in-progress approvals, and discuss any environmental or regulatory concerns. Through these regular meetings, technical representatives for the Haisla Nation are aware of any project changes being contemplated well in advance of regulatory submissions. This amendment was specifically discussed with technical reviewers at meetings on May 14 and June 17, 2025.

On August 21, 2025, Cedar, along with discipline specialists from Stantec, met with Haisla Nation technical reviewers to provide an overview of the results of the air quality modelling conducted in support of this amendment.

On September 10, 2025, Cedar sent a follow-up email with the air quality modelling presentation attached.

Through discussions with Haisla Nation technical reviewers, Cedar understands the cumulative effects to air quality and the associated potential for human health effects are Haisla Nation's primary concern. The increase in emissions associated with the increase in capacity will contribute to the cumulative air quality effects. Air quality and human health are assessed in Section 6.3 and Section 6.5.

4.2 Kitselas First Nation

On July 9, 2025, Cedar met with Kitselas First Nation to provide an overview of this amendment and to respond to any preliminary questions. That same day, Cedar shared a copy of the presentation from the meeting.

On August 28, 2025, Cedar, along with discipline specialists from Stantec, met with Kitselas First Nation to provide an overview of the results of the air quality modelling conducted in support of this amendment.



On September 10, 2025, Cedar sent a follow-up email with the air quality modelling presentation attached.

Through discussions with Kitselas First Nation, Cedar understands the effects to air quality associated with the increase in capacity (particularly cumulative effects) and the associated potential for human health and environmental effects are Kitselas First Nation's primary concern. These VCs are the focus of this amendment application (Section 6.0). No specific concerns were raised regarding the accommodation block.

4.3 Kitsumkalum First Nation

On June 25, 2025, Cedar met with Kitsumkalum First Nation to provide an overview of this amendment and to respond to any preliminary questions. On July 3, 2025, Cedar shared a copy of the presentation from the meeting.

On September 5, 2025, Cedar, along with discipline specialists from Stantec, met with Kitsumkalum First Nation to provide an overview of the results of the air quality modelling conducted in support of this amendment.

On September 10, 2025, Cedar sent a follow-up email with the air quality modelling presentation attached.

Through discussions with Kitsumkalum First Nation, Cedar understands the cumulative air quality effects associated with the increase in capacity and the potential for consequential human health and environmental effects are Kitsumkalum First Nation's primary concern. These VCs are the focus of this amendment application (Section 6.0). In addition, Cedar has committed to meeting with Kitsumkalum First Nation to present the results of both the human health and acidification and eutrophication assessments. No specific concerns were raised regarding the accommodation block.

4.4 Gitga'at First Nation

Cedar schedules monthly meetings with the Gitga'at First Nation to provide Project updates and discuss areas of interest with the Nation.

On June 24, 2025, Cedar met with Gitga'at First Nation to provide an overview of this amendment and to respond to any preliminary questions. On July 3, 2025, Cedar shared a copy of the presentation from the meeting.

On August 26, 2025, Cedar, along with discipline specialists from Stantec, met with Gitga'at First Nation to provide an overview of the results of the air quality modelling conducted in support of this amendment.

On September 10, 2025, Cedar sent a follow-up email with the air quality modelling presentation attached.

Through discussions with Gitga'at First Nation, Cedar understands the direct and cumulative air quality effects associated with the increase in capacity and the potential for consequential human health and environmental effects are Gitga'at First Nation's primary concern. These VC are the focus of this amendment application (Section 6.0). No specific concerns were raised regarding the accommodation block.

4.5 Gitxaala Nation

On July 3, 2025, Cedar met with Gitxaala Nation to provide an overview of this amendment and to respond to any preliminary questions. On that same day, Cedar shared a copy of the presentation from the meeting.

On August 26, 2025, Cedar, along with discipline specialists from Stantec, met with Gitxaala Nation to provide an overview of the results of the air quality modelling conducted in support of this amendment.

On September 10, 2025, Cedar sent a follow-up email with the air quality modelling presentation attached.

Through discussions with Gitxaala Nation technical reviewers, Cedar understands the cumulative effects to air quality is Gitxaala Nation's primary concern. Air quality, including cumulative effects, is assessed in Sections 6.3. No specific concerns were raised regarding the accommodation block.

4.6 Metlakatla First Nation

On June 25, 2025, Cedar met with Metlakatla First Nation to provide an overview of this amendment and to respond to any preliminary questions. On July 3, 2025, Cedar shared a copy of a presentation summarizing the information from the meeting.

On July 30, 2025, Cedar sent an email to Metlakatla First Nation offering to meet to provide an overview of the results of the air quality modelling conducted in support of this amendment.

On September 10, 2025, Cedar sent a follow-up email with the air quality modelling presentation attached. In this email, Cedar offered to meet with Metlakatla First Nation to discuss the results of the air quality modelling.

4.7 Lax Kw'alaams Band

On July 11, 2025, Cedar met with Lax Kw'alaams to provide an overview of this amendment and to respond to any preliminary questions. On July 17, 2025, Cedar shared a copy of the presentation from the meeting.

On July 30, 2025, Cedar sent an email to Lax Kw'alaams offering to meet to provide an overview of the results of the air quality modelling conducted in support of this amendment.

On September 10, 2025, Cedar sent a follow-up email with the air quality modelling presentation attached. In this email, Cedar offered to meet with Lax Kw'alaams to discuss the results of the air quality modelling.

4.8 Métis Nation British Columbia

On July 30, 2025, Cedar sent Métis Nation British Columbia an email summary of the planned amendment application, including a copy of the overview presentation. In this email, Cedar offered to meet with Métis Nation British Columbia to discuss the amendment application.



On September 10, 2025, Cedar sent a follow-up email with the air quality modelling presentation attached. In this email, Cedar offered to meet with Métis Nation British Columbia to discuss the amendment application or the results of the air quality modelling.

4.9 Haida Nation

On July 30, 2025, Cedar sent Haida Nation an email summary of the planned amendment application, including a copy of the overview presentation. In this email, Cedar offered to meet with Haida Nation to discuss the amendment application.

On September 10, 2025, Cedar sent a follow-up email with the air quality modelling presentation attached. In this email, Cedar offered to meet with Haida Nation to discuss the amendment application or the results of the air quality modelling.

4.10 District of Kitimat

On September 11, 2025, Cedar sent the District of Kitimat an email summary of the amendment application, including a copy of the overview presentation. In this email, Cedar offered to meet with the District to discuss the amendment application or to present the results of the air quality modelling.

5.0 Amendment Processes

5.1 Environmental Assessment Act

Under section 32 of the *Environmental Assessment Act*, an amendment refers to any changes to an existing Certificate or Exemption Order. This includes modifications to the CPD, Table of Conditions, or equivalent documents (EAO 2024). Amending the EAC requires the assessment of potential changes to potential effects of a project on Indigenous nations and their constitutional rights and interests. It also involves consideration of the assessment matters outlined in section 25 of the *Environmental Assessment Act*.

Once the amendment application is submitted, the EAO will review the application for completeness. If deemed complete, EAO will issue a confirmation letter to Cedar. Following acceptance by the EAO, the EAO will work collaboratively with participating Indigenous nations and Technical Advisory Committee (TAC) members to identify information requirements, establish a work plan, and estimate timelines for the technical review of the amendment application (EAO 2020a).

During the technical review of the amendment application, Cedar will track and respond to issues and concerns raised by TAC members. If required, Cedar will also provide supplemental materials and complete supplementary information requirements for the EAO's and TAC's review. The EAO will prepare a draft amendment application report that may include revised or new conditions. This draft will be reviewed by EAO Compliance, members of the TAC, and Cedar. A public comment period may also be held, during which Cedar will address comments received from the public. Upon completion of the review, the amendment assessment report and conditions will be finalized and referred to the EAO's Executive Director for a decision on whether to issue the amendment (EAO 2024).

Cedar has reviewed the EAO's guidance in Environmental Assessment Certificate and the Amendments to Environmental Assessment Certificates and Exemption Orders – Guidance for Holders (EAO 2024). Based on the description of amendment types, Cedar believes the proposed changes fall within the “typical amendment” category as there will be no change in the identified parameters listed in the EAC #23-01 for the following:

- Project components or their locations
- Physical footprint of the Project
- Number of employees/workers to be employed during construction or operation
- Predicted GHG emissions
- Number of LNG carriers visiting the Project on an annual basis

5.2 Impact Assessment Act

Section 68(1) of the *Impact Assessment Act* provides the Minister of Environment and Climate Change with the authority to amend a Decision Statement where the decision itself is not altered and the extent of any adverse effects will not increase. This may include adding, removing, or modifying a condition, or changing the Designated Project's description. While the Act imposes limitations on how conditions may be changed, it does not restrict modifications to the Project description. There are no published guidelines on the information to be provided in an application to amend a Decision Statement, therefore the information requirements established under the provincial *Environmental Assessment Act* amendment process have been adopted to guide the submission.

Following receipt of an application, the IAAC will consult with federal authorities and Indigenous nations on the potential effects within federal jurisdiction. It will also hold a public comment period. To the extent possible, this will be coordinated with the provincial amendment process led by the EAO. The IAAC will then issue an Analysis of Proposed Changes with a summary of its analysis and its recommendations to the Minister on whether to support the Decision Statement amendment. This may include recommended changes to the description of the Designated Project and/or conditions established under section 64 of the Act.

6.0 Valued Components Assessment

6.1 Identification of Potential Interactions with Proposed Changes

The following sections provide an analysis of the potential effects of each proposed change to the Project and whether they alter the conclusions of the Assessment Report. This analysis specifically considered whether the proposed changes would induce any new effects, whether they would alter the characterization of the predicted effects (e.g., a change in the magnitude of an effect), or whether any new mitigation measures are needed to prevent a change in the characterization of the effects in the Assessment Report.

Potential interactions the proposed changes could have with each of the VCs considered in the Assessment Report have been assessed here. Table 6.1 outlines the potential interactions between the VCs as defined in the Assessment Report and the proposed physical changes that would result from this amendment application. Rationale for the interactions is described for each VC in Table 6.2.

TABLE 6.1 POTENTIAL INTERACTIONS WITH VALUED COMPONENTS

Valued Components	Increased Liquefaction Capacity	Accommodation on FLNG
Air Quality	2	2
Acoustics	2	2
Vegetation Resources	2	0
Wildlife	0	0
Freshwater Fish	2	0
Marine Resources	1	0
Employment and Economy	0	1
Land and Resource Use	0	0
Marine Use	0	0
Infrastructure and Services	0	1
Heritage	0	0
Human Health	2	2

Notes:

0 = No VC interaction; no further consideration warranted. Rationale is provided in Table 6.2.

1 = Negligible change relative to the potential effects previously assessed; can be appropriately managed via existing mitigation measures and commitments; rationale for exclusion from further assessment discussed in Table 6.2.

2 = Potential interaction with potential to result in changes to previously assessed effects or application of new mitigation or management measures; warrants further consideration and carried forward in the amendment application, as outlined in Table 6.2.

TABLE 6.2 VALUED COMPONENTS TO BE INCLUDED/EXCLUDED IN THE AMENDMENT APPLICATION

Valued Component	Interaction Identified	Carried Forward for Further Assessment	Rationale for Inclusion or Exclusion
Air Quality	Potential	Carried forward	The liquefaction capacity increase from 400 to 500 million standard cubic feet per day will increase emissions of nitrogen (NO _x), sulphur dioxide (SO ₂), fine particulate (PM _{2.5}), and carbon monoxide (CO) to the atmosphere. Off-shift workers living in the FLNG's accommodation block may be exposed to air emissions associated with the operation of the facilities onboard.
Acoustics	Potential	Carried forward	The liquefaction capacity increase from 400 to 500 million standard cubic feet per day may increase noise emissions. Off-shift workers living in the FLNG's accommodation block may be exposed to noise emissions associated with the operation of the facilities onboard.
Vegetation Resources	Potential	Carried forward	No changes to the physical footprint of the Project are proposed; therefore, no new or additional direct interactions (i.e., clearing) with vegetation resources will occur. The liquefaction capacity increase from 400 to 500 million standard cubic feet per day is anticipated to increase nitrogen dioxide (NO ₂) and SO ₂ emissions, which may result in increased deposition, eutrophication and acidification that could have adverse effects on vegetation resources.
Wildlife	No	Excluded	No changes to the physical footprint of the Project are proposed; therefore, no new or additional direct interactions with wildlife will occur. As discussed in Section 6.4, sensory disturbance to wildlife is not re-evaluated in this amendment application because the updated noise modelling predicts lower sound levels than those considered in the EAC Application noise assessment. As there is no increase to predicted noise levels or the previously assessed spatial extent of potential effects, the conclusions regarding sensory disturbance to wildlife remain valid and are not carried forward for further analysis in this amendment application.
Freshwater Fish	Potential	Carried forward	No changes to the physical footprint of the Project are proposed; therefore, no new or additional direct interactions with freshwater fish will occur. The liquefaction capacity increase from 400 to 500 million standard cubic feet per day is anticipated to increase nitrogen dioxide (NO ₂) and SO ₂ emissions, which may result in increased eutrophication and acidification that could have adverse effects on freshwater fish due to changes in water quality.
Marine Resources	Negligible	Excluded	No changes to the physical footprint of the Project are proposed; therefore, no direct interactions with marine resources will occur. The addition of workers living onboard the FLNG while off-shift will result in an increase of 10.5 m ³ /day of treated domestic wastewater being discharged to Douglas Channel. Wastewater will be treated to meet the Municipal Wastewater Regulation (under the <i>Environmental Management Act</i>) and the Wastewater Systems Effluent Regulations (under the <i>Fisheries Act</i>). Cedar is applying for Waste Discharge Authorizations for effluent discharge associated with the FLNG operation. The application would include the increased volume of domestic wastewater from the worker accommodation. As such, effects on marine water quality will be minor and adverse changes to marine resources are anticipated to be negligible and addressed through permitting. Federal Condition 3.10 that requires a marine water quality follow-up program will apply to all discharges; this will apply to the increased wastewater discharge volume.
Employment and Economy	Negligible	Excluded	The operations workforce will not change from the range described in the EAC Application. This includes up to 100 workers during normal operations, and up to 100 workers during turnaround every 3-5 years, and a peak of 100-150 workers during decommissioning. Services that would be provided in worker camps (e.g., food, housekeeping, laundry) will also be provided on the FLNG. As there are no changes in workforce levels, there are no changes to the effects on employment that are reported in the Assessment Report. The increase in liquefaction capacity will not involve changes to the equipment or facility infrastructure, therefore no additional costs are anticipated. The increase in facility liquefaction capacity is expected to have predominately positive effects on economy, including: the ability to achieve a higher rate of return on the investment in the Project; an increased diversity of markets for western Canada natural gas; and more tax revenue for provincial and federal governments. The Conditions in EAC #23-01 and the Decision Statement will apply to the Project changes, including the Socioeconomic Management Plan (provincial Condition 14), the requirement to participate in a regional social and economic management and monitoring committee (provincial Condition 16.1), the Gender Equity and Diversity Plan (federal Conditions 8.9, 8.10 and 8.12), measures to inform Indigenous peoples of employment and procurement opportunities (federal Condition 8.6), and measures to increase opportunities for local businesses (federal Condition 8.7).
Land and Resource Use	No	Excluded	The proposed changes do not change the physical footprint or activities required for operations of the Project. As a result, there is no change in interactions with land and resource use. The Conditions in EAC #23-01 and the Decision Statement will apply to the Project changes, including the Socioeconomic Management Plan (provincial Condition 14), the Community Feedback Process (provincial Condition 11 and federal Condition 9), and an accommodation policy (federal Condition 8.16).
Marine Use	No	Excluded	The proposed changes, including the proposed increase in LNG production, will not increase marine shipping levels or activities. There will be no increase in the number of LNG carriers berthing and loading per year beyond the 50 per year approved in EAC #23-01 and the Decision Statement. As a result, there will not be any change in the effects to marine navigation, marine fisheries, and other uses as summarized in the Assessment Report.

Valued Component	Interaction Identified	Carried Forward for Further Assessment	Rationale for Inclusion or Exclusion
Infrastructure and Services	Negligible	Excluded	<p>The proposed changes do not alter the physical footprint, activities, or number of workers. The addition of a worker accommodation block on the FLNG will provide housing for the portion of the operations workforce that will be sourced non-locally. This will reduce demand on hotels and local workforce accommodation facilities and reduce the volume of traffic associated with workers travelling to and from the FLNG daily. As described in the EAC Application, medical facilities will be provided onsite in accordance with the approved Health and Medical Services Plan and are expected to reduce potential pressure effects on the local health infrastructure and services during operations. Effects on infrastructure and services are expected to be negligible with the implementation of mitigation measures outlined in the Socioeconomic Management Plan (Cedar 2024a) and the Health and Medical Services Plan (Cedar 2024b).</p> <p>The Conditions in EAC #23-01 and the Decision Statement will apply to the Project changes, including the Health and Medical Services Plan (provincial Condition 13 and federal Condition 8.5), Socioeconomic Management Plan (provincial Condition 14), Community Feedback Process (provincial Condition 11 and federal Condition 9), and an accommodation policy (federal Condition 8.16).</p>
Heritage	No	Excluded	<p>No changes to the physical footprint of the Project, therefore no change in interactions with heritage resources, including archaeological resources and palaeontological resources, will occur.</p>
Human Health	Potential	Carried forward	<p>The capacity increase from 400 to 500 million standard cubic feet per day may increase air and noise emissions that could potentially affect human health in the vicinity of the Project.</p> <p>Air quality and noise in the worker accommodation area in the FLNG may affect the health of off-shift workers.</p>

6.2 Valued Component Assessment Methods

The amendment application identifies VCs previously assessed in the Assessment Report that have the potential to interact with the proposed changes to the Project (Section 6.1). Table 6.2 identifies VCs, their potential interactions with the Project, and rationale for their inclusion or exclusion as VCs in the amendment application. Where there is the potential for proposed changes to interact with a VC, these interactions are carried forward in the assessment. The assessment will evaluate whether the proposed changes will change the residual or cumulative effects and conclusions presented in the Assessment Report (EAO 2022). The effects assessment follows the approach outlined in EAO's Effects Assessment Policy (EAO 2020b).

The effects assessment evaluates the following:

- Mechanism: a description of how the proposed changes could result in interactions with the VC
- Mitigation: identification of mitigation measures to reduce or eliminate potential negative effects of the proposed changes
- Characterization of effects: a description of if and how the proposed changes alter the characterization of effects set out in the Assessment Report
- Risks and uncertainties: a description of risks and uncertainties, including the likelihood of positive or adverse residual effects, and results of any interaction between effects will be provided. The level of confidence and potential need for additional risk analysis in case of uncertainty is stated

For cumulative effects to occur, there must be residual adverse environmental effects and a spatial and temporal overlap of adverse effects from past, present, and reasonably foreseeable projects and activities. For each VC carried forward in the amendment application, a cumulative effects assessment will be conducted if the proposed changes adversely alter the characterization of residual effects from the Assessment Report (e.g., a residual effect changes from being low magnitude to moderate magnitude or from being reversible to being irreversible). Reasonably foreseeable projects and activities are those that: (a) have been publicly announced with a defined project execution period and with sufficient project details that they can be included in the assessment; (b) are currently undergoing an environmental assessment; or (c) are in a permitting process.

6.3 Air Quality

The proposed Project changes in this amendment application alter the impacts to the Air Quality VC that were considered in the EAC Application and the Assessment Report. Table 6.3 provides a side-by-side comparison of the impacts and potential effects from the Assessment Report versus what is considered in this amendment application for air quality. A description of the changes to the spatial boundaries (i.e., Regional Assessment Area [RAA]) and existing conditions that influence the assessment for the proposed changes to the Project is provided below, followed by the effects assessment.

TABLE 6.3 SUMMARY COMPARISON IMPACTS AND POTENTIAL EFFECTS FOR AIR QUALITY

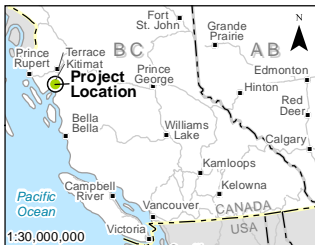
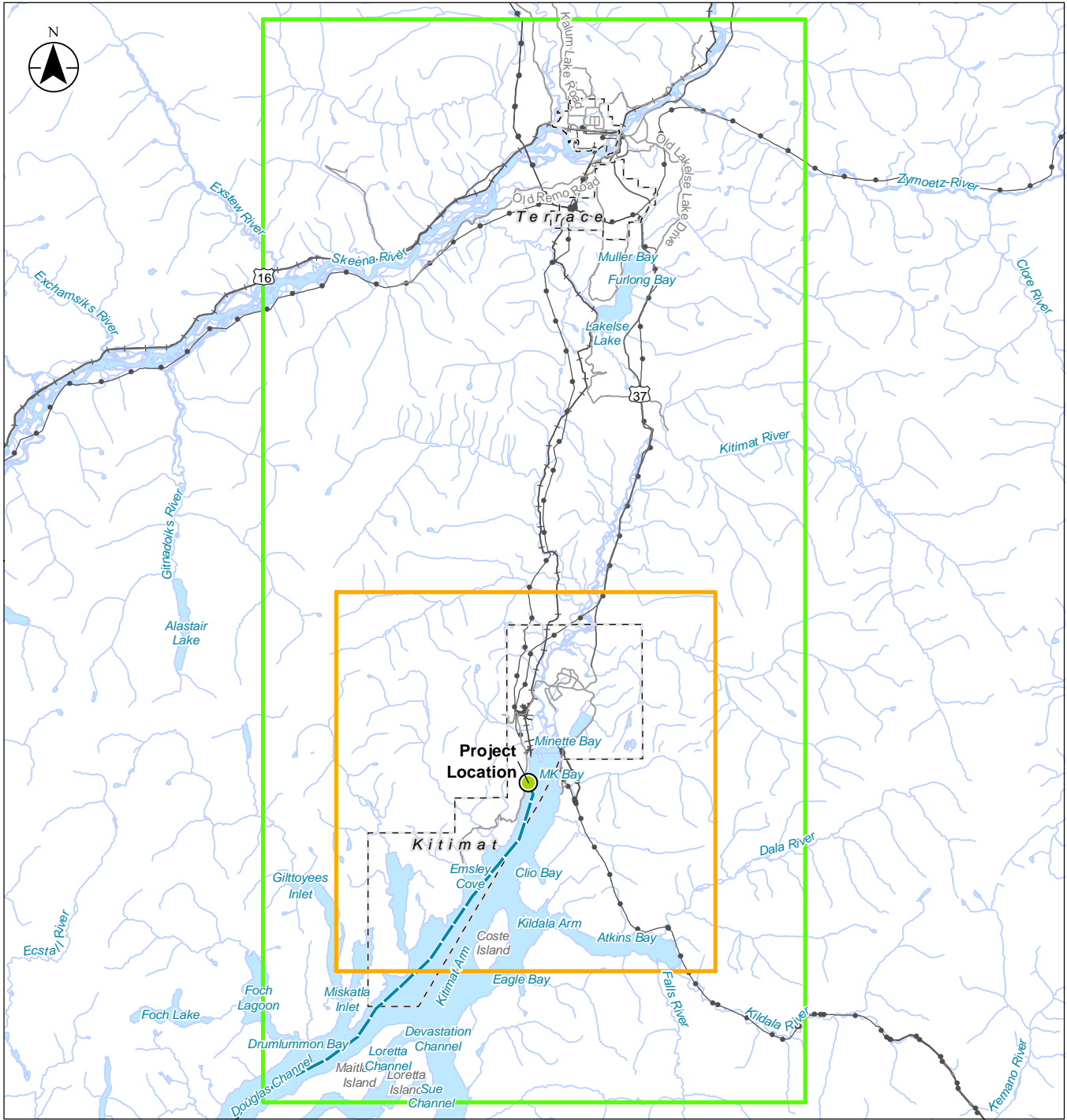
Impacts & Effects	Assessment Report	Amendment Application
Impacts	<ul style="list-style-type: none"> • Increase of NO_x, SO₂, PM_{2.5}, CO emission rates • Increase of nitrogen (N), sulphur (S), S+N deposition rates 	<ul style="list-style-type: none"> • Additional (incremental) increase of NO_x, SO₂, PM_{2.5}, and CO emission rates • Additional (incremental) increase of N, S, S+N deposition rates
Potential Effects	<ul style="list-style-type: none"> • Change in air quality 	<ul style="list-style-type: none"> • Change in air quality

6.3.1 Boundaries

6.3.1.1 SPATIAL BOUNDARIES

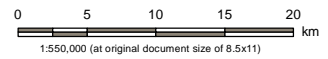
The RAA for the amendment air quality assessment is 50 km x 100 km domain (Figure 6.1). This is an increase from the local assessment area (LAA)/RAA domain of 40 km x 40 km in the EAC Application. The RAA was increased to capture effects of existing emission sources that are in the vicinity of the Project, to align with other recent assessments in the airshed, and to prepare for the Waste Discharge Authorization application for the Project. The LAA for air quality remains the same as the EAC Application; a 40 km by 40 km domain which captures the effects of the Project.

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- Highway
- Road
- +— Railway
- Transmission Line
- Watercourse
- Waterbody
- - - District of Kitimat
- - - Municipal Boundary

- Project Location
- Marine Shipping Route (Approximate Location)
- Air Quality Regional Assessment Area
- Air Quality Local Assessment Area



Project Location: Kitimat, British Columbia
 Project Number 12322394
 Prepared by SPARKER on 20250814
 Discipline Review by AHAUK on 20250814
 GIS Review by TCARDINAL on 20250828

Client/Project/Report
 Cedar LNG Partners (GP) Ltd.
 Cedar LNG Project
 Application to Amend EAC #23-01 and Decision Statement

Figure No.
6.1

Title
Air Quality Regional and Local Assessment Areas

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6.3.2 Existing Conditions

Existing air quality in the RAA/LAA is not changed substantially from that described in the EAC Application and technical memorandum (Stantec 2022). Ambient air quality monitoring is conducted at five monitoring locations in the LAA. Ambient concentrations of NO₂, SO₂, PM_{2.5}, and CO are below the BC air quality objectives (AQOs) most of the time. Current monitoring data for 2020 to 2024 and a partial year of 2025 is available and was used to characterize the baseline concentrations for this amendment. A further description of baseline concentrations is provided in the Air Quality Technical Data Report (TDR) (Appendix A).

For the EAC Application, existing large industrial emissions sources were included in dispersion modelling for the Base Case. These sources include the Rio Tinto Aluminum Smelter and the LNG Canada LNG Export Facility (Phase I and II) (Stantec 2022). The Base Case modelling scenario has been re-assessed for the amendment to reflect the updated emission rates for these existing industrial emission sources based on current authorized emission rates (Appendix A). Rio Tinto's emission rates have been updated to reflect a recent waste discharge authorization amendment (Ministry of Environment and Parks [ENVP] 2025a). LNG Canada's emission rates in the Base Case reflect the current operation of Phase I as authorized in the Facility's waste discharge authorization. Phase II of the LNG Canada Project is assessed in the Future Case (cumulative assessment).

As presented in the EAC Application, the Base Case predicted concentrations of NO₂ are less than the regulatory criteria (Appendix A). The maximum predicted NO₂ concentration occurs near the neighbouring Rio Tinto and LNG Canada facilities (Appendix A, Figure D.1 and Figure D.2). Concentrations above 50% of the BC AQO occur near the two existing facilities, extend south toward the location of the Project, and occurs over a small area in the center of Kitimat.

The predicted SO₂ concentrations are elevated and extending north and south of Kitimat throughout most of the LAA and RAA with area of maximum impact centered on the Rio Tinto facility. The predicted concentrations of SO₂ are greater than the applicable regulatory criteria (Appendix A, Figure D.3 and Figure D.4). These maximum predicted concentrations are believed to substantially overpredict actual conditions, as measured concentrations of SO₂ at Kitimat monitoring stations greater than the BC AQO have been infrequent and the magnitude of maximum predicted SO₂ concentrations are much greater than maximum measured concentrations at nearby air quality monitoring stations (ENVP 2025b).

The predicted concentrations of PM_{2.5} are greater than the applicable regulatory criteria; however, the most substantial effects are in the vicinity of to the Rio Tinto aluminum smelter boundary extending south to the Project location (Appendix A, Figure D.5 and Figure D.6).

The predicted concentrations of CO are low, and well below the applicable regulatory criteria (Appendix A). Further description of the predicted results for the Base Case is provided in Air Quality TDR (Appendix A).

6.3.3 Potential Effects and Mitigation Measures

The Assessment Report considered changes in NO₂, SO₂, PM_{2.5} and CO resulting from combustion sources onsite (regen gas heater, thermal oxidizer, boiler, flare stack, and docked marine vessels). The primary mitigation measure for operations-phase emissions identified in the EAC Application that is applicable to air quality is the design decision to use electrical power from the BC Hydro grid to power the Project during operations. This reduces the release of NO_x, SO₂, PM_{2.5}, and CO emissions by approximately 96% relative to using gas-fired turbines for compression and power. This mitigation will apply to the proposed changes in this amendment application with similar efficacy. No new mitigation measures are required.

The key changes in this application from what was considered in the Assessment Report are the incremental increase in air emissions resulting from the increase in production capacity of the Project, and the geographic extent of the assessment. In addition, the assessment now considers onsite and offsite conditions where off-duty workers may be subject to an increase in NO₂, SO₂, PM_{2.5}, and CO.

TABLE 6.4 SUMMARY OF POTENTIAL EFFECTS AND MITIGATION MEASURES – AIR QUALITY

Proposed Amendment Component	Project Phase	Change in Proposed Works or Activities	Change in Potential Effects	Change in Mitigation or Enhancement Measures	Change in Mitigation or Enhancement Measures Success Rating
Increase liquefaction capacity	Operation and commissioning ¹	No change	Negligible	No change	No change
Off-duty worker accommodations on FLNG	Operation and commissioning ¹	Off-duty worker accommodations on FLNG	Not previously assessed	Not previously assessed	Not previously assessed

Note: ¹Commissioning is included in the Construction Phase in the EAC #E23-01

6.3.4 Changes to Characterization of Residual Effects

Effects on air quality due to the increased production capacity assessed in this chapter focus on changes in air quality beyond the facility boundary where the air quality regulatory criteria apply (ENVP 2020). The assessment of human health effects as a result of air quality at the location of off-duty residence on the FLNG is discussed in Section 6.5 (Human Health VC) because of the mix of regulatory criteria applicable onsite, including worker health and safety standards and off-duty worker health air quality guidelines. As discussed in Section 6.5, the health risk for off-duty workers staying on the FLNG from exposure to NO₂ and PM_{2.5} is considered negligible because concentrations do not exceed the 1-hour and annual average World Health Organization (WHO) Air Quality Guidelines (AQGs) under both the Base Case and Application Case (see Section 6.5). While SO₂ exceeds the AQG in the Base Case and Application Case, the incremental change is small, and these predictions are considered conservative (see Section 6.5). As such, the change to SO₂ health risk to off-duty workers staying on the FLNG with



the addition of the Project is minimal. On this basis, further discussion of air quality on the FLNG is not carried forward in this air quality assessment.

The assessment of the effects of deposition of N, S, and N+S to the aquatic and terrestrial environments are discussed in Section 6.6 (Freshwater Fish VC) and Section 6.7 (Vegetation VC), respectively.

Dispersion modelling results for the Project-Alone Case (Appendix A) show that predicted concentrations of NO₂, SO₂, PM_{2.5}, and CO associated with increase in capacity and facility design changes have increased marginally compared to the modelling results presented in the EAC Application. Consistent with the EAC Application, the predicted concentrations of NO₂, SO₂, PM_{2.5}, and CO for the Project remain below the applicable regulatory criteria and maximum predicted concentrations occur within 1 km of the Project (Appendix A; Figure D.7 to Figure D.12). Further description of the predicted results for the Project-Alone Case is provided in Air Quality TDR (Appendix A).

Dispersion modelling was conducted for the Application Case which includes existing sources (Base Case), the Project, and representative baseline concentration. Results of the Application Case show a small increase to maximum predicted concentrations compared to the Base Case because of the Project emission sources, where maximum predicted 1-hour concentrations increase by 9.5%, 0.1%, 0.0% and 0% for NO₂, SO₂, PM_{2.5}, and CO, respectively (Appendix A).

The maximum predicted NO₂ concentration occurs south of the Project boundary (Appendix A, Figure D.13 and Figure D.14). As shown in the Figures (D.13 and D.14), changes to NO₂ concentrations are generally limited to the immediate area surrounding the Project.

The predicted SO₂ concentrations are elevated and extend north and south of Kitimat throughout most of the LAA and RAA. The predicted concentrations of SO₂ are greater than the applicable regulatory criteria. The maximum is located on the southwest plant boundary of Rio Tinto. Application Case SO₂ isopleth patterns are unchanged compared to the Base Case as the maximum concentrations throughout the LAA are dominated by emissions from the Rio Tinto aluminum smelter facility. The addition of the Project does not affect this pattern (Appendix A, Figure D.15 and Figure D.16).

The predicted concentrations of PM_{2.5} are greater than the applicable regulatory criteria; however, the most substantial effects are in the vicinity of the Rio Tinto aluminum smelter facility boundary and extend south to the Project. Application Case PM_{2.5} isopleths are similar to the Base Case, as maximum concentrations throughout the LAA are dominated by emissions from the Rio Tinto. The addition of the Project does not affect this pattern (Appendix A, Figure D.17 and Figure D.18).

The predicted concentrations of CO are low, and well below the applicable regulatory criteria (Appendix A).

The extent of residual effects of the Project is limited to within the LAA and to the vicinity of the Project (i.e., less than 1 km) and is very small to negligible with increasing distance from the Project (Appendix A). Maximum predicted concentrations for the Application Case for the amendment application have increased compared to the EAC Application associated with changes to the Base Case emission inventory, changes to Project emissions, and changes to meteorology and modelling methodology to meet current model guidance and align with recent assessments in the Kitimat airshed. However, the overall findings and resulting characterization of effects on air quality for the amendment application are unchanged from the Assessment Report; the results are generally similar in magnitude and extent when compared to modelling results presented in the EAC Application. Comparison of maximum measured and

predicted concentrations for the Base Case for the contaminants predicted to exceed the BC AQO indicate that predicted exceedances of the BC AQO are predominantly attributable to model conservatism (i.e., overprediction bias). The Assessment Report concluded that Project effects on the air quality environment are predicted to be not significant. The characterization of residual effects for the amendment application is unchanged from the Assessment Report and is summarized in Table 6.5.

TABLE 6.5 CHANGES TO ASSESSMENT REPORT CHARACTERIZATION OF RESIDUAL EFFECTS ARISING FROM PROPOSED AMENDMENTS – AIR QUALITY

Assessment Report Characterization of Residual Effects			Effect of Proposed Amendments on Characterization
Criteria	Assessment Rating	Rationale	
<i>Context</i>	<i>Low</i>	<i>The base case scenario showed potential concentrations of 1-hour NO₂, SO₂ and PM_{2.5} and annual SO₂ and PM_{2.5} were all predicted to exceed the AQO and/or CAAQS, primarily as a result of Rio Tinto; therefore, the EAO considers air quality in the Kitimat area to have low resiliency or ability to accommodate additional increases in CACs.</i>	No Change
<i>Direction and Magnitude</i>	<i>Adverse and Low</i>	<i>Exceedances of the AQO and/or CAAQS occur in the base case scenario for 1-hour NO₂, SO₂ and PM_{2.5} and annual SO₂ and PM_{2.5}. The application case is expected to result in only small increases for these CACs (with the increase in exceedances of the application case in comparison to the base case ranging from <1 percent to 2.6 percent) and not result in any additional exceedances (of annual NO₂ or 1-hour or 1-hour or annual CO)</i>	No Change
<i>Extent</i>	<i>Local</i>	<i>Predicted effects to air quality from each of the CACs may occur throughout the LAA. The exceedances of the AQO and CAAQS from the application case are from 1-hour NO₂, SO₂ and PM_{2.5} and annual SO₂ and PM_{2.5}. However, the concentrations of these CACs that are associated with the project-alone case are only present within a radius of approximately 100 m to 1 km of the FLNG facility.</i>	No Change
<i>Duration</i>	<i>Long-Term</i>	<i>The increased concentrations of CACs from Cedar LNG facility emissions would last throughout construction and operations of the FLNG facility. Effects from decommissioning would be expected to be less but effects to air quality are still expected over the lifetime of the Project.</i>	No Change



Assessment Report Characterization of Residual Effects			Effect of Proposed Amendments on Characterization
Criteria	Assessment Rating	Rationale	
<i>Frequency</i>	<i>Frequent/Regular</i>	<i>Emissions of CACs from the FLNG facility would occur frequently, at regularly intervals throughout operation.</i>	No Change
<i>Reversibility</i>	<i>Reversible</i>	<i>The residual effects on air quality from the FLNG facility would cease following decommissioning of Cedar LNG.</i>	No Change
<i>Affected Population</i>	<i>Disproportionate</i>	<i>The air quality effects of the facility area would be more acutely experienced by local residents and Indigenous nation members who are located in closer proximity to emissions (such as because of employment or residence location), and have higher frequency (for example, permanency of residence or length of employment/shifts) of exposure, as well as sensitive populations including individuals that are more susceptible to COPC exposure due to physiology (such as newborns, children, pregnant or breastfeeding women and elderly people), health status (such as immune-compromised persons, persons suffering from heart disease, respiratory conditions or allergies), behaviour (such as amount of time spent outdoors), and lifestyle (for example: smoking, Body Mass Index [BMI]) and exercise status).</i>	No Change
<i>Risk (likelihood and consequence)</i>	<i>Likelihood: high likelihood of effects to air quality during construction and operations (medium likelihood during decommissioning). Consequence: minor consequence based on the low magnitude extending throughout the LAA. Risk: based on the high likelihood (construction and operations) and minor consequence of residual effects to air quality the EAO determined that there would be a moderate level of risk during construction and operations and low during decommissioning.</i>		No Change

Assessment Report Characterization of Residual Effects			Effect of Proposed Amendments on Characterization
Criteria	Assessment Rating	Rationale	
<i>Uncertainty</i>	<i>Uncertainty in effects to the air quality VC is considered to be moderate. The EAO has a moderate level of confidence in the characterization of the residual effects presented here based on the air quality modelling completed, the approach used to establish baseline conditions, and the feedback from the Working Group during the assessment.</i>		Change to low to moderate uncertainty (i.e., there is now greater certainty in the effects predictions). Dispersion modelling for the amendment is conducted in accordance with the BC Air Quality Dispersion Modelling Guideline (Guideline) (ENVP 2022) and aligns with recent dispersion modelling for a Waste Discharge Authorization application to the BCER. The modelling domain (LAA/RAA) is increased to capture the extent of the Base Case effects, 1 km resolution (from 4 km) numerical weather forecast data is used to drive dispersion, and updated emission rates for Base Case and Project Alone Cases to reflect current authorized discharge rates and Project updated design. Baseline concentrations have been added to predicted concentrations for the amendment that follow the Guideline (ENVP 2022) and recommendations from ENVP on recent assessments in the airshed.
<i>Significance</i>	<i>In consideration of the above analysis, low magnitude of the predicted effects, and the conditions identified in the TOC (CEMP), proposed federal Mitigation Measures and required permitting process, the EAO concludes that the FLNG facility would not have significant adverse residual effects on the air quality VC.</i>		No Change

Note:

The text in italics is reproduced from the Assessment Report for the Cedar LNG Project (EAO 2022).



6.3.5 Cumulative Effects Assessment

For the amendment, dispersion modelling was conducted for a Future Case, which includes the Application Case plus Phase II of the LNG Canada Export Terminal Project. LNG Canada's Phase II includes the addition of two LNG process trains, which will double the current facility capacity and emission rates. Results of the Future Case generally show a small increase in maximum predicted concentrations compared to the Application Case where predicted concentrations increase by 1.1%, 0.5%, 0.05% and 52% for NO₂, SO₂, PM_{2.5}, and CO, respectively (Appendix A, Figure D.19 to Figure D.24). While maximum predicted CO concentrations increase by approximately 52%, it remains well below regulatory criteria.

The dispersion modelling results show negligible to very small cumulative effects of the Project with the Future Case. The proposed amendment is anticipated to have similar interaction with past, present, and reasonably foreseeable projects and activities compared to the EAC Application. As such, cumulative effects on air quality because of the amendment are predicted to be consistent with the Assessment Report and the characterization of cumulative effects remain valid.

6.3.6 Risk and Uncertainties

The ability of a plume dispersion model to predict ambient concentrations depends on the accuracies of the source and emission inventory, the meteorology, and the assumptions used to represent the atmospheric physics and chemistry processes. The United States Environmental Protection Agency (2005) indicates the application of regulatory dispersion models is viewed as a "best estimate" approach and this approach should be viewed as "acceptable to the decision maker."

The application of CALPUFF in this assessment is consistent with best practices and the Guideline (ENVP 2022). Modelling for this amendment application applied an updated dispersion modelling plan, and aligns with rigorous methodologies used in a recent waste discharge authorization application in Kitimat (Appendix A). The modelling domain (LAA/RAA) was expanded to capture the extent of the Base Case effects, 1 km resolution (from 4 km) numerical weather forecast data was used to develop high resolution meteorological data used as input to the dispersion model, updated emission rates for Base Case and Project Alone Cases to reflect current authorized discharge rates from other facilities in the area, and updated (advanced engineering) design for the Project. Baseline concentrations have been added to predicted concentrations for the amendment modelling that follow the Guideline (ENVP 2022) and recommendations from ENVP on recent assessments in the airshed.

Care has been paid to estimate emission rates and emission parameters. There is a high degree of confidence that predicted concentrations in the assessment are conservative; meaning Project effects are likely overpredicted. Comparison of modelled maximum predicted concentrations that exceed the AQO (PM_{2.5} and SO₂) to the maximum measured concentrations from local air quality monitoring stations for the Base Case scenario indicate that the predicted exceedances of the AQO are predominantly attributable to model conservatism (i.e. overprediction bias).

In consideration of the use of CALPUFF, the updated modelling methods, and the conservative inputs to the mode, there is a high level of certainty in the predictions in this assessment.



6.3.7 Adaptive Management and Monitoring Measures

For operations of the Project, Cedar will obtain a waste discharge permit as required under the *Environmental Management Act* and administered by the BCER. As part of this permitting process, further assessment of the effects on air quality for the Project will be undertaken. Based on this assessment, it is anticipated for discharge of air emissions that operation and monitoring conditions, including a combination of emission source monitoring, ambient monitoring, and reporting will be stipulated in a waste discharge permit, which will be required prior to start of operations.

6.4 Acoustics

The changes proposed in this amendment application potentially alter the effects on the acoustic environment that were considered in the EAC Application and the Assessment Report. Table 6.6 provides a side-by-side comparison of the impacts and potential effects from the Assessment Report versus what is considered in this assessment of acoustics effects. A description of the existing conditions that influence the assessment for the proposed changes to the Project is provided below, followed by the effects assessment.

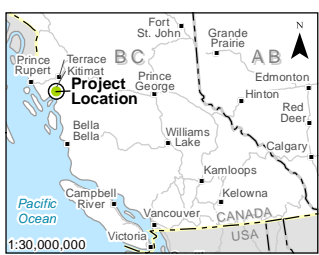
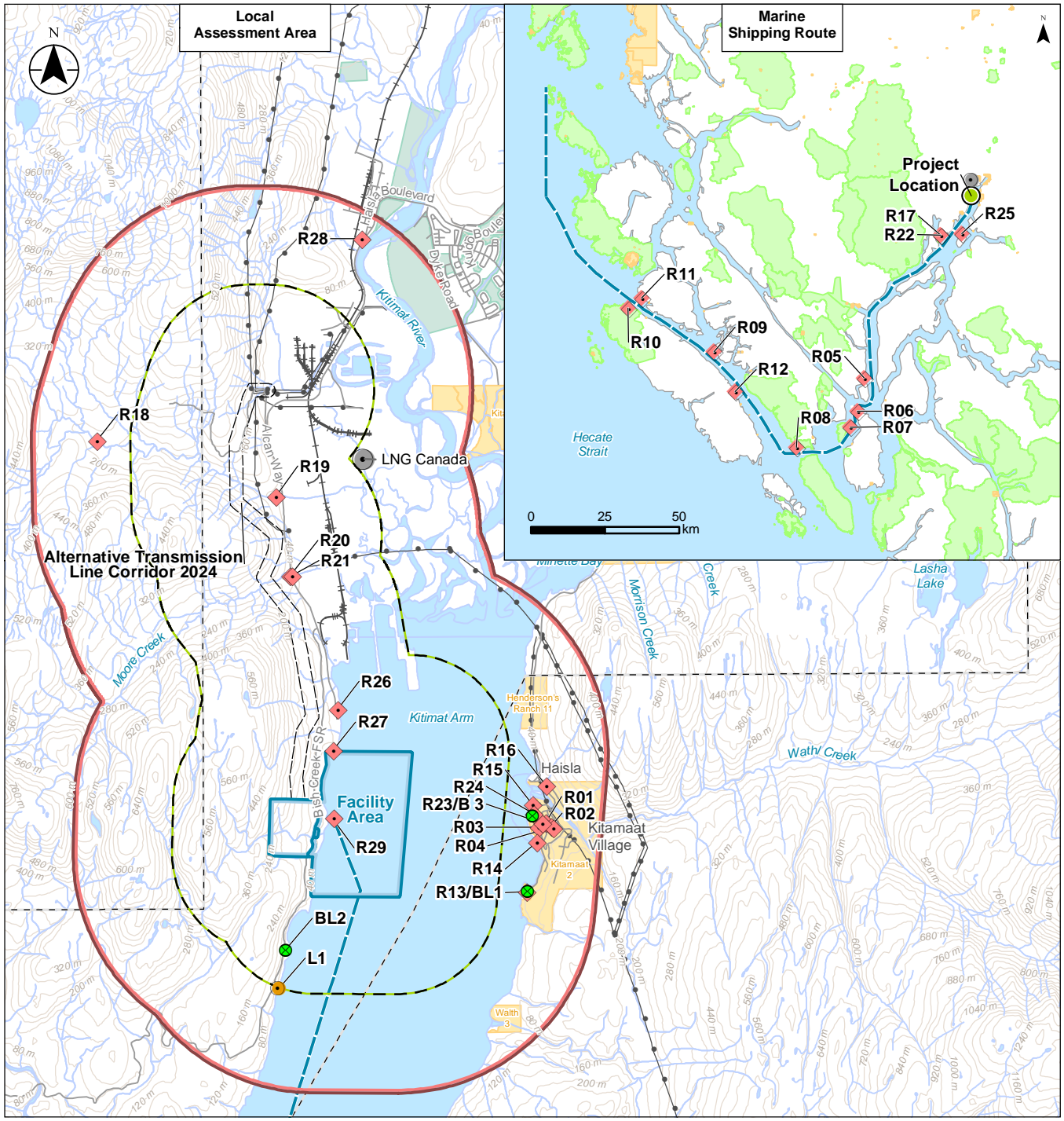
TABLE 6.6 SUMMARY COMPARISON IMPACTS AND POTENTIAL EFFECTS FOR ACOUSTICS

Impacts & Effects	Assessment Report	Amendment Application
Impacts	<ul style="list-style-type: none"> Increase noise levels 	<ul style="list-style-type: none"> Increase noise levels
Potential Effects	<ul style="list-style-type: none"> Increased noise levels causing nuisance, annoyance, and sleep disturbance to people, as well as displacement and sensory disturbance to wildlife 	<ul style="list-style-type: none"> Increased noise levels causing nuisance, annoyance, and sleep disturbance to people

Acoustic emissions from the FLNG will be required to meet the daytime and nighttime Permissible Sound Levels at a distance of 1.5 km from the facility fence line. This threshold is established by the BCER's British Columbia Noise Control Best Practices Guideline (version 2.4, June 2024) and is intended to protect environmental values. This section focusses on the potential noise effects on human receptors. Sensory disturbance to wildlife is not re-evaluated in this amendment application because the updated noise modelling predicts lower sound levels than those considered in the EAC Application noise assessment. As there is no increase in predicted noise levels or the previously assessed spatial extent of potential effects, the conclusions regarding sensory disturbance to wildlife remain valid and are not carried forward for further analysis in this amendment.

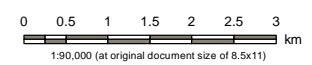
6.4.1 Existing Conditions

In response to Condition 8.2.1 of the Decision Statement issued to Cedar under Canada's *Impact Assessment Act*, multiple days of noise monitoring was conducted at the three locations identified in the Acoustic Follow-Up Program (Cedar 2024c). Figure 6.2 shows the three monitoring locations. Two are in Kitamaat Village (BL1 and BL3) and one monitoring location is on the Bish Creek FSR at a distance of 1.5 km from the facility (BL2). Long-term continuous noise monitoring was conducted at each receptor for a period of five days and provides representative ambient sound levels for Kitamaat Village and rural areas. Detailed information for the field study locations, method, and results is presented in the Acoustic TDR for this amendment (Appendix B).



Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

- LNG Canada
- Highway
- Road
- Railway
- Transmission Line
- Topographic Contour
- Watercourse
- Waterbody
- Reserve Land
- Local Greenspace
- District of Kitimat
- Municipal Boundary
- Facility Area
- Alternative Transmission Line Corridor 2024
- Marine Shipping Route (Approximate Location)
- Regional Assessment Area
- Local Assessment Area
- Cedar LNG Criteria Boundary (1.5 km)
- Noise Monitoring Location
- Noise Sensitive Receptor
- Assessment Location



Project Location:
 Kitimat,
 British Columbia

Client/Project/Report
 Cedar LNG Partners (GP) Ltd.
 Cedar LNG Project
 Application to Amend EAC #23-01 and Decision Statement

Figure No.
6.2

Title
Noise Sensitive Receptor Locations

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

The acoustic environment at the first Kitamaat Village monitoring location (BL1) is characterized by residence activities, construction activities, nature sounds such as dogs barking, bird calls, leaves rustling, and distance activities (e.g., marine vessel, train, jet). The acoustic environment at the second Kitamaat Village monitoring location (BL3) is characterized by human activities at Gya Wa Tlaab Healing Centre Society and playground nearby, local traffic activity, nature sounds such as bird calls, dogs barking, leaves rustling, and distance activities (e.g., marine vessel, train, jet). The Bish Creek FSR (BL2) location is 1.5 km from south of the Project boundary. The acoustic environment at BL2 is characterized by nature sounds such as bird calls, leaves rustling, coastal tide and waves, whale spouts/exhalations, local or logging traffic, and distant activities (e.g., marine vessel, train, jet). The measurement results at BL1, BL2, and BL3 are representative for twelve receptor locations in the noise assessment.

Detailed information for existing conditions at the noise monitoring locations and sensitive receptor sites are summarized in the Acoustic TDR amendment (Appendix B).

6.4.2 Potential Effects and Mitigation Measures

Modelling was conducted for the amendment to assess potential change in noise emissions during operations and potential effects on sensitive receptors. Receptors were updated to include the accommodation on the FLNG. Methods and result details are presented in the Acoustic TDR (Appendix B). The modelling incorporated updated equipment lists based on the current design stage of the Project, baseline noise monitoring completed since EAC#23-01 and the Decision Statement were issued, and an additional receptor located in the worker accommodation cabins on the FLNG. It also considered the equipment loading necessary to liquefy 500 million standard cubic feet per day of natural gas resulting from the proposed increase in liquefaction capacity.

The results of the updated modelling predict lower sound levels at the receptor locations in Kitamaat Village and on the Bish Creek FSR than were predicted by the modelling considered by the EAO in preparation of the Assessment Report. As a result, they are below thresholds in both the British Columbia Noise Control Best Practices Guideline (BCER 2024) and the Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise (Health Canada 2023). Based on these modelling results, the mitigation measures identified in the EAC Application remain applicable for the proposed increase liquefaction capacity in this amendment application and no new mitigation measures are required. Similarly, conditions in EAC #23-01 and the Decision Statement remain appropriate for this amendment application.

Cedar's updated modelling further considered disturbances for off-shift workers at the proposed accommodation block. The primary noise sources for off-shift workers are the natural gas treatment and liquefaction processes, and the HVAC system. The Province of British Columbia does not have noise guidance for industrial camps or similar environments. A review of Canadian and international standards identified five noise thresholds related to industrial accommodations (cabins) and sleep:

- Canadian Labour Code Maritime Occupational Health and Safety Regulations (SOR/2010-120)—75 A--weighted decibel (dBA)
- Canada-Newfoundland and Labrador Offshore Area Occupational Health and Safety Regulations (SOR/2021-247)—70 dBA

- International Maritime Organization (IMO) Code on Noise Levels on Board Ships (IMO 2012) for ships $\geq 10,000$ GT—55 dBA
- ANSI/ASA S12-2019 sound level criteria (intended for hotel or motel rooms) — 44 dBA
- Health Canada’s threshold for sleep disturbance (recommended for private residential bedrooms with very low background noise) —30 dBA

The Health Canada and American National Standards Institute (ANSI) thresholds are not considered suitable for accommodation cabins within the FLNG facility as the FLNG is an industrial facility and is affected by background noise from central HVAC systems and operation equipment.

For Cedar’s sleeping cabins within the proposed accommodation block on the FLNG, the updated modelling predicts sound levels will meet the Canadian Labour Code, Canadian Occupational Health and Safety Regulations and the IMO thresholds. However, the predicted sound levels will exceed the ANSI criteria and Health Canada’s threshold for sleep disturbance.

TABLE 6.7 SUMMARY OF POTENTIAL EFFECTS AND MITIGATION MEASURES – ACOUSTICS

Proposed Amendment Component	Project Phase	Change in Proposed Works or Activities	Change in Potential Effects	Change in Mitigation or Enhancement Measures	Change in Mitigation or Enhancement Measures Success Rating
Increase liquefaction capacity	Operation and commissioning ¹	No Change	No Change	No Change	No Change
Occupancy of the FLNG	Operation	Off-shift workers on the FLNG	No Change	No Change	No Change

Note: ¹Commissioning is included in the Construction Phase in the EAC #E23-01

6.4.3 Changes to Characterization of Residual Effects

Effects to the Acoustics VC due to the increased capacity were assessed for this amendment application. The Assessment Report concluded that Project effects on the acoustic environment are predicted to be not significant. The characterization of residual effects for the amendment application is unchanged from the Assessment Report and is summarized in Table 6.8. The residual effect magnitude is quantified with updated noise modelling based on the equipment used for the proposed increased liquefaction capacity and advanced design stage of the Project. In addition, the FLNG worker accommodation cabins are included as a receptor in the noise assessment.

The modelling results predict noise levels of 28.9 dBA at receptors in Kitamaat Village, 35.0 dBA at the Bish Creek FSR receptor (L1), and 51.0 dBA at the sleeping cabins inside the FLNG’s worker accommodation block. L1 is located 1.5 km south of the Project boundary. The BCER noise guideline requires that environmental noise impacts be assessed at 1.5 km from the facility or at the nearest residential dwelling, whichever is closer. Since there are no residential noise sensitive receptors within 1.5 km from the Facility Area, the L1 location is included.

The FLNG noise effect for receptors in Kitamaat Village, located more than 4 km away, is predicted to be negligible due to the distance and will be below the BCER daytime and nighttime Permissible Sound Levels at all residential receptors (BCER 2024). The change in percentage of people expected to be highly annoyed (%HA) at all receptors in Kitamaat Village is below the community annoyance 6.5% target for the operation phase and hence indicates compliance with the Health Canada guidance (Health Canada 2023). The results indicate that all residential receptors in Kitamaat Village are below the indoor sleep disturbance threshold.

The predicted sound level of 51 dBA in the FLNG worker accommodation cabins meets the Canadian Labour Code Maritime Occupational Health and Safety Regulations threshold of 75 dBA (Canada 2025a, Canada 2025b), the Canada-Newfoundland and Labrador Offshore Area Occupational Health and Safety Regulations of 70 dBA (Canada 2022), and IMO Code on Noise Levels on Board Ships threshold of 55 dBA (IMO 2012). Methods and result details are presented in the Acoustic TDR amendment (Appendix B).

TABLE 6.8 CHANGES TO ASSESSMENT REPORT CHARACTERIZATION OF RESIDUAL EFFECTS ARISING FROM PROPOSED AMENDMENTS – ACOUSTICS

Assessment Report Characterization of Residual Effects			Effect of Proposed Amendments on Characterization
Criteria	Assessment Rating	Rationale	
<i>Context</i>	<i>Moderate</i>	<i>Existing noise levels are not above BCER and Health Canada Guidelines. However, ambient sound levels in the Indigenous residential areas, combined with present projects, make this area sensitive to noise additions.</i>	No Change
<i>Direction and Magnitude</i>	<i>Adverse and Low</i>	<i>Noise will be elevated within the LAA and RAA, with noise effects being greater closer to the Project than those from far away. For instance, Kitamaat Village 1 and 2 have the closest approximate distance from residential dwellings to the Project. However, the change in %HA between total project sound and baseline is <6.5% at all Receptor IDs and application noise levels are all less than the PSLs under the BCER guidelines.</i>	No Change
<i>Extent</i>	<i>Local/Regional (LAA and RAA are the same area)</i>	<i>Residual effects to acoustic environment will not extend beyond the RAA. Noise decreases with distance from the noise source. Noise at a distance greater than 3 km from the FLNG facility and transmission would attenuate to a level that is below the ambient sound level.</i>	No Change
<i>Duration</i>	<i>Long-Term</i>	<i>The residual effects will last for the duration of the Project and in all project phases: Construction, operation, and decommissioning.</i>	No Change
<i>Frequency</i>	<i>Continuous</i>	<i>While construction noises are planned to only take place during the day (0700 to 2200 h), during the operation phase, project noise will occur 24 hours a day.</i>	No Change
<i>Reversibility</i>	<i>Reversible</i>	<i>Effects will cease upon completion of all project phases.</i>	No Change

Assessment Report Characterization of Residual Effects			Effect of Proposed Amendments on Characterization
Criteria	Assessment Rating	Rationale	
<i>Affected Population</i>	<i>Disproportionate</i>	<i>While noise levels will increase the closer to the Project, residential populations are no closer than 2.7 km from the facility boundary. However, the potential effect would disproportionately be experienced by Haisla Nation Communities due to proximity to the Project.</i>	No Change
<i>Risk (likelihood and consequence)</i>	<p><i>Likelihood: high likelihood of acoustic effects during construction and operations.</i></p> <p><i>Consequence: moderate consequence based on the low magnitude extending throughout the RAA.</i></p> <p><i>Risk: based on the high likelihood and moderate consequence of residual effects to the acoustic environment, it was determined that there would be a moderate level of risk.</i></p>		No Change
<i>Uncertainty</i>	<p><i>Uncertainty in acoustic effects at the facility is considered to be moderate. The EAO has a moderate level of confidence in the residual effects characterizations presented here, based on the acoustic modelling completed, the approach to establishing baseline conditions, the feedback received from the Working Group during the EA, and the proposed federal Mitigation Measures and provincial conditions (including a Follow-up Program for noise).</i></p>		No Change
<i>Significance</i>	<p><i>In consideration of the above analysis and proposed conditions and federal Mitigation Measures, the EAO concludes that the Project would not have significant adverse residual effects on the acoustics VC in the Facility Area. Acoustic effects would not exceed Health Canada guidelines and effects would be fully reversible follow decommissioning of the Project.</i></p>		No Change

Note:

The text in italics is reproduced from the Assessment Report for the Cedar LNG Project (EAO 2022).

6.4.4 Cumulative Effects Assessment

Cumulative effects on the Acoustic VC are considered for areas beyond the Marine Terminal Area and are predicted to be lower with the proposed changes outlined in the amendment application than for the approved Project as presented in the EAC Application and Assessment Report.

The proposed amendment is anticipated to have less interaction with past, present, and reasonably foreseeable projects and activities compared to the EAC Application. As such cumulative effects on the Acoustics VC because of the amendment are predicted to be consistent with the Assessment Report and the characterization presented in the EAC Application is anticipated to remain valid.

6.4.5 Risk and Uncertainties

The prediction confidence for Project residual effects and residual cumulative effects for acoustic resources is high and is based on:

- The accuracy of the Project design information, noise source data, and sound propagation algorithm.
- The Cadna/A model predicts outdoor noise in accordance with International Organization for Standardization (ISO) 9613. The ISO 9613 sound propagation algorithms have a published accuracy of ± 3 decibels (dB) over source receiver distances between 100 m and 1,000 m. The accuracy for distances up to or over 1.5 km is not stated. 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, which is more conservative than upwind or crosswind conditions. In addition, all operating equipment was modelled at 100% capacity even though the capacity might be less throughout the year.

6.4.6 Adaptive Management and Monitoring Measures

The Project is not predicted to exceed:

- Health Canada noise guidance (2023)
- BCER noise guideline (2024) thresholds at receptors in Kitamaat Village or at 1.5 km from the FLNG

The predicted sound level of 51 dBA at the FLNG worker accommodation cabin meets:

- Canadian Labor Code Maritime Occupational Health and Safety Regulations threshold of 75 dBA (Canada 2025a, Canada 2025b)
- Canada-Newfoundland and Labrador Offshore Area Occupational Health and Safety Regulations threshold of 70 dBA (Canada 2022)
- IMO Code on Noise Levels on Board Ships threshold of 55 dBA for sleeping cabins (IMO 2012)

Therefore, no changes to the approved follow-up program are proposed for acoustic resources. It is noted that noise effects will also be considered in the *Energy Resource Activities Act* permitting process with the BCER.

6.5 Human Health

The proposed changes in this amendment application alter the potential effects to the Human Health VC that were considered in the EAC Application and the Assessment Report. Table 6.9 provides a side-by-side comparison of the impacts and potential effects from the Assessment Report versus what is considered in this amendment application for air quality and noise.

TABLE 6.9 SUMMARY COMPARISON IMPACTS AND POTENTIAL EFFECTS FOR HUMAN HEALTH

Impacts & Effects	Assessment Report	Amendment Application
Impacts	<ul style="list-style-type: none"> Emissions of air pollutants and noise based on a Project capacity of 400 million standard cubic feet per day of LNG. 	<ul style="list-style-type: none"> Emissions of air pollutants and noise based on a Project capacity to liquefy 500 million standard cubic feet per day of natural gas into LNG.
Potential Effects	<ul style="list-style-type: none"> Change to human health for people in the surrounding communities (e.g., Kitimat and Kitamaat Village) resulting from Project-related emissions of air pollutants and noise. 	<ul style="list-style-type: none"> Change to human health for people in the surrounding communities (e.g., Kitimat and Kitamaat Village) resulting from Project-related emissions of air pollutants and noise. Change to human health for off-duty workers housed on the FLNG resulting from Project-related emissions of air pollutants and noise.

Overall, the proposed changes in this amendment offer several health and safety benefits. The accommodation of up to 80 workers directly on the FLNG facility reduces the need for daily transportation between Kitimat and the Facility Area, thereby lowering the risk of vehicle accidents and potential for injuries. Onboard accommodation also reduces traffic volume on roads and eases pressure on local infrastructure. With fewer non-local workers residing in the community, potential public health risks and the burden on health services are also reduced.

From a safety and operational standpoint, housing personnel on the FLNG improves emergency preparedness, incident response times, and enhances the capacity to effectively manage upsets or emergencies. Reduced shift turnover and improved communication between day and night operations contribute to operational continuity and lower risks of miscommunication-related incidents. Overall, this amendment supports a more self-contained, resilient, and health and safety-conscious operational model that benefits both workers and surrounding communities.

Although the amendment changes improve overall safety and operational efficiency, accommodating workers directly on the FLNG introduces changes in how people may be exposed to environmental pollutants and stressors. Workers housed onboard will be in closer proximity to operational sources of air pollutants and noise when they are off-duty. This means that the air pollutant concentrations and noise levels experienced by off-duty workers on the FLNG are likely to be higher than if they were living in Kitimat or nearby communities.



The EAC Application had assessed air quality and noise effects on people living in Kitimat, Kitamaat Village, and the Cedar Valley Lodge worker accommodations for the LNG Canada Project. However, air quality and noise effects on the FLNG were not assessed since there was no proposed FLNG worker accommodation at the time.

By assessing potential health risks to off-duty workers at the FLNG worker accommodations, the human health assessment considers a worst-case exposure scenario. These workers would be living in close proximity to the Project's major sources of air emissions and noise. This approach provides important context for understanding potential effects at more distant locations, such as Kitimat, Kitamaat Village, and the Cedar Valley Lodge accommodations. At these locations, people are farther away from the Project, which allows air emissions to disperse and noise levels to dissipate over distance. As a result, the Project's effects on human health in these more distant locations are expected to be lower than those for workers living directly at the FLNG worker accommodations.

The assessment of human health is based on the modelling results carried out for the Air Quality VC and the Acoustic VC. Specialists in air quality and acoustics use established methods and tools to model concentrations of air pollutants and levels of noise associated with the Project. These modelling results provide the exposure estimates that are then used as inputs for the human health assessment.

The human health assessment does not generate or validate the air quality or acoustic model results. Instead, it focuses on examining the potential implications of the modelled exposure estimates on human health. From a toxicological perspective, the assessment considers how exposure to the modelled levels of air pollutants or noise could affect people.

For more information on the air quality and acoustic model inputs, refer to Section 6.3 (Air Quality VC) and Section 6.4 (Acoustic VC) and their associated TDRs (Appendix A and Appendix B). Some modelling input information (e.g., emissions inventory) may be presented in the Human Health VC for context; however, when included, it will reference the original source material in the TDRs.

6.5.1 Existing Conditions

Human health is influenced by multiple environmental factors, such as the quality of the air people breathe, the water they drink, and the food they eat. The existing condition for human health reflects the combined effect of these factors. Since the amendment focuses on changes to human health arising from changes in air quality and noise, the existing conditions for human health are linked only to these environmental components. Establishing these conditions is necessary to identify Project-related changes.

6.5.1.1 AIR QUALITY

Table 6.10 presents baseline concentrations for NO₂, SO₂, and PM_{2.5} compared to the WHO AQGs. Baseline air quality is defined as ambient concentrations that are not influenced by major industrial emission sources in the Kitimat region (e.g., emissions related to the Rio Tinto aluminum smelter and the LNG Canada Project). The values selected for baseline air quality are intended to account for emission sources that are not modelled (e.g., traffic emissions, home heating, small industrial and commercial businesses, rail emissions, recreational marine traffic). Baseline air quality concentrations are added to model predictions in the Base Case, Application Case and Future Case to account for the cumulative influence of these sources on air quality.

TABLE 6.10 BASELINE AIR QUALITY

Air Pollutant	Averaging Period	World Health Organization Air Quality Guideline ($\mu\text{g}/\text{m}^3$)	Baseline ($\mu\text{g}/\text{m}^3$)
NO ₂	1-hour	200	9.3
	24-hour	25	7.8
	Annual	10	2.9
SO ₂	24-hour	40	2.5
PM _{2.5}	24-hour	15	9.4
	Annual	5	3.4

Source: Air Quality VC – Dispersion Modelling Plan Technical Data Report (Section 8.0 – Baseline Concentration)

Table 6.11 presents the emissions inventory for SO₂, NO_x, and PM_{2.5} used in the air dispersion modelling scenarios. Four scenarios are considered:

1. **Base Case** – The Base Case represents the total authorized emissions from existing sources, including the Rio Tinto aluminum smelter, the LNG Canada facility, and their associated marine traffic.
2. **Project-Along Case** – The Project-Along Case represents emissions from the Cedar LNG Project in isolation (excluding baseline).
3. **Application Case** – The Application Case represents the future emissions based upon the sum of the Base Case and Project-Along Case. It represents the combined air pollutant emissions from existing major industrial sources and the Project during operations.
4. **Future Case** – The Application Case with reasonably foreseeable future project emissions, primarily from Phase II of the LNG Canada Project.

The emissions inventory provides context regarding the relative scale of major industrial emission sources in the area. It shows that emissions from the Project would increase the total emissions from major industrial sources by 2.2% for SO₂, 9.9% for NO_x, and 2.5% for PM_{2.5}. This relatively small contribution is expected to have a limited influence on the health of residents in Kitimat, Kitamaat Village, and the Cedar Valley Lodge accommodation camp, where greater distance allows for dispersion and dilution of emissions. In contrast, the proximity of the FLNG worker accommodations to the Project's emission sources is an important factor in determining the potential health risks.

TABLE 6.11 EMISSIONS SUMMARY FOR EACH MODELLING SCENARIO

Modelling Scenario	Emissions (tonnes/year)		
	SO ₂	NO _x	PM _{2.5}
Base Case ¹	15,663	1,941	937
Project-Alone Case	354	192	23.4
Application Case	16,017	2,133	960
Future Case	16,349	3,640	985

Source: Air Quality VC – Dispersion Modelling Plan Technical Data Report (Section 6.3 – Model Emission Sources)

¹ Base Case emissions represent the authorized emissions from the Rio Tinto aluminum smelter, LNG Canada facility, and their associated marine traffic (e.g., LNG carriers, tugboats)

6.5.1.2 NOISE

Existing conditions for noise in the vicinity of the proposed FLNG worker accommodations is based on noise monitoring conducted near the Project along the Bish Creek FSR. Baseline monitoring recorded average daytime noise levels of approximately 47.7 dBA, nighttime levels of 43.4 dBA, and a calculated day–night noise level of 50.7 dBA. These measurements are documented in the Acoustic TDR (Appendix B; Table 7 – Cedar LNG Baseline Monitoring Results).

To provide context, these noise levels are similar to those experienced on a quiet street or inside an average urban home. Human-made contributions to noise in the area are limited, with the primary sources being trucks and other vehicles engaged in forestry activities along the Bish Creek FSR.

6.5.2 Potential Effects and Mitigation Measures

6.5.2.1 POTENTIAL EFFECTS FROM AIR QUALITY

Air quality dispersion model results for the Base Case and Application Case are applied towards the assessment of human health. The modelled concentrations of NO₂, SO₂, and PM_{2.5} were compared to the WHO AQG to evaluate potential health risks. The WHO (2021) defines its AQG as, “... *the lowest exposure level of an air pollutant above which the guideline development group is confident that there is an increase in adverse health effects,*” and that, “*It is assumed that adverse health effects do not occur or are minimal below this concentration level*”. Based on this guideline, concentrations of air pollutants below the WHO AQG are assumed to carry a negligible health risk.

Some air pollutants such as NO₂ and PM_{2.5}, are considered non-threshold pollutants, meaning there is no exposure level below which adverse health effects are completely absent. The WHO AQGs are specifically developed to protect vulnerable and susceptible subgroups of the population, including children, the elderly, and individuals with pre-existing health conditions. At concentrations below the AQG, the likelihood and severity of effects are reduced, with potential outcomes limited to less severe health effects such as mild airway irritation, transient decreases in lung function, or temporary exacerbation of respiratory symptoms in sensitive individuals. These effects are comparatively minor relative to the

WHO's primary metric of concern, which is all-cause, non-accidental mortality. While low-level exposures below the AQG may still carry some risk of these less severe effects, no established quantitative metrics currently exist to describe the risk associated with increasing concentrations in this lower range.

The first step in evaluating potential health risks is to determine whether air pollutant concentrations exceed the WHO AQG and estimate the frequency of exceedances at the FLNG worker accommodation during operation. For averaging periods of 1 hour and 24 hours, an exceedance corresponds to one hour or one day within the year, respectively. This is based on the average number of annual exceedances over the modelled 5-year period. This approach allows for a clear interpretation of the model outputs by linking short-term concentration elevations to specific periods of potential exposure. For the annual averaging period, exceedances are expressed as the number of years in which the guideline is exceeded, reported as an average over the modelled 5 years (e.g., an exceedance of 0.2 indicates that one out of five modelled years showed an exceedance of the WHO AQG).

The number of exceedances under the Base Case and Application Case is presented in Table 6.12. The difference from Base Case to the Application Case is the incremental increase that may be attributed to Project emissions.

TABLE 6.12 WORLD HEALTH ORGANIZATION AIR QUALITY GUIDELINE EXCEEDANCE FREQUENCY AT THE FLNG WORKER ACCOMMODATIONS

Air Pollutant	Averaging Period	WHO AQG ($\mu\text{g}/\text{m}^3$)	Average Exceedances Per Year			Maximum Exposure Concentration at the Worker Accommodation ($\mu\text{g}/\text{m}^3$)
			Base Case	Application Case	Base Case	Application Case
NO ₂	1-hour	200	0	0	75.6	127.9
	24-hour	25	4	6.2	27.3	42.6
	Annual	10	0	0	4.7	6.6
SO ₂	24-hour	40	24	24.3	236.0	243.9
PM _{2.5}	24-hour	15	69.4	71.4	22.1	23.1
	Annual	5	5	5	6.3	6.7



The health risk from short-term (1-hour) exposure to NO₂, and from long-term (annual) exposure to NO₂ and PM_{2.5} is considered negligible because concentrations did not exceed the WHO AQGs under both the Base Case and Application Case.

Although there are some incremental increases for the remaining air pollutants for the 24-hour averaging period, the frequency of exceedances shown in Table 6.12 is overestimated as a result of the conservative assumptions applied in the air dispersion model. For example, modelling for the Application Case assumed that the industrial projects would operate at full capacity at all times. The modelling scenario for 1-hour and 24-hour averaging periods also assumed that an LNG carrier and its associated tugboats would be moored at the FLNG every day of the year, whereas in practice an LNG carrier would moor along the FLNG every 7 to 10 days and remain for approximately 24-hours when loading product.

To help explain the conservatism in simpler terms, the air dispersion model was intentionally designed to capture the worst-case scenario, meaning the highest degree of spatial and temporal overlap of air pollutant concentrations that could occur from the model estimates. For this to happen, the peak emissions from other industrial projects in the Base Case and from the Project-Along Case would need to occur at the same location and at the same time. To maximize this overlap, the model for 1-hour and 24-hour averaging periods had assumed that an LNG carrier was moored along the FLNG Facility and adjacent to the worker accommodations for every single day of the year. This assumption artificially forces LNG carrier and tugboat emissions to always be present, so that they line up with the “worst-day” of the Base Case emissions.

The key point for understanding human health risks for off-duty workers on the FLNG facility is how the air dispersion model treated LNG carriers and their emissions for 1-hour and 24-hour averaging periods. Based on the Project’s planned operational capacity, there would be up to 50 LNG carrier shipments per year, or roughly one carrier every 7.3 days. During each shipment, the LNG carrier and tugboats are expected to remain moored for about 24 hours. Under this schedule, emissions from LNG carriers and tugboats would come and go in an oscillating wave pattern. Emissions would rise for the 24 hours when the LNG carrier is moored, then fall back down as the LNG carrier departs, and then rise again about a week later when the next carrier arrives. As a result, there is a much lower probability that peak Project emissions would coincide with peak Base Case emissions from other sources. This is how the model overestimates the number of days that 24-hour average concentrations of NO₂, SO₂, and PM_{2.5} would exceed the WHO AQG.

If other projects operate below their maximum capacity, or if the air dispersion model inputs were refined to reflect the actual LNG carrier, it is unlikely that there would be more than one additional day of exceedance of the WHO AQG for the 24-hour averages of NO₂, SO₂, and PM_{2.5}.

By contrast, the annual average concentrations are considered more representative of operational conditions, as they account for the planned LNG carrier activity of 50 shipments per year. Under this more realistic model estimate, the annual average NO₂ concentrations remain below the WHO AQG for the five modelled years. For annual average PM_{2.5}, concentrations already exceed the WHO AQO for the five modelled years under Base Case. However, under the Application Case, the annual average PM_{2.5} concentration is estimated to rise by only a marginal amount (0.4 µg/m³) relative to the Base Case.

Overall, the potential residual effect on human health is considered low, recognizing that even small increases in non-threshold pollutants like NO₂ and PM_{2.5} may contribute to less severe respiratory effects, but do not represent a significant risk.



6.5.2.2 POTENTIAL EFFECTS FROM NOISE

Acoustic modelling results for the Amendment are described in the Acoustic VC (Section 6.4) and the Acoustics TDR (Appendix B).

The modelled noise level inside the FLNG worker accommodation cabin is 51 dBA. This level reflects typical background conditions on industrial marine vessels, where sound is primarily generated by the HVAC system and by continuous low-frequency noise from electrical and mechanical equipment. In the FLNG worker accommodation cabins, the HVAC system is expected to be the dominant noise source, as it provides cabin ventilation and prevents stagnant air or the accumulation of hazardous gases within enclosed spaces. These steady background sources shape the indoor acoustic environment to a greater extent than short or intermittent noise events.

The assessment of noise levels on human health involves calculating the %HA at the modelled sound levels. The threshold for acceptability is an increase of no more than 6.5 %HA above the baseline percentage of annoyance. In this case, there is no existing FLNG worker accommodation and no workers from which to establish a baseline, so it is assumed to be 0 %HA.

The total %HA can still be estimated using the modelled noise level of 51 dBA into the following formula:

$$\%HA = \frac{100}{1 + e^{[10.4 - 0.132 \cdot Ldn]}}$$

The noise level at which the %HA reaches 6.5 percent is approximately 58.5 dBA. This means that the cabin noise level would need to exceed 58.5 dBA as a minimum requirement to possibly exceed the %HA threshold of +6.5%HA above baseline. The modelled cabin noise level of 51 dBA corresponds to 2.2 %HA, and it is within acceptable limits for daytime annoyance.

To assess the potential for nighttime sleep disturbance, the IMO Code (2012) was applied, which sets recommended noise limits for marine vessels. For cabins and medical areas, the IMO code specifies an indoor limit of 55 dBA. The modelled noise level of 51 dBA is below this limit, indicating that the potential for nighttime sleep disturbance in the FLNG worker accommodations is low.

Consideration was given to Health Canada guidance on indoor noise limits, which recommend that sound levels during the sleep period should not exceed 30 dBA for continuous noise. This threshold is based on conditions typical of private residential bedrooms, where background sound levels are very low and even minor changes in noise may be more noticeable. The FLNG worker accommodation cabins differ substantially from this type of environment, as the required HVAC ventilation system in each cabin produces background noise levels above 30 dBA.

In these cabins, most of the sound originates from the HVAC system and noise from electrical and mechanical equipment. These sources produce a continuous and relatively steady background. Unlike intermittent or irregular sounds such as banging, ticking, or thumping, which tend to be more intrusive and disruptive to sleep, a constant background noise is generally less disturbing and can mask other incidental sounds. For this reason, applying the residential threshold of 30 dBA is not appropriate in this context. Instead, the assessment of potential sleep disturbance should be based on the recognition that cabin noise levels reflect typical background conditions on marine vessels and are not expected to create an unusual or disruptive sleep environment for workers on board.

6.5.2.3 MITIGATION MEASURES

There are no new mitigation measures specific to human health that are proposed for this amendment. Project mitigation and enhancement measures have already been applied to the Project in upstream modelling to reduce the potential effects on human health to the degree that there are no unacceptable effects to human health. No further mitigation measures or enhancement measures other than those committed to in the original EAC Application are required to further reduce potential health risks.

TABLE 6.13 SUMMARY OF POTENTIAL EFFECTS AND MITIGATION MEASURES – HUMAN HEALTH

Proposed Amendment Component	Project Phase	Change in Proposed Works or Activities	Change in Potential Effects	Change in Mitigation or Enhancement Measures	Change in Mitigation or Enhancement Measures Success Rating
Increase liquification capacity	Operation and commissioning ¹	No Change	No Change	No Change	No Change
Occupancy of the FLNG	Operation	Off-duty workers living on the FLNG worker accommodations	No Change	No Change	No Change

Note: ¹Commissioning is included in the Construction Phase in the EAC #E23-01

6.5.3 Changes to Characterization of Residual Effects

Effects to human health due to the increased Project capacity and the introduction of the FLNG worker accommodations were assessed for this amendment application. The Assessment Report concluded that Project effects to human health are predicted to be not significant. The characterization of residual effects for the amendment application is unchanged from the Assessment Report and is summarized in Table 6.14.

The amendment application focuses on potential health risks to off-duty workers on the FLNG worker accommodations because these people would experience the greatest degree of exposure to Project-related emissions of air pollutants and noise due to their proximity to emission sources. The incremental increase in health risk from exposure to Project-related emissions of air pollutants is low, as Project emissions represent a small percentage of overall emissions from other nearby industrial sources. The risk of noise-related annoyance and sleep disturbance within the FLNG worker accommodation cabins is below the applicable noise guidelines and considered to be negligible.

Based on these results, the direction of the residual effect to human health is adverse, with a low magnitude of effect. The effect extends throughout the LAA/RAA, although the assessment focused on the FLNG worker accommodations with the assumption that more distant communities in Kitimat, Kitimaat Village, and the Cedar Valley Lodge worker accommodations would experience a smaller incremental effect from the Project because they are further away. The duration of the residual effect is long-term, lasting for the life of the Project. The frequency of the residual effect is continuous as Project emissions of

air pollutants and noise is continuous for the life of the Project. The effect to human health is reversible at the end of the Project life as air pollutants will disperse into the atmosphere and air quality returns to existing conditions while noise emissions will cease.

The residual effects on human health are disproportionate, affecting those in closest proximity to the Project the greatest, with diminishing effects with increasing distance from the Project. The residual effects may also be more prominent among health-sensitive individuals such as infants, children, seniors, and people with existing health conditions of a respiratory nature (e.g., asthma). However, the likelihood and consequence of residual effects is low, as the air dispersion and acoustic models applied a conservative approach that tends to overestimate the potential health risk. Uncertainty in the assessment is also considered low for the same reason. Overall, the assessment indicates that the residual effect to human health from the Project is not significant.

TABLE 6.14 CHANGES TO ASSESSMENT REPORT CHARACTERIZATION OF RESIDUAL EFFECTS ARISING FROM PROPOSED AMENDMENTS – HUMAN HEALTH

Assessment Report Characterization of Residual Effects			Effect of Proposed Amendments on Characterization
Criteria	Assessment Rating	Rationale	
Context	Noise: Moderate COPCs: Low	Existing noise levels are not above OGC and Health Canada Guidelines. However, ambient sound levels in the Kitimaat Village, combined with present projects, make this area sensitive to noise additions. The modelled base case COPCs are above acceptable levels for human health; therefore, the EAO considers air quality in the Kitimat area to have low resiliency or ability to accommodate additional increases in COPCs.	No Change
Direction and Magnitude	Noise: Adverse and Low COPCs: Adverse and Moderate	The maximum increase in %HA and sleep disturbance sound level were both less than Health Canada's guidelines. The maximum effects to human health from increase in COPCs were minor but in many cases the modelled base case concentration was already greater than acceptable levels.	No Change
Extent	Noise: Local/Regional COPCs: Local	Predicted effects to human health from noise is applicable throughout the LAA/RAA. However, the %HA and sleep disturbance are less than Health Canada guidelines. Predicted effects to human health from increase in COPCs are applicable throughout the LAA.	No Change
Duration	Long-term	The residual effects on human health from the Facility Area occur throughout all Cedar LNG phases.	No Change
Frequency	Noise: Continuous COPCs: Continuous	Effects of noise from the Facility Area would occur continuously throughout all Cedar LNG phases. The increase in COPCs from the Facility Area would be expected throughout all Cedar LNG phases.	No Change



Assessment Report Characterization of Residual Effects			Effect of Proposed Amendments on Characterization
Criteria	Assessment Rating	Rationale	
Reversibility	<i>Reversible / Irreversible</i>	<i>The residual effects on noise and air quality from the activities at the Facility Area would cease following the end of decommissioning of Cedar LNG. Human health effects from exposures to high levels of COPCs to individuals may be irreversible.</i>	No Change
Affected Population	<i>Disproportionate</i>	<i>The effects of the Facility Area would be more acutely experienced by local residents and Haisla members who are located in closer proximity (such as employment or residence) and frequency (such as permanency of residence or length of employment/shifts). In addition, the residents of the Haisla Recovery Centre/hospital, which is located near the shoreline along the Marine Shipping Route, may be more disproportionately affected by changes to VCs affecting human health.</i>	No Change
Risk (likelihood and consequence)	<i>Likelihood: high likelihood of effects due to noise and COPCs during construction and operations. Consequence: moderate consequence based on the low to moderate magnitude extending throughout the RAA. Risk: based on the high likelihood and moderate consequence of residual effects to the acoustic environment, it was determined that there would be a moderate level of risk.</i>		No Change
Uncertainty	<i>Uncertainty is low to moderate. The EAO has a high level of confidence that effects have not been underestimated based on the conservatism applied in the HHRA, and the conservative approach and assumptions applied in the air dispersion and acoustic modelling</i>		No Change
Significance	<i>In consideration of the above analysis and low magnitude of modelled effects, and the conditions identified in the TOC and Mitigation Measures, the EAO concludes that the Facility Area would not have significant adverse residual effects on the human health VC.</i>		No Change

Note:

The text in italics is reproduced from the Assessment Report for the Cedar LNG Project (EAO 2022).



6.5.4 Cumulative Effects Assessment

6.5.4.1 AIR QUALITY

A review of available information indicates that Phase II of the LNG Canada Project would have overlapping spatial and temporal effects on air quality with subsequent effects to human health. Table 6.11 shows the emission inventory for the Future Case, which includes the increased emissions from Phase II of the LNG Canada Project.

A review of the air dispersion modelling results for the Future Case was conducted in the Air Quality VC (Section 6.3.5 – Cumulative Effects Assessment). The review of the air dispersion modelling results for the Future Case indicates a small increase in the maximum predicted concentrations compared to the Application Case. The maximum concentration of NO₂, SO₂, and PM_{2.5} in the LAA/RAA increased by 1.1%, 0.5%, and 0.05%, respectively, compared to the Application Case. At the FLNG worker accommodations, the incremental increase is lower because the Project is situated southwest of the LNG Canada Project, where prevailing winds blow northward.

The dispersion modelling results show a negligible to small cumulative effect to air quality in the Future Case, and a subsequently small cumulative effect to human health. The proposed amendment is anticipated to have similar interactions with past, present, and reasonably foreseeable future projects and activities compared to the EAC Application. Therefore, the cumulative effects to human health from the changes described in the amendment are consistent with the Assessment Report and the characterization presented in the EAC Application is anticipated to remain valid.

6.5.4.2 ACOUSTICS

A review of available information indicates that there are no reasonably foreseeable future projects that would result in spatially or temporally overlapping effects on noise in combination with the amendment. As such, potential cumulative effects from external sources are not anticipated. Cumulative effects on human health related to noise for the amendment are anticipated to be the same as those described in the EAC Application.

With the addition of the FLNG worker accommodations, off-duty personnel will be located in the immediate vicinity of machinery and equipment that generates noise. Given this proximity, these on-site sources will dominate noise conditions at the FLNG worker accommodations. Noises from more distant sources would likely be negligible in comparison. Consequently, the cumulative effects on human health from noise are expected to be driven primarily by the FLNG facility's own operations. Therefore, the cumulative effects to human health from the changes described in the amendment are consistent with the Assessment Report and the characterization presented in the Assessment Report is anticipated to remain valid.



6.5.5 Risk and Uncertainties

6.5.5.1 MODEL UNCERTAINTIES

The assessment of human health is based on modelled exposures to air pollutants and noise during operations at the FLNG worker accommodations. While model results indicate that the magnitude of health risk is low, these conclusions rely on model estimates from the Air Quality and Acoustic VCs. The assessment of human health does not involve conducting or validating the air quality and acoustic models. Specialists in air quality and acoustics use established methods and tools to model concentrations of air pollutants and levels of noise associated with the Project. For the purposes of this assessment, it is assumed that the modelling reflects the conditions described in the assessed scenarios.

As with all models, there is an inherent uncertainty because the outputs are only as reliable as the inputs. When uncertainty exists, a conservative approach is applied to avoid underestimating the potential environmental effect. For example, the air dispersion model assumes that the major industrial emission sources in the Application Case are always operating at their permitted maximum capacity. This mitigates underestimating the emissions and the resulting health risk. If projects operate below their permitted capacity, the realized emissions are likely lower than the model estimates.

Additionally, factors such as weather and climate variability introduce uncertainty because they cannot be predicted with absolute certainty, although general trends can be inferred from historical data. Other events like forest fires, which the model does not incorporate, can have a substantial impact on air quality beyond the scope of the model estimates. This means the model results should not be interpreted as what will happen, but rather as what could occur under the specific input conditions that were selected to represent each scenario.

In contrast, noise modelling is less affected by such variability. Noise propagation models are well suited to predict sound levels accurately over both short and long distances, including in near-field conditions.

Overall, the uncertainties associated with air quality and acoustic modelling results as they relate to human health are low, given that a conservative approach is applied to avoid underestimating the health risk when uncertainties exist.

6.5.5.2 UNCERTAINTY FROM EXPOSURE TO MULTIPLE AIR POLLUTANTS

People are continuously exposed to a complex mixture of air pollutants rather than to individual substances in isolation. Common air pollutants such as NO₂, SO₂, and PM_{2.5} originate from both natural processes (e.g., wildfires, dust storms, volcanic activity) and anthropogenic activities (e.g., combustion of fossil fuels, industrial processes, transportation). In the atmosphere, these pollutants coexist and interact dynamically, with concentrations and mixtures changing over time and space depending on factors such as weather conditions, chemical transformations, and emission patterns.

The health risks from exposure cannot be fully understood by evaluating each pollutant independently. Interactions among multiple air pollutants may have additive, synergistic, or antagonistic effects on health. However, the scientific understanding of how mixtures of air pollutants interact and modify health outcomes is limited. The current risk assessment frameworks are not yet capable of fully addressing such combined effects. The WHO AQG (2021) also recognizes this knowledge gap, stating that its guidelines



do not include recommendations about air pollutant mixtures or the combined effects of multiple pollutant exposures.

At present, scientifically accepted health risk assessment methods are usually designed for individual pollutants or defined groups of pollutants with similar mechanisms of action. For most common air pollutants, however, mixture-based assessment methods are not well established. Consequently, health risk assessments typically evaluate the potential risks of each pollutant separately, with the implicit recognition that this approach may underestimate or oversimplify the risks associated with combined exposures.

6.5.6 Adaptive Management and Monitoring Measures

There are no recommended adaptive management or monitoring measures specific to human health. Mitigation and enhancement measures for air quality and acoustics, as outlined in the EAC Application and Assessment Report, have already been incorporated into the Project's modelling to reduce potential effects on human health. As a result, no unacceptable health risk is anticipated. The assessment of human health at the FLNG worker accommodations therefore did not identify any additional need for adaptive management or monitoring.

6.6 Freshwater Fish

The increase in liquefaction capacity included in this amendment application may alter the effects to the Freshwater Fish VC that were considered in the EAC Application and the Assessment Report. Potential effects previously assessed included: changes in surface water quality; change in fish habitat; and change in fish health or mortality risk.

The proposed changes do not include any physical works, and therefore, there are no changes to the assessment of change in fish habitat or fish health or mortality risk. However, two potential issues were identified in connection with surface water quality:

- Acid deposition (of sulphur and nitrogen compounds) can lower surface water pH, a process known as acidification.
- Nitrogen deposition can increase the nitrogen available as a nutrient within surface water, a process known as eutrophication.

Table 6.15 provides a side-by-side comparison of the impacts and potential effects from the Assessment Report versus what is considered in this amendment application for freshwater fish. A description of the existing conditions that influence the assessment for the proposed changes to the Project is provided below, followed by the effects assessment.

The updated air quality dispersion and deposition modelling developed in 2025 was used to assess potential changes to the effects of eutrophication and acidification on surface water associated with the increased facility capacity. An acidification and eutrophication assessment of surface waters was conducted in 2021 for the EAC Application, details are found in the 2021 Surface Water Acidification and Eutrophication Assessment TDR (Stantec 2021a).

For a detailed description of the updated acidification and eutrophication assessment refer to 2025 Surface Water Eutrophication and Acidification Assessment TDR (Appendix C). The updated 2025 air quality dispersion and deposition modelling was applied to the same three lakes and five stream sites as the 2021 assessment, with site details provided in the 2021 Surface Water Acidification and Eutrophication Assessment TDR (Stantec 2021a). In addition, the same baseline water quality data from ESSA (2013) and LNG Canada (2014) were used to consider the 2025 assessment as for the 2021 assessment.

TABLE 6.15 SUMMARY COMPARISON IMPACTS AND POTENTIAL EFFECTS FOR FRESHWATER FISH

Impact & Effect	Assessment Report	Amendment Application
Impacts	Increase in N, S, S+N deposition rates, resulting in: <ul style="list-style-type: none"> • No predicted changes in trophic state • Predicted critical load of acidity exceedance for LAK028 	Change in predicted increase in N, S, S+N deposition rates (Appendix C), resulting in: <ul style="list-style-type: none"> • No predicted changes in trophic state • No predicted critical load of acidity exceedance
Potential Effects	<ul style="list-style-type: none"> • Change in surface water quality 	<ul style="list-style-type: none"> • Change in surface water quality



6.6.1 Existing Conditions

As discussed in Section 6.3.1 (Air Quality Existing Conditions), existing air quality in the Kitimat Valley has not changed substantially from that described in the EAC Application and technical memorandum (Stantec 2022). Also, existing conditions for water quality and freshwater fish resources are not expected to have changed substantially (e.g., same watercourses and fish species present) from that described in the EAC Application.

The Kitimat Valley airshed remains impacted at baseline by existing and historical emissions sources. The majority of existing acidifying emissions are due to Rio Tinto emissions, and LNG Canada is the primary source of existing nitrogen emissions.

The results of the eutrophication assessment indicated that the assessed lake (LAK54) is mesotrophic while the stream sites (STR02, STR015 and STR18) are oligotrophic at baseline (Appendix C). One lake (LAK028) is classified as sensitive to acid inputs while the remaining sites are considered to have low (STR14) or very low (LAK027, LAK030, STR01, STR02, STR15 and STR20) sensitivity to acid inputs at baseline (Appendix C).

6.6.2 Potential Effects and Mitigation Measures

The Assessment Report considered three potential effects on freshwater fish in relation to changes in water quality, fish habitat, and fish health and/or mortality risk. No new Project effects (or effects pathways) were identified for the amendment.

The eutrophication and acidification results from the EAC Application and the 2021 Surface Water Acidification and Eutrophication TDR (Stantec 2021a) were reassessed with updated methods and air quality dispersion and deposition modelling. The results from the 2025 assessments indicate that Project-related emissions of S and N will not lead to new eutrophication and acidification effects in the lakes and streams within the Project's local study area.

The results of the 2025 eutrophication assessment indicate that there are no predicted changes to the trophic state for the lake and stream sites for the Base Case, Project Alone Case, and Application Case (Appendix C). The same conclusions were made in the EAC Application and 2021 Surface Water Acidification and Eutrophication TDR (Stantec 2021a).

The 2025 acidification assessment identified no predicted exceedances for critical load of acidity ($CL_{(A)}$) in stream and lake sites for the Project Alone Case using the updated 2025 method. In contrast, the method used in the 2021 Surface Water Acidification and Eutrophication TDR reported predicted $CL_{(A)}$ exceedances for the Project Alone Case for LAK028. The difference in conclusions between the two methods are attributed to the different methods used to calculate $CL_{(A)}$, with the 2025 methods considered more appropriate and consistent with other studies (Appendix C).

The mitigation measure identified in the EAC Application and Assessment Report applicable to air quality included the design decision to use electrical power from the BC Hydro grid for the Project during operations, which minimizes the release of NO_x , SO_2 , $PM_{2.5}$, and CO emissions. This mitigation is still applicable to the proposed changes in this amendment application, and no new mitigation measures are proposed for freshwater fish (Table 6.16).

TABLE 6.16 SUMMARY OF POTENTIAL EFFECTS AND MITIGATION MEASURES – FRESHWATER FISH

Proposed Amendment Component	Project Phase	Change in Proposed Works or Activities	Change in Potential Effects	Change in Mitigation or Enhancement Measures	Change in Mitigation or Enhancement Measures Success Rating
Increase liquefaction capacity	Operation and commissioning ¹	No	No	No change	No change

Note: ¹Commissioning is included in the Construction Phase in the EAC #E23-01

6.6.3 Changes to Characterization of Residual Effects

Effects to freshwater fish due to the increased facility liquefaction capacity were assessed for this amendment application. The Assessment Report concluded that Project effects on the Freshwater Fish VC are predicted to be not significant. The characterization of residual effects for the amendment application is unchanged from the Assessment Report and is summarized in Table 6.17.

Potential effects assessed as part of the Assessment Report included: changes in surface water quality; change in fish habitat; and change in fish health or mortality risk and mostly focused on direct effects on watercourses as shown in Table 6.17. The proposed changes do not include any physical works, and therefore, there are no changes to the assessment of change in fish habitat or fish health or mortality risk.

For changes to surface water quality, the Assessment Report considered increases in total suspended solids (TSS) related to clearing, grading and construction, and removal of land-based infrastructure which is also unchanged as part of this amendment since the proposed changes do not have physical works in the vicinity of watercourses. The results from the 2025 assessments indicate that Project-related emissions of S and N will not lead to new eutrophication and acidification effects in the lakes and streams within the Project's local study area. Therefore, the context, direction and magnitude, extent, duration, frequency, and reversibility of the effects for the amendment are unchanged from the Assessment Report.

**TABLE 6.17 CHANGES TO ASSESSMENT REPORT CHARACTERIZATION OF RESIDUAL EFFECTS
ARISING FROM PROPOSED AMENDMENTS – FRESHWATER FISH**

Assessment Report Characterization of Residual Effects			Effect of Proposed Amendments on Characterization
Criteria	Assessment Rating	Rationale	
Context	<p>Water Quality: Low to Moderate</p> <p>Fish Habitat: Moderate</p> <p>Fish Health/Mortality: Moderate</p>	<p>Water Quality: Water quality is considered to have low to moderate resiliency because existing conditions show a moderate to high sensitivity to acidification inputs in waterbodies. Water temperature and pH was within optimal range for fish.</p> <p>Fish Habitat: Of the watercourses along the proposed transmission line right-of-way, 3 were fish bearing and 11 were not. Fish habitat is considered to have moderate resiliency because existing fish habitat quality in the fish-bearing watercourses within the LSA ranged from poor to good. In general, spawning quality was moderate at the assessed fish bearing watercourses while migration was poor due to observed barriers to fish passage.</p> <p>Fish Health/Mortality: None of the 16 fish species present in the RAA are listed under SARA. However, oolichan have been documented in Moore Creek and the Central Pacific Coast population of oolichan are considered endangered under COSEWIC and listed as special concern provincially. Cutthroat trout is also listed as special concern provincially. These occurrences are downstream of the transmission line right of way.</p>	No change
Direction and Magnitude	Adverse and Low	Clearing, grading and construction and removal of land-based infrastructure is expected to have adverse effects on water quality, and therefore, potentially effect fish health and mortality. However, during construction, TSS is expected to stay within the Land Development guidelines, and BCWQG-FAL. Additionally, with implementation of mitigation strategies and BMPs, the magnitude of these effects should be localized and low. Effects from clearing of riparian habitat may also lead to alteration of instream habitat (cover, nutrients, shading). These would be mitigated by limiting clearing to the extent possible and delineating clearing boundaries prior to site preparation.	No change
Extent	Local	Residual effects will be localized to the LAA.	No change
Duration	Medium-term	Residual effects will be present during the construction and decommission phases.	No change
Frequency	Infrequent	Effects from clearing, grading and construction and subsequent removal of the land-based infrastructure will be irregular events during construction and decommissioning.	No change

Assessment Report Characterization of Residual Effects			Effect of Proposed Amendments on Characterization
Criteria	Assessment Rating	Rationale	
Reversibility	<i>Reversible</i>	<i>Potential adverse effects due to increased total suspended solids (TSS) from the described project activities will be reversible upon the completion of the construction and decommissioning Project phases.</i>	No change
Risk (likelihood and consequence)	<i>Likelihood – Medium likelihood of residual effects to fish health, and habitat during construction and decommissioning activities. Consequence – Moderate consequence based on the magnitude of effects being localized and mitigated by BMPs. Risk – Based on the medium likelihood and moderate consequence of residual effects to fish habitat and health it was determined that there would be a moderate level of risk.</i>		No change
Uncertainty	<i>Uncertainty associated with residual effects to freshwater fish is considered to be low. The EAO has a high level of confidence in the characterization of residual effects, based on the proven effectiveness of Mitigation Measures that will be used following industry standard operating procedures and best management practices that include erosion and sediment controls. Such proven avoidance and Mitigation Measures include electrification of the Project to reduce potential acidifying emissions, no instream works or water withdrawals in fish-bearing watercourses, and large spans between transmission lines to reduce riparian clearing.</i>		No change
Significance	<i>In consideration of the above analysis of effects, the proven effectiveness of standard Mitigation Measures that will be utilized, and reversibility of the effects, the EAO concludes that the Project would not have significant adverse residual effects on the freshwater fish VC.</i>		No change

Notes:

The text in italics is reproduced from the Assessment Report for the Cedar LNG Project (EAO 2022).

BCWQG-FAL = British Columbia Water Quality Guidelines for Freshwater Aquatic Life; BMPs = best management practices; LAA= local assessment area; LSA=local study area; RAA = regional assessment area; EAO = British Columbia Environmental Assessment Office; TSS=total suspended solids; VC = valued component



6.6.4 Cumulative Effects Assessment

Cumulative effects on freshwater fish for the proposed changes outlined in the amendment application are predicted to be of similar nature as for the approved Project as presented in the EAC Application and Assessment Report.

The proposed amendment is anticipated to have similar interaction with past, present, and reasonably foreseeable projects and activities compared to the EAC Application. As such cumulative effects on the freshwater fish because of the amendment are predicted to be consistent with the Assessment Report and the characterization presented in the EAC Application is anticipated to remain valid.

6.6.5 Risk and Uncertainties

See Section 6.3.6 for risk and uncertainties related to estimate of emission rate and emission parameters. Overall confidence in the air dispersion modelling results is higher than the level of confidence for the original EAC Application due to the availability of more accurate emissions input to the model. Further, there is a high degree of confidence that predicted concentrations in the assessment are conservative, meaning Project effects are likely overpredicted, attributable to model conservatism (i.e. overprediction bias). Therefore, uncertainty and risks associated with residual effects to freshwater fish are considered low for the amendment.

Further, the EAO indicated they had a high level of confidence in the characterization of the freshwater fish residual effects and the proven effectiveness of the Project's proposed mitigation measures (EAO 2022). Use of industry standard BMPs to avoid or mitigate potential effects to freshwater fish is still expected to reduce the risk of adverse effects on freshwater fish.

6.6.6 Adaptive Management and Monitoring Measures

No new potential effects have been identified, and no new or additional mitigation measures are recommended as a result of this amendment application. Therefore, no changes to adaptive management and monitoring measures are recommended and existing recommendations are sufficient for the amendment application.

For operation of the Project, Cedar will obtain a waste discharge permit as required under the *Environmental Management Act* and administered by the BCER. As part of this permitting process, further assessment of the effects on air quality for the Project will be undertaken. Based on this assessment, operation and monitoring conditions for discharge of air emissions will be stipulated in a waste discharge permit, which will be required prior to startup of operation.

6.7 Vegetation

The increase in liquefaction capacity included in this amendment application has the potential to incrementally increase the acidification and eutrophication effects to the Vegetation Resources VC that were considered in the EAC Application and the Assessment Report. There are no physical works associated with the proposed changes to the Project and therefore no changes related to clearing and ground disturbance will occur.

Three potential acidification and eutrophication issues have been identified in connection with vegetation:

- Elevated concentrations of SO₂ in the atmosphere which can affect sensitive vegetation such as lichens and can negatively affect vegetation health and productivity
- Acid deposition (of sulphur and nitrogen compounds) can lower soil pH, dissolve nutrients and minerals from the soil, and increase bioavailability of aluminum in soil. This can subsequently affect vegetation growth, productivity and biodiversity of species and ecological communities. This process is known as soil acidification.
- Nitrogen deposition can increase the nitrogen available as a nutrient for plant growth and can alter vegetation biodiversity of species ecological communities. This process is known as eutrophication.

Table 6.18 provides a side-by-side comparison of the impacts and potential effects from the Assessment Report versus what is considered in this amendment application for vegetation. A description of the existing conditions that influence the assessment for the proposed changes to the Project is provided below, followed by the effects assessment. As noted above, there are no physical works associated with the proposed changes to the Project and therefore no changes related to clearing and ground disturbance will occur.

The acidification and eutrophication results from the EAC Application and the 2021 Terrestrial Air Emissions Assessment TDR (Stantec 2021b) were reassessed with updated air quality dispersion and deposition modelling developed in 2025. The updated air quality modelling (described in Section 6.3) was used to assess potential changes to the effects of acidification and eutrophication on terrestrial receptors associated with the increased facility capacity to support this amendment application. Technical details regarding the updated terrestrial assessment can be found in the 2025 Terrestrial Acidification and Eutrophication Assessment TDR (Appendix D).

An acidification and eutrophication assessment of terrestrial receptors (soil and vegetation) was conducted in 2021 to support the EAC Application. For a detailed description of the acidification and eutrophication assessment conducted for the EAC Application, refer to the 2021 Terrestrial Air Emissions Assessment TDR (Stantec 2021b).

The LAA and RAA areas used in this updated assessment remain the same as those in the 2021 assessment to allow for a direct comparison of results. The air emissions LAA was defined as the largest extent of the cumulative deposition of all authorized air emissions and of those that are reasonably foreseeable as the study area (in this case, the 2021 Application Case acid deposition 150 eq/ha/yr threshold). The air emissions RAA is the 40 km by 40 km air dispersion modelling domain.

TABLE 6.18 SUMMARY COMPARISON IMPACTS AND POTENTIAL EFFECTS FOR VEGETATION RESOURCES

Impacts & Effects	Assessment Report	Amendment Application
Impacts	<p>Increase in N, S, S+N deposition rates, resulting in:</p> <ul style="list-style-type: none"> • SO₂ atmospheric concentration critical level exceedance, 152 hectares (ha) (representing 2.1% of the total 7,361 ha Application Case exceedance and 0.2% of LAA area; Stantec 2021b). The Assessment Report discusses the 73.6 ha of Project-related exceedance over land. • Acidification of soils and vegetation (150 eq/ha/yr threshold) exceedance, 516 ha (0.8% of the 64,172 ha Application Case exceedance and 0.8% of LAA area; Stantec 2021b). The Assessment Report discusses the Application Case calculated critical load exceedance, 76.2 ha of additional exceedance due to Project emissions. • Eutrophication of soils and vegetation (4 kg/ha/yr empirical critical load) exceedance, 578 ha (26% of the 2,221 ha Application Case exceedance and 0.9% of LAA area; Stantec 2021b). The Assessment Report discusses the empirical critical load exceedance. In the Application Case, no additional vegetated area was predicted to exceed calculated critical loads of nutrient nitrogen compared to the Base Case. 	<p>Additional increase in N, S, S+N deposition rates (Appendix D), resulting in:</p> <ul style="list-style-type: none"> • SO₂ atmospheric concentration critical level exceedance, 871 ha total area (5.7% of the total 15,329 ha Application Case exceedance and 1.4% of LAA area) • Acidification of soils and vegetation (150 eq/ha/yr threshold) 716 ha of exceedance and 1.1% of LAA area (1.8% of the 39,577 ha Application Case exceedance) • Eutrophication of soils and vegetation (4 kg/ha/yr empirical critical load) 337 ha (30% of the 1,122 ha Application Case exceedance and 0.5% of LAA area)
Potential Effects	<ul style="list-style-type: none"> • Change in native vegetation health and diversity due to air emissions 	<ul style="list-style-type: none"> • Change in native vegetation health and diversity due to air emissions

6.7.1 Existing Conditions

Existing air quality in the Kitimat Valley has not changed substantially from that described in the EAC Application and technical memorandum (Stantec 2022), as discussed in Section 6.3.1 (Air Quality Existing Conditions). Also, except for clearing for the Project which has begun, existing conditions for vegetation resources have not changed substantially from those described in the EAC Application. The detailed description of vegetation, terrain, and soil existing conditions in the 2021 Terrestrial Air Emissions Assessment TDR (Stantec 2021b) remains broadly applicable in 2025.



The Kitimat Valley airshed remains impacted at baseline by existing and historical emissions sources. According to the updated 2025 modelling, total land area coverage where model outputs identify exceedances of thresholds:

- Atmospheric SO₂ concentrations: 14,458 ha (23% of LAA area) exceeds the 10 µg/m³/yr critical limit
- Acidification (acid deposition): 38,861 ha (99% of LAA area) exceeds the 150 eq/ha/yr threshold
- Eutrophication (nitrogen deposition): 785 ha (1% of LAA area) exceeds the 4 kg/ha/yr empirical critical load

The Assessment Report and 2021 Terrestrial Air Emissions Assessment TDR (Stantec 2021b) note that lichen communities are particularly vulnerable to acidifying emissions and that a decline in lichen species has likely already occurred in the air emissions RAA at baseline. Soil acidification has not been observed in Rio Tinto's soil monitoring to date; however, soil buffering capacity has likely been affected, and acidification may develop over time (EAO 2022 and Stantec 2021b). Modelled nitrogen deposition exceedance at baseline affects an area in the immediate vicinity of the town of Kitimat. A majority of existing acidifying emissions are due to Rio Tinto emissions, and LNG Canada is the primary source of existing nitrogen emissions.

6.7.2 Potential Effects and Mitigation Measures

The Assessment Report considered four potential effects on vegetation resources in relation to changes in abundance or condition of plant species of interest, changes in abundance or condition of ecological communities of interest, changes in wetland functions and changes in native vegetation health and diversity due to air emissions. No new Project effects (or effects pathways) were identified for this amendment. Of the four potential effects on vegetation resources considered in the Assessment Report, only native vegetation health and diversity due to air emissions effects is considered in this amendment application.

The air quality mitigation measure identified in the EAC Application and Assessment Report included the design decision to use electrical power from the BC Hydro grid for the Project during operations which minimizes the release of NO_x, SO₂, PM_{2.5}, and CO emissions. This mitigation is still applicable to the proposed changes in this amendment application. No new mitigation measures are required for vegetation resources (Table 6.19).

TABLE 6.19 SUMMARY OF POTENTIAL EFFECTS AND MITIGATION MEASURES – VEGETATION RESOURCES

Proposed Amendment Component	Project Phase	Change in Proposed Works or Activities	Change in Potential Effects	Change in Mitigation or Enhancement Measures	Change in Mitigation or Enhancement Measures Success Rating
Increase liquefaction capacity	Operation and commissioning ¹	No change	Negligible	No change	No change

Note: ¹Commissioning is included in the Construction Phase in the EAC #E23-01

6.7.3 Changes to Characterization of Residual Effects

Predicted effects on vegetation resources and the residual effects characterization ratings presented in the Assessment Report are unchanged as a result of the increased facility capacity in this amendment. A comparison of the Assessment Report conclusions and amendment residual effects is presented below and in Table 6.20.

The extent, duration, frequency, and reversibility of the effects for the amendment are unchanged because the approach to Project operation and pathways of effects (i.e., type of air emissions) are the same as proposed in the EAC Application. The context of the residual effects is unchanged because existing emission sources in the RAA are essentially the same for the amendment application as for the EAC Application, with the exception that Kitimat LNG has been removed (this removal was previously examined in a technical memo; Stantec 2022).

There will be a negligible increase in effects on vegetation resources due to the increased facility capacity for the amendment compared to the amount predicted in the EAC Application and considered in the Assessment Report, as shown in Table 6.18. The Project remains a minor component of overall predicted exceedance for SO₂, acid and sulphur deposition in the Kitimat airshed. For nitrogen deposition, predicted exceedance area remains localized to the vicinity of the Project, near the LNG Canada facility and the town of Kitimat.

Despite the increase in area affected by air emissions deposition resulting from the increased facility capacity, the magnitude characterization remains “adverse and low”. Though a measurable change in native vegetation health and diversity due to Project air emissions is predicted, regional population density or community’s extent or function is sufficient to sustain that population, community, and associated wetland functions without active management. The Assessment Report concluded that Project effects on vegetation resources are predicted to be not significant. The characterization of residual effects for the amendment application is unchanged from the Assessment Report and is summarized in Table 6.20.

**TABLE 6.20 CHANGES TO ASSESSMENT REPORT CHARACTERIZATION OF RESIDUAL EFFECTS
ARISING FROM PROPOSED AMENDMENTS – VEGETATION RESOURCES**

Assessment Report Characterization of Residual Effects			Effect of Proposed Amendments on Characterization
Criteria	Assessment Rating	Rationale	
Context	<i>Low</i>	<i>Resiliency is low due to existing industrial projects and historical logging in the marine terminal RAA, which have reduced the abundance and distribution of traditional use plant species, ecological communities of interest and wetland functions while increasing pollutants. Ecological communities at risk face forest harvesting and climate change threats on the provincial scale. Each new project with air emissions increases effects on native vegetation health and diversity. Lichen communities are particularly vulnerable to acidifying emissions and lichen richness has been affected in the air emissions RAA. Soils which have not currently exceeded the critical load of acid or nitrogen deposition are vulnerable to further inputs.</i>	No change
Direction and Magnitude	<i>Adverse and Low</i>	<p><i>With the proposed Mitigation Measures in place, Cedar LNG is anticipated to have low magnitude adverse residual effects associated with the marine terminal and supporting infrastructure and transmission line.</i></p> <p><i>Air emissions effects:</i> <i>The incremental effects of the Project include an increase from baseline in the vegetated area exceeding sulphur dioxide empirical critical level (1 percent), acid deposition calculated critical loads (2 percent), nitrogen deposition calculated critical loads (0 percent) and nitrogen deposition empirical critical load (26 percent). Of the 171.4 ha exceeding the nitrogen deposition empirical critical load, 31.1 ha is within estuarine communities (saltmarsh), which has a much higher empirical critical load (63 kg/ha/yr) than the general 4 kg/ha/yr threshold used in the assessment.</i></p>	No change
Extent	<i>Local</i>	<i>Residual effects will extend into the Project footprint and LAA.</i>	No change
Duration	<i>Permanent</i>	<i>Air emissions effects:</i> <i>The residual changes in native vegetation health and diversity due to nitrogen deposition, eutrophication and acidification are predicted to be permanent. The decrease of sulphur dioxide deposition is associated with the recovery of lichen communities, that ranges in time from years to decades.</i>	No change
Reversibility	<i>Reversible / Irreversible</i>	<i>The residual change in native vegetation health and diversity due to nitrogen deposition is considered reversible once emissions cease.</i>	No change

Assessment Report Characterization of Residual Effects			Effect of Proposed Amendments on Characterization
Criteria	Assessment Rating	Rationale	
Frequency	<i>Continuous</i>	<p><i>The residual changes in native vegetation health and diversity due to nitrogen deposition, sulphur dioxide emissions and project-related acid deposition and subsequent soil acidification are predicted to be continuous during operations.</i></p> <p><i>Though no additional vegetated ecological communities will be affected by eutrophication exceedances due to project emissions, the Project will bring soils in the LAA closer to the eutrophication critical load. The residual change is projected to be continuous during operation.</i></p>	No change
Risk (likelihood and consequence)	<p><i>Likelihood: There is a medium likelihood that a decline in the vegetation health and diversity will occur from sulphur dioxide atmospheric concentrations and acid deposition in the emissions LAA and there is uncertainty as to how native vegetation will respond in the operation timeframe.</i></p> <p><i>Consequence: Although measurable changes in native vegetation health and diversity are predicted due to air emissions from existing conditions, the regional extent of these parameters is sufficient to sustain the affected species and communities without active management. Therefore, the consequence is considered minor.</i></p> <p><i>Risk: Based on the medium to high likelihood and minor consequence of residual effects on vegetation resources, the risk level would be low.</i></p>	No change	
Uncertainty	<p><i>Air emissions: Although there is high confidence in the reliability of site specific and regional information, there is moderate confidence given the uncertainty of the actual vegetation responses to air emissions over the operation phase. The risk and uncertainty are likely overestimated for the change in native vegetation health and diversity due to acid deposition and potential acidification because modelling incorporates conservative assumptions, both in the dispersion modelling and in the calculated critical loads. Modelling incorporates conservative assumptions, both in the dispersion modelling and in the calculated critical loads, also leading to the likely overestimation of effects. Overall uncertainty regarding residual effects on vegetation resources is low. There is a good understanding of the cause-effect relationship between the Project and the VC, and sufficient data is available to support the conclusions on the maximum extent of potential effects considered here.</i></p>	No change	
Significance	<p><i>The EAO predicts that adverse residual effect on vegetation resources would not be significant because effects are low magnitude and following the application of avoidance and Mitigation Measures, the long-term viability of plants and ecological communities of interest, including those of cultural or traditional importance, will persist in the marine terminal RAA and there will be no loss of wetland functions of ecologically important wetland.</i></p>	No change	

Note:

The text in italics is reproduced from the Assessment Report for the Cedar LNG Project (EAO 2022).



6.7.4 Cumulative Effects Assessment

Cumulative effects on vegetation resources for the proposed changes outlined in the amendment application are predicted to be of similar nature as for the approved Project as presented in the EAC Application and Assessment Report. Though the Project will contribute to an existing cumulative residual effect, the Project's incremental contribution remains small in magnitude in comparison to the overall cumulative residual effects.

The proposed amendment is anticipated to have similar interaction with past, present, and reasonably foreseeable projects and activities compared to the EAC Application. As such cumulative effects on vegetation resources because of the amendment are predicted to be consistent with the Assessment Report and the characterization presented in the EAC Application is anticipated to remain valid.

6.7.5 Risk and Uncertainties

See Section 6.3.5 for risk and uncertainties related to estimate of emission rate and emission parameters. Inputs for all facilities assume the maximum allowable emissions levels under their respective permits and therefore predicted air quality concentrations and deposition rates result in conservative estimates (i.e., there is an inherent overprediction bias in the modelling). While past emissions in the Kitimat Valley have likely affected soil buffering capacity, soil acidification has not yet been observed in Rio Tinto's soil monitoring (EAO 2022 and Stantec 2021b). Therefore, there is a high degree of confidence that predicted concentrations in the assessment are conservative; meaning Project effects are likely overpredicted. Therefore, uncertainty and risks associated with residual effects to vegetation resources remain low for the amendment.

6.7.6 Adaptive Management and Monitoring Measures

No new potential effects or mitigation measures are recommended as a result of this amendment application; therefore, adaptive management and monitoring measures are also not recommended to change and are considered sufficient for the amendment application.

For operation of the Project, Cedar will obtain a waste discharge permit as required under the *Environmental Management Act* and administered by the BCER. As part of this permitting process, further assessment of the effects on air quality for the Project will be undertaken. Based on this assessment, operation and monitoring conditions for discharge of air emissions will be stipulated in a waste discharge permit, which will be required prior to startup of operation.

7.0 Interactions with Section 25 Assessment Matters

Section 25 of the *Environmental Assessment Act* requires every assessment to: (1) assess the effects of a project on the rights and interests of Indigenous nations; and (2) consider a number of matters (a through k in Table 7.1). Table 7.1 provides a summary of how these matters are approached in this amendment application.

TABLE 7.1 SCREENING OF SECTION 25 MATTERS

Section	Assessment Matter	Considered Further (Yes/No)	Approach
25(1)	The effects of the project on Indigenous nations and rights recognized and affirmed by section 35 of the <i>Constitution Act, 1982</i> .	Yes	<p>Cedar undertook assessments for Haisla Nation as the changes to the Project are located within their territory (Section 8.0).</p> <p>The Assessment Report concluded the Project would result in residual effects on Haisla Nation harvesting rights, use and integrity of sacred and culturally important sites and landscape features, governance, and health and wellbeing.</p> <p>No changes are anticipated for potential effects on the marine environment, or the terrestrial environment beyond those described in the Assessment Report. As a result, the effects on Indigenous nations and rights under section 35 of the <i>Constitution Act, 1982</i> are consistent with the effects identified in the Section 8 of the Assessment Report, and the conclusions as presented in the Assessment Report remain unchanged.</p> <p>Lax Kw'alaams Band, Metlakatla First Nation Gitga'at First Nation, Gitxaala Nation, Kitselas First Nation, Kitsumkalum First Nation, Haida Nation and Métis Nation British Columbia were each engaged regarding the planned changes to the Project and the anticipated changes to Project-related effects (see Section 4.1). Through Cedar's discussions with Indigenous nations, Cedar understands air quality in the Kitimat Valley is an issue of particular importance to Indigenous nations.</p> <p>Cedar is committed to continuing to engage with Indigenous nations throughout the review of this amendment application and subsequent permitting. Cedar will respond to questions as they arise and consider inputs received during engagement activities as part of Project construction and operation.</p>



Section	Assessment Matter	Considered Further (Yes/No)	Approach
25(2)(a)	Positive and negative direct and indirect effects of the reviewable project, including environmental, economic, social, cultural and health effects and adverse cumulative effects.	Yes	Sections 6.0, 7.0 and 8.0 of this amendment application provide consideration of potential changes to environmental, economic, social, cultural or health effects associated with the proposed changes. The Project has the potential to result in positive and negative direct and indirect effects, including environmental, economic, social, cultural and health effects and adverse cumulative effects. These effects were assessed in the EAC Application and Assessment Report (EAO 2022). With respect to the proposed changes to the Project, potential effects with potential to change the characterization from the Assessment Report (2022) are carried forward and considered in Section 6.0.
25(2)(b)	Risks and uncertainties associated with those effects, including the results of any interaction between effects.	Yes	Risks and uncertainties of potential effects, including interactions identified between effects, have been considered as part of the VC assessment in Section 6.0. Air quality and noise modelling completed in support of this amendment application has incorporated updated project design information and methods. This increases the confidence in the assessment predictions and lowers the overall uncertainty in the conclusions of the assessment.
25(2)(c)	Risks of malfunctions or accidents.	No	Section 9.0 of the EAC Application and Section 6.1 of the Assessment Report included an assessment of malfunctions and accidents. There are no changes to the LNG production facilities or products being held or transferred, and there are Canadian engineering design standards for all infrastructure that will be built or installed on site. In addition, the BCER permitting process requires operators to plan for and respond to accidents and malfunctions through Emergency Response Plans, risk assessments and incident reporting requirements. Cedar has developed an Accidents, Malfunctions, and Communication Plan (Cedar 2025) that addresses BCER requirements. The proposed changes will not lead to additional risks of malfunctions or accidents from those previously assessed; as such, these matters are not considered further in this application.



Section	Assessment Matter	Considered Further (Yes/No)	Approach
25(2)(d)	Disproportionate effects on distinct human populations, including populations identified by gender.	Yes	The EAO incorporated consideration of the potential for disproportionate effects throughout the Assessment Report, where effects on human populations are assessed. There is potential for disproportionate effects on distinct human populations, including human populations identified by gender, as a result of introducing worker accommodations on the FLNG. Disproportionate effects are considered in the residual effects evaluation for each VC carried forward for assessment in this amendment application.
25(2)(e)	Effects on biophysical factors that support ecosystem function.	No	This was addressed in Section 21 of the EAC Application and Section 6.6 of the Assessment Report. As described in Section 6.0, the proposed changes will not result in a change in potential effects on biophysical factors that support ecosystem function and therefore they are not considered further.
25(2)(f)	Effects on current and future generations.	No	The proposed changes will not change the number of workers compared to what was included in the EAC Application and Assessment Report. The proposed changes will not alter access to marine or terrestrial environments, and there will be no change in residual effects to marine or terrestrial harvesting as described in the Assessment Report. Therefore, there is no anticipated change to effects on current and future generations.
25(2)(g)	Consistency with any land use plan of the government or an Indigenous nation if the plan is relevant to the assessment and to any assessment conducted under Section 35 or 73.	No	Section 7.9 of the EAC Application and Section 5.8 of the Assessment Report considered potential Project effects to land and resource use and land use plans. The changes do not alter the physical footprint of the Project and therefore do not overlap any new land use plans, or any new plans developed since the EAC Application and Assessment Report. The changes remain consistent with established land use plans.
25(2)(h)	Greenhouse gas emissions, including the potential effects on the province being able to meet its targets under the <i>Greenhouse Gas Reduction Targets Act</i> (now called the <i>Climate Change Accountability Act</i>).	No	Section 8.0 of the EAC Application and Section 6.4 of the Assessment Report included estimates of GHG emissions that will be applicable to the proposed changes. The majority of the GHG emissions for the Project are associated with carbon dioxide in the feed gas. The original GHG emissions estimates were based on a preliminary, and intentionally conservative, gas composition. Since the environmental assessment, Cedar has



Section	Assessment Matter	Considered Further (Yes/No)	Approach
			<p>developed a greater understanding of the feed gas composition. The increased liquefaction capacity reflects an updated feed gas composition and will not result in an increase in GHG emissions over what was considered in the EAO's Assessment Report.</p> <p>Furthermore, there will be no increase in the number of LNG carriers loading at the marine terminal beyond the 50 carriers per year already approved in EAC #23-01 and the Decision Statement. Cedar's original estimate regarding the number of LNG carriers calling at the FLNG terminal was conservative and intended to provide flexibility (e.g., ability to use small LNG carriers). The size of LNG carriers calling at the Cedar LNG terminal will not change as a result of the increase in capacity. The proposed changes will not change the province's ability to meet its target under the <i>Climate Change Accountability Act</i>. The increase in liquefaction capacity will not result in an increase in GHG emissions beyond those approved in EAC #23-01 and the Decision Statement.</p>
25(2)(i)	Alternative means of carrying out the project that are technically and economically feasible, including the use of the best available technologies, and the potential effects, risks and uncertainties of those alternatives.	Yes	Cedar assessed the alternative means of carrying out the Project within their EAC Application and the outcomes of the assessment are reflected in the Assessment Report. The amendment application expands on the alternative means considered in the Assessment Report as described in Section 2.0. This amendment proposes changes to the location of worker accommodation to within the FLNG instead of off-site and an increase in liquefaction capacity. Alternatives to having worker accommodation on the FLNG were considered in the EAC Application, including use of existing work camps and local housing supply in Kitimat (Section 2.1).
25(2)(j)	Potential changes to the reviewable project that may be caused by the environment	No	Section 10 of the EAC Application assessed effects of the environment on the Project. It addressed potential effects of the environment (e.g., seismic events and tsunamis) on the marine and terrestrial infrastructure. There are no proposed changes to the Project infrastructure as part of this amendment. Project infrastructure design will integrate site specific data to manage potential effects from environmental constraints.
25(2)(k)	Other prescribed matters	N/A	N/A

8.0 Indigenous Interests

8.1 Scope of the Amendment

Under section 25(1) of the *Environmental Assessment Act* and section 22(1)(c) of the *Impact Assessment Act*, effects of the Project on Indigenous nations and rights recognized and affirmed by section 35 of the *Constitution Act, 1982* must be assessed. Effects on Indigenous interests were fully considered in the Assessment Report (EAO 2022) and separate submissions to the ministers were received by the EAO from Kitsumkalum First Nation, Gitxaala Nation and Gitga'at First Nation. The EAC Application included a literature review from publicly available information and Project-specific Indigenous knowledge and/or social and economic studies prepared by the Indigenous nations (Cedar 2022b).

The following sections provide an analysis of the effects of each proposed change to the Project and whether they alter the conclusions of the Assessment Report regarding the exercise of Indigenous interests. Indigenous interests, as defined by the EAO, include "interests related to an Indigenous nation and their rights recognized and affirmed by section 35 of the *Constitution Act, 1982*, including Treaty rights and Aboriginal rights and title, that may be impacted by a proposed project" (EAO 2020b). This analysis specifically considered whether the proposed changes would induce any new effects, whether they would alter the characterization of the predicted effects (e.g., a change in the magnitude of an effect), or whether any new mitigation measures are needed to prevent a change in the EAO characterization of the effects.

Table 8.1 identifies the Indigenous interests that were presented in the Assessment Report and interactions with the proposed changes. There are no anticipated additional effects to Indigenous interests that were not previously assessed in the EAC Application and the Assessment Report (Cedar 2022a; EAO 2022). Rationale is provided in Table 8.1 as to whether the Indigenous interests were included or excluded from this amendment application.

Cedar continues to engage with Haisla Nation, Gitga'at First Nation, Gitxaala Nation, Kitselas First Nation, Kitsumkalum First Nation, Metlakatla First Nation, Lax Kw'alaams Band, Haida Nation and Métis Nation British Columbia. Section 4.0 provides a summary of this engagement as well as the outcomes that have informed the amendment application. Given the feedback shared by potentially affected Indigenous nations to date (Section 4.0) and the predicted interactions of the environmental and social and economic VCs related to Indigenous interests, effects on Haisla Nation interests are anticipated from the proposed changes (as summarized in Table 8.1). An assessment of these effects is provided in Section 8.2.

Through Cedar's discussions with Indigenous nations, it is understood that changes to air quality in the Kitimat Valley are a concern (as summarized in Table 7.1). Cedar has accordingly undertaken modelling of air quality effects of the amended Project with a focus on cumulative effects. As detailed in Section 6.3, dispersion modelling incorporating mitigation predicts that residual changes in NO_x, SO₂, PM_{2.5}, and CO would be low in magnitude, localized to the LAA (i.e., within 1 km of the Project), and below the BC AQOs at the five monitoring stations in the LAA. Any modelled exceedances are considered conservative and not representative of actual expected conditions. No change to the residual effects characterization for air quality is anticipated for the amendment, and there are no anticipated new or expanded interactions with the Indigenous interests of Gitga'at First Nation, Gitxaala Nation, Kitselas First Nation, Kitsumkalum First Nation, Metlakatla First Nation, Lax Kw'alaams Band, Haida Nation and Métis Nation British



Columbia (as summarized in Table 8.1). As such, there is also no change from previously assessed residual adverse environmental effects with a spatial and temporal overlap of adverse effects from past, present, and reasonably foreseeable projects and activities for Gitga'at First Nation, Gitxaala Nation, Kitselas First Nation, Kitsumkalum First Nation, Metlakatla First Nation, Lax Kw'alaams Band, Haida Nation and Métis Nation British Columbia.

As described above, effects on Haisla Nation interests are anticipated from the proposed changes as they occur within Haisla Nation territory and within the LAA described in the EAC Application and the Assessment Report. An assessment of these effects is provided in Section 8.2.

TABLE 8.1 INDIGENOUS INTERESTS TO BE INCLUDED/EXCLUDED FROM THE AMENDMENT APPLICATION

Indigenous Interest	Conclusion from Assessment Report	Interaction Identified	Assessment Approach	Rationale
Haisla Nation				
Harvesting Rights	Negligible to minor negative impact on Haisla's ability to harvest in the marine and terrestrial environment.	Yes	Carried forward for assessment	The proposed amendment to worker accommodations and increased natural gas capacity are entirely within Haisla Nation's territory and are further evaluated in Section 8.2.
Use and Integrity of Sacred and Culturally Important Sites and Landscape Features	Minor impact on Haisla's use and integrity of sacred and culturally important sites and landscape features.	Yes	Carried forward for assessment	
Indigenous Governance	Minor negative impact and a minor positive impact on Haisla's Indigenous governance.	Yes	Carried forward for assessment	
Indigenous Health and Well-being	Minor negative impact and a minor positive impact on Haisla's Indigenous health and well-being.	Yes	Carried forward for assessment	
Kitselas First Nation				
History	Potential adverse effects of the Project on the Indigenous Interests of Kitselas have been adequately avoided, minimized or otherwise accommodated.	No	Excluded from further assessment	The proposed amendment to worker accommodations and increased natural gas capacity do not result in changes that overlap with Kitselas First Nation's territory; therefore, there is no anticipated additional impact to Kitselas First Nation's Future. Despite this, Cedar understands cumulative effects of air emissions in the Kitimat Valley remains an issue of concern to Kitselas First Nation. Cedar will work with Kitselas through the Waste Discharge Authorization process. Air quality dispersion modelling predicts no additional, measurable amendment-related effects (see Section 6.3); therefore, there is no anticipated additional impact to Kitselas First Nation's History, Future, Lands, Authority or Community.
Future		No	Excluded from further assessment	
Lands		No	Excluded from further assessment	
Authority		No	Excluded from further assessment	
Community		No	Excluded from further assessment	
Kitsumkalum First Nation				
Harvesting Rights	Minor on harvesting rights.	No	Excluded from further assessment	The proposed amendment to worker accommodations and increased natural gas capacity do not result in changes that overlap with Kitsumkalum First Nation's territory; therefore, there is no anticipated additional impact to Kitsumkalum First Nation's Future. Despite this, Cedar understands cumulative effects of air emissions in the Kitimat Valley remains an issue of concern to Kitsumkalum First Nation. Cedar will work with Kitsumkalum First Nation through the Waste Discharge Authorization process. Air quality dispersion modelling predicts no additional, measurable amendment-related effects (see Section 6.3); therefore, there is no anticipated additional impact to Kitsumkalum First Nation's Harvesting Rights, Use and Integrity of Sacred and Culturally Important Sites and Landscape Features, Indigenous Governance, or Indigenous Health and Well-being.
Use and Integrity of Sacred and Culturally Important Sites and Landscape Features	Minor on use and integrity of sacred and culturally important sites and landscape features.	No	Excluded from further assessment	
Indigenous Governance	Minor negative impact and minor positive impact on Indigenous governance.	No	Excluded from further assessment	
Indigenous Health and Well-being	Minor negative impact and minor positive impact on Indigenous health and well-being.	No	Excluded from further assessment	
Gitga'at First Nation				
Consumption and Harvesting Rights	Chronic moderate adverse residual and cumulative impacts on Gitga'at's ability to travel in and carry out Indigenous harvesting activities in the marine environment.	No	Excluded from further assessment	The proposed amendment to worker accommodations and increased natural gas capacity do not result in changes that overlap with Gitga'at First Nation's territory; therefore, there is no anticipated additional impact to Gitga'at First Nation's Future. Despite this, Cedar understands cumulative effects of air emissions in the Kitimat Valley remains an issue of concern to Gitga'at First Nation. Cedar will work with Gitga'at First Nation through the Waste Discharge Authorization process. Air quality dispersion modelling predicts no additional, measurable amendment-related effects (see Section 6.3); therefore, there is no anticipated additional impact to Gitga'at First Nation's Consumption and Harvesting Rights, Use and Integrity of Sacred and Culturally Important Sites and Land and Marine-Scape Features, Governance, Rights and Title, or Health and Community Well-being.
Use and Integrity of Sacred and Culturally Important Sites and Land and Marine-Scape Features	Long-term moderate impact on Gitga'at's use and integrity of sacred and culturally important sites and land and marine-scape features.	No	Excluded from further assessment	
Governance	Longterm moderate negative impact on Gitga'at's Indigenous governance, self-determination and territorial stewardship	No	Excluded from further assessment	
Rights and Title	N/A	No	Excluded from further assessment	
Health and Community Well-being	Overall moderate negative impact and a potentially minor positive impact on some aspects of Gitga'at's Indigenous health and well-being.	No	Excluded from further assessment	

Indigenous Interest	Conclusion from Assessment Report	Interaction Identified	Assessment Approach	Rationale
Gitxaala Nation				
Governance	Potential adverse effects of the Project on the Indigenous Interests of Gitxaala have been adequately avoided, minimized or otherwise accommodated.	No	Excluded from further assessment	The proposed amendment to worker accommodations and increased natural gas capacity do not overlap with Gitxaala Nation's territory; therefore, there is no anticipated additional impact to Gitxaala Nation's Governance, Cultural Identity, Harvesting, or Sacred Places.
Cultural Identity		No	Excluded from further assessment	
Harvesting		No	Excluded from further assessment	
Sacred Places		No	Excluded from further assessment	
Lax Kw'alaams Band and Metlakatla First Nation (Coast Tsimshian Nations)				
Marine Harvesting	Moderate effect on marine harvesting.	No	Excluded from further assessment	The proposed amendment to worker accommodations and increased natural gas capacity do not overlap with Lax Kw'alaams Band and Metlakatla First Nation's traditional territories; therefore, no additional impact to Lax Kw'alaams Band and Metlakatla First Nation's Marine Harvesting, or Sense of Place are predicted.
Sense of Place	Moderate effect on sense of place.	No	Excluded from further assessment	
Metis Nation British Columbia				
Harvesting	Adequately avoided, minimized or otherwise accommodated.	No	Excluded from further assessment	The proposed amendment to worker accommodations and increased natural gas capacity do not overlap with Métis Nation British Columbia area of interest; therefore, there is no anticipated additional impact to Métis Nation British Columbia Harvesting, or Sacred and Culturally Important Sites and Landscape Features.
Sacred and Culturally Important Sites and Landscape Features	Negligible to minor impact on Métis use and integrity of sacred and culturally important sites and landscape features.	No	Excluded from further assessment	
Haida Nation				
N/A	No effects to Haida within the scope of the environmental assessment of the Project.	No	Excluded from further assessment	The proposed amendment to worker accommodations and increased natural gas capacity do not overlap with Haida Nation territory; therefore, there is no anticipated additional impact to Haida Nation within the scope of the environmental assessment of the Project.



8.2 Haisla Nation

As the Project is Haisla-owned, the proposed changes are understood to be reflective of Haisla Nation ability to make decisions regarding land and marine use within its traditional territory. The following sections provide an assessment for Haisla Nation, including potential effects to Haisla Nation interests, mitigations proposed, and changes to the characterization of residual effects from the Assessment Report or the original EAC Application, as applicable. Existing conditions for Haisla Nation relevant to the amendment have not changed from the conditions described in the EAC Application (Cedar 2022b) and the Assessment Report (EAO 2022).

8.2.1 Potential Effects and Mitigation Measures

The potential effects and mitigation measures on Haisla Nation's interest are informed by Acoustics, Air Quality, Freshwater Fish, Human Health and Vegetation VCs. This assessment on Haisla Nation interests considers the predicted effects of the proposed changes to the Project on each of the VCs assessed in the amendment (Section 6.0) and considers how these effects could affect the ability of Haisla Nation to exercise its rights. Given the interactions identified in Table 8.1, and in consideration of the Assessment Report, the proposed changes are anticipated to result in the same or similar potential effects on Haisla Nation interests as described in Section 11.0 of the EAC Application (Cedar 2022b) and the Assessment Report. No new or different pathways of effect have been identified.

No changes are anticipated to the predicted effects, mitigation or enhancement measures, or their expected effectiveness ratings for each of the proposed changes to the Project and the effects of those proposed changes on Haisla Nation interests.

8.2.1.1 HARVESTING RIGHTS

The proposed amendment to accommodate up to 80 workers on the FLNG and increase the liquefaction capacity from 400 to 500 million standard cubic feet per day will not require changes to FLNG infrastructure or additional vegetation clearing compared to what was described in the Assessment Report. While Project air emissions may result in minor, measurable changes to native vegetation health and diversity, the effects are predicted to be low in magnitude and will not change the characterization of effects in the EAO's Assessment Report. Regional vegetation community extent is sufficient to sustain vegetation communities and associated wetland functions without the need for active management. Accordingly, the residual effects characterization for vegetation and species-at-risk remains unchanged from that described in the Assessment Report. As a result, the proposed changes to the Project will not further affect the availability of traditional use plants for harvest.

As described in Section 2.0, non-local shift rotation staff will travel via Northwest Regional Airport and be transported directly to the FLNG. In the absence of the proposed accommodation block, local personnel, including Haisla Nation members, would be transported daily between the FLNG and the Cedar office. The addition of the proposed accommodation block is expected to reduce daily vehicular traffic to and from the FLNG is expected and reduce effects on access to terrestrial harvesting areas in the vicinity of Project infrastructure.



The proposed changes are not anticipated to alter the direction or magnitude of potential effects on habitat availability, wildlife movement, or mortality risk for species of cultural importance. Existing mitigations for wildlife remain applicable and are expected to be effective in managing adverse effects of the proposed changes on wildlife habitat availability, movement, and mortality risk. The updated noise modelling predicts lower sound levels than those considered in the EAC Application noise assessment (see Section 6.4). As there is no increase to predicted noise levels or the spatial extent of potential effects, the conclusions regarding sensory disturbance to wildlife remain valid. As a result, the proposed changes to the Project will not further affect the availability of wildlife for harvest.

The proposed changes will not result in an increase in LNG carriers beyond the 50 per year approved in EAC #23-01 and the Decision Statement. There will be no change in vessel types required, or a change in the marine shipping route during the operation phase. No changes to the characterization of residual effects in the Assessment Report regarding water quality, marine habitat, marine fish or marine mammal behaviour, injury, or mortality risk are predicted because of the proposed changes. As a result, the proposed changes to the Project will not further affect the effects on marine use by Haisla Nation members.

Overall, the proposed changes do not change the characterization of residual effects on freshwater fish, vegetation, marine mammals, or access to terrestrial and marine harvesting areas. The characterization of residual effects for Haisla Nation harvesting rights is unchanged from that described in the EAC Application and Assessment Report.

8.2.1.2 USE AND INTEGRITY OF SACRED AND CULTURALLY IMPORTANT SITES AND LANDSCAPE FEATURES

As described above, the proposed amendments will not involve physical changes, therefore the use and integrity of sacred and culturally important sites and landscape features will not change. There is no change in the characterization of residual effects on Haisla Nation access and travel in the marine or terrestrial environment. This conclusion is understood to extend to Haisla Nation's use and integrity of sacred and culturally important sites and landscape features, and in combination with the prediction for no change in access to marine and terrestrial areas, the characterization of residual effects for Haisla Nation use and integrity of sacred and culturally important sites and landscape features remains unchanged from that described in the EAC Application and Assessment Report.

8.2.1.3 INDIGENOUS GOVERNANCE

The proposed amendment to worker accommodation will not change the number of workers proposed in the EAC Application. Consistent with Haisla Nations ownership of the Project, the proposed changes reflect Haisla Nation decision-making regarding land and marine use within its traditional territory. The characterization of residual effects for Haisla Nation Indigenous governance is unchanged from that described in the EAC Application and Assessment Report.



8.2.1.4 INDIGENOUS HEALTH AND WELL-BEING

Potential changes to health and well-being are predominantly related to changes in air emissions and noise emissions that will result from the higher production capacity of the FLNG. Off-duty workers utilizing the proposed onboard accommodation block would experience the highest degree of exposure to Project-related air emissions due to their proximity to emission sources. However, the proposed onboard accommodation block is intended for non-local workers and while workforce composition is not yet confirmed, Haisla community members are not expected to routinely occupy the onboard accommodation.

With the application of mitigation measures and based on dispersion modelling results, potential effects to human health from these exposures are predicted to remain within applicable health-based standards, with negligible effects at locations within Indigenous communities in the LAA and at receptors outside the LAA. As Project emissions represent a small contribution relative to overall emissions from nearby industrial sources, the incremental increase in health risk from Project-related pollutants is predicted to be negligible.

Noise modelling has been completed to assess potential effects on off-duty workers and residents of Kitamaat Village. The risk of noise-related annoyance or sleep disturbance within FLNG worker accommodation cabins is also considered negligible, as predicted noise levels are below applicable guideline thresholds. Modelling indicates that noise levels in Kitamaat Village will be slightly lower than predicted in the original EAC Application.

The residual effects characterization for air quality and noise, including potential implications for Indigenous health and well-being, remains unchanged from that described in the EAC Application and Assessment Report.

8.2.2 Changes to Characterization of Residual Effects

Based on the findings for relevant VCs set out in Section 6.0 of this amendment application, and feedback received from Haisla Nation on the proposed changes and the identified mitigation measures, Cedar has concluded there are no anticipated changes to the characterization of residual effects on Haisla Nation interests as described in the Assessment Report. Potential effects to the VCs assessed in Section 6.0 can be mitigated, and no changes were predicted relative to the conclusions of the Assessment Report.

The Assessment Report concluded the potential for adverse effects of the Project on Haisla Nation interests had been adequately avoided, minimized or otherwise accommodated. Characterization of residual effects for the proposed changes remains unchanged from the Assessment Report. A summary of the EAO conclusions relative to the amendment is provided in Table 8.2.

**TABLE 8.2 CHANGES TO ASSESSMENT REPORT CHARACTERIZATION OF RESIDUAL EFFECTS
ARISING FROM PROPOSED AMENDMENTS – HAISLA NATION INTERESTS**

Assessment Report Characterization of Residual Effects			Effect of Proposed Amendments on Characterization
Criteria	Assessment Rating	Rationale	
Harvesting Rights (Marine and Terrestrial Environments)			
Context	Medium resilience	<p>Haisla users along the Marine Shipping Route are considered moderately sensitive to change based on existing conditions and existing impacts to marine harvesting.</p> <p>Haisla users within the terrestrial area that may be affected by the Project are considered moderately sensitive to change based on existing conditions and existing impacts to terrestrial harvesting.</p>	No change
Magnitude	Low	<p><i>Methods, locations and opportunities:</i> Cedar will result in a low magnitude of residual effect due to minor reduction in preferred marine and terrestrial harvesting locations and minor increase in local population.</p> <p><i>Time:</i> Cedar will result in a low magnitude of residual effects to time available for marine harvesting based on frequency of LNG carriers during operations (approximately 50 vessels per year). The frequency of Project-related vessel traffic during construction would be similar.</p> <p>Cedar will result in a low magnitude of residual effects to time available for terrestrial harvesting based on the increase in hunting and vehicle traffic.</p> <p><i>Access:</i> Cedar will result in a low magnitude of residual effects on access to marine harvesting sites based on frequency of LNG carriers.</p> <p>Cedar will result in a low magnitude of residual effects on access to harvesting sites based on size of the Facility Area (125 hectares [ha]).</p> <p><i>Experience:</i> Cedar will result in a low residual effect on experience based on presence of LNG carriers (approximately 50 vessels per year) and the FLNG Facility and the associated noise and lights.</p> <p>Cedar will result in a low residual effect on experience based on presence of the FLNG Facility and their associated noise and lights, as well as the clearing required for the Facility Area and the transmission line right-of-way (32.5 ha).</p> <p><i>Subsistence based livelihoods and trade:</i> Cedar will result in a low magnitude of residual effects on livelihoods and trade based on the size of the FLNG Facility and frequency of LNG carriers, and based on the size of the Facility Area and transmission line right-of-way.</p>	No change

Assessment Report Characterization of Residual Effects			Effect of Proposed Amendments on Characterization
Criteria	Assessment Rating	Rationale	
<i>Extent</i>	<i>Regional</i>	<i>The residual effects to harvesting within the marine environment would apply throughout the Marine Terminal Area and Marine Shipping Route. The residual effects to harvesting within the terrestrial environment would apply throughout the wildlife, vegetation and freshwater fish LAAs.</i>	No change
<i>Duration</i>	<i>Long-term</i>	<i>The residual effect to harvesting in the marine and terrestrial environments would persist for the life of Cedar LNG (i.e., 25 to 40 years), which is longer than one generation (i.e., 25 years).</i>	No change
<i>Reversibility</i>	<i>Partially reversible</i>	<i>While the change in marine and terrestrial resources will be reversible following decommissioning, the lifespan of Cedar LNG may result in permanent change to harvesting methods.</i>	No change
<i>Frequency</i>	<i>Irregular</i>	<i>Residual effects will occur continuously as the Project is located on Haisla territory. The potential residual effect related to marine harvesting would occur at sporadic intervals based on the low volume of marine traffic during 527 Assessment Report November 16, 2022, construction and approximately one LNG vessel visiting the Project every 7-10 days during operations (up to approximately 50 carriers annually).</i>	No change
<i>Affected Populations</i>	<i>Disproportionate</i>	<i>The reduction in marine and terrestrial access may disproportionately affect Haisla members who rely heavily on terrestrial resources for purposes such as food and social.</i>	No change
<i>Uncertainty</i>	<i>Moderate</i>	<i>The effectiveness of Mitigation Measures may be moderate; uncertainty is moderate overall based on uncertainty in the extent of marine shipping effects such as wake, the difficulty in predicting and quantifying experiential effects or choices made by Indigenous marine users. For example, it is uncertain if individual Indigenous users may forgo certain marine or terrestrial uses when faced with potential effects of the Project.</i>	No change
Use and Integrity of Sacred and Culturally Important Sites and Landscape Features			
<i>Context</i>	<i>Medium resilience</i>	<i>Haisla's use and integrity of sacred and culturally important sites and landscape features as an Indigenous Interest in the context of Cedar LNG is considered moderately sensitive to change based on the current projects and volume of marine shipping in the area.</i>	No change

Assessment Report Characterization of Residual Effects			Effect of Proposed Amendments on Characterization
Criteria	Assessment Rating	Rationale	
Magnitude	Low	<p><i>Access and use: Cedar will result in a low magnitude of residual effects to access and use of sites and landscape features. This is due to frequency of LNG carriers (approximately 50 per year) during operations (low magnitude), which is similar to marine shipping frequency during construction, as well as the lack of access to Facility Area during and following completion of construction and associated effects such as increase in traffic.</i></p> <p><i>Traditional knowledge: Cedar will result in a low magnitude of residual effects to transfer of traditional knowledge between generations (i.e., 25 years) based on the low magnitude of effects on access and use.</i></p> <p><i>Experience: Cedar will result in a low magnitude of residual effects to experience of sites and landscape features based on size of Facility Area, frequency of LNG carriers and the associated noise and light impacts.</i></p>	No change
Extent	Local	<i>The residual effects would apply throughout the Marine Terminal Area, Facility Area, transmission line right-of-way and Marine Shipping Route.</i>	No change
Duration	Long-term	<i>The residual effect would persist for the life of the Cedar LNG (i.e., 25 to 40 years) which is longer than one generation (i.e., 25 years) and is therefore anticipated to be long-term.</i>	No change
Reversibility	Irreversible	<i>A change in use and integrity of sacred and culturally important sites and landscape features would be irreversible due to factors such potential effects to sites and landscape features due to construction and the transmission of knowledge between generations (i.e., 25 years).</i>	No change
Frequency	Irregular and Continuous	<p><i>Marine: The potential residual effect would occur at sporadic intervals, varying by phase and based on low volume of marine traffic during construction and approximately one LNG carrier visiting the Project every 7-10 days during operations (up to approximately 50 carriers annually).</i></p> <p><i>Terrestrial: The potential residual effect would occur continuously as the land would be permanently altered following completion of construction.</i></p>	No change
Affected Populations	Disproportionate	<i>The reduction in marine and terrestrial access may disproportionately affect Haisla members who rely heavily on access and resources for purposes such as ceremonial and spiritual.</i>	No change
Uncertainty	Moderate	<i>The effectiveness of Mitigation Measures may be moderate; uncertainty is moderate overall based on the uncertainty in the extent of marine shipping effects such increase wake and reduction in access to sacred and culturally important sites and landscape features (increase in large vessel movements) and the uncertainty regarding the potential for chance find during construction.</i>	No change

Assessment Report Characterization of Residual Effects			Effect of Proposed Amendments on Characterization
Criteria	Assessment Rating	Rationale	
Indigenous Governance			
Context	Medium resilience	<i>Haisla's Indigenous governance has a medium resilience based on the stress that have been experienced from the current projects in the region.</i>	No change
Direction and Magnitude	Low	<i>Decision making: Cedar may result in a low magnitude of positive residual effect to the Indigenous governance's decision making as the Project is a Haisla-led partnership. Resource access and usage: the residual effect to resource access and usage may have a low magnitude of negative residual effect as the size of the Facility Area is relatively small. Employment and economy: the residual effect to Haisla members' employment may result in a combination of positive and negative residual effects. A low magnitude of positive effects will be experienced through increase in local employment opportunities. A low magnitude of negative effects will be experienced due to inequitable ability for subpopulations to participate in employment opportunities.</i>	No change
Extent	Local	<i>Haisla may be impacted by activities overlapping the Marine Shipping Route and the terrestrial activities overlapping their traditional territory (e.g., Facility Area), as well as by employment.</i>	No change
Duration	Long-term	<i>Indigenous governance may be impacted throughout all phases of the Project.</i>	No change
Reversibility	Irreversible	<i>The various factors that may influence Indigenous governance (e.g., employment, accommodations, marine traffic) will last throughout the lifetime of the Project, which is longer than one generation (i.e., 25 years).</i>	No change
Frequency	Regular	<i>Residual effects may occur continuously as the Project is located on Haisla territory.</i>	No change
Affected Populations	Disproportionate	<i>Residual effects may be disproportionately experienced by subgroups who are already experiencing challenges regarding employment due to external factors (e.g., women, families).</i>	No change
Uncertainty	Moderate	<i>The effectiveness of Mitigation Measures may be moderate; uncertainty is moderate overall based on the uncertainty regarding employment and economy and decision-making including volume of employment throughout the Project's lifetime.</i>	No change
Indigenous Health and Wellbeing			
Context	Low resilience	<i>Haisla's Indigenous health and wellbeing has a low resilience based on the current conditions in the region that have resulted from the current projects, which do not allow for Haisla's Indigenous health and wellbeing to easily adapt to additional residual effects.</i>	No change

Assessment Report Characterization of Residual Effects			Effect of Proposed Amendments on Characterization
Criteria	Assessment Rating	Rationale	
<i>Direction and Magnitude</i>	<i>Low</i>	<p><i>Human health: Cedar will result in a low magnitude of residual effect to mental health, primarily due to increase in sensory disturbance and concern for potential accidents and malfunctions.</i></p> <p><i>Social determinants of health: Cedar will result in a combination of positive and negative residual effects. A minor magnitude of positive residual effects will be experienced due to increase in employment opportunities and local business opportunities. A low magnitude of negative residual effects to social determinants of health will be experienced due to social, health and cultural effects.</i></p> <p><i>Infrastructure and services: Cedar will result in a low magnitude residual effect to Haisla's infrastructure and services with respect to increase in burden on regional healthcare capacity which is already at capacity. In addition, a low to minor residual effect will occur due to increase in local traffic.</i></p>	No change
<i>Extent</i>	<i>Regional</i>	<i>The Project will have residual effects throughout the region and human health and social determinants of health will be experienced in some manner by Haisla members residing throughout the region.</i>	No change
<i>Duration</i>	<i>Long-term</i>	<i>As the Project lifetime is longer than a single generation (i.e., 25 years), the residual effects, with respect to Haisla, on human health and social determinants of health are considered long-term.</i>	No change
<i>Reversibility</i>	<i>Irreversible</i>	<i>As the Project lifetime is longer than a single generation, the residual effects, with respect to Haisla, on human health and social determinants of health are considered irreversible.</i>	No change
<i>Frequency</i>	<i>Continuous</i>	<i>The residual effects related to human health and social determinants of health will occur continuously throughout the lifetime of Cedar LNG.</i>	No change
<i>Affected Populations</i>	<i>Disproportionate</i>	<i>Residual effects may be disproportionately experienced by subgroups (e.g., women, children, families, Indigenous women requiring specific health services, low income families requiring housing, other vulnerable populations) who already experience challenges in accessing infrastructure and services and housing in larger centers in Terrace and Kitimat. These subgroups may be more adversely affected than other groups by the increased competition for such services resulting from a Project-related temporary increase in the population.</i>	No change
<i>Uncertainty</i>	<i>Moderate</i>	<i>The effectiveness of Mitigation Measures may be moderate; uncertainty is moderate overall based on the uncertainty regarding employment and economy and decision making including volume of employment throughout the Project's lifetime.</i>	No change

Note:

The text in italics was copied from the Assessment Report for the Cedar LNG Project (EAO 2022).

8.2.3 Cumulative Effects Assessment

The proposed changes are anticipated to have the same interaction with past, present, and reasonably foreseeable projects and activities compared to the cumulative effects interactions presented in the Assessment Report. A further assessment of potential cumulative environmental effects to Haisla Nation interests was not conducted as the proposed changes do not alter the characterization of residual effects presented in the EAC Application (Cedar 2022a, b) or the Assessment Report. Measures to mitigate potential effects will be in place through continued implementation of existing management plans (i.e., Socio-Economic Management Plan, Health and Medical Services Plan) and industry standard mitigation measures.

8.2.4 Risks and Uncertainties

The level of confidence in the predictions for residual effects and residual cumulative effects on Haisla Nation interests is considered high. The prediction confidence is supported by engagement with Haisla Nation to inform understanding of current baseline conditions, understanding of amendment activities, locations and described interactions, the known effectiveness of mitigation measures, and experience of the assessment team. There is also a higher level of confidence in the predicted changes in air quality and noise levels due to the updated modelling work that incorporates final design information for the FLNG.

8.2.5 Follow-up Strategy to Effects on Indigenous Interests

As described in the Assessment Report, the recommended federal Mitigation Measures and Follow-up Programs under the *Impact Assessment Act* inform the federal conditions. The legally binding federal conditions as well as the recommended mitigation measures and follow-up programs that are not linked to the *Impact Assessment Act* are applicable to the amendment components. As described in Table 118 of the Assessment Report, recommended key mitigation measures and follow-up programs were identified for air quality, acoustics, vegetation resources, wildlife, marine resources, marine use, infrastructure and services, GHG emissions and gender-based analysis plus. Annual summary reports and other monitoring reports required by select follow-up programs will be provided to the Indigenous nations for review, as applicable.

Cedar has a Socioeconomic Management Plan (Cedar 2024a), a Health and Medical Services Plan (Cedar 2024b), and a Gender Equity and Diversity Plan (Cedar 2024d) which will be applicable to the amendment components. Cedar engaged the Indigenous nations for review and feedback relative to each of these plans and for the purpose of informing adaptive management strategies (Cedar 2024a, b, d). Cedar will continue to work with Indigenous nations to understand and address the Project's effects on their interests, discuss concerns, and share information about employment and contracting opportunities to enhance local benefits.

9.0 Effects within Federal Jurisdiction

Conditions 2.16.1 to 2.16.3 of the Decision Statement ask the Proponent to provide:

2.16.1. a description of the proposed change(s) to the Designated Project and the federal effects that may result from the proposed change(s);

2.16.2. any modified or additional measure to mitigate any federal effect that may result from the proposed change(s) and any modified or additional follow-up requirement; and

2.16.3. an explanation of how, taking into account any modified or additional mitigation measure referred to in condition 2.16.2, the federal effects that may result from the proposed change(s) may differ from the federal effects of the Designated Project identified during the impact assessment.

Table 9.1 below provides a concordance between the list of potential federal effects as defined in section 2 of the *Impact Assessment Act*, and where the relevant information is presented in the amendment application. A summary of engagement with Indigenous nations is presented in Section 4.0.

TABLE 9.1 EFFECTS WITHIN FEDERAL JURISDICTION

Effects within Federal Jurisdiction (as defined in section 2 of the Impact Assessment Act)	Section of Amendment Application Where Considered	Changes to the Decision Statement Conclusions
(a) a non-negligible adverse change to the following components of the environment that are within the legislative authority of Parliament:		
(i) fish and fish habitat, as defined in subsection 2(1) of the <i>Fisheries Act</i> .	Section 6.6 and Appendix C – Increased liquefaction is anticipated to marginally increase deposition and acidification. Any adverse changes to fish and fish habitat as a result of increased deposition and acidification are anticipated to be negligible.	No
(ii) aquatic species, as defined in subsection 2(1) of the <i>Species at Risk Act</i> .	Section 6.6 and Appendix C – Increased liquefaction is anticipated to marginally increase deposition and acidification. Any adverse changes to aquatic species at risk as a result of increased deposition and acidification are anticipated to be negligible.	No
(iii) migratory birds, as defined in subsection 2(1) of the <i>Migratory Birds Convention Act, 1994</i> .	N/A – no new or additional interaction with migratory birds is anticipated.	No
(iv) any other component of the environment that is set out in Schedule 3.	N/A – There are no other components of the environment set out in Schedule 3 to the <i>Impact Assessment Act</i> (Components of the Environment and Health, Social or Economic Matters)	No
(b) a non-negligible adverse change to the environment that would occur on federal lands	Section 6.3 Air Quality and Section 6.4 Acoustics	No
(c) a non-negligible adverse change to the marine environment that is caused by pollution and that would occur outside Canada	N/A – no interaction with the marine environment that would occur outside of Canada is anticipated.	No

Effects within Federal Jurisdiction (as defined in section 2 of the Impact Assessment Act)	Section of Amendment Application Where Considered	Changes to the Decision Statement Conclusions
(d) a non-negligible adverse change — that is caused by pollution — to boundary waters or international waters, as those terms are defined in subsection 2(1) of the <i>Canada Water Act</i> , or to interprovincial waters	N/A – no interaction with the marine environment falling within the definition of boundary waters or international waters is anticipated.	No
(e) with respect to the Indigenous peoples of Canada, a non-negligible adverse impact — occurring in Canada and resulting from any change to the environment — on:		
(i) physical and cultural heritage,	N/A – no new or additional interaction with heritage resources is anticipated.	No
(ii) the current use of lands and resources for traditional purposes, or	N/A – no new or additional interaction with lands and resources for traditional purposes is anticipated.	No
(iii) any structure, site or thing that is of historical, archaeological, paleontological or architectural significance.	N/A – no new or additional interaction with heritage resources is anticipated.	No
(f) a non-negligible adverse change occurring in Canada to the health, social or economic conditions of the Indigenous peoples of Canada; and.	Section 6.5 Human Health and Section 8.0 Indigenous Interests	No
(g) a non-negligible adverse change to a health, social or economic matter that is within the legislative authority of Parliament that is set out in Schedule 3.	Section 6.5 Human Health and Section 8.0 Indigenous Interests	No

10.0 Conclusions

With submission of this application, Cedar is requesting the CPD in Schedule A of EAC #E23-01 and the Description of the Designated Project in Schedule 1 of the *Impact Assessment Act* Decision Statement are amended to:

- Add accommodations on the FLNG to house up to 80 workers
- Increase the facility liquefaction capacity from 400 to 500 million standard cubic feet per day of natural gas

Based on the assessments presented within this amendment application, it is Cedar's conclusion that the proposed changes do not alter the findings or conclusions of the EAO's Assessment Report for the Project. Key findings presented in this amendment application are:

- The characterization of residual effects for air quality in the amendment application is unchanged from the Assessment Report, and there is an increased level of confidence in the air dispersion modelling results due to changes in modelling methods and the advanced stage of engineering for the FLNG. The proposed increase in facility liquefaction capacity will result in an additional increase of NO_x, SO₂, PM_{2.5}, and CO emission rates causing changes to air quality. Model predictions for the amendment application have increased incrementally compared to the EAC Application; however, the characterization of effects on air quality for the amendment application based on these results are similar in magnitude and extent compared to the EAC Application. The Assessment Report concluded that Project effects to air quality are predicted to be not significant.
- The characterization of residual effects for acoustics in the amendment application is unchanged from the Assessment Report and there is an increased level of confidence in the noise modelling results due to the advanced stage of engineering for the FLNG. The Project is not predicted to exceed Health Canada noise guidance (2023) and BCER noise guideline (2024) thresholds at receptors in Kitamaat Village or at 1.5 km from the FLNG. The predicted sound level of 51 dBA at the FLNG worker accommodation cabin meets Canadian Labor Code Maritime Occupational Health and Safety Regulations threshold of 75 dBA (Canada 2025a, Canada 2025b); Canada-Newfoundland and Labrador Offshore Area Occupational Health and Safety Regulations threshold of 70 dBA (Canada 2022), and IMO Code on Noise Levels on Board Ships threshold of 55 dBA for sleeping cabins (IMO 2012). The Assessment Report concluded that Project effects to acoustics are predicted to be not significant.
- The characterization of residual effects to human health for the amendment application is unchanged from the Assessment Report and there is an increased level of confidence in the predictions due to the increased confidence in the air dispersion and noise modelling results. The amendment application focuses on potential health risks to off-duty workers on the FLNG worker accommodations because these people would experience the greatest degree of exposure to Project-related emissions of air pollutants and noise due to their proximity to emission sources. The incremental increase in health risk from exposure to Project-related emissions of air pollutants is low, as Project emissions represent a small percentage of regional emissions from other nearby industrial sources. The risk of noise-related annoyance and sleep disturbance within the FLNG worker accommodation cabins is below the applicable noise guidelines and considered to be negligible. The Assessment Report concluded that Project effects to human health are predicted to be not significant.



- The characterization of residual effects for freshwater fish in the amendment application is unchanged from the Assessment Report. The updated air quality dispersion and deposition modelling developed for the amendment application was used to assess potential changes to the effects of eutrophication and acidification on surface water associated with the increased facility liquefaction capacity. The 2025 acidification assessment identified no predicted changes to the trophic state for the lake and stream sites for the Base Case, Project Alone Case, and Application Case. The same conclusions were made in the EAC Application. The 2025 acidification assessment identified no predicted exceedances for critical load of acidity ($CL_{(A)}$) in stream and lake sites for the Project Alone Case using the updated 2025 method. The Assessment Report concluded that Project effects to freshwater fish are predicted to be not significant.
- The characterization of residual effects for vegetation in the amendment application is unchanged from the Assessment Report. The updated air quality dispersion and deposition modelling developed for the amendment application was used to assess potential changes to the effects of eutrophication and acidification on terrestrial resources (soil and vegetation) associated with the increased facility liquefaction capacity. The Project remains a minor component of overall predicted exceedance for SO_2 , acid, and sulphur deposition in the Kitimat airshed. For nitrogen deposition, predicted exceedance area remains localized to the vicinity of the Project, near the LNG Canada facility and Kitimat town centre. The Assessment Report concluded that Project effects to vegetation are predicted to be not significant..
- No changes are anticipated to the predicted effects, mitigation or enhancement measures, or their expected effectiveness ratings for each of the proposed changes to the Project and the effects of those proposed changes on Haisla Nation interests.

Accordingly, the mitigation measures in existing management plans and the Assessment Report remain appropriate for the amendment. Potential effects will be managed through existing management plans (including the Socioeconomic Management Plan [Cedar 2024a] and Health and Medical Services Plan [Cedar 2024b]). The amendment has not identified additional mitigation measures and no additional effects to Indigenous interests are anticipated.

Cedar engaged with Haisla Nation, Kitselas First Nation, Kitsumkalum First Nation, Gitga'at First Nation, Gitxaala Nation, Metlakatla First Nation, Lax Kw'alaams Band, Métis Nation British Columbia, and Haida Nation during preparation of this amendment application. As described, cumulative effects to air quality is the primary concern that Cedar heard from Indigenous nations during this engagement; air quality modelling was undertaken in support of this amendment and is presented in Section 6.3 and Appendix A. Cedar remains committed to continued engagement with Indigenous nations throughout the amendment process and for the life of the Project.

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Appendix A

Air Quality Technical Data Report

Cedar LNG Project Technical Data Report—Air Quality Dispersion Modelling

Application for an Amendment to
Provincial Environmental Assessment Certificate and Federal Decision Statement

September 2025

Prepared for:





Prepared by:
Stantec Consulting Ltd.

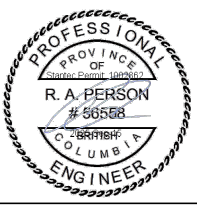
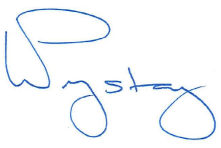
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Limitations and Sign-off

This document entitled Technical Data Report Air Quality Dispersion Modelling was prepared by Stantec Consulting Ltd. (“Stantec”) for the account of Cedar LNG Partners LP (the “Client”). In connection therewith, this document may be reviewed and used by the Environmental Assessment Office, Impact Assessment Agency of Canada, participating Indigenous nations, and all members of the Technical Advisory Committee participating in the review process in the normal course of their duties. Except as set forth in the previous sentence, any reliance on this document by any other party or use of it for any other purpose is strictly prohibited. The material in it reflects Stantec’s professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

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Executive Summary

Stantec conducted an air quality assessment in support of the EAC #E23-01 amendment application. The dispersion modelling was performed in accordance with the British Columbia (BC) Air Quality Dispersion Modelling Guideline (BC Ministry of Environment and Parks (ENVP), 2022a), Guidance on NO₂ Dispersion Modelling in BC (ENVP, 2022b), and the Dispersion Modelling Plan in Appendix A.

The air quality assessment predicts maximum ground-level concentrations of nitrogen dioxide (NO₂), sulphur dioxide (SO₂), fine particulate matter (PM_{2.5}), and carbon monoxide (CO).

Predicted concentrations of SO₂ and PM_{2.5} for the Base Case including existing emission sources (Rio Tinto and LNG Canada) plus baseline are greater than the BC air quality objectives (AQO). Highest concentrations are predicted to occur near the Rio Tinto facility, the dominant source of SO₂ and PM_{2.5} emissions within the local assessment area (LAA). SO₂ concentrations predicted near the Rio Tinto boundary are approximately an order of magnitude greater than the BC AQO, however based on an understanding of model performance, these maximum predicted concentrations are believed to be substantially overpredict as measured concentrations of SO₂ at Kitimat monitoring stations that are greater than the BC AQO have been infrequent. This over-prediction is predominantly attributable to conservatism within the modelling.

For the Project-Alone Case, predicted concentrations of all parameters are below the BC AQO. Maximum concentrations occur within a few hundred metres of the Project. Predicted plume behaviour generally follows the valley orientation, reflecting prevailing winds and terrain, with the highest concentrations occurring over Douglas Channel rather than inland.

In the Application Case (Base Case with Project-Alone Case) and Future Case (Application Case with LNG Canada Phase II), predicted concentrations for NO₂ and CO are less than the BC AQO. Compared to the Base Case, the addition of the Project results in an extension of NO₂ isopleths southward along Douglas Channel, with less pronounced increases observed up-valley over the Kitimat townsite. Predicted concentrations of SO₂ and PM_{2.5} for the Application Case and Future Case are greater than the BC AQO. The elevated predicted concentrations of SO₂ and PM_{2.5} are a result of existing facilities and occur at or near the plant boundary of the Rio Tinto facility. The addition of the Project does not affect this pattern.

Predicted maximum concentrations for the Non-Routine Flaring Case, of NO₂, SO₂, PM_{2.5}, and CO are below the BC AQO.

Model predictions for the amendment application have increased compared to the EAC Application (Stantec, 2021); however, the characterization of effects on air quality for amendment application based on these results are similar in magnitude and extent compared to the EAC Application (Stantec, 2021).



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Acronyms / Abbreviations

AQO	Air Quality Objective
ARM 2	Ambient Ratio Method 2
BC	British Columbia
BCER	BC Energy Regulator
BOG	boil-off gas
CAAQS	Canadian Ambient Air Quality Standards
CEPA	Canadian Environmental Protection Act
CCME	Canadian Council of Ministers of the Environment
Cedar	Cedar LNG Partners LP by its general partner Cedar LNG Partners (GP) Ltd.
CO	carbon monoxide
D1HM	daily 1-hour maximum
EAC	Environmental Assessment Certificate
ECCC	Environment and Climate Change Canada
ENVP	British Columbia Ministry of Environment and Parks
FLNG	floating liquified natural gas
HHV	higher heating value
km	kilometre
LAA	local assessment area
LNG	liquefied natural gas
m	metres
mm	millimetres
m asl	metres above sea level
MMSCFD	million standard cubic feet per day
NO	nitrogen oxide
NO ₂	nitrogen dioxide
NO _x	oxides of nitrogen
PM _{2.5}	fine particulate matter with an aerodynamic diameter less than equal to 2.5 micrometres
ppm _v	parts per million by volume
RAA	regional assessment area
SO ₂	sulphur dioxide



Cedar LNG Project
Technical Data Report—Air Quality Dispersion Modelling
Acronyms / Abbreviations
September 2025

$\mu\text{g}/\text{m}^3$	microgram per cubic metre
VOC	volatile organic compound
WRF	Weather Research and Forecasting



1 Introduction

Cedar LNG Partners LP, by its general partner Cedar LNG Partners (GP) Ltd. (Cedar), a Haisla Nation led partnership with Pembina Pipeline Corporation, is constructing a liquefied natural gas (LNG) export facility within the District of Kitimat, British Columbia (BC) (the Project). The LNG facility is currently planned to have the capacity to liquify up to and including 500 million standard cubic feet per day (MMSCFD) (14.12 million cubic meters per day [million m³/day]) of natural gas to produce LNG for export. The location of the Project is presented in Figure 2.1.

In the amendment application, Cedar is proposing to amend the Project, by increasing the production capacity of the floating LNG (FLNG) facility by approximately 25%, from 400 MMSCFD of inlet feed gas to 500 MMSCFD.

The air quality assessment focuses on effects on air quality beyond the facility boundary where the air quality regulatory criteria apply. This technical data report provides details on the air quality modelling work to assess the increase in Project capacity, including air emissions, modelling methodology, dispersion modelling results, and evaluating changes in ambient air quality. The assessment of human health effects associated with changes to air quality at the location of off-duty residence located on the FLNG is discussed in Section 6.5 (Human Health VC). The assessment of the effects of deposition of nitrogen, sulphur, and nitrogen and sulphur to the aquatic and terrestrial environments are discussed in Section 6.6 (Freshwater Fish VC) and Section 6.7 (Vegetation VC), respectively.

An Air Quality Dispersion Modelling Plan (Appendix A) for this modelling work was prepared following the BC Air Quality Dispersion Modeling Guideline (ENVP 2022a). This Air Quality Dispersion Modelling Plan is generally consistent with methods applied on other recent LNG Project assessments in the same airshed previously reviewed by BC Ministry of Environment and Parks (ENVP) and the BC Energy Regulator (BCER).



2 Method

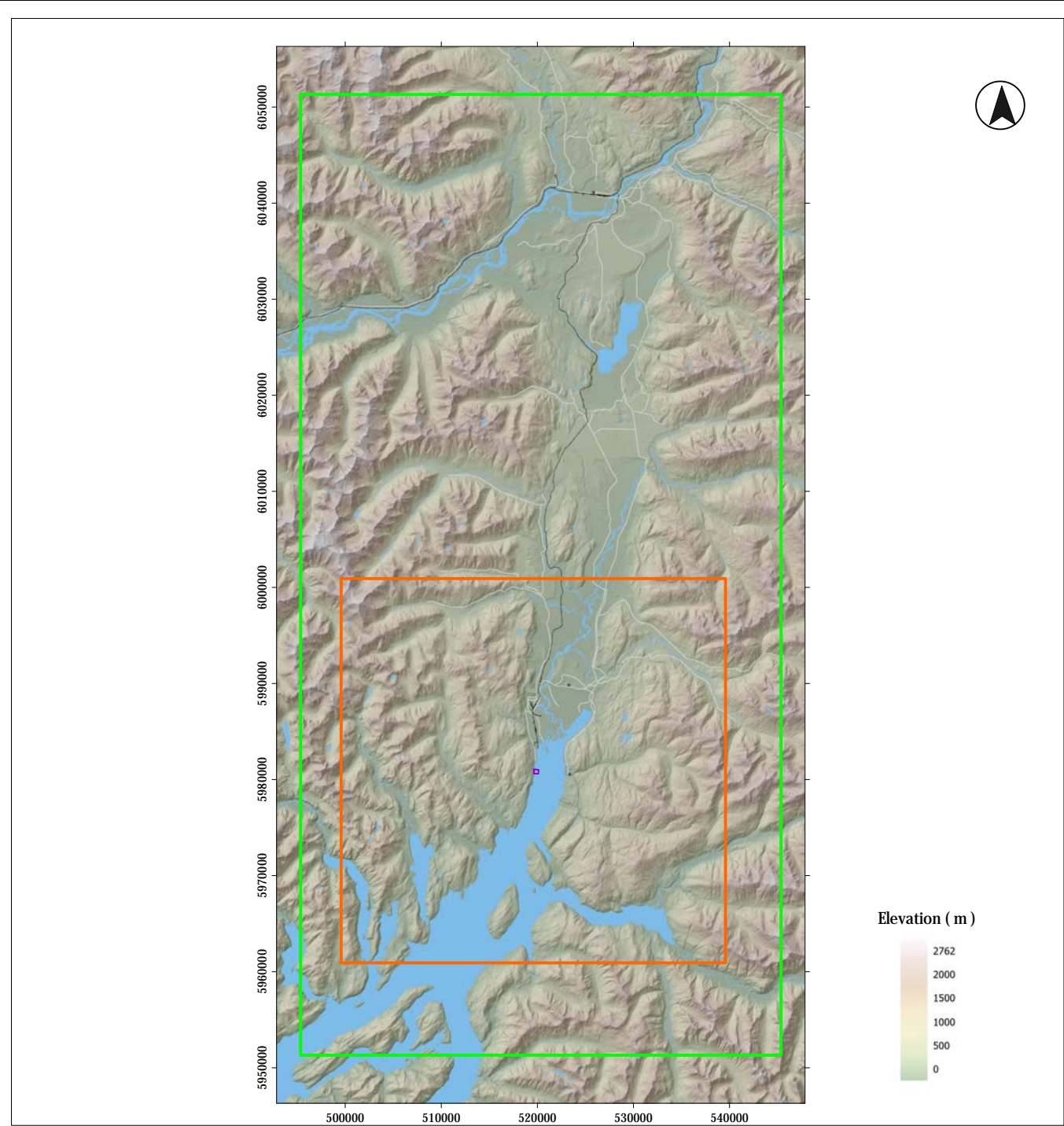
2.1 Local and Regional Assessment Area Boundaries

The local assessment area (LAA) and regional assessment area (RAA) presented in this technical data report represents the area selected as the dispersion modelling domain in the air quality assessment. The RAA for the amendment air quality assessment is 50 kilometre (km) x 100 km domain. This is an increase from the LAA/RAA domain of 40 km x 40 km in the Environmental Assessment Certificate (EAC) Application. The RAA was increased to capture effects of existing emission sources that are in the vicinity of the Project, to align with other recent assessments in the airshed, and to prepare for a Waste Discharge Authorization application for the Project. The LAA for Air Quality remains the same as the EAC Application; a 40 km x 40 km domain that captures the effects of the Project.

The Project Facility Area occupies land and water on the western shores of Douglas Channel. Project Facility Area elevation is approximately sea level to 100 metres above sea level (m asl). Local relief to the west of the Project Facility Area rises up to 1,000 metres (m) within 10 km. The region consists of complex terrain including ocean channels and inlets, mountains, and river valleys.

Figure 2.1 illustrates the LAA/RAA, CALMET domain, CALPUFF domain and local terrain. Appendix B includes detailed information on local terrain for the CALMET domain. The modelling domain captures the key effects of the Project, and the cumulative effects with the existing and future emission sources nearby, with respect to the BC Air Quality Objectives (AQOs).





- Cedar LNG Boundary
- Air Quality Regional Assessment Area
- Air Quality Local Assessment Area

- Highway
- Road
- Railway
- Transmission Line
- Watercourse
- Waterbody



Project Location: Kitimat, British Columbia
 Project Number: 123223008

Client/Project/Report:
 Cedar LNG Partners (GP) Ltd
 Cedar LNG Project
 Air Quality Technical Data Report

Figure No.: 2.1

Title:
 Air Quality Study Area, CALMET Domain
 and CALPUFF Domain

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2.2 Level of Assessment

The Guideline (ENVP, 2022a) defines three levels of air quality assessment that vary in the degree of detail and scope. Section 2.2.2 of the Guideline (ENVP, 2022a) indicates that a Level 3 modelling assessment using the CALPUFF modelling system is appropriate for modelling air emissions associated with the Project due to the complex topography and wind flows in the region and the multiple emission sources. Dispersion modelling methods for this assessment followed the Guideline (ENVP, 2022a) and are described in further detail in Appendix A.

2.3 Applicable Objectives for Air Quality

Effects on air quality are determined, in part, by comparing predicted ground-level concentrations of the substances to the applicable AQOs. The AQOs are used to gauge current and historical air quality and guide decisions on environmental impact assessments and authorizations. In BC, the ENVP have stated the BC AQOs are applicable beyond the facility fence line ((ENVP, 2016), (ENVP, 2020)). Where exceedances of the BC AQO are predicted through dispersion modelling, the ENVP considers the context of magnitude, frequency, timing, and proximity to sensitive receptors. Should there be exceedances of the BC AQO, the ENVP would manage these in accordance with the federal Air Zone Management Framework (Canadian Council of Ministers of Environment [CCME] (CCME, 2019)) for improvements in air quality across the affected area and would include all important sources (ENVP, 2020)).

The regulatory criteria in BC for nitrogen dioxide (NO₂), sulphur dioxide (SO₂), fine particulate matter with an aerodynamic diameter less than equal to 2.5 micrometres (PM_{2.5}) and carbon monoxide (CO) applicable to this assessment are shown in Table 2.1 (ENVP, 2021a).

The BC AQO for NO₂ is based on the Canadian Ambient Air Quality Standards (CAAQS), announced by the Government of Canada in 2017 (CEPA, 2017) for the year 2020. The CCME have stated that achievement of the CAAQS is determined on an airshed and air zone basis, which cover broad geographical areas (CCME, 2019). They are regional ambient standards and were not developed to be applied to individual projects and facilities as regulatory standards (CCME, 2019). Rather, they are used by provinces and territories to guide air zone management actions intended to reduce ambient concentrations below the CAAQS and prevent CAAQS exceedances. Ambient air quality monitoring stations located at or near the property (fence) line of an industrial facility should not be used for CAAQS reporting unless the monitoring station is near a populated area or a sensitive ecosystem ((CCME, 2020a), (CCME, 2020b)).



Table 2.1 British Columbia Air Quality Objectives

Substance	Averaging Interval	British Columbia Air Quality Objective microgram per cubic metre (µg/m³)
NO ₂	1-hour	113 ^a
	Annual	32 ^b
SO ₂	1-hour	183 ^c
	Annual	13 ^d
PM _{2.5}	24-hour	25 ^e
	Annual	8 ^f
CO	1-hour	14,300
	8-hour	5,500

Notes:

- ^a Achievement for 1-hour NO₂ is based on 3-year average of the annual 98th percentile of daily 1-hour maximum (D1HM). This requires the extraction of the highest predicted 1-hour value at each location for each day, followed by the calculation of the 98th percentile (the eighth highest) of those 365 values for each year, then average the three annual values.
- ^b Achievement for annual NO₂ is based on the average of all 1-hour average concentrations over a single calendar year
- ^c Achievement for 1-hour SO₂ is based on 3-year average of the annual 99th percentile D1HM. This requires the extraction of the highest predicted 1-hour value at each location for each day, followed by the calculation of the 99th percentile (the fourth highest) of those 365 values for each year, then average the three annual values.
- ^d Achievement for SO₂ is based on the average of 1-hour concentrations averaged over one year
- ^e Achievement for PM_{2.5} is based on annual 98th percentile of daily average, averaged over one year
- ^f Achievement for PM_{2.5} is based on annual average, averaged over one year

Source: (ENVP, 2021a)

ENVP has not stated if the 2025 or 2030 CAAQS will be adopted as provincial AQOs. Regulatory agencies, including ENVP, Environment and Climate Change Canada (ECCC), Northern Health, and Health Canada, have expressed an interest in referencing objectives other than the BC AQOs in assessments. Specifically, they are interested in referencing the 2020, 2025 and 2030 CAAQS (CCME, 2025). The 2025 CAAQS (and 2030 CAAQS for PM_{2.5}) are provided in this assessment for information purposes. Effects on air quality will be evaluated using the BC AQO (ENVP, 2021a). The regulatory criteria applicable to this assessment are shown in Table 2.2 which lists the CAAQS for the year 2025 for NO₂ and SO₂, and 2030 for PM_{2.5}.



Table 2.2 2025 Canadian Air Quality Standards

Substance	Averaging Interval	Air Quality Objective (µg/m³)
NO ₂	1-hour	79 ^a
	Annual	23 ^b
SO ₂	1-hour	170 ^c
	Annual	11 ^d
PM _{2.5}	24-hour	23
	Annual	8.0

Notes:

Data are for the year 2025 for NO₂ and SO₂, and 2030 for PM_{2.5}. The statistical forms for each are the same as for the applicable regulatory criteria Table 2.1.

Source: (CCME, 2025)

2.4 Regional Atmospheric Conditions

This section describes the existing regional conditions in the study area. The background climate and meteorology, and air quality are described. Understanding both the existing climate and air quality, and its relationship with the landscape, helps establish the link between cause (emissions) and effect (resultant changes in air quality) and supports the Project air quality assessment.

2.4.1 Climate and Meteorology

Climate is defined as the weather conditions prevailing in an area over a long-time interval (several decades). The climate of the site was characterized using the 30-year ECCC Canadian Climate Normals (1981 to 2010) for the Kitimat Townsite station (ECCC, 2025). The Kitimat Townsite station was selected because it is located less than 10 km from the Project Facility Area and is therefore the most representative of local conditions. Although more recent 30-year normals (1991–2020) are available for nearby stations such as Terrace, they are located approximately 55 km from the site and are less representative of local climate. Canadian Climate Normals are calculated by the ECCC using the recommended methods for validity established by the World Meteorological Organization (ECCC, 2025).

Air Temperature

The average daily temperature in Kitimat is 7.4 degrees Celsius (°C). January is the coldest month, and July is the warmest (-1.7°C and 16.7°C daily average temperature). Extreme temperatures vary from -25.0°C (January 3, 1979 and December 25, 1964) to 37.0°C (June 20, 2004).



Precipitation

The average annual total precipitation in Kitimat is 2211 millimetres (mm), of which 85% falls as rain. October is the wettest month (323.5 mm average), and July is the driest (62.4 mm average). The extreme daily precipitation was 144.8 mm (October 26, 1976). The extreme daily snowfall was 112.3 centimetres (cm) (February 18, 1972), and the extreme snowpack depth was 140 cm (February 12, 1999).

2.4.1.2 Meteorology

Meteorology is the study of the changes in wind speed and direction, temperature, air pressure, humidity, and other parameters in the atmosphere. Local meteorological conditions influence the transport and dispersion of air emissions. Wind speed, wind direction, and atmospheric turbulence are major meteorological elements that influence the transport and dispersion of particulate and gaseous emissions.

The Guideline (ENVP, 2022a) requires the application of at least three years of meteorological data as input for dispersion modelling and recommends use of a ENVP-supplied Weather Research and Forecasting (WRF) meteorological dataset. The WRF model allows for the dynamic spatial and temporal downscaling of reanalysis datasets to predict site-specific meteorological conditions more accurately. Hourly-averaged meteorological data from ENVP were applied as input to CALMET and CALPUFF based on the 1 km WRF model output for the years 2011–2015, developed by Exponent (ENVP, 2021b). The WRF data is augmented with additional meteorological measurement data from several monitoring stations. These meteorological data were used in dispersion modelling and are discussed in Section 2.6.2 and presented in detail in the CALMET Appendix (Appendix B).

2.4.2 Baseline Air Quality

It is useful in this type of study to know the predicted incremental air quality contribution of the source or sources being modelled. It is also important to know about the cumulative effects on air quality. This is especially important when comparing model predictions to ambient objectives. The cumulative air quality is calculated by accounting for the contribution from all sources except the source or sources being modelled and adding that to the predicted increment from the Project.

The term “baseline” is being used to describe existing air quality conditions and the contribution from existing sources. The Guideline (Section 8.1 (ENVP, 2022a)) states that baseline may be determined from air quality monitoring data or may be estimated from modelling existing contributing sources or a combination of both. Choosing the appropriate baseline concentration can be critical in assessing overall air quality. In order of priority, the information sources used to establish the baseline concentration level are:

- A network of long-term ambient monitoring stations near the source under study
- Long-term ambient monitoring at a different location that is adequately representative; and
- Modelled baseline



For the Project, baseline will be determined by both modelling existing large industrial emission sources (the Base Case, Section 2.5.1) and using data from local monitoring stations to account for sources not modelled (i.e., traffic, home heating, food preparation, other marine traffic). The development of the baseline concentrations is described in Appendix A.

Baseline concentrations for selected substances were established based on data from existing monitoring stations in Terrace and Kitimat including Terrace Skeena Middle School, Kitimat (Kitamaat) Haisla Village, Kitimat Haul Road, Kitimat Riverlodge, Kitimat Whitesail, and Smithers St. Josephs (the nearest monitoring station with valid CO data). Table 2.3 summarizes baseline representative of the LAA/RAA. These values are consistent with Section 8.1.4 of the Guideline (ENVP 2022a) and conservatively characterized as a large increment of measured values (i.e., the 98th percentile of the D1HM values for NO₂, the 98th percentile for other hourly and daily averages, and the mean values for annual averages).

The NO₂ Guidance (ENVP, 2022b) provides three options to add baseline NO₂ to dispersion modelling predictions. For this work, the 288-value array option is used to more realistically account for photochemical reactivity driven seasonal and diurnal variations in baseline concentrations associated with NO₂ concentrations. This array is comprised of the first highest measured value for each hour in each month, then average over the monitoring period. The 288-data array using Kitimat Whitesail monitoring data are presented in Appendix A.



Table 2.3 Summary of Baseline

Substance	Averaging Period	Baseline Concentration ($\mu\text{g}/\text{m}^3$)
NO ₂	1-hour	26.8
	Annual	2.9
SO ₂	1-hour	14.5 (5.53 ppb)
	Annual	1.23 (0.47 ppb)
PM _{2.5}	24-hour	9.3
	Annual	3.4
CO	1-hour	869
	8-hour	715

Notes:

Baseline air quality data were developed by Stantec from ENVP 1998-2023 summary spreadsheets (ENVP 2024) and BC Air Data Archive (ENVP, 2025a). Conversions from ppb to $\mu\text{g}/\text{m}^3$ assume Standard conditions of 20°C and 101.325 kPa.

NO₂:

The 1-hour baseline NO₂ concentration was determined based on the D1HM concentrations, followed by the calculation of the 98th percentile for the years 2020 to 2024. Then 3-year average for 2020 to 2022, 2021 to 2023 and 2022 to 2024. The maximum 3-year average is presented here (2020 to 2022).

Annual NO₂ baseline concentration was determined based on the average of all 1-hour values for each year for 2020 to 2024. Then 3-year average for 2020 to 2022, 2021 to 2023 and 2022 to 2024. The maximum 3-year average is presented here (2020 to 2022).

Baseline NO₂ was determined using the five most recent years of data from the nearest representative station: Kitimat Whitesail

SO₂:

The 1-hour and annual baseline concentrations were chosen based on previous assessments in the Kitimat Valley. These values were used in the Rio Tinto Comprehensive Review (Rio Tinto 2019).

PM_{2.5}:

The 24-hour PM_{2.5} baseline was determined based on an average of the 98th percentile of the 24-hour averages for 2020-2024

The annual PM_{2.5} baseline was determined based on the average of 1-hour values for 2020-2024.

Baseline PM_{2.5} was determined using the five most recent years of data from the nearest representative station: Kitimat Riverlodge (BAM1020 instrument).

CO:

The 1-hour CO baseline was determined based on the average of the 98th percentile of 1-hour averages. The 8-hour baseline was determined based on the average of the 98th percentile of the daily averages. Baseline was determined using the two most recent years (2011-2012) of data from the nearest representative station: Smithers St. Joseph School.



2.5 Emission Inventory Overview

Four model scenarios have been identified to examine the air quality implications of the Project. These are called the Base Case, Project-Along Case, Application Case, and Future Case. A fifth scenario considering expected worst case flaring events is modelled separately (Flaring Case).

Base Case: The regional emission sources making up the Base Case dispersion modelling scenario are:

- The modernized Rio Tinto aluminum smelter with the maximum authorized emissions scenario from PA-110588 (ENVP, 2024). The key pollutants associated with the Rio Tinto smelter are SO₂, NO_x, PM_{2.5} and CO.
- Existing marine traffic associated with Rio Tinto smelter. The key pollutants from the existing marine traffic are SO₂, NO_x, PM_{2.5}, and CO.
- LNG Canada facility with maximum authorized emissions scenario from PA-110588 (ENVP, 2024). The key pollutants associated with the LNG Canada facility are SO₂, NO_x, and PM_{2.5}, and CO.
- Marine traffic associated with the LNG Canada facility Phase I (i.e., two liquefaction trains). The key pollutants from the marine traffic are SO₂, NO_x, PM_{2.5}, and CO.
- Baseline concentrations are added to the Base Case to account for sources not modelled (e.g., traffic, home heating, small industrial / commercial businesses, rail, other marine traffic).

Project-Along Case: consists of the proposed Project equipment, including Project marine vessels, operating at hourly, daily, and annual emission rates consistent with full equipment capacity. Units designated as backup, emergency, or on standby will be depicted in the modelling exercise as not operating.

Application Case: consists of the Project-Along Case plus the Base Case with baseline concentrations added. Baseline is added to the Application Case to account for sources not modelled.

Future Case: Application Case plus LNG Canada Phase II (an additional two liquefaction trains for a total of four trains) with baseline concentrations added. Baseline is added to the Future Case to account for sources not modelled.

Flaring Case: consists of the expected worst case flaring event for each flare stack (i.e., warm flare, cold flare, low pressure flare) assessed independently.

The summary of emission sources for each modelling scenario and the emission summary for each modelling scenario are provided in Table 2.4 and Table 2.5. As most emission rates for the industrial facility sources are based on permit discharge limits, the resulting values are expected to be conservative and may overstate actual emissions.



Table 2.4 Summary of Emission Sources for each Modelling Scenario

Equipment	Base Case	Project- Alone Case	Application Case	Flaring Case	Future Case
Regional Emission Sources					
Rio Tinto Aluminum Smelter	x	N/A	x	N/A	x
Rio Tinto Smelter Marine Traffic	x	N/A	x	N/A	x
LNG Canada LNG Facility Phase I	x	N/A	x	N/A	x
LNG Canada Marine Traffic	x	N/A	x	N/A	x
LNG Canada Phase II	N/A	N/A	N/A	N/A	x
Proposed Project Equipment					
Acid Gas Thermal Oxidizer	N/A	x	x	N/A	x
Auxiliary Boilers	N/A	x	x	N/A	x
Regen Gas Heater	N/A	x	x	N/A	x
LNG Carrier	N/A	x	x	N/A	x
Assist Harbour Tugboats	N/A	x	x	N/A	x
Warm Flare	N/A	x ^a	x ^a	x ^b	x ^a
Cold Flare	N/A	x ^a	x ^a	x ^b	x ^a
Low Pressure Flare	N/A	x ^a	x ^a	x ^b	x ^a
Emergency Diesel Generator	N/A	N/A	N/A	N/A	N/A
Essential Diesel Generators	N/A	N/A	N/A	N/A	N/A
Firewater Pumps	N/A	N/A	N/A	N/A	N/A
Baseline					
Baseline	x	N/A	x	N/A	x

Notes:

'x' means operational in the associated scenario

'N/A' means not operational in the associated scenario

^a Includes normal operation of the flare (i.e., pilot, purge)

^b Includes emergency flaring scenario and pilot, purge



Table 2.5 Emissions Summary for Each Modelling Scenario

Modelling Scenario	Emissions (tonnes/year)				
	SO ₂	NO _x	PM _{2.5}	CO	VOC ^e
Base Case, Total ^a	15,663	1,941	937	1,383	105
Project-Along Case, Total ^b	354	192	23.4	138	64.9
Application Case, Total ^c	16,017	2,133	960	1,521	170
Future Case, Total ^d	16,349	3,640	985	2,842	210

Notes:

- ^a The Base Case total emissions represent the authorized emissions from the Rio Tinto aluminum smelter, Rio Tinto smelter marine traffic, LNG Canada facility (Phase I), and LNG Canada marine traffic (Phase I).
- ^b The Project-Along includes Acid Gas thermal oxidizer, regen gas heater, auxiliary boilers, warm flare pilot & purge, cold flare pilot & purge, LP Flare pilot & purge, and marine traffic. The emission rates for regen gas heater are based on operating hours of 3,982 per year. The marine traffic is scaled based on the number and duration of visits.
- ^c Application is Base Case plus Project-alone.
- ^d Future Case includes the Application Case with baseline plus LNG Canada Phase II. Phase II sources include two incinerators, four Waste Heat Recovery Units, and marine sources (i.e., two additional liquefaction trains). The source emission rates are the same as Phase I. This is assumed to be conservative as LNG Canada has not applied for a Waste Discharge Authorization for Phase II. See Appendix B for the detail.
- ^e VOC = volatile organic compound

2.5.1 Base Case

The Base Case modelling scenario consists of emissions from regional sources operating at their maximum authorized capacities. These sources include the Rio Tinto Aluminum Smelter, the associated marine traffic, the LNG Canada facility (Phase I), and its associated marine traffic, and the baseline concentrations for sources not modelled (i.e., residential heating, traffic, small industrial/commercial sources, other marine vessel traffic). Key pollutants from each of these sources include SO₂, NO_x, PM_{2.5}, and CO.

2.5.2 Project-Along Case

The Project-Along Case modelling scenario consists of emissions from key process equipment: the acid gas thermal oxidizer, two auxiliary boilers, a regen gas heater, flare stacks, and associated marine vessels including an LNG carrier and assist harbour tugboat.

The amendment application proposes a 25% increase in overall facility production capacity; this translates to an increase in emissions from sources that were assessed in the EAC Application (Cedar LNG 2022). Air emission sources associated with the Project include one acid gas thermal oxidizer, two auxiliary boilers, one regen gas heater, flare sources with continuous pilot and purge for each warm flare,



cold flare, low pressure Flare, marine sources, and emergency diesel equipment (located on the FLNG facility) (i.e., two essential generators, two diesel firewater pumps, one emergency diesel generator). For modelling a conservative approach is taken to assume the thermal oxidizer, the two auxiliary boilers, and the regen heater are operating continuously and simultaneously 100% of the time. It is noted that SO₂ emission rates for facility equipment are conservative based upon the maximum anticipated sulphur content in feed gas. This is a conservative approach as typical sulphur content will be less, and occurrences of the maximum sulphur content are expected to be infrequent. In addition, Cedar confirmed there are no changes to marine traffic compared to the EAC Application as the number of LNG carriers assumed were conservative and adequate for the increase in production capacity.

The two essential generators are tested monthly for maintenance purposes. The two diesel firewater pumps are similarly operated on a weekly basis for maintenance purposes. The emergency diesel equipment is operated occasionally to test operability and conduct maintenance, and during emergency conditions. As this equipment is operated infrequently and for a short duration, the two essential generators, two diesel firewater pumps, and one emergency diesel generator are depicted in the model as not operating.

A summary of the anticipated emission sources is presented in Table 2.6 (FLNG continuous combustion sources), Table 2.7 (marine sources) and Table 2.8 (flares). These emissions reflect maximum emission rates, assuming continuous full-capacity operation. Maximum rates are used for short-term modelling (1-hour, 8-hour, and 24-hour averages), while average emission rates based on expected operational activity are applied for long-term (annual average) modelling.



Table 2.6 Stack Parameters and Emission Rates for Proposed Equipment

Source Identification		Acid Gas Thermal Oxidizer	Auxiliary Boiler A ^b	Auxiliary Boiler B ^b	Regen Gas Heater
Unit Description		Continuous	Continuous	Continuous	Continuous (operates at 45% of year, 3,982 hours/yr)
Fuel Properties ^c					
Fuel Type		Design Fuel Gas + Acid Gas + Flash Gas	Design Fuel Gas	Design Fuel Gas	Design Fuel Gas
Feed Gas Higher Heating Value (HHV)	MJ/sm ³	6.55 ^d	94.1	94.1	94.1
Feed Gas Consumption ^c	s m ³ /h	13184	987	987	451
Stack Location (UTM Zone 9, NAD 83)					
UTM Easting	m E	519,974	520,023	520,023	519,999
UTM Northing	m N	5,980,929	5,980,927	5,980,933	5,980,933
Stack Parameters ^c					
Rain Cap	Yes/No	No	Yes	Yes	Yes
Release Direction		Vertical	Vertical	Vertical	Vertical
Stack Height above sea level	m	55.4	47.4	47.4	54.7
Stack Diameter	m	2.10	1.20	1.20	1.02
Maximum Exit Velocity ^e	m/s	19.9	11.6	11.6	7.11
Exit Temperature	°C	982	125	125	219
	K	1,255	398	398	492



Source Identification		Acid Gas Thermal Oxidizer	Auxiliary Boiler A ^b	Auxiliary Boiler B ^b	Regen Gas Heater
Maximum Emission Rates ^{a c}					
SO ₂	t/d	0.862	0.035	0.035	0.015
NO _x	t/d	0.226	0.082	0.082	0.040
PM _{2.5}	t/d	0.013	0.015	0.015	0.005
CO	t/d	0.112 ^f	0.084	0.084	0.015
VOC	t/d	0.062	0.014	0.014	0.008
SO ₂	g/s	9.980	0.407	0.407	0.178
NO _x	g/s	2.620	0.953	0.953	0.464
PM _{2.5}	g/s	0.152	0.172	0.172	0.061
CO	g/s	1.300 ^f	0.968	0.968	0.178
VOC	g/s	0.712	0.167	0.167	0.092

Notes:

^a Based on inlet gas flow rate 500 MMSCFD.

^b Both auxiliary boilers will operate at 50% load; however, for modelling 100% load (emission rate presented here) for both auxiliary boilers was assumed.

^c Provided by Cedar

^d Calculated based on flow rate and heating values of three gas streams, fuel gas, flash gas, and acid gas.

^e Calculated based on assumed 25% excess air for acid gas thermal oxidizer and 15% excess air for auxiliary boilers and regen gas heater.

^f Calculated based on emission limit 100 mg/Nm³ (dry and 3% O₂) from manufacturer information.



Table 2.7 Marine Vessel Equipment Specification and Emission Summary

Unit Description		LNG Carrier					Assist Harbour Tugboats
		Main Engine	Auxiliary Engine		Boiler		Maneuvering/Loading
		Maneuvering	Maneuvering	Loading	Maneuvering	Loading	
Engine Power ^a	kW	31,200	8,020	8,020	371	3,000	1,194
Load Factor ^a		0.04	0.43	0.43	1.00	1.00	0.43
Berthing/Unberthing ^a	hour	3	3	24	3	24	3
Vessel Numbers Per Year ^a		50					2
Fuel Type ^a		Distillate marine gas oil or marine diesel oil					Distillate marine gas oil or marine diesel oil
Engine NOx Emission Standard ^a		Tier III	Tier III		N/A		Tier III
Stack Location							
South	UTM Zone 9, NAD 83	m E	520,034				520,071
		m N	5,980,653				5,980,717
North		m E	-				520,085
		m N	-				5,980,861
Stack Dimensions ^a							
Height	m	50.0 ^b					10.0
Inside Tip Diameter	m	1.50					0.75
Exhaust Parameters ^a							
Exit Velocity	m/s	13.3 ^c					9.43
Exit Temperature	°C	337					537
	K	610					810



Unit Description		LNG Carrier					Assist Harbour Tugboats
		Main Engine	Auxiliary Engine		Boiler		
		Maneuvering	Maneuvering	Loading	Maneuvering	Loading	Maneuvering/Loading
Emission Rates (Maximum) (assume all engines work simultaneously) ^a							
SO ₂	kg/h	7.19				0.214	
NO _x	kg/h	30.5				0.667	
PM _{2.5}	kg/h	2.51				0.015	
CO	kg/h	17.2				0.608	
VOC	kg/h	9.69				0.021	
SO ₂	g/s	2.00				0.059	
NO _x	g/s	8.46				0.185	
PM _{2.5}	g/s	0.698				0.004	
CO	g/s	4.79				0.169	
VOC	g/s	2.69				0.006	
Emission Rates (Annual Average) (based on berthing/unberthing hours and vessel numbers per year) ^d							
SO ₂	kg/h	0.985				0.004	
NO _x	kg/h	4.17				0.011	
PM _{2.5}	kg/h	0.344				0.0003	
CO	kg/h	2.36				0.010	
VOC	kg/h	1.33				0.0004	
SO ₂	g/s	0.274				0.001	
NO _x	g/s	1.16				0.003	
PM _{2.5}	g/s	0.096				0.0001	



Unit Description		LNG Carrier					Assist Harbour Tugboats
		Main Engine	Auxiliary Engine		Boiler		
		Maneuvering	Maneuvering	Loading	Maneuvering	Loading	Maneuvering/Loading
CO	g/s	0.656					0.003
VOC	g/s	0.369					0.0001

Notes:

- ^a No changes proposed to the marine vessel specifications, operations, and emission rates, these are assumed to be the same as the EAC Application.
- ^b Assumed by Stantec.
- ^c Based on manufacturer information.
- ^d Calculated based on the maximum emission rates, berthing/unberthing hours, and vessel numbers per year.



Table 2.8 Stack Parameters and Emission Rates for the Proposed Flare (Normal Operation)

Source Identification		Warm Flare	Cold Flare	Low Pressure Flare
Unit Description ^a		Pilot & Purge (Continuous)	Pilot & Purge (Continuous)	Pilot & Purge (Continuous)
Fuel Properties ^a				
Fuel Type		Design Fuel Gas	Design Fuel Gas	Design Fuel Gas
Fuel Gas HHV	MJ/m ³	94.1	94.1	94.1
Sulphur Content	ppmv	417	417	417
Fuel Gas Flow Rate ^a				
Fuel Gas Flow Rate	s m ³ /h	53.5	53.5	42.1
Stack Location (UTM Zone 9, NAD 83)				
UTM Easting	m E	519,991	519,994	519,997
UTM Northing	m N	5,980,917	5,980,915	5,980,917
Stack Physical Parameters ^a				
Stack Height	m	138.0	137.4	137.4
Stack Diameter	m	0.86	0.86	0.76
Stack Pseudo Parameters ^b				
Stack Height	m	139.8	139.2	139.0
Stack Diameter	m	0.346	0.346	0.307
Exit Velocity	m/s	20.0	20.0	20.0
Exit Temperature	°C	1,000	1,000	1,000
	K	1,273	1,273	1,273



Source Identification		Warm Flare	Cold Flare	Low Pressure Flare
Emission Rates ^a				
SO ₂ ^c	t/d	0.002	0.002	0.001
NO _x	t/d	0.006	0.006	0.005
PM _{2.5} ^c	t/d	0.004	0.004	0.003
CO	t/d	0.012	0.012	0.010
VOC	t/d	0.019	0.019	0.015
SO ₂	g/s	0.022	0.022	0.017
NO _x	g/s	0.072	0.072	0.057
PM _{2.5} ^c	g/s	0.043	0.043	0.034
CO	g/s	0.144	0.144	0.113
VOC	g/s	0.216	0.216	0.170

Notes:

^a Values provided by Cedar

^b Pseudo stack parameters calculated following the methods in Section 10.1.1 of the Guideline (ENVP 2022)

^c PM_{2.5} emission estimated based on the method presented by McEwen J.D.N and Johnson M.R (2012)



2.5.3 Application Case

Application Case emission scenario consists of Project sources (Base Case + Project-Alone Case) plus the baseline concentrations. Summary of baseline concentrations are provided in Table 2.4 and discussed in Section 2.4.2 and Appendix A.

2.5.4 Future Case

Future Case emission scenario consists of Application Case plus LNG Canada Phase II (an additional two liquefaction trains) with baseline concentrations added. Aside from LNG Canada Phase II, no other reasonably foreseeable projects have been identified that are expected to contribute material emissions within the airshed.

2.5.5 Flaring Case

The Flaring Case emission scenario consists of three worst-case flaring events (one scenario selected for each of the three flare stacks), assessed independently: warm flare (regen gas compressor trip), cold flare (liquefaction train 1 cold start-up), and low-pressure flare (biol-off gas [BOG]/offloading compressor trip – holding mode). Each flare stack will include a continuous pilot and purge.

A summary of the anticipated emission sources is presented in Table 2.9. These emissions reflect maximum emission rates during the flare event. Maximum rates are used for short-term modelling (1-hour and 24-hour averages).



Table 2.9 Stack Parameters and Emission Rates for the Flare Scenarios (Worst-Case)

Source Identification		Warm Flare	Cold Flare	Low Pressure Flare
Unit Description ^a		Regen Gas Compressor Trip	Liquefaction Train 1 Cold S/U	BOG/ Offloading Compressor Trip -Holding Mode
Frequency		~2 per year	~4 per year	~2 per year
Duration		12 hours per event	6 hours per event	12 hours per event
Fuel Properties ^a				
Fuel Type		Treated Gas + Design Fuel Gas (Pilot and Purge)	Heavies Vapor + Design Fuel Gas (Pilot and Purge)	BOG + Design Fuel Gas (Pilot and Purge)
Fuel Gas HHV	MJ/m ³	42.3	58.1	35.3
Sulphur Content ^b	ppmv	108	35.6	0.460
Gas Flow Rate ^a				
Flared Gas Flow Rate	s m ³ /h	51,914	54,670	48,899
Pilot and Purge Gas Flow Rate	s m ³ /h	53.5	53.5	42.1
Stack Location (UTM Zone 9, NAD 83)				
UTM Easting	m E	519,991	519,994	519,997
UTM Northing	m N	5,980,917	5,980,915	5,980,917
Stack Physical Parameters ^a				
Stack Height	m	138.0	137.4	137.4
Stack Diameter	m	0.86	0.86	0.76
Stack Pseudo Parameters ^c				
Stack Height	m	172.8	179.8	168.4
Stack Diameter	m	7.67	9.43	6.79
Exit Velocity	m/s	20.0	20.0	20.0



Source Identification		Warm Flare	Cold Flare	Low Pressure Flare
Exit Temperature	°C	1,000	1,000	1,000
	K	1,273	1,273	1,273
Emission Rates ^{a,f}				
SO ₂ ^c	t/d	0.042	0.032	0.001
NO _x	t/d	0.771	0.584	0.614
PM _{2.5} ^e	t/d	0.087	0.065	0.069
CO	t/d	3.19	2.39	2.50
VOC	t/d	0.645	0.485	0.511
SO ₂ ^c	g/s	0.966	1.47	0.017
NO _x	g/s	17.8	27.0	14.2
PM _{2.5} ^e	g/s	2.02	2.99	1.59
CO	g/s	73.8	110.4	57.9
VOC	g/s	14.9	22.4	11.8

Notes:

^a Provided by Cedar.

^b Stantec calculated sulphur content based on SO₂ emission rates provided by Cedar for both flared gas and pilot and purge gas.

^c Pseudo stack parameters calculated following the methods in Section 10.1.1 of the Guideline (ENVP, 2022b).

^e For pilot and purge gas, PM_{2.5} emission estimated based on the method presented by McEwen J.D.N and Johnson M.R (2012). For flared gas, PM_{2.5} emissions were provided by Cedar.

^f Emission rates are calculated assuming one flare event during a single day



2.6 Dispersion Modelling Methodology

Effects of the Project operation emissions on ambient air quality were assessed using dispersion modelling. Dispersion models provide a scientific link between the emission sources and downwind concentration profiles associated with the sources. Dispersion models incorporate meteorological conditions to account for the transport and dilution of the plume in the atmosphere and incorporate terrain influences. The dispersion modelling was conducted in accordance with the Guideline (ENVP, 2022b) and the Dispersion Modelling Plan for the Project (Appendix A).

2.6.1 Dispersion Model Selection

The following models are used for the Level 3 Assessment for the Project with no modifications to the original computer code. They have been optimized to run in a LINUX computing environment.

- CALMET v6.5.0
- CALPUFF v7.2.1
- CALPOST v7.0.0

Stantec developed post-processing tools that provide predicted concentrations at modelled receptors for applicable regulatory averaging intervals.

2.6.2 Meteorology

All details regarding CALMET, including modelling domain, topography, land use, meteorological data inputs, CALMET model options and an evaluation of the CALMET predictions are included in Appendix B.

For this application, the CALMET model is run in hybrid mode (ENVP, 2022a) by using surface observations and WRF (ENVP, 2022b) model output for the period of January 1, 2011 to December 31, 2015.

There are eight hourly surface weather stations within CALMET domain:

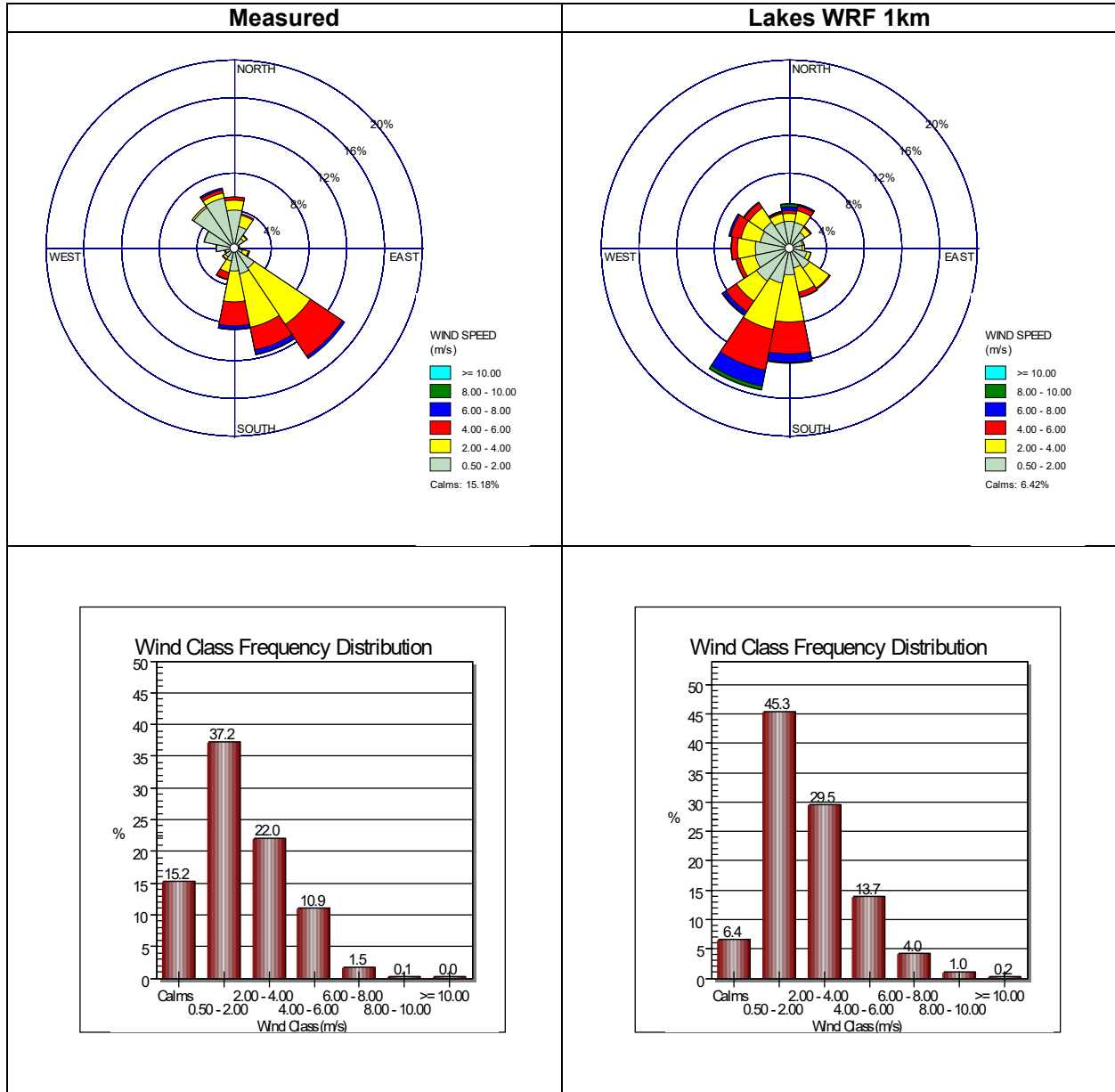
- ENV Kitimat Whitesail, Kitimat Haul Road, Kitimat Haisla Village, Kitimat Riverlodge, Kitimat Yacht Club, Kitimat Smeltersite Road monitoring stations
- ENV Terrace Access Centre monitoring station
- ECCC Terrace Airport weather station

Valid surface temperature, relative humidity, wind speed, wind direction, and station pressure parameters at these eight stations are included in CALMET modeling.

Figure 2.2 presents a comparison of measured and predicted surface winds at Kitimat Haul Road monitoring station (2011–2015). The measured prevailing winds at Kitimat Haul Road monitoring station are mainly from south-east, while the predicted prevailing winds, from WRF, are mainly from south-southwest. Use of surface wind speed and direction data from surface stations helps to correct or adjust the WRF data to align with observations.



Figure 2.2 Comparison of Measured and WRF predicted Wind Roses and Wind Class Frequency at Kitimat Haul Road Station (2011-2015)



2.6.3 Modelling Domain, Receptors, Land Use, and Terrain

The modelling domain boundaries are established to focus the scope of the assessment and to enable a meaningful analysis of potential effects on air quality arising from the Project. The CALPUFF and CALMET modelling domains are presented in Figure 2.1.

The CALPUFF receptor grid is 50 km x 100 km domain. The proposed receptor grid spacing for CALPUFF domains follows recommendations in Section 7.2 in the Guideline (ENVP, 2022a), expectations of the BCER, and are detailed in Appendix C.

Note the receptors located inside the nearby facility are removed. The described grid comprises 23,322 receptor locations. This extent of the receptor grid is considered sufficient to indicate the magnitude and spatial variation of the predicted concentrations resulting from the Project emissions.

The receptors are broadly grouped as follows:

- 105 sensitive receptors corresponding to nearby lakes, creeks, and rivers.
- 28 sensitive receptors corresponding to schools, daycares, health care facilities and residential areas.
- 7 sensitive receptors on the Project Facility Area at the locations where workers are staying on the FLNG facility, sea walk, or onshore.
- 8 air quality monitoring stations.
- 2 deposition stations.

The “plant boundary” is the term used in the Guideline (ENVP, 2022a) section 7.3) to describe a line of receptors that demarcates public vs. worker exposures. Often the highest predicted concentrations are on or very near to this boundary. The plant boundary for this assessment is defined as the fence line, where access to Project is restricted.

Within the plant boundary, meeting occupational health and safety criteria are of primary importance. The applicable regulatory criteria for this assessment are applied to areas where there is public access on and beyond the plant boundary.

2.6.4 Oxides of Nitrogen-to-Nitrogen Dioxide Conversion

NO_x are primarily comprised of NO and NO₂. Only NO₂ concentrations have applicable AQOs. For this assessment, the Ambient Ratio Method 2 (ARM 2) approach using the coastal curve is used to convert predicted NO_x to NO₂.



2.6.5 Chemical Transformation

All of the required and recommended switch settings outlined in Section 7.8 of the Guideline (ENVP, 2022a) are used. See further discussion in Appendix A.

The updated Regional Impact in Visibility and Acid Deposition Model scheme with inorganic aerosol thermodynamic equilibrium model equilibrium (Chemical mechanism flag = 6) is used per Section 7.8 of the Guideline (ENVP, 2022a). The aqueous phase chemistry flag and liquid water content flag are disabled (Appendix A).

The CALPUFF deposition options are enabled to predict deposition of NO_x, SO₂, nitrates and sulfates to be used evaluating acidification, eutrophication, and effects on vegetation.

2.6.5.1 Secondary Particulate Formation

The CALPUFF model is used to predict secondary inorganic PM_{2.5} formation attributable to precursor SO₂ and NO_x emissions as the sum of primary PM_{2.5} and ammonium nitrate and ammonium sulphate concentrations.

2.6.5.2 Stagnation

This assessment employs the CALPUFF dispersion modelling system, which as a non-steady-state puff model, can treat zero wind speeds, trapping effects during inversions, and causality explicitly. This assessment uses numerical weather prediction model output (from WRF) to provide near-zero wind speeds for periods where measurements indicate a calm (i.e., less than anemometer threshold speeds).

2.6.6 Building Plume Downwash Effects

There is potential for building downwash from structures on the floating LNG facility and LNG carrier while at port. Therefore, these are included in Building Profile Input Program and Plume Rise Model Enhancements. Structure dimensions and a simplified plot plan are provided in Appendix A.

Building downwash is modelled consistent with Section 7.6 in the Guideline (ENVP, 2022a). For sloped or peaked roofs, the building height is equivalent to halfway between the trough and the peak, consistent with ENVP direction.



3 Results

Dispersion modelling is used to predict the maximum NO₂, SO₂, PM_{2.5} and CO concentrations for the Base Case, Project-Alone Case, Application Case, Future Case and Flaring Case. Baseline values are added to Base Case, Application Case, and Future Case predictions. To provide context and understanding of potential over prediction of dispersion modelling results, in Section 3.1, an evaluation of the hourly Base Case dispersion modelling predictions, without baseline added, at receptors representing the Whitesail and Riverlodge air monitoring station locations were compared to measured values at those stations. The air quality assessment results for the Project are presented in tabular form and discussed in Sections 3.2, 3.3, 3.4, 3.5, and 3.6. Isopleth figures showing predicted concentrations (by modelled case) are presented in Appendix D.

3.1 Model Performance

To evaluate model prediction uncertainty and bias, the hourly Base Case dispersion modelling results, without baseline added, at receptors representing the Whitesail and Riverlodge air monitoring station locations were compared to measured values at those stations. A ratio of predicted to measured concentrations was calculated for each station.

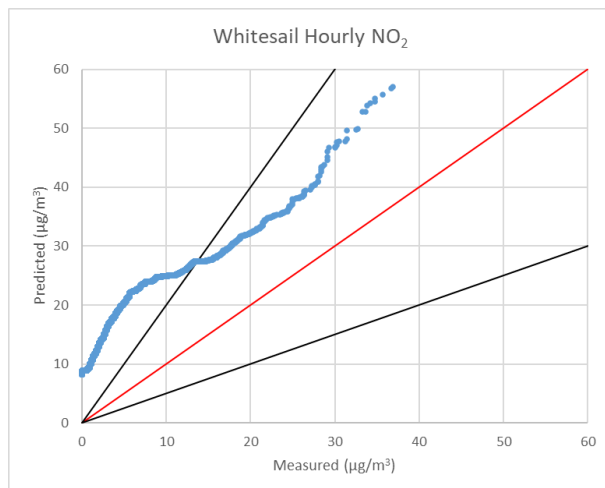
Q-Q plots rank the predicted and observed concentrations from maximum to minimum and then pair them by their rank. Perfect correlation or perfect model performance would be expressed by data points along the 1:1 line. The Q-Q plots provide a visual evaluation of model performance and bias. Model performance is typically deemed acceptable if the ratio of predicted to measured values falls within a factor of two. This analysis was not completed as a rigorous statistical model performance evaluation, rather to provide an indication of which model predictions are associated with increased uncertainty or substantial prediction bias. Model performance was evaluated for NO₂ and SO₂.

Tables of predicted NO₂, SO₂ and PM_{2.5} concentrations at the Kitimat regional monitoring stations (Whitesail, Haul Road, Haisla Village, Riverlodge, Yacht club and Industrial Ave) are provided in Table E.1 to E.4 (Appendix E). Table E.1 (Appendix E) presents a comparison of measured and modelled concentrations, indicating the model generally overpredicts concentrations.

Figure 3.1 shows the Q-Q plot of 1-hour NO₂ predictions compared to measurements at Whitesail. Approximately half of the predicted concentrations fall within a factor of 1 to 2 of the measured values, while the remainder slightly overpredict concentrations. A comparison of the top 25 predicted concentrations to the top 25 measured concentrations at the Whitesail monitoring station fall within predicted to measured ratios of 1.5 to 1.7. This conservative tendency is generally acceptable in air quality assessments and supports a precautionary approach.



Figure 3.1 *NO₂ Model Performance – Q-Q Plot*



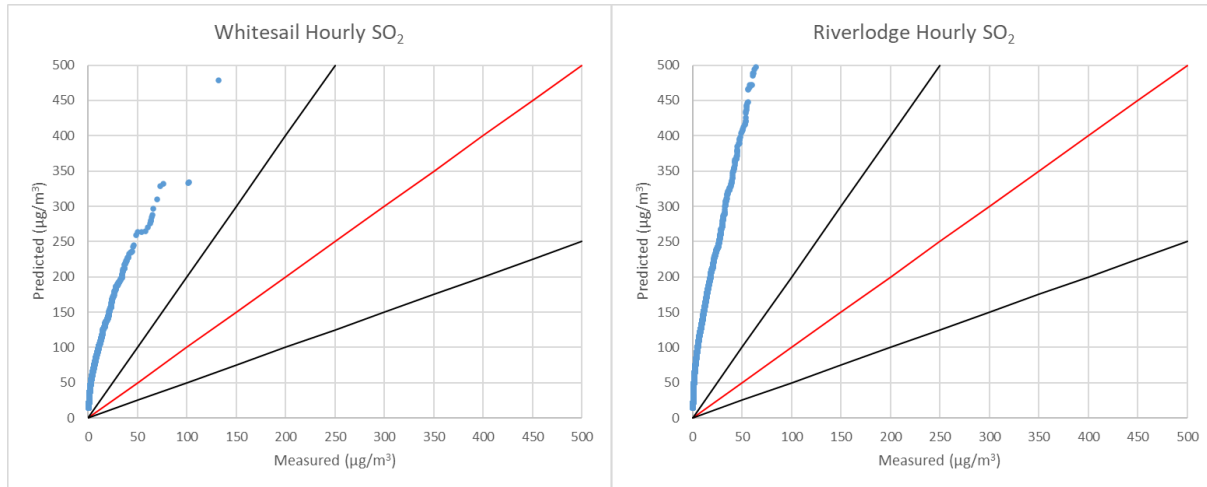
Note: Figure 3.1 shows rank-ordered measured and predicted hourly values (blue dots). The graph also indicates the 1:1 relationship (red line) and the factor-of-two accuracy metric for good model performance (black lines).

Figure 3.2 shows the Q-Q plots for 1-hour Base Case SO₂ predictions without baseline added compared to measurements at Whitesail and Riverlodge monitoring station locations. Predicted concentrations tend to be overestimated, with values falling outside (above) the 2:1 band. A comparison of the top 25 predicted concentrations to the top 25 measured concentrations at the Riverlodge monitoring station fall within predicted to measured ratios of 3.3 to 5.7. This is partially attributable to the fact that actual SO₂ emissions from the facility were lower than the emission rates used in the dispersion modelling compared to the 2020–2024 ambient monitoring period. A labour dispute in 2021 led to a prolonged plant shutdown, resulting in near zero emissions throughout 2022.

However, even accounting for reduced actual emissions over the 2020 to 2024 period, maximum predicted SO₂ concentrations remain substantially greater than concentration measurements. Therefore, the SO₂ model results should be interpreted considering a likely overprediction bias.



Figure 3.2 SO₂ Model Performance – Q-Q Plots



Note: Figure 3.2 shows rank-ordered measured and predicted hourly values (blue dots). The graph also indicates the 1:1 relationship (red line) and the factor-of-two accuracy metric for good model performance (black lines).

A comparison of the Q-Q plot for predicted and measured PM_{2.5} concentrations is not included because many of the highest measured concentrations are associated with unique events such as wildfires and influenced by meteorological conditions where community emissions, which are not directly modelled, are associated with elevated concentrations such as use of wood-fired heating. Nonetheless, a general comparison of maximum and average predicted and measured PM_{2.5} concentrations (Appendix E, Table E.1) indicates the model tends to achieve adequate to slightly conservative performance.



3.2 Base Case

Predicted concentrations for the Base Case are shown in Table 3.1.

Table 3.1 Base Case Modelling Results for the Project

Substance	Averaging Period	Maximum Predicted Concentrations ($\mu\text{g}/\text{m}^3$)	Baseline ($\mu\text{g}/\text{m}^3$)	Maximum Predicted Concentration Including Baseline ($\mu\text{g}/\text{m}^3$)	BC AQO / CAAQS ($\mu\text{g}/\text{m}^3$)
NO ₂	1-hour	81.8	288-value array (Appendix A)	92.7	113 / 79
	Annual	5.5	2.9	8.4	32 / 23
SO ₂	1-hour	1,722	14.5	1,736	183 / 170
	Annual	74.0	1.2	75.2	13 / 11
PM _{2.5}	24-hour	73.4	9.3	82.7	25 / 23
	Annual	19.3	3.4	22.7	8
CO	1-hour	978	869	1,847	14,300
	8-hour	327	715	1,042	5,500

Notes:

Achievement for each parameter and time averaging interval is as described in the notes section of Table 2.3

Bolded black values are greater than the BC AQO.

NO to NO₂ conversion is using ARM 2 Coastal Sites.

For NO₂, the Base Case maximum 98th percentile of the predicted daily one-hour maximum ground-level concentration with baseline added is 92.7 $\mu\text{g}/\text{m}^3$, which is less than the BC AQO. Figure D.1 (Appendix D) shows that this maximum is near the neighbouring LNG Canada and Rio Tinto facilities. Concentrations above 50% of the BC AQO occur near the two existing facilities, extend south toward the location of the Project, and occurs over a small area in the center of Kitimat.

The maximum predicted annual average ground-level NO₂ concentration with baseline added is 8.4 $\mu\text{g}/\text{m}^3$, which is less than the BC AQO. Figure D.2 (Appendix D) shows an isopleth pattern extends along the valley, reflecting the influence of prevailing winds and local terrain.

For SO₂, the Base Case maximum 99th percentile of the predicted daily one-hour maximum ground-level SO₂ concentration with baseline added is 1,736 $\mu\text{g}/\text{m}^3$, which is greater than the BC AQO. Figure D.3 (Appendix D) shows that a large area where the 99th percentile D1HM exceeds the BC AQO, extending throughout most of the LAA. The isopleth pattern is centered on the Rio Tinto, the dominant source of SO₂ emissions in the LAA. Maximum predicted SO₂ concentrations near the Rio Tinto boundary are approximately an order of magnitude greater than the BC AQO. As discussed in Section 3.1 and



Appendix E, these maximum predicted concentrations are believed to substantially overpredict actual conditions, as measured concentrations of SO₂ at Kitimat monitoring stations greater than the BC AQO have been infrequent (ENVP, 2025a).

The maximum predicted annual average ground-level SO₂ concentration with baseline added is 75.2 µg/m³, which is greater than the BC AQO. Figure D.4 (Appendix D) shows that this maximum occurs on the south plant boundary of Rio Tinto. The annual SO₂ isopleth pattern extends along the valley, reflecting prevailing wind and terrain influences, with predicted exceedances that are conservative relative to measured values. Annual SO₂ concentrations measured at monitoring stations are substantially lower than the BC AQO.

For PM_{2.5}, the Base Case maximum 98th percentile of the predicted daily maximum ground-level PM_{2.5} concentration with baseline added is 82.7 µg/m³, which is greater than the BC AQO. Figure D.5 (Appendix D) shows that this maximum occurs on the south plant boundary of Rio Tinto, the dominant source of PM_{2.5} emissions in the LAA, with concentrations above the BC AQO extending approximately 3.5 km south.

The maximum predicted annual average ground-level PM_{2.5} concentration with baseline added for the Base Case is 22.7 µg/m³, which is greater than the BC AQO. Figure D.6 (Appendix D) shows that this maximum occurs on the south plant boundary of Rio Tinto, the dominant source of PM_{2.5} emissions in the LAA, with concentrations above the BC AQO extending approximately 2.5 km south.

For CO, the Base Case maximum predicted daily one-hour maximum ground-level CO concentration with baseline added is 1,847 µg/m³, which is less than the BC AQO. The maximum predicted 8-hour average ground-level CO concentration with baseline added is 1,042 µg/m³, which is less than the BC AQO.

Maximum predicted concentrations for the Base Case for the amendment application have increased compared to the EAC Application (Stantec, 2021) associated with changes to the Base Case emission inventory and changes to meteorology and modelling methodology to meet current model guidance and align with recent assessments in the Kitimat airshed. However, the overall findings and resulting characterization of effects on air quality for amendment application are unchanged as the results are generally similar in magnitude and extent compared to the EAC Application (Stantec, 2021). Comparison of model predictions to concentration measurements in the LAA demonstrate the maximum concentrations which are predicted to be greater than the AQO are predominantly attributable to conservatism (i.e., overprediction bias).

3.3 Project-Along Case

Predicted concentrations for the Project-Along Case are shown in Table 3.2.



Table 3.2 Project-Along Case Modelling Results for the Project

Substance	Averaging Period	Maximum Predicted Concentrations (µg/m³)	BC AQO / CAAQS (µg/m³)
NO ₂	1-hour	84.0	113 / 79
	Annual	8.5	32 / 23
SO ₂	1-hour	133	183 / 170
	Annual	4.0	13 / 11
PM _{2.5}	24-hour	6.6	25 / 23
	Annual	1.5	8
CO	1-hour	713	14,300
	8-hour	183	5,500

Notes:

Achievement for each parameter and time averaging interval is as described in the notes section of Table 2.3
NO to NO₂ conversion is using ARM 2 Coastal Sites.

For NO₂, the Project-Along Case maximum 98th percentile of the predicted daily one-hour maximum ground-level NO₂ concentration is 84 µg/m³, which is less than the BC AQO. Figure D.7 (Appendix D) shows that this maximum occurs 600 m south of the Project plant southern boundary.

The maximum predicted annual average ground-level NO₂ concentration is 8.5 µg/m³, which is less than the BC AQO. Figure D.8 (Appendix D) shows that this maximum occurs 450 m north of the Project plant northern boundary.

For SO₂, the Project-Along Case maximum 99th percentile of the predicted daily one-hour maximum ground-level SO₂ concentration is 133 µg/m³, which is less than the BC AQO. Figure D.9 (Appendix D) shows that this maximum occurs 350 m south of the Project plant southwest boundary.

The maximum predicted annual average ground-level SO₂ concentration is 4.0 µg/m³, which is less than the BC AQO. Figure D.10 (Appendix D) shows that this maximum occurs 500 m north of the Project plant northern boundary.

For PM_{2.5}, the Project-Along Case maximum 98th percentile of the predicted daily maximum ground-level PM_{2.5} concentration is 6.6 µg/m³, which is less than the BC AQO. Figure D.11 (Appendix D) shows that this maximum occurs 450 m north of the Project plant northern boundary.

The maximum predicted annual average ground-level PM_{2.5} concentration is 1.5 µg/m³, which is less than the BC AQO. Figure D.12 (Appendix D) shows that this maximum occurs 500 m north of the Project plant northern boundary.



For CO, the Project-Alone Case maximum predicted daily one-hour maximum ground-level CO concentration is 713 µg/m³, which is less than the BC AQO. The maximum predicted 8-hour average ground-level CO concentration is 183 µg/m³, which is less than the BC AQO.

In general, for the contaminants modelled, maximum predicted concentrations for the Project-Alone Case occur within a few hundred meters of the Project. Predicted plumes generally follow the valley orientation, reflecting prevailing winds and terrain influences, with the majority of concentration impacts occurring over the open waters of Douglas Channel rather than inland.

Project-Alone model predictions for the amendment application have increased compared to the EAC Application (Stantec, 2021) associated with both changes to Project emissions as well as changes to meteorology and modelling methodology to meet current model guidance and align with recent assessments in the Kitimat airshed. However, the overall findings and resulting characterization of effects on air quality for amendment application based on these results are unchanged as the results are generally similar in magnitude and extent compared to the EAC Application (Stantec, 2021).

3.4 Application Case

Predicted concentrations for the Application Case are shown in Table 3.3.

Table 3.3 Application Case Modelling Results for the Project

Substance	Averaging Period	Maximum Predicted Concentrations (µg/m ³)	Baseline (µg/m ³)	Maximum Predicted Concentration Including Baseline (µg/m ³)	BC AQO / CAAQS (µg/m ³)	Percent Change from Base Case (%)
NO ₂	1-hour	84.1	288-value array (Appendix A)	102	113 / 79	9.5
	Annual	10.2	2.9	13.1	32 / 23	56.0
SO ₂	1-hour	1,723	14.5	1,737	183 / 170	0.1
	Annual	74.6	1.2	75.8	13 / 11	0.8
PM _{2.5}	24-hour	73.4	9.3	82.7	25 / 23	0
	Annual	19.4	3.4	22.8	8	0.4
CO	1-hour	978	869	1,847	14,300	0
	8-hour	327	715	1,042	5,500	0

Notes:

Achievement for each parameter and time averaging interval is as described in the notes section of Table 2.3

Bolded black values are greater than the BC AQO.

NO to NO₂ conversion is using ARM 2 Coastal Sites.



For NO₂, the Application Case maximum 98th percentile of the predicted daily one-hour maximum ground-level NO₂ concentration with baseline added is 102 µg/m³, which is less than the BC AQO. The percent change from the Base Case to the Application Case for the maximum 98th percentile of the predicted daily one-hour maximum ground-level NO₂ concentration is a 9.5% increase. Figure D.13 (Appendix D) shows that this maximum occurs 400 m south of the Project plant southern boundary at the same location as Project Case (Figure D.7).

The maximum predicted annual average ground-level NO₂ concentration with baseline added for the Application Case is 13.1 µg/m³, which is less than the BC AQO. The percent change from the Base Case to the Application Case is a 57% increase. Figure D.14 (Appendix D) shows that this maximum occurs 450 m north of the Project plant northern boundary. Compared to the Base Case isopleths, the addition of the Project results in an extension of NO₂ isopleths southward along Douglas Channel, with less pronounced increases observed up-valley over the Kitimat townsite.

For SO₂, the maximum Application Case 99th percentile of the predicted daily one-hour maximum ground-level SO₂ concentration with baseline added is 1,737 µg/m³, which is greater than the BC AQO. Figure D.15 (Appendix D) shows that this maximum occurs 2.5 km north from the Project northern boundary, which is on the southwest plant boundary of Rio Tinto.

The maximum predicted annual average ground-level SO₂ concentration with baseline added for the Application Case is 75.8 µg/m³, which is greater than the BC AQO. Figure D.16 (Appendix D) shows that this maximum occurs 2.5 km north from the Project northern boundary, which is on the southwest plant boundary of Rio Tinto. Application Case SO₂ isopleth patterns are similar to the Base Case, as maximum concentrations throughout the LAA are dominated by emissions from the Rio Tinto; the addition of the Project does not affect this pattern.

For PM_{2.5}, the Application Case maximum 98th percentile of the predicted daily maximum ground-level PM_{2.5} concentration with baseline added is 82.7 µg/m³, which is greater than the BC AQO. Figure D.17 (Appendix D) shows that this maximum occurs 2.5 km north from the Project northern boundary, which is on the southwest plant boundary of Rio Tinto.

The maximum predicted annual average ground-level PM_{2.5} concentration with baseline added for the Application Case is 22.8 µg/m³, which is greater than the BC AQO. Figure D.18 (Appendix D) shows that this maximum occurs 2.5 km north from the Project northern boundary, which is on the southwest plant boundary of Rio Tinto. Application Case PM_{2.5} isopleths are similar to the Base Case, as maximum concentrations throughout the LAA are dominated by emissions from the Rio Tinto; the addition of the Project does not effect this pattern.

For CO, the Application Case maximum predicted daily one-hour maximum ground-level CO concentration with baseline added is 1,847 µg/m³, which is less than the BC AQO. The maximum predicted 8-hour average ground-level CO concentration with baseline added is 1,042 µg/m³, which is less than the BC AQO.



Maximum predicted concentrations for the Application Case for the amendment application have increased compared to the EAC Application (Stantec, 2021) associated with changes to the Base Case emission inventory, changes to Project emissions, and changes to meteorology and modelling methodology to meet current model guidance and align with recent assessments in the Kitimat airshed. However, the overall findings and resulting characterization of effects on air quality for amendment application are unchanged as the results, including the changes in concentrations as compared to the Base Case, are generally similar in magnitude and extent compared to the EAC Application (Stantec, 2021). Comparison of maximum measured and predicted concentrations for the Base Case for the contaminants predicted to exceed the AQO indicate that predicted exceedances of the AQO are predominantly attributable to conservatism (i.e. overprediction bias).

3.5 Future Case

Predicted concentrations for the Future Case are shown in Table 3.4.

Table 3.4 Future Case Modelling Results for the Project

Substance	Averaging Period	Maximum Predicted Concentrations (µg/m ³)	Baseline (µg/m ³)	Maximum Predicted Concentration Including Baseline (µg/m ³)	BC AQO / CAAQS (µg/m ³)	Percent Change from Application Case (%)
NO ₂	1-hour	84.1	288-value array (Appendix A)	103	113 / 79	1.1
	Annual	11.0	2.9	13.9	32 / 23	6.1
SO ₂	1-hour	1,732	14.5	1,746	183 / 170	0.5
	Annual	75.0	1.2	76.2	13 / 11	0.5
PM _{2.5}	24-hour	73.5	9.3	82.8	25 / 23	0.1
	Annual	19.4	3.4	22.8	8	0
CO	1-hour	1,944	869	2,813	14,300	52.3
	8-hour	552	715	1,267	5,500	21.6

Notes:

Achievement for each parameter and time averaging interval is as described in the notes section of Table 2.3

Bolded black values are greater than the BC AQO.

NO to NO₂ conversion is using ARM 2 Coastal Sites.



For NO₂, the Future Case maximum 98th percentile of the predicted daily one-hour maximum ground-level NO₂ concentration with baseline added is 103 µg/m³, which is less than the BC AQO. The percent change from the Application Case to the Future Case for the maximum 98th percentile of the predicted daily one-hour maximum ground-level NO₂ concentration is a 1.1% increase. Figure D.19 (Appendix D) shows that this maximum occurs 2.5 km north from the Project northern boundary, which is just outside the southwest plant boundary of Rio Tinto.

The maximum predicted annual average ground-level NO₂ concentration with baseline added for the Future Case is 13.9 µg/m³, which is less than the BC AQO. The percent change from the Application Case to the Future Case is a 6.1% increase. Figure D.20 (Appendix D) shows that this maximum occurs 2.5 km north from the Project northern boundary, which is just outside the southwest plant boundary of Rio Tinto. The NO₂ isopleths indicate an increase in concentrations with the addition of LNG Canada Phase II; however, maximum values remain below the BC AQO.

The SO₂, the Future Case maximum 99th percentile of the predicted daily one-hour maximum ground-level SO₂ concentration with baseline added is 1,746 µg/m³, which is greater than the BC AQO. The percent change from the Application Case to the Future Case is a 0.5% increase, consistent with the Application Case, reflecting the Rio Tinto facility remains the dominant source of SO₂ emissions in the LAA. Figure D.21 (Appendix D) shows that this maximum occurs 2.5 km north from the Project northern boundary, which is on the southwest plant boundary of Rio Tinto.

The maximum predicted annual average ground-level SO₂ concentration with baseline added for the Future Case is 76.2 µg/m³, which is greater than the BC AQO. The percent change from the Application Case to the Future Case is a 0.5% increase, consistent with the Application Case, reflecting the Rio Tinto facility remains the dominant source of SO₂ emissions in the LAA. Figure D.22 (Appendix D) shows that this maximum occurs 2.5 km north from the Project northern boundary, which is on the southwest plant boundary of Rio Tinto.

For PM_{2.5}, the Future Case maximum 98th percentile of the predicted daily maximum ground-level PM_{2.5} concentration with baseline added is 82.8 µg/m³, which is greater than the BC AQO. The percent change from the Application Case to the Future Case is a 0.1% increase, consistent with the Application Case, reflecting the Rio Tinto facility remains the dominant source of PM_{2.5} emissions in the LAA. Figure D.23 (Appendix D) shows that this maximum occurs 2.5 km north from the Project northern boundary, which is on the southwest plant boundary of Rio Tinto.

The maximum predicted annual average ground-level PM_{2.5} concentration with baseline added for the Future Case is 22.8 µg/m³, which is greater than the BC AQO. There is no change from the Application Case to the Future Case, reflecting the Rio Tinto facility remains the dominant source of PM_{2.5} emissions in the LAA. Figure D.24 (Appendix D) shows that this maximum occurs 2.5 km north from the Project northern boundary, which is on the southwest plant boundary of Rio Tinto.

For CO, the Future Case maximum predicted daily one-hour maximum ground-level CO concentration with baseline added is 2,813 µg/m³, which is less than the BC AQO. The maximum predicted 8-hour average ground-level CO concentration with baseline added is 1,267 µg/m³, which is less than the BC AQO.



Maximum predicted concentrations for the Future Case for the amendment application have increased compared to the EAC Application (Stantec, 2021) associated with changes to the Base, Project and Future emission inventories and changes to meteorology and modelling methodology to meet current model guidance and align with recent assessments in the Kitimat airshed. However, the overall findings and resulting characterization of effects on air quality in the LAA for amendment application are unchanged as the results, including the changes in concentrations as compared to the Base and Application Cases, are generally similar in magnitude and extent compared to the EAC Application (Stantec, 2021). Comparison of maximum measured and predicted concentrations for the Base Case for the contaminants predicted to exceed the AQO indicate that predicted exceedances of the AQO are predominantly attributable to assessment conservatism (i.e., overprediction bias).

3.6 Non-Routine Flaring Case

Predicted concentrations for the non-routine Flaring Cases are shown in Table 3.5.

Table 3.5 Non-Routine Flaring Case Modelling Results for the Project

Substance	Averaging Period	Maximum Predicted Concentrations (µg/m ³)			
		Warm Flare Regen Gas Compressor Trip	Cold Flare Liquefaction Train 1 Cold S/U	Low Pressure Flare BOG/ Offloading Compressor Trip - Holding Mode	BC AQO / CAAQS (µg/m ³)
NO ₂	1-hour (1 st highest)	70	81.3	72.6	113 / 79
	1-hour (98 th percentile of D1HM)	16.5	20.0	14.5	
SO ₂	1-hour (1 st highest)	4.8	6.8	0.11	183 / 170
	1-hour (99 th percentile of D1HM)	1.6	2.0	0.03	
PM _{2.5}	24-hour (1 st highest)	0.7	1.1	0.7	25 / 23
	24-hour (8 th highest)	0.2	0.3	0.2	
CO	1-hour (1 st highest)	436	508	366	14,300

Notes:

Achievement for each parameter and time averaging interval is as described in the notes section of Table 2.3
NO to NO₂ conversion is using ARM 2 Coastal Sites.

The predicted maximum ground-level concentrations of NO₂, SO₂, PM_{2.5} and CO associated with non-routine flaring events of the Project are less than the BC AQO (Table 3.5). On this basis, comparison to the Guideline (ENVP, 2022a) foliar injury criteria and the Alberta non-routine flaring risk-based criteria (Alberta Energy Regulator, 2025) were not required. Out of the three scenarios evaluated, maximum predictions are associated with the cold flare scenario related to a liquefaction train shut down. Maximum concentrations of NO₂ (1-hour 98th percentile of D1HM), SO₂ (1-hour 99th percentile of D1HM), PM_{2.5} (24-hour 8th highest), and CO (1-hour 1st highest) are 20 µg/m³, 2.0 µg/m³, 0.3 µg/m³, and 508 µg/m³, respectively.



4 Closure

Stantec conducted an air quality assessment in support of the EAC #E23-01 amendment application. The dispersion modelling was performed in accordance with the Guideline (BC ENV, 2022a), Guidance for NO₂ (ENVP, 2022b), and the Dispersion Modelling Plan in Appendix A.

Model predictions for the amendment application have increased compared to the EAC Application (Stantec, 2021); however, the characterization of effects on air quality for amendment application based on these results are similar in magnitude and extent compared to the EAC Application (Stantec, 2021).



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Appendices



Appendix A Dispersion Modelling Plan



Cedar LNG Project Dispersion Modelling Plan

Air Quality Dispersion Assessment for the Cedar LNG Project

September 2025

Prepared for:



Prepared by:
Stantec Consulting Ltd.

Revision: 0

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Appendix A	CALMET Model Options and Land Use Characterization Translation Table
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Acronyms / Abbreviations

AQO	Air Quality Objective
BC	British Columbia
BCER	BC Energy Regulator
EAC	Environmental Assessment Certificate
EAO	Environmental Assessment Office
ENVP	British Columbia Ministry of Environment and Parks
°C	degrees Celsius
CCME	Canadian Council of Ministers of the Environment
CEC	Commission for Environmental Cooperation
Cedar	Cedar LNG Partners LP by its general partner Cedar LNG Partners (GP) Ltd.
CO	carbon monoxide
D1HM	Daily 1-hour maximum
FLNG	floating liquified natural gas
g/s	grams per second
The Guideline	The BC Air Quality Dispersion Modelling Guideline
HHV	higher heating value
K	Kelvin
km	kilometre
kPa	Kilopascal
kW	Kilowatt
LNG	liquefied natural gas
LP	low pressure
m	metre
m/s	metres per second
m asl	metres above sea level
m E	Easting (metres)
m N	Northing (metres)
MJ/m ³	Megajoules per cubic metre
MMSCFD	Million standard cubic feet per day



Cedar LNG Project Dispersion Modelling Plan

Acronyms / Abbreviations

September 2025

NAD83	North American Datum of 1983
NO	nitrogen oxide
NO ₂	nitrogen dioxide
NO _x	oxides of nitrogen
PM _{2.5}	fine particulate matter with an aerodynamic diameter less than equal to 2.5 micrometres
ppm _v	parts per million by volume
the Project	Cedar LNG Project
S m ³ /h	Standard (101.325 kPa and 20°C) cubic metres per hour
SO ₂	sulphur dioxide
t/d	tonnes per day
µg/m ³	microgram per cubic metre
UTM	Universal Transverse Mercator
WRF	Weather Research and Forecast model



1 Dispersion Modelling Plan

The format of this dispersion modelling plan follows the template provided by the British Columbia (BC) Ministry of Environment and Parks (ENVP; (ENVP, 2022a)). Text in *italics* is provided as part of the ENVP template and details the required information for each section of the dispersion modelling plan. This assessment will use the CALPUFF modelling system therefore any requirements in the ENVP template related to other dispersion modelling systems (i.e., AERMOD) have been removed.



2 General

Date: 14-August-2025

Facility Name: Cedar LNG Project

Company: Cedar LNG Partners LP

Company Contact:

Lara Taylor
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lara.taylor@cedarlng.com

Location:

Latitude: 53.9756°N Northing: 5,980,854 m N Zone 9

Longitude: -128.6990°W Easting: 519,749 m E Zone 9

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Cedar LNG Project Dispersion Modelling Plan

Section 2: General

September 2025

Level of Assessment (1, 2 or 3) and provide rationale for the proposed level of assessment:

A Level 3 Assessment will be conducted to assess the air quality consequences of emissions for an increase of operational capacity of the Cedar LNG Project (the Project). Section 2.2.2 of the British Columbia Air Quality Dispersion Modelling Guideline (the Guideline) (ENVP, 2022b) indicates that a Level 3 assessment is appropriate for modelling the Project emission sources. This is due to the complex topography and wind flows in the region and the multiple emission sources.

This plan follows an air dispersion modelling approach similar to that of a recent assessment for another liquefied natural gas (LNG) export facility in Kitimat BC. The modelling methodology described here is specific to the Cedar LNG Project.



3 Project Description and Geographic Setting

Provide an overview of the project, including process description and the purpose of the dispersion modelling study:

Cedar LNG Partners LP, by its general partner Cedar LNG Partners (GP) Ltd. (Cedar), a Haisla Nation led partnership with Pembina Pipeline Corporation, is constructing a liquefied natural gas (LNG) export facility within the District of Kitimat, British Columbia (BC) (the Project). The LNG facility is currently planned to have the capacity to liquify up to and including 500 million standard cubic feet per day (MMSCFD) (14.12 million cubic meters per day [million m³/day]) of natural gas to produce LNG for export.

The Project underwent an environmental assessment from 2019 to 2023 and received an environmental assessment certificate (EAC) under British Columbia's *Environmental Assessment Act* (EAC #23-01) and a positive Decision Statement under Canada's *Impact Assessment Act* (reference number 80208) in March 2023. Cedar received an amendment to EAC #E23-01 on April 9, 2025, and the Decision Statement on May 29, 2025, to allow for changes to the powerline route and floating liquid nitrogen gas (FLNG) facility mooring system, and to add a distribution powerline to the scope of the Project.

Cedar is proposing to amend the Project, by increasing the production capacity of the FLNG facility by approximately 25% resulting in an increase in the maximum inlet gas flow rate from 400 MMSCFD (previously assessed) to 500 MMSCFD (current design). The purpose of the dispersion modelling assessment is to evaluate air quality consequences of the production capacity increase.

Provide a description of the following:

- *Terrain characteristics within domain: flat terrain or complex terrain (i.e., will complex flow need to be considered?)*
- *Dominant land cover: urban, rural, industrial, agricultural, forested, rock, water, grassland*

The Project Facility Area occupies land and water on the western shores of Douglas Channel. Project Facility Area elevation is approximately sea level to 100 metres above sea level (m asl). Local relief to the west of the Project Facility Area rises up to 1,000 metres (m) within 10 kilometre (km). The region consists of complex terrain including ocean channels and inlets, mountains, and river valleys. The dominant land cover is evergreen forest and ocean.

The dispersion of emissions from the Project are dictated by local meteorology, which is influenced by the surrounding complex terrain and marine-land boundary. The nearest permanently occupied dwellings are located approximately 3 km from the Project across Douglas Channel in Kitamaat Village.



4 Dispersion Model

4.1 Selected Dispersion Model

List model(s) and version to be used:

The following models will be used for the Level 3 Assessment of the Project with no modifications to the original computer code. They have been optimized to run in a LINUX computing environment.

- CALMET v6.5.0
- CALPUFF v7.2.1
- CALPOST v7.0.0

Stantec developed post-processing tools that provide predicted concentrations at modelled receptors for applicable regulatory averaging intervals are used to more efficiently extract and summarize contaminant concentrations and deposition rates.

Specify any non-guideline models or versions (i.e., beta-test versions) planned for use. Provide rationale:

No non-guideline models or versions are planned for this assessment.

If modifications to any of the models are planned, provide a description and the rationale:

No modifications to the models are planned.

4.2 Default Switch Settings

For CALMET/CALPUFF identify any key switch settings in CALMET and CALPUFF that will be different from the “black (do not touch)” defaults as per Tables 6.2 and 7.1 (BC ENVP 2022b). Provide rationale.

The key switch settings in CALPUFF will be the “black (do not touch)” defaults as per Table 6.2 and Table 7.1 in the Guideline (ENVP, 2022b). As CALMET is being run in hybrid mode, the proposed values for R1 and RMAX1 are 2 km and 6 km, respectively, to control the distance weighting of surface meteorological measurement data. LVARY=F, denoting that RMAX1 is used to exclude observations. More switch settings are provided in Appendix A (Table A.1).

For the CALMET model provide:

- *A CALMET domain map that also shows the locations of surface meteorological stations and upper air stations:*

Two CALMET domain maps are shown in Figure 4.1 and Figure 4.2. These figures also show the location of nine surface meteorological stations. See Section 10.2 for more information.

- *Anticipated grid resolutions:*



Cedar LNG Project Dispersion Modelling Plan

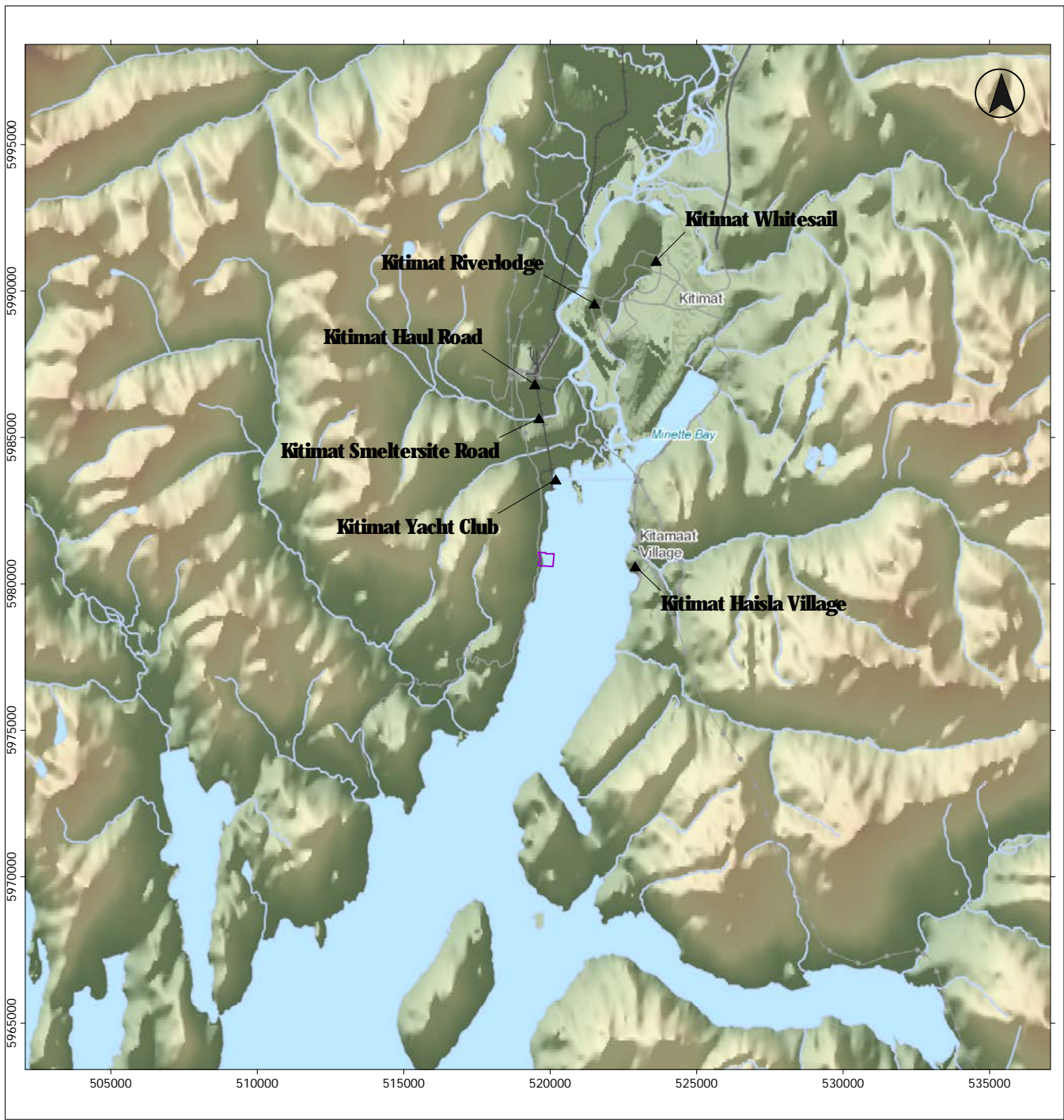
Section 4: Dispersion Model

September 2025

There are two CALMET modelling domains centered on the Project associated with this work to allow for both a sufficiently large study area in combination with reduced grid spacing near important emission sources while achieving acceptable model run times:

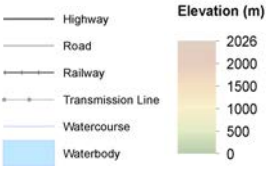
- A near -field CALMET domain 35 km x 35 km with 250 m grid resolution centered at the Project Site (Figure 4.1)
- A far-field CALMET domain 55 km x 110 km with 1 km grid resolution centered at 520,360 m Universal Transverse Mercator (UTM) Easting and 6,001,310 m UTM Northing (Figure 4.2)
- It is anticipated that the relevant Project effects will be captured in the near-field domain (i.e., 35 km by 35 km domain). The far-field 55 km x 110 km domain will be used to capture the Base Case effects and combined with the Project emissions (Application Case) effects.
- *Number of grids in X and Y direction:*
NX = 140, NY = 140 (35 km x 35 km domain)
NX = 55, NY = 110 (55 km X 110 km domain)
- *Vertical levels (m):*
12 vertical levels are used 10, 30, 60, 100, 200, 400, 700, 1100, 1570, 2100, 2690 and 3500
(13 ZFACE layers (m): 0, 20, 40, 80, 120, 280, 520, 880, 1320, 1820, 2380, 3000 and 4000)





Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

Cedar LNG Boundary

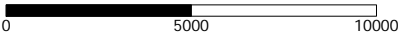


Project Location: Kitimat, British Columbia
 Project Number: 123223008

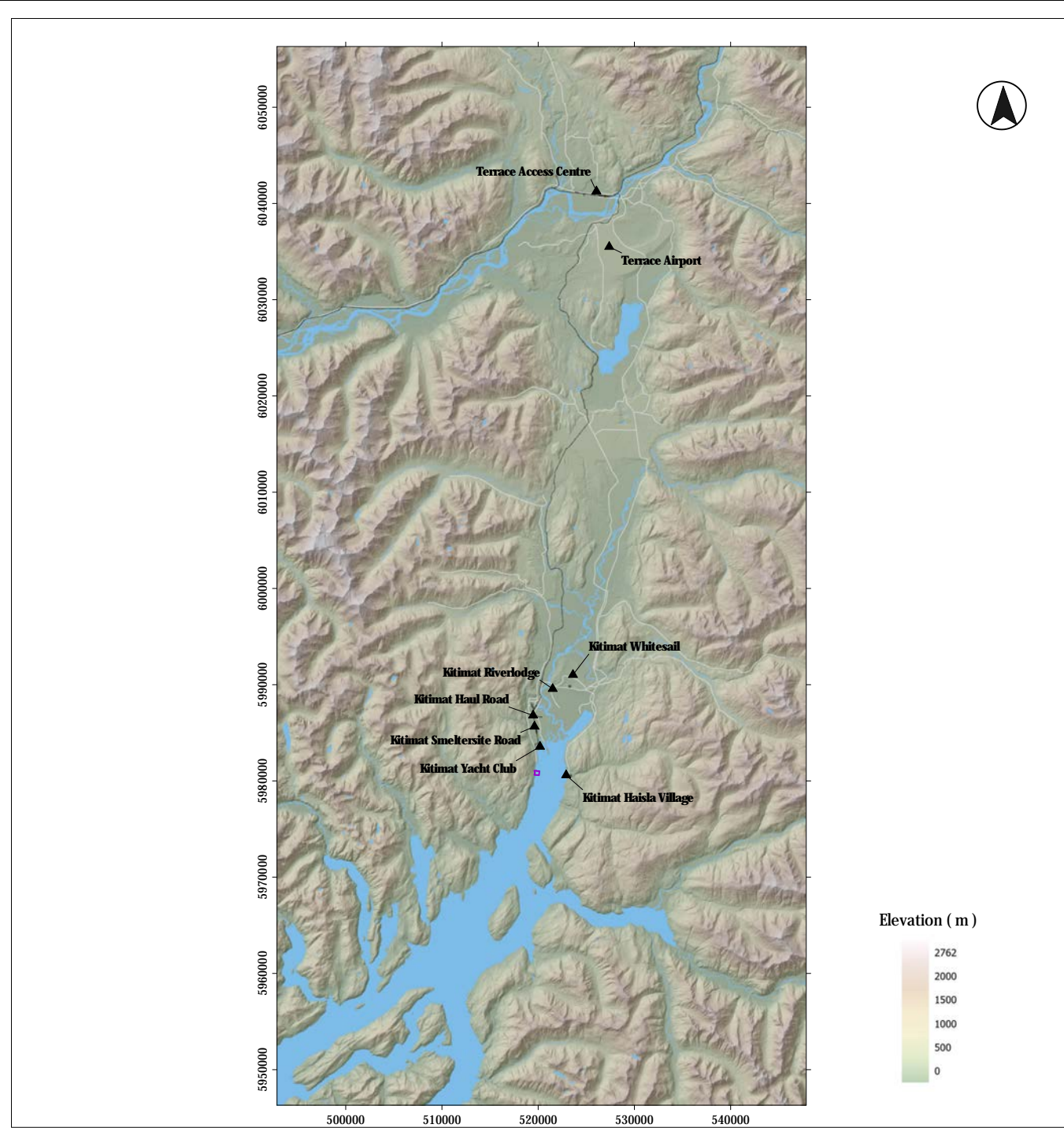
Client/Project/Report:
 Cedar LNG Partners (GP) Ltd.
 Cedar LNG Project
 Dispersion Modelling Plan

Figure No.
 4.1

Title:
 CALMET 35kmx35km Model Domain, Terrain,
 and Meteorological Surface Stations



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Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

Cedar LNG Boundary

- Highway
- Road
- Railway
- Transmission Line
- Watercourse
- Waterbody



Project Location
 Kitimat,
 British Columbia

Project Number 123223008

Client/Project/Report
 Cedar LNG Partners (GP) Ltd.
 Cedar LNG Project
 Dispersion Modelling Plan

Figure No.

4.2

Title:

CALMET 55kmx110km Model Domain, Terrain,
 and Meteorological Surface Stations

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4.3 CALPUFF and Receptors

4.3.1 Gridded Receptors

For the CALPUFF model

The CALPUFF receptor grid is 50 km x 100 km domain. The proposed receptor grid spacing for CALPUFF domains follows recommendations in Section 7.2 in the Guideline (ENVP, 2022b) and expectations of the BCER. The grid spacing for this assessment is as follows:

- 20 m receptor spacing along the plant boundary
- 50 m spacing within 2.0 km x 2.0 km of the Project
- 50 m spacing within a 3.5 km x 4.5 km area centered on the Base Case point of maximum impingement
- 50 m spacing along other industrial facility plant boundaries
- 50 m spacing over residential areas of Kitimat and Kitamaat Village
- 250 m spacing within 7.0 x 5.0 km of the Project
- 500 m spacing within 10 km x 14 km of the Project
- 1,000 m spacing within 40 km x 40 km of the Project
- 2,000 m spacing beyond 1,000 m grid spacing area and within 50 km x 100 km domain

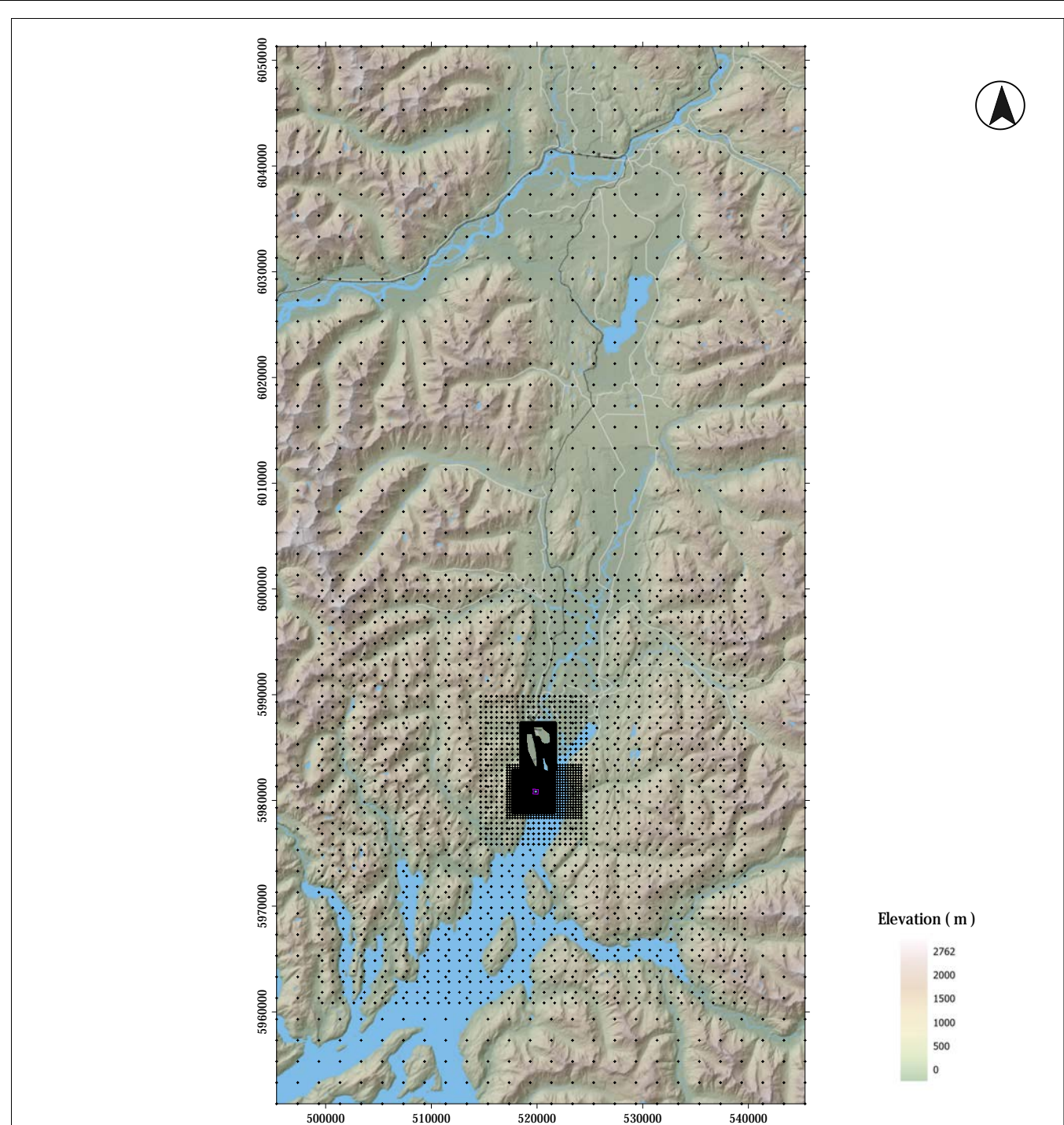
A map of the CALPUFF domain and receptor grid.

A map of the CALPUFF domain and gridded receptors for the Project assessment is shown in Figure 4.3.

Receptor (flagpole) height (m) (see Section 7.5 (ENV 2022b)).

Flagpole receptors are not required. There are no elevated receptors of interest nearby.





Notes
1. Coordinate System: NAD 1983 UTM Zone 9N
2. Data Sources: DataBC, Government of British Columbia;
Natural Resources Canada: Canadian Hydrographic Service

- Highway
 - Road
 - Railway
 - Transmission Line
 - Watercourse
 - Waterbody
- ▭ Cedar LNG Boundary
- + Gridded Receptor



Project Location
Kitimat,
British Columbia

Project Number 123223008

Client/Project/Report
Cedar LNG Partners (GP) Ltd.
Cedar LNG Project
Dispersion Modelling Plan

Figure No.
4.3
Title
CALPUFF Gridded Receptors (50km by 100km)

4.3.2 Sensitive Receptors

For the CALPUFF model the proposed sensitive receptors (see Section 7.4 in the Guideline [ENVP 2022b]):

For the CALPUFF model the proposed sensitive receptors are listed in Table 4.1.

These receptors were broadly grouped as follows:

- 105 sensitive receptors corresponding to nearby lakes, creeks, and rivers.
- 28 sensitive receptors corresponding schools, daycares, health care facilities and residential areas.
- 7 sensitive receptors on the Project-Site at the locations where workers are staying on the FLNG facility, sea walk, or onshore.
- 8 air quality monitoring stations.
- 2 deposition stations.

Table 4.1 Sensitive Receptors

Receptor ID	UTM Zone 9		Description
	m E	m N	
HHERA1	524,512	5,990,357	Mt Elizabeth Secondary HS
HHERA10	523,067	5,989,132	Kitimat General Hospital and Health Centre
HHERA11	522,881	5,980,891	Haisla Recovery Centre - Kitimaat village
HHERA12	523,078	5,981,322	Nearest resident - Kitimaat Village (Haisla)
HHERA13	522,056	5,988,463	Nearest resident - Kitimat town
HHERA14	521,314	5,989,938	Kitimat residence2
HHERA15	523,502	5,986,309	SE residence
HHERA16	522,694	5,991,544	Kitimat residence (N)
HHERA17	524,485	5,993,829	N Kitimat (SW)
HHERA18	524,907	5,994,564	N Kitimat (NW)
HHERA19	525,922	5,994,860	N Kitimat (NE)
HHERA2	524,114	5,989,809	Nechako Elementary School
HHERA20	526,001	5,993,572	N Kitimat (SE)
HHERA21	522,929	5,989,229	Kiwanis Senior Society
HHERA22	516,535	5,968,079	Coste Island
HHERA23	519,911	5,982,474	SW dockyard
HHERA24	519,840	5,981,852	Half Moon Bay



Cedar LNG Project Dispersion Modelling Plan

Section 4: Dispersion Model

September 2025

Receptor ID	UTM Zone 9		Description
	m E	m N	
HHERA25	525,621	5,986,610	Minette Bay1
HHERA26	524,665	5,987,418	Minette Bay Lodge
HHERA27	520,279	5,989,605	Kitimat Service Area
HHERA29	533,408	5,965,438	Kildala Beach
HHERA3	522,251	5,989,177	Kildala Elementary school
HHERA4	524,975	5,989,606	St Anthony's Catholic Elementary School
HHERA5	523,302	5,989,884	Kitimat City High School
HHERA6	523,150	5,980,708	Haisla Community School
HHERA7	523,016	5,980,749	C'Imo'Ca Child Care Centre
HHERA8	524,529	5,990,549	Kitimat Child Development Centre
HHERA9	524,198	5,990,214	Stepping Stones Preschool
R1	523,616	5,991,027	Kitimat Whitesail monitoring station
R2	519,474	5,986,812	Kitimat Haul Road monitoring station
R3	522,907	5,980,600	Kitimat Haisla Village monitoring station
R4	521,509	5,989,568	Kitimat Riverlodge monitoring station
R5	520,189	5,983,566	Kitimat Yacht Club monitoring station
R6	519,616	5,985,656	Kitimat Smeltersite Road monitoring station
R7	519,269	5,986,252	Cedar Valley Lodge Monitor
R8	520,422	5,990,354	Kitimat Industrial Ave monitoring station
LAK 01	524902	6030031	LAKE 01
LAK 02	526167	6029625	LAKE 02
LAK 04 - S	509376	5967643	LAKE 04 - S
LAK 06 - S	523917	6020863	LAKE 06 - S
LAK 12 - S	524199	6020996	LAKE 12 - S
LAK 13	528030	6029449	LAKE 13
LAK 22 - S	524142	6023003	LAKE 22 - S
LAK 23 - S	522673	6018972	LAKE 23 - S
LAK 24	529485	6027587	LAKE 24
LAK 32	521235	6047108	LAKE 32
LAK 34	525386	6049589	LAKE 34
LAK 35	532929	6048155	LAKE 35
LAK 37	529805	6047783	LAKE 37



Cedar LNG Project Dispersion Modelling Plan

Section 4: Dispersion Model

September 2025

Receptor ID	UTM Zone 9		Description
	m E	m N	
LAK 38	531275	6047088	LAKE 38
LAK 39	530899	6048213	LAKE 39
LAK 41	510173	6048579	LAKE 41
LAK 42	520911	6048362	LAKE 42
LAK 42 - S	520904	6048413	LAKE 42 - S
LAK 44	522541	6050321	LAKE 44
LAK 44 - S	522602	6050387	LAKE 44 - S
LAK 47	512026	6016712	LAKE 47
LAK 47 - S	511976	6016644	LAKE 47 - S
LAK 49	514619	6017762	LAKE 49
LAK 50	511772	6020675	LAKE 50
LAK 51	513427	6030393	LAKE 51
LAK 51 - S	513356	6030313	LAKE 51 - S
LAK 53	507548	5973909	LAKE 53
LAK 54	509425	5967551	LAKE 54
LAK 55	509678	5970261	LAKE 55
LAK 56	509126	5968749	LAKE 56
LAK 57	509833	5969514	LAKE 57
Lakelse inlet	529936	6027821	Lakelse Lake inlet
Lakelse Lake	526961	6025304	Lakelse Lake
Lakelse middle	528853	6026718	Lakelse Lake middle
Lakelse outlet	526166	6024493	Lakelse Lake outlet
STR 01	516262	5986538	STREAM 01
STR 02	518978	5985696	STREAM 02
STR 02 - S	519018	5985724	STREAM 02 - S
STR 03	528251	6019455	STREAM 03
STR 03 - S	527899	6020199	STREAM 03 - S
STR 04	531506	6028178	STREAM 04
STR 05	530637	6025347	STREAM 05
STR 05 - S	530775	6025442	STREAM 05 - S
STR 06	526210	5990748	STREAM 06
STR 07	528275	6004359	STREAM 07



Cedar LNG Project Dispersion Modelling Plan

Section 4: Dispersion Model

September 2025

Receptor ID	UTM Zone 9		Description
	m E	m N	
STR 08	531185	6012512	STREAM 08
STR 08 - S	531026	6012640	STREAM 08 - S
STR 09	524711	5996333	STREAM 09
STR 10	520838	6030544	STREAM 10
STR 10 - S	520829	6030555	STREAM 10 - S
STR 11	515370	6032863	STREAM 11
STR 11 - S	515283	6032676	STREAM 11 - S
STR 12	514480	5998366	STREAM 12
STR 13	522827	5998156	STREAM 13
STR 14	515607	5982383	STREAM 14
STR 15	519186	5984492	STREAM 15
STR 15 - S	519220	5984496	STREAM 15 - S
STR 16	529109	6022205	STREAM 16
STR 17	517313	6010274	STREAM 17
STR 18	524585	5998646	STREAM 18
STR 18 - S	524585	5998657	STREAM 18 - S
STR 19	533988	6032904	STREAM 19
STR 20	523506	5980726	STREAM 20



5 Planned Model Output: Air Quality Assessment Needs

What model output is required for decision makers and stakeholders? (i.e., what is the purpose of the assessment?). Circle as appropriate. Air Quality: concentrations, depositions, visibility, fogging, icing, other (specify)

For the air quality assessment to support the amendment application, model output for the Project will include predicted ground-level concentrations for nitrogen dioxide (NO₂), sulphur dioxide (SO₂), particulate matter with aerodynamic diameter less than 2.5 microns (PM_{2.5}), and carbon monoxide (CO). The 1-hour, 8-hour, 24-hour, and annual averages will be presented following the statistical form of the applicable regulatory criteria used for comparison.

Tables and Figures for Level 2 and 3 Assessments (see detailed list in Section 8.3.2 (ENVP, 2022b):

- *Spatial distribution maps of air quality parameters (maximums, exceedance frequencies, annual averages)*

For the air quality assessment, figures will include spatial distribution maps of maximum predicted concentrations for NO₂, SO₂, and PM_{2.5} for the Project. Both hourly (i.e., 1-hour, 24-hour) and annual averages will be presented. Averages will be presented as the appropriate statistical form for comparison to the applicable regulatory criteria (e.g., maximum predicted 3-year average of the 98th percentile of the daily 1-hour maximum NO₂ concentration). Spatial distribution maps for CO and the non-routine (i.e., worst case) flaring event will not be presented unless maximum predicted concentrations are greater than 50% of the applicable regulatory criteria.

- *Tables of maximum short and long term average air quality parameters (locations and associated meteorological conditions)*

For the air quality assessment, tables of maximum predicted concentrations for NO₂, SO₂, PM_{2.5}, and CO equivalent to the statistical form of the applicable regulatory criteria (e.g., maximum predicted 3-year average of the 98th percentile of the daily 1-hour maximum nitrogen dioxide concentration) will be provided. The meteorological conditions that generally result in maximum predicted concentrations will be discussed.

- *Tables of air quality parameters at select receptors of interest (maximums, frequency distributions)*

For the air quality assessment, tables of air quality parameters will be provided for the air quality monitoring locations (Receptor IDs, R1 to R5) (Table 4.1).



Cedar LNG Project Dispersion Modelling Plan

Section 5: Planned Model Output: Air Quality Assessment Needs

September 2025

- *Tables of air quality parameters under abnormal emission situations (upsets, start-up)*

Normal operation with sources operating at 100% of rated capacity represents worst case emissions and is the basis of the air quality assessment.

Non-routine flaring events that may occur during start-up, maintenance, or emergency conditions will be assessed. These events are considered to be short-term and infrequent. See Table 6.4 for air quality parameters associated with these events.

- *Output spatial scale: near-field (<10 km), local (<50 km), regional (>50 km)*

The air quality assessment figures will be provided for the local modelling domain (i.e., 30 km by 30 km), that encompasses the Project and nearby by emission sources that may act cumulatively, local sensitive receptors, and informed by recent assessments. The final size may be adjusted slightly depending upon magnitude of model results.

- *Special output required for vegetation, health risk or visibility assessments*

Air quality parameters for the human health sensitive receptors (HHERA) (Table 4.1) will be produced for discussion in the Human Health valued component section (Section 6.5) of the amendment application.

For vegetation and aquatic receptors, model output will include predicted ground-level sulphur, nitrogen, and sulphur plus nitrogen deposition rates. These will be discussed as part of the amendment application.

Visibility is not assessed for the Project. The Project's emission sources burn natural gas and have low potential for impacts to visibility.

- *Other (specify):*

There are no other tables or figures proposed at this time.



6 Emission Sources and Characteristics

6.1 Contaminants Emitted for Each Emission Scenario

Provide the following details of the sources to be modelled, type, contaminants, basis of emissions.

Characteristics of emissions from the Project operation consist of those from the combustion of natural gas. The Project's emissions include oxides of nitrogen (NO_x), SO₂, PM_{2.5}, CO, and volatile organic compounds (VOC). VOCs are quantified below for information purposes; however, are not carried forward in the modelling because results from assessments of other recent similar projects in a similar setting indicated that the health risk of VOCs is low (LNG Canada, 2019). NO_x, SO₂, PM_{2.5}, CO will be carried forward in each model scenario described below. For each model scenario and for the substances modelled, the source type is Point (P).

6.2 Emission Inventory

6.2.1 Base Case Emission

The base case emissions include emissions from the modernized Rio Tinto (RT) Aluminum Smelter and LNG Canada with the maximum authorized emissions and related marine sources associated with both facilities. Table 6.1 shows the emission summary for both facilities. The detailed source descriptions and source emission rates are shown in Appendix B.

Table 6.1 Emission Rates from Regional Sources

Regional Emission Sources	SO ₂	NO _x	PM _{2.5}	CO	VOCs
	Tonnes/yr				
Rio Tinto (RT) Aluminum Smelter					
Land based sources	15,330	409	900	30.6	2.00
Marine based sources	0.618	18.6	0.536	1.73	0.757
Total for RT Aluminum Smelter	15,331	427	900	32.3	2.76
LNG Canada					
Land based sources	321	1469	32.4	1331	93.4
Marine based sources	10.9	44.5	3.84	19.2	9.10
Total for LNG Canada	332	1,513	36.3	1,351	103
Total for Regional Sources	15,663	1,941	937	1,383	105



6.2.2 Project Emission

The amendment application proposes a 25% increase in overall facility production capacity; this translates to an increase in emissions from sources that were assessed in the original Environmental Assessment (EA)(Cedar LNG 2022). Air emission sources associated with the Project include one acid gas thermal oxidizer, two auxiliary boilers, one regen gas heater, flare sources with continuous pilot and purge for each Warm Flare, Cold Flare, Low Pressure (LP) Flare, marine sources, and emergency diesel equipment (located on the FLNG facility) (i.e., two essential generators, two diesel firewater pumps, one emergency diesel generator). For modelling a conservative approach is taken to assume the thermal oxidizer, the two auxiliary boilers, and the regen heater are operating continuously and simultaneously 100% of the time. It is noted that SO₂ emission rates for facility equipment assume the maximum sulphur content in feed gas. This is a conservative approach as typical sulphur content will be less, and occurrences of the maximum sulphur content are rare and short-term.

The two essential generators test monthly for maintenance purposes and two diesel firewater pumps operate on a weekly basis. The emergency diesel equipment is operated occasionally to test operability and conduct maintenance, and during emergency conditions. As this equipment is operated infrequently and for a short duration, the two essential generators, two diesel firewater pumps, and one emergency diesel generator are depicted in the model as not operating.

Table 6.2 provides fired equipment source descriptions and emission rates. The Project is obtaining electrical power from the BC Hydro grid and uses electric drive refrigeration compressors; therefore, there are no continuous natural gas-fired compressors or power generators operating during normal operations. Table 6.3 and Table 6.4 provide flare source descriptions and emission rates associated with normal operation and worst case flaring non-routine operations, respectively. The gas compositions associated with the Project are shown in Appendix B. Table 6.5 provides marine sources information, which is consistent with that used for the original EA (Cedar LNG 2022) as the current assumptions for number and size of LNG carriers still apply for the amendment application.



Table 6.2 Stack Parameters and Emission Rates for Proposed Equipment

Source Identification		Acid Gas Thermal Oxidizer ^a	Auxiliary Boiler A ^b	Auxiliary Boiler B ^b	Regen Gas Heater
Unit Description		Continuous	Continuous	Continuous	Continuous (operates at 45% of year, 3,982 hours/yr)
Fuel Properties ^c					
Fuel Type		Design Fuel Gas + Acid Gas + Flash Gas	Design Fuel Gas	Design Fuel Gas	Design Fuel Gas
Feed Gas Higher Heating Value (HHV)	MJ/sm ³	6.55 ^d	94.1	94.1	94.1
Feed Gas Consumption ^c	s m ³ /h	13184	987	987	451
Stack Location (UTM Zone 9, NAD 83)					
UTM Easting	m E	519,974	520,023	520,023	519,999
UTM Northing	m N	5,980,929	5,980,927	5,980,933	5,980,933
Stack Parameters ^c					
Rain Cap	Yes/No	No	Yes	Yes	Yes
Release Direction		Vertical	Vertical	Vertical	Vertical
Stack Height above sea level	m	55.4	47.4	47.4	54.7
Stack Diameter	m	2.10	1.20	1.20	1.02
Maximum Exit Velocity ^e	m/s	19.9	11.6	11.6	7.11
Exit Temperature	°C	982	125	125	219
	K	1,255	398	398	492



Source Identification		Acid Gas Thermal Oxidizer ^a	Auxiliary Boiler A ^b	Auxiliary Boiler B ^b	Regen Gas Heater
Maximum Emission Rates ^c					
SO ₂	t/d	0.862	0.035	0.035	0.015
NO _x	t/d	0.226	0.082	0.082	0.040
PM _{2.5}	t/d	0.013	0.015	0.015	0.005
CO	t/d	0.112 ^f	0.084	0.084	0.015
VOC	t/d	0.062	0.014	0.014	0.008
SO ₂	g/s	9.980	0.407	0.407	0.178
NO _x	g/s	2.620	0.953	0.953	0.464
PM _{2.5}	g/s	0.152	0.172	0.172	0.061
CO	g/s	1.300 ^f	0.968	0.968	0.178
VOC	g/s	0.712	0.167	0.167	0.092

Notes:

^a Based on inlet gas flow rate 500 MMSCFD.

^b Both auxiliary boilers will operate at 50% load; however, for modelling 100% load (emission rate presented here) for both auxiliary boilers was assumed.

^c Provided by Cedar

^d Calculated based on flow rate and heating values of three gas streams, fuel gas, flash gas, and acid gas.

^e Calculated based on assumed 25% excess air for acid gas thermal oxidizer and 15% excess air for auxiliary boilers and regen gas heater.

^f Calculated based on emission limit 100 mg/Nm³ (dry and 3% O₂) from manufacturer information.



Table 6.3 Stack Parameters and Emission Rates for the Proposed Flare (Normal Operation)

Source Identification		Warm Flare	Cold Flare	Low Pressure (LP) Flare
Unit Description ^a		Pilot & Purge (Continuous)	Pilot & Purge (Continuous)	Pilot & Purge (Continuous)
Fuel Properties ^a				
Fuel Type		Design Fuel Gas	Design Fuel Gas	Design Fuel Gas
Fuel Gas HHV	MJ/m ³	94.1	94.1	94.1
Sulphur Content	ppmv	417	417	417
Fuel Gas Flow Rate ^a				
Fuel Gas Flow Rate	s m ³ /h	53.5	53.5	42.1
Stack Location (UTM Zone 9, NAD 83)				
UTM Easting	m E	519,991	519,994	519,997
UTM Northing	m N	5,980,917	5,980,915	5,980,917
Stack Physical Parameters ^a				
Stack Height	m	138.0	137.4	137.4
Stack Diameter	m	0.86	0.86	0.76
Stack Pseudo Parameters ^b				
Stack Height	m	139.8	139.2	139.0
Stack Diameter	m	0.346	0.346	0.307
Exit Velocity	m/s	20.0	20.0	20.0
Exit Temperature	°C	1,000	1,000	1,000
	K	1,273	1,273	1,273



Source Identification		Warm Flare	Cold Flare	Low Pressure (LP) Flare
Emission Rates ^a				
SO ₂ ^c	t/d	0.002	0.002	0.001
NO _x	t/d	0.006	0.006	0.005
PM _{2.5} ^c	t/d	0.004	0.004	0.003
CO	t/d	0.012	0.012	0.010
VOC	t/d	0.019	0.019	0.015
SO ₂	g/s	0.022	0.022	0.017
NO _x	g/s	0.072	0.072	0.057
PM _{2.5} ^c	g/s	0.043	0.043	0.034
CO	g/s	0.144	0.144	0.113
VOC	g/s	0.216	0.216	0.170

Notes:

^a Values provided by Cedar

^b Pseudo stack parameters calculated following the methods in Section 10.1.1 of the Guideline (ENVP 2022)

^c PM_{2.5} emission estimated based on the method presented by McEwen J.D.N and Johnson M.R (2012).



Table 6.4 Stack Parameters and Emission Rates for the Flare Scenario (Worst-Case)

Source Identification		Warm Flare	Cold Flare	LP Flare
Unit Description ^a		Regen Gas Compressor Trip	Liquefaction Train 1 Cold S/U	BOG/ Offloading Compressor Trip -Holding Mode
Frequency		~2 per year	~4 per year	~2 per year
Duration		12 hours per event	6 hours per event	12 hours per event
Fuel Properties ^a				
Fuel Type		Treated Gas + Design Fuel Gas (Pilot and Purge)	Heavies Vapor + Design Fuel Gas (Pilot and Purge)	BOG + Design Fuel Gas (Pilot and Purge)
Fuel Gas HHV	MJ/m ³	42.3	58.1	35.3
Sulphur Content ^b	ppmv	108	35.6	0.460
Gas Flow Rate ^a				
Flared Gas Flow Rate	s m ³ /h	11,730	54,670	48,899
Pilot and Purge Gas Flow Rate	s m ³ /h	53.5	53.5	42.1
Stack Location (UTM Zone 9, NAD 83)				
UTM Easting	m E	519,991	519,994	519,997
UTM Northing	m N	5,980,917	5,980,915	5,980,917
Stack Physical Parameters ^a				
Stack Height	m	138.0	137.4	137.4
Stack Diameter	m	0.86	0.86	0.76



Source Identification		Warm Flare	Cold Flare	LP Flare
Stack Pseudo Parameters ^c				
Stack Height	m	172.8	179.8	168.4
Stack Diameter	m	7.67	9.43	6.79
Exit Velocity	m/s	20.0	20.0	20.0
Exit Temperature	°C	1,000	1,000	1,000
	K	1,273	1,273	1,273
Emission Rates ^a				
SO ₂ ^c	t/d	0.042	0.032	0.001
NO _x	t/d	0.771	0.584	0.614
PM _{2.5} ^e	t/d	0.087	0.065	0.069
CO	t/d	3.19	2.39	2.50
VOC	t/d	0.645	0.485	0.511
SO ₂ ^c	g/s	0.966	1.47	0.017
NO _x	g/s	17.8	27.0	14.2
PM _{2.5} ^e	g/s	2.02	2.99	1.59
CO	g/s	73.8	110.4	57.9
VOC	g/s	14.9	22.4	11.8

Notes:

^a Provided by Cedar.

^b Stantec calculated sulphur content based on SO₂ emission rates provided by Cedar for both flared gas and pilot and purge gas.

^c Pseudo stack parameters calculated following the methods in Section 10.1.1 of the Guideline (ENV 2022b).

^e For pilot and purge gas, PM_{2.5} emission estimated based on the method presented by McEwen J.D.N and Johnson M.R (2012). For flared gas, PM_{2.5} emissions were provided by Cedar.



Table 6.5 Marine Vessel Equipment Specification and Emission Summary

Unit Description		LNG Carrier					Assist Harbor Tugboats
		Main Engine	Auxiliary Engine		Boiler		Maneuvering/Loading
		Maneuvering	Maneuvering	Loading	Maneuvering	Loading	
Engine Power ^a	kW	31,200	8,020	8,020	371	3,000	1,194
Load Factor ^a		0.04	0.43	0.43	1.00	1.00	0.43
Berthing/Unberthing ^a	hour	3	3	24	3	24	3
Vessel Numbers Per Year ^a		50					2
Fuel Type ^a		Distillate marine gas oil (MGO) or marine diesel oil (MDO)					Distillate marine gas oil (MGO) or marine diesel oil (MDO)
Engine NOx Emission Standard ^a		Tier III	Tier III		N/A		Tier III
Stack Location							
South	UTM Zone 9, NAD 83	m E	520,034				520,071
		m N	5,980,653				5,980,717
North		m E	-				520,085
		m N	-				5,980,861
Stack Dimensions ^a							
Height	m	50.0 ^b					10.0
Inside Tip Diameter	m	1.50					0.75
Exhaust Parameters ^a							
Exit Velocity	m/s	13.3 ^c					9.43
Exit Temperature	°C	337					537
	K	610					810



Unit Description		LNG Carrier					Assist Harbor Tugboats
		Main Engine	Auxiliary Engine		Boiler		
		Maneuvering	Maneuvering	Loading	Maneuvering	Loading	Maneuvering/Loading
Emission Rates (Maximum) (assume all engines work simultaneously) ^a							
SO ₂	kg/h	7.19				0.214	
NO _x	kg/h	30.5				0.667	
PM _{2.5}	kg/h	2.51				0.015	
CO	kg/h	17.2				0.608	
VOC	kg/h	9.69				0.021	
SO ₂	g/s	2.00				0.059	
NO _x	g/s	8.46				0.185	
PM _{2.5}	g/s	0.698				0.004	
CO	g/s	4.79				0.169	
VOC	g/s	2.69				0.006	
Emission Rates (Annual Average) (based on berthing/unberthing hours and vessel numbers per year) ^d							
SO ₂	kg/h	0.985				0.004	
NO _x	kg/h	4.17				0.011	
PM _{2.5}	kg/h	0.344				0.0003	
CO	kg/h	2.36				0.010	
VOC	kg/h	1.33				0.0004	
SO ₂	g/s	0.274				0.001	
NO _x	g/s	1.16				0.003	
PM _{2.5}	g/s	0.096				0.0001	



Unit Description		LNG Carrier					Assist Harbor Tugboats
		Main Engine	Auxiliary Engine		Boiler		
		Maneuvering	Maneuvering	Loading	Maneuvering	Loading	Maneuvering/Loading
CO	g/s	0.656					0.003
VOC	g/s	0.369					0.0001

Notes:

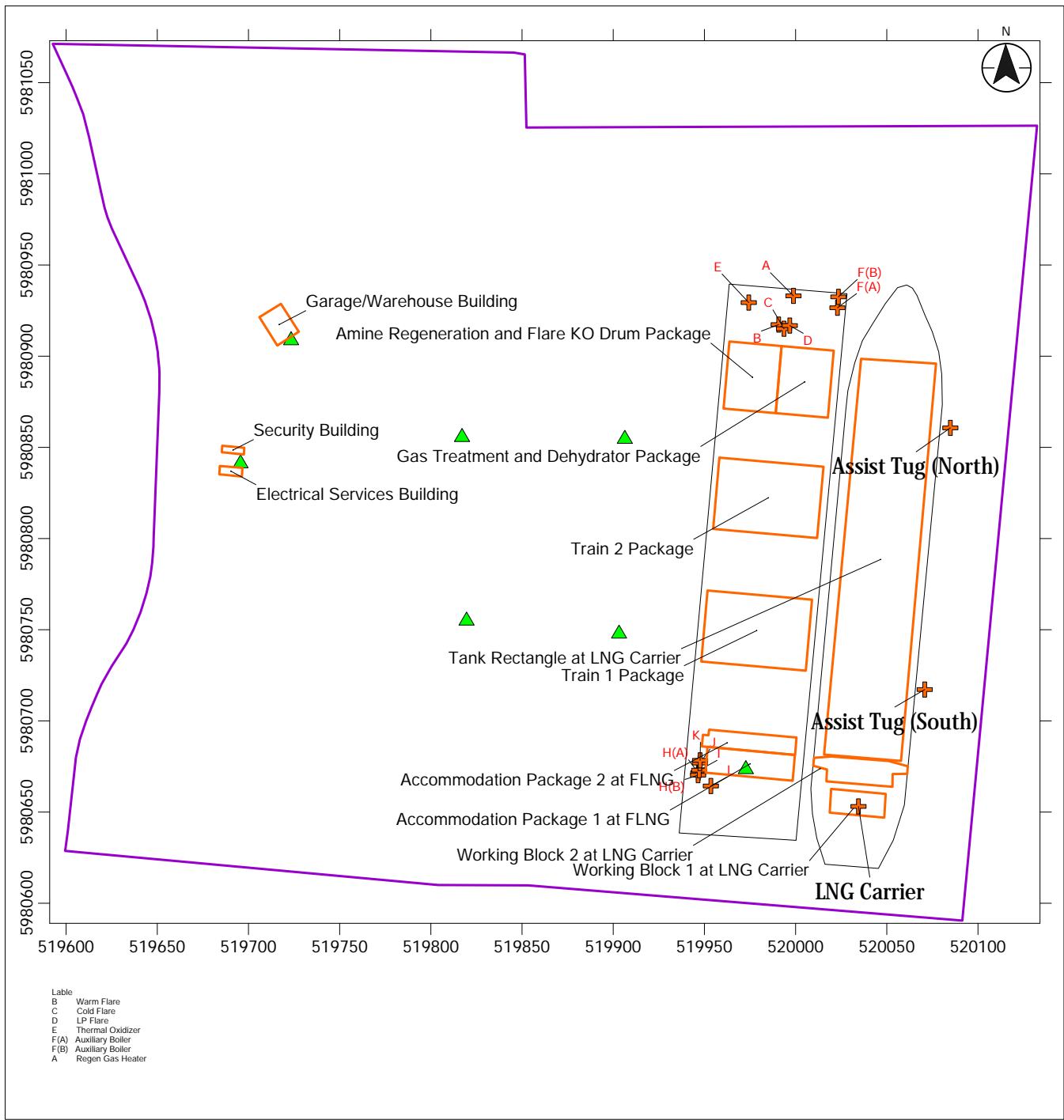
- ^a No changes proposed to the marine vessel specifications, operations, and emission rates, these are assumed to be the same as the original EA.
- ^b Assumed by Stantec.
- ^c Based on manufacturer information.
- ^d Calculated based on the maximum emission rates, berthing/unberthing hours, and vessel numbers per year.



Provide a map showing the source locations, buildings, and facility fence line.

The facility layout, showing source locations, buildings or solid structures, and the plant boundary are shown in Figure 6.1.

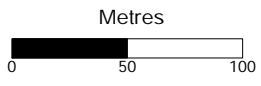




- Label
- B Warm Flare
- C Cold Flare
- D LP Flare
- E Thermal Oxidizer
- F(A) Auxiliary Boiler
- F(B) Auxiliary Boiler
- A Regen Gas Heater



- Cedar LNG Boundary
- ▲ Project-site Sensitive Receptors
- Buildings or structures
- + Stacks
- FLNG



Project Location: Kitimat, British Columbia
 Project Number: 123223008

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project Dispersion Modelling Plan

Figure No. 6.1

Title: Cedar LNG Simplified Plot Plan

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6.3 Model Emission Scenarios

If applicable, describe the different model emission scenarios required for the assessment if multiple options are under consideration. For example, different source characteristics (stack dimensions, emission rates) or source arrangements (locations, types, buildings) may need separate modelling runs to examine the air quality implications of different scenarios.

Four model scenarios are proposed to examine the air quality implications of the Project. These are called the Base Case, Project-Alone Case, Application Case, and Future Case. A fifth scenario considering credible worst case flaring events will be modelled separately (Flaring Case).

Base Case: The regional emission sources making up the Base Case dispersion modelling scenario are:

- The modernized Rio Tinto aluminum smelter with the maximum authorized emissions scenario. The key pollutants associated with the Rio Tinto smelter are SO₂, NO_x, PM_{2.5}, CO, and VOC.
- Existing marine traffic associated with Rio Tinto smelter. The key pollutants from the existing marine traffic are SO₂, NO_x, PM_{2.5}, and CO.
- LNG Canada facility with maximum authorized emissions associated with Phase 1 (i.e., two liquefaction trains) of the LNG Canada project. The key pollutants associated with the LNG Canada facility are SO₂, NO_x, PM_{2.5}, and CO.
- Marine traffic associated with the LNG Canada facility Phase 1 (i.e., two liquefaction trains). The key pollutants from the marine traffic are SO₂, NO_x, PM_{2.5}, and CO.
- Baseline concentrations (Section 8.0) are added to the Base Case to account for sources not modelled (e.g., traffic, home heating, small industrial / commercial businesses, rail, other marine traffic)

Project-Alone Case: consists of the proposed Project equipment, including Project marine vessels, operating at hourly, daily, and annual emission rates consistent with full equipment capacity. Units designated as backup, emergency, or on standby will be depicted in the modelling exercise as not operating.

Application Case: consists of the Project-Alone Case plus the Base Case with baseline concentrations added (Table 8.3 Section 8). Baseline is added to the Application Case to account for sources not modelled.

Future Case: Application Case plus LNG Canada Phase II (an additional two liquefaction trains for a total of four trains) with baseline concentrations added (Table 8.3 Section 8). Baseline is added to the Future Case to account for sources not modelled.

Flaring Case: consists of the expected worst case flaring event for each flare stack (i.e., warm flare, cold flare, low pressure flare) assessed independently.

The modelling scenarios are summarized in Table 6.6 and the summary of scenario emissions is presented in Table 6.7.



Table 6.6 Summary of Emission Sources for each Modelling Scenario

Equipment	Base Case	Project- Alone Case	Application Case	Flaring Case	Future Case
Regional Emission Sources					
Rio Tinto Aluminum Smelter	x	N/A	x	N/A	x
Rio Tinto Smelter Marine Traffic	x	N/A	x	N/A	x
LNG Canada LNG Facility	x	N/A	x	N/A	x
LNG Canada Marine Traffic	x	N/A	x	N/A	x
LNG Canada Phase II	N/A	N/A	N/A	N/A	x
Proposed Project Equipment					
Acid Gas Thermal Oxidizer	N/A	x	x	N/A	x
Auxiliary Boilers	N/A	x	x	N/A	x
Regen Gas Heater	N/A	x	x	N/A	x
LNG Carrier	N/A	x	x	N/A	x
Assist Harbour Tugboats	N/A	x	x	N/A	x
Warm Flare	N/A	x ^a	x ^a	x ^b	x ^a
Cold Flare	N/A	x ^a	x ^a	x ^b	x ^a
Low Pressure (LP) Flare	N/A	x ^a	x ^a	x ^b	x ^a
Emergency Diesel Generator	N/A	N/A	N/A	N/A	N/A
Essential Diesel Generators	N/A	N/A	N/A	N/A	N/A
Firewater Pumps	N/A	N/A	N/A	N/A	N/A
Baseline					
Baseline	x	N/A	x	N/A	x

Notes:

'x' means operational in the associated scenario

'N/A' means not operational in the associated scenario

^a Includes normal operation of the flare (i.e., pilot, purge)

^b Includes emergency flaring scenario and pilot, purge



Table 6.7 Emissions Summary for Each Modelling Scenario

Modelling Scenario	Emissions (tonnes/year)				
	SO ₂	NO _x	PM _{2.5}	CO	VOC
Base Case, Total ^a	15,663	1,941	937	1,383	105
Project-Alone Case, Total ^b	354	192	23.4	138	64.9
Application Case, Total ^c	16,017	2,133	960	1,521	170
Future Case, Total ^d	16,349	3,640	985	2,842	210
Worse Case Flaring Event ^e	0.127	2.334	0.258	9.54	1.94

Notes:

- ^a The Base Case total emissions represent the authorized emissions from the Rio Tinto aluminum smelter, Rio Tinto smelter marine traffic, LNG Canada facility, and LNG Canada marine traffic.
- ^b The Project-Alone includes Acid Gas thermal oxidizer, regen gas heater, auxiliary boilers, warm flare pilot & purge, cold flare pilot & purge, LP Flare pilot & purge, and marine traffic. The emission rates for regen gas heater are based on operating hours of 3,982 per year. The marine traffic is scaled based on the number and duration of visits.
- ^c Application is Base Case plus Project-alone.
- ^d Future Case includes the Application Case with baseline plus LNG Canada Phase II. Phase II sources include two incinerators, four WHRUs, and marine sources (i.e., two additional liquefaction trains). The source emission rates are the same as Phase I. This is assumed to be conservative as LNG Canada has not applied for a WDA for Phase II. See Appendix B for the detail.
- ^e The flaring event with the highest emissions is associated with the Cold flare and occurs with the start-up of one liquefaction train.

6.4 Source Emission Rate Variability

Do emissions have sub-hourly variation (e.g., blow-down flares with high emission peaks during the hour)? If so, describe the approach to assess air quality implications of those sub-hourly high emission peaks.

Emission sources are depicted as continuous emissions sources. Non-routine flare events are assumed to occur for periods greater than one-hour and are conservatively evaluated assuming continuous flaring at the maximum initial flare rate.

Describe the approach to assess air quality implications under the 25, 50, 75% emission scenario. See Section 3.4.2 (ENVP, 2022b).

Project operation is depicted as 100% rated capacity.



If there are batch processes, provide a temporal emission profile (emission rate vs time) for each batch process.

The periodic loading of the LNG carriers and corresponding use of the tugboats could be considered a batch process. For the maximum 1-hour concentration modelling, it is assumed the LNG carrier and tugboats are present 100% of the time. The periodic nature of these marine vessels is captured in the annual average modelling where the number and duration of visits are accounted for in the annual average emission rate. See Table 6.3 for marine vessel specifications.

Describe anticipated abnormal emission scenarios (e.g., start-up, shut-down, maintenance of control works) and their anticipated frequency of occurrence. See Section 3.4.3. (ENVP, 2022b).

See Section 6.3 for a description of the worst-case emergency flaring scenario.



7 Applicable Air Quality Objectives

Effects on air quality are determined, in part, by comparing predicted ground-level concentrations of the substances to the applicable air quality objectives. Air quality objectives are used to gauge current and historical air quality and guide decisions on environmental effects assessments and authorizations. The AQOs are used to gauge current and historical air quality and guide decisions on environmental impact assessments and authorizations. In British Columbia, the ENVP have stated that the BC AQOs are applicable beyond the facility fence line ((ENVP, 2016), (ENVP, 2020)). Where exceedances of the BC AQO are predicted through dispersion modelling, the ENVP considers the context of magnitude, frequency, timing, and proximity to sensitive receptors. Should there be exceedances of the BC AQO, the ENVP in collaboration with the BC Energy Regulator (the administrator of a WDA for LNG facilities) would manage these in accordance with the federal Air Zone Management Framework (Canadian Council of Ministers of Environment [CCME] (CCME, 2019)) for improvements in air quality across the affected area and would include all important sources ((ENVP, 2020)).

The regulatory criteria in BC for NO₂, SO₂, PM_{2.5} and CO applicable to this assessment are shown in Table 7.1 (ENVP, 2021).

The BC AQO for NO₂ is based on the Canadian Ambient Air Quality Standards (CAAQS), announced by the Government of Canada in 2017 (CEPA, 2017) for the year 2020. The CCME have stated that achievement of the CAAQS is determined on an airshed and air zone basis, which covers broad geographical areas (CCME, 2019). The CAAQS were developed as regional ambient standards and not intended to be applied to evaluate the acceptability or design of an individual project or function as a regulatory compliance standard to be achieved near an industrial facility (CCME, 2019). Rather, they are used by provinces and territories to guide air zone management actions intended to reduce ambient concentrations below the CAAQS and prevent CAAQS exceedances.

Ambient air quality monitoring stations located at or near the property (fence) line of an industrial facility should not be used for CAAQS reporting unless the monitoring station is near a populated area or a sensitive ecosystem ((CCME, 2020a), (CCME, 2020b)).



Table 7.1 British Columbia Air Quality Objectives

Substance	Averaging Interval	British Columbia Air Quality Objective (µg/m³)
NO ₂	1-hour	113 ^a
	Annual	32 ^b
SO ₂	1-hour	183 ^c
	Annual	13 ^d
PM _{2.5}	24-hour	25 ^e
	Annual	8 ^f
CO	1-hour	14,300
	8-hour	5,500

Notes:

- ^a Achievement for 1-hour NO₂ is based on 3-year average of the annual 98th percentile of daily 1-hour maximum. This requires the extraction of the highest predicted 1-hour value at each location for each day, followed by the calculation of the 98th percentile (the eighth highest) of those 365 values for each year, then average the three annual values.
- ^b Achievement for annual NO₂ is based on the average of all 1-hour average concentrations over a single calendar year
- ^c Achievement for 1-hour SO₂ is based on a 3-year average of the annual 99th percentile of daily 1-hour maximum. This requires the extraction of the highest predicted 1-hour value at each location for each day, followed by the calculation of the 99th percentile (the fourth highest) of those 365 values for each year, then average the three annual values.
- ^d Achievement for SO₂ is based on the average of 1-hour concentrations averaged over one year
- ^e Achievement for PM_{2.5} is based on the annual 98th percentile of daily average, averaged over one year
- ^f Achievement for PM_{2.5} is based on the annual average, averaged over one year

Source: (ENVP, 2021)

ENVP has not stated if the 2025 CAAQS will be adopted as provincial AQOs. Regulatory agencies including ENVP, Environment and Climate Change Canada (ECCC), Northern Health, and Health Canada, have expressed an interest in referencing objectives other than the BC AQOs in assessments. Specifically, they are interested in referencing the 2020, 2025 and 2030 Canadian Ambient Air Quality Standards (CAAQS) (CCME, 2025). The 2025 CAAQS are provided in this assessment for information purposes. Effects on air quality will be evaluated using the BC AQO (ENVP, 2021). The regulatory criteria applicable to this assessment are shown in Table 7.2 which lists the CAAQS for the year 2025 for NO₂ and SO₂, and 2030 for PM_{2.5}.



Table 7.2 2025 Canadian Air Quality Standards

Substance	Averaging Interval	Air Quality Objective ($\mu\text{g}/\text{m}^3$)
NO ₂	1-hour	79 ^a
	Annual	23 ^b
SO ₂	1-hour	170 ^c
	Annual	11 ^d
PM _{2.5}	24-hour	23
	Annual	8.0

Notes:

The other regulatory criteria are for the year 2025 for NO₂ and SO₂, and 2030 for PM_{2.5}. The statistical forms for each are the same as for the applicable regulatory criteria Table 7.1.

Source: (CCME, 2025)



8 Baseline Concentration

Indicate method used to determine baseline concentrations for each pollutant (Section 8.1):

- X* monitoring data (Section 8.1.1 and 8.1.2)
- establish monitoring program (Section 8.1.3)
- X* modelled sources (Section 8.1.5)
- other method (describe)

It is useful in this type of study to know the predicted incremental air quality contribution of the source or sources being modelled. It is also important to know about the cumulative effects on air quality. This is especially important when comparing model predictions to ambient objectives. The cumulative air quality is calculated by accounting for the contribution from all sources except the source or sources being modelled and adding that to the predicted increment from the Project.

The term “baseline” is being used to describe existing air quality conditions and the contribution from existing sources. The Guideline (Section 8.1 (ENVP, 2022b)) states that baseline may be determined from air quality monitoring data or may be estimated from modelling existing contributing sources or a combination of both. Choosing the appropriate baseline concentration can be critical in assessing overall air quality. In order of priority, the information sources used to establish the baseline concentration are:

- A network of long-term ambient monitoring stations near the source under study
- Long-term ambient monitoring at a different location that is adequately representative; and
- Modelled baseline

For the Project, baseline will be determined by modelling existing large sources (the Base Case, Section 6.3) and using data from local monitoring stations to account for sources not modelled (i.e., traffic, home heating, small industrial / commercial businesses, rail, other marine traffic). The development of the baseline concentrations is described below.

If existing monitoring data to be used, complete the following table: Representative Air Quality Measurements, including station name, location, period of record, contaminants measured.

The baseline values are derived from local and representative monitoring stations using the most recent and representative years of ambient air quality data available in ENVP’s annual summaries and ENVP’s online air quality data archive (ENVP 2024; ENVP 2025a). Baseline concentrations for selected substances were reviewed from the four existing monitoring stations in Kitimat, one in Terrace, and one in Smithers. These stations include Kitimat (Kitamaat) Haisla Village, Kitimat Haul Road, Kitimat Riverlodge, Kitimat Whitesail, Terrace Skeena Middle School, and Smithers St. Josephs (the nearest monitoring station with valid CO data). A summary of the nearby long-term monitoring station locations in the development of these baseline values are provided in Table 8.1. A summary of air quality data statistics for these monitoring stations are provided in Table 8.2.



Table 8.1 Summary of Long-Term Monitoring Stations

Monitoring Station	Elevation (m asl)	Location (UTM NAD83)			Data Periods	Substances Monitored			
		m E	m N	Zone		NO ₂	SO ₂	PM _{2.5}	CO
Kitimat (Kitamaat) Haisla Village	5	522,907	5,980,600	9	NO ₂ : July 2024-June 2025 SO ₂ , PM _{2.5} : 2020 - 2024	x	x	x	-
Kitimat Haul Road	2	519,474	5,986,812	9	SO ₂ , PM _{2.5} : 2020 - 2024	-	x	x	-
Kitimat Riverlodge	18	521,509	5,989,568	9	NO ₂ : May 2024-April 2025 SO ₂ , PM _{2.5} : 2020 - 2024	x	x	x	-
Kitimat Whitesail	119	523,616	5,991,027	9	NO ₂ , SO ₂ , PM _{2.5} : 2020 - 2024	x	x	x	-
Terrace Skeena Middle School	81	525,373	6,041,636	9	NO ₂ , SO ₂ , PM _{2.5} : 2020 - 2024	x	x	x	-
Smithers St Josephs	495	617,204	6,072,167	9	CO: 2012	-	-	-	x



Table 8.2 Air Quality Monitoring Data Summary

Statistic	Kitimat (Kitamaat) Haisla Village			Kitimat Haul Road		Kitimat Riverlodge			Kitimat Whitesail			Terrace Skeena Middle School			Smithers St. Joseph
	NO ₂ ^a (µg/m ³)	SO ₂ (µg/m ³)	PM _{2.5} (µg/m ³)	SO ₂ (µg/m ³)	PM _{2.5} (µg/m ³)	NO ₂ ^b (µg/m ³)	SO ₂ (µg/m ³)	PM _{2.5} (µg/m ³)	NO ₂ (µg/m ³)	SO ₂ (µg/m ³)	PM _{2.5} (µg/m ³)	NO ₂ (µg/m ³)	SO ₂ (µg/m ³)	PM _{2.5} (µg/m ³)	CO (µg/m ³)
Maximum 1-hour	47.6 (2024/5)	111.6 (2020)	167.0 (2023)	299.6 (2020)	158.0 (2020)	26.9 (2024/5)	158.2 (2024)	230.0 (2021)	40.3 (2022)	131.7 (2021)	98.0 (2023)	62.1 (2020)	41.6 (2023)	151.7 (2022)	2,141 (2010)
99 th Percentile	4.9 (2024/5)	12.6 (2020)	23.0 (2023)	131.1 (2024)	40.0 (2023)	10.0 (2024/5)	25.1 (2023)	27.0 (2023)	17.9 (2020)	15.7 (2023)	25.0 (2023)	34.1 (2020)	8.9 (2023)	33.7 (2022)	1,076 (2011)
90 th Percentile	1.7 (2024/5)	2.4 (2024)	7.0 (2020/2/3)	43.7 (2024)	12.0 (2023)	3.4 (2024/5)	2.4 (2023)	8.0 (2023)	5.6 (2020/1)	1.6 (2023/4)	8.0 (2022/3)	15.1 (2020)	3.9 (2024)	11.8 (2022)	538 (2012)
75 th Percentile	0.9 (2024/5)	1.3 (2024)	5.0 (2020/3)	11.5 (2024)	8.0 (2023)	1.7 (2024/5)	0.8 (2020/2/3/4)	6.0 (2023)	3.8 (2021)	1.0 (2024)	6.0 (2022/3)	6.2 (2023)	2.1 (2024)	6.9 (2022)	389 (2012)
Mean	0.8 (2024/5)	1.2 (2024)	3.5 (2023)	13.7 (2024)	6.4 (2023)	1.5 (2024/5)	1.6 (2023)	4.9 (2023)	3.4 (2021)	1.2 (2023/4)	4.5 (2022)	5.2 (2020)	1.7 (2024)	5.5 (2020)	332.8 (2010)
25 th Percentile	0.4 (2024/5)	0.5 (2024)	2.0 (2020)	0.8 (2020/1/3/4)	3.0 (2023)	0.4 (2024/5)	0.3 (2020-4)	3.0 (2023)	1.9 (2021)	0.5 (2024)	2.0 (2022/3)	1.3 (2021/2/3)	0.5 (2024)	2.6 (2023)	206 (2012)
10 th Percentile	0.2 (2024/5)	0.3 (2024)	0.0 (2020-4)	0.5 (2021/4)	1.0 (2023)	0.2 (2024/5)	0.3 (2020,2,3,4)	1.0 (2023)	1.5 (2021)	0.3 (2021/2/3/4)	1.0 (2022)	0.8 (2021/2/3)	0.3 (2021/2/3/4)	1.8 (2023/4)	206 (2010)
Average 98 th / 99 th Percentile D1HM 2020 – 2022	N/A	12.9 ^d	N/A	174.6 ^d	N/A	N/A	49.8 ^d	N/A	26.8 ^c	27.6 ^d	N/A	42.5 ^c	8.6 ^d	N/A	N/A
Average 98 th / 99 th Percentile D1HM 2021 – 2023	N/A	13.4 ^d	N/A	171.2 ^d	N/A	N/A	58.0 ^d	N/A	24.5 ^c	36.6 ^d	N/A	38.3 ^c	11.1 ^d	N/A	N/A
Average 98 th / 99 th Percentile D1HM 2022 – 2024	18.6 ^c (2024/5)	19.6 ^d	N/A	182.5 ^d	N/A	16.2 ^a (2024/5)	57.1 ^d	N/A	22.1 ^c	37.5 ^d	N/A	35.9 ^c	25.5 ^d	N/A	N/A
Average 98 th Percentile 24-hour Average 2020 – 2022 ^e	N/A	N/A	8.4	N/A	12.5	N/A	N/A	8.9	N/A	N/A	9.7	N/A	N/A	13.9	N/A
Average 98 th Percentile 24-hour Average 2021 – 2023 ^e	N/A	N/A	9.3	N/A	11.1	N/A	N/A	8.9	N/A	N/A	11.4	N/A	N/A	14.4	N/A
Average 98 th Percentile 2022 – 2024 ^e	N/A	N/A	9.5	N/A	16.4	N/A	N/A	10.4	N/A	N/A	11.1	N/A	N/A	17.9	N/A

Notes:

Five years (2020 to 2024) of monitoring data was reviewed using ENVP summary stat files (ENVP 2024) and BC Air Data Archive (ENVP 2025a)

99th, 90th, 75th, 50th, 25th, and 10th percentiles and mean are calculated using 1-hour averages

Year in brackets indicate the maximum value of that metric over the five years of data reviewed (2020 to 2024)

D1HM means - daily 1-hour maximum

^a NO₂ monitoring data at Kitamaat Village reviewed for period July 15, 2024, at 1:00 pm to June 12, 2025, at 12:00 am

^b NO₂ monitoring data at Riverlodge reviewed for the period May 22, 2024, at 5:00 pm to May 22, 2025, at 4:00 pm

^c Three-year average 98th percentile D1HM

^d Three-year average 99th percentile D1HM

^e Three-year average 98th percentile of 24-hour averages

Cedar LNG Project Dispersion Modelling Plan

Section 8: Baseline Concentration

September 2025

The Kitimat monitoring data is considered representative of air quality conditions in the modelling domain. When choosing baseline and modelling the Base Case, consideration of existing sources influence on the monitoring data must be considered so not to double count existing sources in the air quality assessment. During the period (2020 – 2024) for which monitoring data is available, the Rio Tinto Smelter was operating. The LNG Canada Facility was not operational during this period; however, LNG Canada was carrying out construction. The Rio Tinto Smelter permitted maximum NO_x emissions is 1.12 tonnes/day, and total particulate matter is 1.3 kg/ tonne aluminum (production) however they consistently discharged below these limits (BC ENV, 2025b; Rio Tinto 2024). Other sources of NO_x and PM_{2.5} emissions include road traffic, construction activities, space heating, food preparation, marine traffic, and fugitive dust. Elevated PM_{2.5} baseline concentrations are also influenced by wildfire smoke.

In comparison, the NO₂ and PM_{2.5} monitoring data from the Terrace Skeena Middle School monitoring station are found to be less representative of the data collected in Kitimat for the same time period. Terrace is 59 km from the Project and is a larger community with more NO_x emissions sources (i.e., road traffic, construction activities, space heating, food preparation), while it is less influenced by marine vessel and port emissions, and marine boundary (meteorology) influences. Comparing the maximum 1-hour and annual averages, Terrace data is 1.58 and 1.75 times higher, respectively than Kitimat data (Whitesail). Similarly, PM_{2.5} concentrations in Terrace are 1.66 and 1.5 time higher, respectively than Kitimat data (Whitesail and Riverlodge). On this basis, the Kitimat Whitesail NO₂ and PM_{2.5} monitoring data are considered most representative and are selected to represent baseline for the air quality assessment for the amendment application.

After review of available monitoring data, Table 8.3 summarizes the proposed baseline representative of the modelling domain. These values are consistent with Section 8.1.4 of the Guideline (ENVP 2022b) and conservatively characterized as a large increment of measured values (i.e., 98th percentile of the daily 1-hour maximum values for NO₂, the 98th percentile for other hourly and daily averages, and the mean values for annual averages).



Table 8.3 Summary of Baseline

Substance	Averaging Period	Baseline Concentration ($\mu\text{g}/\text{m}^3$)
NO ₂	1-hour	26.8
	Annual	2.9
SO ₂	1-hour	14.5 (5.53 ppb)
	Annual	1.23 (0.47 ppb)
PM _{2.5}	24-hour	9.3
	Annual	3.4
CO	1-hour	869
	8-hour	715

Notes:

Baseline air quality data were developed by Stantec from ENVP 1998-2023 summary spreadsheets (ENVP 2025) and BC Air Data Archive (ENVP 2025a). Conversions from ppb to $\mu\text{g}/\text{m}^3$ assume Standard conditions of 20°C and 101.325 kPa.

NO₂:

The 1-hour baseline NO₂ concentration was determined based on the daily 1-hour maximum concentrations, followed by the calculation of the 98th percentile for the years 2020 to 2024. Then 3-year average for 2020 to 2022, 2021 to 2023 and 2022 to 2024. The maximum 3-year average is presented here (2020 to 2022).

Annual NO₂ baseline concentration was determined based on the average of all 1-hour values for each year for 2020 to 2024. Then 3-year average for 2020 to 2022, 2021 to 2023 and 2022 to 2024. The maximum 3-year average is presented here (2020 to 2022).

Baseline NO₂ was determined using the five most recent years of data from the nearest representative station: Kitimat Whitesail.

SO₂:

The 1-hour and annual baseline concentrations were chosen based on previous assessments in the Kitimat Valley. These values were used in the Rio Tinto Comprehensive Review (Rio Tinto 2020).

PM_{2.5}:

The 24-hour PM_{2.5} baseline was determined based on an average of the 98th percentile of the 24-hour averages for 2020-2024.

The annual PM_{2.5} baseline was determined based on the average of 1-hour values for 2020-2024.

Baseline PM_{2.5} was determined using the five most recent years of data from the nearest representative station: Kitimat Riverlodge (BAM1020 instrument).

CO:

The 1-hour CO baseline was determined based on the average of the 98th percentile of 1-hour averages. The 8-hour baseline was determined based on the average of the 98th percentile of the daily averages. Baseline was determined using the two most recent years (2011-2012) of data from the nearest representative station: Smithers St. Joseph School.



The NO₂ Guidance (BC ENVP, 2022c) provides three options to add baseline NO₂ to dispersion modelling predictions. For this work, the 288-value array option is used to more realistically account for seasonal and diurnal influences on baseline. This array is comprised of the first highest measured value for each hour in each month, then average over the monitoring period. The 288-data array using Kitimat Whitesail monitoring data is presented in Table 8--4. This is derived from the most recent ENVP Annual Summary Stats (ENVP 2024) and the BC Air Data Archive Website (ENVP, 2025a).

Table 8.4 288-Value Array NO₂ Baseline Summary using Kitimat Whitesail Monitoring Data

Hour of Day	NO ₂ Baseline Value (µg/m ³)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	25.46	28.01	32.98	13.95	8.35	9.44	7.97	9.32	8.27	14.40	18.57	30.08
1	27.49	25.38	32.04	16.54	8.38	8.87	6.28	9.40	7.86	12.56	16.66	28.50
2	26.73	23.27	31.36	15.75	11.09	9.55	6.24	9.78	6.77	11.47	16.92	24.82
3	23.88	22.64	29.85	18.84	8.84	8.16	7.41	7.97	6.24	10.00	17.71	23.01
4	22.82	23.16	26.40	21.13	12.14	11.39	9.44	7.75	7.03	11.24	15.98	25.27
5	23.73	23.58	31.10	22.41	11.51	9.21	8.61	8.42	7.41	12.07	18.35	24.59
6	24.74	27.00	34.63	24.06	11.84	9.36	7.82	8.95	8.27	12.82	20.04	26.13
7	26.06	32.15	36.81	25.19	12.60	10.53	9.06	10.79	14.89	16.51	21.36	27.56
8	29.10	36.43	35.91	22.64	13.80	10.98	10.26	11.36	15.60	21.06	27.34	28.28
9	34.29	38.39	35.57	21.09	11.28	7.71	8.31	9.70	17.03	19.63	25.94	30.08
10	34.07	33.88	26.06	13.72	5.19	6.17	5.41	7.07	12.75	16.84	28.01	29.63
11	30.12	32.30	20.42	11.28	5.11	5.90	4.96	5.98	8.50	15.00	27.18	30.19
12	31.06	25.57	13.84	6.28	5.53	4.02	4.14	4.32	7.67	13.20	24.21	29.82
13	31.13	22.18	12.90	8.54	4.17	4.40	2.56	3.50	6.66	9.55	22.45	28.12
14	23.39	22.48	16.09	7.78	3.95	4.32	3.05	3.53	6.02	9.78	22.67	28.05
15	24.59	23.39	16.32	8.54	3.46	3.84	3.16	4.59	6.99	9.70	22.30	30.00
16	30.46	24.82	12.90	6.20	4.17	4.59	3.38	4.78	7.93	12.86	23.84	31.17
17	31.62	25.83	13.57	5.49	3.57	2.90	2.90	5.68	6.84	13.72	25.19	32.90
18	35.34	31.32	14.66	5.38	3.46	3.76	2.48	3.84	7.48	17.67	28.76	34.48
19	39.63	38.95	25.15	5.38	3.99	3.65	2.90	4.85	13.46	19.40	27.11	33.99
20	35.64	36.13	27.60	8.46	4.44	3.46	3.23	7.26	15.72	20.23	22.00	33.24
21	28.91	35.57	26.40	13.54	6.77	5.60	7.48	11.13	14.70	16.96	21.43	30.98
22	29.06	33.95	28.50	13.87	10.08	7.63	10.53	12.26	12.52	16.88	21.32	31.21
23	31.02	32.04	31.13	15.42	9.55	7.82	11.43	10.00	10.08	14.36	19.82	30.08

Notes:

Kitimat Whitesail monitoring data for 2020 to 2024 (ENVP, 2024) (ENVP, 2025a)

An array consisting of these values are repeated over model period: first highest measured value for each hour in each month.



9 Building Downwash

Potential for building downwash. Please provide rationale if building downwash is not modelled.

If building downwash included, provide a site map to indicate buildings to be processed by BPIP-PRIME, and complete the Table.

Building Profile Input Program for PRIME (BPIPPRM) can be used to prepare downwash related input for the Plume Rise Model Enhancements (PRIME) building downwash algorithm. BPIPPRM can determine whether a stack is subjected to wake effects from a structure(s), calculate building heights (BH), and projected building widths (PBW) for cases when the plume is affected by building wakes.

In multiple building situations, BPIPPRM determines building separation distances and will fill in the gap between the buildings under specific circumstances if they are “sufficiently close”. With the addition of more buildings and stacks, a maze of influence zones results, and BPPPRM automates these calculations for these complicated situations.

There is potential for building downwash from structures from compressor buildings and other Project compressor station buildings. Therefore, these have been included in BPIP-PRIME. Structure dimensions are provided in Table 9.1 and locations are shown on Figure 6.1.

Table 9.1 Building or Structure Package Dimensions

Building or Structure Package ID	Description	Length (m) ^a	Width (m) ^a	Height (m) ^b
1	Electrical Services Building	12.5	4.6	3.5
2	Security Building	12.2	3.6	3.5
3	Garage/Warehouse Building	18.4	14.0	6.6
4	Accommodation Package 1 at FLNG	47.9	14.2	42.5
5	Tank Rectangle at LNG Carrier	218.0	42.3	40.4
6	Accommodation Package 2 at FLNG	51.3	48.7	44.5
7	Working Block 1 at LNG Carrier	30.0	13.0	40.4
8	Working Block 2 at LNG Carrier	51.7	13.9	45.4
9	Gas Treatment and Dehydrator Package	36.9	28.7	36.6
10	Amine Regeneration and Flare KO Drum Package	36.9	28.7	41.4
11	Train 2 Package	57.3	39.2	55.4
12	Train 1 Package	57.6	39.1	55.4

Notes:

^a Based on the most recent Cedar LNG Project plot plan layout.

^b Building or structure package height is the average of peak and eave which is above ground level for those located onshore and is above sea level for those located on FLNG and LNG carrier and based on site data provided by Cedar or assumptions.



Cedar LNG Project Dispersion Modelling Plan

Section 9: Building Downwash

September 2025

Building downwash will be modelled consistent with Section 7.6 in the Guideline (ENVP, 2022b). For sloped or peaked roofs, the building height is equivalent to halfway between the trough and the peak, consistent with ENVP direction. Building dimensions are provided in Table 9.1 and building locations are shown on Figure 6.1.



10 Geophysical Data Input

10.1 Topography and Land Use Data

Terrain data (specify source of data) and an elevation map for the model domain: Canadian Digital Elevation Model (CDEM) (Natural Resources Canada, 2017). Available at: <https://open.canada.ca/data/en/dataset/7f245e4d-76c2-4caa-951a-45d1d2051333>

Land use data (specify source of data) and a land use map for the Project CALMET model domain: 2015 30 m North American Land Cover data (CEC, 2020). Available at: <http://www.cec.org/north-american-environmental-atlas/land-cover-30m-2015-landsat-and-rapideye/>

10.1.1 Surface Characteristics

For this Level 3 Assessment the five recommended seasonally varied surface characteristics (surface roughness length, albedo, Bowen ratio, soil heat flux, vegetation leaf area index, and anthropogenic heat flux) are used for the dispersion modelling study consistent with Section 4.4 in the Guideline (ENVP, 2022b).

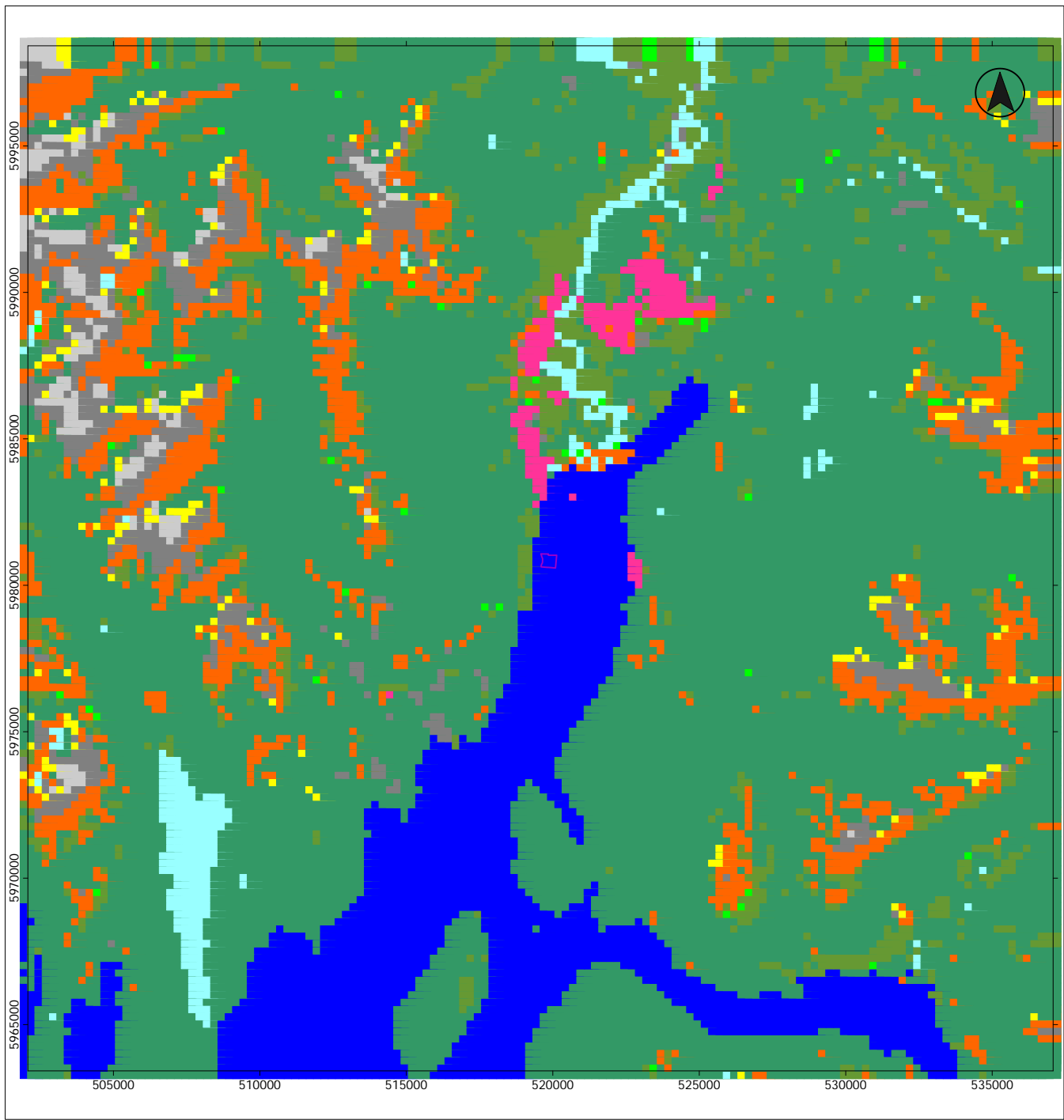
For this Level 3 Assessment, the five recommended seasonally varied surface characteristics (surface roughness length, albedo, Bowen ratio, soil heat flux, vegetation leaf area index, and anthropogenic heat flux) are used for the dispersion modelling study consistent with Section 4.4 in the Guideline (ENVP, 2022b). As requested by ENVP during the WDA application for the LNG Canada Facility, the seasons have been adjusted to align to the ENVP subject matter experts' recommendations of seasonal timeframes in Kitimat; these differ from the seasonal timeframes listed in the Guideline (ENVP, 2022b). The adjusted season assignments are shown in Table 10.1.

Table 10.1 Seasonal Assignments for GEO.dat file

Month	January	February	March 1–15	March 16–31	April	May	June
Season	4	4	4	5	5	5	1
Month	July	August 1–15	August 16–31	September	October	November	December
Season	1	1	2	2	3	3	4

The 30 m resolution Commission for Environmental Cooperation (CEC) land cover data is employed by CALMET to develop both 250 m and 1 km resolution land use files. Figure 10.1 and Figure 10.2 illustrate the land-use classes within the 35 km x 35 km and 55 km x 110 km CALMET model domains, respectively. Based on the 250 m grid resolution data, the domain is comprised of 63.3% evergreen forest, 13.6% water, 8.6% shrub rangeland, 6.8% mixed forest, 4.4% barren land, 1.0% snow or ice, 1.0% rangeland, 0.9% urban land, and 0.3% deciduous forest. Based on the 1 km grid resolution data, the 55 km x 110 km CALMET domain is comprised of 64.8% evergreen forest, 10.0% barren land, 8.2% shrub rangeland, 5.6% large water body, 5.1% mixed forest, 3.9% snow or ice, 1.5% small water body, 0.5% urban land, and 0.3% rangeland.





Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

 Cedar LNG Boundary

-  Urban or Build-up Land
-  Rangeland
-  Shrub Rangeland
-  Deciduous Forest
-  Evergreen Forest
-  Mixed Forest
-  Small Water
-  Large Water
-  Barren Land
-  Perennial Snow or Ice



Project Location
 Kitimat,
 British Columbia

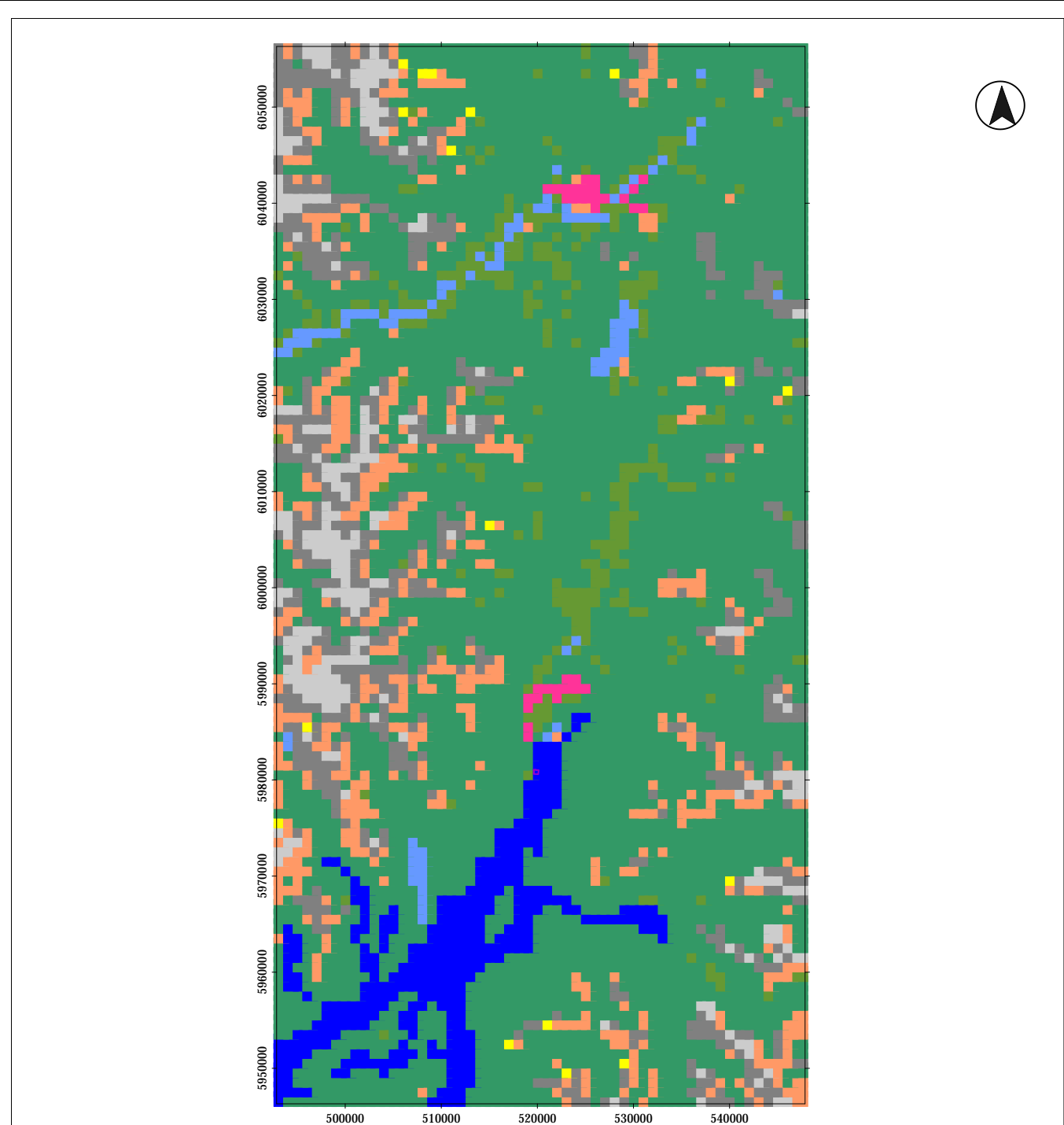
Project Number 123221301

Client/Project/Report
 Cedar LNG Partners (GP) Ltd.
 Cedar LNG Project
 Dispersion Modelling Plan

Figure No.
 10.1

Titel
 CALMET Land Use Classification
 in 35km x 35km Model Domain

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.



Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia;
 Natural Resources Canada: Canadian Hydrographic Service

Cedar LNG Boundary

- Urban or Build-up Land
- Rangeland
- Shrub Rangeland
- Evergreen Forest
- Mixed Forest
- Small Water
- Large Water
- Barren Land
- Perennial Snow or Ice



Project Location
 Kitimat,
 British Columbia

Project Number 123223008

Client/Project/Report
 Cedar LNG Partners (GP) Ltd.
 Cedar LNG Project
 Dispersion Modelling Plan

Figure No.

10.2

Title:

CALMET Land Use Classification
 in 55km x 110km Model Domain

A translation table of 30 m resolution CEC land cover categories to CALMET landuse categories and the seasonal CALMET land-use characterization parameters tables are included in Appendix B.

10.2 Meteorological Data Input (For Level 2 and 3 Assessments Only)

10.2.1 Surface Meteorological Data

Table 10.2 summarizes the station coordinates and meteorological parameters available for the years 2011–2015 at eight surface meteorological stations. Data for 2011–2015 is used to align with the Weather Research Forecast (WRF) numerical weather predictions used as input with CALMET (Section 10.3).

Table 10.3 summarizes the station coordinates and meteorological parameters of two Fisheries and Oceans Canada buoy meteorological stations included in the CALMET modeling. No adjustments will be made.

Figure 4.1 and Figure 4.2 illustrate the location of eight surface meteorological stations within the CALMET model domain. Figure 10.3 presents a comparison of measured and predicted surface winds at Kitimat Haul Road monitoring station (2011–2015). The extracted WRF 1 km grid cell is 1.2 km southwest from the Haul Road monitoring station. While both figures show prevailing winds from generally southerly directions and the occurrence of higher wind speeds from the south, the WRF data indicates more of a south south-westerly bias to prevailing winds compared to the southeasterly prevailing wind measured at the Haul Road monitoring station. These differences demonstrate the importance of blending the surface wind data with WRF using CALMET.



Cedar LNG Project Dispersion Modelling Plan

Section 10: Geophysical Data Input

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Table 10.2 Coordinates and Meteorological Parameters of Surface Stations within the CALMET Modelling Domain

Source	Station Name	Latitude	Longitude	Elevation (masl)	UTM NAD 83 (Zone 9)		Parameters included in 2011–2015 CALMET Modeling
					m East	m North	
ENV	Kitimat Whitesail ^a	54.0669	-128.6391	94	523,616	5,991,027	Air temperature, and relative humidity
	Kitimat Haul Road	54.0292	-128.7027	2	519,474	5,986,812	Wind speed, wind direction, and air temperature
	Kitimat Haisla Village	53.9732	-128.6508	5	522,907	5,980,600	Wind speed, wind direction, and air temperature
	Kitimat Riverlodge	54.0539	-128.6714	18	521,509	5,989,568	Air temperature
	Kitimat Yacht Club	54.0000	-128.6920	2	520,189	5,983,566	Wind speed, wind direction, and air temperature
	Kitimat Smeltersite Road	54.0188	-128.7006	12	519,616	5,985,656	Air temperature
	Terrace Access Centre	54.5183	-128.5975	67	526,054	6,041,266	Wind speed, wind direction, air temperature, relative humidity
ECCC	Terrace Airport	54.4664	-128.5775	217	527,384	6,035,497	Wind speed, wind direction, air temperature, relative humidity and station pressure

Note:

^a Wind direction at both Kitimat Whitesail and Kitimat Yacht Club reflect adjustments that were implemented on the recommendation of ENVP following the discovery of inconsistencies in directions in the 2011-2015 time interval.

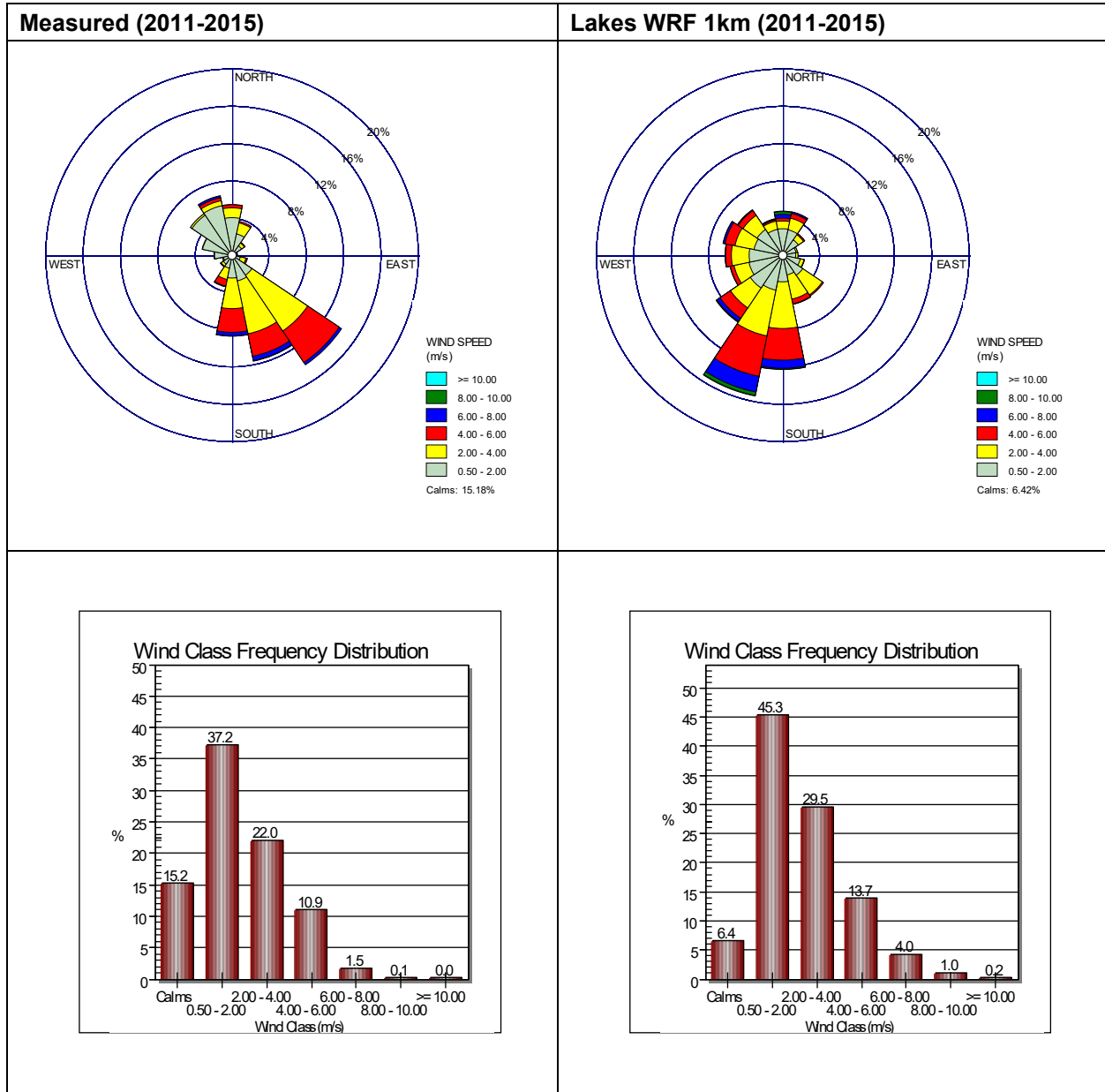


Table 10.3 Coordinates of Buoy Stations included in the CALMET Modeling

Source	Station Name	Latitude (degree N)	Longitude (degree W)	Elevation (m asl)	UTM NAD 83 (Zone 9)		Parameters included in 2011–2015 CALMET Modeling
					km East	km North	
DFO	Nanakwa Shoal Buoy	53.8333	-128.8317	0	511.076	5964.988	Air-sea surface temperature difference, air temperature, wind speed and wind direction
	South Hecate Strait Buoy	52.4250	-129.7917	0	446.166	5808.604	



Figure 10.3 Comparison of Measured and WRF predicted Wind Roses and Wind Class Frequency at Kitimat Haul Road Station (2011-2015)



10.2.2 Upper-Air Meteorological Data

Upper air meteorological data will not be used in this assessment.

10.3 Numerical Weather Prediction Model Output

The proposed numerical weather prediction model output use is as follows:

- Lakes Environmental 2011-2015 WRF 1 km grid resolution output. The 1 km WRF dataset increases the computational runtime of CALMET and CALPUFF. An optimized set of nested CALMET domains is proposed to balance model resolution with reasonable computational load.
- CALMET: Surface station data available. Modelling will proceed in hybrid mode using both surface observations and WRF data as input to CALMET.



11 Treatments

11.1 Nitrogen Oxide to NO₂ Conversion

Identify the method to be used. Please note that the results of total conversion must be presented as part of all model reports, regardless of the conversion method selected for the project (Section 3.2 [ENVP 2022b]). Specify the considerations given to ambient concentrations, characteristics of modelled sources, and availability of relevant monitoring data when selecting the NO₂ modelling method indicated above.

Ambient Ratio Method

Indicate which nitrogen oxide (NO)/NO₂ dataset is used for the ARM2 curve (ENVP developed category curve, or single site representative of project site) and explain the basis for selecting the dataset.

For the air quality assessment, to predict NO₂ concentrations, the ARM2 conversion is selected using the Coastal Sites ARM2 curve, as provided in the NO₂ Guidance (ENVP 2022c).

If a single site dataset is used, provide the dataset and completeness statistics (e.g., number of years, percent complete per quarter).

No single site data is proposed for this assessment

If CALPOST is used, provide the 24 values used for the step function.

CALPOST is not used for this assessment.

11.2 Chemical Transformation

Specify transformation method and provide details on inputs if secondary PM_{2.5}, acid deposition or visibility effects are to be estimated. Depending on the transformation method, this could include ammonia, ozone, hydrogen peroxide concentrations, nighttime loss and formation rates for nitrates and sulphates.

The required and recommended switch settings outlined in Section 7.8 of the Guideline (ENVP, 2022b) will be used.

The updated RIVAD scheme with ISOROPPIA equilibrium (MCHEM = 6) will be used per Section 7.8 of the Guideline (ENVP, 2022b). Aqueous phase chemistry flag (MAQCHEM) and Liquid Water Content flag will be turned off. Stantec has conducted CALPUFF model performance analysis of recent deposition measurements with and without the MAQCHEM option in Kitimat. Specifically, total sulphur deposition measurements collected as part of the Rio Tinto (RT) Sulphur Dioxide Environmental Effects Monitoring Program (EEMP) were compared to CALPUFF model predictions to evaluate accuracy of sulphur deposition predictions and understand model performance and prediction bias. CALPUFF model estimates of total sulphur deposition (using MCHEM=6, RIVAD/ARM3 with ISORROPIA) were predicted



for both the Coho Flats and Lakelse Lake sites and compared to total (wet plus dry) measured deposition rates at these locations for model runs both with and without the new aqueous phase enhanced chemistry and deposition option (MAQCHEM).

Predicted sulphur deposition rates for the CALPUFF model runs including the new aqueous phase enhanced chemistry and deposition model option (i.e., MAQCHEM=1) were found to significantly overpredict measured deposition rate (600% to 700%) at both Coho Flats and Lakelse Lake. The magnitude of overprediction is consistent with poor model performance. The predicted deposition rates when this model option is disabled (i.e., MAQCHEM=0) were found to also overpredict measured deposition rates; however, were acceptable from a model performance perspective (40% to 90%). The overprediction bias is likely attributable to the high precipitation rates and relative humidity on the north coast. There are no known published validation studies of CALPUFF using MAQCHEM=1 in a similar setting. Based upon the results of this comparison, it is recommended that the aqueous phase enhancement model option not be used (i.e., MAQCHEM=0) for the dispersion modelling.

The CALPUFF deposition options will be turned on to enable the prediction and deposition of NO_x, SO₂, nitrates and sulfates to be used in the acid deposition analysis.

11.2.1 Secondary Particulate Formation

CALPUFF model will be used to predict secondary PM_{2.5} formation attributable to precursor SO₂ and NO_x emissions.

11.3 Acidification Effects

The predicted deposition rates of pollutants containing sulphur and nitrogen that can contribute to acidification and eutrophication effects will be obtained from dispersion modelling and then used by other disciplines (including water quality, vegetation, and soils) to support the amendment application.

11.4 Particle Deposition

If non-recommended particle size distributions (see Section 3.6) are used, provide Table of particle emission (including heavy metals if modelled) size/density distribution and indicate the basis for the Table.

The Project is a negligible source of coarse particulate during operations. Concerns about impacts on the environment associated with particle deposition, as dustfall, are not applicable.



11.5 Stagnation

Provide an estimate of the frequency of stagnation based on local meteorological data if available.

This assessment employs the CALPUFF dispersion modelling system which can simulate transport and dispersion associated with very low wind speeds (calms). This assessment will use both surface station wind data in combination with numerical weather prediction model output to realistically consider the effects of calms on air quality.

11.6 Shore/Coastal Effects

If included, indicate whether sub-grid-scale Thermal Internal Boundary Layer option is selected along with the required input coastline coordinate data (see Section 10.3).

Given the Project location is close to Douglas Channel, the sub-grid-scale Thermal Internal Boundary Layer option (Shore/Coastal Effects) will not be included since the 250 m grid CALMET model provides adequate resolution of the land/water boundary on selection of boundary layer calculations to scale turbulence and determine mixing heights. The use of high resolution WRF data adds the ability to account for the influence of the coastal meteorology at and near the Project location.

11.7 Plume Condensation (Fogging) and Icing

Indicate if this will be included (Section 10.6).

Plume condensation and freezing (Fogging and Icing) are not selected as an option because there is no evaporative cooling associated with the Project. Combustion source plumes have limited stack moisture, and sufficient buoyancy and momentum such that they are not expected to be a substantive cause of condensing or freezing plumes near ground level.



12 Quality Management Program

The model inputs for this assessment include sources (locations and elevation) and emission characteristics, geographic and land use data, and meteorological data. These data are subject to Stantec's quality management system wherein they are subject to scrutiny by a qualified Quality Reviewer and Independent Reviewer. Quality assurance related materials will be presented in dedicated Appendices to the technical data report (CALMET and CALPUFF).

The quality of the meteorological inputs and outputs will be evaluated to confirm that specific data treatments have been applied properly. For CALMET output there are several tests listed in Section 9.1 in the Guideline (ENVP 2022a) to test the quality of the generated meteorological fields. The CALMET Appendix for the technical data report will include plots and graphs depicting:

- Contour plots of topography and land use for the entire CALMET model domain.
- Annual wind rose / wind frequency distribution plots of surface wind speeds and average monthly temperature plot at the two surface meteorological stations (annual, seasonal).
- WRF raw data quality assurance and quality control checks (annual wind rose, monthly temperature comparison against the nearest representative surface meteorological station). These checks will be completed using the CALWRF files as raw WRF files are no longer available for purchase.
- Wind field maps (surface and different elevations) for select periods where topographic influences (channeling, thermally driven flows) would be evident.
- Frequency distributions of various meteorological parameters (annual, seasonal) such as PG-stability class, mixing heights.
- Plots of hourly average parameters such as temperature, mixing height, precipitation at key locations (seasonal and annual).
- Selected wind fields as vector plots.

Tests of the CALPUFF output will be conducted to confirm the quality of the model output (intermediate pre-processing files and concentration predictions).

The Guideline (ENVP 2022b: Section 9.2) notes that models are more reliable for estimating longer time-averaged concentrations than for estimating short-term concentrations at specific locations. Estimates of concentrations that occur at a specific time and site are poorly correlated with actual observed concentrations (paired in space and time) and are much less reliable. For this reason, Stantec avoids employing metrics which evaluate the models' ability to reproduce observations paired in space and time.

To evaluate model prediction uncertainty and bias, the hourly and annual Base Case dispersion modelling results at receptors representing the air monitoring station locations will be compared to measured values at those stations. A ratio of predicted to measured concentrations will be calculated for each station. Model performance is typically deemed acceptable if the ratio of predicted to measured values falls within a factor of two. This analysis is not intended to represent a rigorous statistical model



performance evaluation, rather to provide an indication of which model predictions are associated with increased uncertainty or provide an indication of prediction bias. This comparison will be completed using measurement data from Kitimat Whitesail and Kitimat Haisla Village.

If exceedances are predicted the areal extent of exceedance, frequency of exceedance, and meteorological circumstances associated with exceedances will be investigated.

Note: All computer files associated with the modelling will be submitted to the ENVP and BCER.



13 Regulator Review of Plan and Revisions

A modelling plan can change over the course of developing the air quality assessment so acceptance of the initial submission of the plan is on the basis of the best information provided to date. Changes to the plan (additions, modifications) should be noted and agreed to with the ENVP and BCER as necessary. An updated Dispersion Modelling Plan may be necessary.

Regulator Acceptance of Original Plan

ENVP

Name: _____

Date: _____

BCER

Name: _____

Date: _____



14 References

- CEC (Commission for Environmental Cooperation). 2020: North American Land Change Monitoring System (NALCMS) North American Land Cover 30m, 2015. Retrieved from <http://www.cec.org/north-american-environmental-atlas/land-cover-30m-2015-landsat-and-rapideye/>
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- ENVP. 2022a. Appendix A. Dispersion Modelling Plan. British Columbia Air Quality Dispersion Modelling Guideline. British Columbia Ministry of Environment, August 2022. Available at: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/air/reports-pub/bc_dispersion_modelling_guideline.pdf
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Cedar LNG Project Dispersion Modelling Plan

Section 14: References

September 2025

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Appendices



Appendix A CALMET Model Options and Land Use Characterization Translation Table



Cedar LNG Project Dispersion Modelling Plan

Appendix A: CALMET Model Options and Land Use Characterization Translation Table
September 2025

Table A.1 Project Specific CALMET Model Options

Parameter	Default	Project	Comment
Wind Field Model Options:			
IEXTRP	-4	-4	Similarity theory used
ICALM	0 or 1	0	Extrapolate surface winds even if calm
BIAS	0	12*0	Layer-dependent biases modifying the weights of surface and upper air stations
IPROG	2,4 or 14	14	Use gridded prognostic wind field model output fields as input to the diagnostic wind field model (from WRF 3D.DAT)
Radius of Influence Parameters:			
LVARY	F	F	Use varying radius of influence
RMAX1	-	6	Maximum radius of influence over land in the surface layer (km)
RMAX2	-	10	Maximum radius of influence over land aloft (km)
Other Wind Field Input Parameters:			
TERRAD	-	5	Radius of influence of terrain features (km)
R1	-	2	Relative weighting of the first guess field and observations in the surface layer (km)
R2	-	5	Relative weighting of the first guess field and observations in the layers aloft (km)
Relative Humidity Parameters:			
IRHPROG	0	0	Use RH from SURF.DAT file
Temperature Parameters:			
ITPROG	0	1	Use Surface station; Use WRF/3D for upper air data



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Appendix A: CALMET Model Options and Land Use Characterization Translation Table
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Table A.2 Translation Table of 30 m resolution CEC Land Cover Categories to CALMET Categories

30 m Resolution CEC Land Cover Code	30 m Resolution CEC Land Cover Type	CALMET Code	CALMET Land Use Category
1	Temperate or sub-polar needleleaf forest	42	Evergreen Forest Land
2	Sub-polar taiga needleleaf forest	42	
3	Tropical or sub-tropical broadleaf evergreen forest	42	
4	Tropical or sub-tropical broadleaf deciduous forest	41	Deciduous Forest Land
5	Temperate or sub-polar broadleaf deciduous forest	41	
6	Mixed forest	43	Mixed Forest Land
7	Tropical or sub-tropical shrubland	32	Shrub Rangeland
8	Temperate or sub-polar shrubland	32	
9	Tropical or sub-tropical grassland	30	Rangeland
10	Temperate or sub-polar grassland	30	Rangeland
11	Sub-polar or polar shrubland-lichen-moss	32	Shrub Rangeland
12	Sub-polar or polar grassland-lichen-moss	30	Rangeland
13	Sub-polar or polar barren-lichen-moss	32	Shrub Rangeland
14	Wetland	60	Wet Land
15	Cropland	20	Agricultural Land
16	Barren lands	70	Barren Land
17	Urban	10	Urban or Build-up Land
18	Small Water Body	51	Small Water Body
19	Snow and Ice	90	Perennial Snow or Ice
20	Large Water Body	55	Large Water Body



Appendix B Regional Emission Details and Facility Gas Compositions



B.1 Regional Emission Details

Table B-1 Emission Sources from Rio Tinto Alcan Kitimat Aluminum Smelter (Land Based Sources)

Source ID	Source Description	Location (UTM Zone 9, NAD83)			Stack Parameters				Emissions (g/s)				
		mE	mN	Base Elevation (m)	Height (m)	Diameter (m)	Exit Velocity (m/s)	Exit Temperature (K)	SO ₂	NO _x	PM _{2.5}	CO	VOCs
Point Source_1 ^a	Pyroscrubber	519774	5983572	9.0	46.8	2.57	18.8	1,245	106.2	9.28 ^b	5.86 ^e	0	0
Point Source_2 ^a	Cooler	519718	5983612	12.1	15.9	0.71	18.0	368	8.24	0	1.08 ^e	0	0
Point Source_3 ^a	B-Casting Furnace 41	519715	5985291	16.5	34.1	0.89	10.7	570	0	0.083 ^c	0.168 ^a	0	0
Point Source_4 ^a	B-Casting Furnace 42	519709	5985290	16.6	34.1	0.89	10.0	557	0	0.083 ^c	0.175 ^a	0	0
Point Source_5 ^a	C-Casting Furnace 62	519698	5985420	16.0	46.0	1.47	6.2	325	0	0.083 ^c	0.013 ^a	0	0
Point Source_6 ^a	C-Casting Furnace 63-64	519665	5985414	16.0	46.0	1.47	9.6	377	0	0.083 ^c	0.007 ^a	0	0
Point Source_7 ^a	Gas Treatment Center East (GTC1)	519559	5985239	17.0	59.8	7.56	19.6	361	167.1	0	4.84 ^f	0	0
Point Source_8 ^a	Gas Treatment Center West (GTC2)	519441	5985218	17.0	59.7	7.56	19.7	364	167.1	0	1.82 ^f	0	0
Point Source_9 ^a	Fume Treatment Center (Anode Bake Furnace)	519233	5985429	18.6	50.4	2.18	15.2	378	34.1	2.20 ^d	1.64 ^g	0	0



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Appendix B: Regional Emission Details and Facility Gas Compositions

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Source ID	Source Description	Location (UTM Zone 9, NAD83)			Stack Parameters				Emissions (g/s)				
		mE	mN	Base Elevation (m)	Height (m)	Diameter (m)	Exit Velocity (m/s)	Exit Temperature (K)	SO ₂	NO _x	PM _{2.5}	CO	VOCs
Point Source_10 ^a	Dust Collector For Bath Unloading Area in Anode Rodding Shop annex. Building (5710-DCB-001)	519344	5985490	18.1	12.7	1.40	8.1	304	0	0	0.525 ^h	0	0
Point Source_11 ^a	Vacuum Filter for Vacuum Elevator (5710-DCB-003)	519275	5985482	18.0	30.3	0.30	22.7	295	0	0	0.333 ^h	0	0
Point Source_12 ^a	Anode Paste Plant DC-10	519771	5983766	9.3	50.8	1.16	5.5	305	0	0	1.09 ^h	0	0
Point Source_13 ^a	Anode Paste Plant DC-11	519776	5983764	9.3	50.8	0.54	5.4	322	0	0	0.300 ⁱ	0	0
Point Source_14 ^a	Anode Paste Plant DC-12	519775	5983770	9.1	50.8	0.54	5.1	308	0	0	0.300 ⁱ	0	0
Point Source_15 ^a	Anode Paste Plant DC-13	519782	5983761	9.2	50.8	0.43	6.5	289	0	0	0.200 ⁱ	0	0
Point Source_16 ^a	Anode Paste Plant DC-14	519778	5983773	9.0	50.8	0.44	6.9	301	0	0	0.200 ⁱ	0	0
Point Source_17 ^a	Anode Paste Plant FC3	519752	5983727	10.0	41.3	0.51	6.0	512	0	0	0.14 ^h	0	0
Point Source_18 ^a	Dry Coke scrubber PFTC 5130-DCB-002	519762	5983829	11.3	46.5	1.15	11.5	321	0	0	0.315 ^h	0	0
Point Source_19 ^a	Boiler 4 at the 2610-steam plant	519861	5984266	13.3	8.3	0.61	10.0	513	0.002 ^d	0.385 ^d	0.029 ^d	0.323 ^d	0.021 ^j



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Appendix B: Regional Emission Details and Facility Gas Compositions

September 2025

Source ID	Source Description	Location (UTM Zone 9, NAD83)			Stack Parameters				Emissions (g/s)				
		mE	mN	Base Elevation (m)	Height (m)	Diameter (m)	Exit Velocity (m/s)	Exit Temperature (K)	SO ₂	NO _x	PM _{2.5}	CO	VOCs
Point Source_20 ^a	Boiler 5 at the 2610-steam plant	519849	5984265	13.8	8.3	0.61	10.0	513	0.002 ^d	0.385 ^d	0.029 ^d	0.323 ^d	0.021 ^j
Point Source_21 ^a	Carbon South Boiler Stack	519753	5983813	10.5	8.3	0.61	10.0	513	0.002 ^d	0.385 ^d	0.029 ^d	0.323 ^d	0.021 ^j
Point Source_22 ^k	Dust Collection at Dross Loading Station (6900-DCB-001)	519681	5985409	16.0	12.5	1.40	8.1	304	0	0	0.35 ^h	0	0
Point Source_23 ^k	Pitch Incinerator (Liquid pitch storage tanks)	519995	5983578	8.3	20.0	1.50	10.0	773	0	0	0.292 ^h	0	0
Point Source_24 ^k	Dust Collection System For Bath Removal C/W Baghouse (5610-DCB-001)	519427	5985530	16.1	12.5	1.40	8.1	304	0	0	0.28 ^h	0	0
Point Source_25 ^k	Dust Collector – Carbon Processing (5610-DCB-003)	519351	5985560	18.4	12.5	1.40	8.1	304	0	0	0.263 ^h	0	0
Point Source_26 ^k	Dust Collector, Pulse Jet (5810-DCB-001)	519492	5985525	16.0	12.5	1.40	8.1	304	0	0	0.333 ^h	0	0
Point Source_27 ^k	Dust Collector for B4421 (4421-DCB-001)	519693	5985100	15.0	16.8	1.73	19.8	291	0	0	0.35 ^h	0	0



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Appendix B: Regional Emission Details and Facility Gas Compositions
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Source ID	Source Description	Location (UTM Zone 9, NAD83)			Stack Parameters				Emissions (g/s)				
		mE	mN	Base Elevation (m)	Height (m)	Diameter (m)	Exit Velocity (m/s)	Exit Temperature (K)	SO ₂	NO _x	PM _{2.5} ^h	CO	VOCs
Point Source_28 ^k	Dust Collector for B4424 (4424-DCB-001)	519698	5985070	15.0	16.8	1.73	19.8	291	0	0	0.025 ^h	0	0
Point Source_29 ^k	Potshell repair and shotblasting (B7123-DCB-001)	519703	5985046	15.0	16.8	1.73	19.8	291	0	0	0.059 ^h	0	0
Point Source_30 ^k	Crucible Cleaning Dust collector (B221-cruce cleaner)	519755	5985222	15.5	12.5	1.40	8.1	304	0	0	1.32 ^h	0	0
Point Source_31 ^k	Dust collector for carbon crushing (550-DCB-001)	519825	5983609	9.9	12.5	1.40	8.1	304	0	0	0.070 ^h	0	0
Point Source_32 ^k	Dust collector for conveyor 13A extension, building 514	519967	5983766	9.1	12.5	1.40	8.1	304	0	0	0.015 ^h	0	0
Point Source_33 ^k	Dust collector for conveyor 13B extension	519928	5983756	7.5	12.5	1.40	8.1	304	0	0	0.015 ^h	0	0
Point Source_34 ^k	Dust collector for TT-01	519658	5984729	12.3	12.5	1.40	8.1	304	0	0	0.050 ^h	0	0
Point Source_35 ^k	Filter Receiver for TT-01	519674	5984730	13.0	12.5	1.40	8.1	304	0	0	0.003 ^h	0	0
Point Source_36 ^k	Dust collector for TT-01	519656	5984736	12.4	12.5	1.40	8.1	304	0	0	0.025 ^h	0	0



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Appendix B: Regional Emission Details and Facility Gas Compositions

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Source ID	Source Description	Location (UTM Zone 9, NAD83)			Stack Parameters				Emissions (g/s)				
		mE	mN	Base Elevation (m)	Height (m)	Diameter (m)	Exit Velocity (m/s)	Exit Temperature (K)	SO ₂	NO _x	PM _{2.5}	CO	VOCs
Point Source_37 ^k	Dust collector for aluminum fluoride Debagging Station	519768	5984750	13.2	12.5	1.40	8.1	304	0	0	0.015 ^h	0	0
Line Source_1 ^a	Pallet Storage	519323	5985446	17.0	12.0	-	-	-	0	0	0.518 ^a	0	0
		519537	5985485										
Line Source_2 ^a	Potline A South	519674	5984837	15.5	23.05	-	-	-	0.422	0	0.682 ^f	0	0
		519624	5985110										
Line Source_3 ^a	Potline A North	519619	5985128	14.1	23.05	-	-	-	0.422	0	0.682 ^f	0	0
		519570	5985409										
Line Source_4 ^a	Potline B South	519609	5984798	16.0	23.05	-	-	-	0.422	0	0.682 ^f	0	0
		519555	5985095										
Line Source_5 ^a	Potline B North	519550	5985116	15.0	23.05	-	-	-	0.422	0	0.682 ^f	0	0
		519502	5985387										
Line Source_6 ^a	Potline C South	519553	5984813	16.5	23.05	-	-	-	0.422	0	0.682 ^f	0	0
		519503	5985085										
Line Source_7 ^a	Potline C North	519501	5985107	15.5	23.05	-	-	-	0.422	0	0.682 ^f	0	0
		519449	5985387										
Line Source_8 ^a	Potline D South	519484	5984806	16.0	23.05	-	-	-	0.422	0	0.682 ^f	0	0
		519435	5985071										
Line Source_9 ^a	Potline D North	519432	5985093	14.4	23.05	-	-	-	0.422	0	0.682 ^f	0	0
		519380	5985369										



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Appendix B: Regional Emission Details and Facility Gas Compositions

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Source ID	Source Description	Location (UTM Zone 9, NAD83)			Stack Parameters				Emissions (g/s)				
		mE	mN	Base Elevation (m)	Height (m)	Diameter (m)	Exit Velocity (m/s)	Exit Temperature (K)	SO ₂	NO _x	PM _{2.5}	CO	VOCs
Total emissions (g/s)									486	13.0	28.5	0.970	0.063
Total emissions (t/d)									42.0	1.12	2.47	0.084	0.005
Total emissions (t/y)									15,330	409	900	30.6	2.00

Notes:

- ^a For point sources 1 to 21 and all line sources, source locations and stack parameters are from RT provided database (RT 2021).
SO₂ emissions for point sources 1 to 18 and PM_{2.5} emissions for point sources 3 to 6 are from RT (2021).
SO₂ and NO_x emissions for all line sources and PM_{2.5} emission for line source 1 are from RT (2021).
- ^b Stantec adjusted based on emission rate shown in RT (2013) and the facility NO_x emission limit 1.12 t/d (ENVP 2025).
- ^c From RT (2013).
- ^d From RT BC Works 2022 Environmental Report (RT 2022).
- ^e From permit 100138 (ENVP 2025)
- ^f Obtained single TPM emission from permit 100138 (ENVP 2025) based on aluminum production rate 420,000 t/y, then obtained PM_{2.5} emission based on the PM_{2.5} to TPM ratio 0.7 (derived from RT (2021)).
Finally, distribute PM_{2.5} emissions to two gas treatment centers and eight potline sources proportionally based on PM_{2.5} emissions shown in RT (2021) for these sources.
- ^g Obtained TPM emission from permit 100138 (ENVP 2025b) based on an assumed anode consumption rate of 420 kg per tonne of aluminum production. Assumed TPM is equal to PM₁₀. Then obtained PM_{2.5} emission based on the ratio of PM_{2.5} to PM₁₀ for this source presented in RT (2021).
- ^h Obtained TPM emission from permit 100138 (ENVP 2025b), then obtained PM_{2.5} emission based on the PM_{2.5} to TPM ratio 0.7 (derived from RT (2021))
- ⁱ Obtained TPM emission from permit 100138 (ENVP 2025), then obtained PM_{2.5} emission based on the assumption that TPM = PM₁₀ = PM_{2.5} for these sources.
- ^j Stantec calculated based on CO emission rate and AP42 emission factors for CO (84 lb/MMscf) and VOC (5.5 lb/MMscf) (U.S. EPA 1998)
- ^k For point sources 22 to 37, stack locations are estimated based on information from permit 100138 (ENVP 2025b). All stack parameters are assumed by Stantec.



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Appendix B: Regional Emission Details and Facility Gas Compositions

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Table B-2 Emission Sources from Rio Tinto Alcan Kitimat Aluminum Smelter (Marine Sources) (Source: RT 2013)

Source		Location (UTM Zone 9, NAD83)			Stack Parameters				Emissions (g/s)				
Description	Type	mE	mN	Base Elevation (m)	Height (m)	Diameter (m)	Exit Velocity (m/s)	Exit Temperature (K)	SO ₂	NO _x	CO	PM _{2.5}	VOCs
Bulk Carrier	Point Source	520439	5983111	0.0	30.0	1.50	37.58	558	0.018	0.447	0.039	0.007	0.016
Tug 1	Point Source	520370	5983048	0.0	10.0	0.75	14.53	558	0.001	0.071	0.008	0.005	0.004
Tug 2	Point Source	520365	5983190	0.0	10.0	0.75	14.53	558	0.001	0.071	0.008	0.005	0.004
Total emissions (g/s)									0.020	0.589	0.055	0.017	0.024
Total emissions (t/d)									0.002	0.051	0.005	0.001	0.002
Total emissions (t/y)									0.631	18.6	1.73	0.536	0.757



Cedar LNG Project Dispersion Modelling Plan

Appendix B: Regional Emission Details and Facility Gas Compositions

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Table B-3 Emission Sources from LNG Canada (Land Based Sources) (Phase I)

Source		Location (UTM Zone 9, NAD83)			Stack Parameters				Emissions (g/s)					Note for Emissions
Description	Type	mE ^a	mN ^a	Base Elevation (m)	Height (m) ^a	Diameter (m) ^a	Exit Velocity (m/s)	Exit Temperature (K)	SO ₂	NO _x	PM _{2.5}	CO	VOCs	
Acid Gas Incinerator (AGI) (train 1)	Point Source	520900	5986413	14.0	50.0	3.35	9.96 ^b	1255 ^a	5.05	1.93	0.126	0.966	0.005	From PA-110588
Acid Gas Incinerator (AGI) (train 2)	Point Source	520690	5986392	9.0	50.0	3.35	9.96 ^b	1255 ^a	5.05	1.93	0.126	0.966	0.005	
Waste Heat Recovery Unit (Train 1)	Point Source	520871	5986370	12.9	60.0	3.85	27.4 ^b	470 ^b	0.020	10.63	0.104	9.84	0.243	
Waste Heat Recovery Unit (Train 1)	Point Source	520894	5986149	16.7	60.0	3.85	27.4 ^b	470 ^b	0.020	10.63	0.104	9.84	0.243	
Waste Heat Recovery Unit (Train 2)	Point Source	520661	5986348	10.0	60.0	3.85	27.4 ^b	470 ^b	0.020	10.63	0.104	9.84	0.243	
Waste Heat Recovery Unit (Train 2)	Point Source	520683	5986128	7.3	60.0	3.85	27.4 ^b	470 ^b	0.020	10.63	0.104	9.84	0.243	



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Appendix B: Regional Emission Details and Facility Gas Compositions

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Source		Location (UTM Zone 9, NAD83)			Stack Parameters				Emissions (g/s)					Note for Emissions
Description	Type	mE ^a	mN ^a	Base Elevation (m)	Height (m) ^a	Diameter (m) ^a	Exit Velocity (m/s)	Exit Temperature (K)	SO ₂	NO _x	PM _{2.5}	CO	VOCs	
Warm Wet Flare	Point Source	521140	5985571	6.3	122 (124.5) ^c	1.42 (0.48) ^c	20.0 ^e	1273 ^e	0.001	0.070	0.123	0.318	0.678	From Stantec (2023)
Cold Dry Flare	Point Source	521149	5985572	7.2	122 (125.0) ^c	1.42 (0.58) ^c	20.0 ^e	1273 ^e	0.001	0.104	0.183	0.473	1.01	
Low Pressure Flare (Storage Flare)	Point Source	521143	5985571	6.6	122 (123.4) ^c	1.42 (0.26) ^c	20.0 ^e	1273 ^e	0.0002	0.021	0.038	0.097	0.207	
Liquid Burner	Point Source	521198	5985683	14.0	60 (60.8) ^c	0.076/0.15 ^d (0.14) ^c	20.0 ^e	1273 ^e	0	0.006	0.011	0.027	0.058	
Spare Flare	Point Source	521146	5985572	6.9	122 (122.5) ^c	1.42 (0.10) ^c	20.0 ^e	1273 ^e	0	0.003	0.005	0.014	0.029	
Total emissions (g/s)									10.2	46.6	1.03	42.2	2.96	
Total emissions (t/d)									0.880	4.02	0.089	3.65	0.256	
Total emissions (t/y)									321	1,469	32.4	1331	93.4	

Notes:

^a From permit PA-110588 (ENVP 2024).

^b From Stantec (2023).

^c Values in bracket represent pseudo parameters, which are from Stantec (2023).

^d There are 9 individual burners, three burners with stack ID 0.076 m and six burners with stack ID 0.15 m.

^e Pseudo stack parameters following the methods in Section 10.1.1 of the Guideline (ENVP 2022)



Cedar LNG Project Dispersion Modelling Plan

Appendix B: Regional Emission Details and Facility Gas Compositions

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Table B-4 Emission Sources from LNG Canada (Marine Sources) (Phae I) (Source: Stantec 2023)

Source		Location (UTM Zone 9, NAD83)			Stack Parameters				Emissions (g/s)				
Description	Type	mE	mN	Base Elevation (m)	Height (m)	Diameter (m)	Exit Velocity (m/s)	Exit Temperature (K)	SO ₂	NO _x	CO	PM _{2.5}	VOCs
LNG Carrier South	Point Source	520952	5982973	0	42	1.5	37.6	558	0.171	0.698	0.061	0.298	0.144
LNG Carrier North	Point Source	520800	5983403	0	42	1.5	37.6	558	0.171	0.698	0.061	0.298	0.144
Tug Boat South_1	Point Source	520899	5982873	0	10	0.5	14.5	558	0.001	0.004	0.0001	0.004	0.0001
Tug Boat South_2	Point Source	520872	5983073	0	10	0.5	14.5	558	0.001	0.004	0.0001	0.004	0.0001
Tug Boat North_1	Point Source	520768	5983326	0	10	0.5	14.5	558	0.001	0.004	0.0001	0.004	0.0001
Tug Boat North_2	Point Source	520757	5983487	0	10	0.5	14.5	558	0.001	0.004	0.0001	0.004	0.0001
Total emissions (g/s)									0.347	1.41	0.122	0.610	0.289
Total emissions (t/d)									0.030	0.122	0.011	0.053	0.025
Total emissions (t/y)									10.9	44.5	3.84	19.2	9.10



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Appendix B: Regional Emission Details and Facility Gas Compositions

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Table B-5 Emission Sources from LNG Canada (Land Based Sources) (Phase II)

Source		Location (UTM Zone 9, NAD83) ^a			Stack Parameters ^b				Emissions (g/s) ^b				
Description	Type	mE	mN	Base Elevation (m)	Height (m)	Diameter (m)	Exit Velocity (m/s)	Exit Temperature (K)	SO ₂	NO _x	PM _{2.5}	CO	VOCs
Acid Gas Incinerator (AGI) (train 3)	Point Source	520479	5986370	10.00	50.0	3.35	9.96	1255	5.05	1.93	0.126	0.966	0.005
Acid Gas Incinerator (AGI) (train 4)	Point Source	520268	5986349	10.00	50.0	3.35	9.96	1255	5.05	1.93	0.126	0.966	0.005
Waste Heat Recovery Unit (Train 3)	Point Source	520450	5986327	10.00	60.0	3.85	27.4	470	0.020	10.63	0.104	9.84	0.243
Waste Heat Recovery Unit (Train 3)	Point Source	520472	5986106	10.00	60.0	3.85	27.4	470	0.020	10.63	0.104	9.84	0.243
Waste Heat Recovery Unit (Train 4)	Point Source	520239	5986305	9.08	60.0	3.85	27.4	470	0.020	10.63	0.104	9.84	0.243
Waste Heat Recovery Unit (Train 4)	Point Source	520261	5986084	9.00	60.0	3.85	27.4	470	0.020	10.63	0.104	9.84	0.243
Total emissions (g/s)									10.2	46.4	0.669	41.3	0.983
Total emissions (t/d)									0.880	4.0	0.058	3.57	0.085
Total emissions (t/y)									321	1462	21.1	1302	31.0

Notes:

^a Estimated by Stantec.

^b Assumed same as Phase I.



Table B-6 Emission Sources from LNG Canada (Marine Sources) (Phase II) ^a

Source		Location (UTM Zone 9, NAD83)			Stack Parameters				Emissions (g/s)				
Description	Type	mE	mN	Base Elevation (m)	Height (m)	Diameter (m)	Exit Velocity (m/s)	Exit Temperature (K)	SO ₂	NO _x	CO	PM _{2.5}	VOCs
LNG Carrier South	Point Source	520952	5982973	0	42	1.5	37.6	558	0.171	0.698	0.061	0.298	0.144
LNG Carrier North	Point Source	520800	5983403	0	42	1.5	37.6	558	0.171	0.698	0.061	0.298	0.144
Tug Boat South_1	Point Source	520899	5982873	0	10	0.5	14.5	558	0.001	0.004	0.0001	0.004	0.0001
Tug Boat South_2	Point Source	520872	5983073	0	10	0.5	14.5	558	0.001	0.004	0.0001	0.004	0.0001
Tug Boat North_1	Point Source	520768	5983326	0	10	0.5	14.5	558	0.001	0.004	0.0001	0.004	0.0001
Tug Boat North_2	Point Source	520757	5983487	0	10	0.5	14.5	558	0.001	0.004	0.0001	0.004	0.0001
Total emissions (g/s)									0.347	1.41	0.122	0.610	0.289
Total emissions (t/d)									0.030	0.122	0.011	0.053	0.025
Total emissions (t/y)									10.9	44.5	3.84	19.2	9.10

Note:

^a Assumed same as Phase I.



B.2 Facility Gas Compositions

Table B-7 Gas Compositions (mole fraction) ^a

Compound	Design Fuel Gas	Treated Gas	Heavies Vapour	Acid gas	Flash Gas	BOG
H ₂	0	0	0	0	0	0
N ₂	0.0354	0.002	0.0017	0	0.0006	0.0641
He	0	0	0	0	0	0
Ar	0	0	0	0	0	0
CO	0	0	0	0	0	0
CO ₂	0	0	0	0.9463	0.0069	0
H ₂ S	0	0	0	0.0011	0	0
C1	0.5173	0.8839	0.5850	0.0048	0.8462	0.9358
C2	0.0001	0.0763	0.1940	0.0008	0.0873	0.0001
C3	0	0.0261	0.1376	0.0001	0.0219	0
iC4	0	0.0043	0.0302	0	0.0046	0
nC4	0.0002	0.0054	0.0416	0	0.0042	0
iC5	0.0646	0.0010	0.0068	0	0.0011	0
nC5	0.1781	0.0008	0.0031	0	0.0008	0
C6	0.1132	0.0003	0	0.0002	0.0004	0
C7+	0.0907	0.0003	0	0.0011	0.0011	0
H ₂ O	0	0	0	0.0456	0.0249	0
NH ₃	0	0	0	0	0	0
COS (Carbonyl Sulfide)	0	0	0	0	0	0
O ₂	0	0	0	0	0	0
Mercaptans (R-SH)	0.0004	0	0	0	0	0
diM-Sulphide	0.00002	0	0	0	0	0
Total	1.00	1.00	1.00	1.00	1.00	1.00
MW (kg/kml)	45.7	18.4	26.2	42.7	18.7	16.8
LHV (MJ/sm ³)	86.7	38.3	52.9	0.32	37.3	31.8
HHV (MJ/sm ³)	94.1	42.4	58.0	0.43	41.3	35.3

Note:

^a Provided by Cedar.



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Appendix B CALMET



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B.1 Introduction

This appendix provides technical details and assumptions regarding the application of the CALMET model to determine the meteorology for dispersion modelling of Cedar LNG Project (the Project). The CALMET modelling was completed following the Province of British Columbia Ministry of Environment and Parks (ENVP) Air Quality Dispersion Modelling Guideline (the Guideline) (ENVP, 2022). The appendix focuses on model input data preparation and an overview of main CALMET predicted parameters.

For the air quality assessment completed for the Project, the CALMET meteorological model (Scire et al., 2000) was run for a five-year period, January 1, 2011 to December 31, 2015. The selection of a five-year period is consistent with the Guideline (ENVP, 2022). CALMET was run in hybrid mode using both Weather Research and Forecasting (WRF) model 1 km gridded data (Lakes Environmental, 2025), surface weather station observations within the CALMET model domain, and observations at two nearest buoy stations. Two nested model domains at 250 m and 1km grid resolutions were selected for the assessment (see Section B.2).

B.2 CALMET Application

The CALMET model is available from the model developer's (i.e., Exponent, Inc.) web site (<http://www.src.com/calpuff/calpuff1.htm>). The current United States Environmental Protection Agency (US EPA) version of CALMET is Version 5.8.4, level 130731. For this assessment, a more recent version, Version 6.50 - Level 150223 was adopted.

For this assessment, a set of two nested model domains (shown in Table B.1 and Table B.2) were used to balance model resolution with reasonable computational load (see Section B.3). Terrain in the 35 km x 35 km and 55 km x 110 km CALMET model domains are shown in Figure B.1 and Figure B.2, respectively. It is anticipated that the relevant Project effects will be captured in the 35 km x 35 km model domain. The larger domain was established to capture the extent of the Base Case emissions sources. The smaller 35 km x 35 km domain (centered on the Project) used a higher grid 250 m resolution due to the complex terrain in the vicinity of the Project.

To simulate transport and dispersion processes, it is also important to simulate representative vertical profiles of wind direction, wind speed, temperature, and turbulence intensity within the atmospheric boundary layer (i.e., the layer within about 2,000 m of the Earth's surface). To capture this vertical structure, twelve vertical layers were selected. CALMET defines a vertical layer as the midpoint between two faces (i.e., thirteen faces correspond to twelve layers, with the lowest layer always being ground level or 10 m). The vertical faces used in this study are 0 m, 20 m, 40 m, 80 m, 120 m, 280 m, 520 m, 880 m, 1,320 m, 1,820 m, 2,380, 3,000 m and 4,000 m.

The WRF 1 km dataset for the years 2011–2015 (Lakes Environmental, 2025) was used as an initial guess field. The CALMET model was then used to adjust this initial guess field for the kinematic effects of terrain, slope flows, and terrain blocking effects using the finer scale terrain data to produce a modified wind field.



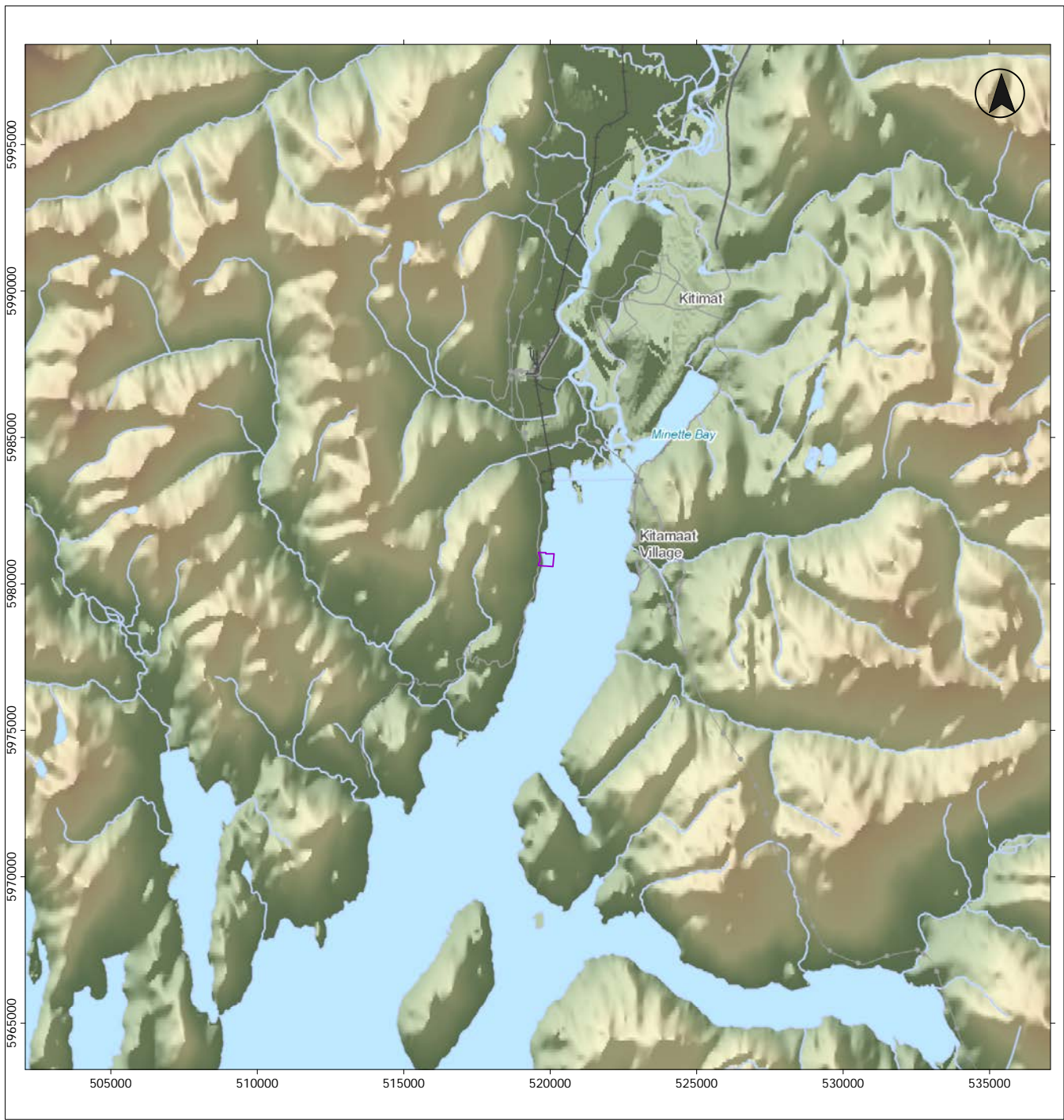
Table B.1 Coordinates of the 35 km x 35 km CALMET Domain (250 m grid resolution)

Domain Corner	Location (UTM NAD 83, Zone 9)	
	East (m)	North (m)
Northwest	502080	5998420
Southwest	502080	5963420
Southeast	537080	5963420
Northeast	537080	5998420

Table B.2 Coordinates of the 55 km by 110 km CALMET Domain (1 km grid resolution)

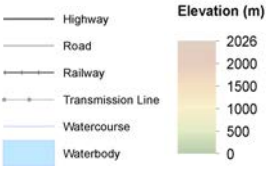
Domain Corner	Location (UTM NAD 83, Zone 9)	
	East (m)	North (m)
Northwest	494580	6005920
Southwest	494580	5955920
Southeast	544580	5955920
Northeast	544580	6005920





Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia;
 Natural Resources Canada; Canadian Hydrographic Service

Cedar LNG Boundary



Project Location: Kitimat, British Columbia
 Project Number: 123223008

Client/Project/Report:
 Cedar LNG Partners (GP) Ltd.
 Cedar LNG Project
 CALMET

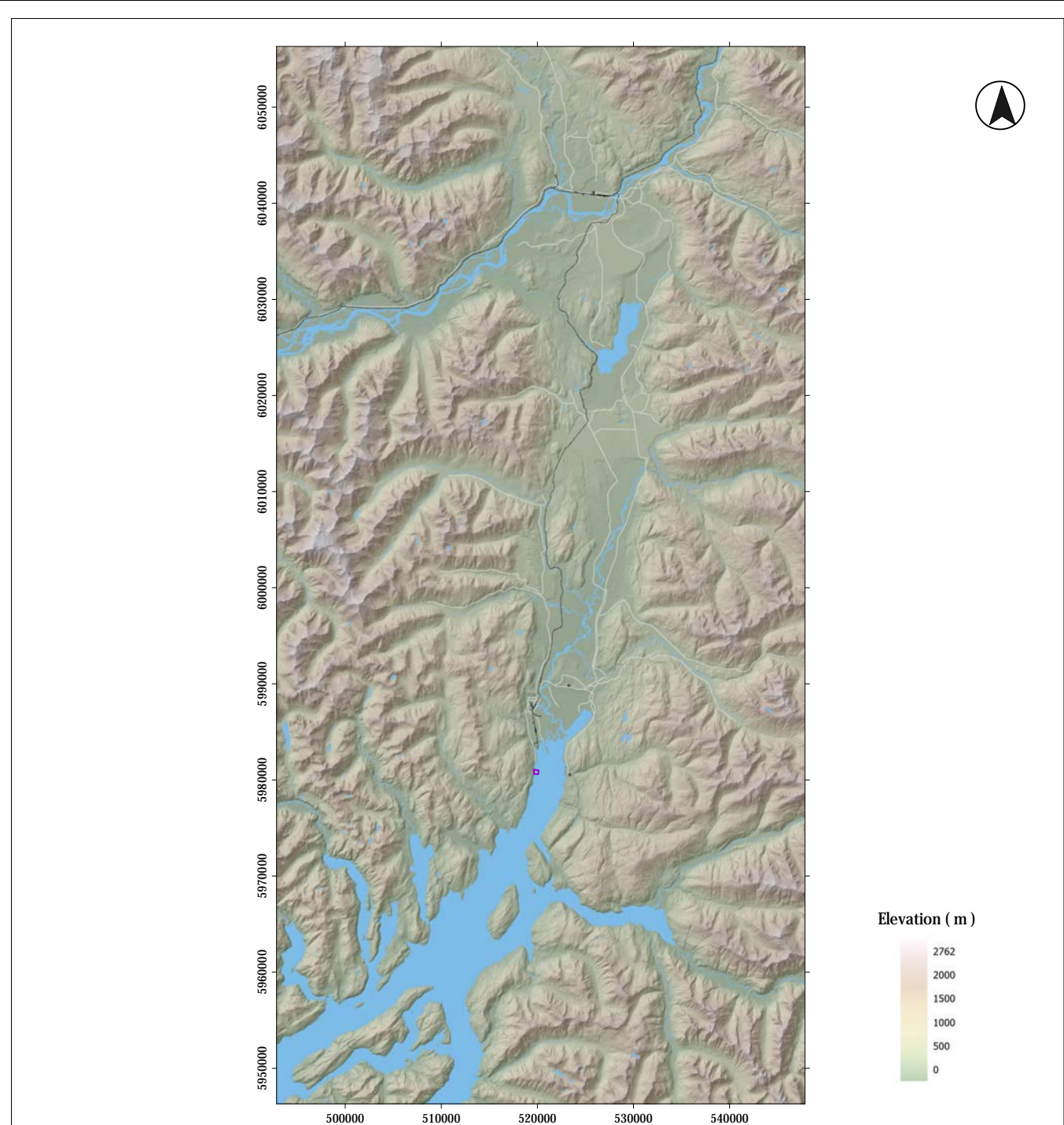
Figure No.

B.1

Title:
 Terrain in CALMET Model Domain
 (35 km x 35 km at 250 m grid)



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Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia;
 Natural Resources Canada: Canadian Hydrographic Service

Cedar LNG Boundary

- Highway
- Road
- Railway
- Transmission Line
- Watercourse
- Waterbody



Project Location: Kitimat, British Columbia
 Project Number: 123223008

Client/Project/Report:
 Cedar LNG Partners (GP) Ltd.
 Cedar LNG Project
 CALMET

Figure No.

B.2

Title:
 Terrain in CALMET Model Domain
 (55 km x 110 km at 1 km grid)

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B.3 Topography and Land Cover

B.3.1 Topography

Valleys and elevated terrain features influence surface wind flow patterns. Terrain data that are used to define these features were obtained from Canadian Digital Elevation Model (CDEM) (Natural Resources Canada, 2017). A CDEM mosaic can be obtained for a pre-defined or user-defined extent. The coverage and resolution of a mosaic varies according to latitude and to the extent of the requested area. Derived products such as slope, shaded relief and colour shaded relief maps can also be generated on demand. The pre-packaged GeoTif datasets are based on the National Topographic System of Canada (NTS) at the 1:250 000 scale. These data have a horizontal resolution of ~30 m, which is more than sufficient for air quality assessment purposes.

In the middle portion of the 55 km x 110 km model domain (shown in Figure B.2), a predominantly flat valley more than 5 km wide connects Kitimat to Terrace, 60 km to the north. Major water features in the model domains include:

- **Douglas Channel** is located in the south and southwest portions of the domain.
- **Kitimat Arm** and **Minette Bay** are located in the middle portion of the 35 km x 35 km model domain.
- **Kitimat River** is located in the middle portion of the 55 km x 110 km model domain. It flows from the mountains south of Terrace into Douglas Channel.
- **Lakelse Lake** is located in the northern portion of the domain.

Broadly speaking, the higher elevations are towards the west and east portions of the 55 km x 110 km domain and the lowest elevations are near the middle and southwest portions of the domain. Major elevated features in the 55 km x 110 km domain include:

- **Kitimat Ranges** rise around Kitimat and across the entire near-field domain. The Kitimat Ranges comprise one of the three main subdivisions of the Coast Mountains in British Columbia (BC).
- **Mount Holt, Mount Temple, and Mount Light** are located in the northwestern portion of the near-field domain and rise to an elevation of over 1,650 m above mean sea level (asl).

These terrain features can influence the transport and dispersion of air emissions as they are transported by the wind from their source locations.

B.3.2 Land-Cover Data

In addition to terrain elevation data, the CALMET model uses surface parameters such as surface roughness length, albedo, Bowen ratio, leaf area index, soil heat flux, and anthropogenic heat flux to provide input to calculate surface heat flux and mechanical turbulence.



For this assessment, the North American Land Cover data (CEC, 2020) set was used to determine land use categories for the CALMET model. The 2015 North American Land Cover data set was produced as part of the North American Land Change Monitoring System (NALCMS); a trilateral effort between the Canada Centre for Remote Sensing, the United States Geological Survey, and three Mexican organizations including the National Institute of Statistics and Geography, National Commission for the Knowledge and Use of the Biodiversity and the National Forestry Commission of Mexico. The resulting 2015 Land Cover of North America data are at a resolution of 30 m.

This land cover information was then converted into the fractional land-use data file by the CALMET CTGPROC program (described in Table B.3). Five seasons (shown in Table B.4) were determined based on Table 4.5 of the Guideline (ENVP, 2022). A slight adjustment to the months of April, May, August and November was recommended by ENVP to improve representation of transitional months. Table B.5 to Table B.9 provides seasonal values for surface roughness (z0), albedo, Bowen ratio, soil heat flux, anthropogenic heat flux and leaf area index (LAI). The selected values are consistent with Section 4.4 of the Guideline (ENVP, 2022) and CALMET User Guide (Scire et al. 2000). The latter was used in the absence of a specific recommendation in the Guideline (ENVP, 2022). Using the fractional land use data from CTGPROC, CALMET MAKEGEO pre-processor calculates the dominant land use for each cell and computes weighted surface parameters based on seasonal values provided in Table B.4 to Table B.8.

Figure B.3 and Figure B.4 show the land-cover data within the 35 km x 35 km and 55 km x 110 km CALMET model domains, respectively. Based on the 250 m grid resolution data, 35 km x35 km domain is comprised of 63.3% evergreen forest, 13.6% water, 8.6% shrub rangeland, 6.8% mixed forest, 4.4% barren land, 1.0% snow or ice, 1.0% rangeland, 0.9% urban land, and 0.3% deciduous forest. Based on the 1 km grid resolution data, the 55 km x 110 km CALMET domain is comprised of 64.8% evergreen forest, 10.0% barren land, 8.2% shrub rangeland, 5.6% large water body, 5.1% mixed forest, 3.9% snow or ice, 1.5% small water body, 0.5% urban land, and 0.3% rangeland.

Table B.3 Translation Table of 30 m resolution CEC Land Cover Categories to CALMET Categories

30 m Resolution CEC Land Cover Code	30 m Resolution CEC Land Cover Type	CALMET Code	CALMET Land Use Category
1	Temperate or sub-polar needleleaf forest	42	Evergreen Forest Land
2	Sub-polar taiga needleleaf forest	42	
3	Tropical or sub-tropical broadleaf evergreen forest	42	
4	Tropical or sub-tropical broadleaf deciduous forest	41	Deciduous Forest Land
5	Temperate or sub-polar broadleaf deciduous forest	41	
6	Mixed forest	43	Mixed Forest Land
7	Tropical or sub-tropical shrubland	32	Shrub Rangeland
8	Temperate or sub-polar shrubland	32	



30 m Resolution CEC Land Cover Code	30 m Resolution CEC Land Cover Type	CALMET Code	CALMET Land Use Category
9	Tropical or sub-tropical grassland	30	Rangeland
10	Temperate or sub-polar grassland	30	Rangeland
11	Sub-polar or polar shrubland-lichen-moss	32	Shrub Rangeland
12	Sub-polar or polar grassland-lichen-moss	30	Rangeland
13	Sub-polar or polar barren-lichen-moss	32	Shrub Rangeland
14	Wetland	60	Wet Land
15	Cropland	20	Agricultural Land
16	Barren lands	70	Barren Land
17	Urban	10	Urban or Build-up Land
18	Small Water Body	51	Small Water Body
19	Snow and Ice	90	Snow and Ice
20	Large water body	55	Large water body

Table B.4 Five Seasons Applied in CALMET Modeling for the Latitude of 50o to 55o N

Season	ENVP 2022 Guideline Definitions	Months
1	Midsummer with lush vegetation	June, July and August 1-15
2	Autumn with cropland that has not been harvested	August 16-31 and September
3	Winter 1, later autumn after frost, no snow on the ground	October and November
4	Winter 2, snow on the ground and subfreezing	December, January, February, March 1-15
5	Transitional spring with partially green short annuals	March 16-31, April and May



Table B.5 CALMET Land-use Characterization and Associated Geophysical Parameters for the Season 1 (Mid-Summer)

NALCMS Code	Surface Roughness (m)	Albedo	Bowen Ratio	Soil Heat Flux (fraction)	Anthropogenic Heat Flux (W/m ²)	Leaf Area Index	CALMET Code	CALMET Land Cover Type
1	1.300	0.120	0.300	0.150	0.000	5.000	42	Evergreen Forest
2	1.300	0.120	0.300	0.150	0.000	5.000	42	
3	1.300	0.120	0.300	0.150	0.000	5.000	42	
4	1.300	0.160	0.300	0.150	0.000	3.400	41	Deciduous Forest
5	1.300	0.160	0.300	0.150	0.000	3.400	41	
6	1.300	0.140	0.300	0.150	0.000	4.500	43	Mixed Forest
7	0.300	0.180	1.000	0.150	0.000	4.500	32	Shrub Rangeland
8	0.300	0.180	1.000	0.150	0.000	4.500	32	
9	0.150	0.200	0.500	0.150	0.000	1.000	30	Rangeland
10	0.150	0.200	0.500	0.150	0.000	1.000	30	
11	0.300	0.180	1.000	0.150	0.000	4.500	32	Shrub Rangeland
12	0.150	0.200	0.500	0.150	0.000	1.000	30	Rangeland
13	0.300	0.180	1.000	0.150	0.000	4.500	32	Shrub Rangeland
14	0.200	0.140	0.100	0.300	0.000	0.200	60	Wet Land
15	0.200	0.200	0.500	0.150	0.000	2.000	20	Agricultural Land
16	0.050	0.200	1.500	0.150	0.000	0.000	70	Barren Land
17	0.540	0.160	0.800	0.250	8.000	0.300	10	Urban or Build-up
18	0.001	0.100	0.100	1.000	0.000	0.000	51	Small Water Body
19	0.200	0.700	0.500	0.150	0.000	0.000	90	Snow or Ice
20	0.001	0.100	0.100	1.000	0.000	0.000	55	Large Water Body

Notes:

For latitude 50° to 55° N, Season 1 (Mid-Summer) = June, July and August 1-15; W/m² = watts per square metre



Table B.6 CALMET Land-use Characterization and Associated Geophysical Parameters for Season 2 (Autumn)

NALCMS Code	Surface Roughness (m)	Albedo	Bowen Ratio	Soil Heat Flux (fraction)	Anthropogenic Heat Flux (W/m ²)	Leaf Area Index	CALMET Code	CALMET Land Cover Type
1	1.300	0.120	0.800	0.150	0.000	5.000	42	Evergreen Forest
2	1.300	0.120	0.800	0.150	0.000	5.000	42	
3	1.300	0.120	0.800	0.150	0.000	5.000	42	
4	1.300	0.160	1.000	0.150	0.000	1.900	41	Deciduous Forest
5	1.300	0.160	1.000	0.150	0.000	1.900	41	
6	1.300	0.140	0.900	0.150	0.000	3.500	43	Mixed Forest
7	0.300	0.180	1.500	0.150	0.000	3.500	32	Shrub Rangeland
8	0.300	0.180	1.500	0.150	0.000	3.500	32	
9	0.150	0.200	0.700	0.150	0.000	1.000	30	Rangeland
10	0.150	0.200	0.700	0.150	0.000	1.000	30	
11	0.300	0.180	1.500	0.150	0.000	3.500	32	Shrub Rangeland
12	0.150	0.200	0.700	0.150	0.000	1.000	30	Rangeland
13	0.300	0.180	1.500	0.150	0.000	3.500	32	Shrub Rangeland
14	0.200	0.140	0.100	0.300	0.000	0.200	60	Wet Land
15	0.200	0.200	0.700	0.150	0.000	1.500	20	Agricultural Land
16	0.050	0.200	1.500	0.150	0.000	0.000	70	Barren Land
17	0.540	0.160	1.000	0.250	12.000	0.200	10	Urban or Build-up
18	0.001	0.100	0.100	1.000	0.000	0.000	51	Small Water Body
19	0.200	0.700	0.500	0.150	0.000	0.000	90	Snow or Ice
20	0.001	0.100	0.100	1.000	0.000	0.000	55	Large Water Body

Notes:

For latitude 50° to 55° N, Season 2 (Autumn) = August 16-31 and September; W/m² = watts per square metre



Table B.7 CALMET Land-use Characterization and Associated Geophysical Parameters for Season 3 (Winter 1)

NALCMS Code	Surface Roughness (m)	Albedo	Bowen Ratio	Soil Heat Flux (fraction)	Anthropogenic Heat Flux (W/m ²)	Leaf Area Index	CALMET Code	CALMET Land Cover Type
1	1.300	0.120	0.800	0.150	0.000	5.000	42	Evergreen Forest
2	1.300	0.120	0.800	0.150	0.000	5.000	42	
3	1.300	0.120	0.800	0.150	0.000	5.000	42	
4	0.600	0.170	1.000	0.150	0.000	0.100	41	Deciduous Forest
5	0.600	0.170	1.000	0.150	0.000	0.100	41	
6	0.950	0.140	0.900	0.150	0.000	2.300	43	Mixed Forest
7	0.300	0.180	1.500	0.150	0.000	2.300	32	Shrub Rangeland
8	0.300	0.180	1.500	0.150	0.000	2.300	32	
9	0.020	0.180	0.700	0.150	0.000	1.000	30	Rangeland
10	0.020	0.180	0.700	0.150	0.000	1.000	30	
11	0.300	0.180	1.500	0.150	0.000	2.300	32	Shrub Rangeland
12	0.020	0.180	0.700	0.150	0.000	1.000	30	Rangeland
13	0.300	0.180	1.500	0.150	0.000	2.300	32	Shrub Rangeland
14	0.200	0.140	0.100	0.300	0.000	0.100	60	Wet Land
15	0.020	0.180	0.700	0.150	0.000	1.000	20	Agricultural Land
16	0.050	0.200	1.500	0.150	0.000	0.050	70	Barren Land
17	0.500	0.180	1.000	0.250	21.000	0.100	10	Urban or Build-up
18	0.001	0.100	0.100	1.000	0.000	0.000	51	Small Water Body
19	0.200	0.700	0.500	0.150	0.000	0.000	90	Snow or Ice
20	0.001	0.100	0.100	1.000	0.000	0.000	55	Large Water Body

Notes:

For latitude 50° to 55° N, Season 3 (Winter 1) = October and November, W/m² = watts per square metre



Table B.8 CALMET Land-use Characterization and Associated Geophysical Parameters for Season 4 (Winter 2)

NALCMS Code	Surface Roughness (m)	Albedo	Bowen Ratio	Soil Heat Flux (fraction)	Anthropogenic Heat Flux (W/m ²)	Leaf Area Index	CALMET Code	CALMET Land Cover Type
1	1.300	0.350	0.500	0.150	0.000	5.000	42	Evergreen Forest
2	1.300	0.350	0.500	0.150	0.000	5.000	42	
3	1.300	0.350	0.500	0.150	0.000	5.000	42	
4	0.500	0.500	0.500	0.150	0.000	0.000	41	Deciduous Forest
5	0.500	0.500	0.500	0.150	0.000	0.000	41	
6	0.900	0.420	0.500	0.150	0.000	2.300	43	Mixed Forest
7	0.150	0.500	0.500	0.150	0.000	2.300	32	Shrub Rangeland
8	0.150	0.500	0.500	0.150	0.000	2.300	32	
9	0.010	0.600	0.500	0.150	0.000	1.000	30	Rangeland
10	0.010	0.600	0.500	0.150	0.000	1.000	30	
11	0.150	0.500	0.500	0.150	0.000	2.300	32	Shrub Rangeland
12	0.010	0.600	0.500	0.150	0.000	1.000	30	Rangeland
13	0.150	0.500	0.500	0.150	0.000	2.300	32	Shrub Rangeland
14	0.100	0.300	0.500	0.300	0.000	0.000	60	Wet Land
15	0.010	0.600	0.500	0.150	0.000	0.000	20	Agricultural Land
16	0.050	0.600	0.500	0.150	0.000	0.050	70	Barren Land
17	0.500	0.450	0.500	0.150	17.000	0.000	10	Urban or Build-up
18	0.002	0.700	0.500	0.150	0.000	0.000	51	Small Water Body
19	0.200	0.700	0.500	0.150	0.000	0.000	90	Snow or Ice
20 ^a	0.001	0.100	0.100	1.000	0.000	0.000	55	Large Water Body

Notes:

For latitude 50° to 55° N, Season 4 (Winter 2) = December, January, February, March 1-15; W/m² = watts per square metre

^a season 3 large water body values applied for land cover code 20 as Kitimat port and Douglas Channel is ice-free year around



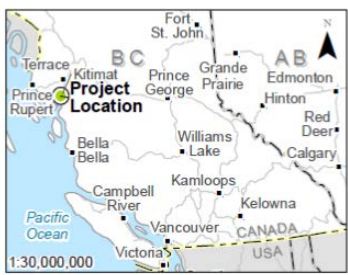
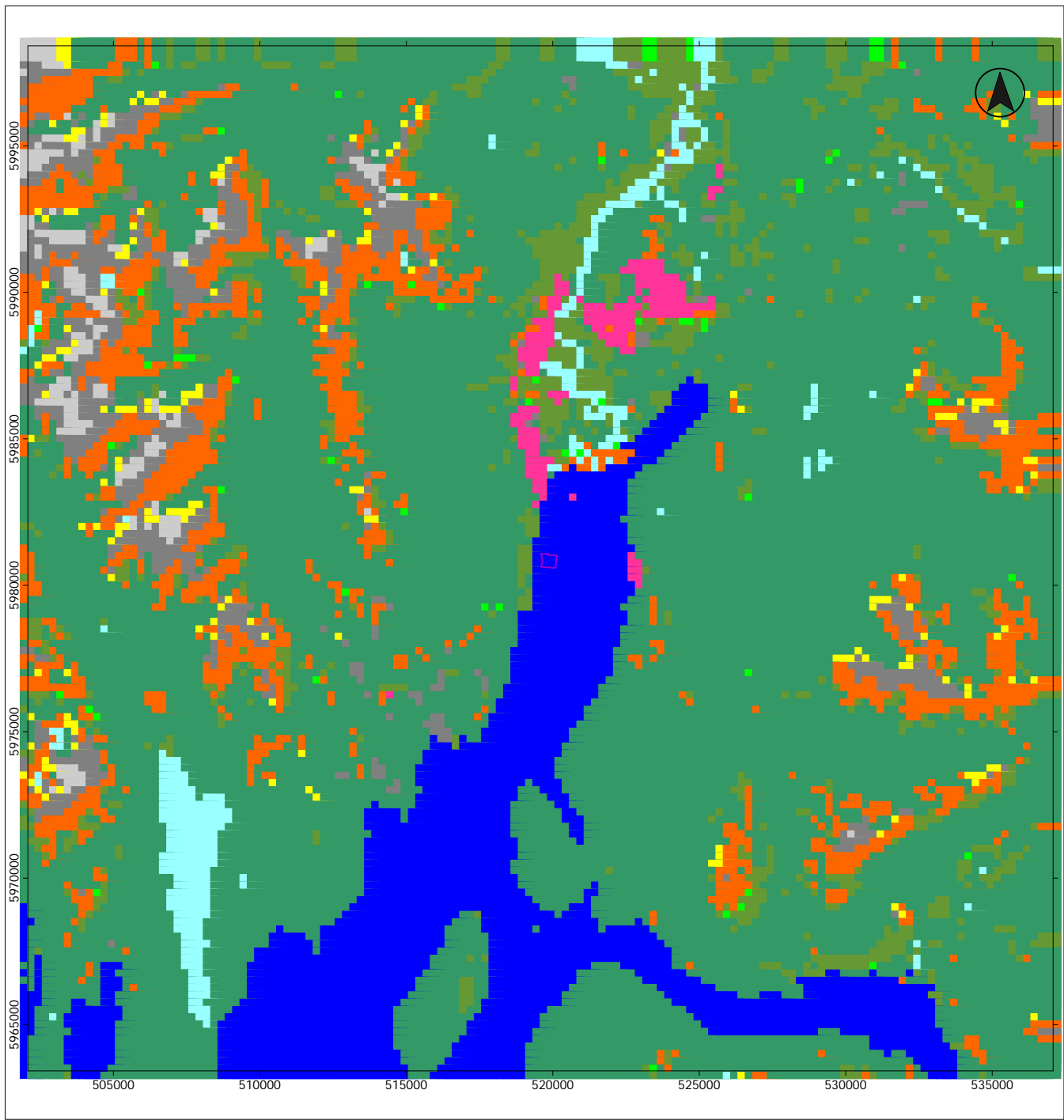
Table B.9 CALMET Land-use Characterization and Associated Geophysical Parameters for Season 5 (Transitional Spring)

NALCMS Code	Surface Roughness (m)	Albedo	Bowen Ratio	Soil Heat Flux (fraction)	Anthropogenic Heat Flux (W/m ²)	Leaf Area Index	CALMET Code	CALMET Land Cover Type
1	1.300	0.120	0.700	0.150	0.000	5.000	42	Evergreen Forest
2	1.300	0.120	0.700	0.150	0.000	5.000	42	
3	1.300	0.120	0.700	0.150	0.000	5.000	42	
4	1.000	0.160	0.700	0.150	0.000	0.800	41	Deciduous Forest
5	1.000	0.160	0.700	0.150	0.000	0.800	41	
6	1.150	0.140	0.700	0.150	0.000	3.300	43	Mixed Forest
7	0.300	0.180	1.000	0.150	0.000	3.300	32	Shrub Rangeland
8	0.300	0.180	1.000	0.150	0.000	3.300	32	
9	0.030	0.140	0.300	0.150	0.000	1.000	30	Rangeland
10	0.030	0.140	0.300	0.150	0.000	1.000	30	
11	0.300	0.180	1.000	0.150	0.000	3.300	32	Shrub Rangeland
12	0.030	0.140	0.300	0.150	0.000	1.000	30	Rangeland
13	0.300	0.180	1.000	0.150	0.000	3.300	32	Shrub Rangeland
14	0.200	0.140	0.100	0.300	0.000	0.100	60	Wet Land
15	0.030	0.140	0.300	0.150	0.000	1.000	20	Agricultural Land
16	0.050	0.200	1.500	0.150	0.000	0.000	70	Barren Land
17	0.520	0.160	0.800	0.250	15.000	0.200	10	Urban or Build-up
18	0.001	0.100	0.100	1.000	0.000	0.000	51	Small Water Body
19	0.200	0.700	0.500	0.150	0.000	0.000	90	Snow or Ice
20	0.001	0.100	0.100	1.000	0.000	0.000	55	Large Water Body

Notes:

For latitude 50° to 55° N, Season 5 (Transitional Spring) = March 16-31, April and May; W/m² = watts per square metre





Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

- Cedar LNG Boundary
- Urban or Build-up Land
- Rangeland
- Shrub Rangeland
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Small Water
- Large Water
- Barren Land
- Perennial Snow or Ice



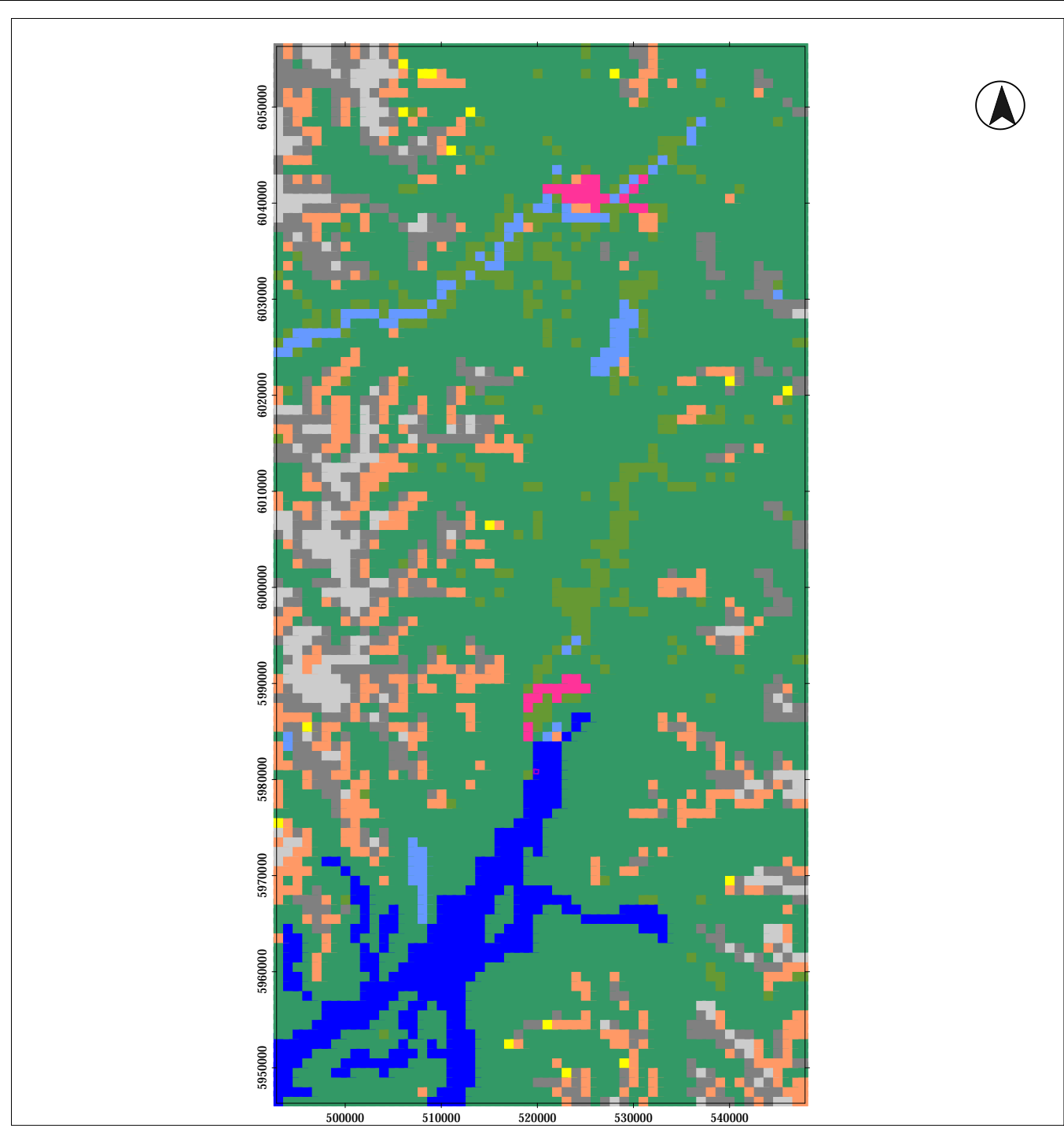
Project Location: Kitimat, British Columbia
 Project Number: 123221301

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project CALMET

Figure No.: B.3
 Title:

Land-cover Classes in CALMET Model Domain (35 km x 35 km at 250 m grid)

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Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia;
 Natural Resources Canada: Canadian Hydrographic Service

- Cedar LNG Boundary
- Urban or Build-up Land
- Rangeland
- Shrub Rangeland
- Evergreen Forest
- Mixed Forest
- Small Water
- Large Water
- Barren Land
- Perennial Snow or Ice



Project Location
 Kitimat,
 British Columbia

Project Number 123223008

Client/Project/Report
 Cedar LNG Partners (GP) Ltd.
 Cedar LNG Project
 CALMET

Figure No.
B.4

Title
 Land-cover Classes in CALMET Model Domain
 (55 km x 110 km at 1 km grid)

B.4 Meteorological Inputs

The CALMET model requires the input of surface and upper air meteorological fields. For this application, CALMET model was run in Hybrid mode (ENVP, 2022) by using surface observations, buoy station observations and WRF model 1km gridded data (Lakes Environmental, 2025) for the period of January 1, 2011 to December 31, 2015. There is no available upper air station within the CALMET model domain.

B.4.1 Surface Observations

Surface Meteorological Stations

The locations of the eight surface meteorological stations within the model domain are summarized in Table B.10 and shown in Figure B.5. These stations include:

- Environment and Climate Change Canada (ECCC) airports: Terrace Airport.
- ENVP monitoring stations: Kitimat Whitesail, Kitimat Haul Road, Kitimat Haisla Village, Kitimat Riverlodge, Kitimat Yacht Club, Kitimat Smeltersite Road, and Terrace Access Centre

Figure B.6 shows measured wind roses for three ENVP surface stations in Kitimat (Kitimat Haul Road, Kitimat Whitesail, and Kitimat Yacht Club) for the five-year period 2011 to 2015. The prevailing wind direction at the Kitimat Haul Road station is from the southeast, whereas winds at the Whitesail and Yacht Club stations exhibit a more north-south orientation. These differences are likely attributable to the local topography near each of the stations. For instance, winds at the Kitimat Whitesail station are influenced by proximity to the Kitimat River valley, which has a north-south orientation.

Figure B.7 shows measured wind roses from two stations in Terrace (Terrace Airport and Terrace Access Centre) for the five-year period 2011 to 2015. Prevailing winds at Terrace Airport are oriented north-south along the Lakelse Lake valley, whereas at the Terrace Access Centre winds show more directional variety, likely due to greater influence of the Skeena River valley.

In addition to terrain influences, observed winds can be influenced by the presence and orientation of nearby tree canopies. Therefore, wind information from the location where it was measured may not reflect conditions at another nearby location. Winds at the Project site are expected to be strongly influenced by local topography and land cover.

Note that the wind directions at both Kitimat Whitesail and Kitimat Yacht Club reflect adjustments that were implemented on the recommendation of ENVP following the discovery of inconsistencies in directions in the 2011-2015 time interval. The adjustments are as per the Trinity (2011) letter report



Buoy Meteorological Stations

If the modeling application involves overwater transport and dispersion, the CALMET boundary layer model requires observations of the air-sea temperature difference, air temperature, relative humidity, and overwater mixing height. Therefore, it is necessary to include observations of nearby buoy stations in the CALMET modeling. The closest stations are buoy station Nanakwa Shoal and South Hecate Strait. The locations of the two Department of Fisheries and Oceans Canada (DFO) buoy meteorological stations in the domain are summarized in Table B.11. Data from these two stations were included in the CALMET modeling. No adjustments were made.



Table B.10 Coordinates of Meteorological Surface Stations in the Model Domain

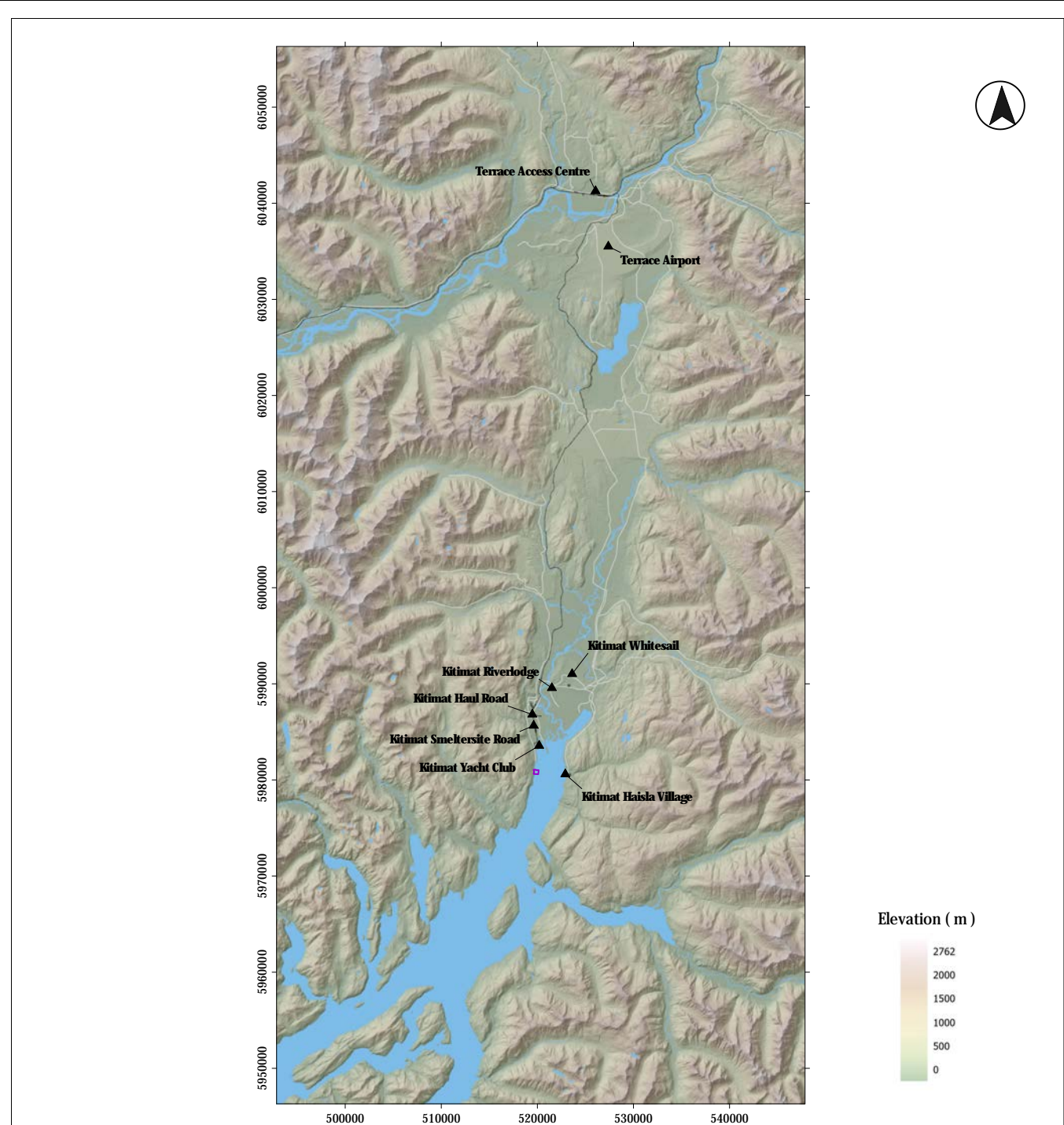
Source	Station Name	Latitude (degree N)	Longitude (degree W)	Elevation (m asl)	UTM NAD 83 (Zone 9)		Parameters included in 2011–2015 CALMET Modeling
					km East	km North	
BCENV	Kitimat Whitesail	54.0669	-128.6391	94	523,616	5,991,027	Wind speed, wind direction, air temperature, relative humidity
	Kitimat Haul Road	54.0292	-128.7027	2	519,474	5,986,812	Wind speed, wind direction, and air temperature
	Kitimat Haisla Village	53.9732	-128.6508	5	522,907	5,980,600	Wind speed, wind direction, and air temperature
	Kitimat Riverlodge	54.0539	-128.6714	18	521,509	5,989,568	Air temperature
	Kitimat Yacht Club	54.0000	-128.6920	2	520,189	5,983,566	Wind speed, wind direction, and air temperature
	Kitimat Smeltersite Road	54.0188	-128.7006	12	519,616	5,985,656	Wind speed, wind direction, and air temperature
	Terrace Access Centre	54.5183	-128.5975	67	526,054	6,041,266	Wind speed, wind direction, air temperature, relative humidity
ECCC	Terrace Airport	54.4664	-128.5775	217	527.384	6035.497	Wind speed, wind direction, air temperature, relative humidity, and station pressure



Table B.11 Coordinates of Buoy Stations included in the CALMET Modeling

Source	Station Name	Latitude (degree N)	Longitude (degree W)	Elevation (m asl)	UTM NAD 83 (Zone 9)		Parameters included in 2011–2015 CALMET Modeling
					km East	km North	
DFO	Nanakwa Shoal Buoy	53.8333	-128.8317	0	511.076	5964.988	Air-sea surface temperature difference, air temperature, wind speed and wind direction
	South Hecate Strait Buoy	52.4250	129.7917	0	446.166	5808.604	





Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

- Highway
 - Road
 - Railway
 - Transmission Line
 - Watercourse
 - Waterbody
- Cedar LNG Boundary



Project Location: Kitimat, British Columbia
 Project Number: 123223008

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project CALMET

Figure No.: B.5
 Title: Surface Meteorological Stations in the CALMET Model Domains

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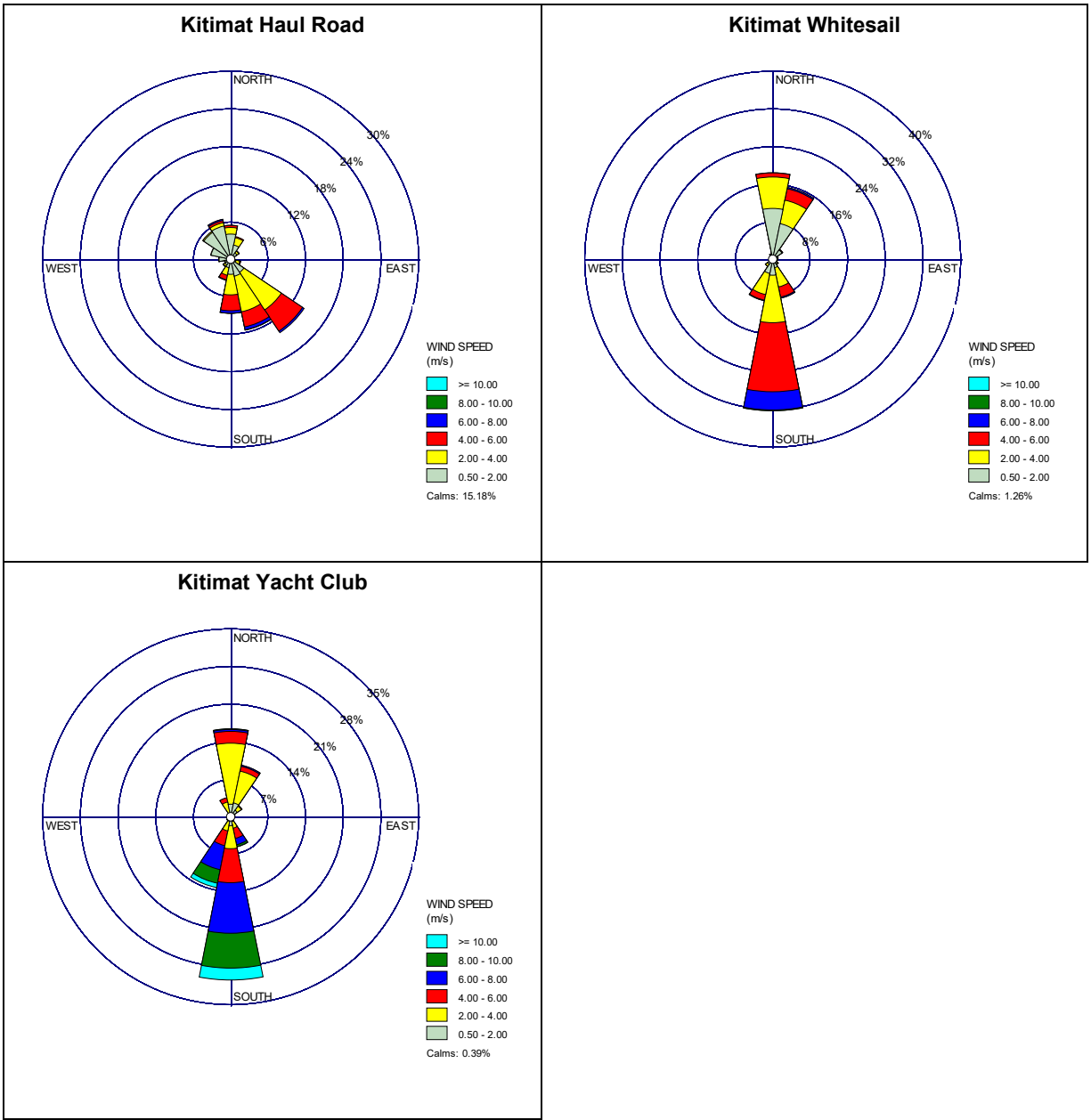


Figure B.6 Wind Roses for Three Meteorological Stations in the Kitimat Area (2011 to 2015)



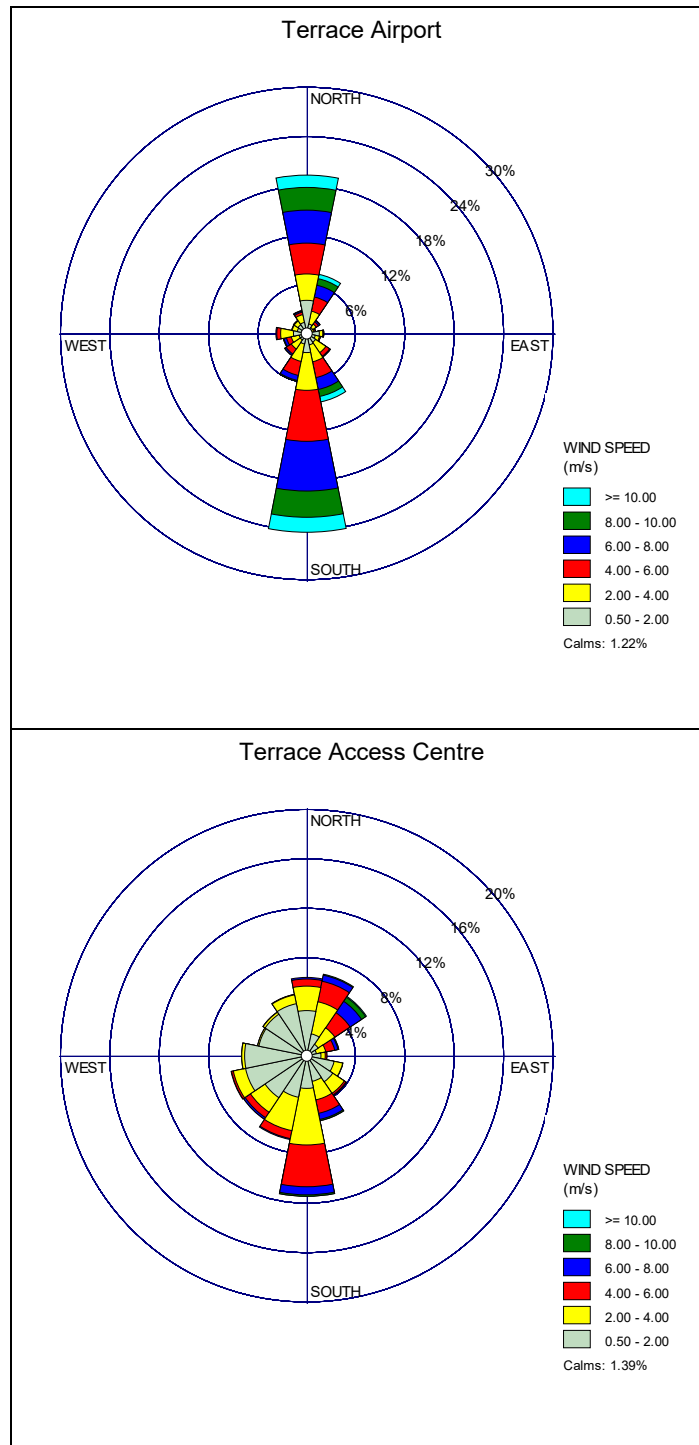


Figure B.7 Wind Roses for Two Meteorological Stations in the Terrace Area (2011 to 2015)



B.5 Lakes Environmental 2011–2015 WRF 1km grid Model Data

In this assessment, Lakes Environmental 2011–2015 WRF 1 km grid model data was used as an initial guess field for the CALMET model. The WRF resolution was changed to 1 km from the originally proposed 4 km on the advice of ENVP during another assessment in the Kitimat Valley. This more finely resolves the interactions between wind and terrain features, improving the accuracy and precision of the predicted wind field, and by extension, the predicted effects on air quality.

While WRF model predictions have been compared to observations at surface and upper air stations in order to provide assurance that the outputs can be used for dispersion modelling purposes (ENVP 2022), the outputs are predictions that may not necessarily be representative for the study area. For this reason, ENVP recommends that WRF data users assess the representativeness of the WRF output at their particular location (ENVP 2022).

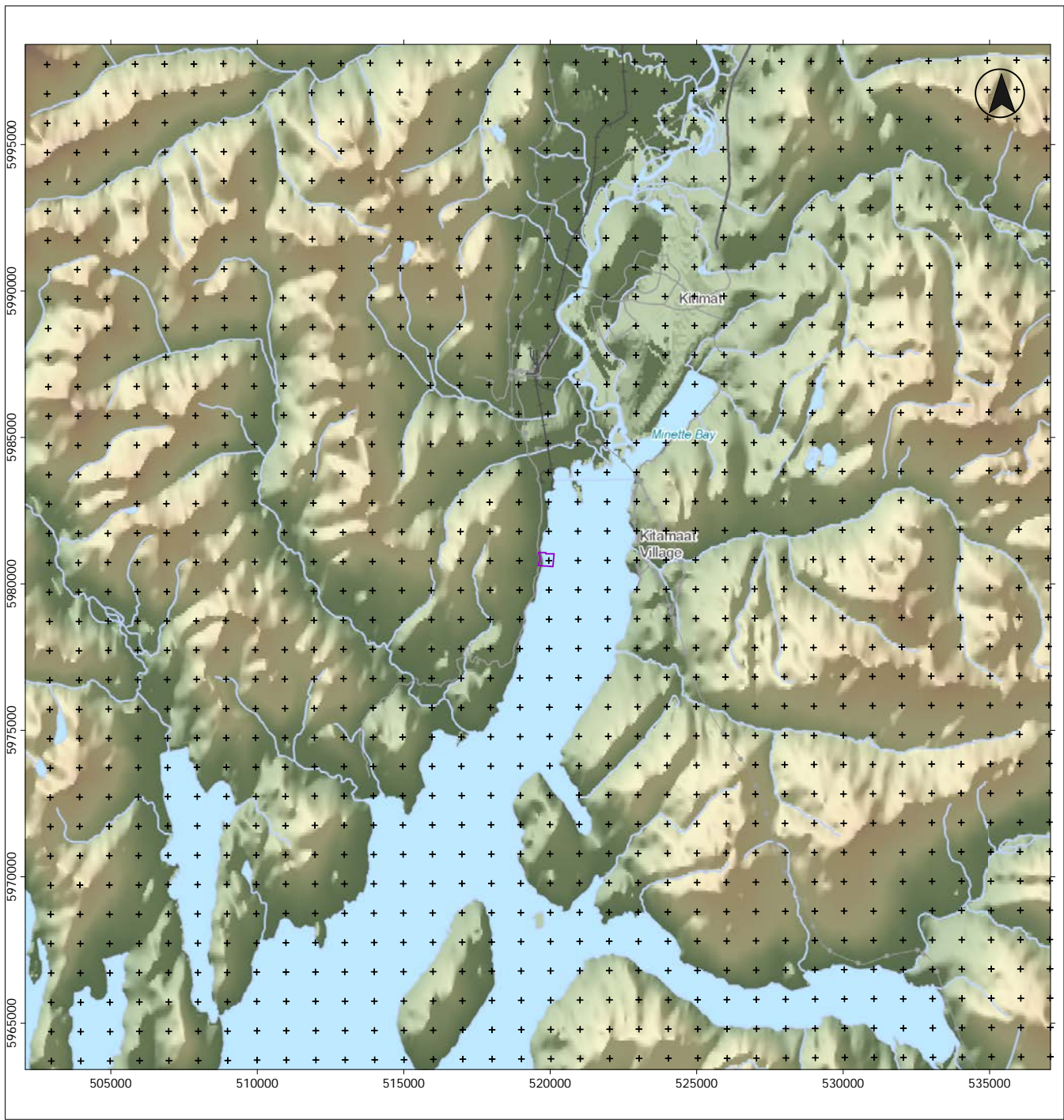
Figure B.8 and Figure B.9 show the WRF 1 km resolution grid point locations within the 35 km x 35 km and the 55 km by 110 km CALMET model domains, respectively. The ENVP Kitimat Haul Road monitoring station was used to determine the representativeness of the WRF data. This Kitimat Haul Road monitoring station is located approximately 6 km to the north of the Project site. Wind speed, wind direction and temperature data at the lowest model level were extracted from WRF data and compared to the measurements for the five period from 2011 to 2015.

Figure B.10 compares the wind roses generated from the WRF model predictions with the wind rose based on measurements at the Kitimat Haul Road monitoring station. Both measured and predicted wind roses show the most frequent winds are from southwest, south, or southeast. The WRF node is 1.2 km southwest from the Haul Road monitoring station. While both figures show prevailing winds from generally southerly directions and the occurrence of higher wind speeds from the south, the WRF data indicates more of a south south-westerly bias to prevailing winds compared to the southeasterly prevailing wind measured at the Haul Road station. These differences demonstrate the importance of blending the surface wind data with WRF using CALMET.



Figure B.11 compares the monthly average surface temperatures from the WRF model predictions with measurements at the Kitimat Haul Road monitoring station. The WRF model predictions show small cold bias but still in reasonable agreement with observations throughout the five-year period.

As the WRF model predictions and measurements are similar at the Kitimat Haul Road monitoring station that is located close to the Project site, the WRF model predictions should also be representative of meteorological conditions in the model domain.





Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia;
 Natural Resources Canada; Canadian Hydrographic Service

 Cedar LNG Boundary
 WRF 1km Grid



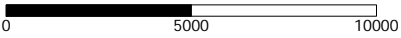
Project Location
 Kitimat,
 British Columbia Project Number 123223008

Client/Project/Report
 Cedar LNG Partners (GP) Ltd.
 Cedar LNG Project
 CALMET

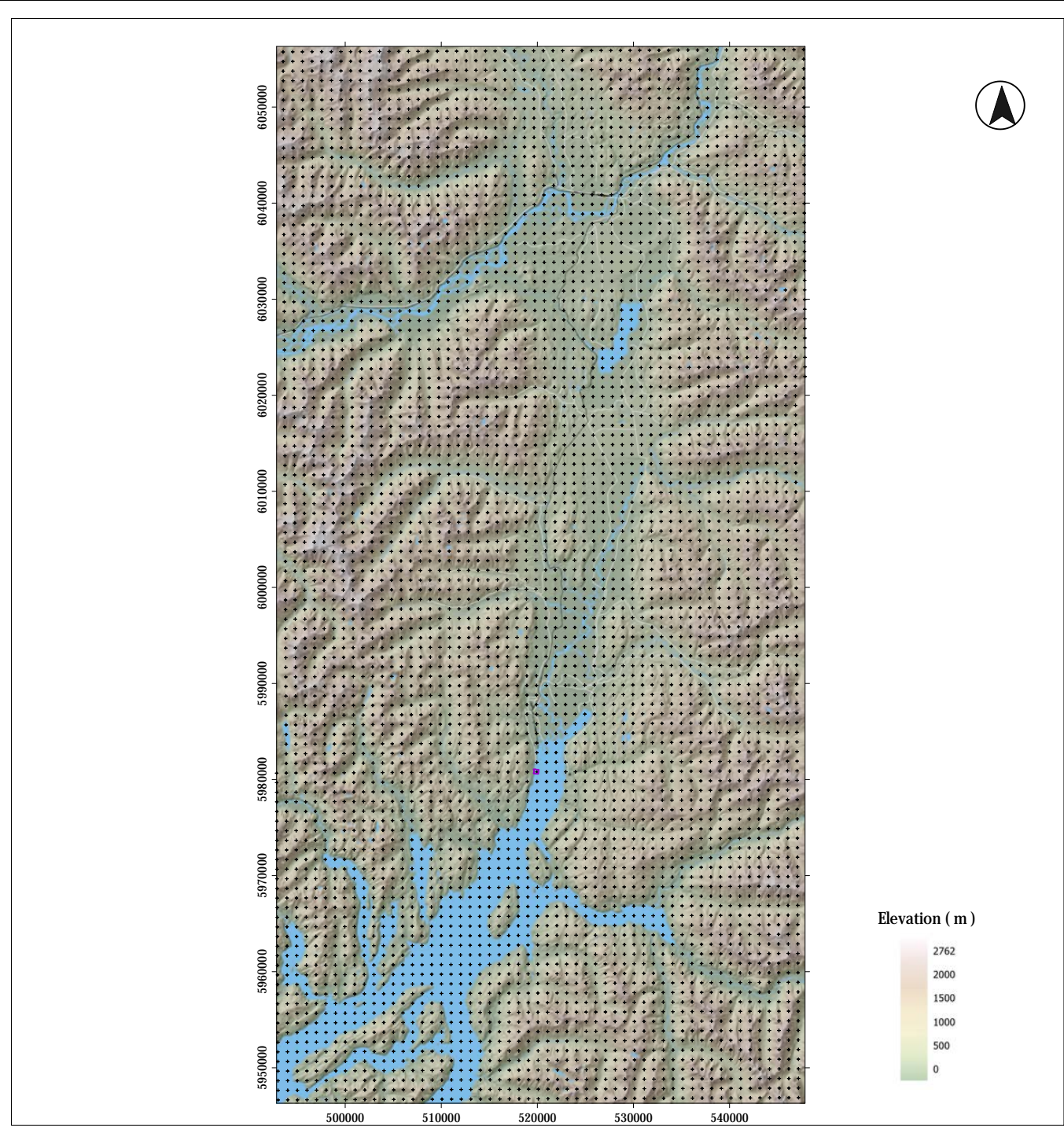
Figure No.

B.8



Title
 WRF 1 km grids in CALMET Model Domain
 (35 km x 35 km)



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Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia;
 Natural Resources Canada: Canadian Hydrographic Service

 Cedar LNG Boundary
 WRF 1km Grid

-  Highway
-  Road
-  Railway
-  Transmission Line
-  Watercourse
-  Waterbody



Project Location: Kitimat, British Columbia
 Project Number: 123223008

Client/Project/Report:
 Cedar LNG Partners (GP) Ltd.
 Cedar LNG Project
 CALMET

Figure No.:
B.9

Title:
 WRF 1 km grids in CALMET Model Domain
 (55 km x 110 km)

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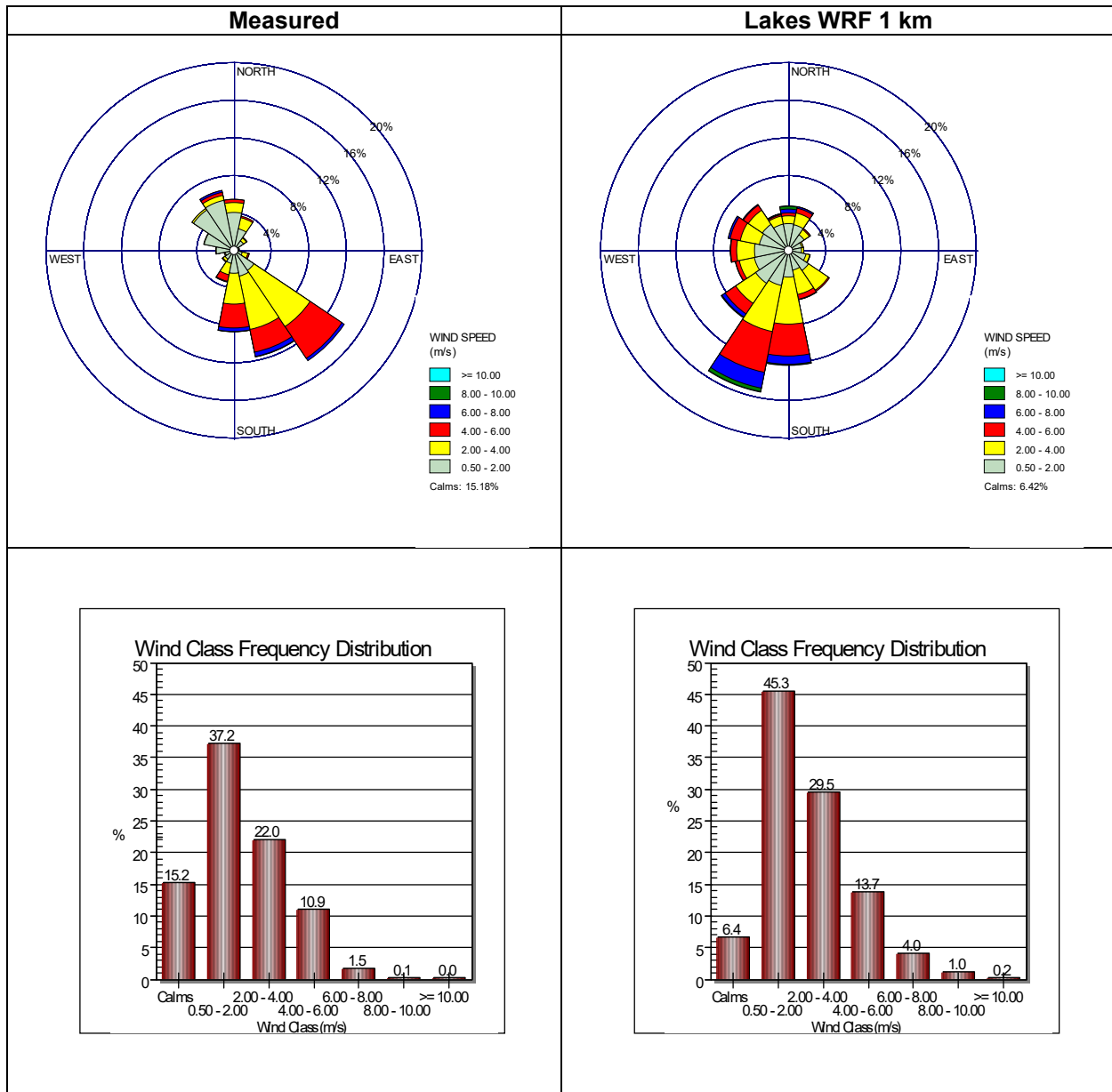


Figure B.10 Comparison of Measured and WRF predicted Wind Roses and Wind Class Frequency at Kitimat Haul Road Station (2011-2015)



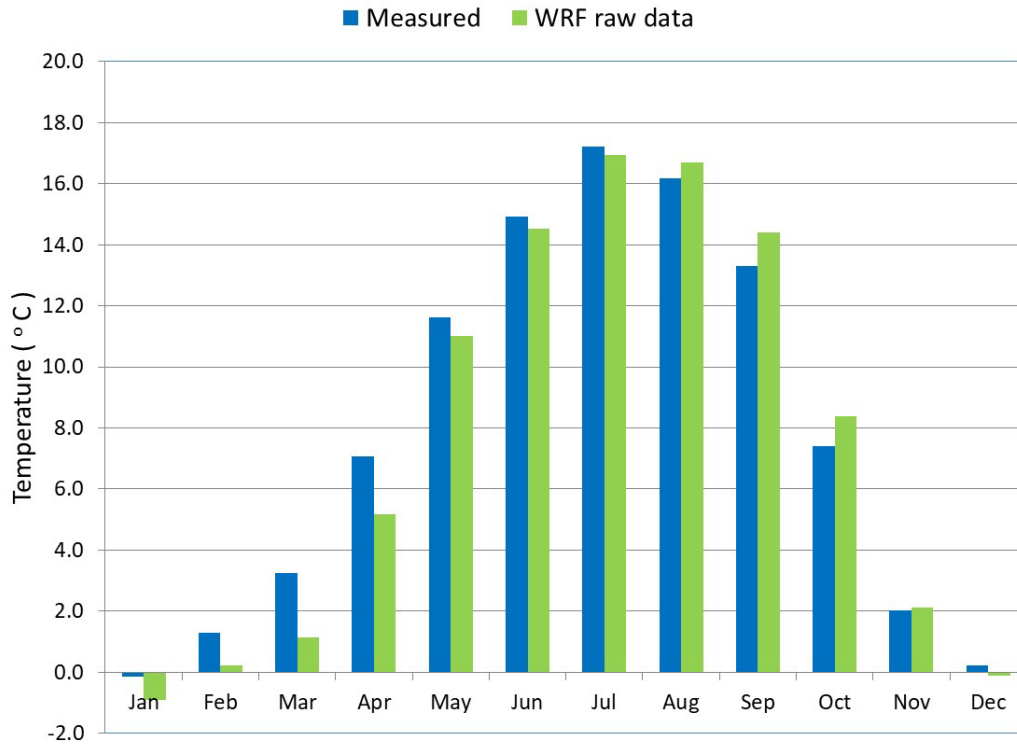


Figure B.11 Comparison of Measured and Predicted Monthly Average Temperature at Kitimat Haul Road Station (2011–2015)



B.6 CALMET Predictions

In order to assess the value of the WRF-CALMET model approach for this assessment, 35 km x 35 km CALMET 250 m grid resolution run output parameters including surface and elevated winds, surface temperature, mixing height and PG stability class data were extracted at the Project Site for analysis. These are the main parameters that influence transport and dispersion of emissions (Scire et al., 2000).

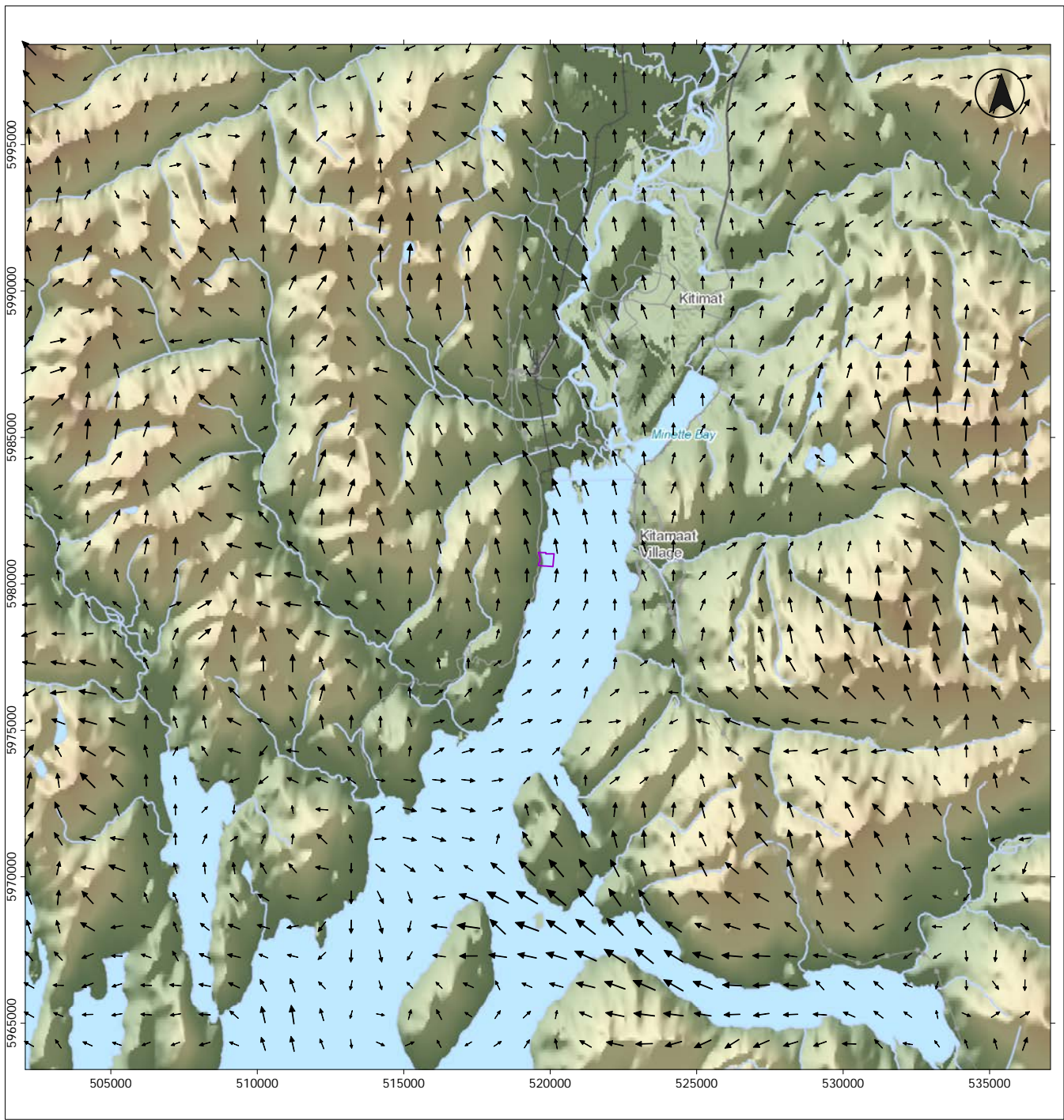
B.6.1 Predicted Surface Winds Field

The CALMET model can provide surface wind vector plots for all the grid points across a model domain. Three plots were generated to represent unstable, stable, and neutral conditions for the near-field model domain. The three sample wind vector plots are described below:

- Figure B.12 shows the wind field as a vector plot at 1200 LST on July 25, 2015, for convective (i.e., unstable) conditions (PG class B). Winds in the southwest and middle portion of the domain tend to be from the south, whereas those in the rest part of the domain tend to be less organized. The predicted winds at the Project site are mainly from the south.
- Figure B.13 shows the wind field as a vector plot at 0300 LST on January 24, 2015, for stable conditions (PG class F). The winds in the water parts of the domain tend to be from south, whereas those in the other part of the domain tend to be less organized. The predicted winds at the Project site are mainly from the south.
- Figure B.14 shows the wind field as a vector plot at 1600 LST on November 16, 2015, for high wind speed (i.e., neutral) conditions. Under these conditions, winds are from the south and southwest across most of the domain. The predicted winds at the Project site are mainly from the south with a wind speed of 13.0 m/s.

The vector plots were not selected to represent a specific meteorological condition; they are provided to show the variability of the airflow that can occur over the 35 km x 35 km area during any given hour. Departures of the predicted vector plots from the actual wind field for a given hour are to be expected given the nature of modelling and the relatively low density of actual observations across the region. The predicted values, however, are preferable to assuming a homogeneous wind field across the domain for each hour, based on the local terrain influences that are reflected in the measured data.





Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

Cedar LNG Boundary



Project Location
 Kitimat,
 British Columbia

Project Number 123223008

Client/Project/Report
 Cedar LNG Partners (GP) Ltd.
 Cedar LNG Project
 CALMET

Figure No.

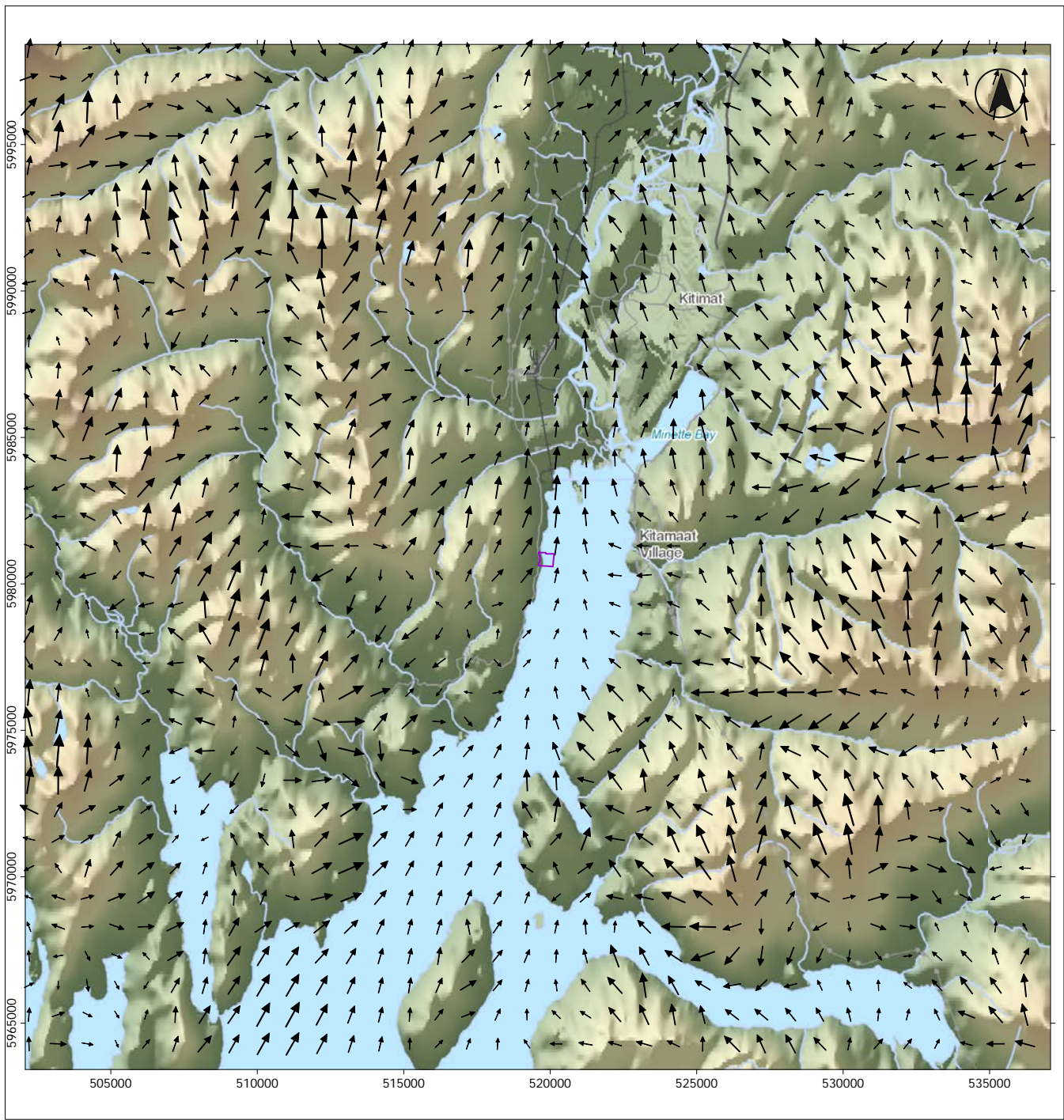
B.12


Title:

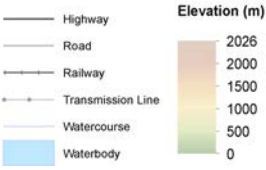
**Predicted Surface Wind Field
 for Unstable Conditions
 (1200 LST July 25, 2015)**



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 Cedar LNG Boundary



Project Location
Kitimat,
British Columbia

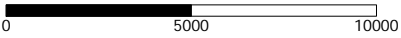
Project Number 123223008

Client/Project/Report
Cedar LNG Partners (GP) Ltd.
Cedar LNG Project
CALMET

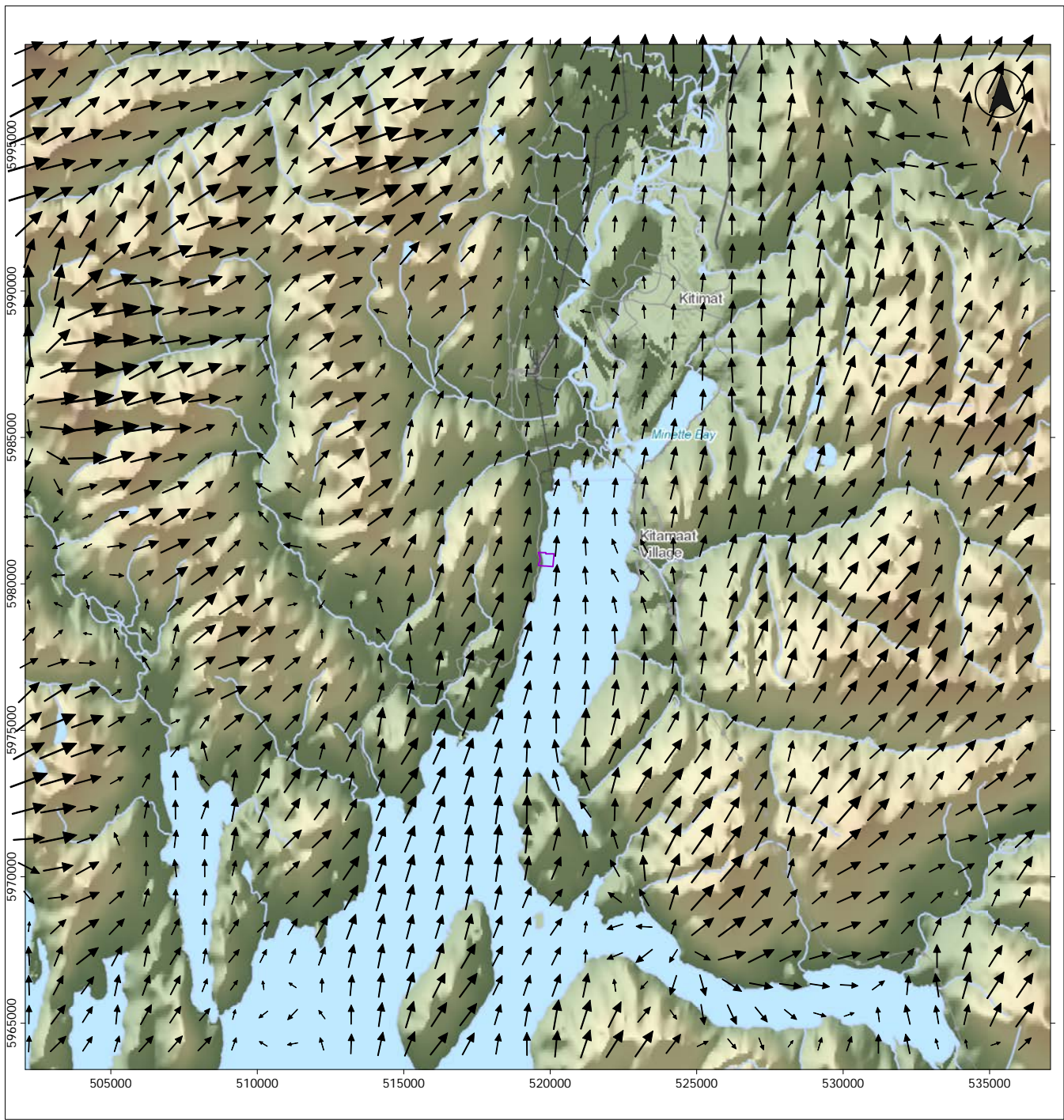
Figure No.

B.13

Title:
**Predicted Surface Wind Field
for Stable Conditions
(0300 LST January 24, 2015)**



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Notes
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 2. Data Sources: DataBC, Government of British Columbia;
 Natural Resources Canada: Canadian Hydrographic Service

Cedar LNG Boundary



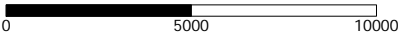
Project Location
 Kitimat,
 British Columbia Project Number 123223008

Client/Project/Report
 Cedar LNG Partners (GP) Ltd.
 Cedar LNG Project
 CALMET

Figure No.

B.14

Title
**Predicted Surface Wind Field
 for High Winds Conditions
 (1600 LST November 16, 2015)**



Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

B.6.2 Predicted Winds at Project Site

Figure B.15 shows the wind roses predicted by CALMET for the Project site at various elevations above ground (10 m, 60 m, 100 m and 200 m). The results indicate:

- At all four levels, winds are mainly from north and south. Higher winds are also mainly from the south. This is likely due to local topography surrounding the Project Site.
- Wind speed increases with increasing height above the ground.

Figure B.16 shows the annual wind roses predicted by CALMET for the Project site at 10 m above the ground. Little annual variation in the dominant winds is evident at this site.



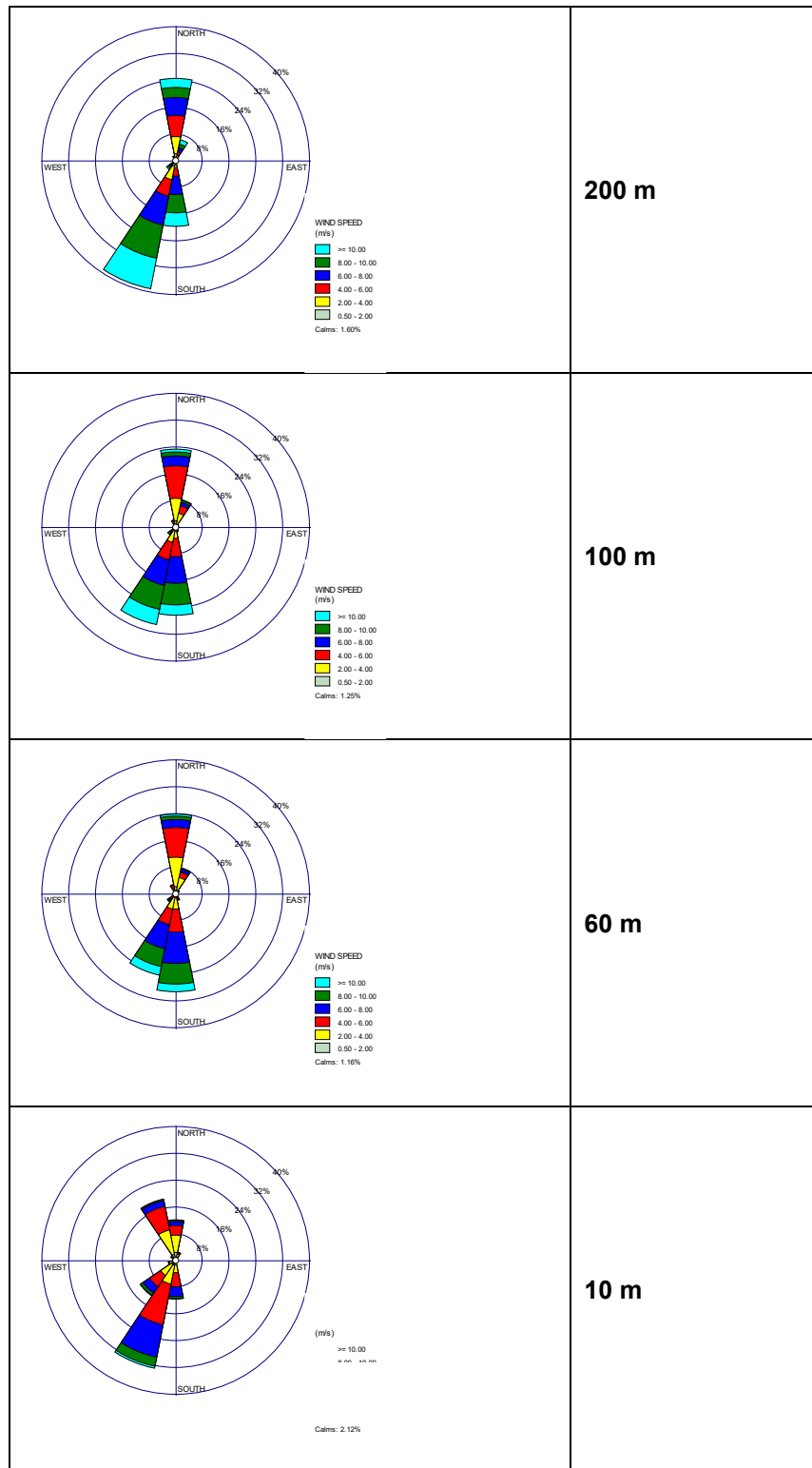


Figure B.15 CALMET Predicted Wind Roses at 4 Levels at the Project Site (2011–2015)



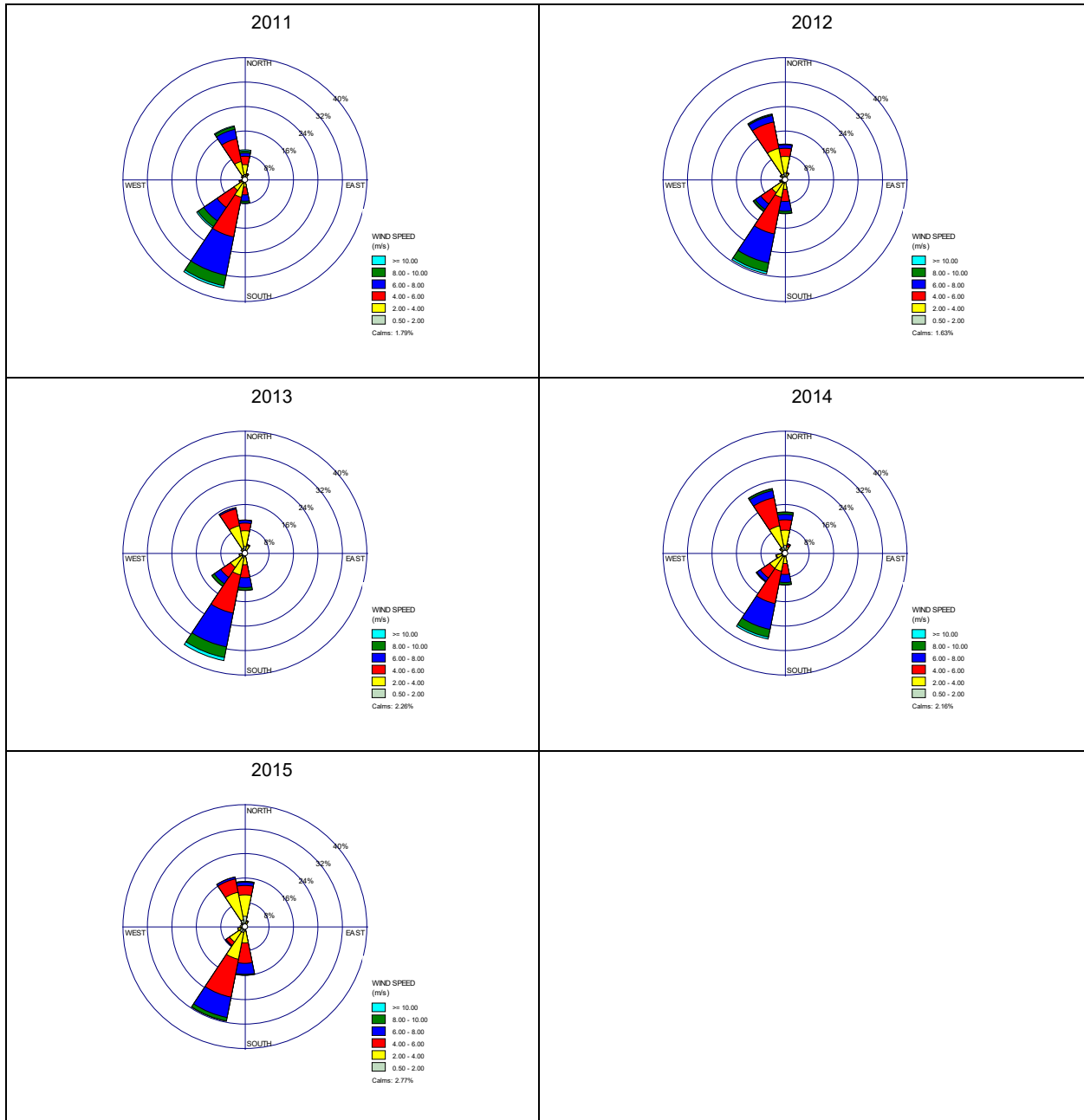


Figure B.16 Predicted Project Site Wind Roses at the 10 m Level for Individual Years (2011–2015)



B.6.3 Predicted Surface Temperatures at Project Site

Figure B.17 shows the monthly average surface temperatures predicted by CALMET for the Project site for 2011–2015. The predicted monthly temperatures indicate similar and reasonable seasonal surface temperature variations.

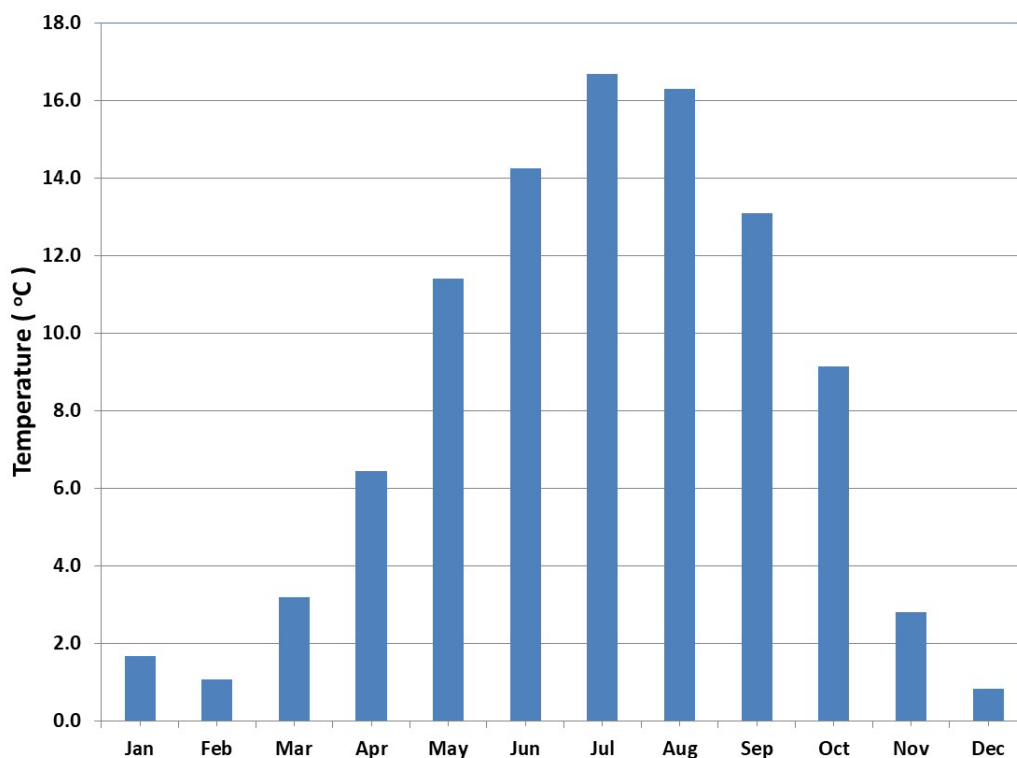


Figure B.17 CALMET Predicted Monthly Average Surface Temperature at the Project Site (2011–2015)

B.6.4 Predicted Mixing Heights

CALMET predicted seasonal mean diurnal mixing heights extracted at the Project Site for 2011–2015 are provided in Figure B.18 (definitions of five seasons refer to Table C-2). Extractions are as per the CALMET user guide (Scire, J.S., F.R. Robe, M.E. Ferneau, and R.J. Yamartino, 2000). The results show:

- Season 1 (mid-summer): The mean maximum values are about 1,273 m.
- Season 2 (autumn): The mean maximum afternoon values are about 1,099 m.
- Season 3 (winter 1): The mean maximum afternoon values are about 757 m.
- Season 4 (winter 2): The mean maximum afternoon values are about 583 m.
- Season 5 (transitional spring): The mean maximum afternoon values are about 1,184 m.



The convective mixing process dominates during the day, leading to maximum mixed layer depths during the afternoon. The minimum values for each season are predicted to occur during the night.

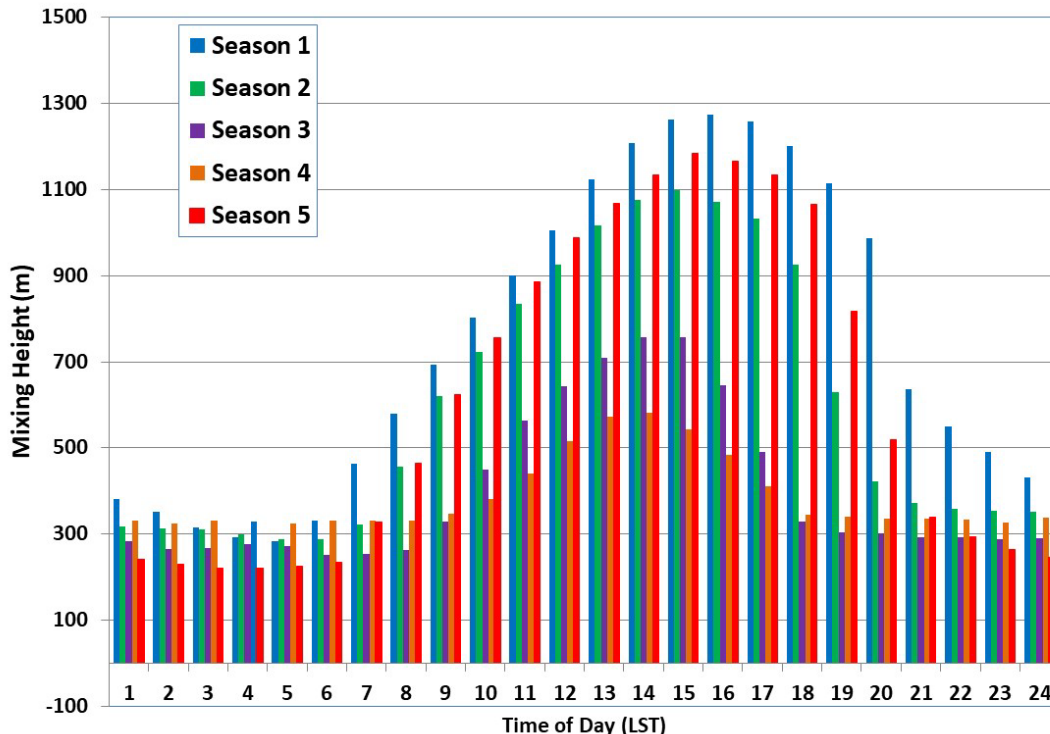


Figure B.18 CALMET Predicted Mean Diurnal Mixing Heights at the Project site (2011–2015)

B.6.5 Predicted Atmospheric Stability Class

Table B.12 provides the stability class frequency distributions based on the CALMET model predictions for the Project site. Figure B.19 shows the frequency distributions of predicted seasonal PG stability classes at the Project site on a diurnal basis.

- The neutral condition (Stability Class D) Neutral conditions are most frequent during the fall (season 3) and winter (season 4), during both day and night. This is due to the combination of high winds and persistent cloud cover, which are present in the area during the fall and winter storm season.
- Unstable conditions (Stability Classes A, B and C) are more frequent during the summer and spring seasons (seasons 1, 2 and 5), and are associated with daytime periods, clear skies and low wind speeds.
- Stable conditions (Stability Classes E and F) are more frequent during nighttime periods.



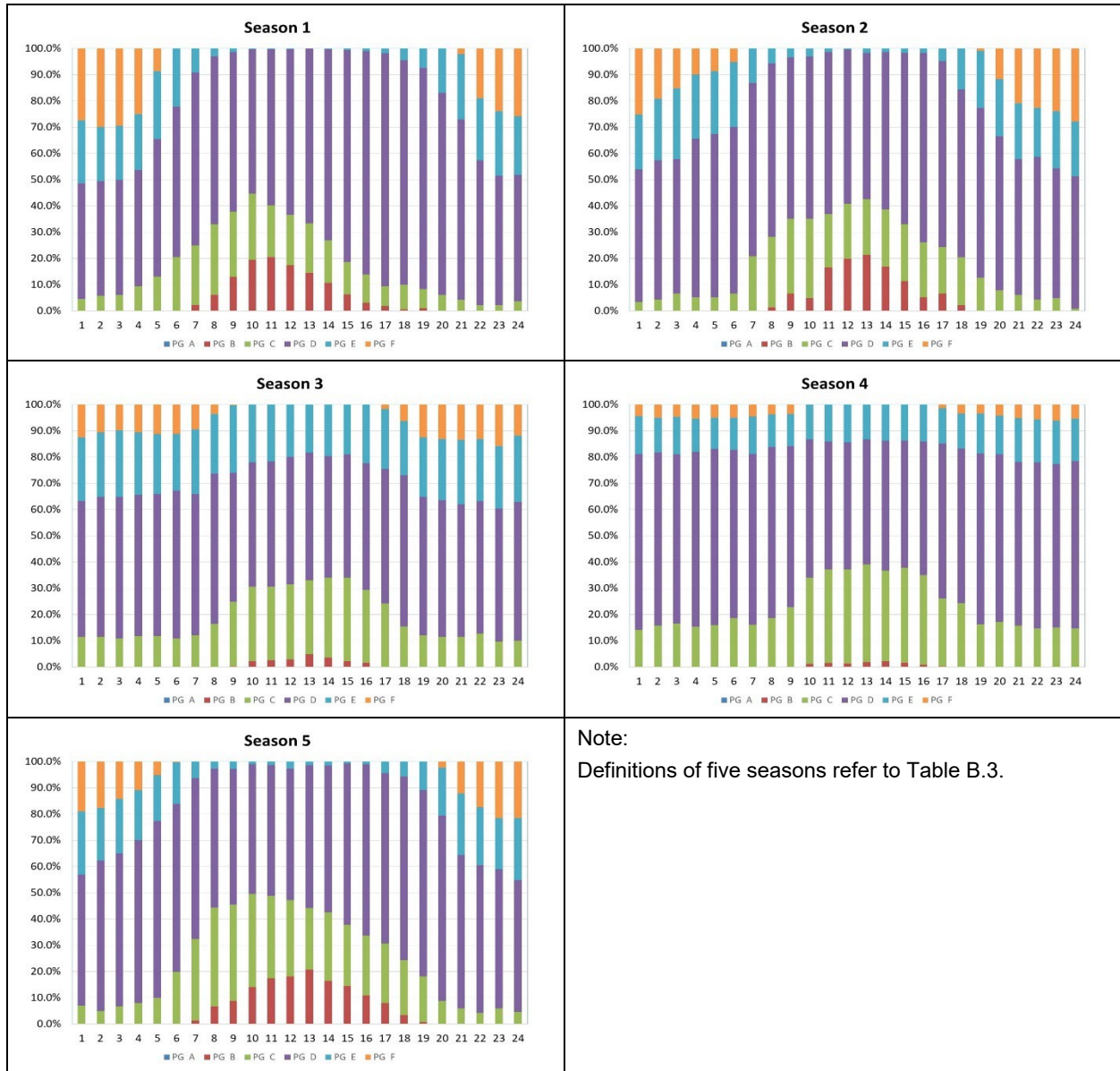
Table B.12 Predicted Stability Class Frequency Distributions (%) at the Project site (2011–2015)

	Number of Hours	A	B	C	D	E	F
Season 1	9120	0.0	4.9	12.5	63.2	11.5	8.0
Season 2	5520	0.0	4.7	14.1	59.7	13.5	8.0
Season 3	7320	0.0	0.9	18.0	51.5	22.7	6.9
Season 4	12624	0.0	0.5	22.7	59.6	14.0	3.2
Season 5	9240	0.0	5.9	18.5	58.6	11.1	5.9
2011–2015	43824	0.0	3.1	17.8	58.8	14.3	6.0

Note:

Definitions of five seasons refer to Table B.4.





Note:
 Definitions of five seasons refer to Table B.3.

Figure B.19 Frequency of Predicted Seasonal PG Stability Class at the Project Site (2011 to 2015)



B.7 CALMET Model Options

The model developer provided the CALMET user with numerous options to address a range of user needs. The parameters for the CALMET control file used in this assessment are provided in Table B.13 to Table B.19.

The default values recommended by the US EPA (US EPA, 1998) are presented for comparative purposes. In most cases, these default values are used. The Guideline (ENV, 2022) Section 9.4 also indicates some specific values in CALMET Input Group 5 that are to be used instead of the default values. Some of the recommendations are mandatory (indicated by orange shading in Table B.17 and others are left to professional judgment (indicated by green shading in Table B.17).

Table B.13 CALMET Model Options Groups 0 and 1

Parameter	Default	Project	Comment
Input Group 0: Input and Output File Names			
NUSTA	-	0	Number of upper air stations
NOWSTA	-	2	Number of overwater met stations
MM3D	-	60	Number of CALWRF 3D.DAT files (one for each month)
NIGF	-	0	Number of IGF-CALMET.DAT files
Input Group 1: General run control parameters			
IBYR	-	2011	Starting year
IBMO	-	1	Starting month
IBDY	-	1	Starting day
IBHR	-	0	Starting hour
IBSEC	-	0	Starting second
IEYR	-	2016	Ending year
IEMO	-	1	Ending month
IEDY	-	1	Ending day
IEHR	-	0	Ending hour
IESEC	-	0	Ending second
ABTZ	-	UTC-0800	UTC time zone
NSECDT	3,600	3600	Length of modeling time-step (seconds)
IRTYPE	1	1	Run type
LCALGRD	T	T	Special data fields
ITEST	2	2	Flag to stop run after SETUP phase



Table B.14 CALMET Model Options Group 2: Grid Control Parameters

Parameter	Default	Project	Comment
PMAP	UTM	UTM	Map projection
IUTMZN	-	9	UTM Zone
UTMHEM	N	N	Hemisphere for UTM projection
DATUM	WGS-84	NAR-C	Datum-region for output coordinate
NX	-	55 (55 km x 110 km domain)	No. X grid cells
		140 (35 km x 35 km domain)	
NY	-	110 (55 km x 110 km domain)	No. Y grid cells
		140 (35 km x 35 km domain)	
DGRIDKM	-	1.0.(55 km x 110 km domain)	Grid spacing (km)
		0.25 (35 km x 35 km domain)	
XORIGKM	-	492.860 (55 km x 110 km domain)	Reference coordinate of SW corner of grid cell (1,1) -X coordinate (km)
		502.080 (35 km x 35 km domain)	
YORIGKM	-	5946.310 (55 km x 110 km domain)	Reference coordinate of SW corner of grid cell (1,1) -Y coordinate (km)
		5963.420 (35 km x 35 km domain)	
NZ	-	12	Vertical grid definition: Number of vertical layers
ZFACE	-	0, 20, 40, 80, 120, 280, 520, 880, 1320, 1820, 2380, 3000 and 4000	Vertical grid definition: Cell face heights in arbitrary vertical grid (m)

Table B.15 CALMET Model Options Group 3: Output Options

Parameter	Default	Project	Comment
Disk Output:			
LSAVE	T	T	Save met. fields in the unformatted output files
IFORMO	1	1	Type of unformatted output file
Line Printer Output:			
LPRINT	F	F	Print meteorological fields
IPRINF	1	1	Print intervals (hrs)
IUVOUT (NZ)	0	12*0	Specify which layers of U,V wind component to print
IWOUT (NZ)	0	12*0	Specify which level of the w wind component to print
ITOUT (NZ)	0	12*0	Specify which levels of the 3-D temperature field to print



Parameter	Default	Project	Comment
Meteorological fields to print:			
Variable		Print? 0 = no print 1 = print	Comment
STABILITY		1	PGT stability
USTAR		0	Friction velocity
MONIN		0	Monin-Obukhov length
MIXHT		1	Mixing height
WSTAR		0	Convective velocity scale
PRECIP		1	Precipitation rate
SENSHEAT		0	Sensible heat flux
CONVZI		0	Convective mixing height
Testing and debug print options for micrometeorological module:			
LDB	F	F	Print input meteorological data and internal variables
NN1	1	1	First time step for which debug data are printed
NN2	1	1	Last time step for which debug data are printed
LDBCST	F	F	Print distance to land internal variables
Testing and debug print options for wind field module:			
IOUTD	0	0	Control variable for writing the test/debug wind fields to disk files
NZPRN2	1	1	Number of levels, starting at surface, to print
IPR0	0	0	Print the interpolated wind components
IPR1	0	0	Print the terrain adjusted surface wind components
IPR2	0	0	Print the smoothed wind components and the initial divergence fields
IPR3	0	0	Print the final wind speed and direction
IPR4	0	0	Print the final divergence fields
IPR5	0	0	Print the winds after kinematic effects are added
IPR6	0	0	Print the winds after the Froude number adjustment is made
IPR7	0	0	Print the winds after slope flows are added
IPR8	0	0	Print the final wind field components



Table B.16 CALMET Model Options Group 4: Meteorological Data Options

Parameter	Default	Project	Comment
NOOBS	0	1	Use surface and overwater stations (no upper air observations)
Number of Surface & Precipitation Meteorological Stations:			
NSSTA	-	8	Number of surface stations
NPSTA	-	Not applicable	Number of precipitation stations
Cloud Data Options:			
MCLLOUD	0	4	Gridded cloud cover from prognostic relative humidity at all levels
File Formats:			
IFORMS	2	Not applicable	Surface meteorological data file format
IFORMP	2	Not applicable	Precipitation data file format
IFORMC	2	Not applicable	Cloud data file format

Table B.17 CALMET Model Option Group 5: Wind Field Options and Parameters

Parameter	Default	Project	Comment
Wind Field Model Options:			
IWFCOD	1	1	Model selection variables
IFRADJ	1	1	Compute Froude number adjustment
IKINE	0	0	Compute kinematic effects
IOBR	0	0	Use O'Brien procedure for adjustment of the vertical velocity
ISLOPE	1	1	Compute slope flow effects
IEXTRP	-4	-4	Similarity theory used
ICALM	0 or 1	0	Extrapolate surface winds even if calm
BIAS	0	12*0	Layer-dependent biases modifying the weights of surface and upper air stations
RMIN2	4	Not applicable	Minimum distance from nearest upper air station to surface station for which extrapolation of surface winds at surface station will be allowed
IPROG	2,4 or 14	14	Use gridded prognostic wind field model output fields as input to the diagnostic wind field model (from WRF 3D.DAT)
ISTEPPGS	3600	3600	Time step (seconds) of the prognostic model input data
IGFMET	0	0	Use coarse CALMET fields as initial guess fields



Parameter	Default	Project	Comment
Radius of Influence Parameters:			
LVARY	F	F	Use varying radius of influence
RMAX1	-	6	Maximum radius of influence over land in the surface layer (km)
RMAX2	-	10	Maximum radius of influence over land aloft (km)
RMAX3	-	Not applicable	Maximum radius of influence over water
Other Wind Field Input Parameters:			
RMIN	0.1	0.1	Minimum radius of influence used in the wind field interpolation (km)
TERRAD	-	5	Radius of influence of terrain features (km)
R1	-	2	Relative weighting of the first guess field and observations in the surface layer (km)
R2	-	5	Relative weighting of the first guess field and observations in the layers aloft (km)
RPROG	-	0	Relative weighting parameter of the prognostic wind field data (km)
DIVLIM	5.0E-6	5.0E-6	Maximum acceptable divergence in the divergence minimization procedure
NITER	50	50	Maximum number of iterations in the divergence minimization procedure
NSMTH (NZ)	2,(mxnz-1)*4	2,11*4	Number of passes in the smoothing procedure
NINTR2	99	12*99	Maximum number of stations used in each layer for the interpolation of data to a grid point
CRITFN	1.0	1.0	Critical Froude number
ALPHA	0.1	0.1	Empirical factor controlling the influence of kinematic effects
FEXTR2(NZ)	0.0	12*0	Multiplicative scaling factor for extrapolation of surface observations to upper layers
Barrier Information:			
NBAR	0	0	Number of barriers to interpolation of the wind fields
KBAR	NZ	12	Level (1 to NZ) up to which barriers apply
XBBAR	-	0	X coordinate of beginning of each barrier
YBBAR	-	0	Y coordinate of beginning of each barrier
XEBAR	-	0	X coordinate of ending of each barrier
YEBAR	-	0	Y coordinate of ending of each barrier



Parameter	Default	Project	Comment
Diagnostic Module Data Input Options:			
IDIOPT1	0	0	Surface temperature (0 = compute internally from hourly surface observation)
ISURFT	-	-1	use 2-D spatially varying surface temperatures
IDIOPT2	0	0	Domain-averaged temperature lapse (0 = compute internally from hourly surface observation)
IUPT	-	Not applicable	Upper air station to use for the domain-scale lapse rate
ZUPT	200	Not applicable	Depth through which the domain-scale lapse rate is computed (m)
IDIOPT3	0	0	Domain-averaged wind components
IUPWND	-1	-1	Upper air station to use for the domain-scale winds (-1 indicating 3-D initial guess fields)
ZUPWND	1., 1000	1., 1000	Bottom and top of layer through which domain-scale winds are computed (m)
IDIOPT4	0	0	Observed surface wind components for wind field module
IDIOPT5	0	0	Observed upper air wind components for wind field module
Lake Breeze Information:			
LLBREZE	F	F	Use lake breeze module
NBOX	-	Not applicable	Number of lake breeze regions
XG1	-	Not applicable	X Grid line 1 defining the region of interest
XG2	-	Not applicable	X Grid line 2 defining the region of interest
YG1	-	Not applicable	Y Grid line 1 defining the region of interest
YG2	-	Not applicable	Y Grid line 2 defining the region of interest
XBCST	-	Not applicable	X Point defining the coastline in kilometres (Straight line)
YBCST	-	Not applicable	Y Point defining the coastline in kilometres (Straight line)
XECST	-	Not applicable	X Point defining the coastline in kilometres (Straight line)
YECST	-	Not applicable	Y Point defining the coastline in kilometres (Straight line)
NLB	-	Not applicable	Number of stations in the region
METBXID	-	Not applicable	Station ID's in the region

Notes:

Orange shading = mandatory recommendations

Green shading = left up to professional judgment



Table B.18 CALMET Model Option Group 6: Mixing Height, Temperature and Precipitation Parameters

Parameter	Default	Project	Comment
Empirical Mixing Height Constants:			
CONSTB	1.41	1.41	Neutral, mechanical equation
CONSTE	0.15	0.15	Convective mixing height equation
CONSTN	2400	2400	Stable mixing height equation
CONSTW	0.16	0.16	Over water mixing height equation
FCORIO	1.0E-4	1.0E-04	Absolute value of Coriolis (l/s)
Spatial Averaging of Mixing Heights:			
IAVEZI	1	1	Conduct spatial averaging
MNMDAV	1	1	Maximum search radius in averaging (grid cells)
HAFANG	30	30	Half-angle of upwind looking cone for averaging
ILEVZI	1	1	Layer of winds used in upwind averaging
Convective Mixing Heights Options:			
IMIXH	1	1	Method to compute the convective mixing height (Maul-Carson)
THRESHL	0.05	0.05	Threshold buoyancy flux required to sustain convective mixing height growth overland (W/m ³)
THRESHW	0.05	0.05	Threshold buoyancy flux required to sustain convective mixing height growth overwater (W/m ³)
IZICRLX	1	1	Use convective mixing height relaxation to equilibrium value
TZICRLX	800	800	Relaxation time (seconds) of convective mixing height to equilibrium value
ITWPROG	0	0	Option for overwater lapse rates used in convective mixing height growth (1=use prognostic lapse rates)
ILUOC3D	16	16	Land use category ocean in 3D.DAT datasets
Other Mixing Height Variables:			
DPTMIN	0.001	0.001	Minimum potential temperature lapse rate in the stable layer above the current convective mixing height (K/m)
DZZI	200	200	Depth of layer above current convective mixing height through which lapse rate is computed (m)
ZIMIN	50	50	Minimum overland mixing height (m)
ZIMAX	3000	3000	Maximum overland mixing height (m)
ZIMINW	50	50	Minimum overwater mixing height (m)
ZIMAXW	3000	3000	Maximum overwater mixing height (m)



Parameter	Default	Project	Comment
Overwater Surface Fluxes Method and Parameters:			
ICOARE	10	10	COARE with no wave parameterization
DSHELF	0	0	Coastal/Shallow water length scale (km)
IWARM	0	0	COARE warm layer computation
ICOOL	0	0	COARE cool skin layer computation
Relative Humidity Parameters:			
IRHPROG	0	0	3D relative humidity from observations
Temperature Parameters:			
ITPROG	-	1	Surface temperature from observations; Use WRF/3D for upper temperature data
IRAD	1	1	Interpolation type
TRADKM	500	500	Radius of influence for temperature interpolation (km)
NUMTS	-	8	Maximum number of stations to include in temperature interpolation
IAVET	1	1	Conduct spatial averaging of temperatures (1 = yes)
TGDEFB	-0.0098	-0.0098	Default temperature gradient below the mixing height over water (K/m)
TGDEFA	-0.0045	-0.0045	Default temperature gradient above the mixing height over water (K/m)
JWAT1	-	999	Beginning land use categories for temperature interpolation over water
JWAT2	-	999	Ending land use categories for temperature interpolation over water



Table B.19 CALMET Model Option Group 7: Surface Meteorological Station Parameters

Name	ID	X coordinate (km)	Y coordinate (km)	Time Zone	Anemometer Height
KTWS	99991	523.616	5991.027	8	10
KTHR	99992	519.474	5986.812	8	10
KTHV	99993	522.907	5980.600	8	10
KTRL	99994	521.509	5989.568	8	10
KTYC	99995	520.189	5983.566	8	10
KTSR	99996	519.616	5985.656	8	10
TEAC	99997	526.054	6041.266	8	10
TERA	71951	527.384	6035.497	8	10

Notes:

- KTWS Kitimat Whitesail
- KTHR Kitimat Haul Road
- KTHV Kitimat Haisla Village
- KTRL Kitimat Riverlodge
- KTYC Kitimat Yacht Club
- KTSR Kitimat Smeltersite Road
- TEAC Terrace Access Centre
- TERA Terrace Airport



B.8 References

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Appendix C CALPUFF



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C.1 Introduction

This section discusses the application of the primary dispersion model that was used for the air quality assessment for the proposed Cedar LNG Project (the Project). The dispersion modelling was conducted in accordance with the British Columbia Ministry of Environment and Parks (ENVP)'s 2022 British Columbia Air Quality Dispersion Modelling Guideline (the Guideline) (ENVP 2022a).

C.2 CALPUFF Model

C.2.1 Model Description

The CALPUFF model (Scire et al. 2000) is a multi-layer, multi-species, non-steady state puff dispersion model that can simulate the effects of time and space-varying meteorological conditions on substance transport, transformation, and removal. CALPUFF contains algorithms for near-source effects such as building downwash, transitional plume rise, partial plume penetration, as well as longer-range effects such as chemical transformation, and pollutant removal (wet scavenging and dry deposition). It can accommodate arbitrarily varying point source and area source emissions. Most of the algorithms contain options to treat physical processes at differing levels of detail depending on the requirements for the particular model application:

- **Atmospheric Dispersion:** Several options are provided in CALPUFF for the computation of dispersion coefficients:
 - similarity theory to estimate sigma v (or σ_v) and sigma w (or σ_w) from surface heat and momentum fluxes provided by CALMET
 - Pasquill-Gifford (PG) or McElroy-Pooler (MP) dispersion coefficients
 - dispersion equations based on the Complex Terrain Dispersion Model (CTDM)
 - hourly values of direct turbulence measurements (σ_v and σ_w)
- **Chemical Transformation:** CALPUFF includes options to parameterize chemical transformation effects using the five species scheme (SO_2 , SO_4^{2-} , NO_x , nitric acid [HNO_3], and NO_3^-) used in the MESOPUFF II model; a modified six-species scheme (SO_2 , SO_4^{2-} , nitric oxide [NO], NO_2 , HNO_3 , and NO_3^-) adapted from the RIVAD/ARM3 (Regional Impact in Visibility and Acid Deposition/ Acid Rain Mountain Mesoscale Model) method; updated RIVAD with ISORROPIA inorganic aerosol thermodynamic equilibrium model; or a set of user specified, diurnally-varying transformation rates.
- **Dry Deposition:** A full resistance model is provided to calculate dry deposition rates of gases and particulate matter as a function of geophysical parameters, meteorological conditions and substance properties. Options are provided to allow user-specified, diurnally varying deposition velocities to be used for one or more pollutants instead of the resistance model (e.g., for sensitivity testing) or to bypass the dry deposition model completely.



- **Wet Deposition:** An empirical scavenging coefficient approach is used in CALPUFF to compute the depletion and wet deposition fluxes due to precipitation scavenging. The scavenging coefficients are specified as a function of the pollutant and precipitation type (i.e., frozen versus liquid precipitation).

The following section describes the application of the CALPUFF model specific to the Project assessment. The most recently available version of the CALPUFF model was selected (i.e., Version 7.2.1 [Level 150618]).

C.2.2 Model Application

C.2.2.1 CALPUFF Modeling Domain

The CALPUFF model requires the user to define a domain where the emissions sources are identified, the meteorological conditions are characterized, and the locations where the air quality changes are to be predicted. By considering the significant increase of runtime of CALPUFF when using the computationally intensive RIVAD ISOROPIA chemistry scheme for nitrogen and sulphur deposition predictions, a set of two nested CALMET model domains was applied to the CALPUFF modeling:

- A far-field CALMET domain 55 km x 110 km with 1 km grid resolution.
- A near-field CALMET domain 35 km x 35 km with 250 m grid resolution centred at the Project Site.

A CALPUFF modelling domain is comprised of 50 km (north-south) by 110 km (east-west) area within the 55 km x 110 km CALMET model domain. Table C.1 provides the corners of the CALPUFF modelling domain. The CALPUFF modeling domain is sized to capture the values of interest for the Project sources, existing and planned industrial sources (i.e., predicted concentrations greater than 10% of the applicable ambient air quality objective) as per the Guideline (ENVP 2022a).

Table C.1 Coordinates of the CALPUFF Modeling Domain (50 km x 100 km)

Domain Corner	Location (UTM NAD 83, Zone 9)	
	East (m)	North (m)
Northwest	495360	5951310
Southwest	495360	6051310
Southeast	545360	6051310
Northeast	545360	5951310



C.2.2.2 Meteorological Data

For the air quality assessment completed for the Project, the CALMET meteorological model (Scire et al., 2000) was run for a five-year period, January 1, 2011 to December 31, 2015. The selection of a five-year period is consistent with the Guideline (ENVP, 2022a). CALMET was run in hybrid mode using both Weather Research and Forecasting (WRF) model 1km gridded data (Lakes Environmental, 2025), and surface weather station observations within the CALMET model domain and observations at two nearest buoy stations. Two nested model domains at 250 m and 1 km grid resolutions were selected for the assessment (see Section B.2, Appendix B).

C.2.2.3 Emissions and Source Characteristics

CALPUFF was used to simulate the transport and dispersion of emissions from the Cedar LNG Project and other regional existing sources. Appendix A of the Technical Data Report provides emission source characteristics and emission rates for the Project sources and the other existing sources used for this assessment.

C.2.2.4 Receptor Locations

Two types of receptors within the domain are defined: nested Cartesian grid points and discrete (sensitive and distance) locations.

Gridded Cartesian Receptors

Predictions of ground-level air concentrations on and outside the plant boundary were produced according to the Guideline (ENVP 2022a), using a series of nested Cartesian grids with increasing receptor density with proximity to the site.

The receptor grids and their corresponding spacing are as follows:

- 20 m receptor spacing along the plant boundary
- 50 m spacing within 2.0 km x 2.0 km of the Project
- 50 m spacing within a 3.5 km x 4.5 km area centered on the Base Case point of maximum impingement
- 50 m spacing along other industrial facility plant boundaries
- 50 m spacing over residential areas of Kitimat and Kitimaat Village
- 250 m spacing within 7.0 x 5.0 km of the Project
- 500 m spacing within 10 km x 14 km of the Project
- 1,000 m spacing within 40 km x 40 km of the Project
- 2,000 m spacing beyond 1,000 m grid spacing area and within 50 km x 100 km domain



The described grid comprises 23,322 receptor locations. Figure C.1 shows the receptor grid used within the CALPUFF modelling domain

Discrete Receptors

In addition, 150 discrete locations corresponding to specific sites of interest were included in the assessment. The sensitive receptors were broadly grouped as follows:

- 105 sensitive receptors corresponding to nearby lakes, creeks, and rivers (shown in Figure C.2).
- 28 human health sensitive receptors corresponding to schools, daycares, health care facilities and residential areas (shown in Figure C.2).
- 7 sensitive receptors on the Project-Site at the location of where workers are staying on the Floating LNG facility, seawalk, or onshore.
- 8 air quality monitoring stations.
- 2 deposition stations.

C.2.2.5 Building Downwash

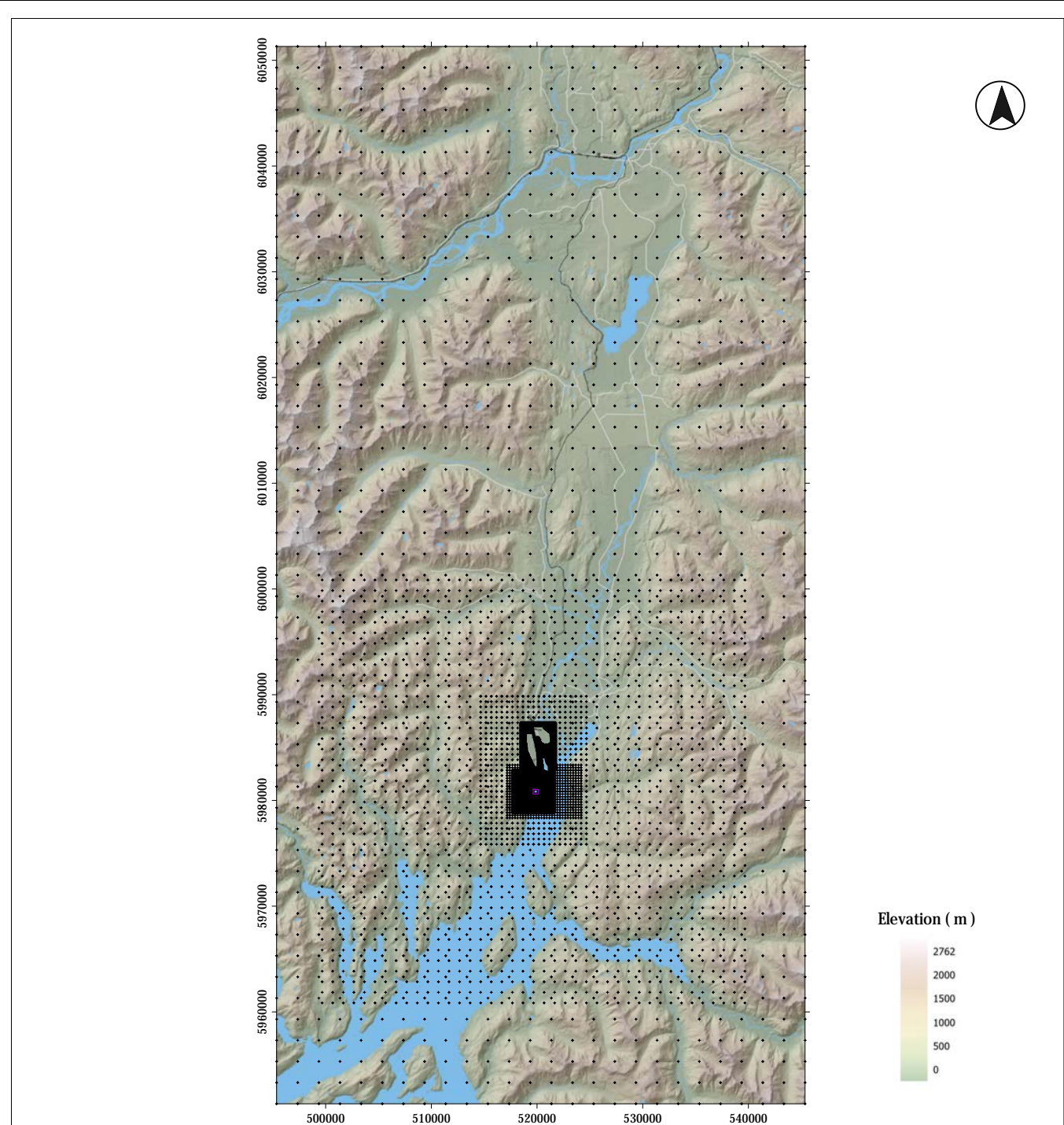
Buildings or other solid structures may affect the flow of air near a source and cause building downwash effects (e.g., eddies on the downwind side), which have potential to reduce plume rise and affect dispersion. For dispersion modelling purposes, building downwash effects were considered for the Project sources with the Plume Rise Model Enhancement (PRIME) downwash routine (MBDW=2) suggested in the Guideline (ENVP 2022a). For the building and structure dimensions considered in dispersion modelling, see Appendix A.

C.2.2.6 Terrain Effects

The CALPUFF model was used to estimate concentrations, for each species considered, at each receptor location. Since some of these receptors were located in terrain at elevations greater than puff release points, terrain effects were considered. To account for the possible distortion of the plume trajectory over elevated terrain, the Partial Plume Path Adjustment Method was used to modify the height of the plume.

The Partial Plume Path Adjustment Method employs a plume path coefficient (PPC) to adjust the height of the plume above the ground. PPC default values of 0.50, 0.50, 0.50, 0.50, 0.35 and 0.35 for PG stability classes A, B, C, D, E, and F, respectively, were used.





Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

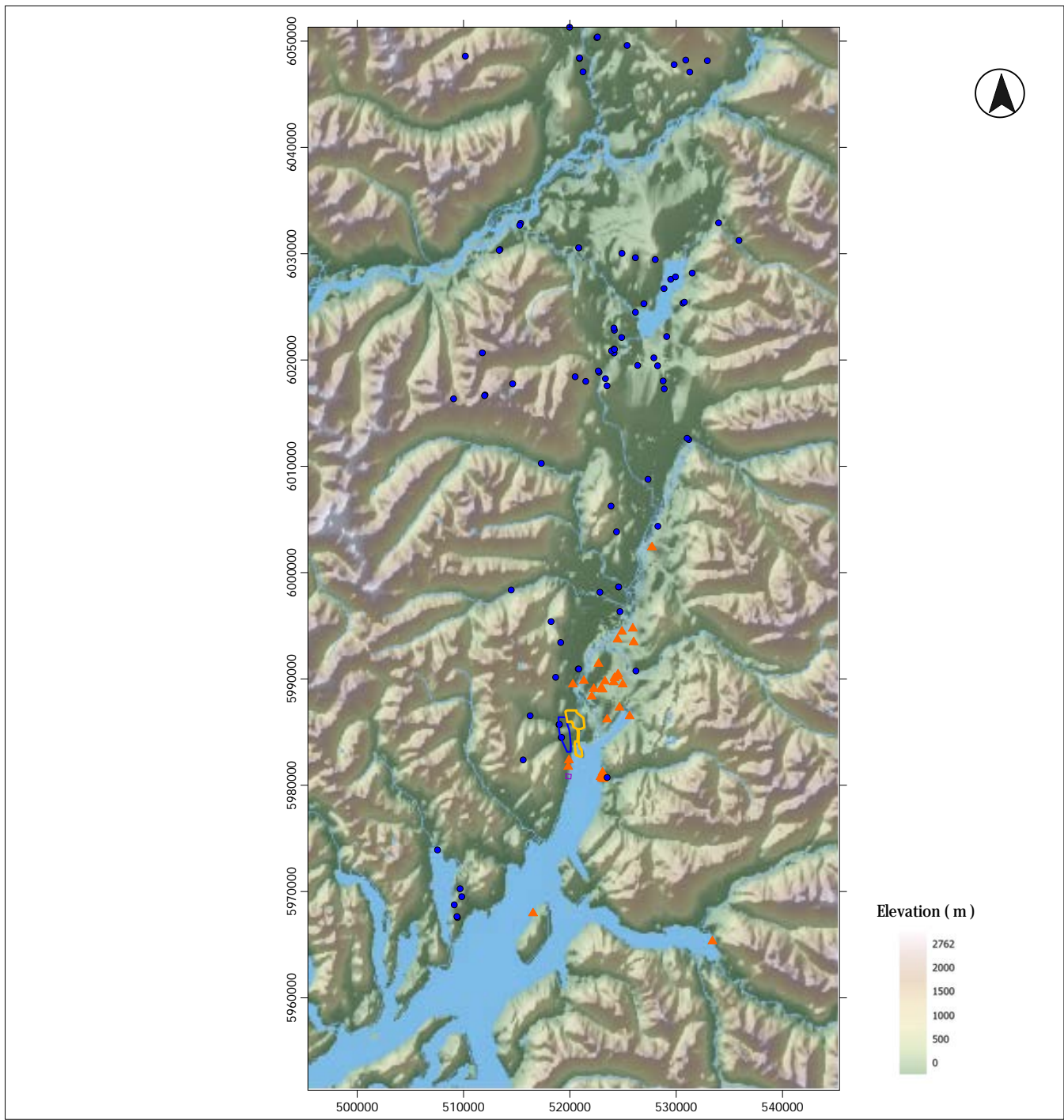
- Cedar LNG Boundary
- Gridded Receptor
- Highway
- Road
- Railway
- Transmission Line
- Watercourse
- Waterbody



Project Location: Kitimat, British Columbia
 Project Number: 123223008

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project CALPUFF

Figure No.: C.1
 Title: Receptor Grid in the CALPUFF Modelling Domain



Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

- Cedar LNG Boundary
- Highway
- Road
- Railway
- Transmission Line
- Watercourse
- Waterbody

- Sensitive Receptors for Human Health Assessment
- Sensitive Receptors for Aquatics Assessment



Project Location: Kitimat, British Columbia
 Project Number: 123223008

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project CALPUFF

Figure No.: C.2
 Title: Sensitive Receptors within CALPUFF Domain

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

C.2.2.7 Dispersion Coefficients

Fundamental parameters controlling plume dispersion in a Gaussian model such as CALPUFF are the dispersion coefficients. These values, which must be specified for both the horizontal and the vertical directions, can be estimated in CALPUFF using several different methods. For this application, dispersion coefficients were internally computed from turbulence estimates based on micrometeorological data from CALMET (MDISP = 2). This selected method is based on ENVP recommendations (i.e., Table 7.1 in the Guideline (ENVP 2022a)).

C.2.2.8 Chemical Transformation

The updated RIVAD scheme with ISOROPPIA equilibrium (MCHEM = 6) will be used per Section 7.8 of the Guideline (ENVP, 2022a). Aqueous phase chemistry flag (MAQCHEM) and Liquid Water Content flag (MLWC) will be turned off. Stantec has conducted CALPUFF model performance analysis of recent deposition measurements with and without the MAQCHEM option in Kitimat. Specifically, total sulphur deposition measurements collected as part of the Rio Tinto (RT) Sulphur Dioxide Environmental Effects Monitoring Program (EEMP) (Rio Tinto, 2020) were compared to CALPUFF model predictions to evaluate accuracy of sulphur deposition predictions and understand model performance and prediction bias. CALPUFF model estimates of total sulphur deposition (using MCHEM=6, RIVAD/ARM3 with ISORROPIA) were predicted for both the Coho Flats and Lakelse Lake sites and compared to total (wet plus dry) measured deposition rates at these locations for model runs both with and without the new aqueous phase enhanced chemistry and deposition option (MAQCHEM).

Predicted sulphur deposition rates for the CALPUFF model runs including the new aqueous phase enhanced chemistry and deposition model option (i.e., MAQCHEM=1) were found to significantly overpredict measured deposition rate (600% to 700%) at both Coho Flats and Lakelse Lake. The magnitude of overprediction is consistent with poor model performance. The predicted deposition rates when this model option is disabled (i.e., MAQCHEM=0) were found to also overpredict measured deposition rates; however, were acceptable from a model performance perspective (40% to 90%). The overprediction bias is likely attributable to the high precipitation rates and relative humidity on the north coast. There are no known published validation studies of CALPUFF using MAQCHEM=1 in a similar setting. Based upon the results of this comparison, it is recommended that the aqueous phase enhancement model option not be used (i.e., MAQCHEM=0) for the dispersion modelling.

The CALPUFF deposition options will be turned on to enable the prediction and deposition of NO_x, SO₂, nitrates and sulfates to be used in the acid deposition analysis.



C.2.2.9 NO_x to NO₂ Chemistry

The Guideline (ENVP, 2022a) identifies several NO_x to NO₂ conversion approaches: the total conversion method (TCM) that assumes all NO_x is converted to NO₂; the ambient ratio method (ARM); the ozone limiting method (OLM) using representative ozone measurements; and the CALPUFF predictions based on the RIVAD/ISORROPIA approach. For the methods that use representative ozone data, it is desirable to adopt ozone concentrations that match the time period that match the meteorological data (i.e., hourly values for the 2012).

NO to NO₂ conversion will be carried out using the ambient ratio method 2 (ARM2) consistent with Section 3.2.1.2 and Appendix A of the Guidance for NO₂ Dispersion Modelling in British Columbia (NO₂ Guidance) (ENVP, 2022b). The Coastal Sites ARM2 curve was used to convert NO to NO₂, as provided in the NO₂ Guidance (ENVP, 2022b).

C.2.2.10 NH₃ Concentrations

The Interagency Workshop of Air Quality Modeling Phase 2 report (IWAQM 1998) recommends background ammonia (NH₃) concentration of 10 ppb for grassland and 0.5 ppb for forest land. Considering the majority of the area surrounding Kitimat is forest land, a constant value of 0.5 ppb was selected as monthly background NH₃ for this assessment.

C.2.2.11 Secondary Particular Formation

The CALPUFF model was used to predict secondary PM_{2.5} formation due to precursor SO₂ and NO_x emissions. The model predicts particulate nitrate NO₃⁻, which can exist as an aerosol (i.e., dissolved in a water droplet) or as a particle (e.g., NH₄NO₃). Similarly, sulphate SO₄²⁻ can also exist as an aerosol (i.e., dissolved in a water droplet) or as a particle (e.g., ammonium sulphate [(NH₄)₂SO₄]). NO₃⁻ and SO₄²⁻ are assumed to react with ambient NH₃ to produce NH₄NO₃ and (NH₄)₂SO₄, respectively; the predicted sulphate and nitrate are multiplied by the factors indicated in Table C.2.

Table C.2 PM_{2.5} Multipliers for SO₄²⁻ and NO₃⁻

Predicted Parameter	SO ₄ ²⁻	NO ₃ ⁻
Molecular mass	96	62
End product	(NH ₄) ₂ SO ₄	NH ₄ NO ₃
Molecular mass	132	80
Multiplier	1.375	1.290

Note:

Multiplier = (Molecular Mass of End Product)/(Molecular Mass of Predicted Parameter)



The PM_{2.5} predictions derived from the CALPUFF model include the primary PM_{2.5} contribution plus the secondary sulphate contribution and the secondary nitrate contribution.

C.2.2.12 Deposition Calculation Approach

Deposition Parameters

Deposition is comprised of dry and wet removal mechanisms. The dry and wet deposition rates depend on the phase of the compound being deposited (e.g., vapour or particle), and other physical and chemical properties of the compound. For this assessment, deposition of nitrogen and sulphur compounds is required to predict as these compounds can have potential acidification or eutrophication effects on terrestrial and aquatic systems.

For dry deposition, the compound groups are discussed in terms of the deposition options that are available in the CALPUFF model:

- For SO₂, NO, NO₂, and HNO₃, dry deposition is calculated using the CALPUFF internal vapour-phase resistance sub-model. The default resistance model input parameters are listed in Table C.10.
- For SO₄²⁻ and NO₃⁻, dry deposition is calculated using the CALPUFF internal particle-phase resistance sub-model. The default geometric mass mean diameters and standard deviations of 0.48 µm and 2 µm (respectively) based on the CALPUFF manual (Scire et al. 2000) were adopted.

The calculation of wet deposition requires wet scavenging coefficients that vary with phase and form of the precipitation (i.e., liquid (rain) or solid (snow)). The CALPUFF model assumes the scavenging coefficient approach for both gases and particles. For the nitrogen and sulphur compounds, the default wet scavenging coefficients listed in Table C.11 are used; and these are based on the CALPUFF manual (Scire et al. 2000) and CALPUFF GUI species library.

Sulphur and Nitrogen Compound Depositions

The project will be a source of acid forming emissions (SO₂ and NO_x contributions). The CALPUFF model predicts SO₂, SO₄²⁻, NO, NO₂, HNO₃ and NO₃⁻ deposition as annual averages attributable to emission sources located in the model domain.

Sulphur Deposition

The total sulphur deposition (S) was calculated as follows:

$$S = \frac{96}{64} [SO_2] + [SO_4^{2-}]$$



where S is expressed in kg SO₄²⁻/ha/a and the values in the square brackets represent the sum of the predicted wet and dry deposition values in kg SO₄²⁻/ha/a. The multiplication coefficients account for molecular mass differences for the individual species.

Nitrogen Deposition

The total nitrogen deposition (N) was calculated as follows:

$$N = \frac{14}{30}[NO] + \frac{14}{46}[NO_2] + \frac{14}{63}[HNO_3] + \frac{14}{62}[NO_3^-]$$

where the N is expressed in kg N/ha/a and the values in the square brackets represent the sum of the predicted wet and dry deposition values in kg/ha/a. The multiplication coefficients account for molecular mass differences for the individual species.

Sulphur and Nitrogen Depositions

The total sulphur and nitrogen depositions (S + N) was calculated as follows:

$$S + N = \left(\frac{2}{64}[SO_2] + \frac{2}{96}[SO_4^{2-}] + \frac{1}{30}[NO] + \frac{1}{46}[NO_2] + \frac{1}{63}[HNO_3] + \frac{1}{62}[NO_3^-] \right) * 1000$$

where the (S + N) is expressed in eq/ha/a and the values in the square brackets represent the sum of the predicted wet and dry deposition values in kg/ha/a. The multiplication coefficients account for valance and molecular mass differences for the individual species.

C.2.3 Model Options

The input parameters for the CALPUFF control file used in the modelling assessment are provided in Table C.3 to Table C.16. The input groups that are applicable to this assessment are indicated by grey shading in Table C.3. Section 7.8 and Section 10.7 of the Guideline indicate the key CALPUFF model options. Although not specified in the Guideline, it is assumed that the default values are those defined in the CALPUFF user manual (Scire et al. 2000). In most cases, these default values are used. Table 7.1 of the Guideline (ENVP 2022a) also indicates specific values to be used instead of the default values. Some of the recommendations are mandatory (indicated by orange shading) and others are left to professional judgment (indicated by green shading).



Table C.3 Input Groups in the CALPUFF Control

Input Group	Description	Applicable to Project?
0	Input and output file names	Yes
1	General run control parameters	Yes
2	Technical options	Yes
3	Species list	Yes
4	Grid control parameters	Yes
5	Output options	Yes
6	Sub grid scale complex terrain inputs	No
7	Dry deposition parameters for gases	Yes
8	Dry deposition parameters for particles	Yes
9	Miscellaneous dry deposition for parameters	No
10	Wet deposition parameters	Yes
11	Chemistry parameters	Yes
12	Diffusion and computational parameters	Yes
13	Point source parameters	Yes
14	Area source parameters	No
15	Line source parameters	Yes
16	Volume source parameters	No
17	FLARE source control parameters	No
18	Road Emissions parameters	No
19	Emission rate scale-factor tables	No
20	Non-gridded (discrete) receptor information	Yes

Table C.4 Input Group 0: Input and Output File Names

Parameter	Default	Project	Comments
NMETDOM	-	2	Two CALMET.DAT Domains used
NMETDAT	-	24	Number of CALMET.DAT files (Total for ALL Domains) per year
DOMAIN1	-	1000m	outermost CALMET domain grid resolution
DOMAIN2	-	250m	inner CALMET domain grid resolution



Table C.5 Input Group 1: General Run Control Parameters

Parameter	Default	Project	Comments
METRUN	0	0	All model periods in met file(s) will be run
IBYR	-	2011	Starting year
IBMO	-	1	Starting month
IBDY	-	1	Starting day
IBHR	-	0	Starting hour
IEYR	-	2016	Ending year
IEMO	-	1	Ending month
IEDY	-	1	Ending day
IEHR	-	0	Ending hour
ABTZ		UTC-0800	Base time zone
NSPEC	-	11	Number of chemical species
NSE	-	8	Number of chemical species to be emitted
ITEST	2	2	Program is executed after SETUP phase
MRESTART	0	0	Do not read or write a restart file during run
NRESPD	0	0	File updated every 24 periods
METFM	1	1	CALMET binary file (CALMET.MET)
AVET	60	60	Averaging time in minutes
PGTIME	60	60	PG Averaging time in minutes
IOUTU	1	1	Output units for binary concentration and flux files written in Dataset v2.2 or later formats. 1 = mass - g/m ³ (conc) or g/m ² /s (dep)



Table C.6 Input Group 2: Technical Options

Parameter	Default	Project	Comments
MGAUSS	1	1	Gaussian distribution used in near field
MCTADJ	3	3	Partial plume path terrain adjustment
MCTSG	0	0	Scale-scale complex terrain not modelled
MSLUG	0	0	Near-field puffs not modelled as elongated
MTRANS	1	1	Transitional plume rise modelled
MTIP	1	1	Stack tip downwash used
MRISE	1	1	Method used to compute plume rise for point sources not subject to building downwash. 1 = Briggs plume rise
MBDW	1 or 2	2	PRIME Method is used to simulate building downwash
MSHEAR	0	0	Vertical wind shear is not modelled
MSPLIT	0	0	Puff splitting not used
MCHEM	1	6	Transformation rates computed internally (Updated RIVAD scheme with ISORROPIA equilibrium)
MAQCHEM	1	1	Transformation rates and wet scavenging coefficients adjusted for in-cloud aqueous phase reactions
MLWC	1	1	Gridded cloud water data read from CALMET water content output files
MWET	1	1	Wet removal modelled
MDRY	1	1	Dry deposition modelled
MTILT	0	0	Gravitational settling (plume tilt) is not modelled
MDISP	2 or 3	2	Dispersion coefficients from internally calculated sigma v, sigma w using micrometeorological variables (u*, w*, L, etc.) per ENVP Guideline
MTURBVW	3	Not applicable	Used only if MDISP = 1 or 5.
MDISP2	3	Not applicable	Used only if MDISP = 1 or 5.
MTAULY	0	0	Draxler default 617.284 (s)
MTAUADV	0	0	No turbulence advection
MCTURB	1	1	Standard CALPUFF subroutines
MROUGH	0	0	PG σ_y and σ_z is not adjusted for roughness
MPARTL	1	1	Partial plume penetration of elevated inversion
MPARTLBA	1	1	Partial plume penetration of elevated inversion modelled for the buoyant area sources
MTINV	0	0	Strength of temperature inversion computed from default gradients
MPDF	0 or 1	1	Yes if MDISP = 2 (turbulence based dispersion coefficients).



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Parameter	Default	Project	Comments
MSGTIBL	0	0	Sub-grid TIBL module not used for shoreline
MBCON	0	0	Boundary concentration conditions not modelled
MSOURCE	0	0	Individual source contributions not saved
MFOG	0	0	Do not configure for FOG model output
MREG	1	0	Do not test options specified to see if they conform to regulatory values

Notes:

Mandatory or recommendations by the Guideline Section 7.8.

Professional judgement required per the Guideline Section 7.8.



Table C.7 Input Group 3: Species List

CSPEC	Modelled¹	Emitted²	Dry Deposition³	Output Group Number
SO ₂	1	1	1	0
SO ₄	1	0	2	0
NO	1	1	1	0
NO ₂	1	1	1	0
HNO ₃	1	0	1	0
NO ₃	1	0	2	0
PM _{2.5}	1	1	2	0
CO	1	1	0	0
NO _x	1	1	0	0
H ₂ S	1	1	0	0
VOC	1	1	0	0

Notes:

0 = no, 1 = yes

0 = no, 1 = yes

0 = none, 1 = computed-gas, 2 = computed particle, 3 = user-specified



Table C.8 Input Group 4: Map Projection and Grid Control Parameters

Parameter	Default	Project	Comments
PMAP	UTM	UTM	Universal Transverse Mercator
FEAST	0	0	False Easting (km) at the projection origin
FNORTH	0	0	False Northing (km) at the projection origin
IUTMZN	-	9	UTM zone
UTMHEM	N	N	Northern Hemisphere for UTM projection
DATUM	WGS-84	NAR-C	NAR-C is applicable for this assessment. WGS-84 is just the datum for TRC demo case along with the CALPUFF release.
NX	-	55	Number of X grid cells in meteorological grid
NY		110	Number of Y grid cells in meteorological grid
NZ	-	12	Vertical grid definition: Number of vertical layers
DGRIDKM	-	1.0	Grid spacing (km) to match CALMET (see Attachment C)
ZFACE	-	0, 20, 40, 80, 120, 280, 520, 880, 1320, 1820, 2380, 3000 and 4000	Vertical grid definition: Cell face heights (m). Selected to match CALMET (Attachment C).
XORIGKM	-	492.860	Reference X coordinate for SW corner of grid cell (1,1) of meteorological grid (km)
YORIGKM	-	5946.310	Reference Y coordinate for SW corner of grid cell (1,1) of meteorological grid (km)
IBCOMP	-	1	X index of lower left corner of the computational grid
JBCOMP	-	1	Y index of lower left corner of the computational grids
IECOMP	-	55	X index of the upper right corner of the computational grid
JECOMP	-	110	Y index of the upper right corner of the computational grid
LSAMP	T	F	Sampling grid is not used
IBSAMP	-	Not applicable	X index of lower left corner of the sampling grid
JBSAMP	-	Not applicable	Y index of lower left corner of the sampling grid
IESAMP	-	Not applicable	X index of upper right corner of the sampling grid
JESAMP	-	Not applicable	Y index of upper right corner of the sampling grid
MESHDN	1	1	Nesting factor of the sampling grid



Table C.9 *Input Group 5: Output Options*

Parameter	Default	Project	Comments
ICON	1	1	Output file CONC.DAT containing concentrations is created
IDRY	1	1	Output file DFLX.DAT containing dry fluxes is created
IWET	1	1	Output file WFLX.DAT containing wet fluxes is created
IT2D	0	0	2D Temperature
IRHO	0	0	Density
IVIS	1	0	Output file containing relative humidity data is not created
LCOMPRS	T	T	Perform data compression in output file
IQAPLOT	1	1	Create a standard series of output files (e.g., locations of sources, receptors, grids ...) suitable for plotting
IMFLX	0	0	Do not calculate mass fluxes across specific boundaries
INRISE	0	0	Do not create a file with plume properties for each rise increment, for each model timestep
IMBAL	0	0	Mass balances for each species are not reported hourly
ICPRT	0	1	Print concentration fields to the output list file
IDPRT	0	0	Do not print dry flux fields to the output list file
IWPRT	0	0	Do not print wet flux fields to the output list file
ICFRQ	1	1	Concentration fields are printed to output list file every 24-hour
IDFRQ	1	1	Dry flux fields are printed to output list file every 24-hour
IWFRQ	1	1	Wet flux fields are printed to output list file every 24-hour
IPRTU	1	3	Units for line printer output are in $\mu\text{g}/\text{m}^3$ for concentration and $\mu\text{g}/\text{m}^2/\text{s}$ for deposition
IMESG	2	2	Messages tracking the progress of run are written on screen
LDEBUG	F	F	Logical value for debug output
IPFDEB	1	1	First puff to track
NPFDEB	1	1	Number of puffs to track
NN1	1	1	Meteorological period to start output
NN2	10	10	Meteorological period to end output



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Parameter	Default	Project	Comments					
Species	Concentrations Printed (0 = no, 1 = yes)		Dry Fluxes Printed (0 = no, 1 = yes)		Wet Fluxes Printed (0 = no, 1 = yes)		Mass Flux	
	Printed	Saved to Disk	Printed	Saved to Disk	Printed	Saved to Disk	Printed	Saved to Disk
SO ₂	0	1	0	1	0	1	0	0
SO ₄	0	1	0	1	0	1	0	0
NO	0	1	0	1	0	1	0	0
NO ₂	0	1	0	1	0	1	0	0
HNO ₃	0	1	0	1	0	1	0	0
NO ₃	0	1	0	1	0	1	0	0
PM _{2.5}	0	1	0	1	0	1	0	0
CO	0	1	0	1	0	1	0	0
NO _x	0	1	0	1	0	1	0	0
H ₂ S	0	1	0	1	0	1	0	0
VOC	0	1	0	1	0	1	0	0



Table C.10 Input Group 6: Sub-Grid Scale Complex Terrain Inputs

Parameter	Default	Project	Comments
NHILL	0	0	Number of terrain features (not applicable)
NCTREC	0	not applicable	Number of special complex terrain receptors
MHILL	-	not applicable	Hill data created by OPTHILL & input below in Subgroup (6b); Receptor data in Subgroup (6c)
XHILL2M	1	not applicable	Conversion factor for changing horizontal dimensions to metres
ZHILL2M	1	not applicable	Conversion factor for changing vertical dimensions to metres
XCTDMKM	-	not applicable	X origin of CTDM system relative to CALPUFF coordinate system (km)
YCTDMKM	-	not applicable	Y origin of CTDM system relative to CALPUFF coordinate system (km)



Table C.11 Input Group 7: Dry Deposition Parameters for Gases

Parameter	Default	Project	Comments
SO ₂	0.1509	0.1509	Diffusivity
	1000	1000	Alpha star
	8.0	8.0	Reactivity
	0.0	0.0	Mesophyll resistance
	0.04	0.04	Henry's Law coefficient
NO	0.1345	0.1345	Diffusivity
	1.0	1.0	Alpha star
	2.0	2.0	Reactivity
	25	25	Mesophyll resistance
	18	18	Henry's Law coefficient
NO ₂	0.1656	0.1656	Diffusivity
	1.0	1.0	Alpha star
	8.0	8.0	Reactivity
	5.0	5.0	Mesophyll resistance
	3.5	3.5	Henry's Law coefficient
HNO ₃	0.1628	0.1628	Diffusivity
	1.0	1.0	Alpha star
	18.0	18.0	Reactivity
	0.0	0.0	Mesophyll resistance
	0.00000008	0.00000008	Henry's Law coefficient
NO _x	0.1656	0.1656	Diffusivity
	1.0	1.0	Alpha star
	8.0	8.0	Reactivity
	5.0	5.0	Mesophyll resistance
	3.5	3.5	Henry's Law coefficient
CO	0.186	0.186	Diffusivity
	1.0	1.0	Alpha star
	2.0	2.0	Reactivity
	61.0	61.0	Mesophyll resistance
	44.0	44.0	Henry's Law coefficient



Table C.12 CALPUFF Model Option Groups 8, 9 and 10

Species	Default	Project	Comments
Input Group 8: Dry Deposition Parameters for Particles			
SO ₄ ²⁻	0.48	0.48	Geometric mass mean diameter of SO ₄ ²⁻ [µm]
SO ₄ ²⁻	2.0	2.0	Geometric standard deviation of SO ₄ ²⁻ [µm]
NO ₃ ⁻	0.48	0.48	Geometric mass mean diameter of NO ₃ ⁻ [µm]
NO ₃ ⁻	2.0	2.0	Geometric standard deviation of NO ₃ ⁻ [µm]
PM _{2.5}	0.48	0.48	Geometric mass mean diameter of PM [µm]
PM _{2.5}	1.5	1.5	Geometric standard deviation of PM [µm]
Input Group 9: Miscellaneous Dry Deposition Parameters			
RCUTR	30	30	Reference cuticle resistance (s/cm)
RGR	10	10	Reference ground resistance (s/cm)
REACTR	8	8	Reference pollutant reactivity
NINT	9	9	Number of particle size intervals for effective particle deposition velocity
IVEG	1	1	Vegetation in non-irrigated areas is active and unstressed
Input Group 10: Wet Deposition Parameters			
SO ₂	3.0E-05	3.0E-05	Scavenging coefficient for liquid precipitation [s ⁻¹]
	0.0	0.0	Scavenging coefficient for frozen precipitation [s ⁻¹]
SO ₄ ²⁻	1.0E-04	1.0E-04	Scavenging coefficient for liquid precipitation [s ⁻¹]
	3.0E-05	3.0E-05	Scavenging coefficient for frozen precipitation [s ⁻¹]
NO	2.9E-05	2.9E-05	Scavenging coefficient for liquid precipitation [s ⁻¹]
	0.0	0.0	Scavenging coefficient for frozen precipitation [s ⁻¹]
NO ₂	5.1E-05	5.1E-05	Scavenging coefficient for liquid precipitation [s ⁻¹]
	0.0	0.0	Scavenging coefficient for frozen precipitation [s ⁻¹]
HNO ₃	6.0E-05	6.0E-05	Scavenging coefficient for liquid precipitation [s ⁻¹]
	0.0	0.0	Scavenging coefficient for frozen precipitation [s ⁻¹]
NO ₃ ⁻	1.0E-04	1.0E-04	Scavenging coefficient for liquid precipitation [s ⁻¹]
	3.0E-05	3.0E-05	Scavenging coefficient for frozen precipitation [s ⁻¹]
PM _{2.5}	1.0E-04	1.0E-04	Scavenging coefficient for liquid precipitation [s ⁻¹]
	3.0E-05	3.0E-05	Scavenging coefficient for frozen precipitation [s ⁻¹]



Table C.13 Input Group 11: Chemistry Parameters

Parameters	Default	Project	Comments
MOZ	1	1	Read hourly ozone concentrations from OZONE.DAT data file (2011-2015 hourly file generated by Kitimat Whitesail monitoring station 288 array ozone values)
BCKO3	12*80	Not used	Background ozone concentration (ppb)
MNH3	0	0	Used only if MCHEM =6 or 7. MNH3 =0, means using monthly background ammonia values (BCKNH3) - no vertical variation
MAVGNH3	1	Not used	Ammonia vertical averaging option. Used only if MCHEM = 6 or 7, and MNH3 = 1
BCKNH3	12*10	12*0.5	Constant background concentration in ppb
RNITE1	0.2	0.2	Night-time NO ₂ loss rate in percent/hour
RNITE2	2	2	Night-time NO _x loss rate in percent/hour
RNITE3	2	2	Night-time HNO ₃ loss rate in percent/hour
MH2O2	1	0	Use a monthly background H ₂ O ₂ value
BCKH2O2	12*1	12*1	Monthly background H ₂ O ₂ concentrations (used for aqueous phase transformations, not applicable)
RH_ISRP	50	50	Used only if MCHEM=6 or 7. Minimum relative humidity used in ISORROPIA computations
SO ₄ _ISRP	0.4	0.4	Used only if MCHEM=6 or 7. Minimum SO ₄ used in ISORROPIA computations
BCKPMF	-	Not used	Fine particulate concentration for secondary organic aerosol option, used only for MESOPUFF II scheme for OH (MCHEM =4) and Updated RIVAD scheme with ISORROPIA equilibrium and CalTech SOA (MCHEM =7)
OFRAC	-	Not used	Organic fraction of fine particulate for secondary organic aerosol option, used only for MESOPUFF II scheme for OH (MCHEM =4) and Updated RIVAD scheme with ISORROPIA equilibrium and CalTech SOA (MCHEM =7)
VCNX	-	Not used	VOC/NO _x ratio for secondary organic aerosol option, used only for MESOPUFF II scheme for OH

Notes:

“-“ means not available.

Mandatory or recommendations by the Guideline Section 7.8.

Professional judgement required per the Guideline Section 7.8.

User specified per the Guideline Section 10.7.



Table C.14 Input Group 12: Misc. Dispersion and Computational Parameters

Parameters	Default	Project	Comments
SYTDEP	550	550	Horizontal size of a puff in metres beyond which the time dependant dispersion equation of Heffter (1965) is used
MHFTSZ	0	0	Do not use Heffter formulas for σ_z
JSUP	5	5	Stability class used to calc dispersion rates for puffs above boundary layer
CONK1	0.01	0.01	Vertical dispersion constant for stable conditions
CONK2	0.1	0.1	Vertical dispersion constant for neutral or stable conditions
TBD	0.5	0.5	Use ISC transition point for determining the transition point between the Schulman-Scire (Schulman et al. 2000) to Huber-Snyder Building Downwash scheme
IURB1	10	10	Lower range of land use categories for which urban dispersion is assumed
IURB2	19	19	Upper range of land use categories for which urban dispersion is assumed
ILANDUIN	20	20	Land use category for RSA
ZOIN	0.25	0.25	Roughness length in meters for domain
XLAIIN	3	3	Leaf area index for domain
ELEVIN	0	0	Elevation above sea level in meters
XLATIN	-999	-999	Latitude of met location in degrees
XLONIN	-999	-999	Longitude of met location in degrees
ANEMHT	10	10	Anemometer height in meters
ISIGMAV	1	1	Sigma-v is read for lateral turbulence data
IMIXCTDM	0	0	Predicted mixing heights are used
MXMLEN	1	1	Maximum length of emitted slug in meteorological grid units
XSAMLEN	1	1	Maximum travel distance of slug or puff in meteorological grid units during one sampling unit
MXNEW	99	99	Max number of puffs released from one source during one time step
MXSAM	99	99	Maximum number of sampling steps during one time step for a puff or slug
NCOUNT	2	2	Number of iterations used when computing the transport wind for a sampling step that includes transitional plume rise
SYMIN	1	1	Minimum sigma y in metres for a new puff or slug
SZMIN	1	1	Minimum sigma z in metres for a new puff or slug



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Parameters	Default	Project	Comments	
SZCAP_M	5.0E06	5.0E06	Maximum sigma z in metres to avoid numerical problem in calculating time or distance	
Stability Class	Parameter			
	SVMIN (Project)		SWMIN (Project)	
	Minimum turbulence (σ_v) (m/s)		Minimum turbulence (σ_w) (m/s)	
	Land	Water	Land	Water
A	0.2	0.2	0.2	0.2
B	0.2	0.2	0.12	0.12
C	0.2	0.2	0.08	0.08
D	0.2	0.2	0.06	0.06
E	0.2	0.2	0.03	0.03
F	0.2	0.2	0.016	0.016
CDIV	0.0, 0.0	0.0, 0.0	Divergence criteria for dw/dz in met cells	
NLUTBIL	4	4	Search radius for nearest land and water cells used in the subgrid TIBL module	
WSCALM	0.5	0.5	Minimum wind speed allowed for non-calm conditions (m/s)	
XMAXZI	3000	3000	Maximum mixing height in metres	
XMINZI	50	50	Minimum mixing height in metres	
WSCAT	1.54	1.54	wind speed category 1 [m/s]	
	3.09	3.09	wind speed category 2 [m/s]	
	5.14	5.14	wind speed category 3 [m/s]	
	8.23	8.23	wind speed category 4 [m/s]	
	10.80	10.80	wind speed category 5 [m/s]	
PLX0	0.07	0.07	Wind Speed Power Law Exponent (Stability class A)	
	0.07	0.07	Wind Speed Power Law Exponent (Stability class B)	
	0.10	0.10	Wind Speed Power Law Exponent (Stability class C)	
	0.15	0.15	Wind Speed Power Law Exponent (Stability class D)	
	0.35	0.35	Wind Speed Power Law Exponent (Stability class E)	
	0.55	0.55	Wind Speed Power Law Exponent (Stability class F)	
PTG0	0.020	0.020	Potential temperature gradient for Stability Class E stability (degK/m)	
	0.035	0.035	Potential temperature gradient for Stability Class F (degK/m)	



Table C.15 CALPUFF Model Option Groups 13

Parameters	Default	Project	Comments
Input Group 13: Point Source Parameters			
NPT1	-	Varies by scenario	Number of point sources with constant stack parameters
IPTU	1	1	Units for point source emission rates are g/s
NSPT1	0	0	Number of source-species combinations with variable emissions scaling factors
NPT2	-	0	Number of point sources with variable emission parameters provided in external file

Note:

Point source (i.e., stacks) parameters are given in Appendix A.

“-“ means not applicable.

Table C.16 CALPUFF Model Option Groups 15

Parameters	Default	Project	Comments
Input Group 15: Line Source Parameters			
NLN2	-	0	Number of buoyant line sources with variable location and emission parameters
NLINES	-	8	Number of buoyant line sources (Base case)
ILNU	1	1	Units for line source emission rates is g s-1
NSLN1	0	0	Number of source-species combinations with variable emission scaling factors
MXNSEG	7	7	Maximum number of segments used to model each line
NLRISE	6	6	Number of distances at which transitional rise computed
XL	-	319.55	Average building length (Base case)
HBL	-	23.5	Average building height (Base case)
WBL	-	26.3	Average building width (Base case)
WML	-	6.0	Average line sources width (Base case)
DXL	-	36.88	Average separation between buildings (Base case)
FPRIMEL	-	607.64	Average buoyancy parameter (Base case)

Notes:

Line source parameters are given in Appendix A.

“-“ means not applicable.



Table C.17 CALPUFF Model Option Groups 20

Parameters	Default	Project	Comments
Input Group 20: Non-gridded Receptor Information			
NREC	-	23,472	Number of receptors

Notes:

Two set of modeled receptors are shown in Figure C.1 and Figure C.2.

“-“ means not applicable.

C.3 References

ENVP. (2022a). British Columbia Air Quality Dispersion Modelling Guideline. British Columbia Ministry of Environment, August 2022.

ENVP. (2022b). Guidance for NO₂ Dispersion Modelling in British Columbia. August 2022

Scire, J.S., D.G. Strimaitis, and R.J. Yamartino. 2000. A User’s Guide for the CALPUFF Dispersion Model (Version 5). Earth Tech, Inc., Concord, MA.

Schulman, L.L., D.G. Strimaitis and J.S. Scire. 2000. Development and Evaluation of the PRIME Plume Rise and Building Downwash Model. Journal of the Air & Waste Management Association. 50(3):378-90.

TRC Environmental Corporation. 2010. CALPUFF Chemistry Updates: User’s Instructions for API Chemistry Options. October 25, 2010.

U.S. EPA (United States Environmental Protection Agency). 1992. Protocol for Determining the Best Performing Model. EPA-454/R-92-025. Office of Air Quality Planning and Standards. Research Triangle Park, NC.

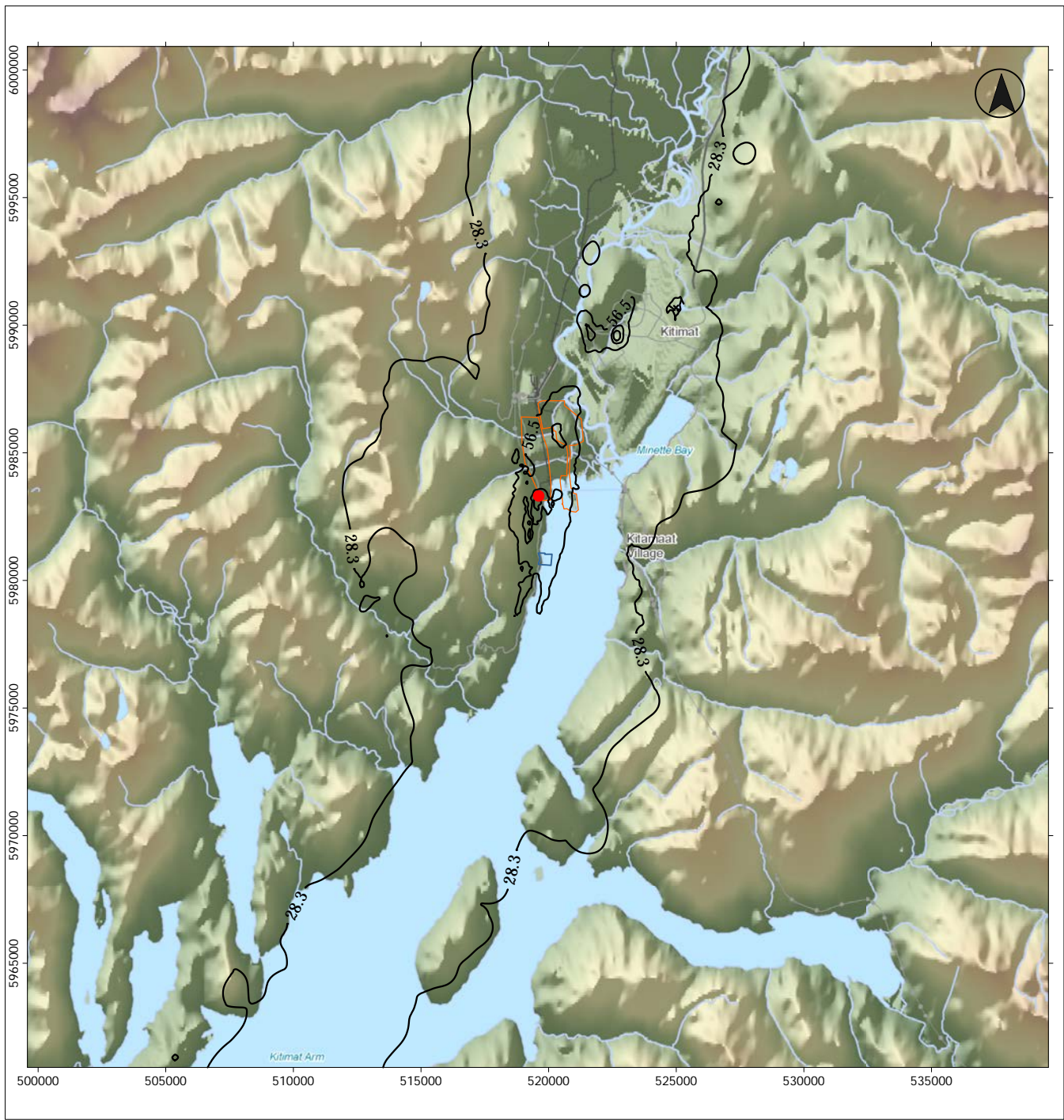
U.S. EPA. 2005. Appendix W to Part 51, Revision to the Guideline on Air Quality Models: Adoption of a Preferred General Purpose (Flat and Complex Terrain) Dispersion Model and Other Revisions; Final Rule. (November 9, 2005 Edition). Research Triangle Park, NC.

US EPA. 1998a. United States Environmental Protection Agency. Interagency Workgroup on Air Quality Modelling (IWAQM) Phase 1 Summary Report and Recommendations for Modelling Long Range Transport Impacts. EPA-454/R-98-019.



Appendix D Isopleth Maps





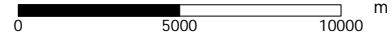
Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

Project Area
 Regional Facility Boundary

Highway
 Road
 Railway
 Transmission Line
 Watercourse
 Waterbody

Elevation (m)
 2026
 2000
 1500
 1000
 500
 0

● Maximum 1-hour Average 98th Daily Maximum NO₂ Concentration:
 92.7 µg/m³
 1-hour NO₂ BC AQO: 113 µg/m³
 Contour Levels: 28.3, 56.5, 79, 84.8 µg/m³
 Baseline: 288 array baseline
 from Kitimat Whitesail station Added



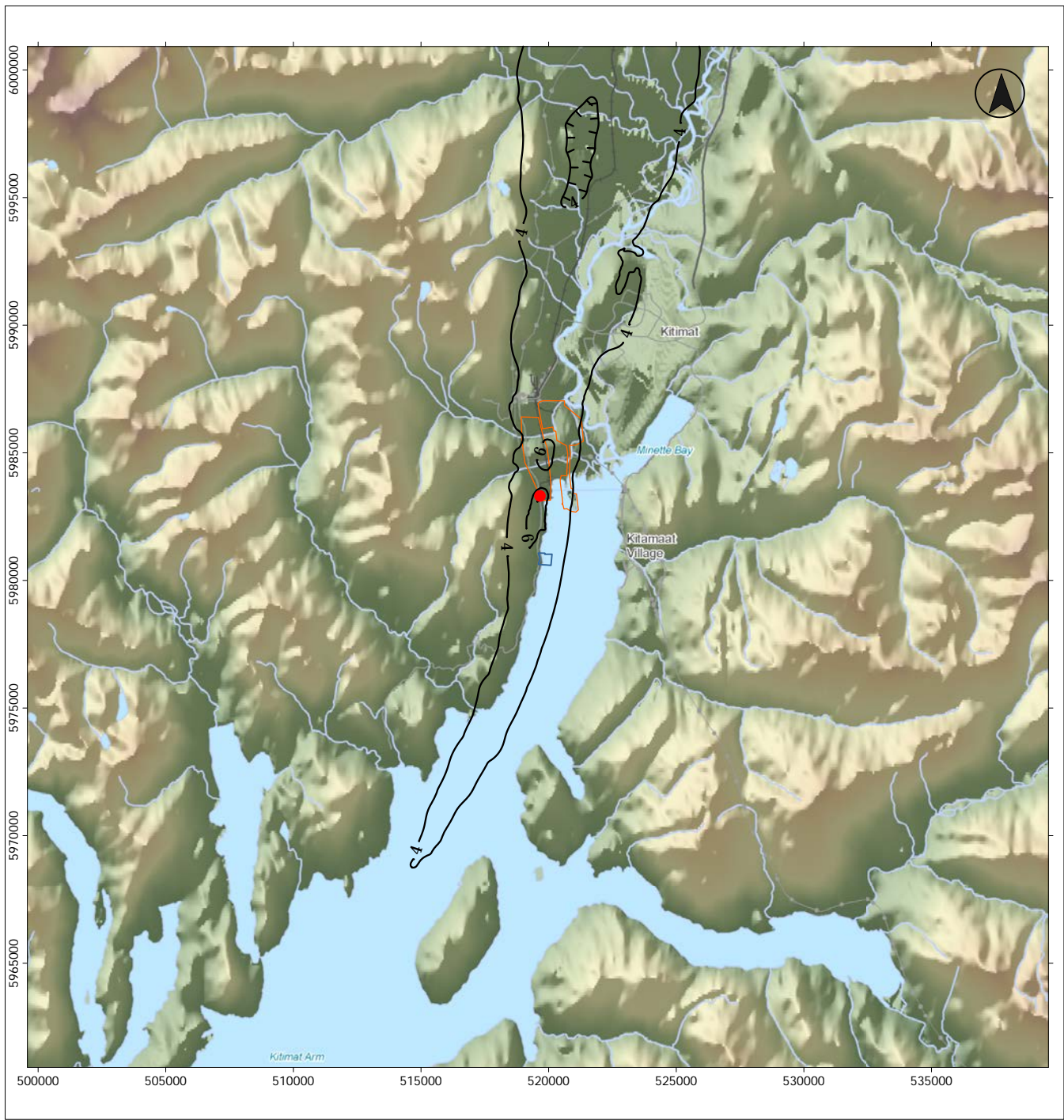
Project Location: Kitimat, British Columbia
 Project Number: 123223008

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project Isopleth Maps

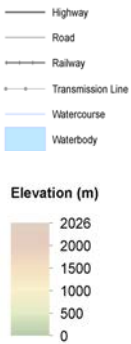
Figure No. **D.1**

Title: **Base Case Predicted Ground-Level 98th Percentile of 1-hour Daily Maximum NO₂ Concentrations (µg/m³)**

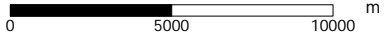
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Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service



Project Area
 Regional Facility Boundary



Maximum Annual Average NO₂ Concentration:
 8.4 µg/m³
 Annual NO₂ BC AQO: 32 µg/m³
 Contour Levels: 4, 6, 8 µg/m³
 Baseline: 2.9 µg/m³



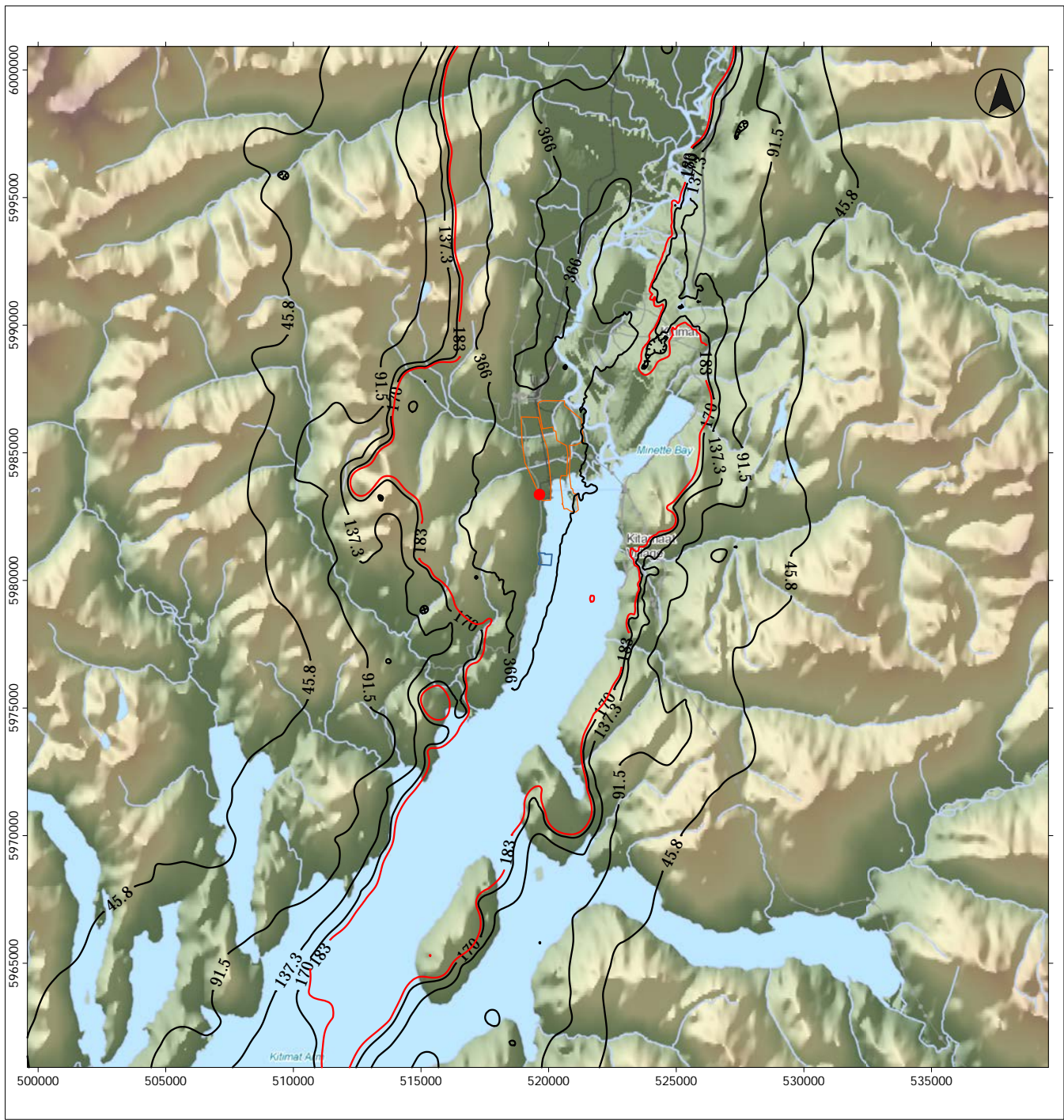
Project Location: Kitimat, British Columbia
 Project Number: 123223008

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project Isopleth Maps

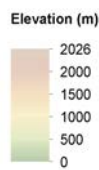
Figure No. **D.2**

Title: **Base Case Predicted Ground-level Annual Average NO₂ Concentrations (µg/m³)**

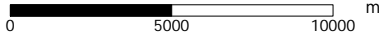
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- Highway
- Road
- Railway
- Transmission Line
- Watercourse
- Waterbody



- Project Area
- Regional Facility Boundary



Project Location: Kitimat, British Columbia
 Project Number: 123223008

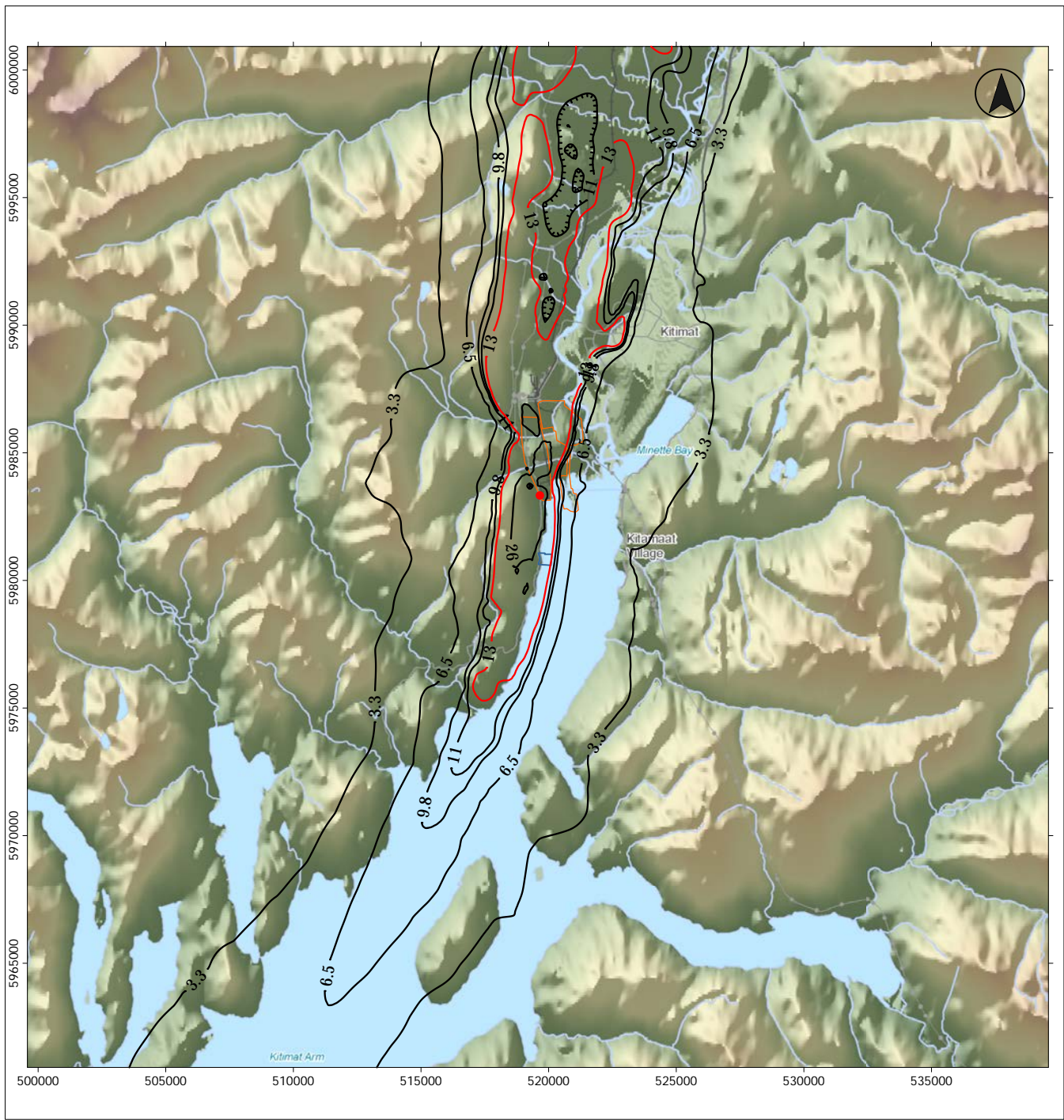
- Maximum 1-hour Average 99th Daily Maximum SO₂ Concentration: 1,736 µg/m³
- 1-hour SO₂ BC AQO: 183 µg/m³ (—)
- Contour Levels: 45.8, 91.5, 137.3, 170, 183, 366 µg/m³
- Baseline: 14.5 µg/m³

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project Isopleth Maps

Figure No. **D.3**

Title: **Base Case Predicted Ground-Level 99th Percentile of 1-hour Daily Maximum SO₂ Concentrations (µg/m³)**

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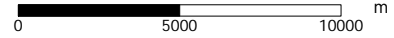


Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

Project Area
 Regional Facility Boundary

● Maximum Annual Average SO₂ Concentration: 75.2 µg/m³
 Annual SO₂ BC AQO: 13 µg/m³ (—)
 Contour Levels: 3.3, 6.5, 9.8, 11, 13, 26 µg/m³
 Baseline: 1.2 µg/m³

Elevation (m)
 2026
 2000
 1500
 1000
 500
 0



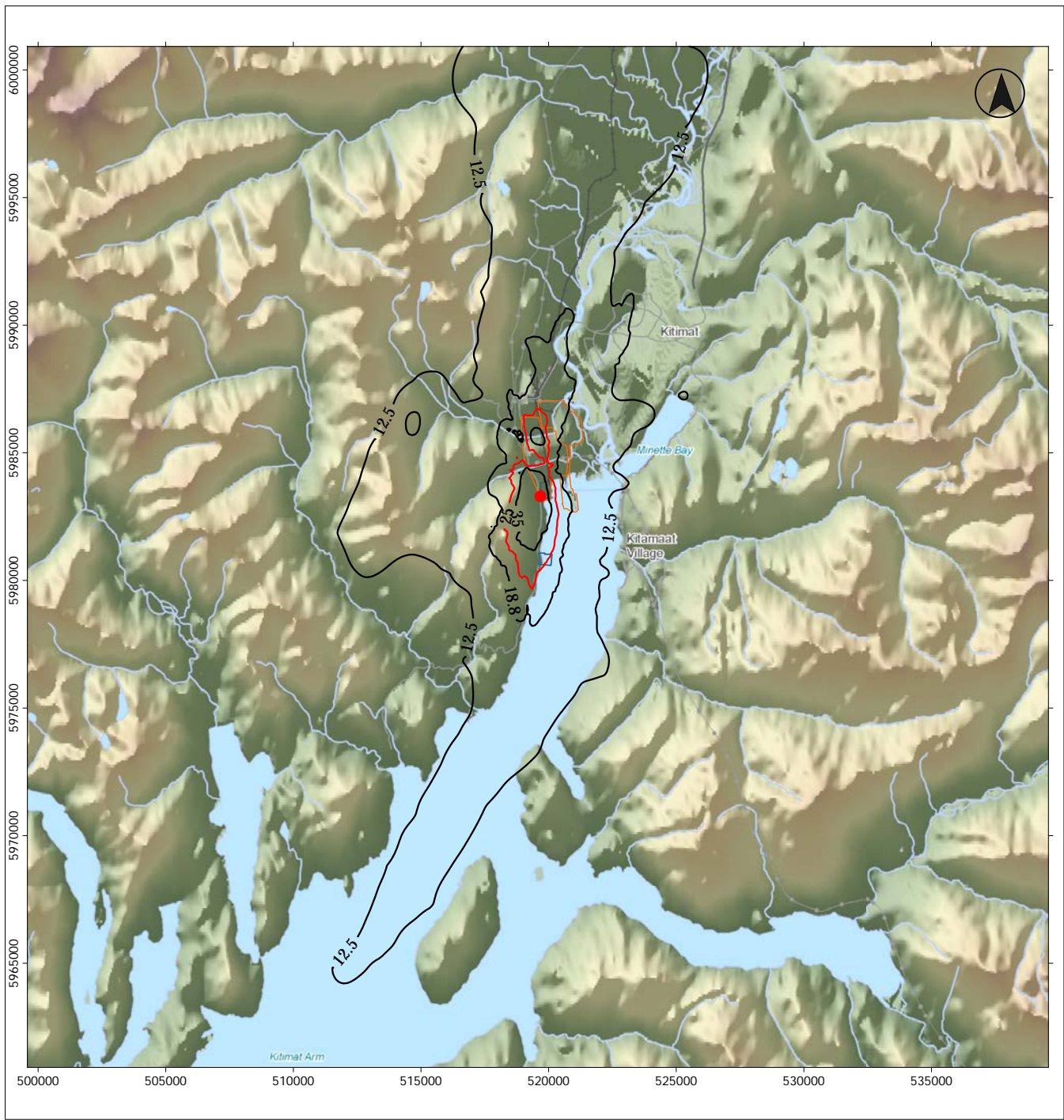
Project Location: Kitimat, British Columbia
 Project Number: 123223008

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project Isopleth Maps

Figure No. **D.4**

Title: **Base Case Predicted Ground-level Annual Average SO₂ Concentrations (µg/m³)**

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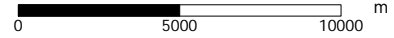


Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

Project Area
 Regional Facility Boundary

● Maximum 24-Hour Average PM_{2.5} Concentration: 82.7 µg/m³
 24-Hour PM_{2.5} BC AQO: 25 µg/m³ (—)
 Contour Levels: 12.5, 18.8, 25, 35 µg/m³
 Baseline: 9.3 µg/m³

Elevation (m)
 2026
 2000
 1500
 1000
 500
 0



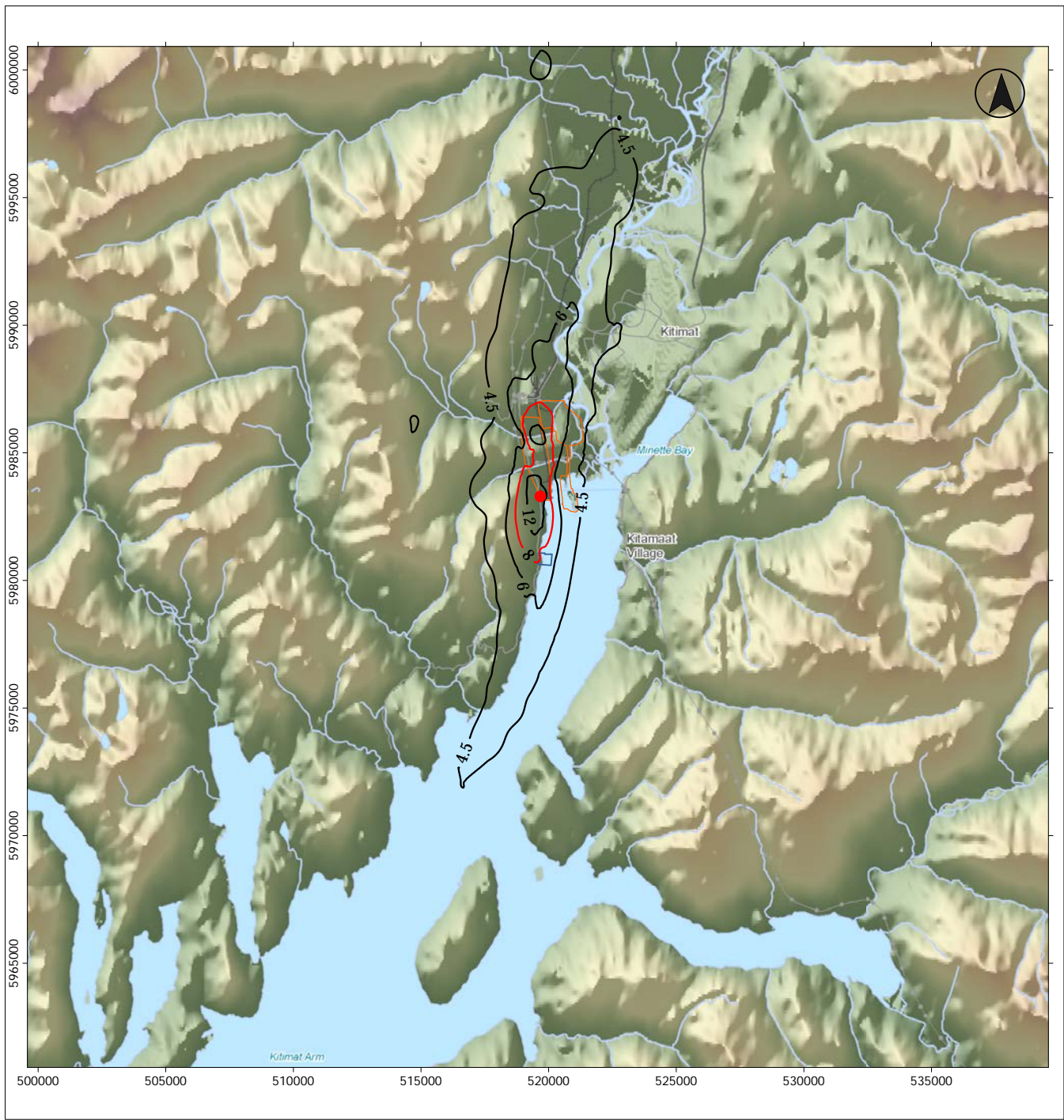
Project Location: Kitimat, British Columbia
 Project Number: 123223008

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project Isopleth Maps

Figure No.: **D.5**

Base Case Predicted Ground-level 98th Percentile 24-Hour Average PM_{2.5} Concentrations (µg/m³)

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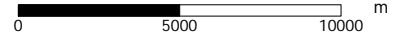


Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

Project Area
 Regional Facility Boundary

● Maximum Annual Average PM_{2.5} Concentration: 22.7 µg/m³
 Annual PM_{2.5} BC ACO: 8 µg/m³ (—)
 Contour Levels: 4.5, 6, 8, 12 µg/m³
 Baseline: 3.4 µg/m³

Elevation (m)
 2026
 2000
 1500
 1000
 500
 0



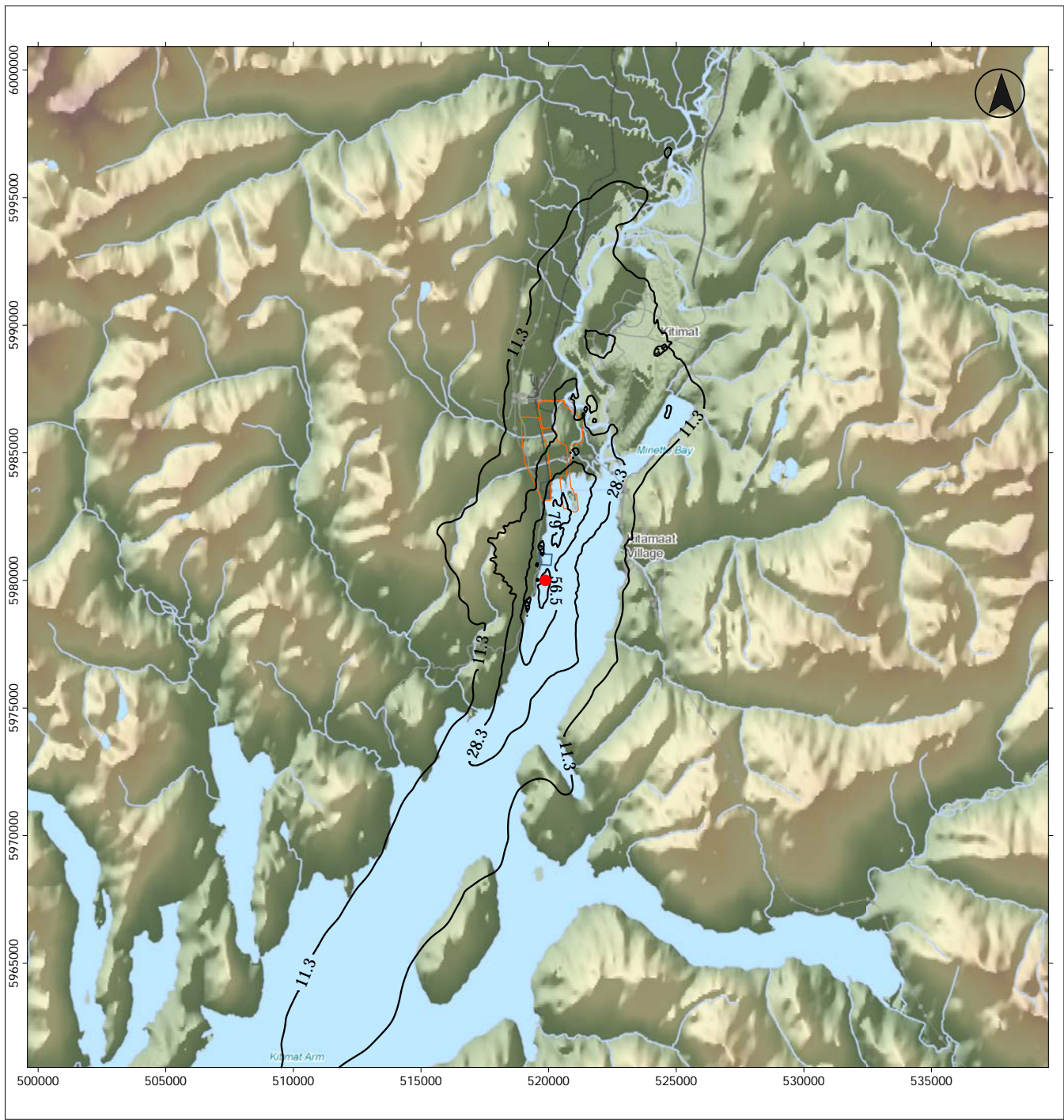
Project Location: Kitimat, British Columbia
 Project Number: 123223008

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project Isopleth Maps

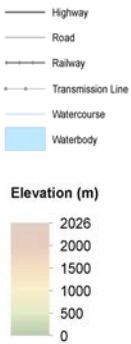
Figure No.: **D.6**

Base Case Predicted Ground-level Annual Average PM_{2.5} Concentrations (µg/m³)

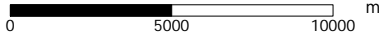
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Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service



Project Area
 Regional Facility Boundary



Maximum 1-hour Average 98th Daily Maximum NO₂ Concentration:
 84.0 µg/m³
 1-hour NO₂ BC AQO: 113 µg/m³
 Contour Levels: 11.3, 28.3, 56.5, 79, 84.8, 113 µg/m³
 Baseline: Not added

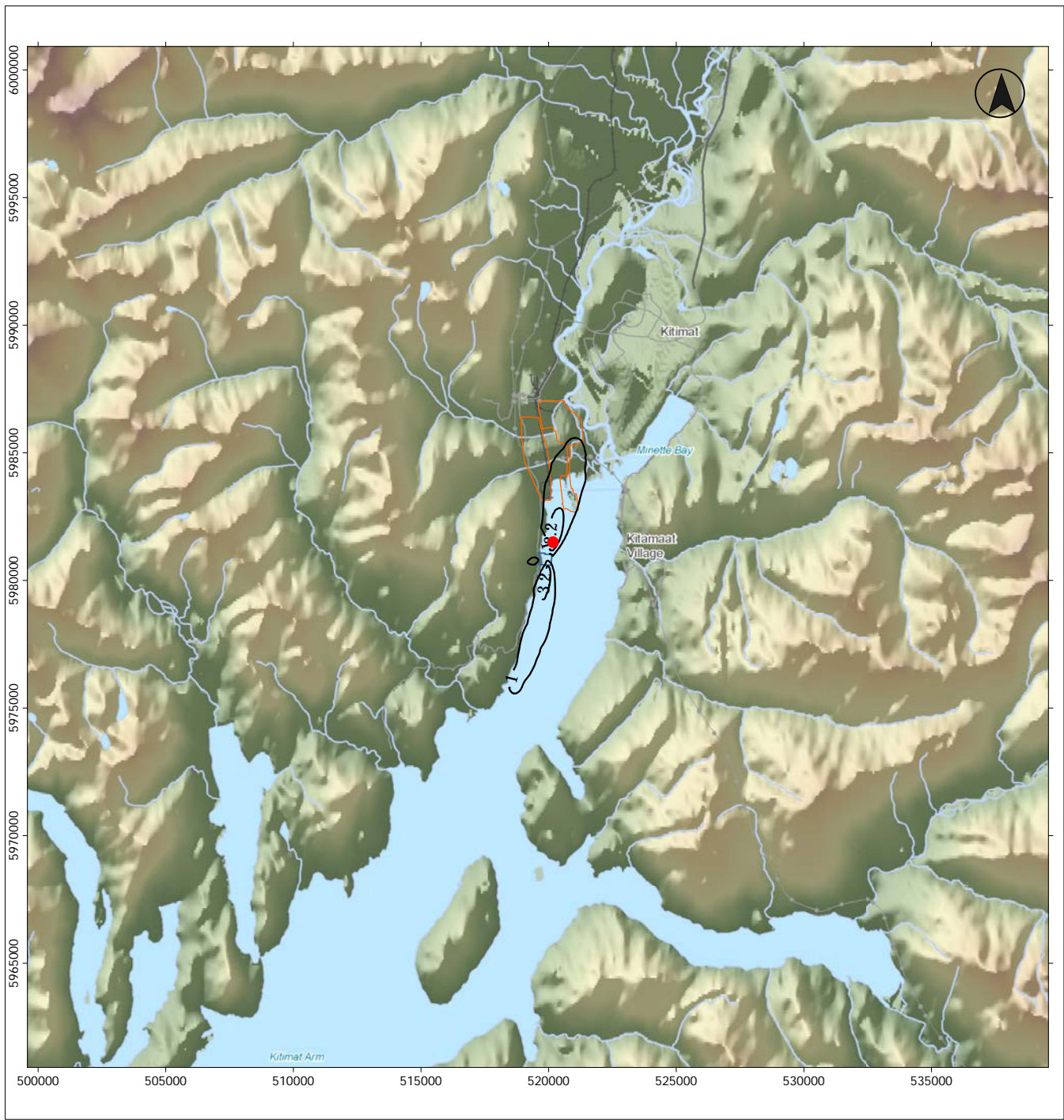


Project Location: Kitimat, British Columbia
 Project Number: 123223008

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project Isopleth Maps

Figure No.: **D.7**
 Title: **Project-Alone Case Predicted Ground-Level 98th Percentile of 1-hour Daily Maximum NO₂ Concentrations (µg/m³)**

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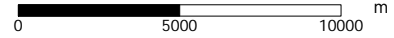


Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

Project Area
 Regional Facility Boundary

Maximum Annual Average NO₂ Concentration: 8.5 µg/m³
 Annual NO₂ BC AQP: 32 µg/m³
 Contour Levels: 1, 3.2 µg/m³
 Baseline: Not added

Elevation (m)
 2026
 2000
 1500
 1000
 500
 0



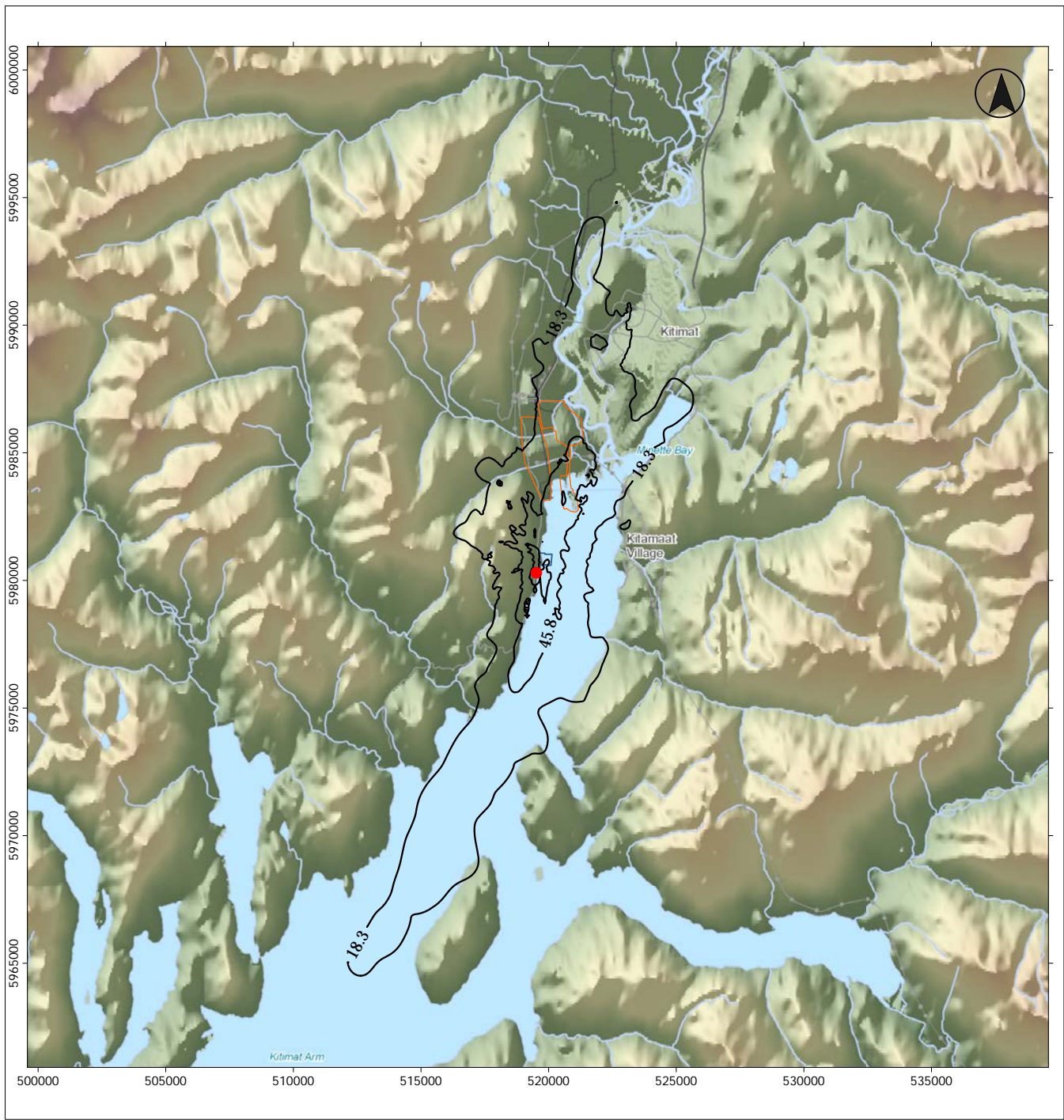
Project Location: Kitimat, British Columbia
 Project Number: 123223008

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project Isopleth Maps

Figure No. **D.8**

Title: **Project-Along Case Predicted Ground-level Annual Average NO₂ Concentrations (µg/m³)**

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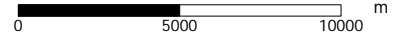
Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

Project Area
 Regional Facility Boundary

Highway
 Road
 Railway
 Transmission Line
 Watercourse
 Waterbody

Elevation (m)
 2026
 2000
 1500
 1000
 500
 0

● Maximum 1-hour Average 98th Daily Maximum SO₂ Concentration:
 133.3 µg/m³
 1-hour SO₂ BC AQO: 183 µg/m³
 Contour Levels: 18.3, 45.8, 91.5 µg/m³
 Baseline: Not added

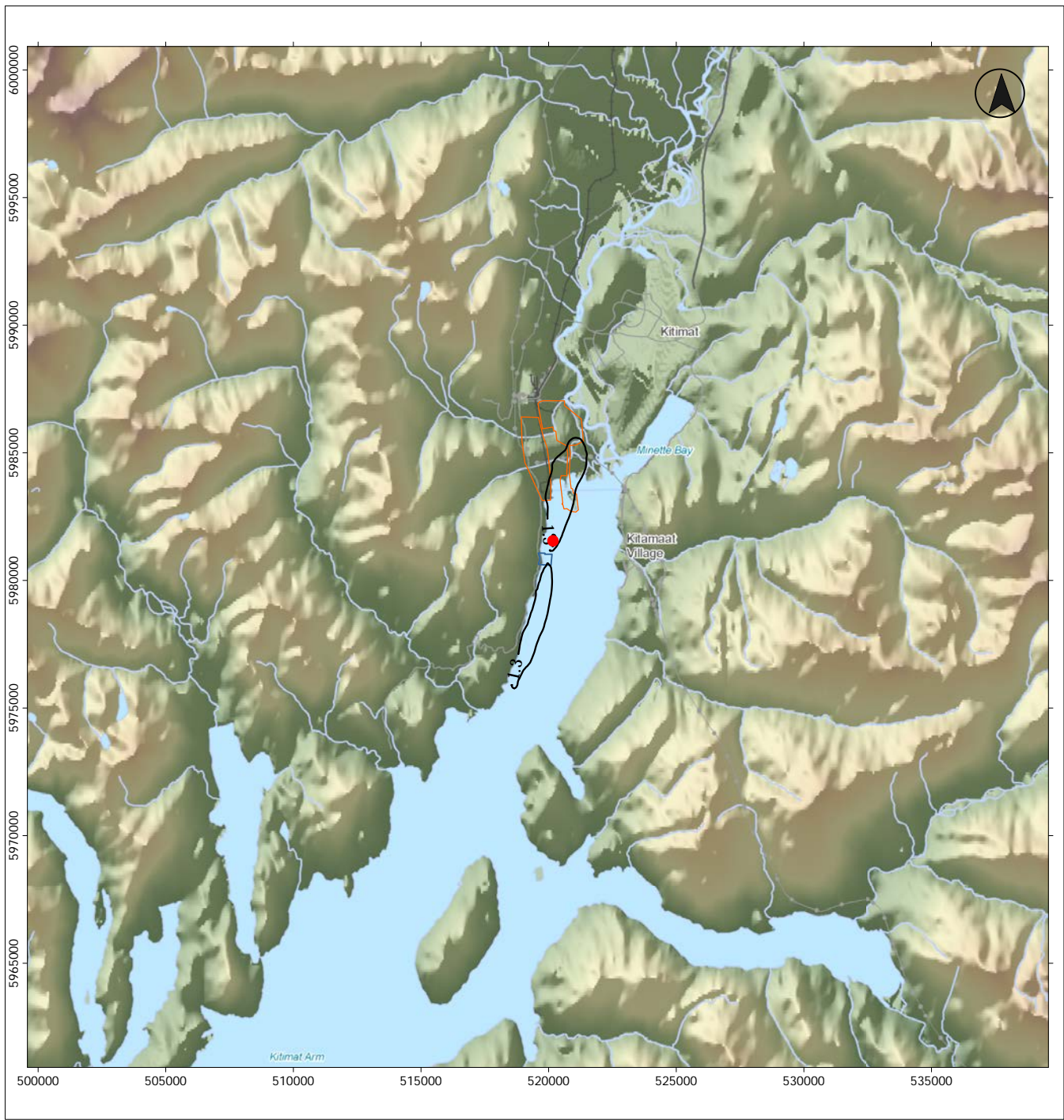


Project Location: Kitimat, British Columbia
 Project Number: 123223008

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project Isopleth Maps

Figure No.: **D.9**
 Title: **Project-Alone Case Predicted Ground-Level 99th Percentile of 1-hour Daily Maximum SO₂ Concentrations (µg/m³)**

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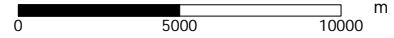
Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

Project Area
 Regional Facility Boundary

Highway
 Road
 Railway
 Transmission Line
 Watercourse
 Waterbody

Elevation (m)
 2026
 2000
 1500
 1000
 500
 0

● Maximum Annual Average SO₂ Concentration: 4.0 µg/m³
 Annual SO₂ BC AQO: 13 µg/m³
 Contour Levels: 1.3 µg/m³
 Baseline: Not added



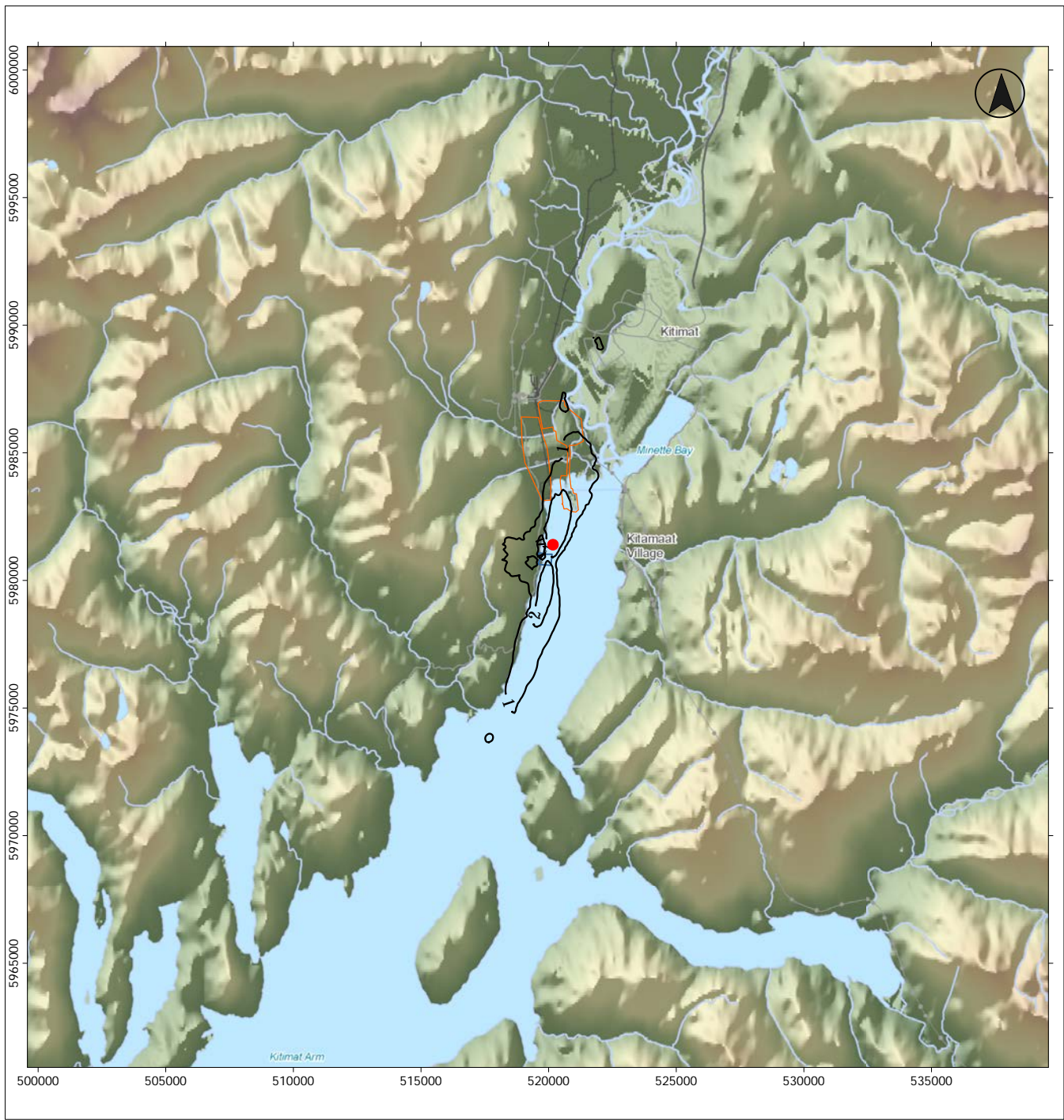
Project Location: Kitimat, British Columbia
 Project Number: 123223008

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project Isopleth Maps

Figure No. **D.10**

Title: **Project-Along Case Predicted Ground-level Annual Average SO₂ Concentrations (µg/m³)**

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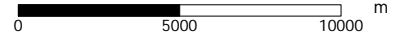
Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

Project Area
 Regional Facility Boundary

Highway
 Road
 Railway
 Transmission Line
 Watercourse
 Waterbody

Elevation (m)
 2026
 2000
 1500
 1000
 500
 0

● Maximum 24-Hour Average PM_{2.5} Concentration:
 6.6 µg/m³
 24-Hour PM_{2.5} BC AQO: 25 µg/m³
 Contour Levels: 1, 2 µg/m³
 Baseline: Not added



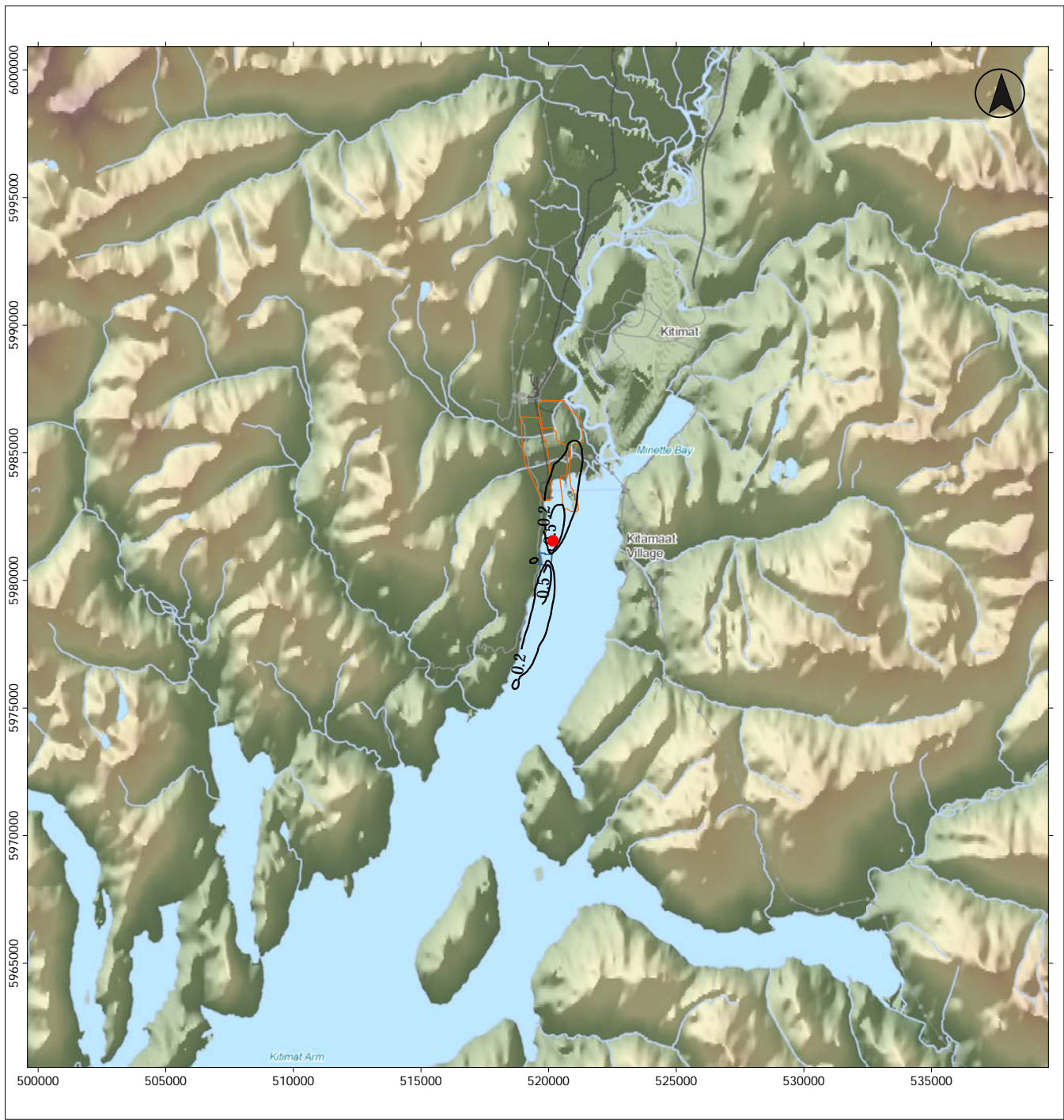
Project Location: Kitimat, British Columbia
 Project Number: 123223008

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project Isopleth Maps

Figure No.: **D.11**

Title: **Project-Alone Case Predicted Ground-level 98th Percentile 24-Hour Average PM_{2.5} Concentrations (µg/m³)**

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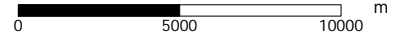


Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

Project Area
 Regional Facility Boundary

Maximum Annual Average PM_{2.5} Concentration:
 1.5 µg/m³
 Annual PM_{2.5} BC ACO: 8 µg/m³
 Contour Levels: 0.2, 0.5 µg/m³
 Baseline: Not added

Elevation (m)
 2026
 2000
 1500
 1000
 500
 0



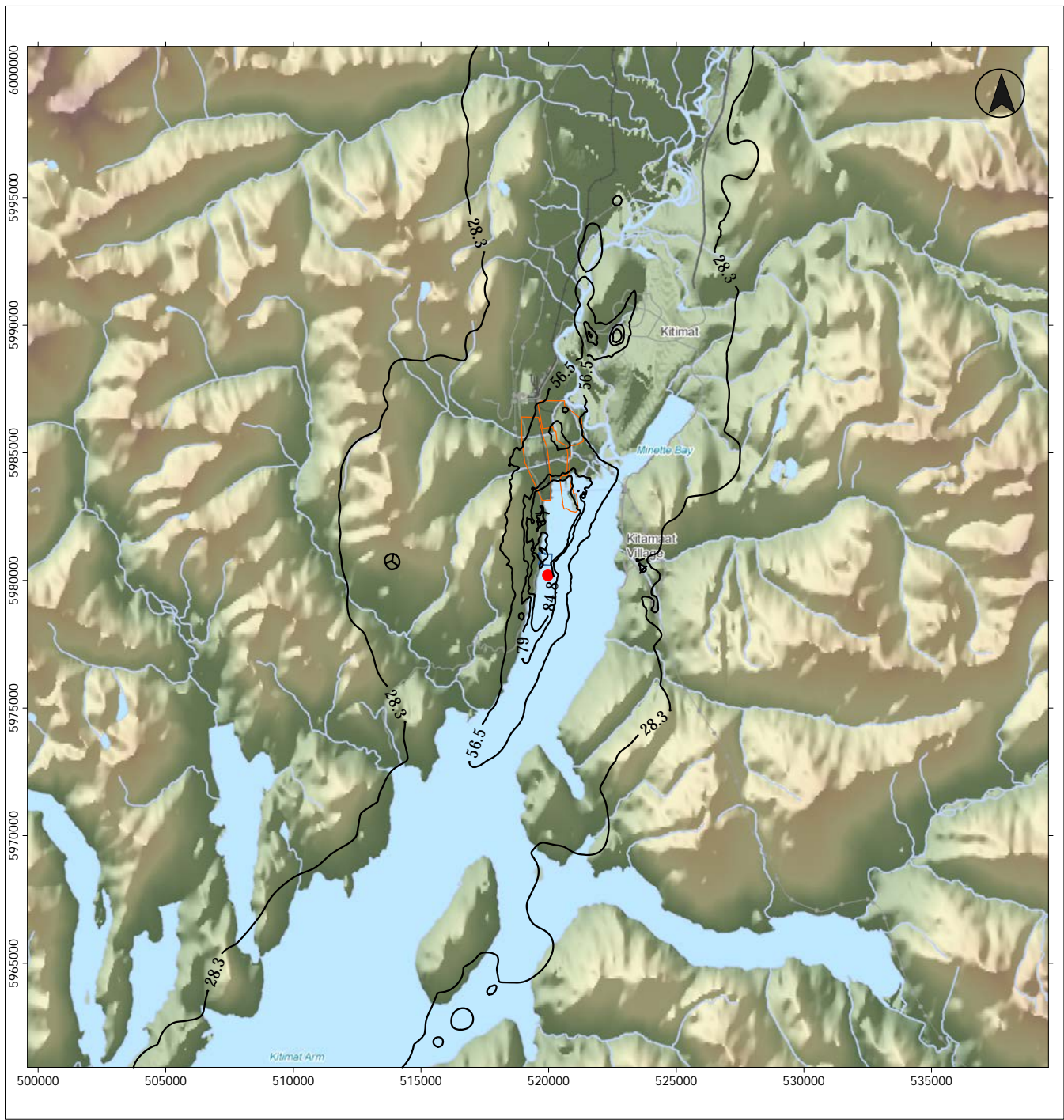
Project Location: Kitimat, British Columbia
 Project Number: 123223008

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project Isopleth Maps

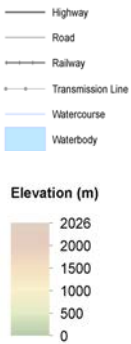
Figure No. **D.12**

Title: **Project-Alone Case Maximum Predicted Ground-level Annual Average PM_{2.5} Concentrations (µg/m³)**

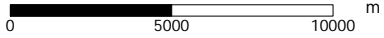
Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.



Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service



Project Area
 Regional Facility Boundary



Project Location: Kitimat, British Columbia
 Project Number: 123223008

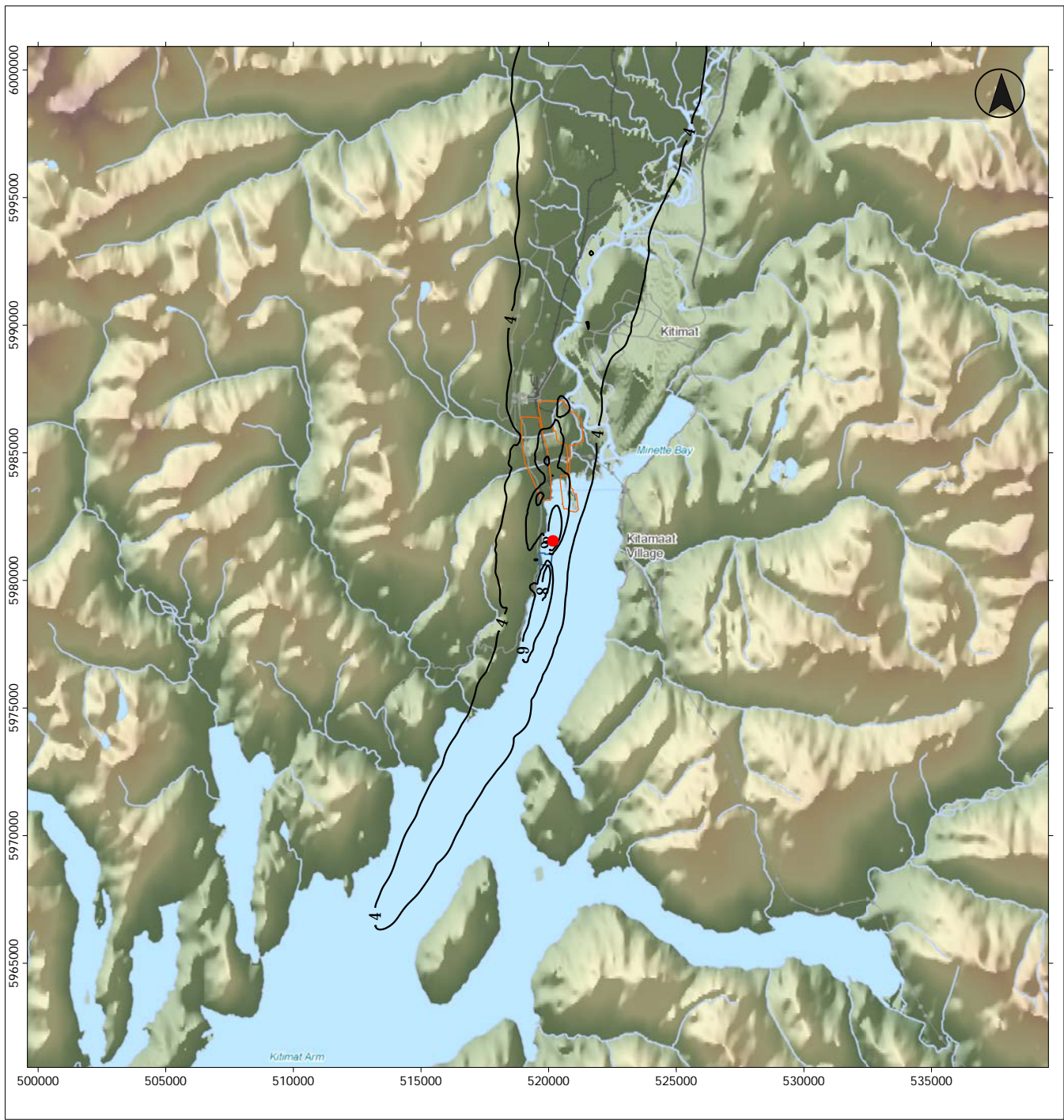
Maximum 1-hour Average 98th Daily Maximum NO₂ Concentration:
 101.5 µg/m³
 1-hour NO₂ BC AQO: 113 µg/m³
 Contour Levels: 11.3, 28.3, 56.5, 79, 84.8, 113 µg/m³
 Baseline: 288 array baseline from Kitimat Whitesail station Added

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project Isopleth Maps

Figure No. **D.13**

Title: **Application Case Predicted Ground-Level 98th Percentile of 1-hour Daily Maximum NO₂ Concentrations (µg/m³)**

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.



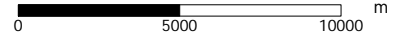
Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

Project Area
 Regional Facility Boundary

Highway
 Road
 Railway
 Transmission Line
 Watercourse
 Waterbody

Elevation (m)
 2026
 2000
 1500
 1000
 500
 0

● Maximum Annual Average NO₂ Concentration:
 13.1 µg/m³
 Annual NO₂ BC AQO: 32 µg/m³
 Contour Levels: 4, 6, 8 µg/m³
 Baseline: 2.9 µg/m³



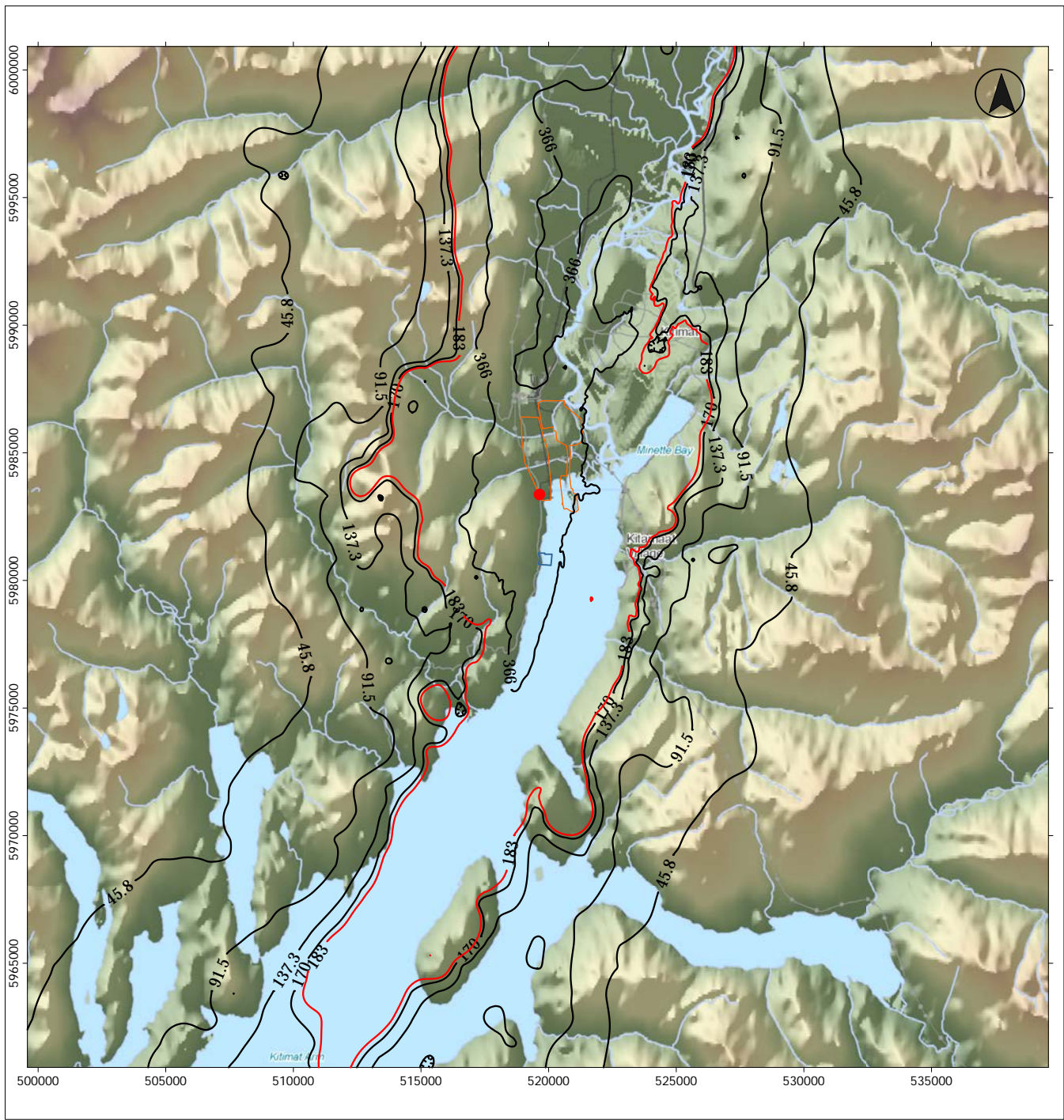
Project Location: Kitimat, British Columbia
 Project Number: 123223008

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project Isopleth Maps

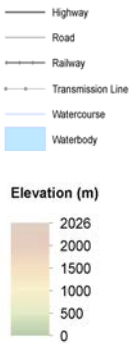
Figure No. **D.14**

Application Case Predicted Ground-level Annual Average NO₂ Concentrations (µg/m³)

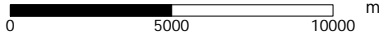
Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.



Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service



Project Area
 Regional Facility Boundary



Project Location: Kitimat, British Columbia
 Project Number: 123223008

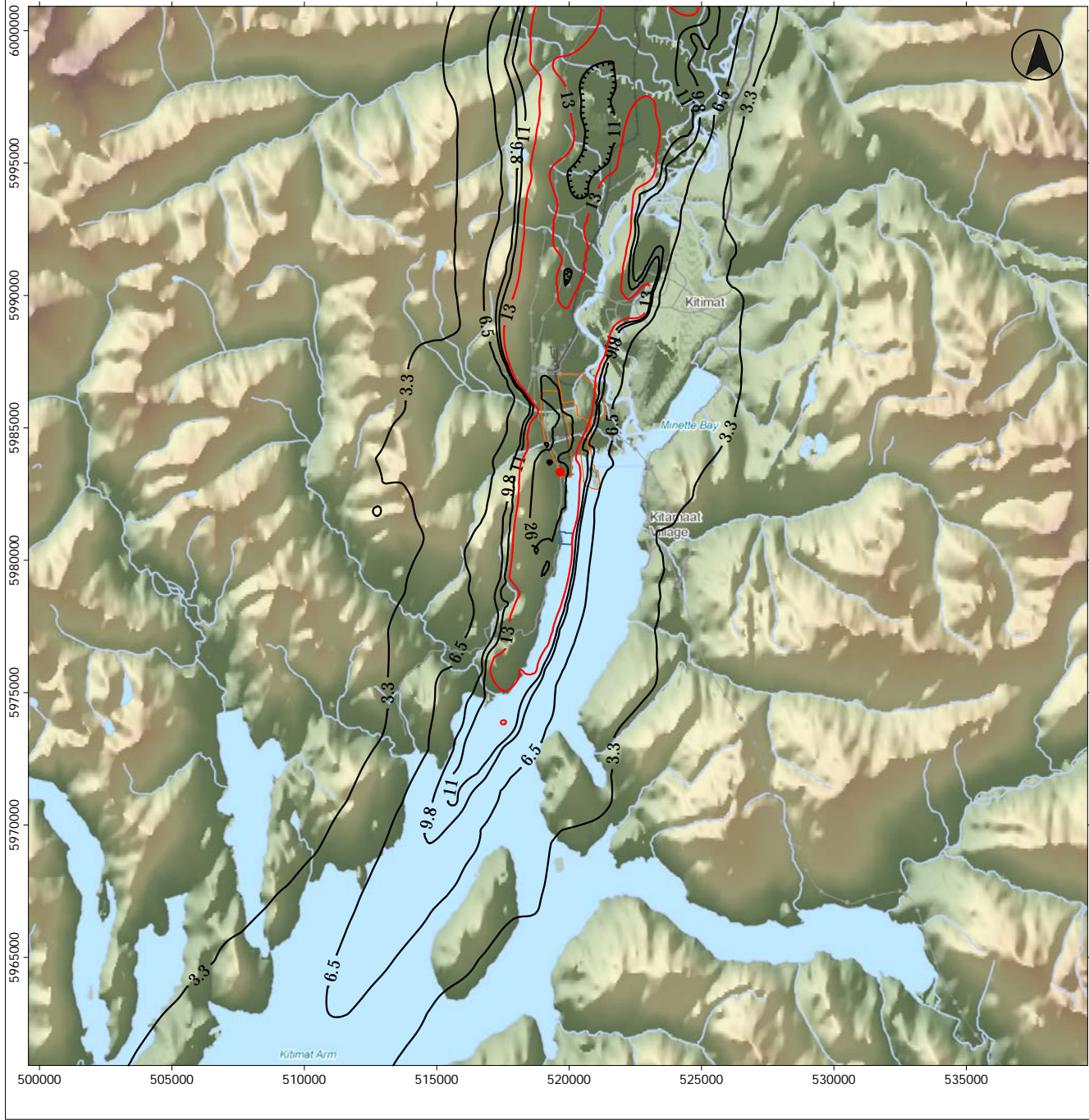
Maximum 1-hour Average 99th Daily Maximum SO₂ Concentration: 1,737 µg/m³
 1-hour SO₂ BC AQO: 183 µg/m³ (—)
 Contour Levels: 45.8, 91.5, 137.3, 170, 183, 366 µg/m³
 Baseline: 14.5 µg/m³

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project Isopleth Maps

Figure No. **D.15**

Title: **Application Case Predicted Ground-Level 99th Percentile of 1-hour Daily Maximum SO₂ Concentrations (µg/m³)**

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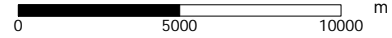


Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

Project Area
 Regional Facility Boundary

● Maximum Annual Average SO₂ Concentration: 75.8 µg/m³
 Annual SO₂ BC AQO: 13 µg/m³ (—)
 Contour Levels: 3.3, 6.5, 9.8, 11, 13, 26 µg/m³
 Baseline: 1.2 µg/m³

Elevation (m)
 2026
 2000
 1500
 1000
 500
 0



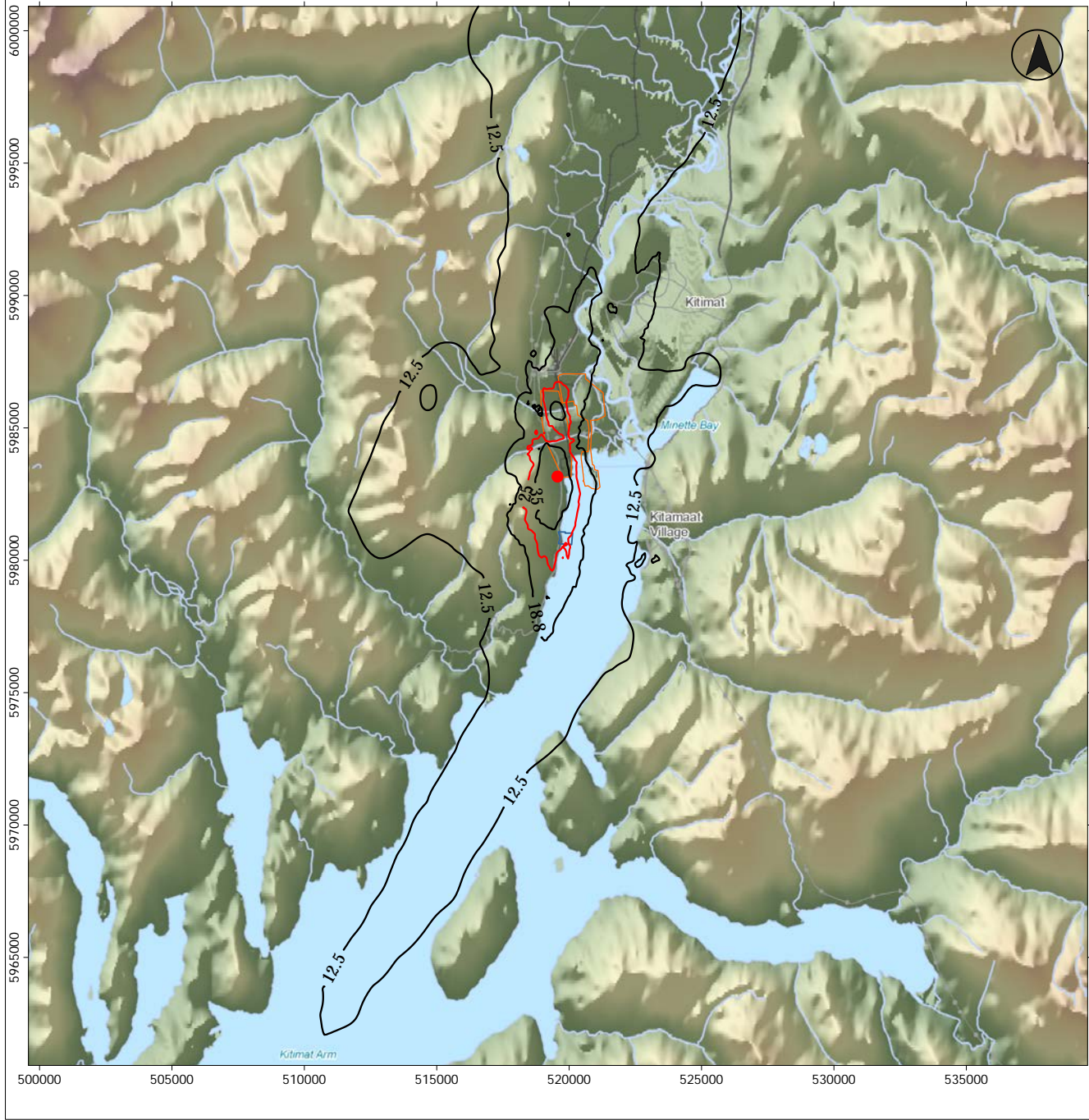
Project Location: Kitimat, British Columbia
 Project Number: 123223008

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project Isopleth Maps

Figure No. **D.16**

Title: **Application Case Predicted Ground-level Annual Average SO₂ Concentrations (µg/m³)**

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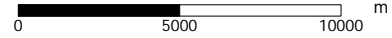
Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

Project Area
 Regional Facility Boundary

Highway
 Road
 Railway
 Transmission Line
 Watercourse
 Waterbody

Elevation (m)
 2026
 2000
 1500
 1000
 500
 0

Maximum 24-Hour Average PM_{2.5} Concentration:
 82.7 µg/m³
 24-Hour PM_{2.5} BC AQO: 25 µg/m³ (—)
 Contour Levels: 12.5, 18.8, 25, 35 µg/m³
 Baseline: 9.3 µg/m³



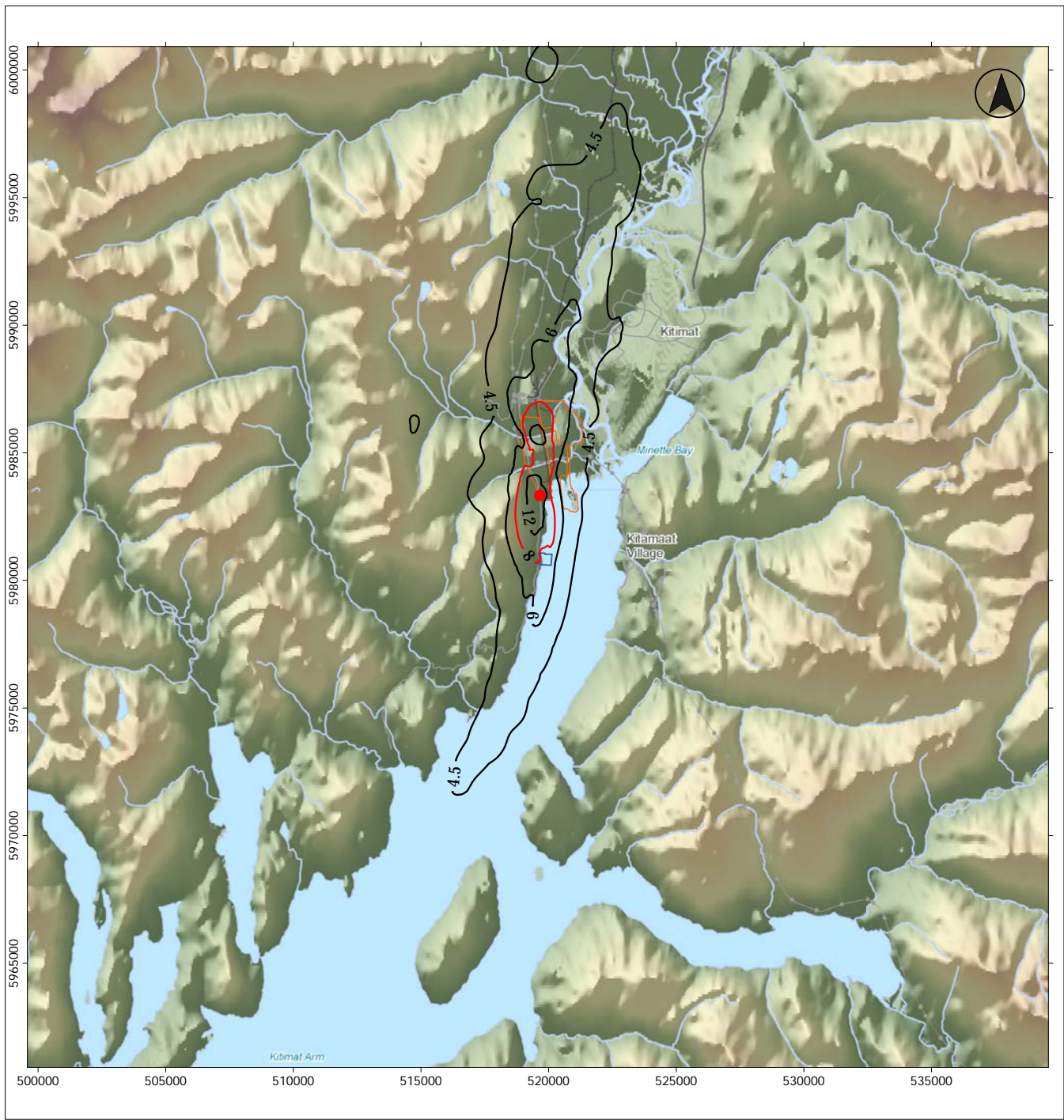
Project Location: Kitimat, British Columbia
 Project Number: 123223008

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project Isopleth Maps

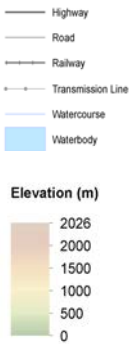
Figure No. **D.17**

Title: **Application Case Predicted Ground-level 98th Percentile 24-Hour Average PM_{2.5} Concentrations (µg/m³)**

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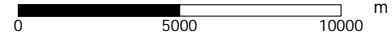


Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service



Project Area
 Regional Facility Boundary

● Maximum Annual Average PM_{2.5} Concentration: 22.8 µg/m³
 Annual PM_{2.5} BC ACO: 8 µg/m³ (—)
 Contour Levels: 4.5, 6, 8, 12 µg/m³
 Baseline: 3.4 µg/m³



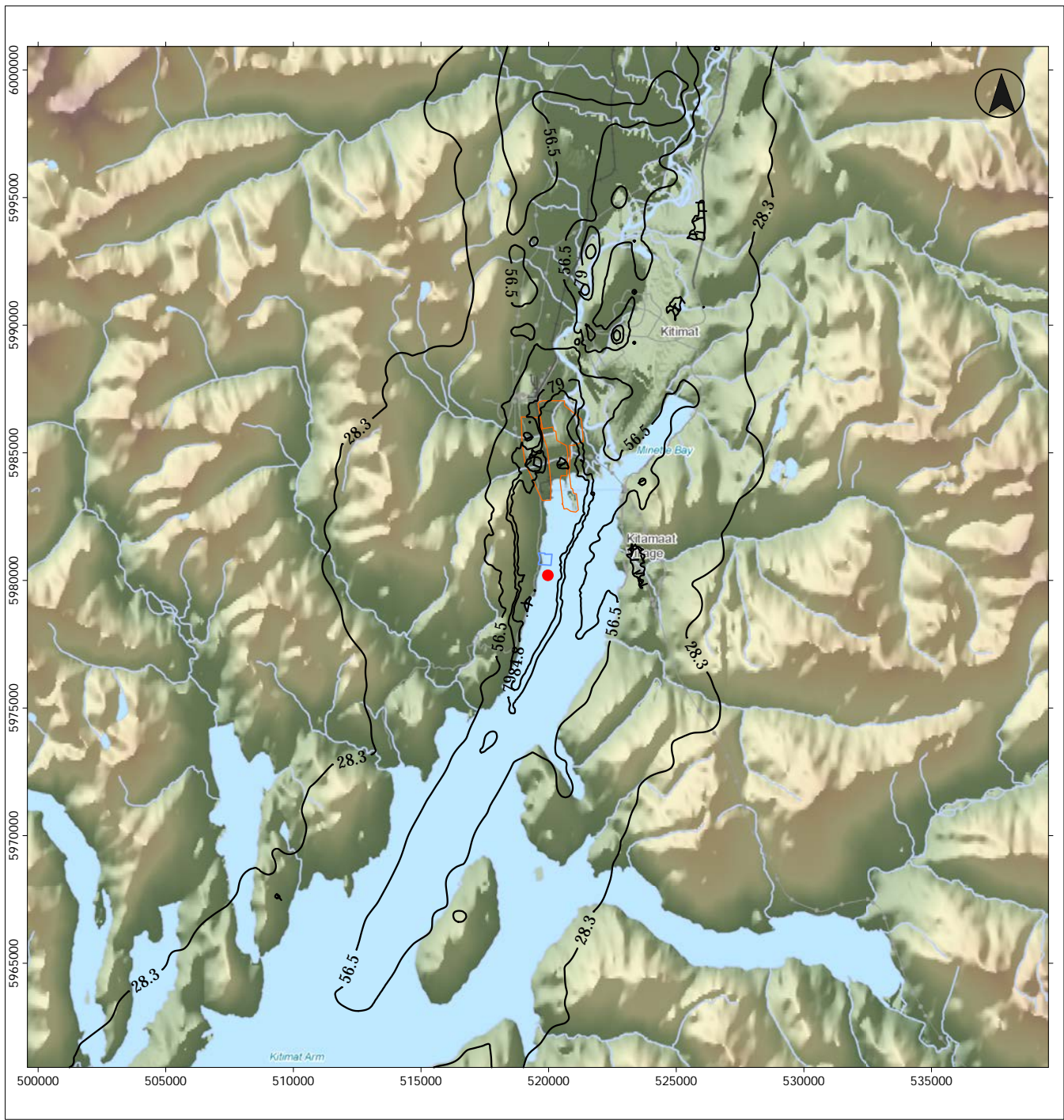
Project Location: Kitimat, British Columbia
 Project Number: 123223008

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project Isopleth Maps

Figure No. **D.18**

Title: **Application Case Predicted Ground-level Annual Average PM_{2.5} Concentrations (µg/m³)**

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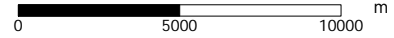
Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

Project Area
 Regional Facility Boundary

Highway
 Road
 Railway
 Transmission Line
 Watercourse
 Waterbody

Elevation (m)
 2026
 2000
 1500
 1000
 500
 0

● Maximum 1-hour Average 98th Daily Maximum NO₂ Concentration:
 102.6 µg/m³
 1-hour NO₂ BC AQO: 113 µg/m³
 Contour Levels: 11.3, 28.3, 56.5, 79, 84.8, 113 µg/m³
 Baseline: 288 array baseline
 from Kitimat Whitesail station Added



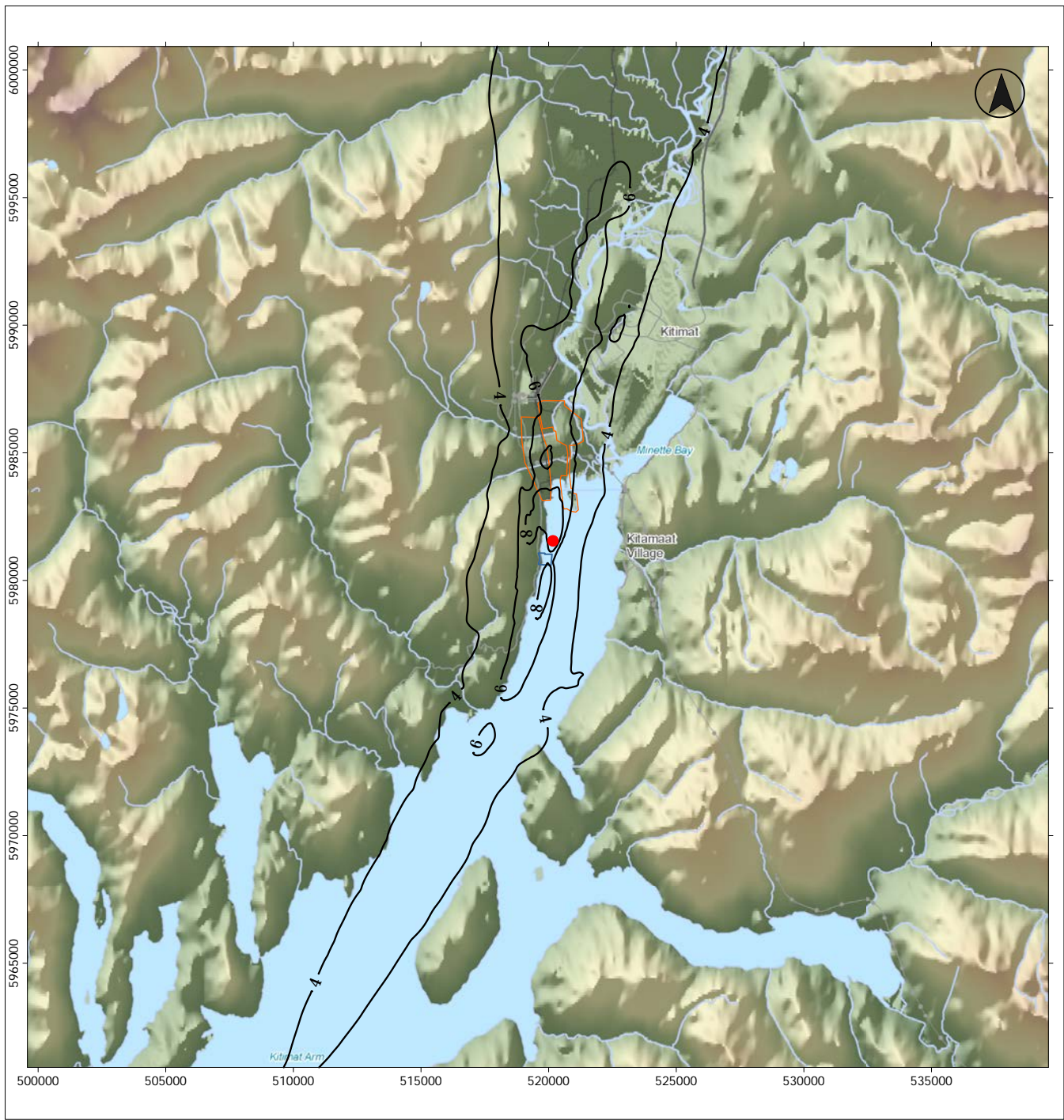
Project Location: Kitimat, British Columbia
 Project Number: 123223008

Client/Project/Report: Cedar LNG Partners (GP) Ltd.
 Cedar LNG Project
 Isopleth Maps

Figure No.: **D.19**

Title: **Future Case Predicted Ground-Level 98th Percentile of 1-hour Daily Maximum NO₂ Concentrations (µg/m³)**

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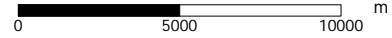
Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

Project Area
 Regional Facility Boundary

Highway
 Road
 Railway
 Transmission Line
 Watercourse
 Waterbody

Elevation (m)
 2026
 2000
 1500
 1000
 500
 0

● Maximum Annual Average NO₂ Concentration: 13.9 µg/m³
 Annual NO₂ BC AQO: 32 µg/m³
 Contour Levels: 4, 6, 8 µg/m³
 Baseline: 2.9 µg/m³



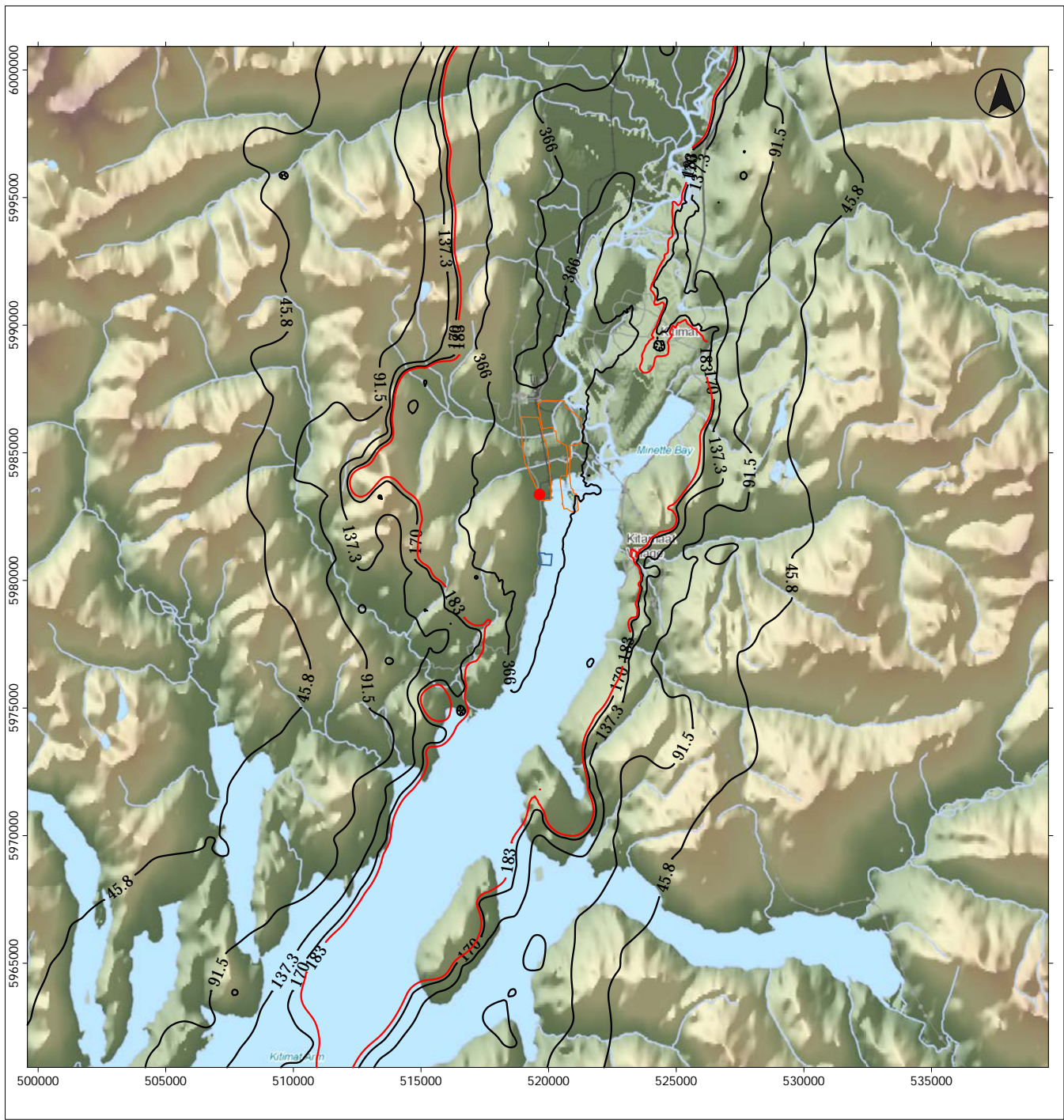
Project Location: Kitimat, British Columbia
 Project Number: 123223008

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project Isopleth Maps

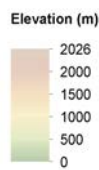
Figure No.: **D.20**

Title: **Future Case Predicted Ground-level Annual Average NO₂ Concentrations (µg/m³)**

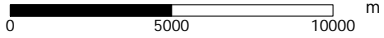
Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.



- Highway
- Road
- Railway
- Transmission Line
- Watercourse
- Waterbody



- Project Area
- Regional Facility Boundary



Project Location: Kitimat, British Columbia
 Project Number: 123223008

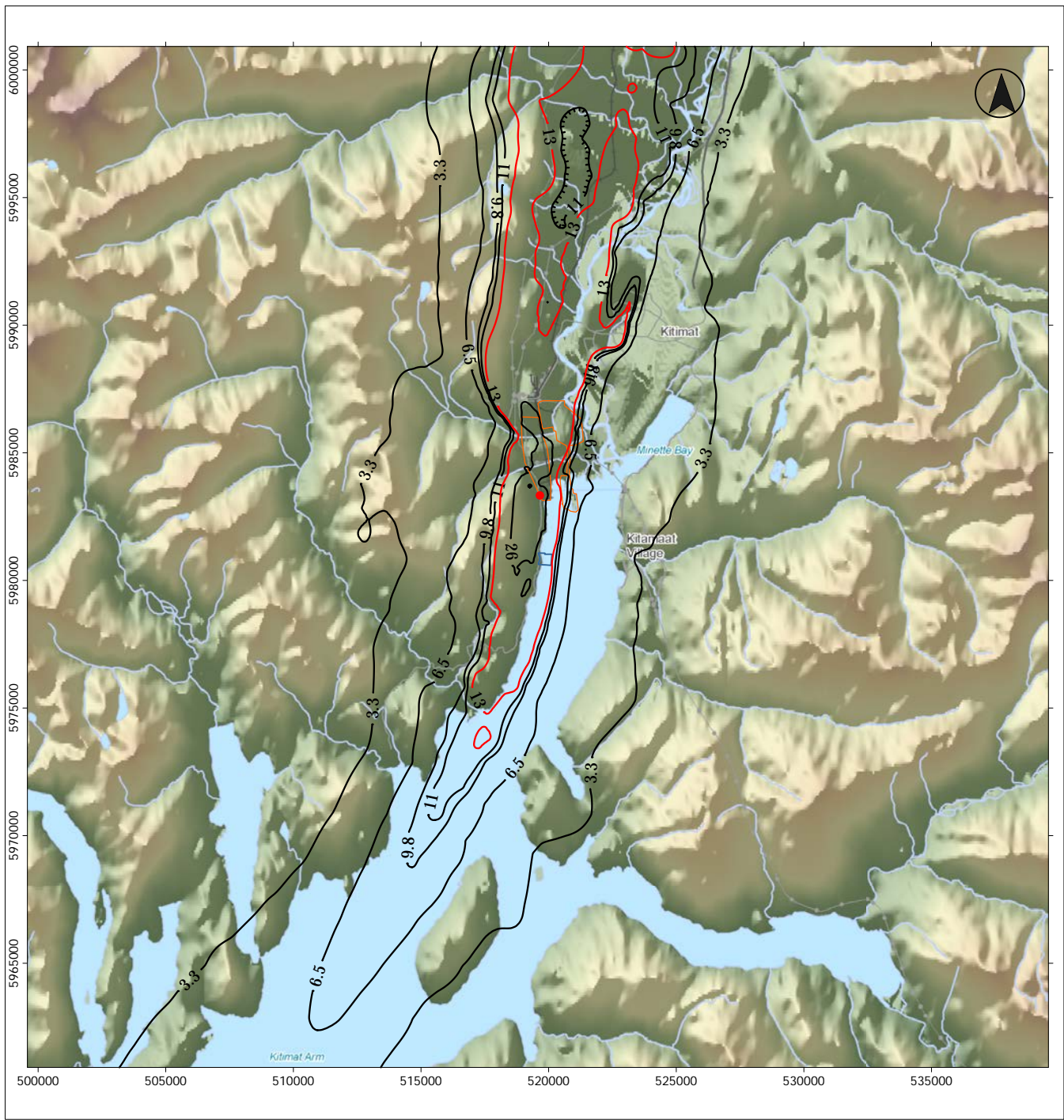
- Maximum 1-hour Average 99th Daily Maximum SO₂ Concentration: 1,746 µg/m³
- 1-hour SO₂ BC AQO: 183 µg/m³ (—)
- Contour Levels: 45.8, 91.5, 137.3, 170, 183, 366 µg/m³
- Baseline: 14.5 µg/m³

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project Isopleth Maps

Figure No. **D.21**

Title: **Future Case Predicted Ground-Level 99th Percentile of 1-hour Daily Maximum SO₂ Concentrations (µg/m³)**

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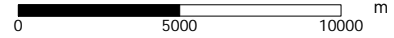
Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

Project Area
 Regional Facility Boundary

Highway
 Road
 Railway
 Transmission Line
 Watercourse
 Waterbody

Elevation (m)
 2026
 2000
 1500
 1000
 500
 0

● Maximum Annual Average SO₂ Concentration:
 76.2 µg/m³
 Annual SO₂ BC AQO: 13 µg/m³ (—)
 Contour Levels: 3.3, 6.5, 9.8, 11, 13, 26 µg/m³
 Baseline: 1.2 µg/m³



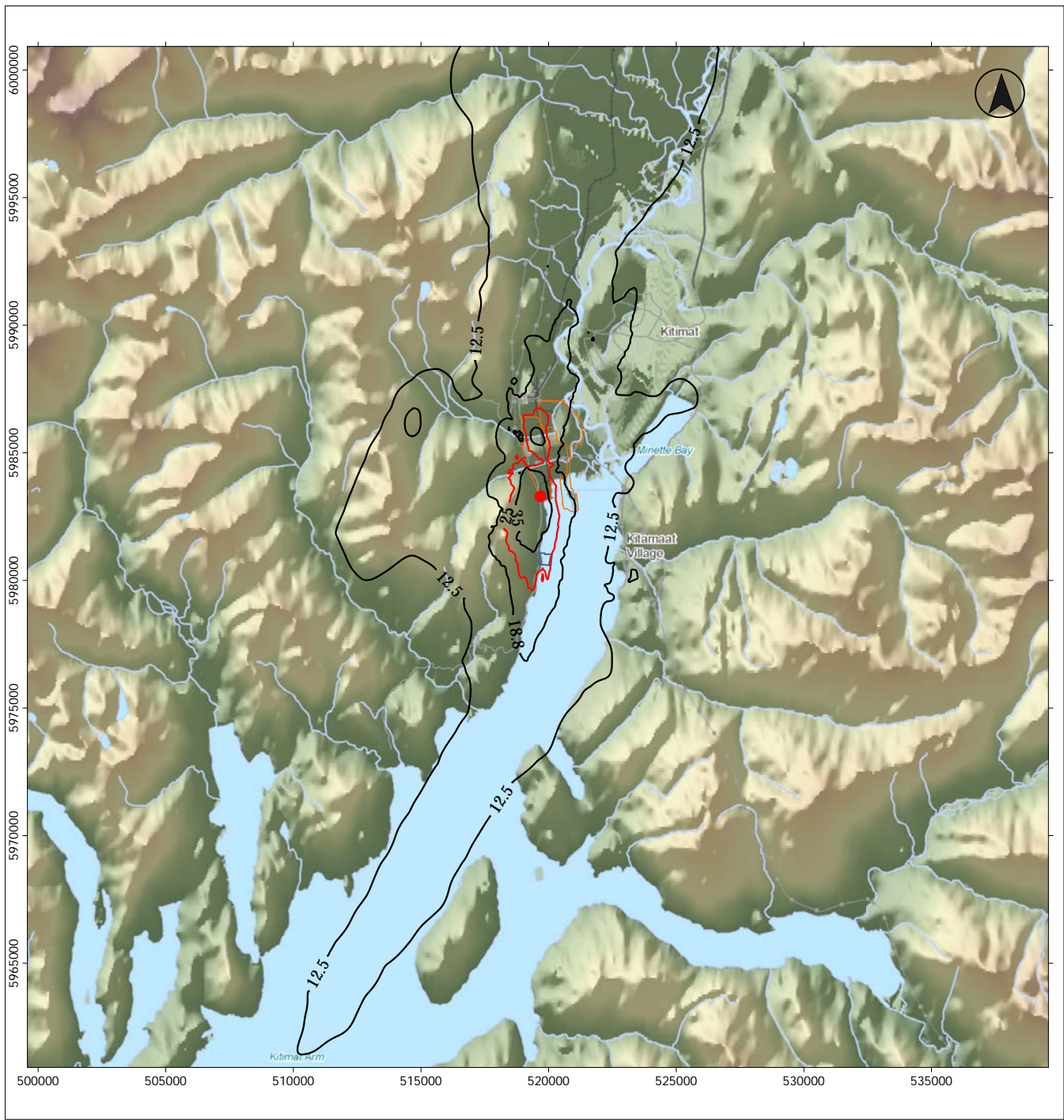
Project Location: Kitimat, British Columbia
 Project Number: 123223008

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project Isopleth Maps

Figure No. **D.22**

Title: **Future Case Maximum Predicted Ground-level Annual Average SO₂ Concentrations (µg/m³)**

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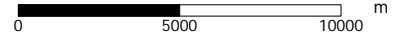


Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

Project Area
 Regional Facility Boundary

● Maximum 24-Hour Average PM_{2.5} Concentration: 82.8 µg/m³
 24-Hour PM_{2.5} BC AQO: 25 µg/m³ (—)
 Contour Levels: 12.5, 18.8, 25, 35 µg/m³
 Baseline: 9.3 µg/m³

Elevation (m)
 2026
 2000
 1500
 1000
 500
 0



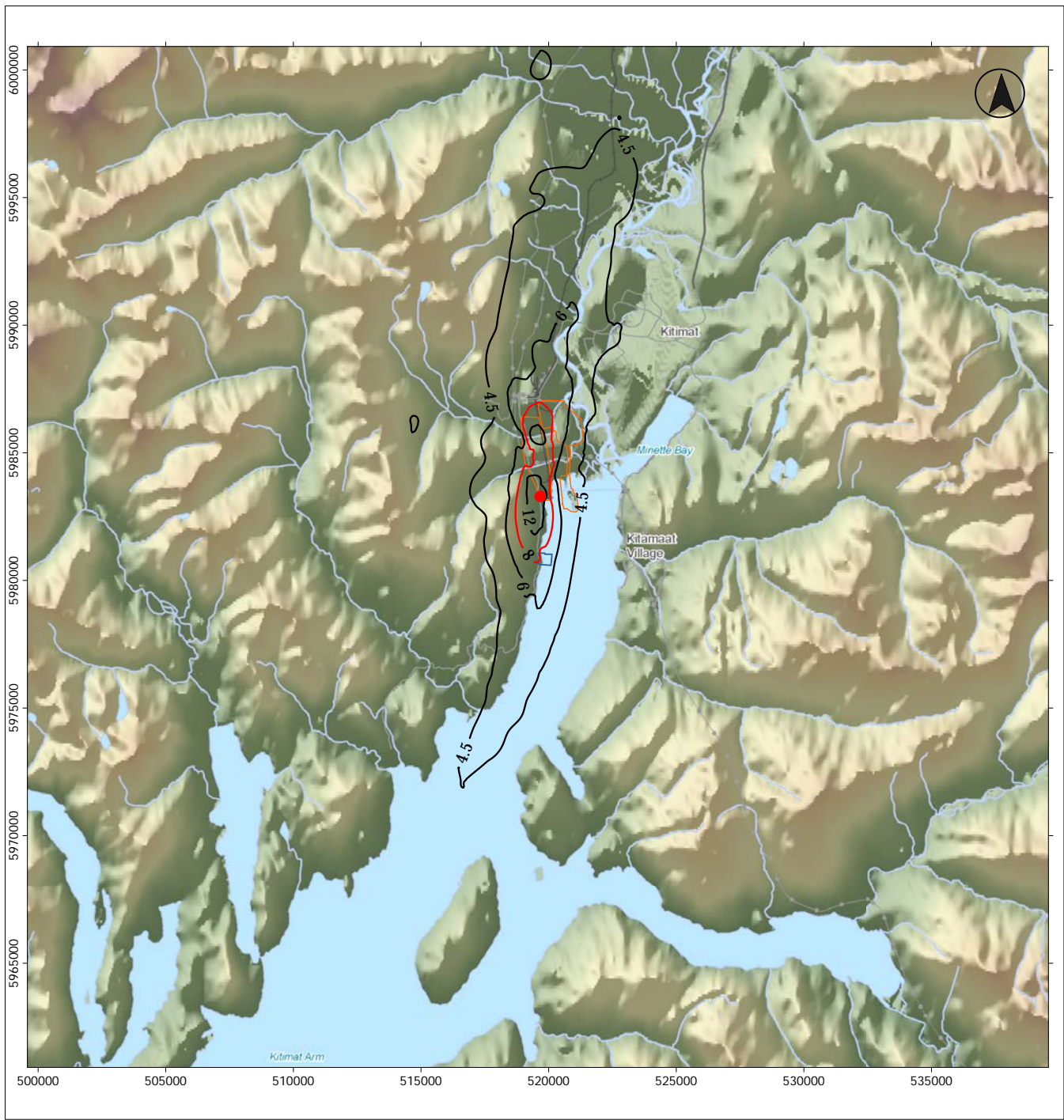
Project Location: Kitimaat, British Columbia
 Project Number: 123223008

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project Isopleth Maps

Figure No. **D.23**

Title: **Future Case Predicted Ground-level 98th Percentile 24-Hour Average PM_{2.5} Concentrations (µg/m³)**

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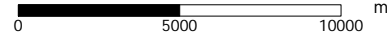


Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

Project Area
 Regional Facility Boundary

● Maximum Annual Average PM_{2.5} Concentration: 22.8 µg/m³
 Annual PM_{2.5} BC ACO: 8 µg/m³ (—)
 Contour Levels: 4.5, 6, 8, 12 µg/m³
 Baseline: 3.4 µg/m³

Elevation (m)
 2026
 2000
 1500
 1000
 500
 0



Project Location: Kitimat, British Columbia
 Project Number: 123223008

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project Isopleth Maps

Figure No.: **D.24**

Title: **Future Case Predicted Ground-level Annual Average PM_{2.5} Concentrations (µg/m³)**

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

Appendix E Measured and Predicted Concentrations at Kitimat Monitoring Stations



Table E.1 Base Case Dispersion Modelling Results vs Measurement at the Monitoring Stations

Substance	Averaging Period	Kitimat Whitesail			Kitimat Haul Road			Kitimat Haisla Village		
		Maximum Predicted Concentration Including Baseline (µg/m ³)	Maximum Measured Concentration (µg/m ³)	Over/ under (%) Prediction	Maximum Predicted Concentration Including Baseline (µg/m ³)	Maximum Measured Concentration (µg/m ³)	Over/ under (%) Prediction	Maximum Predicted Concentration Including Baseline (µg/m ³)	Maximum Measured Concentration (µg/m ³)	Over/ under (%) Prediction
NO ₂	1-hour	40.7	26.3	55%	51.6	-	-	30.4	18.6 ^a	63%
	Annual	3.7	3.4	9%	4.7	-	-	3.2	0.8 ^a	302%
SO ₂	1-hour	272	37.5	626%	652	183	257%	248	51.2	385%
	Annual	7.3	1.2	507%	24.3	13.7	77%	3.6	1.2	199%
PM _{2.5}	24-hour	11.6	13.5	-14%	24.3	20.0	22%	11.8	10.8	10%
	Annual	3.9	4.5	-12%	8.3	6.4	30%	3.7	3.7	1%
Substance	Averaging Period	Kitimat Riverlodge			Kitimat Yacht Club			Kitimat Industrial Ave		
		Maximum Predicted Concentration Including Baseline (µg/m ³)	Maximum Measured Concentration (µg/m ³)	Over/ under (%) Prediction	Maximum Predicted Concentration Including Baseline (µg/m ³)	Maximum Measured Concentration (µg/m ³)	Over/ under (%) Prediction	Maximum Predicted Concentration Including Baseline (µg/m ³)	Maximum Measured Concentration (µg/m ³)	Over/ under (%) Prediction
NO ₂	1-hour	76.9	16.2 ^b	375%	77.4	-	-	34.6	-	-
	Annual	5.3	1.5 ^b	252%	5.2	-	-	4.6	-	-
SO ₂	1-hour	565	58.0	875%	775	-	-	293	84.80	246%
	Annual	18.0	1.6	1025%	12.5	-	-	13.1	3.90	236%
PM _{2.5}	24-hour	18.0	13.8	30%	27.3	-	-	18.7	-	-
	Annual	5.6	4.9	15%	6.9	-	-	5.9	-	-

Notes:
 Achievement for each parameter and time averaging interval is as described in the notes section of Table 2-1 in the technical data report, except for NO₂ at the Kitimat Riverlodge and Kitimat Haisla Village monitoring stations.

^a For the Kitimat Riverlodge station, the maximum measured NO₂ concentrations were based on the period from May 22, 2024 (5 p.m.) to May 22, 2025 (4 p.m.), due to data availability.

^b For the Kitimat Haisla Village station, the maximum measured NO₂ concentrations were based on the period from July 15, 2024 (1 p.m.) to June 12, 2025 (12 a.m.), due to data availability.



Cedar LNG Project
Technical Data Report— Air Quality Dispersion Modelling
Appendix E: Measured and Predicted Concentrations at Kitimat Monitoring Stations
September 2025

Table E.2 Project-Along Case Dispersion Modelling Results

Substance	Averaging Period	Kitimat Whitesail	Kitimat Haul Road	Kitimat Haisla Village	Kitimat Riverlodge	Kitimat Yacht Club	Kitimat Industrial Ave
		Maximum Predicted Concentrations (µg/m ³)					
NO ₂	1-hour	14.1	19.0	13.5	29.7	73.9	18.1
	Annual	0.2	0.4	0.1	0.5	2.0	0.3
SO ₂	1-hour	13.7	17.9	14.7	40.1	69.5	16.9
	Annual	0.4	0.5	0.1	0.9	1.7	0.4
PM _{2.5}	24-hour	0.2	0.5	0.2	0.8	1.7	0.5
	Annual	0.0	0.1	0.0	0.1	0.3	0.1

Notes:

Achievement for each parameter and time averaging interval is as described in the notes section of Table 2-1 in the technical data report



Cedar LNG Project
Technical Data Report— Air Quality Dispersion Modelling
Appendix E: Measured and Predicted Concentrations at Kitimat Monitoring Stations
September 2025

Table E.3 Application Case Dispersion Modelling Results

Substance	Averaging Period	Kitimat Whitesail	Kitimat Haul Road	Kitimat Haisla Village	Kitimat Riverlodge	Kitimat Yacht Club	Kitimat Industrial Ave
		Maximum Predicted Concentrations including Baseline (µg/m ³)					
NO ₂	1-hour	44.5	56.5	35.0	80.4	91.0	41.2
	Annual	3.9	5.1	3.3	5.8	6.9	4.9
SO ₂	1-hour	273	654	251	572	782	294
	Annual	7.6	24.8	3.7	18.8	14.2	13.5
PM _{2.5}	24-hour	12.0	24.7	12.3	19.1	27.5	19.2
	Annual	4.0	8.4	3.8	5.7	7.2	6.0

Notes:

Achievement for each parameter and time averaging interval is as described in the notes section of Table 2-1 in the technical data report



Cedar LNG Project
Technical Data Report— Air Quality Dispersion Modelling
Appendix E: Measured and Predicted Concentrations at Kitimat Monitoring Stations
September 2025

Table E.4 Future Case Dispersion Modelling Results

Substance	Averaging Period	Kitimat Whitesail	Kitimat Haul Road	Kitimat Haisla Village	Kitimat Riverlodge	Kitimat Yacht Club	Kitimat Industrial Ave
		Maximum Predicted Concentrations including Baseline ($\mu\text{g}/\text{m}^3$)					
NO ₂	1-hour	68.0	82.6	45.7	92.7	95.3	53.9
	Annual	4.5	5.7	3.5	6.8	8.1	5.8
SO ₂	1-hour	276	655	256	579	795	300
	Annual	7.8	25.0	3.8	19.2	14.7	13.8
PM _{2.5}	24-hour	11.9	24.7	12.1	18.9	27.8	19.0
	Annual	4.0	8.4	3.8	5.8	7.2	6.0

Notes:

Achievement for each parameter and time averaging interval is as described in the notes section of Table 2-1 in the technical data report



Appendix B

Acoustics Technical Data Report

Cedar LNG Project Technical Data Report—Acoustics

Application for an Amendment to
Provincial Environmental Assessment Certificate and Federal Decision Statement

September 2025

Prepared for:



Prepared by:
Stantec Consulting Ltd.

Revision: 0

Limitations and Sign-off

This document entitled Technical Data Report—Acoustics was prepared by Stantec Consulting Ltd. (“Stantec”) for the account of Cedar LNG Partners LP (the “Client”) to support the regulatory review process for its Application for Operations Phase Amendment to Provincial Environmental Assessment Certificate and Federal Decision Statement (the “Application”) for the Cedar LNG Project (the “Project”). In connection therewith, this document may be reviewed and used by the Environmental Assessment Office, Impact Assessment Agency of Canada, participating Indigenous nations, and all members of the Technical Advisory Committee participating in the review process in the normal course of its duties. Except as set forth in the previous sentence, any reliance on this document by any other party or use of it for any other purpose is strictly prohibited. The material in it reflects Stantec’s professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The information and conclusions in the document are based on the conditions existing at the time the document was published and does not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by the Client or others, unless expressly stated otherwise in the document. Any use which another party makes of this document is the responsibility and risk of such party. Such party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other party as a result of decisions made or actions taken based on this document.

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by Zabani, Sanaz
Sanaz Date: 2025.09.15
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Prepared by:

Signature

Sanaz Zabani, M.Sc., INCE
(signed on behalf of
Jonathan Chui, P.Eng., INCE)

Printed Name

Zabani, Digitally signed
by Zabani, Sanaz
Sanaz Date: 2025.09.15
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Reviewed by:

Signature

Sanaz Zabani, M.Sc., INCE
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Approved by:

Signature

Ward Prystay, M.Sc., R.P.Bio.
Printed Name



Executive Summary

Cedar LNG Partners LP, by its general partner Cedar LNG Partners (GP) Ltd. (Cedar), a Haisla Nation-led partnership with Pembina Pipeline Corporation, is constructing a liquefied natural gas (LNG) export facility within the District of Kitimat, British Columbia (BC) (the Project). The Project underwent an environmental assessment from 2019 to 2023 and received an environmental assessment certificate (EAC) under BC's *Environmental Assessment Act* (EAC #23-01) and a positive Decision Statement under Canada's *Impact Assessment Act* (reference number 80208) in March 2023. Amendments to both the EAC and Decision Statement were issued in May 2025 and updated in July 2025 to modify the infrastructure associated with the Project. More recently, the advancement of Project design has resulted in the following proposed operational changes to the Project:

- Worker accommodations for housing up to 80 workers on the approved floating liquefied natural gas (FLNG) facility
- Increased liquefaction capacity from 400 to 500 million standard cubic feet per day of natural gas

This noise assessment focuses on the potential noise effects during the normal operation of the FLNG and LNG carrier loading with these changes. The Facility Area, local assessment area (LAA), and regional assessment area (RAA) are the same as the areas used in the Environmental Assessment Certificate Application for the Project (EAC Application; Cedar 2022). The LAA/RAA extends 3 km from the Facility Area to encompass the nearest community of Kitimaat Village and Kitimaat 2 Indigenous Reserve. Receptors such as childcare centre, school, church, health center, and residential dwellings within the Kitimaat Village and Kitimaat 2 Indigenous Reserve are included. Noise effect from shipping activities is not included because shipping activities remain the same as assessed in the Environmental Assessment Office (EAO) Assessment Report (EAO 2022). Noise effects associated with the Project decommissioning and construction are not affected by the amendment and are also not included.

These modelling results are based on information provided by Cedar. Noise modelling was completed by Black & Veatch and Samsung Heavy Industries (Samsung). Black & Veatch is the provider of the topsides and Samsung is responsible for the hull and marine systems including construction at their shipyard. Modelling incorporated internationally accepted sound propagation algorithms. The FLNG operational noise model has been revised to represent the proposed operational changes to the Project noted above.

The noise model represents the continuous operation of the FLNG with one LNG carrier loading. There are ten modules associated with receipt, treatment and liquefaction of natural gas on the FLNG. In addition, associated equipment such as hull ventilation fans, hull deck fans and rotating equipment, cargo pumps, and transformers are included in the noise model.

This assessment is based on provincial noise guidelines, federal guidance, and international noise guidance. Compliance with the British Columbia Noise Control Best Practice Guideline (BCER 2024) noise thresholds (permissible sound level and low-frequency noise) was assessed for the operation phase at the residential noise sensitive receptors and locations along the BCER 1.5 km criteria boundary within the LAA/RAA. Model results from the operation phase were also compared to Guidance for



Evaluating Human Health Impacts in Environmental Assessment: Noise (Health Canada 2023) for changes in percent highly annoyed (%HA) as well as sleep disturbance thresholds. In addition, the Canadian Labour Code Maritime Occupational Health and Safety Regulations (SOR/2010-120) (Canada 2025a, Canada 2025b), the Canada-Newfoundland and Labrador Offshore Area Occupational Health and Safety Regulations (SOR/2021-247) (Canada 2022), and the International Maritime Organization (IMO 2012) threshold for noise levels in sleeping cabins on board ships were used to assess sleep disturbance in the FLNG worker accommodation cabins.

Key findings of the assessment were:

- Noise effects from the Project's operation phase in combination with cumulative noise emissions from the LNG Canada Export Terminal and ambient sounds were predicted to comply with the British Columbia Noise Control Best Practices Guideline.
- Low-frequency noise effects from the operation phase of the Project on the residential noise sensitive receptors are not expected.
- The modelled operation phase noise levels do not exceed the recommendations of %HA in Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise at noise sensitive receptors.
- The modelled operation nighttime noise levels do not exceed the sleep disturbance targets in Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise at all residential noise sensitive receptors.
- The predicted noise level of 51 dBA in the FLNG cabins (R29) meets the Canadian Labour Code Maritime Occupational Health and Safety Regulations (Canada 2025a, Canada 2025b), Canada-Newfoundland and Labrador Offshore Area Occupational Health and Safety Regulations (Canada 2022), and IMO - Code on Noise Levels on Board Ships (IMO 2012) for ships $\geq 10,000$ GT noise thresholds.



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Appendix A	Atmospheric Noise Baseline Field Study for Cedar LNG Facility
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Acronyms / Abbreviations

%HA	percent highly annoyed
ANSI	American Standard
BCER	British Columbia Energy Regulator
B&V	Black & Veatch
Cedar	Cedar LNG Partners LP
CPD	Certified Project Description
°C	degrees Celsius
dB	decibel
dBA	A-weighted decibel
dBC	C-weighted decibel
EAC	Environmental Assessment Certificate
EAO	Environmental Assessment Office
FLNG	floating liquefied natural gas facility
FSR	Forest Services Road
G	ground absorption factor
ha	hectare
HVAC	heating, ventilation and air-conditioning
IMO	International Maritime Organization
ISO	International Organization for Standardization
km	kilometre
LAA	local assessment area
L _d	daytime equivalent sound level
L _{dn}	day-night equivalent sound level
L _{eq}	energy equivalent sound level
L _{max}	maximum sound level
LFN	low frequency noise
LNG	liquefied natural gas
m	metre
PSL	permissible sound level



Cedar LNG Project
Technical Data Report—Acoustics
Acronyms / Abbreviations
September 2025

PWL	sound power level
RAA	regional assessment area
Samsung	Samsung Heavy Industries
SPL	sound pressure level
TDR	Technical Data Report
UTM	Universal Transverse Mercator
WHO	World Health Organization



Glossary

Term	Definition
Acoustic Attenuation	Acoustic attenuation is a measure of the energy loss of sound propagation in media.
Ambient Noise	All noises that exist in an area and are not related to a facility. Ambient noise includes sound from other industrial noise not being measured, transportation sources, animals, and nature. Ambient noise is the same as background sound level
Assessment Report	Assessment Report for Cedar LNG (Project) (EAO, November 16, 2022)
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
Facility Area	The area to be utilized by the Project and includes District Lot 99 and marine waters extending approximately 500 m offshore
Daytime	The hours from 0700 to 2200
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)



Term	Definition
dBC – Decibel, C-Weighted	<p>The logarithmic units associated with a sound pressure level, where the sound pressure signals have been filtered using a 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., dBC). C weighted levels are often used in low-frequency noise analysis, as the filtering effect is nearly flat at lower frequencies</p>
Decibel Addition	<p>In acoustics, due to the logarithmic nature of the decibel scale, the addition of two or more sound pressure levels (denoted as SPL1, SPL2 ... SPLn) is done as follows: $\text{SPL1} + \text{SPL2} + \dots + \text{SPLn} = 10 \log (10 (\text{SPL1}/10) + 10(\text{SPL2}/10) + \dots + 10(\text{SPLn}/10))$ As an example: 50 dB + 50 dB = 53 dB</p>
EAC Application	Environmental Assessment Certificate Application (Cedar, February 2022)
Energy-related facility	<p>A facility under the jurisdiction of the Regulator or other regulatory agency, used for energy generation, transport (except by road or rail line) and resource extraction. These include mining, extraction, processing and transportation (except by road or rail line) as well as federally regulated electrical transmission lines and pipelines (BCER 2024).</p>
Floating liquefied natural gas facility	<p>A water-based liquefied natural gas production facility that is purpose-built to liquefy and store liquefied natural gas and transfer it to LNG carriers for global export.</p>
Frequency	<p>Number of cycles per unit of time. In acoustics frequency is expressed in hertz (Hz), i.e., cycles per second</p>
Hertz (Hz)	<p>Unit of measurement of frequency, numerically equal to cycles per second</p>



Term	Definition
L _{eq}	Energy Equivalent Sound Level. 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} [24] 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
L _d	Daytime equivalent sound level from 0700 to 2200.
L _{dn}	Day-night equivalent sound level with an additional 10 dB penalty added to the nighttime period.
L _n	Nighttime equivalent sound level from 2200 to 0700.
Liquefied natural gas (LNG)	Natural gas that has been cooled to approximately -162°C where the methane and other components condense from gas to liquid form. In its liquid state, natural gas takes up 1/600 of the space that the gaseous phase occupies.
LNG carrier	A marine cargo ship with specialized cryogenic tanks that designed for transporting liquefied natural gas.
Natural gas	A naturally occurring hydrocarbon gas mixture consisting primarily of methane (typically >98%) plus varying amounts of ethane, propane, butanes, pentanes, higher molecular weight hydrocarbons, hydrogen sulfide, carbon dioxide, water vapor, and sometimes helium and nitrogen.
Nighttime	The hours from 2200 to 0700
Noise	Unwanted sound
Noise Level	Same as Sound Level, except applied to unwanted sounds
Sound	A dynamic (fluctuating) pressure



Term	Definition
Sound Pressure Level (SPL)	<p>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 equation below where P 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.</p> $\text{SPL (dB)} = 20 \log(P_{\text{RMS}}/P_0)$
Sound Power Level (PWL)	<p>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 equation below where W is the sound power of the source in watts, and W_0 is the reference power of 10^{-12} watts</p> $\text{PWL (dB)} = 10 \log(W/W_0)$
Spectrum	<p>The description of a sound wave's resolution into its components of frequency and amplitude</p>
Tonal Components	<p>Often industrial facilities 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 the BCER noise guideline (BCER 2021): 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 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.</p>



1 Introduction

Cedar LNG Partners LP, by its general partner Cedar LNG Partners (GP) Ltd. (Cedar), a Haisla Nation led partnership with Pembina Pipeline Corporation, is constructing a liquefied natural gas (LNG) export facility within the District of Kitimat, British Columbia (BC) (the Project). The Project underwent an environmental assessment from 2019 to 2023 and received an environmental assessment certificate (EAC) under BC's *Environmental Assessment Act* (EAC #23-01) and a positive Decision Statement under Canada's *Impact Assessment Act* (reference number 80208) in March 2023. The Project commenced construction in July 2024.

More recently, the advancement of the Project design has resulted in the following proposed operational changes to the Project:

- **Worker Accommodations:** The amendment adds the option of housing up to 80 workers on the Floating liquefied natural gas facility (FLNG). This change does not affect the total number of workers that were approved as part of EAC #E23-01 and referenced in the Environmental Assessment Office (EAO) Assessment Report (Assessment Report; EAO 2022). Originally, workers operating and maintaining the FLNG would either live in the local communities (e.g., Kitimat, Terrace, or the Regional District of Kitimat-Stikine) or be housed in existing local workforce accommodation (e.g., camps, hotels).
- **Increased Liquefaction Capacity:** the Project liquefaction capacity is expected to increase from 400 to 500 million standard cubic feet per day of natural gas. This represents an increase in LNG production from approximately 3.0 million tonnes per annum to 3.75 million tonnes per annum.

In consideration of the advancement of the Project planning and design, Cedar is requesting the Certified Project Description (CPD) of EAC #E23-01 and the Description of the Designated Project in Schedule 1 of the *Impact Assessment Act* Decision Statement be amended to reflect the changes described in this application.

This Technical Data Report (TDR) summarizes the assessment of potential changes to noise effects during the operation phase. Noise models are used to predict the noise level at noise sensitive receptors near the operation activities. This assessment specifically considered whether the proposed changes would induce any new noise effects, whether they would change noise effects at noise sensitive receptors, or whether any new mitigation measures are needed to reduce the change in noise effects. Effects associated with the Project decommissioning and construction are not affected by the amendment.



2 Study Area

The Project's facilities are located approximately 10 km southwest of Kitimat's town centre (Figure 1). The nearest residential area is Kitamaat Village, located approximately 3 km directly east across Kitimat Arm.

The Facility Area, local assessment area (LAA), and regional assessment area (RAA) are the same as the areas used in the EAC Application. The LAA/RAA extends 3 km from the Facility Area to encompass the nearest community of Kitamaat Village and Kitamaat 2 Indigenous Reserve.

The British Columbia Energy Regulator's (BCER) British Columbia Noise Control Best Practices Guideline (BCER 2024a) (referred to herein as BCER noise guideline) requires that environmental noise impacts be assessed at a distance of 1.5 km from the facility or at the nearest residential dwelling, whichever is closer (i.e., 1.5 km criteria boundary). Since there are no residential noise sensitive receptors within 1.5 km from the Facility Area, the nearest residential noise sensitive receptor is near Kitamaat Village approximately 1.9 km from the Facility Area (R13, R15, and R24; see Table 1), the LAA/RAA is extended to 3 km. In addition, locations along the Project 1.5 km criteria boundary (i.e., L1) are also assessed. L1 location is revised to 530 m further south from the location in the EAC Application, due to expanded Facility Area.

Figure 1 shows the receptor locations, monitoring locations, LAA and RAA of 3 km and 1.5 km criteria boundary from the Facility Area and transmission line corridor. The identified noise sensitive receptors within the LAA/RAA are listed in Table 1, including a short description, location and distance to the Project. An additional receptor (R29) representing the FLNG worker accommodation is included in Table 1.

Only the residential dwellings are considered noise sensitive receptors as per BCER noise guideline. The remainder are considered noise sensitive receptors as per Health Canada's Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise (Health Canada 2023) (referred to herein as Health Canada noise guidance). Health Canada noise guidance includes a broader definition of noise sensitive receptor than just residential dwellings. Figure 1 shows the location of the noise sensitive receptor locations listed in Table 1.

There is no change in shipping and transmission line; therefore, this assessment only carries forward noise sensitive receptor locations in proximity to the LAA and RAA (i.e., within 3 km).



Table 1 Noise Sensitive Receptors within the Assessment Areas

Receptor ID	Name	Description ¹	Universal Transverse Mercator (UTM) ² Coordinates (m)		Approximate Distance (km) from Facility Area
			Easting	Northing	
R01	Kitimaat Village childcare centre	Daycare center	523066	5980755	2.1
R02	Kitimaat Village school	School	523151	5980707	2.2
R03	Kitimaat Village church	Place of worship	522957	5980687	2.0
R04	Kitimaat Village Health Centre	Hospital	523179	5980675	2.3
R13	Kitimaat Village residence 1	Residential noise sensitive receptor	522774	5979712	1.9
R14	Kitimaat Village residence 2		522934	5980462	2.0
R15	Kitimaat Village residence 3		522869	5981030	1.9
R16	Kitimaat Village Residence 4 (Haisla)		523078	5981322	2.1
R20	Moore Creek 1	Traditional land use area, active and passive recreation areas	519186	5984492	2.7
R21	Moore Creek 2		519220	5984496	2.7
R23	C'Imo'Ca Child Care Centre	Daycare center	523016	5980749	2.1
R24	Haisla Recovery Centre	Hospital	522881	5980891	1.9
R26	SW dockyard	Traditional land use area, active and passive recreation areas	519911	5982474	0.7
R27	Half Moon Bay		519840	5981852	0
R29	FLNG Worker Accommodations	Cabins for workers aboard the FLNG	519853	5980823	na

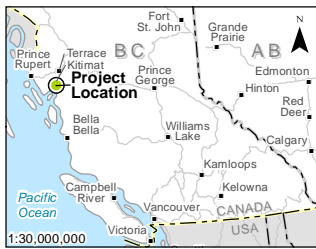
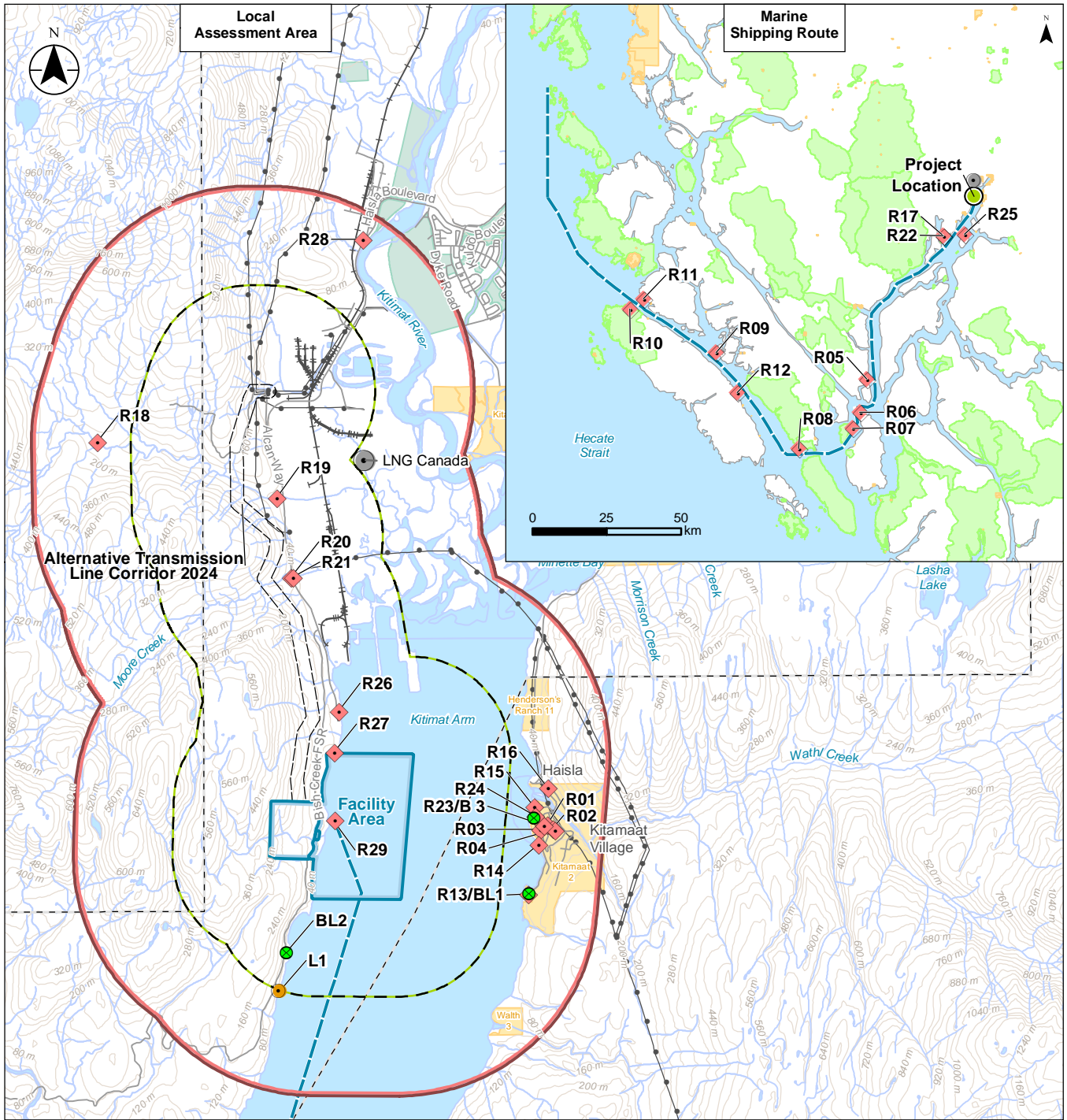


Receptor ID	Name	Description ¹	Universal Transverse Mercator (UTM) ² Coordinates (m)		Approximate Distance (km) from Facility Area
			Easting	Northing	
L1 ³	Assessment Location	BCER noise guideline (1.5 km criteria boundary)	519106 ⁴ 519034 ⁵	5978779 ⁴ 5978254 ⁵	1.5

Notes:

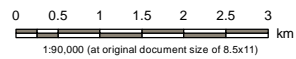
- ¹ The identified noise sensitive receptors are based on the definitions provided in the BCER noise guideline (residential noise sensitive receptors only) and the Health Canada guidance (noise sensitive receptors beyond just residential receptors)
 - ² Coordinate system: NAD 1983 UTM Zone 9
 - ³ Assessment location represents the highest noise effects along the 1.5 km criteria boundary.
 - ⁴ Previous L1 location in EAC Application
 - ⁵ L1 location is revised to 530 m further south from the L1 location in the EAC Application, due to expanded Facility Area.
- “na” not applicable as the receptor is inside the Facility Area





Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

- LNG Canada
- Highway
- Road
- Railway
- Transmission Line
- Topographic Contour
- Watercourse
- Waterbody
- Reserve Land
- Local Greenspace
- District of Kitimat
- Municipal Boundary
- Facility Area
- Alternative Transmission Line Corridor 2024
- Marine Shipping Route (Approximate Location)
- Regional Assessment Area
- Local Assessment Area
- Cedar LNG Criteria Boundary (1.5 km)
- Noise Monitoring Location
- Noise Sensitive Receptor
- Assessment Location



Project Location:
 Kitimat,
 British Columbia

Client/Project/Report
 Cedar LNG Partners (GP) Ltd.
 Cedar LNG Project
 Acoustics Technical Data Report

Figure No.
1
 Title
Noise Sensitive Receptor Locations

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3 Environmental Noise Descriptors

Environmental noise is rarely steady and typically varies over time. To account for this variation, a single number descriptor known as the energy equivalent sound level (L_{eq}) is used to describe environmental noise. Defined as the steady, continuous sound level over a specified time, L_{eq} has the same acoustic energy as the actual varying sound levels over the same time.

The recorded sound can be “frequency-weighted” with A and C scales being the most common. The corresponding weighted L_{eq} values would then be expressed in A-weighted decibels (dBA) or C-weighted decibels (dBC). The A-weighted scale is based on relative loudness of sound at different frequencies and is meant to reflect the human ear response to noise. The C-weighted scale is used to assess the low frequency content of noise. A-weighted and C-weighted L_{eq} are the main noise descriptors in assessing environmental noise effects.

Time periods commonly used for L_{eq} measurements and regulatory criteria are daytime (0700 to 2200) and nighttime (2200 to 0700). The daytime equivalent sound level (L_d) is the 15-hour A-weighted energy equivalent sound level. Similarly, the nighttime equivalent sound level (L_n) is a 9-hour A-weighted energy equivalent sound level. The day-night average sound level (L_{dn}) is a 24-hour time-averaged L_{eq} , with a 10-decibel (dB) penalty applied to nighttime hours. Most regulatory bodies use these environmental noise descriptors. Health Canada, in addition, uses the maximum sound level (L_{max}) and percent highly annoyed (%HA) to quantify noise effects (see Section 4. and the Glossary for more information).



4 Regulatory Requirements

The below sections outline the various regulatory requirements and guidance documents considered and applied in this noise assessment. These are consistent with those used in the EAC Application but have been updated where newer guidance is available.

4.1 Municipal Noise Guideline

The Kitimat Municipal Code (District of Kitimat 2025) is the only applicable municipal regulation in the study areas that pertains to noise. The code, as currently written, is a nuisance-based regulation, which specifies prohibitions on certain types of activities. It provides qualitative guidelines on noise but does not quantify sound level limits for any activities including industrial activities. Because municipal sound limits are not quantified, they are not used in this assessment.

4.2 Provincial Noise Guideline

4.2.1 Liquefied Natural Gas Facility Regulation and LNG Facility Permit Application and Operations Manual

The LNG Facility Regulation under the *Energy Resource Activities Act* and the LNG Facility Permit Application and Operations Manual (BCER 2024b) establish requirements for the construction and operation of an LNG facility in BC. Regarding noise, the LNG Facility Regulation requires permit holders (Project Permit # 100115227) to ensure the engineering design and siting of an LNG facility take into account noise effects associated with the normal operation. In addition, it stipulates the construction and normal operation of the LNG facility must not cause excessive noise, although no quantitative limits are established in regulation. The LNG Facility Permit Application and Operations Manual does not state any quantitative noise limits either; however, it recommends that mitigation measures are built into the design and operating procedures according to the BCER noise guideline (Section 4.2.2).

4.2.2 British Columbia Noise Control Best Practices Guideline

Limits on noise emissions from regulated energy-related facilities¹ (e.g., oil and gas) in BC are specified in the British Columbia Noise Control Best Practices Guideline (BCER 2024a), herein referred to as BCER noise guideline. This is a receptor-oriented guideline, which specifies allowable sound levels from energy-related facilities at designated points of reception.

¹ For a definition of energy-related facility as per BCER 2024a see the glossary



In accordance with the BCER noise guideline, all new regulated oil and gas facilities must meet daytime (0700 to 2200) and nighttime (2200 to 0700) permissible sound levels (PSL) at a distance of 1.5 km (criteria boundary) from the facility boundary or at the nearest receptor, whichever is closer. Only dwellings that are permanently or seasonally occupied are defined as receptors. Exceptions to this definition include any employee or worker residence, dormitory, or construction camp located within an industrial plant boundary. See Section 4.2.3 for how the PSL has been determined for the various residential noise sensitive receptors.

4.2.3 Permissible Sound Level

The daytime and nighttime PSLs at each residential noise sensitive receptor depends on dwelling density and proximity to transportation (i.e., proximity to heavily travelled roadways and rail lines). Daytime PSL is set at 10 dB above the nighttime value to reflect that daytime ambient sound levels are generally higher than nighttime ambient sound levels. The ambient sound level is 5 dB below the PSL. Where there is no receptor within 1.5 km from a project fence line, the nighttime and daytime PSLs along the 1.5 km criteria boundary are set to 40 dBA and 50 dBA L_{eq} , respectively.

Table 2 summarizes the determination of PSLs for the residential noise sensitive receptors. In this noise assessment, all identified residential noise sensitive receptors are located more than 500 metres (m) from heavily travelled roadways. Therefore, the transportation category for these residential dwellings is Category 1. The ambient sound level for residential noise sensitive receptors with the dwelling unit density between 1 and 8 dwellings per quarter section was set at 35 dBA. Correspondingly, the daytime PSL of 50 dBA and nighttime PSL of 40 dBA were determined for these receptors. The ambient sound level for residential noise sensitive receptors with a dwelling unit density between 9 to 160 per quarter section was set at 38 dBA. Correspondingly, the daytime PSL of 53 dBA and nighttime PSL of 43 dBA were determined for these receptors.

4.2.4 Low-Frequency Noise

Low frequency noise (LFN) is identified as a potential concern in the BCER noise guideline. Low frequency noise describes noise with frequency content in the range of 20 to 250 Hertz (Hz). When two conditions are met, LFN may exist:

- Isolated (i.e., non-facility noise, such as wind noise, has been removed) time-weighted average dBC – dBA value for the measured day- or nighttime period is equal to, or greater than, 20 dB
- A clear tonal component exists at a frequency below 250 Hz



Table 2 Calculated Daytime and Nighttime Permissible Sound Levels

Receptor ID	Dwelling Unit Density per Quarter Section ¹ of land	Transportation Category, Proximity to Transportation ²	BCER Ambient Sound Level ³ (dBA)		BCER Permissible Sound Level (PSL) (dBA)	
			Daytime Ambient Sound Level (dBA)	Nighttime Ambient Sound Level (dBA)	Daytime BSL (dBA)	Nighttime BSL (dBA)
R01	-	-	-	-	-	-
R02	-	-	-	-	-	-
R03	-	-	-	-	-	-
R04	-	-	-	-	-	-
R13	1–8	1	45	35	50	40
R14	9–160	1	48	38	53	43
R15	9–160	1	48	38	53	43
R16	9–160	1	48	38	53	43
R20	-	-	-	-	-	-
R21	-	-	-	-	-	-
R23	-	-	-	-	-	-
R24	-	-	-	-	-	-
R26	-	-	-	-	-	-
R27	-	-	-	-	-	-
L1	-	-	45	35	50	40

Notes:

- ¹ Refers to a quarter section, with the most likely affected dwelling at the centre (a 451 m radius). For quarter sections with various land uses or with mixed densities, the density chosen should be factored for the area under consideration. A quarter section is an area of one-fourth of a square mile.
 - ² Definition of transportation proximity category as follows:
Category 1—dwelling units more than 500 m from heavily travelled roads and rail lines and not subject to frequent aircraft flyovers.
Category 2—dwelling units more than 100 m but less than 500 m from heavily travelled roads and rail lines and not subject to frequent aircraft flyovers.
Category 3—dwelling units less than 100 m from heavily travelled roads and rail lines and/or subject to frequent aircraft flyovers.
 - ³ Ambient sound level is 5 dB below the basic sound level, as prescribed in BCER noise guideline.
- “-“ These receptors are not considered residential noise sensitive receptors as per BCER noise guideline, hence they are not assessed against a PSL.



4.3 Federal Noise Guidance

4.3.1 Health Canada

The Health Canada noise guidance addresses noise effects as they relate to perceived annoyance as well as sleep disturbance when assessed at noise sensitive receptors. The Health Canada noise guidance uses daytime or nighttime equivalent sound levels (L_d and L_n , respectively), adjusted day-night average sound levels (L_{dn}), and %HA to quantify noise effects for activities with a duration of more than 12 months (i.e., the construction activities and normal operation) (Health Canada 2023).

4.3.1.1 Annoyance Targets

The Health Canada noise guidance recommends the use of %HA to quantify annoyance due to noise effects for activities with a duration of more than 12 months and therefore was used to quantify both construction and operation noise effects. The baseline %HA values are from the EAC Application. The cumulative case %HA values are determined from the cumulative noise effect from the baseline sound levels in Table 4 and construction noise level in Table 8, and project noise levels in Table 9. The difference between the baseline and cumulative case %HA values quantifies the change in %HA. The baseline and total (baseline + Project) %HA are calculated by the following equations with the L_{dn} corresponding to the baseline or project inclusion:

$$\%HA_{(baseline)} = \frac{100}{1 + e^{[10.4 - 0.132 * L_{dn}(baseline)]}}$$

$$\%HA_{(baseline+Project)} = \frac{100}{1 + e^{[10.4 - 0.132 * L_{dn}(baseline+Project)]}}$$

Receptors in rural areas could be considered to have a greater expectation of “peace and quiet” (i.e., quiet rural areas) than receptors in urban areas. Health Canada considers a “quiet rural area” to be an area with an L_{dn} of 45 dB or less due to human-made sounds. As a conservative approach, receptors with $L_{dn} < 45.5$ dBA are considered for the +10 dB adjustment to account for heightened sensitivity to any increases in noise levels. 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.

Health Canada noise guidance recommends the highest acceptable increase in %HA is 6.5% at a receptor when project activities will have a duration of more than one year. If the change in %HA exceeds 6.5%, effects are of concern and may require mitigation. Health Canada also recommends mitigation of project noise if it exceeds L_{dn} of 75 dBA at a receptor, even if the change in %HA does not exceed 6.5%. Impulsive and tonal characteristics of source noise are accounted for in the %HA calculations because their presence can increase annoyance.



Change in %HA is quantified by determining the difference between %HA calculated for the baseline condition and %HA calculated with inclusion of the Project's noise contribution. The change in %HA is calculated by using the following equation:

$$\text{Change in \%HA} = \%HA_{(\text{baseline+Project})} - \%HA_{(\text{baseline})}$$

4.3.1.2 Sleep Disturbance

To assess sleep disturbance Health Canada recommends a target indoor sound level of no more than 30 dBA L_{eq} for continuous noise during the sleep period for both construction and operation phase of a project. As per Health Canada noise guidance (Health Canada 2023), the recommended outdoor-to-indoor transmission loss with windows at least partially open is 15 dBA and fully closed windows are assumed to reduce outdoor sound levels by approximately 27 dBA. However, the Health Canada sleep disturbance threshold is recommended for private residential bedrooms with very low background noise. The thresholds may not be suitable for cabins within the FLNG facility affected by background noise from central HVAC systems and operation equipment.

4.3.2 Canada Labor Code

In the Canada Labor Code Respecting Occupational Safety and Health of Employees Employed on or in Connection with Exploration or Drilling for, or the Production, Conservation, Processing or Transportation of, Oil or Gas in Canada Lands, as Defined in the Canada Oil and Gas Act (Canada 2025a), Part VIII Levels of Sound, Section 8.3 states that no employee shall be exposed in sleeping quarters to a level of sound of more than 75 dBA.

4.3.3 Canada Labour Code Maritime Occupational Health and Safety Regulations

In the Canadian Labour Code Maritime Occupational Health and Safety Regulations (SOR/2010-120) (Canada 2025b), Section 161 (3) indicates that an employee must not be exposed to a continuous level of sound in crew accommodation that is more than 75 dBA.

4.3.4 Canada–Newfoundland and Labrador Offshore Area Occupational Health and Safety Regulations

In the Canada–Newfoundland and Labrador Offshore Area Occupational Health and Safety Regulations (SOR/2021-247) (Canada 2022) Part 11 Facilities, Section 57 (1b), it prescribes that every employer must ensure the accommodations area at each workplace under its control is constructed so that sleeping quarters are not exposed to sound levels in excess of 70 dBA.



4.4 International Standards

4.4.1 International Maritime Organization (IMO) Code on Noise Levels on Board Ships

Ships that are subject to the International Convention for the Safety of Life at Sea (SOLAS), 1974 are subject to the Code on Noise Levels on Board Ships (the Code). The Code came into force on July 1, 2014 and establishes upper limits for noise levels within machinery spaces, control rooms, workshops, accommodation and other spaces on board new ships of a gross tonnage of 1,600 or more. It was originally adopted by the Maritime Safety Committee of the IMO through Resolution MSC.337(91) in November 2012 (IMO 2012). The Code is intended to prevent seafarer exposure to potentially hazardous noise levels while on board passenger and cargo ships. For ships greater than 10,000 gross tonnage, the indoor noise level limits are 55 dBA in cabins and medical areas, 60 dBA for cafeteria and recreational rooms, and 75 dBA for external recreation areas.

4.4.2 ANSI Sound Level Criteria for Room Noise

The American National Standard (ANSI) ASA/AANSI S12.2-2019 (R2023) Criteria for Evaluating Room Noise (ANSI 2023) is commonly used as a reference guide for assessment of sound level criteria for occupants in various interior environments. The ANSI standard specifies sound level criteria when evaluating the room noise by using the survey method that employs the A-weighted sound level. Table 3 lists the recommended A-weighted sound level criteria for individual rooms or suite in hotels and motels (ANSI 2023). However, the ANSI threshold is suitable for hotel or motel rooms, it may not be suitable for cabins within the FLNG facility affected by background noise from central HVAC systems and operation equipment.

Table 3 ANSI Criteria for Evaluating Room Noise

Occupancy	Description	Recommend Indoor Sound Level (dBA)
Hotels or Motels	Individual rooms or suites	39 to 44
	Meeting/banquet rooms	35 to 44
	Service support areas	48 to 57



5 Methodology

The objective of this TDR is to quantify the noise effect during the operation phase of the Project. Effects associated with the Project decommissioning and construction are not affected by the proposed changes in the amendment. Noise models are used to predict the noise level at noise sensitive receptors near the operation activities. The noise model considers noise emission from mobile and stationary equipment. The noise prediction results are compared to applicable noise guidelines and guidance. If the noise effects exceed the recommended thresholds, mitigation measures are recommended to reduce noise to acceptable levels.

5.1 Assessment Approach

The approach used to assess the potential noise effects during normal operation is summarized as follows:

1. Determine the assessment area and receptor location(s) within the LAA/RAA
2. Establish the applicable regulatory threshold (e.g., PSL, change in %HA, and sleep disturbance threshold for noise sensitive receptors)
3. Quantify the baseline sound levels at the noise sensitive receptors in accordance with the applicable noise guidelines
4. Predict the project-only noise effects during the operation phase of the Project
5. Assess compliance by comparing the noise effect at the receptors to the applicable noise threshold for operation

5.2 Modelling

Neither the BCER noise guideline nor the Health Canada noise guidance endorse any specific standards or modelling software; however, international calculation standards are recommended.

Noise modelling was completed by Black & Veatch (B&V) and Samsung Heavy Industries (Samsung). Samsung prepared a report titled “SN2688 Cedar FLNG Topside Noise Study” (Samsung 2025) that presents predicted noise levels within the study area due to the FLNG and a docked LNG carrier. B&V and Samsung jointly published a report titled “Cedar FLNG Noise Study Report for Hull and Accommodation” (Samsung and B&V 2025). This second report presents the predicted noise level within the accommodation cabins aboard the FLNG.



Noise modelling completed by B&V and Samsung (Samsung 2025, Samsung and B&V 2025) was completed using the Cadna/A software (DataKustik 2023), which incorporates International Organization for Standardization (ISO) Standard 9613 (ISO 1993, 1996) algorithms. These ISO standards are commonly used by noise practitioners and are accepted by BCER and Health Canada. The Cadna/A software model accounts for the following factors:

- Geometric spreading
- Screening effects
- Atmospheric absorption
- Ground condition
- Source size, location, and elevation
- Mild downwind conditions from the Project to the dwelling(s) and or temperature inversion condition
- Source directivity

The values of 10°C temperature and 70% relative humidity are used in the model settings to represent summer nighttime conditions that enhance noise propagation. The wind speed is based on ISO 9613-2 standard (ISO 1996), which assumes 1 to 5 m/s downwind condition from the source to the receptor in the sound propagation calculation. Ground absorption factor (G) is an index with value ranges from 0 to 1 where 0 represents reflective surface and 1 represent absorptive surface. Waterbodies are assigned the G value of 0. The reflection parameter of one represents the order of reflection when the sound emission incident ray hits a structure.

Table 4 lists the modelling parameters used in the models for this assessment in more detail.

The prediction of worker accommodation cabin indoor noise level is based on CadnaR software (DataKustik 2020). CadnaR is a software tool for the calculation and assessment of sound inside rooms and at workplaces.

A structure-borne noise assessment was conducted to infer the expected noise level generated in the FLNG accommodation. The Samsung in-house developed program NASS (Structure-borne Noise Offshore Prediction) was employed. NASS is based on transfer function and decay and evaluates the propagation of the vibrations from the machinery to the room elements and the resulting radiated noise levels.



Table 4 Acoustic Modelling Parameters

Item	Model Parameters	Model Setting
1	Temperature ¹	10°C
2	Relative humidity ¹	70%
3	Wind speed	Downwind condition, wind speed of 1 m/s to 5 m/s (based on ISO 9613-2 standard)
4	Noise source	Section 7
5	Acoustic modelling software	Cadna/A (DataKustik 2023)
6	Noise propagation standard	ISO 9613
7	Ground conditions and attenuation factor	Ground absorption (G): <ul style="list-style-type: none"> • Waterbody G = 0 (G varies between 0 to 1, where 0 represents reflective ground surface and 1 represents absorptive ground surface condition)
9	Reflection parameters ²	1 order of reflection

Notes:

- ¹ The values of 10°C temperature and 70% relative humidity are used in the model settings to represent summer nighttime conditions that enhance noise propagation. The wind speed is based on ISO 9613-2 standard (ISO 1996), which assumes 1 to 5 m/s downwind condition from the source to the receptor in the sound propagation calculation.
- ² The reflection parameter of one represents the order of reflection with the sound emission incident ray hits a structure.



6 Baseline Sound Level

Baseline acoustic conditions can be established through either field measurements or by using default values from guidance documents. Both are acceptable approaches as baseline sound level can be affected by seasons and by surroundings. Along coastal locations, the baseline sound level is characterized by nature sounds and anthropogenic sound sources. The nature sounds include waves, wind interacting with natural surfaces (e.g., wind noise, thunder, vegetation rustling), stream movement, and animal noises (e.g., birds and insects). Anthropogenic sound sources may include human activities, marine traffic and aircraft flyover. The variation in baseline sound level can be affected by seasonality, as well as frequency and intensity (i.e., source strength, distance) of other natural and anthropogenic noise events.

For this assessment, baseline acoustic conditions for all selected noise sensitive receptors are based on both field measurements and guidance documents. This includes Project-specific monitoring results, a noise assessment completed for another project (i.e., LNG Canada 2014), default values as presented in BCER noise guideline, and recommended values from Health Canada noise guidance.

6.1 BCER Ambient Sound Level

The BCER noise guideline prescribes the existing acoustic environment at a given location is described by the ambient sound level. As recommended by the BCER noise guideline, daytime and nighttime ambient sound level for a residential dwelling in an area with low population density (i.e., 1 to 8 dwellings per quarter section) and more than 500 m away from heavily travelled roads is 45 dBA and 35 dBA, respectively. Daytime and nighttime ambient sound level for a residential dwelling in a higher population density (9 to 100 dwellings per quarter section) and more than 500 m away from heavily travelled roads is 48 dBA and 38 dBA, respectively.

6.2 Health Canada Baseline Sound Level

Health Canada noise guidance estimates a day-night sound level less than or equal to 45 dBA for a community type with population density of 28 people per square km in a quiet rural area. Health Canada further recommends that a conservative (i.e., most protective) approach is to consider a reasonable worst-case scenario and assume L_{dn} baselines of 35 dBA for rural areas and 45 dBA for urban/suburban areas. The L_{dn} of 45 dBA is equivalent to the daytime sound level of 45 dBA and nighttime sound level of 35 dBA, similar to the BCER noise guideline prescribed ambient sound level for a rural environment.



6.3 Baseline Monitoring Program

In response to Condition 8.2.1 of the Decision Statement issued to Cedar LNG under Canada’s *Impact Assessment Act*, multiple days of noise monitoring was conducted at three sensitive noise receptors identified during the development of the Acoustic Follow-up Program (Cedar 2024c). As part of the development of the follow-up program, Cedar identified three sensitive noise receptors at which monitoring shall occur. Two receptors are in Kitamaat Village (i.e., BL1 and BL3) and one receptor is on the Bish Creek Forest Services Road (FSR) at a distance of 1.5 km from the facility (i.e., BL2). Figure 1 shows the locations of the three receptors. Long term continuous noise monitoring was conducted at each receptor for a period of five days. The noise monitor will be conducted prior to construction, the peak year of activity during construction, and annually during the first three years of operation (for three to five days each year during summer, when weather conditions do not interfere with sound monitoring).

Table 5 summarizes the monitoring results at the three locations during September 2023, prior to any Project construction activities. The acoustic environment at BL1 is characterized by residence activities, construction activities, nature sounds such as dog barking, bird calls, leaves rustling, and distant anthropogenic activities (e.g., marine vessel, train, jet). The acoustic environment at BL3 is characterized by human activities at Gya Wa Tlaab Healing Centre Society and playground nearby, local traffic activity, nature sound such as bird calls, dog barking, leaves rustling, and distant anthropogenic activities (e.g., marine vessel, train, jet). Receptor location BL2 is located at 1.5 km from south of the Project boundary. The acoustic environment at BL2 is characterized by nature sounds such as bird calls, leaves rustling, coastal tidal and wave action, whale spout/exhalation sounds, local or logging traffic, and distant anthropogenic activities (e.g., marine vessel, train, jet). The measurement results at BL1, BL2, and BL3 are representative for receptor locations R13, L1, and R24, respectively.

Table 5 Cedar LNG Baseline Monitoring Results

ID	Location	Distance from Receptor	Daytime (L _d) (dBA)	Nighttime (L _n) (dBA)	Day-nighttime L _{dn} (dBA)	UTM Coordinates ¹	
						Easting	Northing
BL1	Kitamaat Village Residence	26 m from R13	38.3	27.3	37.9	522795	5979727
BL2	Bish Creek FSR 1.5 km Boundary	<ul style="list-style-type: none"> • 69 m from L1 in the EAC Application • 600 m from L1 in this Amendment Application 	47.7	43.4	50.7	519124	5978846
BL3	Gya Wa Tlaab Healing Centre Society	23 m from R24	42.7	32.9	42.8	522871	5980870

Note:

¹ UTM – Universal Transverse Mercator UTM Zone 9 NAD 83



The detailed methods and results for the baseline monitoring program is summarized in Appendix A.

6.4 Existing Information

Noise monitoring program has been conducted by Stantec in the Kitimat area as part of an environmental assessment for the neighboring LNG facility (i.e., LNG Canada Export Terminal [LNG Canada 2014]). These surveys followed the BCER noise guideline. Ambient noise monitoring surveys were conducted in 2013 and 2014 as part of the environmental assessment for LNG Canada Export Terminal to quantify the existing acoustic environment (LNG Canada 2014). The LNG Canada Export Terminal Project is located within the Project LAA/RAA. The predicted operation noise levels were based on the LNG Canada Export Terminal published Acoustic Environment Technical Data Report (LNG Canada 2014), same as the values used to establish the Baseline sound level in the EAC.

6.5 Noise Sensitive Receptor Baseline Sound Level

The BCER noise guideline (BCER 2024) and Health Canada noise guidance (Health Canada 2023) prescribe different approaches to the definition of a noise sensitive receptor. Therefore, when applying BCER noise limits, the baseline sound level for BCER regulated receptors are determined separately using the BCER approach. In the Health Canada noise guidance framework, the combined baseline sound level for all receptors is determined using the Health Canada approach.

Table 6 shows the baseline sound level for the receptor based on the BCER approach. The baseline sound levels are identical to results presented in the EAC Application.

Table 7 lists the baseline sound levels as used in the compliance assessment against the %HA threshold from the Health Canada guidance. Cedar baseline monitoring results at BL1 are used as ambient sound level for receptor R13 due to its close proximity. Monitoring results at BL3 are used as ambient sound level for nine receptors within the Kitimaat Village (i.e., R01, R02, R03, R04, R14, R15, R16, R23, and R24). Monitoring results at BL2 along the Bish Creek FSR are used for receptor R26 and R27. The ambient sound levels for the remaining receptors are based on values prescribed by BCER.

Receptors in rural areas could be considered to have a greater expectation of “peace and quiet” (i.e., quiet rural areas) than receptors in urban areas. Health Canada considers a “quiet rural area” to be an area with an L_{dn} of 45 dB or less due to human-made sounds. As a conservative approach, receptors with $L_{dn} < 45.5$ dBA are considered for the +10 dB adjustment to account for its heightened sensitivity to any increases in noise levels. 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. Receptor locations with a resulting combined day-night baseline sound levels of L_{dn} less than 45.5 dBA have been adjusted by +10 dB to account for the “peace and quiet” requirement by Health Canada.



Table 6 Baseline Sound Levels at Noise Sensitive Receptors (BCER Guideline)

Receptor ID	BCER Baseline Sound Level (dBA) ¹		PSL	
	Daytime L _d (dBA)	Nighttime L _n (dBA)	Daytime L _d (dBA)	Nighttime L _n (dBA)
R01	-	-	-	-
R02	-	-	-	-
R03	-	-	-	-
R04	-	-	-	-
R13	45.1	35.7	50	40
R14	48.0	38.4	53	43
R15	48.1	38.9	53	43
R16	48.1	38.6	53	43
R20	-	-	-	-
R21	-	-	-	-
R23	-	-	-	-
R24	48.1	38.8	53	43
R26	-	-	-	-
R27	-	-	-	-
R29	-	-	-	-
L1	45.0	35.5	50	40

Notes:

¹ The combined baseline noise level is based on the logarithmic addition of the LNG Canada Export Terminal modelled noise values during operation (LNG Canada 2014) and the BCER noise guideline default ambient sound level.

“-“ These receptors are not considered residential noise sensitive as per BCER noise guideline, hence they are not assessed against a PSL and no baseline level is provided.



Table 7 Baseline Sound Levels at Noise Sensitive Receptors (Health Canada)

Receptor ID	Ambient Sound Levels			LNG Canada Export Terminal Operation Sound Level		Combined Baseline Sound Level (dBA) ¹			
	Daytime L _d (dBA)	Nighttime L _n (dBA)	Reference	Daytime L _d (dBA)	Nighttime L _n (dBA)	Daytime L _d (dBA)	Nighttime L _n (dBA)	Day-nighttime L _{dn} (dBA)	Day-nighttime L _{dn, adjusted} ² (dBA)
R01	42.5	32.9	BL3	29.2	28.6	42.7	34.3	43.3	53.3
R02	42.5	32.9	BL3	28.8	28.3	42.7	34.2	43.2	53.2
R03	42.5	32.9	BL3	29.3	28.8	42.7	34.3	43.3	53.3
R04	42.5	32.9	BL3	28.7	28.2	42.7	34.2	43.2	53.2
R13	38.3	27.3	BL1	27.7	27.2	38.7	30.3	39.3	49.3
R14	42.5	32.9	BL3	28.5	28.0	42.7	34.1	43.2	53.2
R15	42.5	32.9	BL3	32.2	31.7	42.9	35.4	43.9	53.9
R16	42.5	32.9	BL3	30.4	29.9	42.8	34.7	43.5	53.5
R20	45.0	35.0	BCER Noise Guideline	37.5	37.3	45.7	39.3	47.3	47.3
R21	45.0	35.0	BCER Noise Guideline	37.6	37.5	45.7	39.4	47.4	47.4
R23	42.5	32.9	BL3	29.3	28.8	42.7	34.3	43.3	53.3
R24	42.5	32.9	BL3	31.8	31.3	42.9	35.2	43.8	53.8
R26	47.7	43.4	BL2	40.6	39.9	48.5	45.0	52.0	52.0
R27	47.7	43.4	BL2	37.1	36.5	48.1	44.2	51.3	51.3



Receptor ID	Ambient Sound Levels			LNG Canada Export Terminal Operation Sound Level		Combined Baseline Sound Level (dBA) ¹			
	Daytime L _d (dBA)	Nighttime L _n (dBA)	Reference	Daytime L _d (dBA)	Nighttime L _n (dBA)	Daytime L _d (dBA)	Nighttime L _n (dBA)	Day-nighttime L _{dn} (dBA)	Day-nighttime L _{dn, adjusted} ² (dBA)
R29	-	-	-	-	-	-	-	-	-
L1	-	-	-	-	-	-	-	-	-

Notes:

- ¹ The combined noise levels is based on the logarithmic addition of the LNG Canada modelled values and the Health Canada default peace and quiet adjusted L_{dn} values.
 - ² Receptor locations with a combined baseline sound level of L_{dn} <45.5 have been adjusted by +10 dB to account for the “peace and quiet” requirement by Health Canada
- “-“ FLNG worker accommodation cabin (R29) is only considered for sleep disturbance effect. Baseline sound level and the %HA metrics are not applicable to this receptor. Receptor L1 is an assessment location based on the BCER 1.5 km criteria boundary, not applicable for the Health Canada %HA assessment.



7 Project Operation Noise Effects

The CadnaA FLNG operation noise model has been updated to reflect the proposed operational changes to the Project. The operational changes include worker accommodation on the FLNG and increase liquefaction capacity from 400 to 500 million standard cubic feet per day of natural gas.

The noise model represents the continuous operation of the FLNG with one LNG carrier loading. There are ten modules on the FLNG. In addition, associated equipment such as hull ventilation fans, hull deck fans and rotating equipment, cargo pumps, and transformers are included in the noise model. Table 8 presents the equipment and associated sound power level implemented on the topside of the FLNG and the LNG carrier included in the noise model.

Table 8 FLNG and LNG Carrier Noise Emission Summary

ID	System	Equipment Description	Quantity	Noise Rating ¹ (dBA)
FLNG Module 1	Cooling Water	Topsides Water Cooler	6	102
		Hull Water Cooler	6	101
		Topsides Water Pumps	1	102
FLNG Module 2	Liquefaction Train #1	Refrigerant Discharge Condensers	12	99
		Refrigerant Compressors	2	113
		Refrigerant Discharge Pumps	2	95
FLNG Module 3	Liquefaction Train #2	Refrigerant Discharge Condensers	12	99
		Refrigerant Compressors	2	113
		Refrigerant Discharge Pumps	2	90
FLNG Module 4	Amine Unit	Amine Cooler	2	97
		Amine Regenerator Reflux Condenser	2	94
		Amine Circulation Pumps	1	105
		Amine Booster Pumps	1	101
		Regenerator Reflux Pumps	1	92
		Amine Sump Pump	1	92
FLNG Module 5	Steam System	Boiler Module / Forced Draft Fans	2	105
FLNG Module 6	Liquefaction Train #1	Refrigerant Interstage Condensers	12	99
		Refrigerant Interstage Pumps	2	100
	Boil-off Gas (BOG)	BOG/Offloading Interstage Cooler	2	98
		BOG/Offloading Compressors	2	113



ID	System	Equipment Description	Quantity	Noise Rating ¹ (dBA)
FLNG Module 7	Liquefaction Train #2	Refrigerant Interstage Condensers	12	99
		Refrigerant Interstage Pumps	2	100
	LNG Handling and Heavies Handling	Heavies Surge Cooler	1	94
		Heavies Fractionator Reflux Pumps	2	95
FLNG Module 8	Dehydration Unit	Regen Gas Cooler	1	94
		Regen Gas Compressors	1	108
FLNG Module 9	Flare System	Thermal Oxidizer Package Thermal Oxidizer Blowers	2	105
FLNG Module 10	Dehydration Unit	Exhaust noise of Regen Gas Heater	2	102
Aft end	Transformer	Transformer	6	104
Hull	Hull Deck	Ventilation fans for hull	-	105
		Vent fan and rotating equipment on hull deck	-	105
		Cargo pipe	-	114
		Ventilation fans for accommodation	-	94
LNGC	LNG Carrier	Unloading operation	1	110

Notes:

“-“ Not Applicable

¹ All values are sound power level per unit quantity

Noise predictions for the worker accommodation cabin are based on the mechanical equipment list on the hull side of the FLNG. The equipment includes pumps, compressor, air dryer, sewage treatment plant, power generators, process fans, and HVAC fans.

The following assumptions are used in the operation noise model:

- Modelled noise sources represent continuous normal operation during both daytime and nighttime
- All operating stationary equipment was assumed to run at 100% capacity. This is conservative as it can be expected that equipment will not operate at 100% capacity throughout the year. For example, during colder months cooling fan loads will be lower as less cooling will be required.
- Spare or stand-by equipment (e.g., backup power generator, spare pumps) that operate intermittently during upset or emergency conditions were not included in the noise model.
- One LNG carrier is docked for unloading operation.



8 Model Results

Modelled operation noise levels at the noise sensitive receptors within 4 km of the FLNG are shown in Table 9. The FLNG noise effect for receptors located more than 4 km is expected to be negligible due to the longer distance. The predicted noise levels from the amendment application are included in Table 9 for comparison. Based on updated equipment information, the modelling for this amendment application shows noise levels will be lower than predicted in the EAC Application. The results presented are based on operation noise from the FLNG and LNG carrier. Noise effect from shipping activities is not included because shipping activities remain the same as assessed in the EAC Application.

Table 9 Operation Phase Sound Level

Receptor ID	Description	Amendment Results			EAC Application Results		
		Daytime Level, L _d (dBA)	Nighttime Sound Level, L _n (dBA)	Day-Night Sound Level, L _{dn} (dBA)	Daytime Level, L _d (dBA)	Nighttime Sound Level, L _n (dBA)	Day-Night Sound Level, L _{dn} (dBA)
R01	Kitimaat Village childcare centre	29.7	29.7	36.1	33.8	33.7	40.1
R02	Kitimaat Village school	29.7	29.7	36.1	33.4	33.4	39.8
R03	Kitimaat Village church	29.7	29.7	36.1	34.2	34.2	40.6
R04	Kitimaat Village Health Centre	29.7	29.7	36.1	33.3	33.3	39.7
R13	Kitimaat Village residence 1	30.0	30.0	36.4	34.1	34.1	40.5
R14	Kitimaat Village residence 2	29.7	29.7	36.1	34.2	34.2	40.6
R15	Kitimaat Village residence 3	29.7	29.7	36.1	34.6	34.5	40.9
R16	Kitimaat Village Residence 4 (Haisla)	29.7	29.7	36.1	33.6	33.5	39.9
R20	Moore Creek 1	23.4	23.4	29.8	25.4	25.3	31.7
R21	Moore Creek 2	28.4	28.4	34.8	30.5	30.5	36.9
R23	C'Imo'Ca Child Care Centre	29.7	29.7	36.1	34.0	34.0	40.4
R24	Haisla Recovery Centre	29.7	29.7	36.1	34.5	34.5	40.9
R26	SW dockyard	36.6	36.6	43.0	40.4	40.4	46.8



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Receptor ID	Description	Amendment Results			EAC Application Results		
		Daytime Level, L _d (dBA)	Nighttime Sound Level, L _n (dBA)	Day-Night Sound Level, L _{dn} (dBA)	Daytime Level, L _d (dBA)	Nighttime Sound Level, L _n (dBA)	Day-Night Sound Level, L _{dn} (dBA)
R27	Half Moon Bay	45.0	45.0	51.4	47.7	47.7	54.1
R29	FLNG Worker Accommodations	51.0	51.0	57.4	na	na	na
L1	Assessment Location	35.0	35.0	41.4	37.4	37.4	43.8

Note:

“na” Not applicable as FLNG Worker Accommodation was not considered in the EAC Application



9 Compliance Summary

9.1 Compliance with BCER Noise Limits

Table 10 summarizes the modelling results at the residential dwellings and at the 1.5 km criteria assessment location (L1) against the PSL as per the BCER noise guideline (BCER 2024). The FLNG and LNG carrier noise levels from Table 9 are added to the baseline levels (which include the predicted noise levels from the planned LNG Canada Export Terminal) from Table 6 to obtain the cumulative sound levels. The cumulative sound levels are compared against the PSL levels to assess compliance. The results indicate that predictive noise levels are below the daytime and nighttime PSLs. There is no change in shipping and transmission line; therefore, this assessment only considers noise sensitive receptor locations in proximity to the FLNG (i.e., within 4 km).

Condition 8.2.1 of the Decision Statement requires that Cedar monitor, during the year prior to construction and continuing through the first three years of operation (for three to five days each year during summer, when weather conditions do not interfere with sound monitoring), sound levels at the sensitive noise receptors identified during the development of the Acoustic Follow-up Program (Cedar 2024c). In July 2023 the BCER issued Cedar a permit for the LNG facility that included noise monitoring requirements at two locations, one in Kitamaat Village (R13) and the other near the Bish Forest Service Road (FSR) 1.5 km south of the facility (L1). To align the requirements of the BCER permit and Condition 8.2 of the Decision Statement, Cedar proposes to complete the monitoring at two receptors specified in the permit plus a third location in Kitamaat Village (R24).

Noise prediction in linear sound level (dBL) is not available in the latest amendment update noise model. The EAC Application concluded that potential for low frequency noise effect at the residential receptors is low because the sound level results are below the Health Canada target of 70 dBL. Table 9 results indicate that predicted day and night sound levels in dBA for the residential noise sensitive receptors (R13, R14, R15, R16, and R24) are less than assessed in the EAC Application. For similar type of equipment, decrease in dBA level typically will result in lower dBL level; therefore, the dBL level for these receptors are expected to be lower than assessed in the EAC Application. As such, this assessment concludes that a LFN effect is not expected to occur at any of the identified residential noise sensitive receptors.



Table 10 Compliance Assessment - BCER Permissible Sound Levels

Receptor ID	Project Case (FLNG and LNG carrier) Sound Level		Baseline Sound Level		Cumulative Sound Level		Site-Specific Permissible Sound Level ²		Meets PSLs?
	Daytime (dBA)	Nighttime (dBA)	Daytime (dBA)	Nighttime (dBA)	Daytime (dBA)	Nighttime (dBA)	Daytime (dBA)	Nighttime (dBA)	
R01	-	-	-	-	-	-	-	-	-
R02	-	-	-	-	-	-	-	-	-
R03	-	-	-	-	-	-	-	-	-
R04	-	-	-	-	-	-	-	-	-
R13 ¹	30.0	30.0	45.1	35.7	45.2	36.7	50	40	Yes
R14	29.7	29.7	48.0	38.4	48.1	39.0	53	43	Yes
R15	29.7	29.7	48.1	38.9	48.2	39.4	53	43	Yes
R16	29.7	29.7	48.1	38.6	48.1	39.1	53	43	Yes
R20	-	-	-	-	-	-	-	-	-
R21	-	-	-	-	-	-	-	-	-
R23	-	-	-	-	-	-	-	-	-
R24 ²	29.7	29.7	48.1	38.8	48.2	39.3	53	43	Yes
R26	-	-	-	-	-	-	-	-	-
R27	-	-	-	-	-	-	-	-	-
L1 ¹	35.0	35.0	45.0	35.5	45.5	38.3	50	40	Yes

Notes:

“-” These receptors are not considered residential noise sensitive receptors as per BCER noise guideline; hence they are not assessed against a PSL.

¹ BCER permit noise monitoring locations as per Acoustic Follow-up Program (Cedar 2024c)

² A third compliance location as per Acoustic Follow-up Program (Cedar 2024c)



9.2 Compliance with Health Canada Noise Guidance

9.2.1 Change in Percent Highly Annoyed

For the operation phase, change in %HA associated with the Project is compared with the threshold of 6.5% as advised by Health Canada. The change in %HA at a receptor is based on the difference between the baseline %HA and total (project plus baseline) %HA (Health Canada 2023).

The %HA is determined from the adjusted baseline sound level or the adjusted total sound level, based on an equation from the Health Canada guidance. The adjusted baseline sound level and adjusted total sound level is calculated by adding the 10 dB “peace and quiet” adjustment to the baseline sound level (Table 7 in Section 6.4) and total sound level for applicable receptors. The total sound level is the combined noise effect of the baseline sound level (Table 7 in Section 6.4) and Project sound level (Table 9 in Section 7).

The changes in %HA associated with the Project operation phase are summarized in Table 11. The changes in %HA are compared to the target for change in %HA of 6.5% advised in the Health Canada noise guidance. The change in %HA at all receptors is below the 6.5% target for the operation phase and hence indicates compliance with the Health Canada guidance.

Table 11 Operation Phase - Change in %HA

Receptor ID	Description	Baseline		Project L _{dn} (dBA)	Total (Baseline and Project)		Change in %HA (Between Total and Baseline)
		L _{dn, adjusted} (dBA)	%HA		L _{dn, adjusted} (dBA)	%HA	
R01	Kitimaat Village childcare centre	53.4	3.4	36.1	53.4	3.4	0.0
R02	Kitimaat Village school	53.3	3.3	36.1	53.4	3.4	0.1
R03	Kitimaat Village church	53.4	3.4	36.1	53.5	3.4	0.0
R04	Kitimaat Village Health Centre	53.3	3.3	36.1	53.4	3.4	0.1
R13 ¹	Kitimaat Village residence 1	49.3	2.0	36.4	49.5	2.1	0.1
R14 ¹	Kitimaat Village residence 2	53.3	3.3	36.1	53.4	3.4	0.1
R15 ¹	Kitimaat Village residence 3	54.0	3.6	36.1	54.1	3.7	0.1
R16 ¹	Kitimaat Village Residence 4 (Haisla)	53.6	3.5	36.1	53.7	3.5	0.0



Receptor ID	Description	Baseline		Project L _{dn} (dBA)	Total (Baseline and Project)		Change in %HA (Between Total and Baseline)
		L _{dn} , adjusted (dBA)	%HA		L _{dn} , adjusted (dBA)	%HA	
R20	Moore Creek 1	47.4	1.6	29.8	47.5	1.6	0.0
R21	Moore Creek 2	47.5	1.6	34.8	47.7	1.6	0.0
R23 ¹	C'Imo'Ca Child Care Centre	53.4	3.4	36.1	53.5	3.4	0.0
R24 ¹	Haisla Recovery Centre	53.9	3.6	36.1	54.0	3.6	0.0
R26	SW dockyard	52.1	2.9	42.9	52.5	3.0	0.2
R27	Half Moon Bay	51.3	2.6	49.3	53.4	3.4	0.8

Note:

¹ The + 10 dB “peace and quiet” adjustment is included

9.2.2 Sleep Disturbance

Table 12 shows the sleep disturbance assessment results based on the Health Canada, IMO, and ANSI recommendations.

The IMO Code recommends the indoor noise level limit of 55 dBA in cabins. The predicted noise level in the FLNG cabin (R29) the IMO limit of 55 dBA. The ANSI standard for hotel or motel individual rooms or suites indoor sound level criteria is recommended as an achievable target for evaluating interior noise on the FLNG. The predicted noise level of 51 dBA in the FLNG cabin (R29) exceeds the ANSI sound level criteria of 44 dBA. Mitigation measures can be considered to reduce the indoor noise level to 44 dBA.

Health Canada recommends no more than 30 dBA L_{eq} for continuous noise during the sleep period. The results indicate that all residential receptors are below the indoor threshold of 30 dBA 30 dBA L_n. The results at the FLNG worker accommodation cabin are 51 dBA, 21 dB above the Health Canada 30 dBA thresholds. Although the Heath Canada sleep disturbance threshold of 30 dBA is recommended, it is better suited for private residential bedrooms with very low background noise. In spaces with higher occupant density, such as hotel or motel rooms, background noise from central HVAC systems, as well as local human activities, a sound level of 30 dBA may not be feasible.



Table 12 Operation Phase – Sleep Disturbance Assessment

Receptor ID	Nighttime L_n Outdoor (dBA)	Nighttime L_n Indoor (dBA)	Exceed Health Canada 30 dBA
R01	-	-	-
R02	-	-	-
R03	-	-	-
R04	-	-	-
R13	30.0	15.0	No
R14	29.7	14.9	No
R15	29.7	14.9	No
R16	29.7	14.9	No
R20	-	-	-
R21	-	-	-
R23	-	-	-
R24	29.7	14.9	No
R26	-	-	-
R27	-	-	-

Notes:

“-” Location indicates the receptor is not a residential noise sensitive receptor.

9.2.3 FLNG Workers Accommodation

The Province of British Columbia does not have noise guidance for industrial camps or similar environments. A review of Canadian and international standards identified five noise thresholds related to industrial accommodations (cabins) and sleep (Sections 4.3 and 4.4). For Cedar’s sleeping cabins (R29) within the proposed accommodation block on the FLNG, the updated modelling predicts sound levels of 51 dBA meets:

- Canadian Labor Code Maritime Occupational Health and Safety Regulations threshold of 75 dBA (Canada 2025a, Canada 2025b)
- Canada-Newfoundland and Labrador Offshore Area Occupational Health and Safety Regulations threshold of 70 dBA (Canada 2022)
- IMO Code on Noise Levels on Board Ships threshold of 55 dBA for sleeping cabins (IMO 2012)

However, the predicted sound levels will exceed the ANSI criteria and Health Canada’s threshold for sleep disturbance. The Health Canada and ANSI thresholds are not considered suitable for accommodation cabins within the FLNG facility as the FLNG is an industrial facility and is affected by background noise from central HVAC systems and operation equipment.



10 Summary

Advancement of the Project design has resulted in the following proposed operational changes to the Project:

- FLNG worker accommodations for housing up to 80 workers and support staff on the approved FLNG
- Increased FLNG liquefaction capacity from 400 to 500 million standard cubic feet per day of natural gas

The noise assessment focused on the potential noise effects during the normal operation of the FLNG and LNG carrier loading. Noise effects associated with the Project decommissioning and construction are not affected by the amendment.

Noise modelling was completed by B&V and Samsung. The FLNG operation noise model has been revised to represent the proposed operational changes to the Project. There is no change in shipping and transmission line; therefore, this assessment only carrying forward noise sensitive receptor locations in proximity to the FLNG (i.e., within 4 km).

Key findings of the assessment were:

- The cumulative sound levels were found to be below the PSLs at all identified residential dwellings and at the 1.5 km criteria boundary (1.5 km from the Cedar LNG Project and LNG Canada Export Terminal boundaries). In addition, no low frequency noise concerns for the Project are anticipated at the identified residential noise sensitive receptors.
- Project noise effects are predicted to comply with the Health Canada change in %HA threshold for community annoyance at all noise sensitive receptors.
- Project operation activities were predicted to comply with the sleep disturbance thresholds during the nighttime period at the residential noise sensitive receptors.
- The predicted noise level of 51 dBA in the FLNG cabin (R29) meets the Canada Maritime Occupational Health and Safety Regulations recommended limit 75 dBA, Canada-Newfoundland and Labrador Offshore Area Occupational Health and Safety Regulations threshold of 70 dBA, and IMO Code recommended limit of 55 dBA.



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Appendices



Cedar LNG Project

Technical Data Report—Acoustics

Appendix A: Atmospheric Noise Baseline Field Study for Cedar LNG Facility

September 2025

Appendix A Atmospheric Noise Baseline Field Study for Cedar LNG Facility



Cedar LNG Project Atmospheric Noise Baseline Field Study for the Cedar LNG Facility

September 2025

Prepared for:



Prepared by:
Stantec Consulting Ltd.

DC File Number:
123221301EN-RPT0001

Limitations and Sign-off

This document entitled Atmospheric Noise Baseline Field Study for the Cedar LNG Facility was prepared by Stantec Consulting Ltd. ("Stantec") for the account of Cedar LNG Partners LP (the "Client") to support the regulatory review process for its Application for Operations Phase Amendment to Provincial Environmental Assessment Certificate and Federal Decision Statement (the "Application") for the Cedar LNG Project (the "Project"). In connection therewith, this document may be reviewed and used by the Environmental Assessment Office, Impact Assessment Agency of Canada, participating Indigenous nations, and all members of the Technical Advisory Committee participating in the review process in the normal course of its duties. Except as set forth in the previous sentence, any reliance on this document by any other party or use of it for any other purpose is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The information and conclusions in the document are based on the conditions existing at the time the document was published and does not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by the Client or others, unless expressly stated otherwise in the document. Any use which another party makes of this document is the responsibility and risk of such party. Such party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other party as a result of decisions made or actions taken based on this document.

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Stantec Permit # 1002862



Executive Summary

Cedar LNG Partners LP, by its general partner Cedar LNG Partners (GP) Ltd. (Cedar), a Haisla Nation-led partnership with Pembina Pipeline Corporation (Pembina), is planning to construct and operate a liquefied natural gas (LNG) export facility within the District of Kitimat, British Columbia (BC) (the Project). The Project is subject to the requirements of the provincial *Environmental Assessment Act* and federal *Impact Assessment Act* and underwent a comprehensive environmental assessment from 2019 to 2023. Cedar received an Environmental Assessment Certificate (EAC #E23-01) under the *Environmental Assessment Act* (EAC #23-01) on March 13, 2023 and a positive Decision under the *Impact Assessment Act* on March 15, 2023.

The EAO and IAA processes have yielded conditions of approval that Cedar must address. As per Condition 8.2 and 8.2.1 of the Decision Statement (Cedar 2023), Cedar shall develop and implement a follow-up program with respect to adverse federal effects on the health, social and economic conditions of Indigenous peoples from changes to the acoustic environment. As part of the development of the follow-up program, the Proponent shall identify sensitive noise receptors at which monitoring shall occur. The noise monitor will be conducted prior to construction (i.e., 2023), the peak year of activity during construction, and annually during the first three years of operation (for three to five days each year during summer, when weather conditions do not interfere with sound monitoring). The follow-up program is currently being reviewed by Haisla Nation, Health Canada, and Northern Health Authority.

Stantec Consulting Ltd. (Stantec) was retained by Cedar to conduct an atmospheric noise baseline field study for the Project. Multiple days of noise monitoring was conducted at three sensitive noise receptors identified during the development of the follow-up program. Two receptors are in Kitimaat Village (i.e., BL1 and BL3) and one receptor is Bish Creek FSR at 1.5 km boundary (i.e., BL2). Long term continuous noise monitoring was conducted at each receptor for a period of five days.

Two receptor location BL1 and BL3 are located in the Kitimat Village east of the Project site. The acoustic environment at BL1 is characterized by residence activities, construction activities, nature sound such as dog barking, bird calls, leaves rustling, and distance activities (e.g., marine vessel, train, jet). The acoustic environment at BL3 is characterized by human activities at Gya Wa Tlaab Healing Centre Society and playground nearby, local traffic activity, nature sound such as bird calls, dog barking, leaves rustling, and distance activities (e.g., marine vessel, train, jet). Receptor location BL2 is located at 1.5 km from south of the Project boundary. The acoustic environment at BL2 is characterized by nature sound such as bird calls, leaves rustling, coastal tidal waves, whale blowhole sound, local or logging traffic, and distant activities (e.g., marine vessel, train, jet).

Ambient sound level of 45 dBA daytime and 35 dBA nighttime was assumed for BL1 and BL2 in the assessment. Ambient sound level of 48 dBA daytime and 38 dBA nighttime was assumed for BL3. The measured daytime and nighttime sound levels at BL1 and BL3 are below the ambient sound level used in the assessment. BL1 is the quietest location with measured daytime and nighttime sound level of 38.3 dBA and 27.3 dBA, respectively. The measured daytime and nighttime sound levels at BL2 are 47.7 dBA and 43.4 dBA, respectively. These results at BL2 are above the ambient sound level assumed



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in the assessment. The main contributor to the higher values at BL2 is due to the truck activities along the forestry road.

The atmospheric noise baseline field study results quantify the sound level for three receptors' locations, as part of the decision statement issued under Canada's Impact Assessment Act (IAA), (Condition 8.2, 8.2.1).



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Appendix A	Calibration Certificates
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Acronyms / Abbreviations

ANSI	American National Standards Institute
ASL	Ambient Sound Level
Application	Application for an Environmental Assessment Certificate
BC	British Columbia
BCER	British Columbia Energy Regulator
B&K	Bruel & Kjaer
Cedar LNG	Cedar Liquefied Natural Gas
dB	Decibel
dBA	A-Weighted Decibel
EAC	Environmental Assessment Certificate
FLNG	floating liquefied natural gas
IAA	Canada's Impact Assessment Act
L _d	daytime equivalent sound level
L _{dn}	day-night equivalent sound level
L _{eq}	Energy Equivalent Sound Level
L _n	nighttime equivalent sound level
LNG	liquefied natural gas
m	metre
PSL	Permissible Sound Level
RMS	root mean squared
SPL	Sound Pressure Level re 20 µPa
SLM	sound level meter



Glossary

Term	Definition
Ambient Noise	All noises that exist in an area and are not related to a facility. Ambient noise 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)	The ASL consists of all noise in an area that is not related to regulated facilities. This noise includes sound from other non-regulated 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
Background Sound Level (i.e., Baseline)	It includes noise from all sources other than the sound of interest (i.e., sound from other industrial noise not being measured, transportation sources, animals, and nature)
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
Daytime	The hours from 07:00 to 22:00
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)



Term	Definition
Decibel Addition	<p>In acoustics, due to the logarithmic nature of the decibel scale, the addition of two or more sound pressure levels (denoted as SPL₁, SPL₂ ... SPL_n) is done as follows:</p> $SPL_1 + SPL_2 + \dots + SPL_n = 10 \log (10^{(SPL_1/10)} + 10^{(SPL_2/10)} + \dots + 10^{(SPL_n/10)})$ <p>As an example: 50 dB + 50 dB = 53 dB</p>
Energy Equivalent Sound Level (L _{eq})	<p>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}(24) 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</p>
Frequency	<p>Number of cycles per unit of time. In acoustics, frequency is expressed in hertz (Hz), i.e., cycles per second</p>
Hertz (Hz)	<p>Unit of measurement of frequency, numerically equal to cycles per second</p>
Nighttime	<p>the hours from 22:00 to 07:00</p>
Noise	<p>Unwanted sound</p>
Noise Level	<p>Same as Sound Level, except applied to unwanted sounds</p>
Sound	<p>A dynamic (fluctuating) pressure</p>
Sound Pressure Level	<p>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 equation below where P is the root mean squared (RMS) pressure due to a sound and P₀ is the reference pressure. P₀ is usually taken as 2.0 × 10⁻⁵ Pascals.</p> $SPL \text{ (dB)} = 20 \log(P_{RMS}/P_0)$



1 Introduction

Cedar LNG Partners LP, by its general partner Cedar LNG Partners (GP) Ltd. (Cedar), a Haisla Nation-led partnership with Pembina Pipeline Corporation (Pembina), is planning to construct and operate the Cedar LNG Project (the Project), a liquefied natural gas (LNG) export facility within the District of Kitimat, British Columbia (BC).

The Project is subject to the requirements of the provincial *Environmental Assessment Act* and federal *Impact Assessment Act* and underwent a comprehensive environmental assessment from 2019 to 2023. Cedar received an Environmental Assessment Certificate (EAC #E23-01) under the *Environmental Assessment Act* on March 13, 2023 and a positive Decision Statement under the *Impact Assessment Act* on March 15, 2023. Condition 8.2 of the Decision Statement requires Cedar to develop and implement a follow-up program with respect to adverse federal effects on the health, social and economic conditions of Indigenous peoples from changes to the acoustic environment. As part of the development of the follow-up program, Cedar must identify sensitive noise receptors at which to undertake monitoring. In the context of the follow up program, the noise monitor will occur during the year prior to construction. The noise monitor will be conducted prior to construction (i.e., 2023), the peak year of activity during construction, and annually during the first three years of operation (for three to five days each year during summer, when weather conditions do not interfere with sound monitoring).

As part of the follow-up program, Cedar committed to conducting noise monitoring at three locations during August or September in each of:

- Pre-construction or a non-active period in the first year of construction
- The peak year of activity during construction
- Annually during the first three years of operation

August and September were selected as suitable months for monitoring as weather conditions during this period are suitable for high levels of construction activity and typically do not generate high background noise levels thereby increasing the quality of the monitoring data. The follow-up program is currently being reviewed by Haisla Nation, Health Canada, and Northern Health.

In addition to the follow-up program requirement under the *Impact Assessment Act*, noise levels from LNG facilities in British Columbia are regulated by the British Columbia Energy Regulator (BCER) through the *Energy Resource Activities Act* and associated Liquefied Natural Gas Facilities Regulation. In July 2023, BCER issued a permit (BCER 20232) for the LNG facility that included noise monitoring requirements at two locations: one residence receptor (Receptor 1 or BL13 in IAA statement) in Kitamaat Village and one 1.5 km south of the facility (Receptor 2 or L1 in EAC Application). To align the requirements of the follow-up program required by the Decision Statement and BCER permit conditions, Cedar committed to monitoring at the two receptors specified in the permit plus an additional location in Kitamaat Village.



Stantec Consulting Ltd. (Stantec) was retained by Cedar to conduct the pre-construction noise baseline field study as set-out in the follow-up program. The noise baseline field study was conducted during a period of five days in September 2023. This report presents the methods and results of the noise baseline field study.



2 Study Area and Monitoring Location

The Project infrastructure will be located within the traditional Haisla Nation territory. The floating liquefied natural gas (FLNG) facility and marine terminal will be located approximately 2.7 kilometers (km) west of the Kitamaat Village and approximately 10 km southwest of the Kitimat town centre (Figure 1). The Terminal Area will be located within District Lot 99, a portion of the adjacent water lot (Lot A District Lot 5469) and an area of submerged Crown land.

As noted in the introduction, three monitoring locations have been identified as part of the follow up program. Receptor 1 (BL1) is a residence in Kitamaat Village. Receptor 2 (BL2) is an assessment location approximately 1.5 km south of Cedar’s FLNG facility adjacent to the Bish Creek Forest Service Road (FSR). Receptor 3 (BL3) is located adjacent to the Gya Wa Tlaab Healing Centre Society in Kitamaat Village.

The three monitoring locations are summarized in Table 1. Figure 1 shows the 1.5 km criteria boundary and three monitoring locations.

Table 1 Noise Monitoring Locations

ID	Description	UTM				Deviation from BCER Location (m)
		BCER Permit Condition		Monitoring Location		
		Easting	Northing	Easting	Northing	
BL1	Kitamaat Village Residence	522774	5979712	522795	5979727	26
BL2	Bish Creek FSR 1.5 km Boundary ¹	519106	5978779	519124	5978846	69
BL3	Gya Wa Tlaab Healing Centre Society	--	--	522871	5980870	--

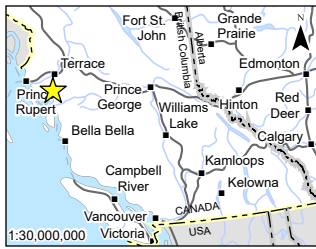
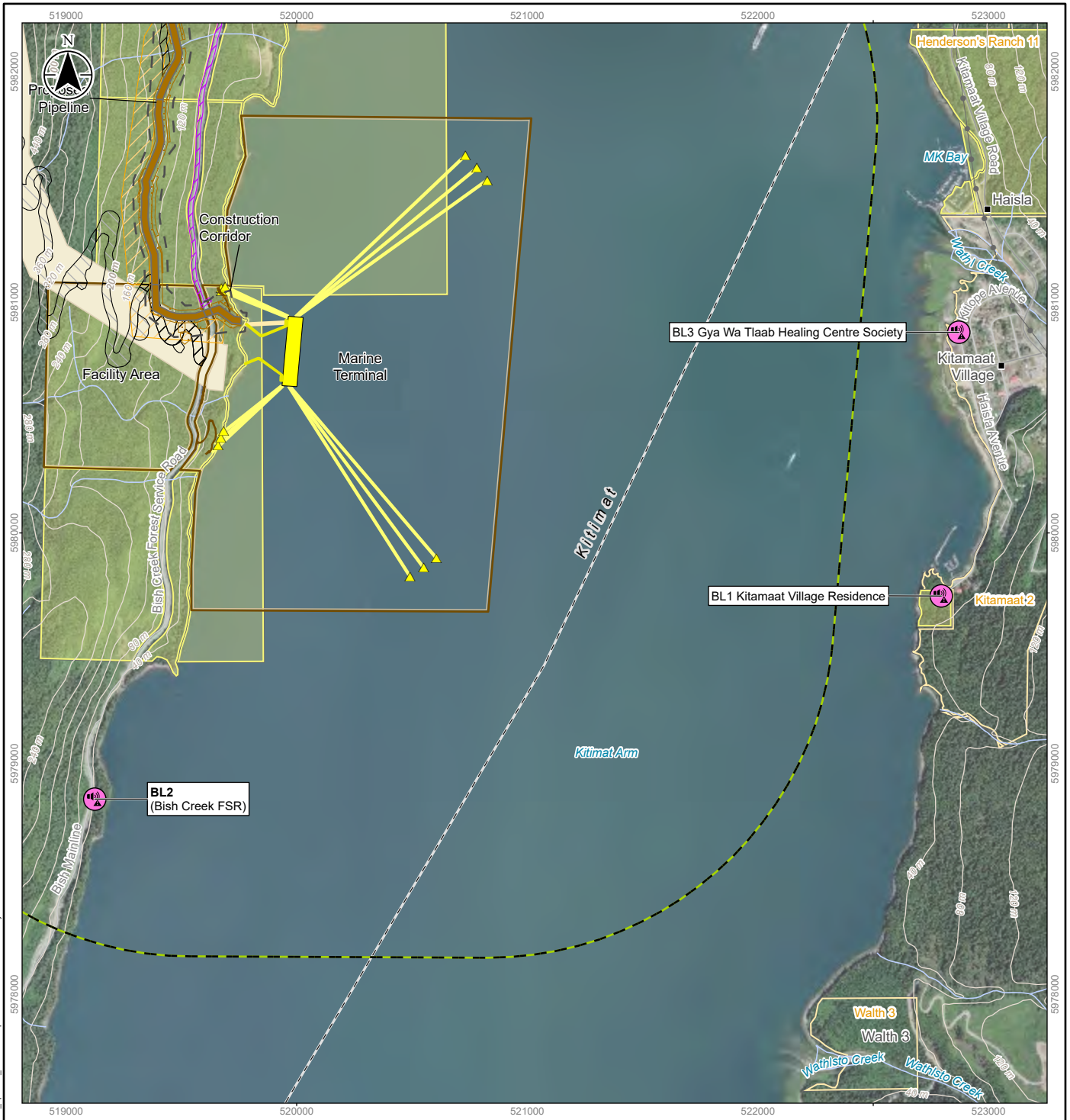
Notes:

--“ not applicable

¹ BL2 is the same location as site “L1” assessed in Cedar’s Environmental Assessment Certificate Application

BCER Permit Condition 41 indicates that Cedar may locate the noise survey equipment in any acoustically comparable location within a 75-meter radius of the target locations in the table identified above in Condition 40e. Due to safety along the FSR (e.g., pull out areas only) and physical constraints near the residence, the monitoring locations could not be located at the exact UTM locations specified in Condition 40e. BL1 and BL2 monitoring locations are within 75 m of the permit condition locations (Table 1).





Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada
 World Imagery: Earthstar Geographics
 World Imagery: Maxar

- Road
- Local Street
- - - Resource Road
- Transmission Line
- Topographic Contour
- Watercourse
- Municipal Boundary
- Land Ownership**
- Private Land
- National Park
- First Nations Reserve
- Provincial Park, Ecological Reserve, or Protected Area
- Conservancy Area
- Wildlife Management Area
- Noise Monitoring Location
- Cedar LNG Criteria Boundary (1.5 km)
- Pipeline Construction Corridor
- Pipeline ROW (AA: 100116060)
- Pipeline Temporary Workspace
- Access Road to Pipeline Under BCER Permit 100116060
- Access Road to Transmission Line under EAC #23-01
- FLNG
- Floating Access
- Access
- Mooring Anchor
- Dynamic Riser
- Mooring Line
- Distribution Powerline Corridor
- Alternative Transmission Line Corridor
- Terminal Area
- Transmission Line Construction Corridor (AA: 100115339)



Project Location: Kitimat, British Columbia
 Project Number: 12322394
 Prepared by TCARDINAL on 20250827
 Requested by JCHU on 20250827
 Reviewed by XXX on 202508XX

Client/Project/Report
 Cedar LNG Partners (GP) Ltd.
 Cedar LNG Project
 Atmospheric Noise Baseline Field Study

Figure No.
1
 Title
Acoustic Monitoring Station

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

\\C:\185-rhag\01\work\group\1232\project\12322394\figures\TDR\recos\ast\bl_noise_recepions_updated_20250827.aprx Revised: 2025-08-27 By: tcardinal

3 Methods

3.1 Monitoring Equipment

Noise monitoring was conducted at monitoring locations BL1, BL2, and BL3 for a period of five days. Brüel and Kjær (B&K) Type 1 integrating sound level meters (SLMs) Model 2250 were used for the measurements. The SLMs are compliant with the American National Standards Institute (ANSI) S1.43-1997 standard for measurement precision.

Each SLM had been laboratory calibrated within the last 24 months. A portable field calibrator, B&K Model 4231, was used to calibrate the SLMs immediately before and after each measurement series and after any change in equipment conditions (e.g., cable or battery replacement). The field calibrator was laboratory calibrated within the last 12 months. This calibrator conforms to ANSI S1.40-2006 standards with an estimated uncertainty for sound pressure level of ± 0.12 dB at a 99% confidence level. Discrepancy in calibration level did not exceed ± 0.5 dB during the measurement period. The calibration certificates for the SLM and field calibration is presented in Appendix A.

The SLMs were set to measure sound levels with the logging frequency of one minute during the measurement period. Along with sound pressure levels, SLMs were set to concurrently record audio. Each audio recording was used in conjunction with the measured sound levels to help identify extraneous events. An extraneous event is defined as an isolated occurrence not representative of baseline conditions and may include events such as field technician activities, construction work, or conversations occurring adjacent to the monitoring equipment. These extraneous events were not included in the data analysis.

The British Columbia Noise Control Best Practices Guideline (BCER 2021) considers wind speeds higher than 15 km/h and rainfall (precipitation) as non-representative weather conditions. Ambient temperatures must also be within the manufacturer's tolerances for instrument operation. The Kestrel 5500 portable weather meters were used to record wind speed, wind direction, temperature, and relative humidity in one-minute interval. The weather meter was located approximately 4.5 m away from the SLMs.

The equipment setup at each monitoring location (i.e., BL1, BL2, and BL3) is shown in Photo 1 to Photo 3.



Photo 1 *Sound Level Meter and Weather Meter Setup at BL1*

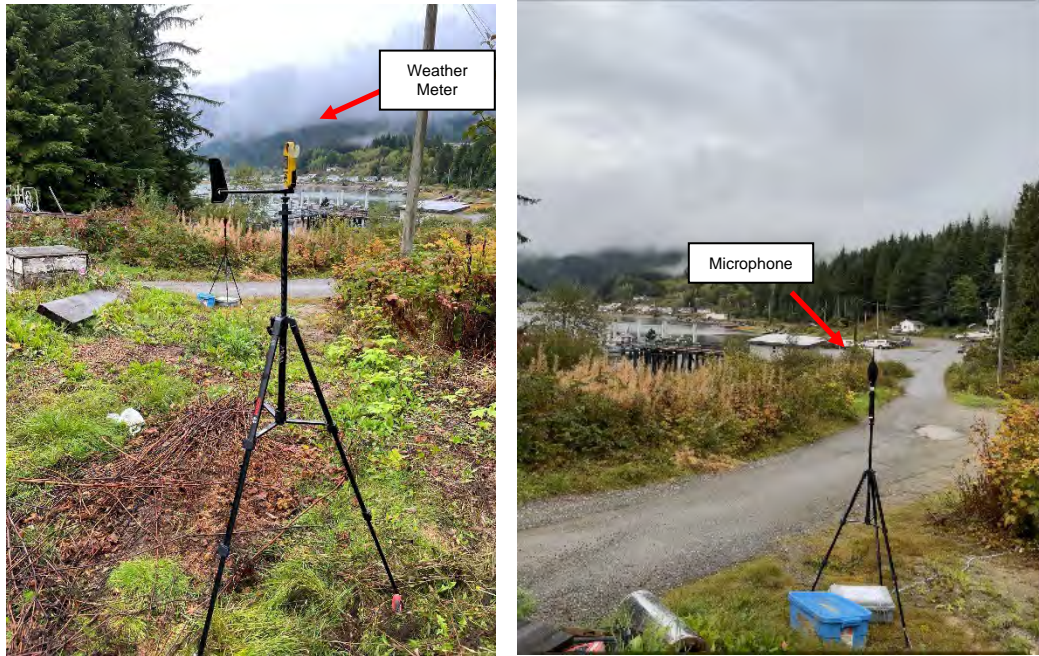


Photo 2 *Sound Level Meter and Weather Meter Setup at BL2*



Photo 3 Sound Level Meter and Weather Meter Setup at BL3



3.2 Data Analysis Approach

The British Columbia Noise Control Best Practices Guideline (BCER 2021) considers three hours per daytime and nighttime period to be the minimum representative sample period. The noise guideline also recommends that invalid or abnormal data not typical of an average ambient sound level (ASL) should be excluded from the measurement. The approach of isolating non-representative events is considered appropriate and results in a lower baseline sound level or quieter existing acoustic environments.

The data from the field study were analyzed using the B&K BZ5503 Measurement Partner Suite® software program. In the program, audio sound recordings were reviewed to identify noise sources for each monitoring period such as natural sounds and local activities. Data that were not representative of existing acoustic environment (e.g., technician activities, birds close to the microphone, helicopter traffic, construction activities, local activities close to the microphone), or non-representative weather conditions (rain or wind speed higher than 15 km/hour) were isolated from the data set prior to the calculation of any averages or other statistical values. After the data isolation, daytime equivalent sound level (L_d), nighttime equivalent sound level (L_n), and day-night sound level (L_{dn}) values were then calculated for the measurement period. The daytime period represents 15 hours from 7:00 to 22:00 and the nighttime period represents nine hours from 22:00 to 7:00.

4 Results

The noise measurement overall duration, valid time, and sound level results (i.e., L_d , L_n , and L_{dn}) are summarized in Table 2. Detailed information including daily sound levels and time history plots are presented in the following sections for each monitoring location.

Table 2 Monitoring Result Summary

Monitoring Location ID	Duration (hours)			Measured Sound Level (dBA)		
	Total	Valid daytime	Valid Nighttime	L_d	L_n	L_{dn}
BL1	117	42	40	38.3	27.3	37.9
BL2	119	41	29	47.7	43.4	50.7
BL3	117	39	36	42.5	32.9	42.7

4.1 Monitoring Location BL1

BL1 is an occupied residence in Kitamaat Village. The acoustic environment at BL1 is influenced by anthropogenic sounds and natural sounds. Anthropogenic sounds include residence activity, construction activity, dog barking, aircraft or helicopter flyover, vehicle traffic, and vehicle idling. Natural sounds include wind, rain, and bird call.

The daily daytime and nighttime sound levels at BL1 are summarized in Table 3. There was 42 hours and 40 hours of valid measurement data collected during the daytime and nighttime periods, respectively. The measured one-minute equivalent sound level ($L_{eq,1\text{minute}}$) for the entire measurement duration is presented in Figure 2. The purple graph segments represent invalid data due to anomalous noise events. These events included activities close to the microphone (e.g., bird calls, dog barking, construction activity, residence activity, vehicle idling, backup alarm, and Stantec staff on site). The red graph segments represent invalid data due to non-representative weather conditions (e.g., rain precipitation). Wind speed did not exceed the threshold of 15 km/hour for non-representative weather during the measurement period. Invalid data was removed from data set for further analysis. The gray graph segments represent valid data that were used for the determination of L_d or L_n . The shaded blue sections in the graphs represent the nighttime period.



Figure 2 BL1 Measured Sound Levels – September 19 to September 24, 2023

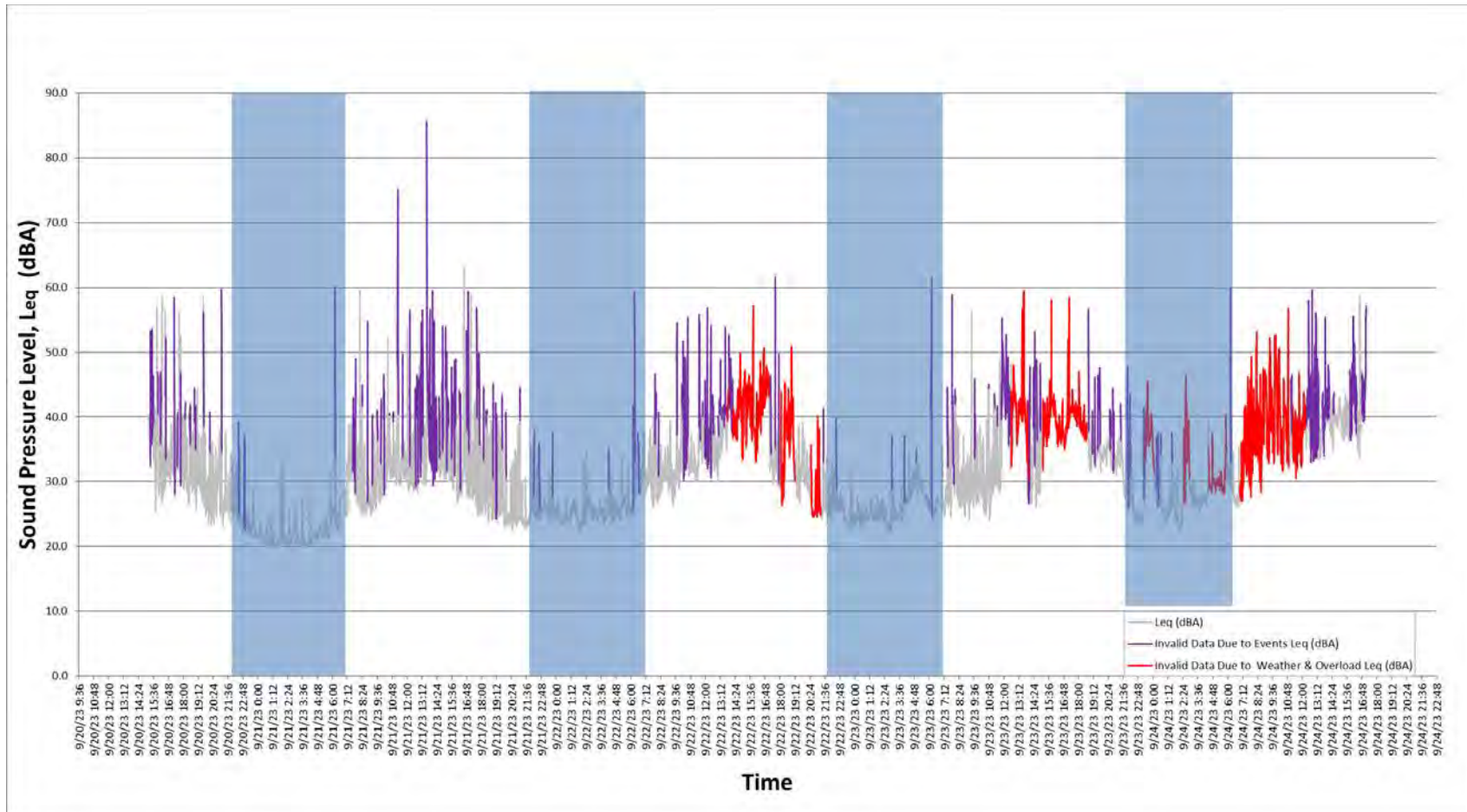


Table 3 BL1 Daytime and Nighttime Sound Level

Date	Daytime		Nighttime	
	L _d (dBA)	Valid Time (hours)	L _n (dBA)	Valid Time (hours)
September 20, 2023	39.5	11	28.5	9
September 20 to 21, 2023	39.1	12	25.1	8
September 21 to 22, 2023	33.5	8	27.7	9
September 22 to 23, 2023	35.3	8	26.8	8
September 23 to 24, 2023	41.5	3	27.9	6
Overall	38.3	42	27.3	40

Note:

--" No data available

4.2 Monitoring Location BL2

BL2 is located 1.5 km from Cedar’s LNG facility and is adjacent to the Bish Creek FSR. The acoustic environment at BL2 is influenced by anthropogenic sounds and natural sounds. Anthropogenic sounds include aircraft or helicopter flyover, truck traffic, marine traffic, and vehicle idling. Natural sounds include wind, rain, coastal waves, bird call, and marine mammals (e.g., whale blowhole). Whale blowhole sounds above water was captured during the noise monitoring as part of the soundscape. The whale blowhole sounds commonly known as blows or spouts, are audible sound of a whale breathing air through its blowhole.

The daily daytime and nighttime sound levels at BL2 are summarized in Table 4. There was 41 hours and 29 hours of valid measurement data collected during the daytime and nighttime periods, respectively. The measured one-minute equivalent sound level (L_{eq,1minute}) is presented in Figure 3. The purple graph segments represent invalid data due to anomalous noise events. These events include activities close to the microphone (e.g., bird calls, animal activity, truck idling, Stantec staff on site). The red graph segments represent invalid data due to non-representative weather conditions (e.g., rain precipitation). Wind speed did not exceed the threshold of 15 km/hour for non-presentative weather during the measurement period. Invalid data was removed from data set for further analysis. The gray graph segments represent valid data that were used for the determination of L_d or L_n. The shaded blue sections in the graphs represent the nighttime period.



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Figure 3 BL2 Measured Sound Levels –September 19 to September 24, 2023

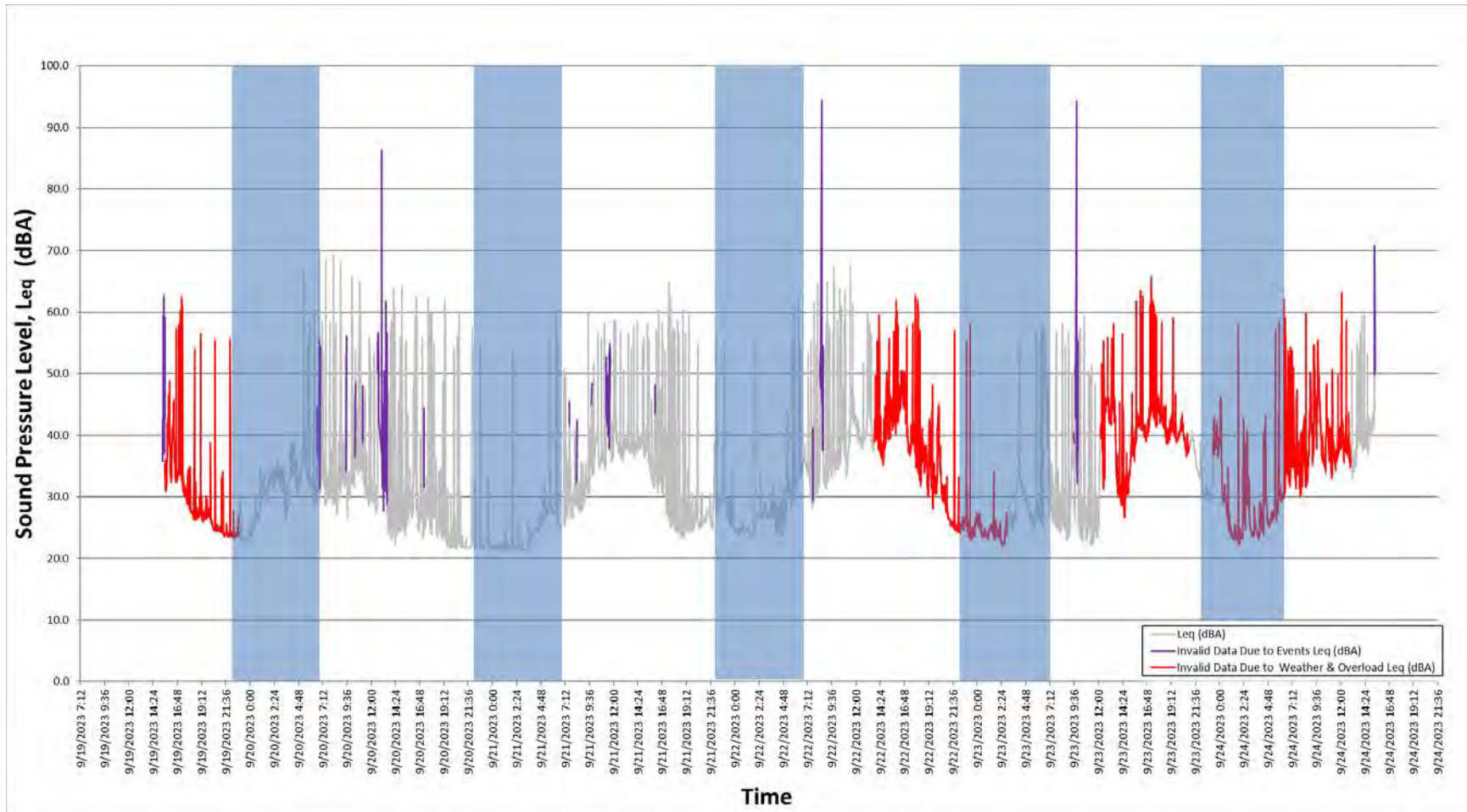


Table 4 *BL2 Daytime and Nighttime Sound Level*

Date	Daytime		Nighttime	
	L _d ¹ (dBA)	Valid Time (hours)	L _n ² (dBA)	Valid Time (hours)
September 19 to 20, 2023	48.9	14	46.8	8
September 20 to 21, 2023	45.1	14	39.3	9
September 21 to 22, 2023	50.1	6	41.0	9
September 22 to 23, 2023	42.3	6	42.3	4
Overall	47.7	41	43.4	29

Notes:

--" No data available

¹ daytime period from 7 AM to 10 PM (start date)

² nighttime period from 10 PM (start date) to 7 AM (following date)

4.3 Monitoring Location BL3

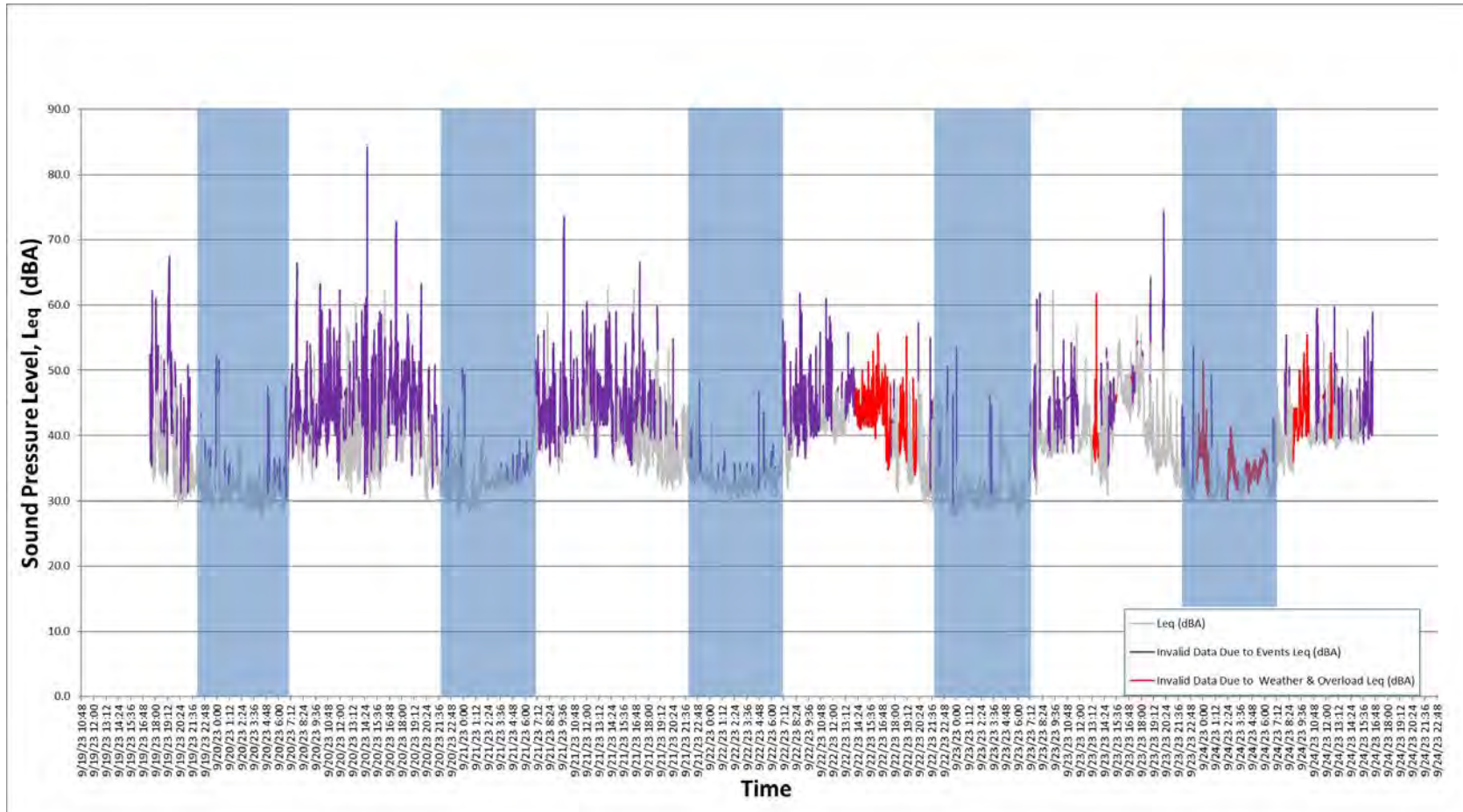
BL3 is located adjacent to the Gya Wa Tlaab Healing Centre Society in Kitamaat Village. The healing centre offers early recovery or stabilization addictions program with treatment beds and stabilization beds for occupants. It is open 24 hours per day 7 days per week. The acoustic environment at BL3 is influenced by anthropogenic sounds and natural sounds. Anthropogenic sounds include human activity, marine traffic, train, vehicle traffic, aircraft flyover, and vehicle idling. Natural sounds include wind, rain, bird calls, and dogs barking.

The daily daytime and nighttime sound levels at BL3 are summarized in Table 5. There were 39 hours and 36 hours of valid measurement data during the daytime and nighttime period, respectively. The measured one-minute equivalent sound level (L_{eq,1minute}) BL3 is presented in Figure 4. The purple graph segments represent invalid data due to anomalous noise events. These events included activities close to the microphone (e.g., bird calls, vehicle idling, garbage truck, human activity, dog barking, backup alarm and Stantec staff on site). Distance marine traffic was included in the data because it is considered as part of the baseline sound level. The red graph segments represent invalid data due to non-representative weather conditions (e.g., rain precipitation). Wind speed did not exceed the threshold of 15 km/hour for non-presentative weather during the measurement period. Invalid data was removed from data set for further analysis. The gray graph segments represent valid data that were used for the determination of L_d or L_n. The shaded blue sections in the graphs represent the nighttime period.



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Figure 4 BL3 Sound Levels – September 19 to September 24, 2023



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Table 5 BL3 Daytime and Nighttime Sound Level

Date	Daytime		Nighttime	
	L _d (dBA)	Valid Time (hours)	L _n (dBA)	Valid Time (hours)
September 19, 2023	37.3	3	-	-
September 19 to 20, 2023	43.4	6	32.0	8
September 20 to 21, 2023	42.9	7	32.7	8
September 21 to 22, 2023	39.4	6	33.2	8
September 22 to 23, 2023	43.9	11	32.6	8
September 23 to 24, 2023	41.4	6	34.7	4
Overall	42.5	39	32.9	36

Note:

“--“ No data available



5 Discussion

The atmospheric noise baseline field study results quantify the ASL for three receptor locations, meeting the pre-construction conditions of the Decision Statement follow-up program and conditions of the BCER permit. The noise monitoring was conducted over a five-day period at each location (BL1, BL2, and BL3) in September 2023. The BCER’s British Columbia Noise Control best Practices Guideline (2021) considers three valid hours per daytime and nighttime period to be the minimum sample period requirement. The monitoring durations at each receptor, as shown in Table 3, Table 4, and Table 5, exceeded this minimum requirement.

Two receptor location BL1 and BL3 are located in the Kitimat Village east of the Project site. Receptor location BL2 is located at 1.5 km from south of the Project boundary. The acoustic environment at the three locations is characterized by both anthropogenic and natural sounds. Anthropogenic sounds include human activity, dog barking, construction activity, aircraft or helicopter flyover, vehicle traffic, marine traffic, train traffic and vehicle idling. Natural sounds include wind, rain, bird calls, whale blowhole sound, animal activity, dog barking and coastal waves.

Table 6 compares the results to the ASL used in the noise assessment completed as part of Condition 8.2 of the IAA Decision Statement. The measured daytime and nighttime sound levels at BL1 and BL3, both within Kitimaat Village, are below the ASL used in the assessment. BL1 is the quietest location with measured L_d and L_n of 38.3 dBA and 27.3 dBA, respectively. On the other hand, measured daytime and nighttime sound levels at BL2 are above the ASL assumed in the assessment. The main contributor to the higher values at BL2 is due to the truck activities along the FSR. The measured nighttime sound level of 43.4 dBA is already above the Permissible Sound Level (PSL) limit of 40 dBA. When the background sound level (i.e., measured ASL) is much higher the noise contribution from other sources of interest, it represents a weak “signal-to-noise ratio” condition. Noise measurement at locations such as BL2 may not be able to distinguish the difference with or without the Project. During operation, compliance with the PSL may be demonstrated by Project noise emission measurement (e.g., fence line and within facility) in combination with noise modelling. The monitoring program during operation can incorporate fence line and facility noise emission measurements to update the noise model for the purpose of compliance validation.

Table 6 Measured Sound Level and Application Ambient Sound Level Comparison

Monitoring Location ID	Measured Sound Level (dBA)			Application Ambient Sound Level (dBA)		
	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
BL1	38.3	27.3	37.9	45.0	35.0	45.0
BL2	47.7	43.4	50.7	45.0	35.0	45.0
BL3	42.5	32.9	42.7	48.0	38.0	48.0



6 References

- Acoustical Society of America. 1997. American National Standard (ANSI) ANSI S1.43 1997. Specifications for Integrating-Averaging Sound Level Meters. Reaffirmed by ANSI 16 March 2007. New York: ANSI.
- ANSI S1.40-2006 (BL2011). Specification and Verification Procedures Sound Calibrators. American National Standards Institute (ANSI).
- BCER (British Columbia Energy Regulator). 2021. British Columbia Noise Control Best Practices Guideline. November 2021.
- BCER 20232. General Permissions, Authorizations and Conditions Application Number 100115227 for Facility Cedar Kitimat B-076-J/103-H-15 001, BCER 100115227-PERMIT-LNG-FACILITY, July 6, 2023
- Cedar Liquefied Natural Gas (Cedar LNG). Cedar LNG Partners (GP) Ltd. July 2023. Section 39-43 Primary Permits. 100115227 Permit LNG Facility. Available at: <https://www.bcer.ca/files/projects/cedar-lng/100115227-PERMIT-LNG-FACILITY.pdf>.



Appendices



Appendix A Calibration Certificates





The Hottinger Brüel & Kjær Inc. Calibration Laboratory
 3079 Premiere Parkway Suite 120
 Duluth, GA 30097
 Telephone: 770-209-6907
 Fax: 770-447-4033
 Web site address: <http://www.hbkworld.com>



Calibration
 Certificate
 # 1568.01

CERTIFICATE OF CALIBRATION

No.: CAS-630035-B6P3Z4-405

Page 1 of 2

CALIBRATION OF:

Microphone: Brüel & Kjær Type 4952 Serial No. 2821387

CUSTOMER:

Stantec
 155 Hawkville Close NW
 Calgary, AB T3G 3C3
 Canada

CALIBRATION CONDITIONS:

Environment conditions: Air temperature: 24.4 °C
 Air pressure: 97.535 kPa
 Relative Humidity: 26.3 %RH
 Applied polarization voltage: 0 Vdc

SPECIFICATIONS:

This document certifies that the instrument as listed under "Type" has been calibrated and unless otherwise indicated under "Final Data", meets acceptance criteria as prescribed by the referenced Procedure. Statements of compliance, where applicable, are based on calibration results falling within specified criteria with no reduction by the uncertainty of the measurements. The calibration of the listed transducer was accomplished using a test system which conforms to the requirements of ISO/IEC 17025, ANSI/NCSL Z540-1, and guidelines of ISO 10012-1. For "as received" and "final" data, see the attached page(s). Items marked with one asterisk (*) are not covered by the scope of the current A2LA accreditation. This Certificate and attached data pages shall not be reproduced, except in full, without written approval of the Hottinger Brüel & Kjær Inc. Calibration Laboratory-Duluth, GA. Results relate only to the items tested. The transducer has been calibrated using Measurement Standards with values traceable to the National Institute of Standards and Technology, National Measurement Institutes or derived from natural physical constants.

PROCEDURE:

The measurements have been performed with the assistance of the Hottinger Brüel & Kjær Inc. Microphone Calibration System B&K 9721 with application software WT9649 and WT9650 version 5.3.0.10 using calibration procedure: 4952-S251

RESULTS:

- "As Received" Data: Within Acceptance Criteria "As Received" Data: Outside Acceptance Criteria
 "Final" Data : Within Acceptance Criteria "Final" Data : Outside Acceptance Criteria

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k=2$ providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from standards, calibration method, effect of environmental conditions and any short term contribution from the device under calibration.

Date of Calibration: March 17, 2023

Certificate issued: March 17, 2023

Meshaun Hobbs
 Calibration Technician

John Avitabile
 Quality Representative

CERTIFICATE OF CALIBRATION

No.: CAS-630035-B6P3Z4-405

Type 4952

Serial No. 2821387

Page 2 of 2

Sensitivity

Nominal sensitivity:	-30 dB re. 1V/Pa	+/-	3 dB
Sensitivity at calibration conditions:	-30.53 dB re. 1V/Pa	or	29.77 mV/Pa
Sensitivity at reference conditions:	-30.61 dB re. 1V/Pa	or	29.47 mV/Pa
Uncertainty:	+/- 0.11 dB		
Correction factor K at reference conditions:	4.61 dB		
Calibration Frequency:	251.19 Hz		

Reference Conditions:

Pressure: 101.3 kPa
 Temperature: 23 °C
 Relative Humidity: 50%

Traceable references

Type	Serial no	Cal. date	Due date	Calibrated by	Trace number
4180	2602440	2021-12-20	2023-12-31	DPLA	M2. 10-1490-3.1

Condition "As Received":

Good

Comments:

Following TEDS parameters updated:
 Sens@Ref = 0.029471 (V/Pa, valid at Reference Ambient Conditions)
 CalDate = 2023-03-17

Rev 11.08

Acoustic Free Field Response of Model 4952 Microphone re 250 Hertz

Reference Calibrator Model 4226 s/n 2295552

Calibration Due: 28 February 2024

Results represent the deviation of the Free Field response at 0 degrees incidence referenced to the absolute sensitivity of the condenser microphone sensitivity at 250 Hertz.

RESULTS

Frequency	Calibrator Acoustic Output Level	System Response	Model 4226 Free Field Correction for the Model 4952	Measured Deviation of Pressure Response	Corrected Deviation re 250 Hertz	Acceptance Criteria	Expanded Uncertainty** k=2
[Hertz]	dB SPL	dB	dB	dB	dB	dB (+/-)	dB
31.5	94.1	-0.16	-0.14	0.13	0.2	2.0	0.17
63	94.1	-0.03	-0.07	0.15	0.1	2.0	0.17
125	94.1	-0.02	-0.06	0.07	0.0	2.0	0.16
250	94.1				0.0 Reference		
500	94.1	0.01	0.17	-0.05	0.1	2.0	0.17
1,000	94.1	0.01	0.38	-0.12	0.3	2.0	0.21
2,000	94.0	0.00	1.06	-0.44	0.6	2.0	0.23
4,000	94.0	0.00	2.21	-1.30	0.8	2.0	0.33
8,000	93.9	0.00	4.99	-3.95	0.8	2.0	0.44
12,500	94.0	0.00	7.44	-7.16	0.2	3.0	0.59

**Expanded uncertainties expressed at approximately 95% confidence level using a coverage factor of k=2



**HOTTINGER
BRÜEL & KJÆR**
The Hottinger Brüel & Kjær Inc. Calibration Laboratory
3079 Premiere Parkway Suite 120
Duluth, GA 30097
Telephone: 770-209-6907
Fax: 770-447-4033
Web site address: <http://www.hbkworld.com>



Calibration
Certificate
1568.01

CERTIFICATE OF CALIBRATION

No.: CAS-562776-V5B6T8-402

Page 1 of 2

CALIBRATION OF:

Microphone: Brüel & Kjær Type 4952 Serial No. 2821388

CUSTOMER:

Stantec
400-3711 North Fraser Way
Burnaby, BC V5J 5J2

CALIBRATION CONDITIONS:

Environment conditions: Air temperature: 23.7 °C
Air pressure: 98.133 kPa
Relative Humidity: 24 %RH
Applied polarization voltage: 0 Vdc

SPECIFICATIONS:

This document certifies that the instrument as listed under "Type" has been calibrated and unless otherwise indicated under "Final Data", meets acceptance criteria as prescribed by the referenced Procedure. Statements of compliance, where applicable, are based on calibration results falling within specified criteria with no reduction by the uncertainty of the measurements. The calibration of the listed transducer was accomplished using a test system which conforms to the requirements of ISO/IEC 17025, ANSI/NCCL Z540-1, and guidelines of ISO 10012-1. For "as received" and "final" data, see the attached page(s). Items marked with one asterisk (*) are not covered by the scope of the current A2LA accreditation. This Certificate and attached data pages shall not be reproduced, except in full, without written approval of the Hottinger Brüel & Kjær Inc. Calibration Laboratory-Duluth, GA. Results relate only to the items tested. The transducer has been calibrated using Measurement Standards with values traceable to the National Institute of Standards and Technology, National Measurement Institutes or derived from natural physical constants.

PROCEDURE:

The measurements have been performed with the assistance of the Hottinger Brüel & Kjær Inc. Microphone Calibration System B&K 9721 with application software WT9649 and WT9650 version 5.3.0.10 using calibration procedure: 4952-S251; 4952 Acoustic Response Worksheet Rev 11.08

RESULTS:

- "As Received" Data: Within Acceptance Criteria
- "As Received" Data: Outside Acceptance Criteria
- "Final" Data : Within Acceptance Criteria
- "Final" Data : Outside Acceptance Criteria

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k=2$ providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from standards, calibration method, effect of environmental conditions and any short term contribution from the device under calibration.

Date of Calibration: March 17, 2022

Certificate issued: March 17, 2022

Meshaun Hobbs
Calibration Technician

William Shipman
Quality Representative

CERTIFICATE OF CALIBRATION

No.: CAS-562776-V5B6T8-402

Type 4952

Serial No 2821388

Page 2 of 2

Sensitivity

Nominal sensitivity:	-30 dB re. 1V/Pa	+/-	3 dB
Sensitivity at calibration conditions:	-31.00 dB re. 1V/Pa	or	28.17 mV/Pa
Sensitivity at reference conditions:	-31.07 dB re. 1V/Pa	or	27.94 mV/Pa
Uncertainty:	+/- 0.11 dB		
Correction factor K at reference conditions:	5.07 dB		
Calibration Frequency:	251.19 Hz		

Reference Conditions:

Pressure: 101.3 kPa
 Temperature: 23 °C
 Relative Humidity: 50%

Traceable references

Type	Serial no	Cal. date	Due date	Calibrated by	Trace number
4180	2602426	2020-06-09	2022-06-30	DPLA	M2.10-1392-2.1

Condition "As Received": Good

Comments:

No TEDS parameters updated.
 See service report.

Acoustic Free Field Response of Model 4952 Microphone re 250 Hertz

Reference Calibrator Model 4226 s/n 2295552

Calibration Due 31 January 2023

Results represent the deviation of the Free Field response at 0 degrees incidence referenced to the absolute sensitivity of the condenser microphone sensitivity at 250 Hertz.

RESULTS

Frequency	Calibrator Acoustic Output Level	System Response	Model 4226 Free Field Correction for the Model 4952	Measured Deviation of Pressure Response	Corrected Deviation re 250 Hertz	Acceptance Criteria	Expanded Uncertainty** k=2
[Hertz]	dB SPL	dB	dB	dB	dB	dB (+/-)	dB
31.5	94.1	-0.14	-0.14	0.44	0.5	2.0	0.17
63	94.1	-0.05	-0.07	0.19	0.2	2.0	0.17
125	94.1	-0.02	-0.06	0.09	0.0	2.0	0.16
250	94.1				0.0 Reference		
500	94.1	0.01	0.17	-0.10	0.1	2.0	0.17
1,000	94.1	0.01	0.38	-0.14	0.2	2.0	0.21
2,000	94.0	0.01	1.06	-0.43	0.6	2.0	0.23
4,000	94.1	0.01	2.21	-1.37	0.8	2.0	0.33
8,000	93.9	0.01	4.99	-4.12	0.7	2.0	0.44
12,500	94.2	0.00	7.44	-7.37	0.2	3.0	0.59

**Expanded uncertainties expressed at approximately 95% confidence level using a coverage factor of k=2



The Hottinger Brüel & Kjær Inc. Calibration Laboratory
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 Web site address: <http://www.hbkworld.com>



Calibration
 Certificate
 # 1568.01

CERTIFICATE OF CALIBRATION

No.: CAS-630035-B6P3Z4-406

Page 1 of 2

CALIBRATION OF:

Microphone: Brüel & Kjær Type 4952 Serial No. 2821509

CUSTOMER:

Stantec
 155 Hawkville Close NW
 Calgary, AB T3G 3C3
 Canada

CALIBRATION CONDITIONS:

Environment conditions:	Air temperature:	24.4 °C
	Air pressure:	97.535 kPa
	Relative Humidity:	26.3 %RH
Applied polarization voltage:	0 Vdc	

SPECIFICATIONS:

This document certifies that the instrument as listed under "Type" has been calibrated and unless otherwise indicated under "Final Data", meets acceptance criteria as prescribed by the referenced Procedure. Statements of compliance, where applicable, are based on calibration results falling within specified criteria with no reduction by the uncertainty of the measurements. The calibration of the listed transducer was accomplished using a test system which conforms to the requirements of ISO/IEC 17025, ANSI/NCSL Z540-1, and guidelines of ISO 10012-1. For "as received" and "final" data, see the attached page(s). Items marked with one asterisk (*) are not covered by the scope of the current A2LA accreditation. This Certificate and attached data pages shall not be reproduced, except in full, without written approval of the Hottinger Brüel & Kjær Inc. Calibration Laboratory-Duluth, GA. Results relate only to the items tested. The transducer has been calibrated using Measurement Standards with values traceable to the National Institute of Standards and Technology, National Measurement Institutes or derived from natural physical constants.

PROCEDURE:

The measurements have been performed with the assistance of the Hottinger Brüel & Kjær Inc. Microphone Calibration System B&K 9721 with application software WT9649 and WT9650 version 5.3.0.10 using calibration procedure: 4952-S251

RESULTS:

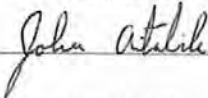
- | | |
|--|--|
| <input checked="" type="checkbox"/> "As Received" Data: Within Acceptance Criteria | <input type="checkbox"/> "As Received" Data: Outside Acceptance Criteria |
| <input checked="" type="checkbox"/> "Final" Data : Within Acceptance Criteria | <input type="checkbox"/> "Final" Data : Outside Acceptance Criteria |

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k=2$ providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from standards, calibration method, effect of environmental conditions and any short term contribution from the device under calibration.

Date of Calibration: March 17, 2023

Certificate issued: March 17, 2023

Meshaun Hobbs
 Calibration Technician


 John Avitabile
 Quality Representative

CERTIFICATE OF CALIBRATION

No.: CAS-630035-B6P3Z4-406

Type: 4952

Serial No. 2821509

Page 2 of 2

Sensitivity

Nominal sensitivity:	-30 dB re. 1V/Pa	+/-	3 dB
Sensitivity at calibration conditions:	-30.75 dB re. 1V/Pa	or	29.02 mV/Pa
Sensitivity at reference conditions:	-30.83 dB re. 1V/Pa	or	28.73 mV/Pa
Uncertainty:	+/- 0.11 dB		
Correction factor K at reference conditions:	4.83 dB		
Calibration Frequency:	251.19 Hz		

Reference Conditions:

Pressure: 101.3 kPa
 Temperature: 23 °C
 Relative Humidity: 50%

Traceable references

Type	Serial no	Cal. date	Due date	Calibrated by	Trace number
4180	2602440	2021-12-20	2023-12-31	DPLA	M2. 10-1490-3.1

Condition "As Received":

Good

Comments:

Following TEDS parameters updated:
 Sens@Ref = 0.028731 (V/Pa, valid at Reference Ambient Conditions)
 CalDate = 2023-03-17

Rev 11.08

Acoustic Free Field Response of Model 4952 Microphone re 250 Hertz

Reference Calibrator Model 4226 s/n 2295552

Calibration Due: 28 February 2024

Results represent the deviation of the Free Field response at 0 degrees incidence referenced to the absolute sensitivity of the condenser microphone sensitivity at 250 Hertz.

RESULTS

Frequency	Calibrator Acoustic Output Level	System Response	Model 4226 Free Field Correction for the Model 4952	Measured Deviation of Pressure Response	Corrected Deviation re 250 Hertz	Acceptance Criteria	Expanded Uncertainty** k=2
[Hertz]	dB SPL	dB	dB	dB	dB	dB (+/-)	dB
31.5	94.1	-0.16	-0.14	0.18	0.2	2.0	0.17
63	94.1	-0.25	-0.07	0.19	0.4	2.0	0.17
125	94.1	-0.01	-0.06	0.09	0.1	2.0	0.16
250	94.1				0.0 Reference		
500	94.1	0.01	0.17	-0.03	0.1	2.0	0.17
1,000	94.1	0.01	0.38	-0.13	0.2	2.0	0.21
2,000	94.0	0.01	1.06	-0.37	0.6	2.0	0.23
4,000	94.0	0.01	2.21	-1.10	1.0	2.0	0.33
8,000	93.9	0.01	4.99	-3.51	1.3	2.0	0.44
12,500	94.0	0.01	7.44	-6.69	0.7	3.0	0.59

**Expanded uncertainties expressed at approximately 95% confidence level using a coverage factor of k=2

Appendix C

2025 Surface Water Acidification and Eutrophication Technical Data Report

Cedar LNG Project

Technical Data Report—2025 Surface Water Eutrophication and Acidification Assessment

Application for an Amendment to
Provincial Environmental Assessment Certificate and Federal Decision Statement

September 2025

Prepared for:



Prepared by:
Stantec Consulting Ltd.

Revision: 0

Limitations and Sign-off

This document entitled Technical Data Report—2025 Surface Water Eutrophication and Acidification Assessment was prepared by Stantec Consulting Ltd. (“Stantec”) for the account of Cedar LNG Partners LP (the “Client”) to support the regulatory review process for its Application for Operations Phase Amendment to Provincial Environmental Assessment Certificate and Federal Decision Statement (the “Application”) for the Cedar LNG Project (the “Project”). In connection therewith, this document may be reviewed and used by the Environmental Assessment Office, Impact Assessment Agency of Canada, participating Indigenous nations, and all members of the Technical Advisory Committee participating in the review process in the normal course of its duties. Except as set forth in the previous sentence, any reliance on this document by any other party or use of it for any other purpose is strictly prohibited. The material in it reflects Stantec’s professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The information and conclusions in the document are based on the conditions existing at the time the document was published and does not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by the Client or others, unless expressly stated otherwise in the document. Any use which another party makes of this document is the responsibility and risk of such party. Such party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other party as a result of decisions made or actions taken based on this document.

Prepared by: **Abirhire, Oghenemise**
Digitally signed by Abirhire, Oghenemise
Date: 2025.09.12 13:00:00 -07'00'
Signature
Oghenemise Abirhire, Ph.D, R.P.Biol.
Printed Name

Reviewed by: **Munro, Karen**
Digitally signed by Munro, Karen
Date: 2025.09.12 14:39:49 -07'00'
Signature
Karen Munro, B.Sc., M.Sc., R.P.Bio
Printed Name

Approved by: **Prystay, Ward**
Digitally signed by Prystay, Ward
Date: 2025.09.12 15:34:48 -07'00'
Signature
Ward Prystay, M.Sc., R.P.Bio.
Printed Name



Executive Summary

Cedar LNG Partners LP, by its general partner Cedar LNG Partners (GP) Ltd. (Cedar), a Haisla Nation-led partnership with Pembina Pipeline Corporation, is constructing a liquefied natural gas (LNG) export facility within the District of Kitimat, British Columbia (BC) (the Project). The Project commenced construction in July 2024. More recently, the continued advancement of the Project design has identified opportunities for operational changes to the Project, including an increase in the liquification capacity from 400 to 500 million standard cubic feet per day of natural gas. This technical data report (TDR) was developed to support an application to amend Environmental Assessment Certificate (EAC) #E23-01 (Amendment #2) and the Decision Statement and considers potential changes to the effects of eutrophication and acidification on surface water associated with the increased facility capacity and providing updated predictions for sulphur (S) and nitrogen (N) emissions.

Eutrophication and acidification results from the 2021 TDR that described the acidification and eutrophication assessment of surface water for the EAC Application (Stantec 2021) were reassessed with an updated method that incorporates updated 2025 air quality dispersion and deposition modelling results and 2023 updated watershed area and catchment runoff data for the lake and stream sites. The results from the 2025 reassessments indicate that Project-related emissions of N and S will not lead to eutrophication and acidification effects in the lake and stream sites located within the Project local study area.



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Appendix A	Stantec 2025 Air Emissions Modelled Deposition Results for Lake and Stream Sites
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Acronyms / Abbreviations

ANC	Acid Neutralizing Capacity
ANC _{limit}	Acid Neutralizing Capacity Limit
ANC _{oaac}	Organic Acid Adjusted Acid Neutralizing Capacity
BC	British Columbia
BC	Base Cations
CL _(A)	Critical Load of Acidity
CLRTAP	Convention on Long-range Transboundary Air Pollution
DO	Dissolved oxygen
ESSA	ESSA Technologies Ltd.
F	F factor
FLNRORD and FS	Ministry of Forests, Lands and Natural Resource Operations and Rural Development; Foundry Spatial
g/m ³	Gram Per Cubic Metre
kg N/ha/y	Kilogram Nitrogen Per Hectare Per Year
LNG	Liquefied Natural Gas
meq/m ³	Milliequivalents Per Cubic Metre
mg/L	Milligrams Per Litre
N	Nitrogen
N _{dep}	Nitrogen Deposition
N _{leach}	Nitrogen Leaching
NO ₃	Nitrate
NWWT	Northwest Water Tool
P	Phosphorus
Qr	Mean Annual Catchment Runoff
S	Sulphur
S + N	Sulphur Plus Nitrogen
SO ₄	Sulphate
SSWC	Steady State Water Chemistry Model
TN	Total Nitrogen



Cedar LNG Project
Technical Data Report—2025 Surface Water Eutrophication and Acidification Assessment
Acronyms / Abbreviations
September 2025

TDR	Technical Data Report
TSI	Trophic Status Index
µeq/L	Microequivalents Per Litre



Glossary

Term	Definition
Acidification	The process of a decrease in pH levels in a body of water.
Acid neutralizing capacity	The amount of acid that an aquatic ecosystem can neutralize.
ANC _{limit}	The threshold of alkalinity required in an aquatic ecosystem to protect biota from acidification.
Annual catchment runoff	The amount of annual water input from precipitation and ice melt into a body of water.
Critical load of acidity	The maximum amount of acid deposition that can occur within a body of water without having a permanent adverse impact on the aquatic ecosystem.
Eutrophic	The trophic status of an aquatic system with high nutrient concentrations and biomass of aquatic vegetation (i.e., algal productivity).
Eutrophication	The process of an increase in biomass of aquatic vegetation (i.e., increased algal productivity) in a body of water due to elevated nutrient concentrations.
Mesotrophic	The trophic status of an aquatic system with moderate nutrient concentrations and biomass of aquatic vegetation (i.e., algal productivity).
Oligotrophic	The trophic status of an aquatic system with low nutrient concentrations and biomass of aquatic vegetation (i.e., algal productivity).
Trophic State Index	A classification system used to determine the trophic status of lakes.



1 Introduction

Cedar LNG Partners LP, by its general partner Cedar LNG Partners (GP) Ltd. (Cedar), a Haisla Nation led partnership with Pembina Pipeline Corporation, is constructing a liquefied natural gas (LNG) export facility within the District of Kitimat, British Columbia (BC) (the Project). The Project underwent an environmental assessment from 2019 to 2023 and received an environmental assessment certificate (EAC) under BC's *Environmental Assessment Act* (EAC #E2301) and a positive Decision Statement under Canada's *Impact Assessment Act* (reference number 80208) in March 2023. The Project commenced construction in July 2024. More recently, the continued advancement of the Project design has identified opportunities for operational changes to the Project, including an increase in the liquification capacity from 400 to 500 million standard cubic feet per day of natural gas.

This technical data report (TDR) has been prepared to support an application to amend EAC #E23-01 by considering potential changes to Project related effects of eutrophication and acidification on surface water that may result from the increased nitrogen (N) and sulphur (S) emissions. For consistency, eutrophication and acidification results from the 2021 TDR that described the acidification and eutrophication assessment of surface water for the EAC Application (Stantec 2021) were reassessed with updated assessment methods that incorporate the updated 2025 air quality dispersion and deposition modelling.

This TDR describes the updated methods, results of the updated 2025 assessment, and conclusions, and provides a comparison and discussion of differences between the 2021 and 2025 assessments.



2 Methods

Methods used for eutrophication and acidification assessment in the 2021 TDR (Stantec 2021) were updated in this 2025 assessment. The 2025 assessment methods are summarized in Table 1 and updated assessment methods are described in Section 2.1, and are in accordance with current requirements. The updated 2025 assessment methods:

- Incorporate the updated 2025 air quality dispersion and deposition modelling for the lake and stream sites (Appendix A).
- Use the same study area as the 2021 assessment and comprise three lakes and five stream sites with details provided in the 2021 TDR (Stantec 2021).
- Use the same baseline water quality data from ESSA Technologies Ltd. (ESSA 2013) and LNG Canada (2014) as the 2021 assessment.
- Use 2023 updated BC Northwest Water Tool (NWWT; Ministry of Forests, Lands and Natural Resource Operations and Rural Development; Foundry Spatial [FLNRORD and FS 2022]) watershed area and catchment run off data for the lake and stream sites.
- Use updated eutrophication and acidification assessment methods as used by Stantec in recent waste discharge permit applications for other facilities in BC.



Table 1 Comparison Between the 2025 Eutrophication and Acidification Assessment Methods and the Methods Used for the EAC Application TDR (Stantec 2021)

Assessment	Parameter	Updated 2025 method	EAC Application TDR method (Stantec 2021)	Method differences
S + N deposition	Air dispersion model and deposition modelling	Used the 2025 updated modelled deposition rates (Appendix A)	As described in the 2021 TDR	The updated 2025 modelled deposition rates had an additional (incremental) increase N, S, S+N deposition rates
Study area	Lake and stream sites	Used the same sites as the 2021 TDR	As described in the 2021 TDR	No difference, the same three lakes and five stream sites were used
Water quality	Water chemistry data	Used the same data as the 2021 TDR	As described in the 2021 TDR	No difference, the same water chemistry data were used
Lake and stream site physical and hydrological attributes of	Watershed area and catchment runoff	Used the 2023 updated watershed area and catchment runoff values. The BC NWWT (FLNRORD and FS 2022) was used to estimate watershed areas. Lake Qr was estimated using a water balance approach that includes precipitation, evapotranspiration, groundwater recharge for the total lake catchment. Stream Qr was estimated based on the total catchment using the BC NWWT (FLNRORD and FS 2022).	As described in the 2021 TDR	Slight differences in the values of watershed area and catchment runoff data used in the two approaches. Watershed area and catchment runoff have been shown to influence eutrophication and acidification (ESSA 2013).



Assessment	Parameter	Updated 2025 method	EAC Application TDR method (Stantec 2021)	Method differences
Eutrophication	Project TN (mg/L or g/m ³)	Baseline TN (as N) (mg/L or g/m ³) ¹ = annual or seasonal average or single value of TN (as N) (mg/L or g/m ³) Project TN (as N) (mg/L or g/m ³) = N_{dep} (deposition flux of nitrogen [as N]) (g/m ² /y) / Q_r (m/y)	Baseline flux of N (g TN/year) = TN (g TN/m ³) x discharge (m/year) x catchment area (m ²) Project flux of N (g TN/year) = 0.1 x nitrogen deposition (g TN/m ² /year) x catchment area (m ²) Increase in flux (%) = $\frac{\text{project flux}}{\text{baseline flux}} \times 100$ Increase in TN (g TN/m ³) = total nitrogen (g TN/m ³) x (increase in flux rate / 100)	The method used to calculate Project related TN in the 2021 TDR is lengthy and is potentially subject to error due to different units, compared to the more efficient and simplified method in 2025. For example, the calculated Project flux of N (g/year) should either be 0.1 x N_{dep} (kg/ha/year) x watershed area (m ²) or N_{dep} (g/m ² /year) x watershed area (m ²). Such subtle changes in units, could result in TN concentration lower by about one order of magnitude for the 2021 TDR.

¹ mg/L and g/m³ are the same concentration, using different units. The use of g/m³ is useful in understanding the conversion of N_{dep} to TN



Assessment	Parameter	Updated 2025 method	EAC Application TDR method (Stantec 2021)	Method differences
Acidification	Steady State Water Chemistry (SSWC) Model To obtain critical load of acidity (CL _(A))	$CL_{(A)} = Qr([BC^*]_0 - [ANC]_{limit})$	$CL_{(A)} = Qr(ANC_{Oaa} - ANC_{limit})$	The updated 2025 assessment incorporates the following components of the SSWC model: <ol style="list-style-type: none"> 1. BC*₀ corrected pre-acidification base cation concentrations 2. Sea salt correction applied to base cation concentrations 3. F-factor is the sine of the ratio of change between the sum of the corrected present base cation concentration multiplied by the annual catchment runoff and the flux of the sum of the uncorrected base cation concentration 4. The pre acidification sulphate concentration The updated approach is consistent with other studies (ESSA 2013 and 2023) and has been applied in this report.

Notes:

The gray highlights show revised method.

N= Nitrogen compounds, S= Sulphur compounds, TN = total nitrogen, N_{dep} = Nitrogen deposition, CL_(A) = Critical load of acidity, Qr= Mean annual catchment runoff (m/y)

[BC*]₀ = Corrected pre-acidification base cations for a waterbody (milliequivalents per cubic metre [meq/m³]),

[ANC]_{limit} = Acid neutralizing capacity critical lower limit (meq/m³),

ANC_{Oaa} = Organic acid adjusted acid neutralizing capacity (meq/m³),

SSWC = Steady State Water Chemistry Model



2.1 Details of the Updated 2025 Assessment Methods

Updated 2025 eutrophication and acidification assessment methods are described below. The updated air quality dispersion and deposition modelling is described in Appendix A.

2.1.1 Eutrophication Assessment

Eutrophication occurs when there is an increase in nutrients such as N and/or phosphorus (P) in lakes and streams at levels leading to increased growth of algae and plankton. No change in P concentrations from Project activities is predicted, but the Project emissions include N, which will be deposited in the watersheds. The potential for eutrophication (increase in total N, i.e., TN) at lake and stream sites was evaluated using modelled N deposition rates and empirical critical loads from the literature. Baseline and predicted TN concentrations were used to conservatively calculate baseline trophic status and predicted status after deposition of Project-related N to further assess potential eutrophication effects, using change in trophic status as an indicator.

2.1.1.1 Empirical Critical Loads

Potential for eutrophication was assessed by comparing predicted N deposition with empirical critical loads from the literature. Empirical critical loads for N deposition for inland surface waters range from 1 to 10 kg/ha/y N, depending on ecosystem type (Bobbink and Hettelingh 2010; de Wit and Lindholm 2010; Baron et al. 2011; Convention on Long-range Transboundary Air Pollution [CLRTAP] 2024). For permanent oligotrophic waterbodies in temperate and boreal regions, deposition rates of 3 to 6 kg N/ha/y have been found to be reliable empirical critical load estimates (CLRTAP 2024). Empirical critical loads of 5 to 10 kg N/ha/y for permanent dystrophic lakes, ponds, and pools are based on expert judgement (CLRTAP 2024). Dystrophic lakes have high amounts of humic substances and organic acids from organic runoff. They can be defined as lakes with pH <6 and organic anions making up more than 50% of anion composition. The 3 kg N/ha/y value was selected as the deposition isopleth for the EAC Application assessment and is consistent with the ENV (2015) recommended study area boundary, which identifies coastal oligotrophic and dystrophic lakes as sensitive to N deposition and potential eutrophication.

2.1.1.2 Baseline Trophic Status

Eutrophication responses can include a change in trophic state, an increase in primary production associated with increased algal growth and blooms, and a change in community composition. As the algal growth and blooms die off, microbial decomposition of the algae consumes dissolved oxygen (DO), potentially leading to low DO levels and fish kills, habitat deterioration, and loss of biodiversity at all trophic levels (Schindler et al. 2008; Paerl et al. 2014). The potential for a change in trophic status associated with N deposition was assessed. Lake and stream trophic classifications based on TN concentrations are provided in Table 2.



Table 2 Lake and Stream Trophic State Classifications Based on Total Nitrogen Concentration

Trophic State	Total Nitrogen Concentration (mg/L)	
	Lakes	Streams and Rivers
Oligotrophic (low nutrient concentrations)	<0.35	<0.7
Mesotrophic (moderate nutrient concentrations)	0.35 – 0.65	0.7 – 1.5
Eutrophic (high nutrient concentrations)	0.65 – 1.2	>1.5
Hyper-eutrophic (extremely high nutrient concentrations)	>1.2	NA

Sources: Kalff 2002. *Limnology: Inland Water Ecosystems*, based on Vollenweider 1968, Forsberg and Ryding 1980, and Dodds et al. 1998.

Lake trophic status was also estimated using the Trophic Status Index (TSI) equation based on TN described in Kratzer and Brezonik (1981) (Equation 1).

Equation 1 $TSI (TN \text{ as } mg/L) = 54.45 + 14.43 \ln (TN)$

TSI values range between 0 and 100 (Carlson and Simpson 1996) and trophic status is assigned as follows:

- Oligotrophic: 0 to 40
- Mesotrophic: 41 to 50
- Eutrophic: 51 to 70
- Hyper-eutrophic: 71 to 100

Predicted Total Nitrogen

Predicted Project-related N deposition was used to conservatively estimate the potential increase in TN in lakes and streams and the potential change in trophic status due to N deposition. Predicted TN concentrations were compared to the trophic categories in Table 2 and the potential for change in trophic status to occur as a result of the Project’s emissions was noted. The predicted TN in lakes and streams was calculated using Equation 2:

Equation 2 $Predicted \text{ TN} = Baseline \text{ TN} + Project \text{ TN}$

Where:

Baseline TN (as N) (mg/L or g/m³)² = annual or seasonal average or single value of TN (as N) (mg/L or g/m³)

Project TN (as N) (mg/L or g/m³) = N_{dep} (deposition flux of N (g/m²/y)) / Q_r (m/y)

² mg/L and g/m³ are the same concentration, using different units. The use of g/m³ is useful in understanding the conversion of N_{dep} to TN



Assumptions and limitations associated with using the predicted increase in TN due to N deposition approach are:

- The assessment assumes 100% of N deposited in a catchment is mobilized to surface water and does not recognize the role of vegetation and soil in taking up the N (Henrikson and Posch 2001; Sutton et al. 2014, Gurmesa et al. 2022).
- Ecosystem processes (i.e., nutrient cycling) that could influence N in the calculation are not accounted for.
- Project activities will not interact with or change the regular lake and stream processes.
- Baseline water chemistry data used for this evaluation captured both terrestrial watershed processes and aquatic ecosystem processes.
- An increase in the flux of N will eventually lead to a new steady state in the waterbody at the higher concentration without considering the roles of water residence time and the size of the aquatic systems.
- The assessment focuses on N inputs and assumes N is the limiting nutrient for productivity and algal growth. Phosphorous is also a limiting nutrient and is not predicted to change as a result of Project activities.

2.1.2 Acidification Assessment

To estimate $CL_{(A)}$ from the water chemistry measurements in lakes and streams, the SSWC model described in Henriksen et al. (1995), Henriksen and Posch (2001), Henriksen et al. (2002), and ESSA (2013) was used.

2.1.2.1 Critical Load

The SSWC model is based on the principle that the $CL_{(A)}$ “... *should not exceed the non-marine and non-anthropogenic base cation input, sources and sinks in a catchment minus a buffer to protect selected biota...*” (Henriksen and Posch 2001) and is calculated using Equation 3. In Equation 3, the $CL_{(A)}$ is the difference between the sum of the corrected³ base cations concentration pre-acidification ($[BC^*]_0$) and the ANC_{limit} multiplied by Q_r . The lower the $CL_{(A)}$, the greater the sensitivity of the waterbody to acid inputs.

Equation 3
$$CL_{(A)} = Q_r ([BC^*]_0 - [ANC]_{limit})$$

Where:

- $CL_{(A)}$ = the critical load of acidity (milliequivalents per square metre per year [$meq/m^2/y$])
- $[BC^*]_0$ = corrected pre-acidification base cations for a waterbody (microequivalents per litre [$\mu eq/L$])
- $[ANC]_{limit}$ = acid neutralizing capacity critical lower limit ($\mu eq/L$)
- Q_r = mean annual catchment runoff (m/y). The values are from the updated to 2023 data.

³ As described in the “Cation and Anion Correction” section, base cation concentrations are corrected to account for the contribution of cations from marine aerosols (i.e., sea spray) to changes in concentrations in a waterbody from pre-acidification to present day.



The sum of the BC^*_0 is estimated using Equation 4, corrected pre-acidification base cation concentrations, an F-factor, and an estimate of the corrected pre-acidification sulphate concentration.

$$\text{Equation 4} \quad [BC^*]_0 = [BC^*]_t - F \times ([SO^*_4]_t - [SO^*_4]_0 + [NO_3]_t - [NO_3]_0)$$

Where:

$[BC^*]_t$ = The sum of the corrected present base cation concentrations ($\mu\text{eq/L}$)

F = A ratio called the F-factor (no units)

$[SO^*_4]_t$ = The corrected, present sulphate concentration ($\mu\text{eq/L}$)

$[SO^*_4]_0$ = The corrected, pre-acidification sulphate concentration ($\mu\text{eq/L}$)

$[NO_3]_t$ = The present nitrate concentration ($\mu\text{eq/L}$). The atomic mass of N was used in the conversion of nitrate (measured as N) to its ionic concentration.

$[NO_3]_0$ = The pre-acidification nitrate concentration ($\mu\text{eq/L}$). The pre-acidification nitrate concentration is assumed to be zero according to Henriksen and Posch (2001).

The initial step to estimate BC^*_0 (Equation 4) is to apply a sea salt correction to base cation concentrations from measured lake and stream water chemistry to estimate changes due to anthropogenic atmospheric deposition. It is assumed all chloride present in the water originates from sea salt spray. Table 3 summarizes the corrections applied to the base cations.

Table 3 *Derivation of Corrected Cations and Anions*

Present Cation and Anion Concentration ($\mu\text{eq/L}$)	Corrected Cation and Anion Concentration ($\mu\text{eq/L}$)
Calcium [Ca]	$[Ca^*] = [Ca] - 0.037 [Cl]$
Magnesium [Mg]	$[Mg^*] = [Mg] - 0.198 [Cl]$
Potassium [K]	$[K^*] = [K] - 0.018 [Cl]$
Sodium [Na]	$[Na^*] = [Na] - 0.858 [Cl]$
Sulphate $[SO_4]$	$[SO_4^*] = [SO_4] - 0.103 [Cl]$
Chloride [Cl]	$[Cl^*] = 0$

Notes:

[] indicates concentration

* indicates sea salt corrected concentrations

Cations are measured as total metal concentrations

Reference: Henriksen and Posch (2001)



The next step to estimate BC^*_0 is to determine the F-factor. The F-factor is the sine of the ratio of change between the sum of the corrected present base cation concentration multiplied by the annual catchment runoff and the flux of the sum of the uncorrected base cation concentration (Equation 5). It represents the ratio of change in base cations flux due to changes in strong acid anion concentrations (Henriksen and Posch 2001).

Equation 5
$$F = \sin \left(\frac{\sum \frac{1}{2} \times Q_r \times [BC^*]_t}{S} \right)$$

Where:

Q_r = The annual catchment runoff (m/yr)

$[BC^*]_t$ = The sum of the corrected present base cation concentration ($\mu\text{eq/L}$)

S = Uncorrected base cation ($\text{meq/m}^2/\text{yr}$) flux at which $F = 1$. The S value was set to $400 \text{ meq/m}^2/\text{yr}$, consistent with previous studies (ESSA 2013; Henriksen and Posch 2001).

The final step in estimating BC^*_0 is to estimate the corrected pre-acidification sulphate concentration using Equation 6. The values for constants (a and b) used in this equation were developed by Henriksen and Posch (2001) (coefficient of determination = 0.78, sample size = 289 lakes). The pre-acidification sulphate concentration ($[SO^*_4]_0$) was constrained to be no greater than the observed sulphate concentration ($[SO^*_4]_t$) as per Henriksen et al. (2002).

Equation 6
$$[SO^*_4]_0 = a + b \times [BC^*]_t$$

Where:

$[SO^*_4]_0$ = Corrected pre-acidification sulphate concentration ($\mu\text{eq/L}$)

a = The intercept ($8 \mu\text{eq/L}$)

b = The slope of the regression model (0.17)

$[BC^*]_t$ = The sum of the corrected present base cation concentrations ($\mu\text{eq/L}$)






The acid neutralizing capacity (ANC) is a measure of the buffering capacity of surface water against acidification. The ANC_{limit} is a critical lower limit of ANC that is protective of sensitive aquatic biota. Previous studies have found an ANC_{limit} of 8 to $50 \mu\text{eq/L}$ to be protective, depending on the aquatic biota present. A higher ANC_{limit} offers increased ecosystem protection; therefore, an ANC_{limit} threshold of $40 \mu\text{eq/L}$ was used, based on Henriksen et al. (2002), and to provide a margin of safety.

2.1.2.2 Acid Sensitivity Classifications

The $CL_{(A)}$ values were used to qualitatively assess acid sensitivity in surface water using the critical load classification system presented in the Rio Tinto Kitimat Modernization Project Sulphur Dioxide Technical Assessment Report (STAR report) (ESSA 2013). Table 4 shows the classification system used to identify acid sensitive waterbodies.



Table 4 Acid Sensitivity Classifications

Acid Sensitivity	Critical Load (meq/m²/y)	Shading Colour
Naturally Acidic	<0	
High	0–20	
Sensitive	20–40	
Moderate	40–60	
Low	60–100	
Very Low	>100	

Note:

meq/m²/y = milliequivalents per square metre per year

2.1.2.3 Critical Load Exceedance

The change in acidification potential was evaluated using predicted deposition rates from the air dispersion modelling scenarios for the Base Case, Project Alone Case, and Application Case. The deposition rate for each lake or stream site represents the maximum annual average values derived from one-hour deposition rates modelled over the five-year model period. In addition, deposition rates are based on the surface area of the entire catchment (vegetated and surface water components) and calculations for CL_(A) exceedances assume that 100% of depositional S (Equation 7) or 100% of S and N (Equation 8) are mobilized to surface water.

Using these deposition values is conservative due to (1) the assumption of continuous deposition at maximum rates, which does not reflect the fluctuations in deposition that occur over the five-year model period, and (2) the assumption that 100% of depositional S and N within a catchment is mobilized to surface water (despite the potential for depositional N to be retained in the biomass and soil of vegetated areas within a catchment).

Potential CL_(A) exceedances were calculated in the SSWC model using two approaches that differ in terms of N contributions (Equation 7 and Equation 8).

In Equation 7, N deposition is not used for exceedance calculations. It is assumed that sulphate is a mobile anion, and that N is largely retained in the catchment soils and vegetation by various processes. As a result, N deposition cannot be directly used in the exceedance calculation (Henriksen and Posch 2001). Instead, N leaching (N_{leach}) is used to calculate the present-day exceedance. N_{leach} is the leaching flux of a catchment calculated as the sum of measured nitrate and ammonia concentrations in surface water (as an approximation for N leaching concentrations in runoff) multiplied by the catchment's annual runoff.



Equation 7 $EX'_{(A)} = S^*_{dep} + N_{leach} - CL_{(A)}$

Where:

$EX'_{(A)}$ = the $CL_{(A)}$ exceedance calculated using N leaching from runoff as the only source of N

S^*_{dep} = the long-term deposition flux of non-marine S (as SO_4^{2-})

N_{leach} = N leaching flux

$CL_{(A)}$ = the critical load of acidity

In Equation 8, it is assumed that both S and N deposition contribute to potential acidification. Therefore, Equation 8 uses N deposition (rather than N leaching) to calculate the contribution of N to exceedance. Equation 8 assumes 100% of depositional S and N within a catchment is mobilized to surface water. This is considered an overestimation of N mobilization to surface water in catchments that contain vegetated landcover because it is likely that a portion of the N deposited in the catchment will be absorbed and retained in biomass and the soil organic layer (Henrikson and Posch 2001; Sutton et al. 2014, Gurmesa et al. 2022).

Equation 8 $EX_{(A)} = S^*_{dep} + N_{dep} - CL_{(A)}$

Where:

$EX_{(A)}$ = the $CL_{(A)}$ exceedance calculated using N from atmospheric deposition as the source of N

S^*_{dep} = the long-term deposition flux of nonmarine (i.e., sea-spray corrected) S (as SO_4^{2-})

N_{dep} = the long-term deposition flux of N

$CL_{(A)}$ = the critical load of acidity

To capture Project-related changes in atmospheric N deposition, the assessment of potential residual and cumulative effects to surface water quality associated with acidification is based on $CL_{(A)}$ exceedance values calculated using Equation 8 (i.e., using N_{dep}).



3 Results

Results of empirical critical load of N and acid sensitivity classification of the lake and stream sites using the updated 2025 assessment method are described below.

3.1 Eutrophication Empirical Critical Loads

To assess eutrophication potential, empirical loads of 3 to 10 kg N/ha/y were compared to the 2025 N depositional values for the lake and stream sites predicted for the three model scenarios (Base Case, Project Alone Case, and Application Case). The empirical loads of 3 to 10 kg N/ha/y were used because the monitoring sites had soft water (<60 mg/L CaCO₃) and are classified as oligotrophic based on surface water TN concentrations (LNG Canada 2014).

The N deposition rates for the lake and streams sites for the Base Case, Project Alone Case, and Application Case were lower than the empirical critical load limit of 3 kg N/ha/y (Table 5).

Table 5 Predicted Nitrogen Critical Load Exceedances for Air Quality Modelling Scenarios

Site ID	Waterbody Name	Modelled Deposition Rates (N _{DEP} as N, kg/ha/y)		
		Base Case	Project Alone Case	Application Case
LAK054	End Lake	0.14	0.02	0.15
STR02	Anderson Creek u/s	1.29	0.19	1.48
STR15	Moore Creek d/s	1.68	0.22	1.89
STR18	Wedeeene River d/s	1.06	0.09	1.15

Note:

Shaded cells indicate modelled N deposition rates that exceed the 3 kg N/ha/y empirical critical load
 d/s =Downstream

3.2 Acid Sensitivity Classification

The CL_(A) estimates were calculated and used to assess acid sensitivity (Table 6) based on classifications shown in Table 4. Results were as follows:

- LAK028 had a CL_(A) value of 28 meq/m²/y and was classified as sensitive to acid inputs.
- STR14 had a CL_(A) value of 92 meq/m²/y and was classified as having a low sensitivity to acid inputs.

The remaining lake and stream sites (LAK027, LAK030, STR01, STR02, STR15 and STR20) had CL_(A) values greater than 100 meq/m²/y and were classified as having very low sensitivity to acid inputs.



3.3 Comparison of Assessment Results Between the 2025 Updated and 2021 Methods

Results of eutrophication and acidification assessments for the Project from the 2021 TDR and those from the updated method were compared to identify differences and determine whether there will be changes in conclusions of the original assessments. Results are presented below.

3.3.1 Eutrophication

The results of the 2025 eutrophication assessment, using the updated 2025 approach, indicate that LAK54 is mesotrophic and the stream (STR02, STR015 and STR18) sites are oligotrophic at baseline and there are no predicted changes to the trophic state for the lake and stream sites for the Base Case, Project Alone Case, and Application Case. The same conclusions were made in the TDR (Stantec 2021). Although results from the eutrophication assessment indicate that Project-related emissions of N will not be associated with adverse eutrophication effects in the lake and stream sites (Table 7), predicted total nitrogen concentrations added from the facility emissions were ten times lower in the EAC Application TDR (Stantec 2021) compared to the updated 2025 results presented herein, due to changes used in the equation shown in Table 1.

3.3.2 Acidification

The 2025 acidification assessment identified no predicted exceedances for $CL_{(A)}$ in stream and lake sites for the Project Alone Case using the updated 2025 method. In contrast, the method used in the 2021 TDR reported predicted $CL_{(A)}$ exceedances for the Project Alone Case for LAK028. The difference in conclusions between the two methods is attributed to the different methods used to calculate $CL_{(A)}$, with the 2025 methods considered more appropriate (Table 1 and Table 8) and consistent with methods used to predict $CL_{(A)}$ and $CL_{(A)}$ exceedance in other studies (e.g., ESSA 2013 and 2023).



Table 6 Acid Sensitivity Classification Based on Critical Load of Acidity Values

Site ID	Data Source	Sampling Depth	Waterbody	Watershed Area (m ²)	Catchment Runoff (m/year)	Organic acid adjusted acid neutralizing capacity (ANCoaa) (meq/m ³)	Base Cations (BC ₀) (meq/m ³)	Critical Load using 40 meq/m ³ for ANClimit (meq/m ² /year)	Acid Sensitivity Classification based on Critical Load (CL _(A))
LAK027	2*	surface and bottom	Bowbyes Lake	1,900,000	1.7	99	147	182	Very Low
LAK028	1	surface only	Unnamed	120,000	1.6	0	57	28	Sensitive
LAK030	1	surface only	Unnamed	660,000	1.8	403	510	846	Very Low
STR01	1	surface only	Anderson Creek u/s	27,200,000	2.6	104	135	249	Very Low
STR02	2*	surface only	Anderson Creek d/s	37,061,000	2.5	159	225	466	Very Low
STR14	1	surface only	Moore Creek u/s	2,620,000	2.4	64	79	92	Low
STR15	2*	surface only	Moore Creek d/s	15,200,000	2.1	124	190	321	Very Low
STR20	1	surface only	Wathl Creek	122,000,000	2.7	324	347	818	Very Low

Notes:

1 indicates 2012 or 2013 water quality data used in the analysis

2* indicates 2012 and 2013 water quality data averaged, 2012 data from ESSA 2013

Acid sensitivity classifications are based on critical load values in the following ranges.

	Acidic (< 0 meq/m ² /y)
	High (0 to 20 meq/m ² /y)
	Sensitive (20 to 40 meq/m ² /y)
	Moderate (40 to 60 meq/m ² /y)
	Low (60 to 100 meq/m ² /y)
	Very Low (> 100 meq/m ² /y)



Table 7 Comparison of Predicted Trophic Status Associated with Base Case, Project Alone Case, and Application Case Maximum Nitrogen Deposition Rates Using the Updated (2025) Method and the 2021 TDR (Stantec 2021) Method

Site ID	Waterbody	Baseline Total Nitrogen mg/L or g/m ³	Modelling Scenario	Results Using the Updated (2025) Method					Results Using the 2021 TDR (Stantec 2021) Method				
				Project Nitrogen mg/L or g/m ³	Estimated Total Nitrogen mg/L or g/m ³	TSI	Estimated Trophic Status		Project Nitrogen mg/L or g/m ³	Estimated Total Nitrogen mg/L or g/m ³	TSI	Estimated Trophic Status	
							from TSI	from TN				from TSI	from TN
LAK054	Unnamed	0.386	Base Case	0.0104	0.3964	41	Mesotrophic	Mesotrophic	0.0010	0.3870	41	Mesotrophic	Mesotrophic
			Project Alone Case	0.0013	0.3873	41	Mesotrophic	Mesotrophic	0.0000	0.3860	41	Mesotrophic	Mesotrophic
			Application Case	0.0117	0.3977	41	Mesotrophic	Mesotrophic	0.0020	0.3880	41	Mesotrophic	Mesotrophic
STR02	Anderson Creek d/s	0.398	Base Case	0.0512	0.4492	n/a	n/a	Oligotrophic	0.0060	0.4040	n/a	n/a	Oligotrophic
			Project Alone Case	0.0075	0.4055	n/a	n/a	Oligotrophic	0.0010	0.3990	n/a	n/a	Oligotrophic
			Application Case	0.0587	0.4567	n/a	n/a	Oligotrophic	0.0070	0.4050	n/a	n/a	Oligotrophic
STR15	Moore Creek d/s	0.340	Base Case	0.0785	0.4185	n/a	n/a	Oligotrophic	0.0130	0.3530	n/a	n/a	Oligotrophic
			Project Alone Case	0.0101	0.3501	n/a	n/a	Oligotrophic	0.0020	0.3420	n/a	n/a	Oligotrophic
			Application Case	0.0886	0.4286	n/a	n/a	Oligotrophic	0.0140	0.3540	n/a	n/a	Oligotrophic
STR18	Wedene River d/s	0.129	Base Case	0.0519	0.1809	n/a	n/a	Oligotrophic	0.0080	0.1370	n/a	n/a	Oligotrophic
			Project Alone Case	0.0046	0.1336	n/a	n/a	Oligotrophic	0.0020	0.1310	n/a	n/a	Oligotrophic
			Application Case	0.0565	0.1855	n/a	n/a	Oligotrophic	0.0200	0.1490	n/a	n/a	Oligotrophic

Notes:

TSI = Trophic State Index, TN = Total nitrogen (mg/L), d/s = Downstream

Trophic Status is colour coded to the following:

	Hyper-eutrophic
	Eutrophic
	Mesotrophic
	Oligotrophic

The gray highlights show how the Project TN estimated for the TDR (Stantec 2021) method was one magnitude lower than those estimated using the updated 2025 method described in Table 1.

The 2025 air quality dispersion and deposition modelling data for the lake and stream sites are presented in Appendix A.



Table 8 Comparison of Predicted Critical Load Exceedances for Air Quality Modelling Scenarios Using the Updated (2025) Method and the 2021 TDR (Stantec 2021) Method

Site ID	Waterbody	Results Using the Updated (2025) Method					Results Using the 2021 TDR (Stantec 2021) Method				
		BC ₀ (meq/m ³)	Critical Load using 40 meq/m ³ for ANC _{limit} (meq/m ² /year)	Critical Load Exceedance			ANC _{oaa} (meq/m ³)	Critical Load using 40 meq/m ³ for ANC _{limit} (meq/m ² /year)	Critical Load Exceedance		
				Base Case (meq/m ² /year)	Project Alone Case (meq/m ² /year)	Application Case (meq/m ² /year)			Base Case (meq/m ² /year)	Project Alone Case (meq/m ² /year)	Application Case (meq/m ² /year)
LAK027	Bowbyes Lake	147	182	-119	-180	-117	99	143	157	-97	159
LAK028	Unnamed	57	28	69	-25	72	0	-69	438	68	442
LAK030	Unnamed	510	846	-730	-843	-727	406	662	-241	-654	-236
STR01	Anderson Creek u/s	135	249	-224	-248	-223	104	169	-95	-141	-94
STR02	Anderson Creek d/s	225	466	-279	-462	-276	179	350	-111	-327	-104
STR14	Moore Creek u/s	79	92	-69	-92	-68	65	60	-11	-48	-11
STR15	Moore Creek d/s	190	321	-38	-317	-34	116	166	153	-189	161
STR20	Wathl Creek	347	818	-804	-817	-803	325	760	-636	-654	-635

Notes:

ANC_{limit} = Acid neutralizing capacity critical lower limit, BC₀ = Corrected pre-acidification base cations for a waterbody, ANC_{oaa} = Organic acid adjusted acid neutralizing capacity

Red highlights indicate positive acid input exceedance values, declining below the ANC_{limit} and no longer being protective of aquatic biota.

A positive critical load exceedance value indicates that inputs of S and N are predicted to exceed the waterbody's ability to buffer increases in acidity, with the risk of the pH of the waterbody

The gray highlights show how the results from the TDR (Stantec 2021) method were inconsistent compared to those estimated using the newly updated 2025 method described in Table 1.

The 2025 air quality dispersion and deposition modelling data for the lake and stream sites are presented in Appendix A.



4 Summary of Findings and Conclusions

The results from the 2025 assessments indicate that Project-related emissions of N and S will not lead to new eutrophication and acidification effects in the lakes and streams within the Project's local study area.

The results of the eutrophication assessment indicate that LAK54 is mesotrophic while the stream sites (STR02, STR015 and STR18) are oligotrophic at baseline, and there are no predicted changes to the trophic state for the lake and stream sites for the Base Case, Project Alone Case, and Application Case.

The following conclusions apply to the study area lake and streams, based on the $CL_{(A)}$ from the 2025 reassessment:

- LAK028 is sensitive to acid inputs and has predicted $CL_{(A)}$ exceedances for Base and Application Cases, but no exceedance predicted for the Project Alone Case.
- STR14 has low sensitivity to acid inputs and no predicted $CL_{(A)}$ exceedances for Base, Project Alone and Application Cases.
- LAK027, LAK030, STR01, STR02, STR15 and STR20 have very low sensitivity to acid inputs and no predicted $CL_{(A)}$ exceedances for Base, Project Alone and Application Case.



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Appendices



Cedar LNG Project

Technical Data Report—2025 Surface Water Eutrophication and Acidification Assessment

Appendix A: Stantec 2025 Air Emissions Modelled Deposition Results for Lake and Stream Sites

September 2025

Appendix A Stantec 2025 Air Emissions Modelled Deposition Results for Lake and Stream Sites



Cedar LNG Project

Technical Data Report—2025 Surface Water Eutrophication and Acidification Assessment

Appendix A: Stantec 2025 Air Emissions Modelled Deposition Results for Lake and Stream Sites

September 2025

Table A.1 Stantec 2025 Air Emissions Modelled Deposition Results for Lake and Stream Sites

Model Scenario	Site ID	Easting	Northing	NDEP as N (kg/ha/yr)	S + N (keq/ha/yr)	S + N (eq/ha/yr)	SDEP as SO4 (kg/ha/yr)
Base Case (Rio Tinto and LNG Canada [Phase1])	LAK027	518232	5995394	0.5738	0.6284	628.3655	28.1554
	LAK028	519139	5993425	1.1096	0.9725	972.5104	42.8170
	LAK030	518664	5990153	1.0241	1.1602	1160.2178	52.1073
	LAK054	509425	5967551	0.1352	0.1404	140.3687	6.2654
	STR01	516262	5986538	0.2547	0.2511	251.0969	11.1640
	STR02	518978	5985696	1.2869	1.8641	1864.0646	84.9459
	STR14	515607	5982383	0.2108	0.2363	236.3373	10.6068
	STR15	519186	5984492	1.6769	2.8327	2832.6775	130.0399
	STR18	524585	5998646	1.0576	0.6006	600.6362	25.1697
	STR20	523506	5980726	0.1949	0.1330	132.9520	5.7056
Project Alone Case (Cedar LNG)	LAK027	518232	5995394	0.0755	0.0160	15.9644	0.5067
	LAK028	519139	5993425	0.1286	0.0261	26.0813	0.8099
	LAK030	518664	5990153	0.1307	0.0267	26.6769	0.8311
	LAK054	509425	5967551	0.0173	0.0043	4.3273	0.1480
	STR01	516262	5986538	0.0243	0.0056	5.6427	0.1873
	STR02	518978	5985696	0.1890	0.0373	37.2898	1.1404
	STR14	515607	5982383	0.0187	0.0041	4.0701	0.1309
	STR15	519186	5984492	0.2162	0.0421	42.0806	1.2769
	STR18	524585	5998646	0.0928	0.0207	20.6771	0.6735
	STR20	523506	5980726	0.0348	0.0076	7.5794	0.2440
Application Case (Rio Tinto and LNG Canada [Phase1] and Cedar LNG)	LAK027	518232	5995394	0.6493	0.6443	644.3304	28.6622
	LAK028	519139	5993425	1.2382	0.9986	998.5911	43.6269
	LAK030	518664	5990153	1.1549	1.1869	1186.8936	52.9384
	LAK054	509425	5967551	0.1526	0.1447	144.6961	6.4134
	STR01	516262	5986538	0.2790	0.2567	256.7396	11.3513
	STR02	518978	5985696	1.4758	1.9014	1901.3542	86.0863
	STR14	515607	5982383	0.2296	0.2404	240.4074	10.7377
	STR15	519186	5984492	1.8931	2.8748	2874.7589	131.3169
	STR18	524585	5998646	1.1504	0.6213	621.3127	25.8432
	STR20	523506	5980726	0.2297	0.1405	140.5316	5.9496



Cedar LNG Project

Technical Data Report—2025 Surface Water Eutrophication and Acidification Assessment

Appendix A: Stantec 2025 Air Emissions Modelled Deposition Results for Lake and Stream Sites

September 2025

Model Scenario	Site ID	Easting	Northing	NDEP as N (kg/ha/yr)	S + N (keq/ha/yr)	S + N (eq/ha/yr)	SDEP as SO4 (kg/ha/yr)
Future Case (Rio Tinto and LNG Canada [Phase 1 and 2] and Cedar LNG)	LAK027	518232	5995394	1.1251	0.6889	688.8960	29.1695
	LAK028	519139	5993425	2.2018	1.0898	1089.7964	44.6998
	LAK030	518664	5990153	2.1645	1.2827	1282.7311	54.0754
	LAK054	509425	5967551	0.2550	0.1546	154.6302	6.5388
	STR01	516262	5986538	0.4752	0.2751	275.1165	11.5604
	STR02	518978	5985696	2.0022	1.9510	1950.9537	86.6617
	STR14	515607	5982383	0.3957	0.2561	256.0634	10.9193
	STR15	519186	5984492	2.7155	2.9520	2951.9506	132.2012
	STR18	524585	5998646	1.9192	0.6898	689.7750	26.4927
	STR20	523506	5980726	0.3742	0.1542	154.1622	6.1085

Note:

For details see The Air Quality Dispersion Modelling Plan (Appendix A [Model Plan] of Appendix A [AQ TDR] of the Amendment).



Appendix D

2025 Terrestrial Acidification and Eutrophication Technical Data Report

Cedar LNG Project Technical Data Report—2025 Terrestrial Eutrophication and Acidification Assessment

Application for an Amendment to
Provincial Environmental Assessment Certificate and Federal Decision Statement

September 2025

Prepared for:



Prepared by:
Stantec Consulting Ltd.

Revision: 0



Limitations and Sign-off

This document entitled Technical Data Report 2025 Terrestrial Eutrophication and Acidification Assessment was prepared by Stantec Consulting Ltd. (“Stantec”) for the account of Cedar LNG Partners LP (the “Client”) to support the regulatory review process for its Application for Operations Phase Amendment to Provincial Environmental Assessment Certificate and Federal Decision Statement (the “Application”) for the Cedar LNG Project (the “Project”). In connection therewith, this document may be reviewed and used by the Environmental Assessment Office, Impact Assessment Agency of Canada, participating Indigenous nations, and all members of the Technical Advisory Committee participating in the review process in the normal course of its duties. Except as set forth in the previous sentence, any reliance on this document by any other party or use of it for any other purpose is strictly prohibited. The material in it reflects Stantec’s professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The information and conclusions in the document are based on the conditions existing at the time the document was published and does not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by the Client or others, unless expressly stated otherwise in the document. Any use which another party makes of this document is the responsibility and risk of such party. Such party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other party as a result of decisions made or actions taken based on this document.

O’Neill,
Meghan

Digitally signed
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Meghan
Date: 2025.09.12
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Prepared by:

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Printed Name

Zwierink,
Melvin

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by Zwierink,
Melvin
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Reviewed by:

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Mel Zwierink M.Sc., P.Ag., RPF

Printed Name

Digitally signed
by Prystay, Ward
Date:
2025.09.12
'15:35:47 -07’00’

Approved by:

Signature

Ward Prystay, M.Sc., R.P.Bio.

Printed Name



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Acronyms / Abbreviations

BC	British Columbia
Cedar LNG Partners Ltd.	Cedar
EAC	environmental assessment certificate
eq/ha/yr	equivalents per hectare per year
kg/ha/y	kilogram per hectare per year
km	kilometre
LNG	liquefied natural gas
NO ₂	nitrogen dioxide
SO ₂	sulphur dioxide
TDR	technical data report
µg/m ³ /yr	micrograms per cubic metre per year



1 Introduction

Cedar LNG Partners LP, by its general partner Cedar LNG Partners (GP) Ltd. (Cedar), a Haisla Nation led partnership with Pembina Pipeline Corporation, is constructing a liquefied natural gas (LNG) export facility within the District of Kitimat, British Columbia (BC) (the Project). The Project underwent an environmental assessment from 2019 to 2023 and received an environmental assessment certificate (EAC) under BC's *Environmental Assessment Act* (EAC #E23-01) and a positive Decision Statement under Canada's *Impact Assessment Act* (reference number 80208) in March 2023. The Project commenced construction in July 2024. More recently, the advancement of engineering design has identified opportunities for operational changes to the Project, including an increase in the liquification capacity from 400 to 500 million standard cubic feet per day of natural gas.

This Technical Data Report (TDR) has been prepared to support an application to amend EAC #E23-01 and the Decision Statement by considering the potential changes in effects of eutrophication and acidification on terrestrial receptors (soil and vegetation) associated with nitrogen and sulphur emissions from the increased facility capacity. Updated air quality dispersion modelling for this amendment is provided in the Air Quality TDR (Appendix A of the amendment application).



2 Methods

Air dispersion modelling was conducted in 2021 in support of the environmental assessment and has been revised in 2025. The 2025 air quality dispersion modelling has made updates to methods and inputs to the CALPUFF model. These include updates consist of the following:

- an expanded modelling domain (i.e., 100 kilometre [km] x 50 km),
- updated emissions rates for the Base Case (i.e., existing sources including Rio Tinto Aluminum Smelter, and LNG Canada Export Facility) based on current authorized emission rates,
- updated Project emission rates to align with increased production capacity,
- updated local ambient monitoring data for baseline concentration to account for sources not included in the modelling (i.e., residential heating, traffic, other marine traffic), and,
- refined meteorology that drive dispersion in the model.

It is important to note the 2025 Application Case has LNG Canada Phase 1 (i.e., two liquefaction trains) included. LNG Canada Phase 2 (i.e., two additional liquefaction trains – a total four trains) is included in the Future Case (Appendix A of the amendment application). The 2021 modelling included both LNG Canada Phases in the Base Case and there was no Future Case.

Stantec prepared a TDR in 2021 that described the terrestrial air emissions assessment (Stantec 2021) completed in support of the Project's Application for an EAC. The Terrestrial TDR assessed effects of air emissions on terrestrial receptors through direct (atmospheric concentrations) and indirect (soil acidification and eutrophication) pathways, specifically:

- Atmospheric concentrations of sulphur dioxide (SO₂) and nitrogen dioxide (NO₂)
- Soil acidification (i.e., changes in soil conditions resulting from acid deposition)
- Soil eutrophication (i.e., changes in soil conditions resulting from nitrogen deposition)

The same critical levels, screening thresholds, and empirical critical loads determined through literature review in the Terrestrial TDR are used in this TDR (Table 1). A critical level refers to concentrations of chemicals in the atmosphere above which direct adverse effects on vegetation may occur, based on scientific literature. A screening threshold refers to a quantitative estimate of an exposure to acid, sulphur, or nitrogen deposition above which harmful effects on vegetation occur, provided through regulatory guidance documents (MOE 2014). Screening threshold values are used as a screening tool to determine the level of assessment required. An empirical critical load is a quantitative estimate of an exposure to nitrogen deposition above which harmful effects on vegetation occur, based on scientific literature. For more details, see the 2021 Terrestrial TDR.

While the 2025 air quality modelling used a 100 km by 50 km domain (Appendix A of the amendment application), only those results within the 40 x 40 km assessment area used for the 2021 terrestrial acidification and eutrophication assessment are used here to allow for a direct comparison of results in the amendment application.



Table 1 Critical Levels, Screening Thresholds, and Empirical Critical Load

Pathway	Compound	Isopleth Unit
Atmospheric Concentration Critical Level (direct)	SO ₂	10 µg/m ³ /yr
	NO ₂	30 µg/m ³ /yr
Deposition Screening Thresholds (indirect)	Acid Deposition (S+N)	150 eq/ha/yr
	Sulphur Deposition	7.5 kg/ha/yr
	Nitrogen Deposition	5 kg/ha/yr
Eutrophication Empirical Critical Load (indirect)	Nitrogen Deposition	4 kg/ha/yr

Note:

Same critical levels, screening thresholds, and empirical critical load as in the Terrestrial TDR.



3 Results

The updated 2025 air quality modelling provides isopleths atmospheric SO₂ and NO₂ concentrations and deposition rates for acid (sulphur + nitrogen), sulphur, and nitrogen. Total land area coverage where model outputs identify exceedances of the thresholds identified in Table 1 are discussed below and contrasted with the 2021 results (Table 2; Table 3; Figures in Appendix A).

3.1 SO₂ Atmospheric Concentrations

The 2025 air dispersion modelling indicates the SO₂ atmospheric concentration critical level (10 µg/m³/yr) is exceeded in both the Base Case and the Application Case but not in the Project-alone Case, similar to the 2021 modelling results. However, the extent of exceedance modelled in 2025 is greater, with the affected area in both the Base Case and Application Case approximately twice as large as that modelled in 2021 (Table 2; Appendix A, Figure A.1). The increase in exceedance area is due to changes to the model inputs (e.g., refined meteorological data, updated emissions inventories for Rio Tinto, LNG Canada and the Project). The incremental increase in the SO₂ exceedance area due to Project emissions (difference between the Application Case and Base Case) remains a small component of overall Application Case exceedance area. A total of 871 ha (5.7%) of 2025 Application Case exceedance area is attributable to the Project, compared to 152 ha (2.1%) of 2021 exceedance area (Table 3).

3.2 NO₂ Atmospheric Concentrations

There are no predicted exceedances of the NO₂ atmospheric concentration critical level (30 µg/m³/yr) for any of the 2025 modelling cases (Table 2). This is consistent with the 2021 modelling results described in the 2021 Terrestrial TDR.

3.3 Deposition Screening Isopleths

The 2025 air dispersion modelling predicts exceedance of the acid (sulphur + nitrogen), sulphur, and nitrogen deposition screening thresholds (150 eq/ha/yr; 7.5 eq/ha/yr; 5 eq/ha/yr) in the Base Case, Project-alone Case, and the Application Case, similar to the 2021 results. However, the predicted exceedance areas for all three deposition thresholds are lower for the 2025 modelling results, compared to the 2021 modelling results (Table 2; Appendix A, Figure A.2, Figure A.3, Figure A.4). The predicted exceedance areas in the 2025 modelling are in a narrower band in the Kitimat Valley than for the 2021 modelling (Appendix A, Figure A.3, Figure A.4). The decrease in modelled exceedance area is due to changes to the inputs (e.g., refined meteorological data, updated emissions inventories for Rio Tinto, LNG Canada and the Project).



Table 2 Comparison of Exceedance Areas Between the 2025 and 2021 Air Quality Modelling

Pathway	Compound	Isopleth Critical Level, Threshold, Critical Load	Exceedance Area (ha) for Each Modeling Scenario						
			Baseline Case		Project-Along Case		Application Case		Future Case
			2021	2025	2021	2025	2021	2025	2025
Atmospheric Concentration Critical Level	SO ₂	10 µg/m ³ /yr	7,210	14,458	0	0	7,361	15,329	15,920
	NO ₂	30 µg/m ³ /yr	0	0	0	0	0	0	0
Deposition Screening Threshold	Acid Deposition	150 eq/ha/yr	63,656	38,861	614	770	64,172	39,577	41,285
	Sulphur Deposition	7.5 kg/ha/yr	60,114	36,233	77	290	60,454	36,758	37,171
	Nitrogen Deposition	5 kg/ha/yr	1,108	455	6	2	1,528	707	1,832
Eutrophication Empirical Critical Load	Nitrogen Deposition	4 kg/ha/yr	1,643	785	14	7	2,221	1,122	2,520

Notes:

There was no Future Case in the 2021 modelling

Shaded cells indicate the 2021 isopleth extends outside the 40x40 km modelling boundary used in 2021 mapping, so 2025 areas were within the same modelling boundary.



Table 3 Project Contribution to Application Case Exceedance Area

Pathway	Compound	Isopleth Critical Level, Threshold, Critical Load	Project Contribution to Application Case Exceedance				Project Contribution to Future Case Exceedance
			2021		2025		2025
			Area (ha)	Percent (%)	Area (ha)	Percent (%)	Percent (%)
Atmospheric Concentration Critical Level	SO ₂	10 µg/m ³ /yr	152	2.1	871	5.7	5.5
	NO ₂	30 µg/m ³ /yr	0	0	0	0	0
Deposition Screening Threshold	Acid Deposition	150 eq/ha/yr	516	0.8	716	1.8	1.7
	Sulphur Deposition	7.5 kg/ha/yr	340	0.6	526	1.4	1.4
	Nitrogen Deposition	5 kg/ha/yr	420	27.5	252	35.6	13.7
Eutrophication Empirical Critical Load	Nitrogen Deposition	4 kg/ha/yr	578	26.0	337	30.0	13.4

Notes:

Area calculated as difference between Application Case and Base Case, % calculated as difference divided by Application Case area or Future Case area.
2021 isopleth extends outside 40x40 km modelling boundary used in 2021 mapping, so 2025 areas were within the same modelling boundary.



The incremental increase in acid and sulphur deposition screening threshold exceedance area due to Project emissions (difference between the Application Case and Base Case) remains a small component of overall Application Case exceedance area. A total of 716 ha (5.7%) of 2025 acid deposition Application Case exceedance area is attributable to the Project, compared to 152 ha (2.1%) of 2021 exceedance area (Table 3). A total of 526 ha (1.4%) of 2025 sulphur deposition exceedance area is attributable to the Project, compared to the 340 ha (0.6%) of 2021 exceedance area (Table 3).

For nitrogen deposition, the incremental increase screening threshold exceedance area due to Project emissions (difference between the Application Case and Base Case) remains a similar but slightly higher component of overall Application Case exceedance area. A total of 252 ha (36%) of 2025 Application Case exceedance area is attributable to the Project, compared to 420 ha (27%) of 2021 exceedance area (Table 3). Predicted exceedance area remains localized to the vicinity of the Project, near the LNG Canada facility and the town of Kitimat.

3.4 Eutrophication Empirical Critical Load

The 2025 air dispersion modelling predicts exceedance of the eutrophication empirical critical load (4 kg/ha/yr) in the Base Case, Project-alone Case, and the Application Case, in a small area near Kitimat and the LNG Canada facility, similar to the 2021 results (Table 2; Appendix A, Figure A.5). However, the 2025 modelling results predict an exceedance area that is about 50% smaller than the 2021 modelling results. The incremental decrease in eutrophication empirical critical load exceedance area due to Project emissions (difference between the Application Case and Base Case) remains a similar but slightly higher component of overall Application Case exceedance area. A total of 337 ha (30%) of 2025 Application Case exceedance area is attributable to the Project, compared to 578 ha (26%) of 2021 exceedance area (Table 3). Predicted exceedance area remains localized to the vicinity of the Project, near the LNG Canada facility and the town of Kitimat.



4 Discussion

While increased facility capacity will result in slightly higher emissions of SO₂ and NO₂, the incremental increase in predicted exceedance area due to Project emissions between the 2025 and 2021 modelling is small for all modelled compounds. The Project remains a minor component of overall predicted exceedance for SO₂, acid and sulphur deposition in the Kitimat airshed. For nitrogen deposition, predicted exceedance area remains localized to the vicinity of the Project, near the LNG Canada facility and the town of Kitimat.

Though the 2025 modelling suggests higher SO₂ atmospheric concentrations and lower annual deposition of acid, sulphur and nitrogen compared to what was predicted by the 2021 modelling, these differences are predominantly a result of different modelling assumptions. Key changes that occurred with the revised modelling are inclusion of updated model inputs for the Rio Tinto and LNG Canada permitted emissions, updated Cedar LNG emissions based on the advanced stage of engineering design, and use of high-resolution meteorological data. Inputs for all facilities assume the maximum allowable emissions levels and therefore predicted air quality concentrations and deposition rates result in conservative estimates (i.e. there is an inherent overprediction bias in the modelling).

The findings of this assessment suggest the characterization of residual effects in the Project's EAC Application remain valid.



5 References

MOE (British Columbia Ministry of Environment). 2014. Air Emissions Impact Assessment for Liquefied Natural Gas Export Terminal Facilities: Critical Load Screening Guidance for Acidification and Eutrophication of Terrestrial Ecosystems.

Stantec (Stantec Consulting Ltd). 2021. Technical Data Report Terrestrial Air Emissions Assessment, Section 7.4, Appendix B: Cedar LNG Project Environmental Assessment Certificate Application. Prepared for Cedar LNG.

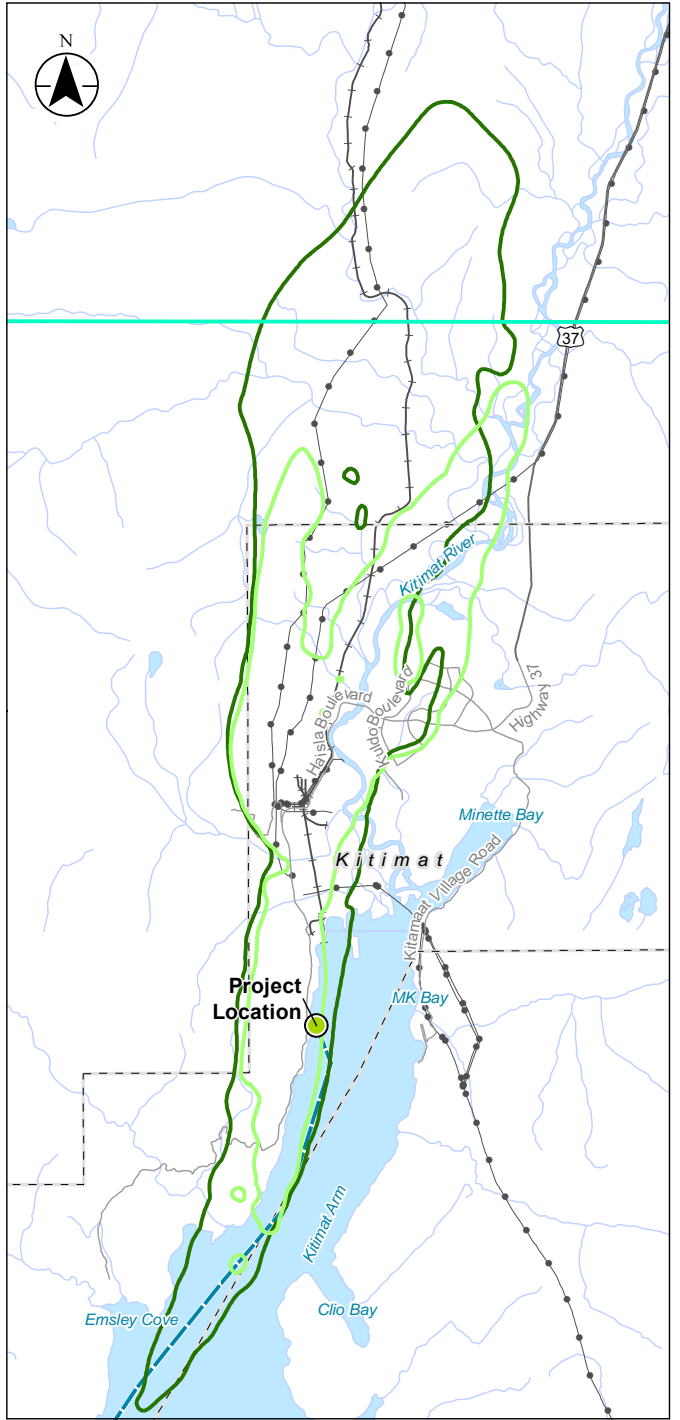
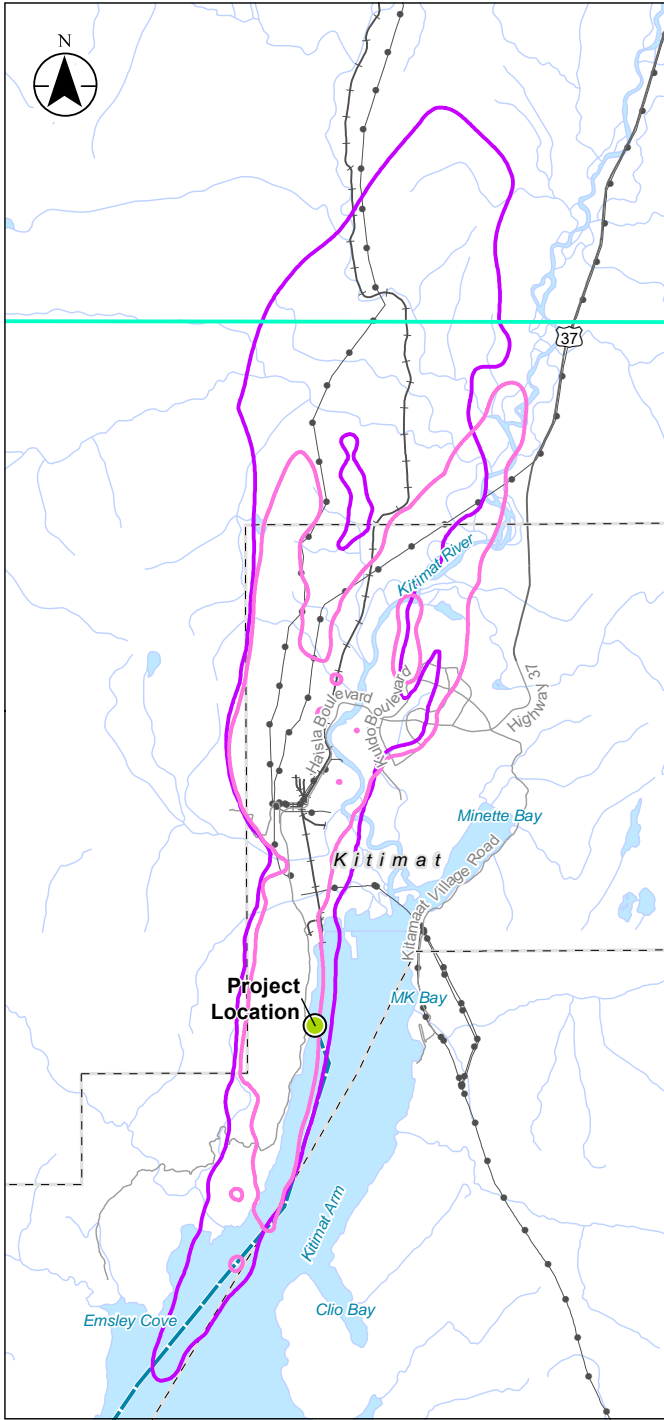


Appendices



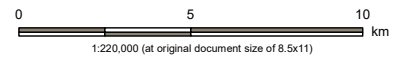
Appendix A Figures





- Highway
- Road
- Railway
- Transmission Line
- Watercourse
- Waterbody
- District of Kitimat
- Municipal Boundary

- Project Location
- Marine Shipping Route (Approximate Location)
- 2021 Modelling Area
- Sulphur Dioxide Annual Contour (10 µg/m3/yr)**
- Base Case 2021
- Base Case 2025
- Application Case 2021
- Application Case 2025



Project Location: Kitimat, British Columbia
 Project Number: 123222394
 Prepared by SPARKER on 20250814
 Discipline Review by MONELL on 20250814
 GIS Review by RCOATTA on 20250908

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project
 Technical Data Report – 2025 Terrestrial Eutrophication and Acidification Assessment

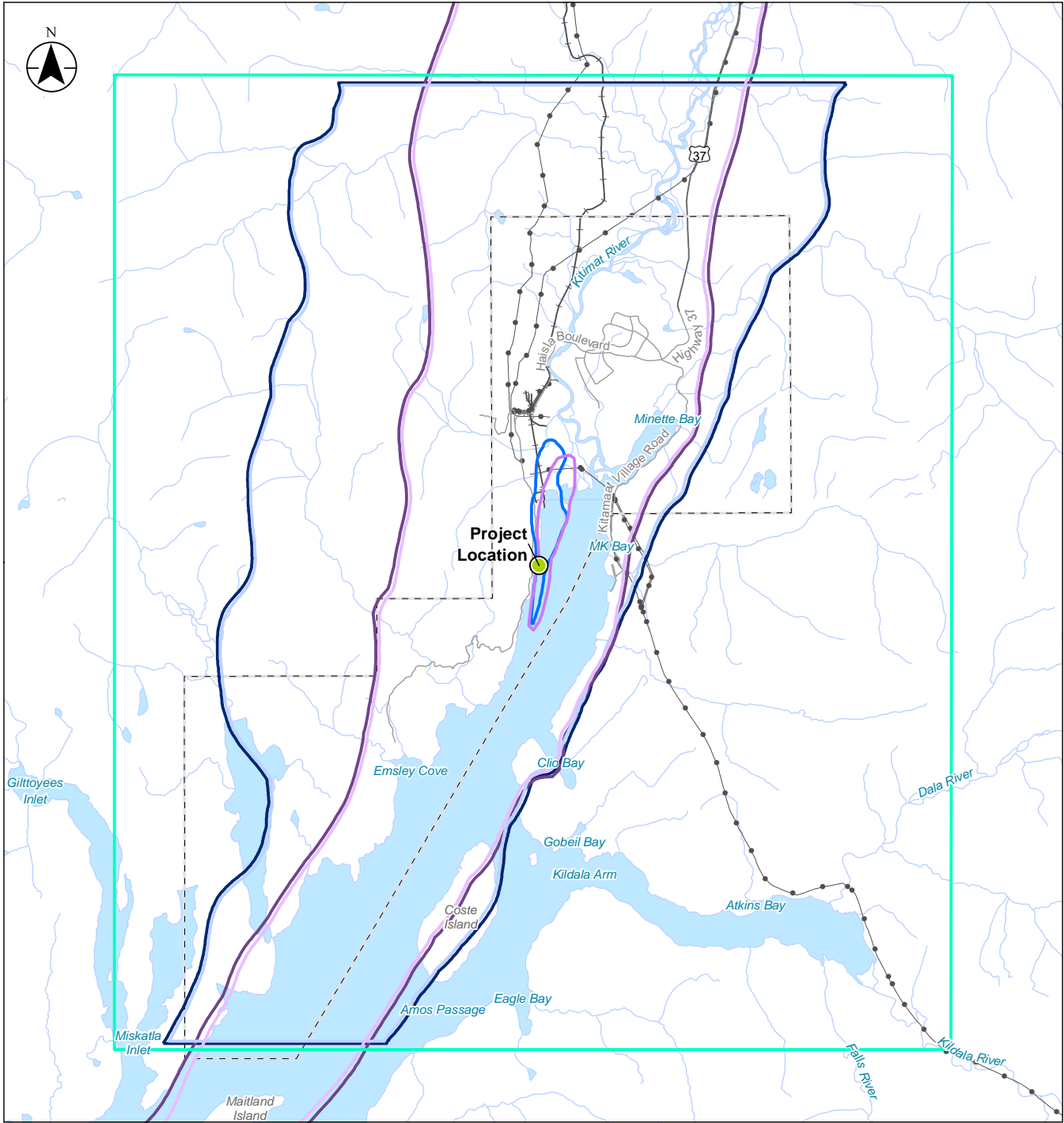
Figure No. **A.1**

Atmospheric Concentrations of Sulphur Dioxide Critical Level

Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

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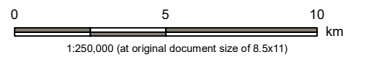
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Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

- Highway
- Road
- Railway
- Transmission Line
- Watercourse
- Waterbody
- - - District of Kitimat
- - - Municipal Boundary

- Project Location
- 2021 Modelling
- 2025 Acid Deposition Screening Threshold (150 eq/ha/yr)**
- Base Case
- Project-alone Case
- Application Case
- 2021 Acid Deposition Screening Threshold (150 eq/ha/yr)**
- Base Case
- Project-alone Case
- Application Case



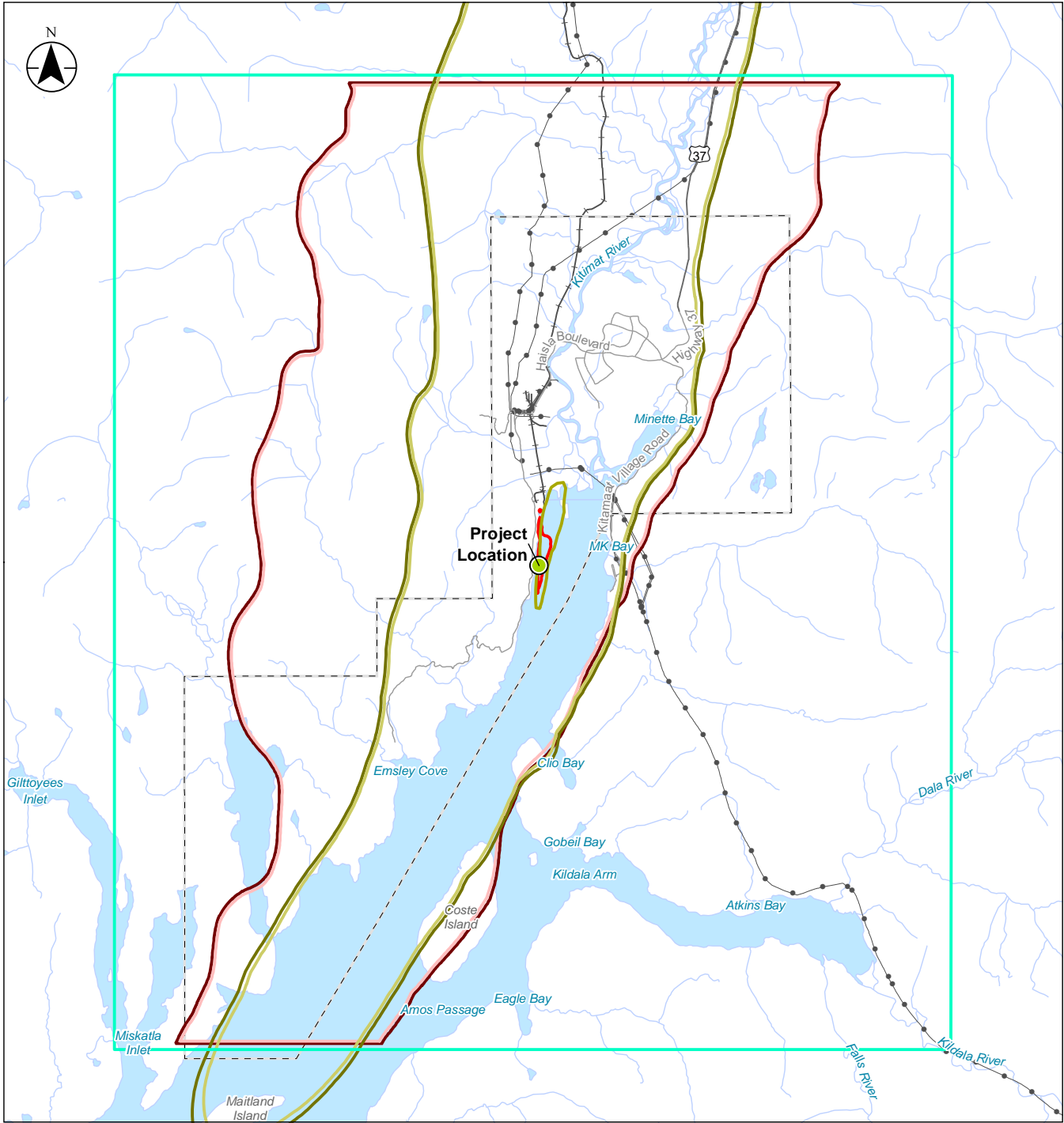
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 Prepared by SPARKER on 20250814
 Discipline Review by MONELL on 20250814
 GIS Review by RCOATTA on 20250908

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project
 Technical Data Report – 2025 Terrestrial Eutrophication and Acidification Assessment

Figure No. **A.2**
 Title **Acid Deposition Screening Threshold**

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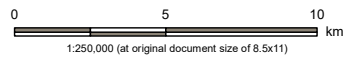
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Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

- Highway
- Road
- +— Railway
- Transmission Line
- Watercourse
- Waterbody
- - - District of Kitimat
- - - Municipal Boundary

- Project Location
- 2021 Modelling
- 2025 Sulphur Deposition Screening Threshold (7.5 kg/ha/yr)
- Base Case
- Project-alone Case
- Application Case
- 2021 Sulphur Deposition Screening Threshold (7.5 kg/ha/yr)
- Base Case
- Project-alone Case
- Application Case

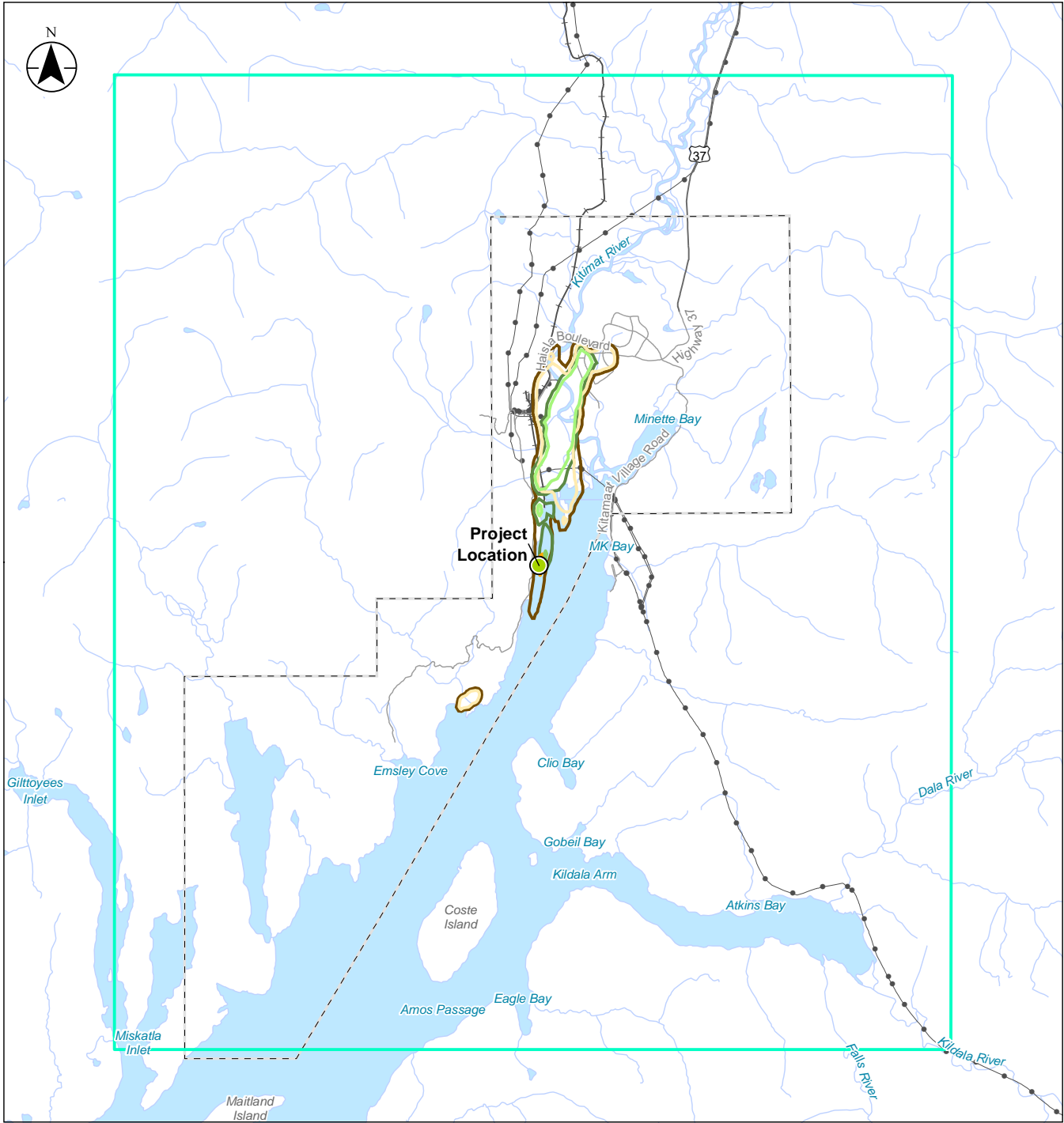


Project Location: Kitimat, British Columbia
 Project Number: 123222394
 Prepared by SPARKER on 20250814
 Discipline Review by MONELL on 20250814
 GIS Review by RCOATTA on 20250908

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project
 Technical Data Report – 2025 Terrestrial Eutrophication and Acidification Assessment

Figure No. **A.3**
 Title **Sulphur Deposition Screening Threshold**

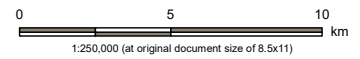
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Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

- Highway
- Road
- +— Railway
- Transmission Line
- Watercourse
- Waterbody
- - - District of Kitimat
- - - Municipal Boundary

- Project Location
- 2021 Modelling
- 2025 Nitrogen Deposition Screening Threshold (5 kg/ha/yr)**
- Base Case
- Project-alone Case
- Application Case
- 2021 Nitrogen Deposition Screening Threshold (5 kg/ha/yr)**
- Base Case
- Project-alone Case
- Application Case



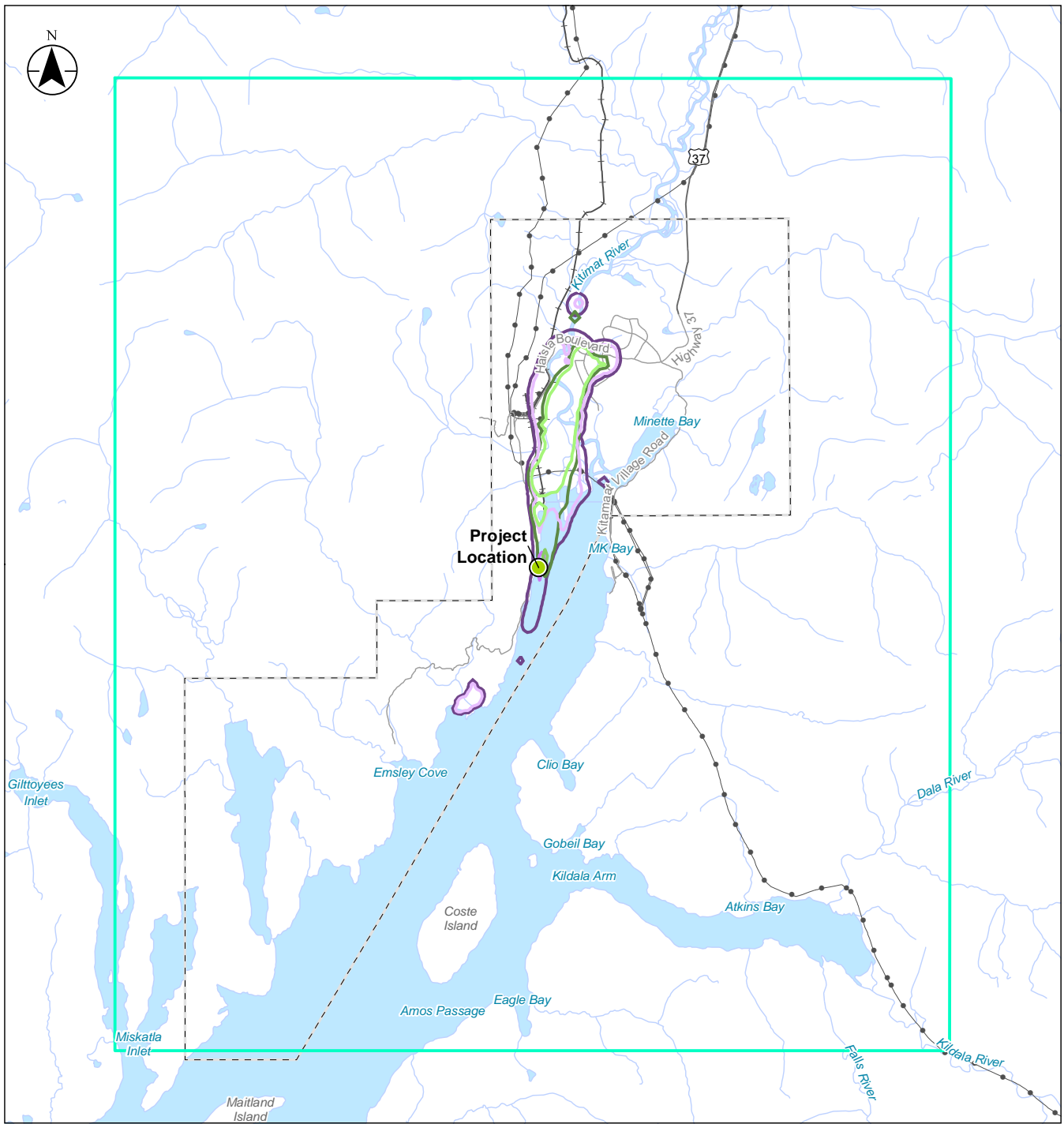
Project Location: Kitimat, British Columbia
 Project Number: 123222394
 Prepared by SPARKER on 20250814
 Discipline Review by MONELL on 20250814
 GIS Review by RCOATTA on 20250908

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project
 Technical Data Report – 2025 Terrestrial Eutrophication and Acidification Assessment

Figure No. **A.4**
 Title **Nitrogen Deposition Screening Threshold**

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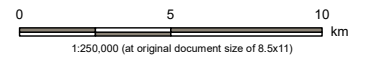
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Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada; Canadian Hydrographic Service

- Highway
- Road
- Railway
- Transmission Line
- Watercourse
- Waterbody
- District of Kitimat
- Municipal Boundary

- Project Location
- 2021 Modelling Area
- 2025 Nitrogen Deposition Empirical Critical Load (4 kg/ha/yr)**
- Base Case
- Project-alone Case
- Application Case
- 2021 Nitrogen Deposition Empirical Critical Load (4 kg/ha/yr)**
- Base Case
- Project-alone Case
- Application Case



Project Location: Kitimat, British Columbia
 Project Number: 123222394
 Prepared by SPARKER on 20250814
 Discipline Review by MONELL on 20250814
 GIS Review by RCOATTA on 20250908

Client/Project/Report: Cedar LNG Partners (GP) Ltd. Cedar LNG Project
 Technical Data Report – 2025 Terrestrial Eutrophication and Acidification Assessment

Figure No. **A.5**

Title: **Eutrophication Empirical Critical Load for Nitrogen Deposition**

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