Mount Bracey Compressor Station Permit Application Technical Assessment Report

CGC16362-STC-EN-RPRT-0002

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June 16, 2025

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Authorization Page

Stantec Consulting Ltd.

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Mount Bracey Compressor Station Permit Application Technical Assessment Report

June 16, 2025

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Project Number:
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Limitations and Sign-off

This document entitled Mount Bracey Compressor Station Permit Application Technical Assessment Report was prepared by Stantec Consulting Ltd. ("Stantec") for the account of Coastal GasLink Pipeline Ltd. (the "Client") to support the application to the British Columbia (BC) Energy Regulator (BCER) for a Waste Discharge Authorization (WDA) (the "Application") for the Mount Bracey Compressor Station (the "Project").

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Table of Contents

Limitations and Sign-off i
Acronyms / Abbreviations iv
Executive Summary vi
1 Project Introduction 1
1.1 Project Overview 1
1.2 Purpose 3
1.3 Regulatory Framework 3
1.3.1 Environmental Management Act 3
1.3.2 Environmental Assessment Act 3
1.3.3 Air Quality Objectives 4
2 Operational System Description 6
2.1 Process, Operational and Relevant Control System 6
2.2 System Flow Diagram 6
2.3 Process Flow Diagrams 7
2.4 Detailed Site Plan 7
3 Air Discharges and Treatments 9
3.1 Point Source Emissions 9
3.2 Non-Routine Emission Scenarios 12
3.3 Fugitive Emissions 12
3.4 Pollutant Control Works and Treatment Efficiencies 13
3.5 Discharge Evaluation 13
3.6 Comparison to Regulatory Criteria 14
3.6.1 Guidelines for the Reduction of NOx Emissions from Combustion Turbines 14
3.7 Best Achievable Technology Assessment 14
4 Receiving Environment 18
4.1 Geophysical Information 18
4.2 Ecosystems 18
4.2.1 Human Health Receptors 18
4.3 Climate and Meteorology 19
4.3.1 Climate 19
4.3.2 Meteorology 19
4.4 Airshed 20
4.4.1 Existing Air Quality 20
4.4.2 Air Quality Management Programs 22
5 Air Quality Assessment 23
5.1 Airshed Impact Assessment 23
5.1.1 Predicted Changes to Air Quality Associated with the Proposed Project Emission Sources 24
5.1.2 Predicted Cumulative Changes to Air Quality in the Study Area 25
5.2 Limitations of Modelling Results 25
5.2.1 Meteorological Uncertainty 26

5.2.2 Quality Assurance and Quality Control ... 26
5.2.3 Model Prediction Confidence ... 27
6 Identification of Receiving Environment Information Gaps ... 28
7 Other Discharges ... 29
7.1 Effluent ... 29
7.2 Hazardous Waste Management ... 29
8 Environmental Management System ... 30
8.1 Corporate Environmental Policy ... 30
8.2 Statutory Requirements ... 30
8.3 Industry Sector-Specific Standards ... 30
8.4 Existing Management Plans ... 31
8.5 Operations Plans and Procedures ... 31
8.5.1 Commissioning Plan ... 31
8.5.2 Maintenance Start-up and Shutdown Plan ... 32
9 Monitoring Programs and Reporting ... 33
9.1 Monitoring ... 33
9.2 Stack Testing ... 33
9.2.1 Turbine Engines ... 33
9.2.2 Rich Burn Primary Power Unit Generator Drivers ... 33
9.3 Venting ... 33
9.4 Reporting ... 34
10 References ... 35

List of Tables

Table 1.1 Air Quality Standards and Objectives ... 5
Table 3.1 Stack Parameters and Emission Rates for the Proposed Equipment at the Mount Bracey CS ... 10
Table 4.1 Summary of Existing Air Quality Based on Measurements at the Closest, Most Representative Stations ... 21
Table 5.1 Mount Bracey Compressor Station Project-Alone Case Dispersion Modelling Results ... 24
Table 5.2 Mount Bracey Compressor Station Application Case Dispersion Modelling Results ... 25

List of Figures

Figure 1.1 Mount Bracey Compressor Station Location and Study Area ... 2
Figure 2.1 Detailed Site Plan ... 8

List of Appendices

Appendix A System Flow Diagrams for Coastal GasLink
Appendix B Process Flow Diagrams for Coastal GasLink
Appendix C Air Quality Technical Data Report
Appendix D Dispersion Modelling Plan

Acronyms / Abbreviations

%	Percent
APU	Auxiliary power unit generator
asl	Above sea level
AQO	Air quality objective
AQMS	Air Quality Management System
BC	British Columbia
BC ENVP	British Columbia Ministry of Environment and Parks
BCER	British Columbia Energy Regulator
BLIERS	Base-Level Industrial Emission Requirements
CAAQS	Canadian Ambient Air Quality Standards
CAC	Criteria Air Contaminants
CCME	Canadian Council of Ministers of the Environment
CEPA	Canadian Environmental Protection Act
CEPEI	Canadian Energy Partnership for Environmental Innovation
CGL	Coastal GasLink
CO	Carbon monoxide
CS	compressor station
EAC	Environmental Assessment Certificate
EAO	Environmental Assessment Office
ECCC	Environment and Climate Change Canada
EMA	Environmental Management Act
ENVP	Ministry of Environment and Parks
ft^3	Cubic feet
g	Grams
g/s	Grams per second
km	kilometres
KP	Kilometre post
$\mu g/m^3$	Micrograms per cubic metre
LNG	Liquified natural gas
m	Metres

m/s	Metres per second
mm	Millimetres
MW	Megawatt
O_3	Ozone
NO	Nitrogen monoxide
NO_2	Nitrogen dioxide
NO_X	Nitrogen oxides
$PM_{2.5}$	Fine particulate matter (particles sizes less than 2.5 microns)
PPU	Primary power unit generator
QPs	Qualified Professionals
TAR	Technical Assessment Report
TDR	Technical Data Report
U.S. EPA	United Stated Environmental Protection Agency
UTM	Universal Transverse Mercator
WDA	Waste Discharge Authorization
WDR	Waste Discharge Regulation

Executive Summary

Purpose of the Application

Coastal GasLink Pipeline Ltd (CGL) constructed and will operate a natural gas pipeline (the CGL pipeline) from the area near the community of Groundbirch (approximately 40 km west of Dawson Creek, British Columbia [BC]) to the LNG Canada Development Inc. (LNG Canada) liquified natural gas (LNG) export facility (LNG Canada export facility) near Kitimat, BC. CGL will leverage this existing infrastructure with the construction of the Cedar Link Project; a connector pipeline, a meter station and a new compressor station (Mount Bracey) to enable the delivery of an additional 0.4 billion cubic feet per day (bcf/day) of natural gas from the CGL pipeline to the Cedar LNG Project, a proposed floating LNG facility in Kitimat, BC.

The Mount Bracey Compressor Station (CS) (the Project) is located at the CGL pipeline Kilometer Post (KP) 163 in the Regional District of Fraser - Fort George. Construction of the Project commenced in 2024 and will be in service in 2028.CGL is seeking a Waste Discharge Authorization (WDA) for air emissions from the Project under the Environmental Management Act (EMA), Waste Discharge Regulation (WDR) from the BC Energy Regulator (BCER). This includes air emissions from the commissioning and normal operations of the Project. Commissioning includes the period of time during and after installation of the authorized works when the works are being prepared for normal operations. An integral part of this application process is the development of a Technical Assessment Report (TAR). The TAR will assist regulatory decision making by providing in-depth information about the sources of air emissions, the discharge quality and quantity, as well as details about the receiving environment, the potential environmental impacts of the discharge, and proposed mitigations and monitoring program.

Emission Sources

Continuous Emission Sources

The Mount Bracey CS consists of three 'plants' that each operate independently. Total emission sources for the three plants include three gas-fired turbines, three gas-fired primary power units (PPU) plus one auxiliary power unit (APU), three seal gas combustors, and six glycol heaters, A maximum of two plants will run at any given time. The standby plant's ancillary equipment will run continuously to maintain the standby plant in a state of readiness. Therefore, the following equipment will run continuously: two gas-fired turbines, three PPUs, three seal gas combustors, and six glycol heaters. This assessment assumes that these sources operate at 100% of their rated capacity, which represents the worst-case scenario emissions and are reflected as such in the air quality assessment. The third gas-fired turbine is on standby and depicted in the air quality assessment as not operating. The APU will only run when one of the PPUs is not available to operate.

Non-Routine Emission Sources

The Project also includes a non-routine emission scenario which occurs during compressor or PPU unit switching to the stand-by turbine and PPU or the APU. This occurs when the standby units are started and ramped up to take over for the operating turbine or PPU. During these events, all gas turbines or PPUs could briefly operate. The duration is short (approximately 15 minutes per event) and consists of unit warm up, ramp up to idle (full RPM with no load), switching the load from one unit to another, and unit cool down. These switching events for the primary and stand-by equipment are anticipated to occur approximately 50 times per year.

During an emergency or during maintenance activities, it may be necessary to vent natural gas. The Project has identified six venting locations. Venting has not been quantified for the WDA as it is regulated under the Drilling and Production Regulation (BCER, 2010).

Fugitive Emission Sources

CGL has adopted a Fugitive Emissions Management Plan to manage the fugitive emissions for the CGL Wilde Lake C/S (CGL, 2024). The Fugitive Emissions Management Plan identifies leaks on compressor station components, such as valves, flanges, and fittings and conducts repairs as needed. The plan will be updated with new CS facilities, as required. The compressor stations are inspected consistent with British Columbia’s Drilling and Production Regulations.

Pollution Control Technology

The proposed gas turbines for the Project incorporate a dry-low emissions (DLE) technology. A DLE equipped gas turbine reduces nitrogen oxide emissions by premixing fuel and air before combustion, which reduces combustion temperature and minimizes NOx formation. The aero-derivative DLE units, such as the Baker Hughes General Electric (BHGE) PGT25+ or Siemens SGTA35, were identified as the potential options for the Project due to their ability to reduce NOx emissions by 80-90% while maintaining high reliability and efficiency. For final design, CGL selected the BHGE PGT25+ unit for the Project. The proposed gas turbine NOx emissions meet the emission limits in the *Guidelines for the Reduction of Nitrogen Oxide Emissions from Natural Gas-fuelled Stationary Combustion Turbines* (the Turbine Guidelines) (Environment and Climate Change Canada (ECCC), 2017)).

The PPUs will be rich-burn engines and specified to have a catalyst in the silencer/exhaust system to meet federal Multi-Section Air Pollutants Regulations (MSAPR) NOx emissions requirements for modern engines (ECCC, 2016).

Compressor seal gas is used to prevent leakage of compressed gas to the atmosphere and to prevent atmospheric gas from leaking into the compressed gas. The seal gas for the Project is sweet natural gas. To avoid the leakage of pressurized gas, seal gas is vented to atmosphere instead. This process is continuous with the operation of the compressor unit. In the effort to reduce methane emissions, the seal gas is captured and destructed (methane converted to carbon dioxide) in seal gas combustors. Each compressor unit (three units) has a dedicated seal gas combustor.

Environmental and Operational Factors

The Project is located in the Regional District of Fraser - Fort George at an elevation of 854 m above sea level (asl). Terrain in the region is complex ranging from approximately 700 m to over 2,600 m asl. The dominant land cover in this rural remote region is evergreen forest, with some deciduous forest. Evergreen forest dominates in the immediate vicinity of the Project. There are no permanent residents in the vicinity of the Project, therefore there are no sensitive receptors identified for the air quality assessment (Section 5 and Appendix C). Three temporary trapping and hunting camps have been identified within 1.5 km of the Project. The camps are occupied temporarily during the year and as such there is the potential for exposure to pollutants while the camp is occupied.

There are no industrial facilities or other substantive emission sources within 5 km of the Project. The overall air quality near the facility is good.

Dispersion modelling was used to determine predicted concentrations of criteria air contaminants (CAC) associated with the Project emission sources (Section 5 and Appendix C). The CACs considered in this assessment as the key pollutants emitted to the atmosphere are nitrogen dioxide (NO_2), fine particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), sulphur dioxide (SO_2), carbon monoxide (CO). Predicted ground-level concentrations are compared against the BC Air Quality Objectives (AQOs), a suite of ambient air quality criteria that have been developed provincially and nationally to inform decisions on the management of air contaminants (BC Ministry of Environment and Parks (BC ENVP), 2021a). The BC AQO may influence decision making, but they are not legally binding.

The Project-Alone Case is a modelling scenario that consists of emission sources from only the Project. The maximum predicted concentrations of NO_2, SO_2, $PM_{2.5}$ and CO for the Project-Alone Case are below the BC AQO (Table 5.1).

The Application Case is a modelling scenario that consists of emission sources from the Project (Project-Alone case) plus baseline air quality near the Project. The maximum predicted concentrations of NO_2, SO_2, $PM_{2.5}$ and CO for the Application Case with baseline added are less than the BC AQO (Table 5.2). The Application Case modeling results show that predicted concentrations at the receptor of interest, i.e., the temporary camp included in the receptor grid, are below the BC AQO. The effects on air quality as a result of the Project are considered not substantial.

1 Project Introduction

1.1 Project Overview

Coastal GasLink Pipeline Ltd (CGL) constructed and will operate a natural gas pipeline (the CGL pipeline) from the area near the community of Groundbirch (approximately 40 km west of Dawson Creek, British Columbia [BC]) to the LNG Canada Development Inc. (LNG Canada) liquified natural gas (LNG) export facility (LNG Canada export facility) near Kitimat, BC. CGL will leverage this existing infrastructure with the construction of the Cedar Link Project; a connector pipeline, a meter station and a new compressor station (Mount Bracey) to enable the delivery of an additional 0.4 billion cubic feet per day (bcf/day) of natural gas from the CGL pipeline to the Cedar LNG Project, a proposed floating LNG facility in Kitimat, BC.

The Mount Bracey Compressor Station (CS) (the Project) is located at the CGL pipeline Kilometer Post (KP) 163 in the Regional District of Fraser - Fort George (Figure 1.1). Construction of the Project commenced in 2024 and will be in service in 2028.

Legend

Mount Bracey Compressor Station

Water Body

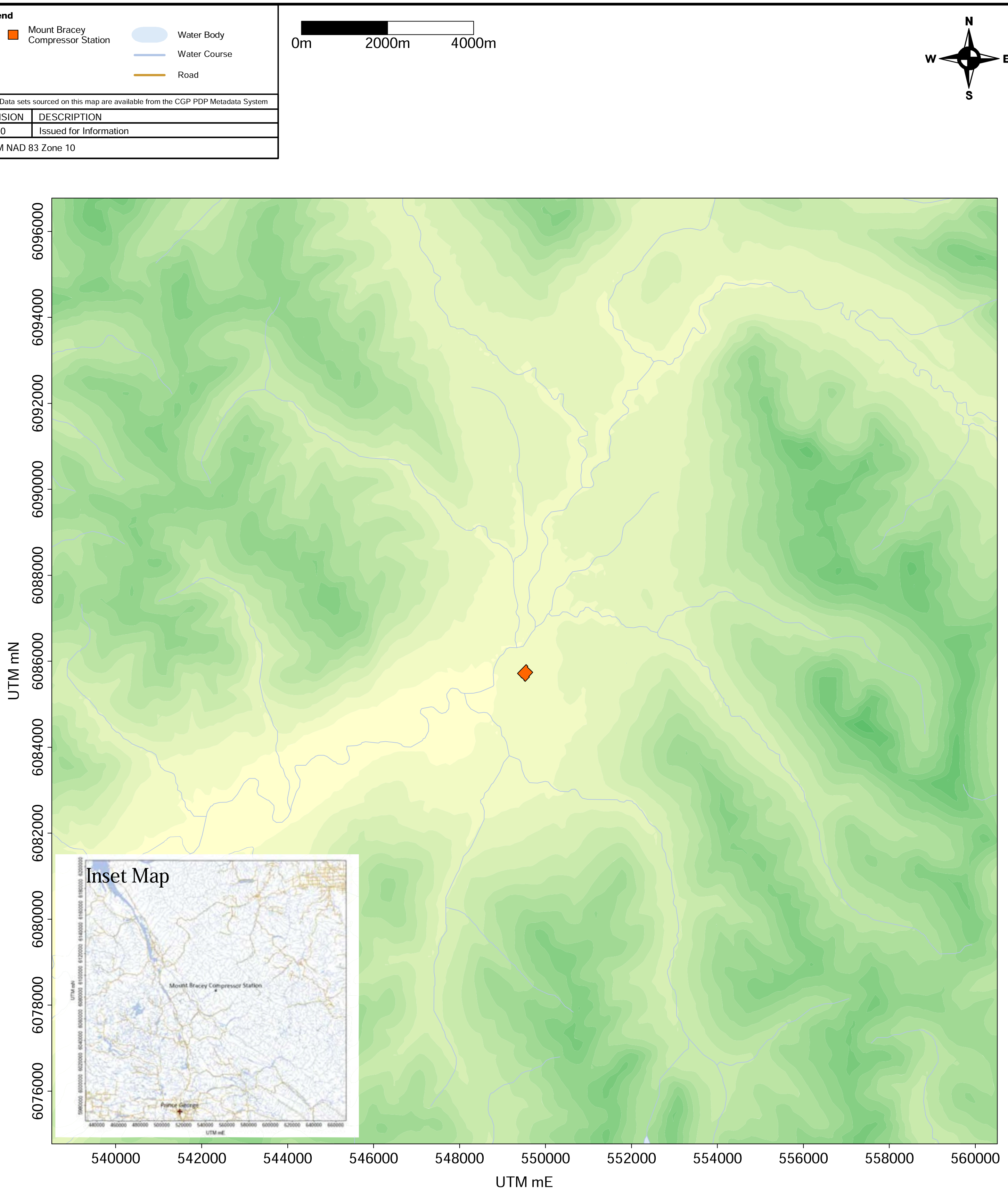
Water Course

Road

Note: Data sets sourced on this map are available from the CGP PDP Metadata System

REVISION	DESCRIPTION
0	Issued for Information

UTM NAD 83 Zone 10



Elevation (m)

700 900 1100 1300 1500 1700 1900 2100 2300 2500

Coastal GasLink Pipeline Project

TransCanada *In business to deliver*

Figure 1.1
Mount Bracey Compressor Station Location and Study Area

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1.2 Purpose

CGL is seeking a Waste Discharge Authorization (WDA) for air emissions from the Project under the *Environmental Management Act* (EMA), *Waste Discharge Regulation* (WDR) from the BC Energy Regulator (BCER). This includes air emissions from the commissioning and normal operations of the Project. Commissioning includes the period of time during and after installation of the authorized works when the works are being prepared for normal operations.

This document, the Technical Assessment Report (TAR), will assist regulatory decision making by providing in-depth information about the sources of air emissions, the discharge quality and quantity, as well as details about the receiving environment, the potential environmental impacts of the discharge, and proposed mitigations and monitoring program.

1.3 Regulatory Framework

1.3.1 Environmental Management Act

Pursuant to the *Environmental Management Act*, Section 6 (Waste Disposal), waste can be introduced into the environment in the course of conducting a prescribed industry, trade, or business with a valid and subsisting permit or approval. “Waste” is defined in the *Environmental Management Act*, and includes, among other things, certain air contaminants that will be associated with the operation of the Project.

The BCER has the jurisdiction to regulate oil and gas activities in BC, including the regulation of emissions under the Environmental Management Act, as contemplated by Section 14 and 15 of the Act. The BCER will primarily be tasked with the jurisdiction over permitting.

1.3.2 Environmental Assessment Act

The Project was issued an Environmental Assessment Certificate (EAC) #E14-03 on October 23, 2014, by the BC Environmental Assessment Office (EAO) (EAO, 2014a).

“Air Quality” was identified as a valued component (VC), for inclusion in the environmental assessment application, because of its intrinsic importance to the health and well-being of people, wildlife, vegetation, and other biota that comprise ecosystems (EAO, 2014b). The scope of the air quality assessment was based on criteria air contaminants (CAC), substances for which there are applicable regulatory criteria, and included air quality dispersion modelling.

1.3.3 Air Quality Objectives

The province of BC uses a suite of ambient air quality criteria that have been developed provincially and nationally to inform decisions in the management of air contaminants. The BC Air Quality Objectives (AQO) are non-statutory limits and are used to:

- Gauge current and historical air quality
- Guide decisions on environmental impact assessments and authorizations
- Guide airshed planning efforts
- Inform regulatory development
- Develop and apply episode management strategies such as air quality advisories

While the BC AQO are used in decision-making, they are not legally binding.

Table 1.1 contains the BC AQO for four CACs that are considered within this TAR (further details on the CACs are provided in Section 5). The BC AQO of NO_2 and SO_2 are based on the 2020 federal Canadian Ambient Air Quality Standards (CAAQS). The CAAQS are used to manage air quality such that human health is protected, and clean air remains clean. This is managed through the federal Air Quality Management System (*Canadian Environmental Protection Act* 2017). The Canadian Council of Ministers of the Environment (CCME) have stated that achievement of the CAAQS is determined on an airshed and air zone basis, which cover broad geographical areas. They are not intended to be facility-level regulatory standards to determine regulatory compliance (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.

Where exceedances of the BC AQO are predicted through dispersion modelling for an application for waste discharge, BCER considers the context of magnitude, frequency, timing, and proximity to sensitive receptors. Should there be exceedances measured within the broader geographic areas, BC Ministry of Environment and Parks (ENVP) would manage air quality, in accordance with the federal Air Zone Management Framework (CCME, 2019), to achieve improvements across the affected area and would include all important sources (BC ENVP, 2020).

The CACs considered in this assessment as the key pollutants emitted to the atmosphere from the Project are nitrogen dioxide (NO_2), fine particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), sulphur dioxide (SO_2) and carbon monoxide (CO). Table 1.1 provides the BC AQO and 2020 CAAQS applicable to the assessment of air quality for the Project. Regulatory agencies including the BCER have expressed an interest in referencing the CAAQS for other years. For this purpose, the 2025 CAAQS are also provided.

Table 1.1 Air Quality Standards and Objectives

CAC	Averaging Period	Air Quality Objective (micrograms per cubic meter [μg/m³])	Jurisdiction
NO_2	1-hour [a]	113	AQO (2020 CAAQS)
		79	2025 CAAQS
	Annual [b]	32	AQO (2020 CAAQS)
		23	2025 CAAQS
SO_2	1-hour [c]	183	AQO (2020 CAAQS)
		170	2025 CAAQS
	Annual [d]	13	AQO (2020 CAAQS)
		11	2025 CAAQS
$PM_{2.5}$	24-hour [e]	25	AQO
	Annual [f]	8	AQO
CO	1-hour	14,300	AQO
	8-hour	5,500	AQO

Notes:

Where conversions have been made between ppb and μg/m³, calculations are based on 25°C and 1 atmosphere.

[a] Achievement for 1-hour NO_2 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, and then average the three annual values ((BC ENVP, 2021a); (CEPA, 2017)).

[b] Achievement for annual NO_2 is based on the average of all 1-hour average concentrations over a single calendar year ((BC ENVP, 2021a); (CEPA, 2017)).

[c] Achievement for 1-hour SO_2 is based on 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, and then average the three annual values ((BC ENVP, 2021a); (CEPA, 2017)).

[d] Achievement for SO_2 is based on the average of 1-hour concentrations averaged over one year ((BC ENVP, 2021a); (CEPA, 2017)).

[e] Achievement for $PM_{2.5}$ is based on annual 98th percentile of daily average, averaged over one year (BC ENVP, 2021a).

[f] Achievement for $PM_{2.5}$ is based on annual average, averaged over one year (BC ENVP, 2021a).

Source: (BC ENVP, 2021a)

2 Operational System Description

As natural gas flows along a pipeline, it slows down due to friction with the pipe and results in a pressure drop of the gas. A compressor station re-pressurizes natural gas at select sites connected to the pipelines by mechanically compressing it to maintain the required flow rate of the gas (CGL, 2021). The number of compressor stations and their location along a pipeline depend on several design aspects of the pipeline, including the operating pressure of the pipeline, pipe diameter, elevation changes along the pipeline route and the volume of gas transported.

2.1 Process, Operational and Relevant Control System

The Mount Bracey CS is equipped with programmable logic control systems that manage, monitor, and control the station equipment based on instructions from the CGL operations control center. The station's logic controllers communicate with CGL's supervisory control and data acquisition (SCADA) system to continuously monitor the process parameters. Each plant within the Mount Bracey CS has a dedicated Emergency Shut Down Logic controller, ensuring safe shutdown during process upsets to protect employees, the public and the environment. Air compressors provide instrument and utility air for various systems throughout the site. Instrument air is used for diaphragm valve actuators and barrier air, while utility air is utilized for air-operated tools and the air intake pulse jet system.

The fuel control system for the gas turbines operate according to the design and installation to help maintain efficiency of fuel combustion and reduce CAC and fugitive emissions. The maintenance programs on the turbine fuel control system are tested with the frequency specified on each turbine. Intervals of inspections for gas turbine fuel control systems may be adjusted based on unique equipment requirements. The following steps are taken to ensure inspection of the fuel control system:

- The temperature of the fuel control average exhaust gas is verified against the temperature of the individual combustor exhaust gas while the turbine is operating.
- The temperature of the air intake is verified against the ambient temperature of the compressor station while the turbine is operating.
- The fuel valve position is checked to ensure that it is not oscillating in the event that the fuel valve has feedback.
- All fuel control pressure transmitters are checked according to the specified procedures.
- The condition and security of the equipment connections on control equipment is visually inspected.

2.2 System Flow Diagram

The Coastal GasLink system flow diagrams are presented in Appendix A.

2.3 Process Flow Diagrams

The Coastal Gaslink process flow diagrams are presented in Appendix B.

2.4 Detailed Site Plan

Figure 2.1 presents a detailed site plan including the location of the buildings and emission point sources for the Mount Bracey CS.

Legend

Building — Fenceline

Emission Source

Vent and Incinerator

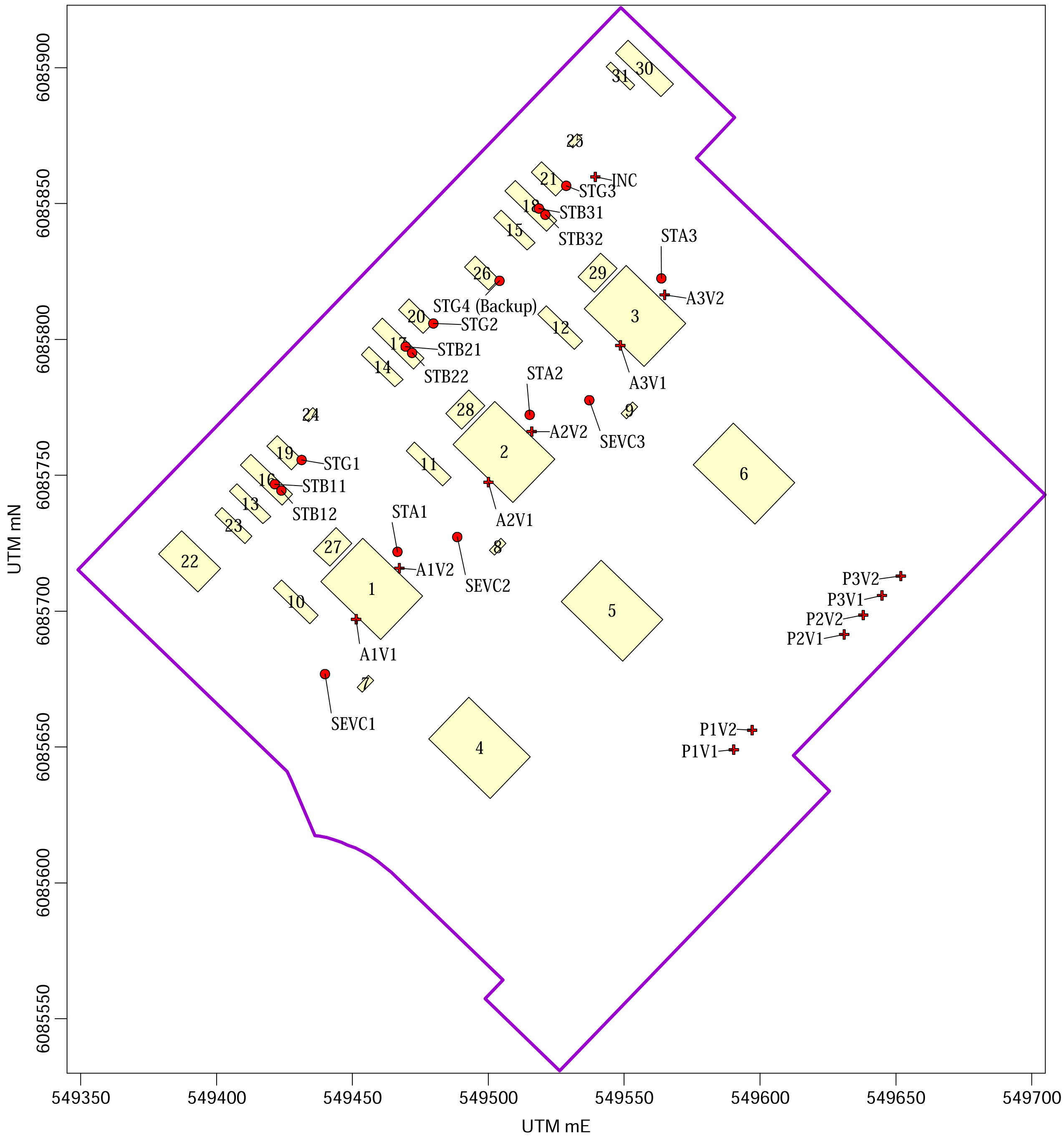
Note: Data sets sourced on this map are available from the CGP PDP Metadata System

REVISION	DESCRIPTION
0	Issued for Information

UTM Zone 10 NAD 83

0m 50m 100m

N E S W



1-3	Compressor Buildings for Unit A1, A2, and A3
4-6	Air Cooled Heat Exchangers for Unit A1, A2, and A3
7-9	Utility Gas Enclosures for Unit A1, A2, and A3
10-12	Local Control Module Buildings for Unit A1, A2, and A3
13-15	Electrical Buildings for Unit A1, A2, and A3
16-18	Mechanical Buildings for Unit A1, A2, and A3
19-21	APU Buildings for Unit A1, A2, and A3
22	Heated Storage Building
23	Personnel Building
24	Drum Rack Building 1
25	Drum Rack Building 2
26	Unit A0 Stand-By PPU Building
27-29	Air Intakes for Unit A1, A2, and A3
30	Living Quaters
31	Fresh Water and Drain Tank Building

STB11	Unit A1 Boiler Exhaust 1
STB12	Unit A1 Boiler Exhaust 2
STB21	Unit A2 Boiler Exhaust 1
STB22	Unit A2 Boiler Exhaust 2
STB31	Unit A3 Boiler Exhaust 1
STB32	Unit A3 Boiler Exhaust 2
STG1	Unit A1 Gen. Skid Exhaust 1
STG2	Unit A2 Gen. Skid Exhaust 2
STG3	Unit A3 Gen. Skid Exhaust 3
STG4	Unit A0 Gen. Skid Exhaust (Backup)
STA1	Compressor Unit A1 Exhaust
STA2	Compressor Unit A2 Exhaust
STA3	Compressor Unit A3 Exhaust
SEVC1	Seal Gas Combustor 1
SEVC2	Seal Gas Combustor 2
SEVC3	Seal Gas Combustor 3

A1V1	Unit A1 Vent 1
A1V2	Unit A1 Vent 2
P1V1	Plant 1 Blowdown Vent 1
P1V2	Plant 1 Blowdown Vent 2
A2V1	Unit A2 Vent 1
A2V2	Unit A2 Vent 2
P2V1	Plant 2 Blowdown Vent 1
P2V2	Plant 2 Blowdown Vent 2
A3V1	Unit A3 Vent 1
A3V2	Unit A3 Vent 2
P3V1	Plant 3 Blowdown Vent 1
P3V2	Plant 3 Blowdown Vent 2
INC	Incinerator

Coastal GasLink Pipeline Project — TC Energy

Figure 2.1
Detailed Site Plan

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3 Air Discharges and Treatments

The Project includes point source emissions from equipment at the compressor station and fugitive emissions from pipeline components and the compressor station.

3.1 Point Source Emissions

The Mount Bracey CS consists of three 'plants' that each operate independently. Total emission sources for the three plants include three gas-fired turbines, three gas-fired PPU plus one APU, three seal gas combustors, and six glycol heaters, A maximum of two plants will run at any given time. The standby plant's ancillary equipment will run continuously to maintain the standby plant in a state of readiness. Therefore, the following equipment will run continuously: two gas-fired turbines, three PPUs, three seal gas combustors, and six glycol heaters. This assessment assumes that these sources operate at 100% of their rated capacity, which represents the worst-case scenario emissions and are reflected as such in the air quality assessment. The third gas-fired turbine is on standby and depicted in the air quality assessment as not operating. The APU will only run when one of the PPUs is not available to operate.

There will be a domestic (food) waste incinerator onsite, but it is not considered a continuous source, and therefore, is not included in the modelling.

Emission factors for oxides of nitrogen (NO_X), CO, and VOC are provided by CGL based upon manufacturer data or based upon AP-42 published emission factors (Table 3.1) where manufacturer data was unavailable. The amount of non-methane VOCs from natural gas combustion are small based on past project experience. Ambient concentrations near emissions sources are expected to be well below regulatory standards from other jurisdictions (i.e., Alberta as BC does not have AQOs for VOCs). On this basis, VOC emissions are quantified for the WDA application; however, they are not carried forward into the dispersion modelling. The sulphur content in source fuel gas for the Project is provided by CGL for the emission sources included in the assessment. For the $PM_{2.5}$ emission factors, a study by Canadian Energy Partnership for Environmental Innovation (CEPEI) was used (CEPEI, 2024).

Design information for the compressor station including building dimensions, and stack heights and diameters are based on site layout and configuration provided by CGL.

Table 3.1 presents the stack parameters, emission rates and source of data for the proposed equipment.

Table 3.1 Stack Parameters and Emission Rates for the Proposed Equipment at the Mount Bracey CS

Source Identification		BHGE PGT25+ Gas Turbine	Source of Data	Waukesha Gas Generator (PPU and APU) L5794GSI	Source of Data	Seal Gas Vapour Combustors	Source of Data	Glycol Heaters	Source of Data
Unit Description		Continuous	CGL	Continuous	CGL	Continuous	CGL	Continuous	CGL
Number of units		2 (+1 Standby)	CGL	3 (+1 Standby)	CGL	3	CGL	6	CGL
Source Type		Point	CGL	Point	CGL	Point	CGL	Point	CGL
Capacity – Heat Input (based on HHV)	MMBtu/hr	290	Stantec [b]	9.47	Stantec [b]	1.5	CGL	1.92	CGL
	GJ/hr	306	Stantec [b]	9.99	Stantec [b]	1.6	Stantec [b]	2.03	Stantec [b]
	kW	85,000	Stantec [b]	2,775	Stantec [b]	N/A	N/A	563	CGL
Output Rating (Assume LHV)	MMBtu/hr	105.40	Stantec [b]	2.90	Stantec [b]	N/A	N/A	1.47	Stantec [b]
	GJ/hr	111	Stantec [b]	3.06	Stantec [b]	N/A	N/A	1.55	Stantec [b]
	kW	30,900	CGL	850	CGL	N/A	N/A	431	CGL
Fuel Type		Fuel Gas	CGL	Fuel Gas	CGL	Fuel Gas	CGL	Fuel Gas	CGL
Fuel Gas Consumption Rate	$10^3m^3/d$	188.8	Stantec [b]	6.2	Stantec [b]	0.99	Stantec [b]	1.25	Stantec [b]
Sulphur Content [b]	ppmv	22.0	CGL	22.0	CGL	22.0	CGL	22.0	CGL
Exhaust Gas Flow Rate	kg/s	82.9	CGL	0.93	Vendor Data [c]	N/A	N/A	N/A	N/A
Exhaust Gas MW	kg/kmol	28.5	CGL	N/A	N/A	N/A	N/A	N/A	N/A
Exhaust Gas H_2O Content	%	4.3	CGL	N/A	N/A	N/A	N/A	N/A	N/A
Exhaust Gas O_2 Content (dry condition)	%	16.1	Stantec [d]	N/A	N/A	N/A	N/A	N/A	N/A
Rain Cap	Yes/No	No	CGL	No	CGL	No	CGL	Yes	CGL
Release Direction		Vertical	CGL	Vertical	CGL	Vertical	CGL	Vertical	CGL
Stack Height	m	14.5	CGL	8.5	CGL	4.2	CGL	6.8	CGL
Stack Diameter	m	2.6	CGL	0.305	CGL	1.58	CGL	0.559	CGL
Maximum Exit Velocity	m/s	38.2	Stantec	37.2	Stantec	0.36	CGL	1.45	Stantec [b]
Exit Temperature	°C	494.4	CGL	580.6	Vendor Data [c]	63	CGL	258	Stantec
	K	768	Stantec	854	Stantec	336	CGL	531	Stantec [b]
Maximum Rate of Discharge	m^3/s @101.325 kPa, 20°C, dry	66.93 [d]	Stantec [b]	0.76 [d]	Stantec [b]	0.45 [d]	Stantec [b]	0.15 [e]	Stantec [b]
NO_X	ppmv@ 15% O_2 and dry	25 [a]	CGL	N/A	N/A	N/A	N/A	N/A	N/A
NO_X	g/kW-hr	N/A	N/A	1.00	CGL	N/A	N/A	N/A	N/A
NO_X	lb/MMBtu	N/A	N/A	N/A	N/A	0.098	AP-42 (Table 1.4-1) [e]	0.098	AP-42 (Table 1.4-1) [e]
CO	ppmv @ 15% O_2 and dry	36 [a]	CGL	N/A	N/A	N/A	N/A	N/A	N/A
CO	g/hp-hr	N/A	N/A	0.17	CGL	N/A	N/A	N/A	N/A
CO	lb/MMBtu	N/A	N/A	N/A	N/A	0.082	AP-42 (Table 1.4-1) [e]	0.082	AP-42 (Table 1.4-1) [e]

Source Identification		**BHGE PGT25+ Gas Turbine**	**Source of Data**	**Waukesha Gas Generator (PPU and APU) L5794GSI**	**Source of Data**	**Seal Gas Vapour Combustors**	**Source of Data**	**Glycol Heaters**	**Source of Data**
$PM_{2.5}$ (CEPEI 2024) [f]	g/GJ (fuel input, HHV)	0.38	CEPEI (CEPEI 2024)	1.11	CEPEI (CEPEI 2024)	0.637	CEPEI (CEPEI 2024)	0.637	CEPEI (CEPEI 2024)
VOC	lb/MMBtu	0.0021	AP-42	N/A	N/A	0.005	AP-42 (Table 1.4-2) [g]	0.005	AP-42 (Table 1.4-2) [g]
VOC	g/bhp-hr	N/A	N/A	0.01	CGL	N/A	N/A	N/A	N/A
NO_X	t/d	0.226	Stantec [b]	0.0204	Stantec [b]	1.64E-03	Stantec [b]	2.05E-03	Stantec [b]
SO_2	t/d	0.011	Stantec [b]	0.0004	Stantec [b]	5.96E-05	Stantec [b]	7.45E-05	Stantec [b]
CO	t/d	0.198	Stantec [b]	0.0047	Stantec [b]	1.38E-03	Stantec [b]	1.72E-03	Stantec [b]
$PM_{2.5}$	t/d	0.003	Stantec [b]	0.0003	Stantec [b]	2.48E-05	Stantec [b]	3.10E-05	Stantec [b]
VOC	t/d	0.007	Stantec [b]	0.0003	Stantec [b]	9.01E-05	Stantec [b]	1.13E-04	Stantec [b]
NO_X	g/s	2.614	Stantec [b]	0.2361	Stantec [b]	0.019	Stantec [b]	0.0237	Stantec [b]
SO_2	g/s	0.130	Stantec [b]	0.0043	Stantec [b]	0.001	Stantec [b]	0.0009	Stantec [b]
CO	g/s	2.291	Stantec [b]	0.0538	Stantec [b]	0.016	Stantec [b]	0.0199	Stantec [b]
$PM_{2.5}$	g/s	0.032	Stantec [b]	0.0031	Stantec [b]	0.0003	Stantec [b]	0.0004	Stantec [b]
VOC	g/s	0.077	Stantec [b]	0.0032	Stantec [b]	0.0010	Stantec [b]	0.0013	Stantec [b]

Notes:

[a] Provided by CGL

[b] Calculated by Stantec

[c] Manufacturer data for Waukesha Gas Generator L5794GSI (Innio, 2019), (CGL, 2019)

[d] Calculated from manufacturer exhaust flow rate; converted to standard conditions (101.325 kPa, 20°C, dry)

[e] Calculated from unit heat input capacity (GJ/hr) to fuel consumption to exhaust flow rate; converted to standard conditions (101.325 kPa, 20°C, dry)

[f] Source: (CEPEI, 2024)

[g] Source: (U.S. EPA, 1998)

The emission rates provided are for each unit, not cumulative.

3.2 Non-Routine Emission Scenarios

Normal operation, based upon emission sources that operate continuously at 100% of rated capacity, represents worst case routine emissions and is the basis of the assessment.

The Project also includes a non-routine emission scenario which occurs during turbine or PPU unit switching to the stand-by turbine or PPU/APU. This occurs when the standby units (i.e., turbine, PPU/APU) are started and ramped up to take over for the operating turbine or PPU. During these events, all gas turbines or PPUs could briefly operate. The duration is short (less than 20 minutes per event) and consists of unit warm up, ramp up to idle (full RPM with no load), switching the load from one unit to another, and unit cool down. These switching events for the primary and stand-by equipment are anticipated to occur less than 50 times per year.

These switching events are automatically controlled through the station operations controls. Due to the short duration, infrequent occurrence, low engine and turbine loads and limited emission data to characterize transient engine and turbine performance during startup, this scenario is not included in the dispersion modelling.

During emergency or maintenance activities, it may be necessary to vent natural gas. The Project has identified six venting locations. Venting has not been quantified for the WDA as it is regulated under the Drilling and Production Regulation (BCER, 2010).

3.3 Fugitive Emissions

Fugitive emission sources from the facility include station piping components, such as full-bore valves and contoured fittings. To reduce the number of fugitive sources for the Mount Bracey CS, process air will be used for pneumatic control valves rather than natural gas, inside the compressor station where practical.

CGL has adopted the Fugitive Emissions Management Plan to manage the fugitive emissions for the CGL Wilde Lake C/S (CGL, 2024). The Fugitive Emissions Management Plan identifies leaks on pipeline and compressor station components, such as valves, flanges and fittings, and conducting repairs as needed. The plan will be updated with new CS facilities, as required. The compressor stations are inspected consistent with British Columbia’s Drilling and Production Regulations.

3.4 Pollutant Control Works and Treatment Efficiencies

The proposed gas turbines for the Project incorporates a dry-low emissions (DLE) technology. A DLE equipped gas turbine reduces nitrogen oxide emissions by premixing fuel and air before combustion, which reduces combustion temperature and minimizes NOx formation. The aero-derivative DLE units, such as the Baker Hughes General Electric (BHGE) PGT25+ or the Siemens SGT-A35 were identified as the potential options for the Project due to their ability to reduce NOx emissions by 80-90% while maintaining high reliability and efficiency. For final design, CGL selected the BHGE PGT25+ units for the Project. The proposed gas turbine NOx emissions meet the emission limits in the *Guidelines for the Reduction of Nitrogen Oxide Emissions from Natural Gas-fuelled Stationary Combustion Turbines* (Turbine Guidelines) (Environment and Climate Change Canada, (ECCC), 2017).

The PPUs will be rich-burn engines and specified to have a catalyst in the silencer/exhaust system to meet federal Multi-Section Air Pollutants Regulations (MSAPR) NOx emissions requirements for modern engines (ECCC, 2016). The primary reason for using a rich-burn engine with a catalyst is its reliability.

Seal gas is used to prevent leakage of compressed gas to the atmosphere and prevent atmospheric gas from leaking into the compressed gas. The seal gas for Project is sweet natural gas. To avoid the leakage of pressurized gas, seal gas is vented to atmosphere instead. This process is continuous with the operation of the compressor unit. In the effort to reduce methane emissions, the seal gas is captured and destructed (methane converted to carbon dioxide) in seal gas combustors. Each compressor unit (three units) has a dedicated seal gas combustor.

3.5 Discharge Evaluation

The BC AQOs are provided in Section 1.3.3. The BC AQO for NO_2 and SO_2 are aligned with the 2020 CAAQS (Table 1.1) (BC ENVP, 2021a). The comparison of the air quality dispersion modelling against the BC AQO is provided in Section 5 and in the technical data report (TDR) (Appendix C). There are currently no existing equipment specific emission limits in BC for the point sources outlined in Section 3.1.

3.6 Comparison to Regulatory Criteria

The Federal guidelines associated with minimizing emissions are outlined herein.

3.6.1 Guidelines for the Reduction of NOx Emissions from Combustion Turbines

The federal *Guidelines for the Reduction of Nitrogen Oxide Emissions from Natural Gas–fueled Stationary Combustion Turbines*, issued under the ECCC *Canadian Environmental Protection Act* (ECCC, 2017) are applicable to technology design guidance for natural gas-fueled stationary combustion turbines as one of three equipment groups targeted: however, not as a specific regulatory limit or performance standard. The Turbine Guidelines are not expected to apply during start-up periods, shut-down periods, periods of part-load operation or when the ambient temperature at the point of air intake is less than -18 degrees Celsius. Implementation of the Turbine Guidelines at the individual project level falls within the jurisdiction and discretion of the applicable provincial regulatory agencies.

The Turbine Guideline states that gas fired turbines between 4 MW and 70 MW should have NOx emissions equal to or less than 25 ppmvd at 15% O_2 (parts per million on a dry volume basis, corrected to 15% oxygen). The selected gas turbines (BHGE PGT25+) comply with the Turbine Guideline (ECCC 2017).

3.7 Best Achievable Technology Assessment

Per the BC ENVP (BC ENVP, 2021c), Best Achievable Technology Assessment to Inform Waste Discharge Standard, a Best Achievable Technology (BAT) assessment evaluates the feasibility, reliability, control-effectiveness, and cost-effectiveness to determine its suitability for meeting waste discharge standards and protecting the environment. The BC Energy Regulator will consider the outcome of the BAT assessment when reviewing the final application for a WDA.

In 2015, during the early planning and design of the Project natural gas-fired turbines were selected as the primary drivers for pipeline compression. The selection of the compressor technology was based on multiple factors, including efficiency, emissions, operational reliability, and environmental performance of the equipment.

A Best Available Technology Economically Achievable (BATEA) assessment was conducted as part of the CGL's Greenhouse Gas (GHG) Emissions Management Plan (CGL, 2016) to support the EAC application process. The BATEA principles were considered when designing the Project. The assessment supported the final selection of the compressor station technology for the Project to prevent and minimize emissions; this technology was evaluated for the Project WDA application.

The BATEA assessment completed for the Project aligns with the new, broader BAT principles (BC ENVP, 2021c), requested as part of WDA applications. BAT represents the most effective and advanced technology proven in commercial applications, demonstrating feasibility, reliability, control-effectiveness, and cost-effectiveness in meeting environmental standards. The BAT assessment process evaluates multiple waste control technologies to ensure compliance with regulatory emission guidelines while minimizing environmental impact.

The BAT assessment follows the seven-step process established by the BC ENVP:

1. Identification of information required for the BAT assessment
2. Identification of all potential technologies or options
3. Screening for feasible options
4. Comparison of the reliability of each option
5. Comparison of the control-effectiveness of each option
6. Comparison of the cost-effectiveness of each option
7. Selection of BAT

The Project BATEA assessment can be found in section 3 of the GHG Emissions Management Plan (CGL, 2016). Below is a summary of the BATEA assessment, including the technology selection process, alternatives considered and key emission considerations.

During the early design phase, CGL assessed multiple technology options before selecting natural gas-fired turbines for compression. This selection process involved evaluating alternatives for feasibility, emissions performance, reliability, and operational considerations.

The potential technology options considered were the following:

- **Electric Compressors:** Evaluated but deemed impractical due to limited grid access at remote station locations and potential reliability issues during power outages. The integration of electric compression would require significant infrastructure investments that were not feasible within the Project's financial and logistical framework.
- **Low-NOx Combustion Technology:** Integrated into the selected gas turbines to minimize nitrogen oxide (NOx) emissions while maintaining combustion efficiency. Advanced combustion technology was chosen to reduce emission without compromising power output.
- **Waste Heat Recovery (WHR) Systems:** Assessed for feasibility but deemed unsuitable due to site-specific constraints such as space limitations and intermittent load profiles.
- **Dry Low Emissions (DLE) Turbines :** Selected due to their superior performance in reducing NOx emissions by 80-90% compared to older technologies. The adoption of these turbines ensures compliance with regulatory standards while maintaining operational efficiency.

Natural gas-fired turbines were chosen based on their ability to operate in cold-weather conditions, meet regulatory emission guidelines, and provide reliability during shutdowns and start-ups. Unlike electric-driven compressors, which were dismissed due to grid power unavailability and reliability concerns, natural gas-fired turbines offer a robust solution that balances emissions, operational efficiency, and environmental impact.

Natural gas-fired turbines were selected to optimize GHG emissions and CACs. However, emissions control decisions require a careful balance, as reducing one pollutant can inadvertently increase others. Examples include:

- **NOx Emissions vs. GHG Emissions**: Low-NOx emissions at part-load operations (<90%) are achieved in most DLE turbines through air bleeding, leading to less efficient combustion and increased GHG emissions. While low-NOx units are optimal for full-load operations, setting stringent NOx limits on part-load operations can drive up overall GHG emissions.
- **NOx Emissions vs. $PM_{2.5}$ Emissions:** Selective catalytic reduction (SCR) systems reduce NOx emissions but can result in higher $PM_{2.5}$ emissions due to ammonium sulfate formation.
- **NOx Emissions vs. Ammonia (NH_3) Emissions:** SCR systems lower NOx emissions but result in ammonia slip, which requires careful control to prevent environmental release. SCR also requires supply of ammonia to remote compressor stations.

In Section 3.1. of the BATEA assessment, aero-derivative DLE units, such as the General Electric LM2500+ and Rolls Royce RB211, were identified in initial design as the best options due to their ability to reduce NOx emissions by 80-90% while maintaining high reliability and efficiency (CGL, 2016). A comparison of these units characteristics are found in Appendix E of the Greenhouse Gas Emissions Technical Data Report submitted as part of the EAC application (CGL, 2014). In final design of the Project, CGL has selected the BHGE PGT25+, which is the current available unit from the manufacturer with similar specification to the GE LM2500+.

Reasons for this selection included the following:

- Advanced DLE combustion technology significantly reduces NOx emissions compared to uncontrolled units.
- These turbines offer unparalleled reliability and efficiency improvements within the energy sector.
- Unlike SCR systems, DLE turbines require lower maintenance and staffing while avoiding ammonia-related safety, environmental, and operational risks.

Technologies deemed infeasible included:

- **Selective Catalytic Reduction (SCR) Systems:** Rejected due to high ammonia slip risks, operational challenges across varying temperature conditions, and safety concerns related to ammonia storage and transport at remote locations.
- **Electric Compressors:** As previously noted, grid power limitations and reliability concerns made them impractical.
- **Flare Systems for Venting Control:** Not required due to the infrequency of blowdowns and logistical constraints at remote sites.

The rationale for not selecting SCR Systems were the following:

- The transportation and storage of ammonia (anhydrous or aqueous urea) pose safety and environmental risks. Accidental releases could impact local populations.
- SCR systems are best suited for base-load operations within a narrow temperature band and do not perform well under the variable load conditions required for pipeline systems operating in BC’s diverse climate.

In conclusion, the 2016 selection of natural gas-fired turbines for pipeline compression was based on a comprehensive BATEA assessment, balancing emissions performance, operational reliability, and environmental impact (CGL, 2016). While alternative technologies were considered, the options to use the GE LM2500+ or Rolls Royce RB211 turbines were determined to be the most effective solution for achieving emission compliance while maintaining system reliability. In final design of the Project, CGL has selected the BHGE PGT25+, which is the current available unit from the manufacturer with similar specification to the GE LM2500+.

4 Receiving Environment

The following receiving environment setting sections provide information regarding existing environmental conditions prior to the proposed air emissions discharge.

4.1 Geophysical Information

The Project is located in the Regional District of Fraser - Fort George at an elevation of 854 m above sea level (asl). The higher elevations are towards the southwest and west portions of the CALMET meteorological model domain and the lowest elevations are in the southwest portions of the domain. Terrain in the region is complex ranging from approximately 700 m to over 2,600 m asl.

4.2 Ecosystems

The dominant land cover in this rural remote region is evergreen forest, with some deciduous forest. Evergreen forest dominates in the immediate vicinity of the Mount Bracey CS. No red- or blue-listed plants or ecological communities have been identified in proximity to the Project. Soils mapped along the Coastal GasLink pipeline right-of-way as part of the Application for an Environmental Assessment Certificate are typical of forested lands in central British Columbia and include orthic brunisols, dystric brunisols, cumulic regosols and orthic gleysols.

One watercourse, an unnamed tributary to the Anzac River is located adjacent to the Project. Site assessments in 2013 and 2019 determined that the watercourse provide limited spawning habitat or potential for fish migration. The Anzac River is located approximately 700 m northwest of the Project, which drains to the west before ultimately joining the Parsnip River.

4.2.1 Human Health Receptors

There are no permanent residents in the vicinity of the Mount Bracey CS; therefore, there are no sensitive receptors for the Project. Three temporary trapping and hunting camps have been identified within 1.5 km of the Project. The camps are occupied temporarily during the year and as such there is the potential for exposure to pollutants while the camp is occupied. These temporary camps have been included in the receptor grid as receptors of interest but are not considered sensitive receptors because they are not permanently occupied.

4.3 Climate and Meteorology

4.3.1 Climate

As noted in Section 4.1, the Project is located in the Regional District of Fraser - Fort George; this is in the Sub-Boreal Spruce zone characterized by hot summers and cold winters (CCAP, 2025).

Historically, the region has excellent forage production capacity without the need for irrigation with only 1.4% of the agricultural land requiring irrigation in 2016. The growing season is a few months long, but the major climate limitation in the area are the long cold winters and cool nighttime temperatures. Most of the region is associated with soil that is high in clay and with appropriate management, the soil can produce forage and grain crops.

Data from Canadian Climate Normals (CCN) Stations are used to describe mean and extreme weather conditions observed over a 30-year period. To describe existing climatic conditions near the Mount Bracey CS, 1991 to 2020 climate normals are the most recent available (ECCC, 2023). The closest CCN station near the Project is the Mackenzie (Composite) climate station (ECCC, 2023). The Mackenzie (Composite) climate station is comprised of three climate stations – Mackenzie Airport, Mackenzie, and Mackenzie A. The long-term data from the Mackenzie (Composite) climate stations represents a combination of the data from the three climate stations that are joined together to create a 30-year (1991 to 2020) data series for this location. Canadian Climate Normals are calculated by the ECCC using the recommended methods for validity established by the World Meteorological Organization (WMO) (ECCC, 2023). The Mackenzie Airport, Mackenzie, and Mackenzie A climate stations are located approximately 72 km northwest of the Mount Bracey CS and their elevations range from 690 m to 694 m asl.

Annual average temperatures range from -9.8 to 15.8°C. The average annual precipitation in Mackenzie (Composite) is 608.7 millimetres (mm). Further detailed information on the regional climate, including descriptions of temperature, precipitation, and wind patterns is provided in the TDR (Appendix C).

4.3.2 Meteorology

Meteorology plays a major role in determining air quality changes downwind of emission sources. Meteorology over the study area varies with time of day, time of the year, and can vary by location because of terrain and land-cover influences. Statistical summaries of meteorological conditions that may affect the discharge plume dispersion patterns are provided in the TDR (Appendix C), including further information on:

- The CALPUFF modelling system (CALPUFF and CALMET) used to assess air quality effects associated with all emission scenarios. The CALPUFF model is a refined model that applies terrain and meteorological data (CALMET), and uses plume rise, dispersion, and terrain algorithms.

- The Weather Research and Forecasting (WRF) model selected as the prognostic model for the CALMET modelling. It is a next-generation mesoscale numerical weather prediction system designed to serve both operational forecasting and atmospheric research needs. The CALMET meteorological model is a diagnostic model. It uses interpolation schemes that can rely on empirical relationships to account for topographical or other influences that can occur between the observing sites.
- CALMET was used to produce hourly three-dimensional meteorological fields (i.e., winds, temperatures, and turbulence) for a five-year period (January 1, 2011, to December 31, 2015). Using five full years of data allows CALMET to reproduce a wide range of meteorological conditions that could occur over the study area.
- Meteorological measurements including visibility and surface winds (direction and speed), surface temperatures, mixing heights, stability classes, and precipitation.

4.4 Airshed

The Project is located within a remote area within the Regional District of Fraser - Fort George, in the Central Interior zone in BC, approximately 198 km northeast of Prince George. A location map is provided in Figure 1.1. There are no industrial facilities and industrial sources of CACs within 5 km of the Project. The overall air quality near the facility is good, where CAC concentrations are well below the BC AQO most of the time. The nearest continuous ambient air quality monitoring stations are located at least 76 km from the Project. Without industrial facilities and associated monitoring stations within 5 km of the Project, the characterization of air quality conditions relies on representative monitoring stations located elsewhere in the province. Representative monitoring stations are chosen based on similar air quality setting to that of the Project. The characteristics of a representative monitoring station include similarities of emission sources, and terrain and meteorology influences.

4.4.1 Existing Air Quality

To characterize baseline air quality conditions near the Project, data from four representative monitoring stations were analyzed. The Blueberry First Nation School monitoring location is located 212 km northeast of the Mount Bracey CS and considered conservative and representative of background NO_2 concentrations, including influences from rural residential heating and traffic, with little to no influence from a major industrial NO_X emission source similar to the Project location. The Pine River Hasler monitoring station is located 76 km north of the Mount Bracey CS and is used to assess baseline ambient concentrations of SO_2. This monitoring station is considered representative of the area due to its rural location. The Peace Valley Attachie Flat Upper Terrace monitoring station is located 156 km northeast of the proposed Mount Bracey CS and provides the $PM_{2.5}$ baseline ambient data. This monitoring station is considered representative of the Project location area due to its rural location. The Kamloops Brocklehurst monitoring station is located 491 km south-southeast of the Mount Bracey CS and was used to assess baseline ambient concentrations of CO. It is noted that the Kamloops Brocklehurst continuous monitoring station is within an urban area; therefore, their measured background concentrations are expected to be generally higher than what is typical for the remote areas where the Project is located. However, there is limited CO monitoring in British Columbia and no CO monitoring in rural areas.

A summary of existing air quality for the Project is presented in Table 4.1, with further information provided in the TDR (Appendix C). The 1-hour, 8-hour, and 24-hour values represent a high percentile value of the measured time series. The annual averages are represented by a mean value. The values of the applicable BC AQO are presented for reference purposes.

Data from the representative monitoring stations indicate baseline concentrations are less than the BC AQO.

Table 4.1 Summary of Existing Air Quality Based on Measurements at the Closest, Most Representative Stations

Substance	Averaging Period	Baseline Concentration ($\mu g/m^3$) [a]	BC AQO / 2025 CAAQS [b]
NO_2 [c]	1-hour [d]	16.6	113 / 79
	Annual [e]	2.1	32 / 23
SO_2 [f]	1-hour [g]	11.5	183 /170
	Annual [h]	0.9	13 / 11
$PM_{2.5}$ [i]	24-hour [j]	18.6	25
	Annual [k]	4.5	8
CO [l]	1-hour [m]	515.2	14,300
	8-hour [n]	515.2	5,500

Notes:

[a] Baseline air quality data was developed by Stantec from BC Air Data Archive Website and British Columbia ENVP 1998-2023 summary spreadsheets (BC ENVP, 2024a). Conversions from ppb or ppm to $\mu g/m^3$ assume standard conditions of 25°C and 101.325 kPa.

[b] BC AQO and 2025 CAAQS are as described in Section 1.3.3 and Table 1.1. It is noted that the BC AQO for NO_2 and SO_2 are equivalent to the 2020 CAAQS. The 2025 CAAQS are presented for informational purposes.

[c] **NO_2:** The database for NO_2 observations used for baseline at Blueberry First Nation School are for 6/23/2016 to 11/28/2017.

[d] **NO_2:** The 1-hour baseline NO_2 concentration was determined based on the 98th percentile of the daily 1-hour maximum concentrations over for 2017 (BC ENVP, 2024a). This value is provided here for characterizing existing conditions.

[e] **NO_2:** The annual NO_2 baseline concentration was determined based on the average of 1-hour values for 6/23/2016 to 11/28/2017.

[f] **SO_2:** The British Columbia ENVP summary database for SO_2 observations at Pine River Hasler are for 2021 - 2023.

[g] **SO_2:** The 1-hour baseline SO_2 concentration was determined based on the daily 1-hour maximum concentrations, followed by the calculation of the 99th percentile for each year, and then averaged over the 3-year period.

[h] **SO_2:** The annual SO_2 baseline concentration was determined based on the average of annual mean values for the 3-year period.

[i] **$PM_{2.5}$:** The British Columbia ENVP summary database for $PM_{2.5}$ observations at Peace Valley Attachie Flat Upper Terrace are for 2019 - 2021.

[j] **$PM_{2.5}$:** The 24-hour $PM_{2.5}$ baseline concentration was determined based on the average of the 98th percentile values for the 24-hour averaging interval over the 3-year period.

[k] **$PM_{2.5}$:** The annual $PM_{2.5}$ baseline concentration was determined based on the average of the annual mean values over the 3-year period.

[l] **CO:** The British Columbia ENVP summary database for CO observations at Kamloops Brocklehurst is for 2010, which is the most recent year.

[m] **CO:** The 1-hour and 8-hour baseline CO concentrations were determined based on the 98th percentile of 1-hour CO concentrations for 2010.

4.4.2 Air Quality Management Programs

There are air quality management programs across Canada at the national, regional, and provincial scales. A high-level description is provided below.

4.4.2.1 National and Regional: The National Air Quality Management System (or AQMS)

The AQMS was developed to standardize a patchwork of air quality regimes and practices across Canada. The AQMS provides a uniform, consistent, science-based measure of protection for human health and the environment while building capacity and avoiding duplication of effort among federal and provincial regulators. The AQMS has established CAAQS and Base-Level Industrial Emission Requirements (BLIERS) for facilities. Under the AQMS framework, pollutant concentrations within air zone are compared to the CAAQS, including the more stringent 2025 CAAQS.

4.4.2.2 Provincial: Air Zone Management

Under the AQMS, air zones are the basis for monitoring, reporting, and taking action on air quality. Air zones are areas that typically exhibit similar air quality characteristics, issues, and trends. It is the responsibility of each province and territory to delineate and manage their air zones based on local conditions. BC has been delineated into a total of seven air zones. These include the Georgia Strait, Coastal, Lower Fraser Valley, Southern Interior, Central Interior, Northwest, and Northeast Air Zones. The Regional District of Fraser - Fort George and the Project location are encompassed within the Central Interior Air Zone.

To avoid duplication of effort, air zone management plans in BC are built upon existing local air management plans. Where the CAAQS are being approached or exceeded, additional work may be required to ensure that good air quality is achieved. In such cases, BC ENVP will work with affected stakeholders, including local air management committees and emitters to develop the appropriate actions given local conditions. The latest report issued for the Central Interior Air Zone is for the three-year period of 2019 to 2021, which includes metrics and air zone management levels for NO_2, SO_2, O_3 and $PM_{2.5}$ from various monitoring stations within the airshed (BC ENVP, 2021b).

For the 2019 to 2021 reporting period, the Central Interior Air Zone achieved the CAAQS for ozone (O_3), NO_2 and SO_2, but not for $PM_{2.5}$ (BC ENVP, 2021b). The nearest monitoring station to the Project included in the metrics for $PM_{2.5}$ in the 2019 to 2021 Air Zone Report is the Vanderhoof station, located approximately 152 km southwest of the Project. Additional details are provided in the Air Zone Report (2019-2021) (BC ENVP, 2021b).

5 Air Quality Assessment

The Project is located at a remote area with no background industrial facilities within 5 km; therefore, only the Project emissions were modelled. The existing air quality before the Project are represented by baseline data from representative monitoring stations (Section 4.4.1). The impacts on air quality as a result of the Project are summarised in Section 5.1. Dispersion modelling was completed in compliance with the BC ENVP's Air Quality Dispersion Modelling Guideline (Guideline) (BC ENVP, 2022a).

5.1 Airshed Impact Assessment

An integral part of the process of seeking a WDA for Project air emissions is the development of the TDR (Appendix C). The TDR describes the Project's emissions, their dispersion in the atmosphere, and their effect on air quality both individually (Project-Alone Case) and in combination with existing conditions (Application Case). Dispersion modelling is employed to predict concentrations of CACs and rates of deposition for acidifying substances at ground-level where they potentially interact with sensitive receptors (i.e., vegetation, soil, surface water, and human health receptors). An important aspect of the TDR is to document the dispersion modelling methodology and provide evidence that the work is credible, defensible, and can be used to reliably inform air quality management decisions.

A substantial effect on air quality is one where concentrations of air contaminants are likely to exceed the applicable objectives for air quality (i.e., to be high in magnitude) and are of concern relative to the geographical extent of predicted exceedances, their frequency of occurrence, and the presence of potentially susceptible receptors (e.g., human, wildlife, vegetation, soils, or water bodies) that uptake ambient air. Air quality effects that are assessed as substantial represent an alteration of air quality that is large, and of increased concern for decision-makers.

The TDR includes the following (but not limited to) (refer to Appendix C):

- Description of the air quality dispersion modelling approach and methodologies (as detailed in the Dispersion Modelling Plan (the Plan) [Appendix D])
- Quantification of CAC emissions; four species of CACs were assessed in the dispersion modelling: NO_2, SO_2, $PM_{2.5}$, and CO
- Existing atmospheric conditions
- Emissions inventory of continuous emission sources
- Application of a combined baseline and background concentration to account for anthropogenic emissions from local domestic sources (e.g., home heating and transportation) and non-anthropogenic sources (i.e., fugitive dust, global transport of volcanic emissions).
- Modelling results for the aforementioned emission sources.

The conclusions of the dispersion modelling for the Project Case and Application Case are summarized in Section 5.1.1 and Section 5.1.2.

5.1.1 Predicted Changes to Air Quality Associated with the Proposed Project Emission Sources

Dispersion modelling was used to determine predicted concentrations of CAC associated with the Project emission sources. The Project-Alone Case is a modelling scenario that consists of emission sources from only the Project.

The maximum predicted concentrations for NO_2, SO_2, $PM_{2.5}$ and CO for the Project-Alone Case are below the BC AQO (Table 5.1). Further details of the air quality assessment for the Project are provided in Appendix C.

Table 5.1 Mount Bracey Compressor Station Project-Alone Case Dispersion Modelling Results

CAC	Averaging Period	Maximum Predicted Concentrations (μg/m^3)	AQO / 2025 CAAQS (μg/m^3)	Percentage of British Columbia AQO (%)
NO_2	1-hour	62.0	113 / 79	55
	Annual	12.9	32 / 23	40
SO_2	1-hour	3.1	183 / 170	2
	Annual	0.5	13 / 11	4
$PM_{2.5}$	24-hour	0.7	25 / 27	3
	Annual	0.2	8 / 8.8	3
CO	1-hour	95.3	14,300	1
	8-hour	41.1	5,500	1

Notes:

Achievement for each parameter and time averaging interval is as described in the notes section of Table 1.1.

NO to NO_2 conversion is using OLM Northeast BC Zone (Appendix C) (BC ENVP, 2022b).

BC AQO and 2025 CAAQS are as described in Section 1.3.3 and Table 1.1. It is noted that the BC AQO for NO_2 and SO_2 are equivalent to the 2020 CAAQS. The 2025 CAAQS are presented for informational purposes.

5.1.2 Predicted Cumulative Changes to Air Quality in the Study Area

The Application Case is a modelling scenario that consists of emission sources from only the Project (Project-Alone case) plus the baseline air quality (Section 4.4.1 and the TDR [Appendix C]) near the Project.

The maximum predicted concentrations for NO_2, SO_2, $PM_{2.5}$ and CO for the Application Case with baseline added are below the BC AQO (Table 5.2). Further details of the air quality assessment for the Project are provided in Appendix C. The Application Case modeling results show that predicted concentrations at the receptor of interest, i.e., the temporary camp included in the receptor grid, are below the BC AQO. The effects on air quality as a result of the Project are considered not substantial.

Table 5.2 Mount Bracey Compressor Station Application Case Dispersion Modelling Results

CAC	Averaging Period	Maximum Predicted Concentrations Including Baseline (µg/m³)	AQO / 2025 CAAQS (µg/m³)	Percentage of British Columbia AQO (%)
NO_2	1-hour	76.7	113 / 79	68
	Annual	15	32 / 23	47
SO_2	1-hour	14.6	183 / 170	8
	Annual	1.4	13 / 11	11
$PM_{2.5}$	24-hour	19.3	25 / 27	77
	Annual	4.7	8 / 8.8	59
CO	1-hour	610.5	14,300	4
	8-hour	556.3	5,500	10

Notes:

Achievement for each parameter and time averaging interval is as described in the notes section of Table 1.1.

NO to NO_2 conversion is using OLM Northeast BC Zone (Appendix C) (BC ENVP, 2022b).

BC AQO and 2025 CAAQS are as described in Section 1.3.3 and Table 1.1. It is noted that the BC AQO for NO_2 and SO_2 are equivalent to the 2020 CAAQS. The 2025 CAAQS are presented for informational purposes.

5.2 Limitations of Modelling Results

The ability of the dispersion model to predict ambient concentrations depends on the accuracy of the source and emission inventory, the meteorology, and the assumptions used to represent the atmospheric physics and chemistry processes. Dispersion models are reasonably reliable in estimating the magnitude of highest concentrations occurring sometime and somewhere within an area. The application of dispersion models is viewed as a “best estimate” approach, and this approach should be viewed as acceptable to the regulatory decision maker.

5.2.1 Meteorological Uncertainty

Meteorological conditions vary systematically and randomly from year to year, with season, and with time of day. In addition, meteorological conditions at any given time can vary with location because of the presence of local tree canopy or terrain influences. It is important to include a wide range of possible meteorological conditions in the assessment. The application of five years of meteorological data instead of the normal three years provides the opportunity to include a wide range of conditions that can affect dispersion of air emissions. Uncertainty in meteorological conditions included in the air quality modelling arises from assumptions made in the meteorological model and the quantity and quality of observed data used for model initialization. (BC ENVP, 2022a).

5.2.2 Quality Assurance and Quality Control

A numerical air quality simulation model is one of the powerful tools available to estimate the effect of air emissions on ambient air quality. The air quality assessment required the preparation of a large amount of numerical data for model input and the processing of a large amount of numerical data output from the model. A number of quality assurance and quality control checks were undertaken for all components of the assessment. These included the following:

- **Emissions inventory**: The Project emissions inventory was constructed using standard methodologies based on available engineering information. The air emissions inventories for other facilities were based on information taken from recent publications. The information contained in these publications has already been reviewed by stakeholders, including regulatory agencies. The emission inventory included in the Plan (Appendix D) was reviewed for logical consistency to confirm values, such as emission rates, stack heights, diameters, exhaust temperatures, and velocities, were within the range of typical values for each source type.
- **Meteorology**: The output of the CALMET model was compared with observations to confirm consistency. Wind direction, wind speed, temperature, mixing height and stability were prepared (Appendix D of the TDR [Appendix C]) for the ECCC Mackenzie Airport station for comparison to measured data and to confirm reasonable model performance.
- **Model application**: CALPUFF concentration predictions were rationalized against the emission inventory information to verify that model concentration predictions are logically consistent with the source emission inventory (e.g., high concentrations occur where expected). During post-processing, if unexpected model results were found, they would be investigated and rationalized in detail to confirm consistency with model input.

The air quality dispersion modelling assessment was undertaken by Stantec's air quality team working together under the direction of the air quality discipline lead. Critical components of the quality assurance/quality control process were numerous progressive reviews and ongoing communication among team members.

5.2.3 Model Prediction Confidence

Uncertainty associated with dispersion model predictions stems from two main areas (U.S. EPA, 2005):

- **Reducible uncertainty**—results from uncertainties associated with the input values and with the limitations of the model physics and formulations. Reducible uncertainty can be reduced by better (i.e., more accurate and representative) measurements and improved model physics.
- **Inherent uncertainty**—associated with the stochastic nature of the atmosphere and its representation. Models predict concentrations that represent an ensemble average of numerous repetitions for the same nominal event. An individual observed value can deviate significantly from the ensemble value. This uncertainty may be responsible for a ±50% deviation from the measured values.

Predictions for a specific site and time are often poorly correlated with observed values. This poor correlation can often be related to errors in wind direction. For example, an uncertainty of 5º to 10º in wind direction can produce a concentration error in the 20% to 70% range (U.S. EPA, 2005).

The U.S.EPA provides guidance to decision makers relative to model uncertainty (U.S. EPA, 2005). Specifically, it recommends that model predictions be accepted as a “best estimate,” until sufficient technical progress has been made to meaningfully implement concepts dealing with uncertainty.

After considering the sources of uncertainty in the dispersion modelling assessment it is concluded that confidence in the assessment is high. The work is credible, defensible, and can be used to reliably inform air quality management decisions.

6 Identification of Receiving Environment Information Gaps

There are no substantial gaps in meteorological and air quality information that are relevant to the assessment of this application. The ambient air quality and meteorology monitoring stations are considered representative for the Project. Both the quality and quantity of data (spatially and temporally) are adequate to characterize the receiving environment. These data are discussed in the Section 4.4.1 and the TDR (Appendix C).

7 Other Discharges

7.1 Effluent

“Effluent” includes both process effluent and collected precipitation (runoff) from areas that might be contaminated by the operations. No process effluent will be generated by the Project.

The Mount Bracey CS has been designed such that precipitation that falls within the facility fenceline will discharge passively from the site. This discharge is planned such that there will be no accumulation of discharged water on the surface of the ground. Discharge will not occur on unstable slopes and will not cause erosion or result in measurable downward or outward movement of soil, rocks, snow, ice, mud or debris.

7.2 Hazardous Waste Management

If hazardous wastes are generated at the facility, they will be managed and disposed of following the requirements of the BC Hazardous Waste Regulation (HWR) (BC ENVP, 2024b) and as per the CGL Environmental Management Plan.

8 Environmental Management System

8.1 Corporate Environmental Policy

CGL has adopted the corporate environmental policy of its parent company, TC Energy. TC Energy (TCE) plans and executes work in compliance with applicable environmental legal requirements and TCE's policies, procedures, specifications and standards.

TCE's corporate environmental policy details their commitments to stewardship, protection, and performance. Coastal Gaslink is committed to being responsible environmental stewards of the land and dedicated to developing innovative solutions to manage their environmental footprint while providing responsible, safe, and affordable energy to the North American economy. Coastal Gaslink will monitor, measure, assess and communicate their environmental performance and recognize the importance of learning from their experiences to continually improve efforts to protect the environment.

Furthermore, Coastal GasLink will implement the environmental management measures and commitments within the Project Environmental Management Plan to avoid or reduce potential adverse effects of construction and operations of the Mount Bracey CS and adhere to permit requirements.

8.2 Statutory Requirements

Coastal GasLink has regulatory requirements on environmental matters under federal and provincial legislation, including the following:

- BC Environmental Assessment Act
- BC Air Quality Objectives (BC ENVP, 2021)
- Environmental Management Act (2003)
- BCER Fugitive Emissions Management Guideline (2025)
- Multi Sector Air Pollutants Regulation
- BC Energy Resource Activity Act (ERAA)

8.3 Industry Sector-Specific Standards

The characteristics of the air emissions at Mount Bracey will be that of sweet natural gas combustion. Emissions controls will be applied to turbine compressors and engine-driven power generators to meet requirements of the Guidelines for the Reduction of Nitrogen Oxide Emissions from Natural Gas –fueled Stationary Combustion Turbines and the Multi-Sector Air Pollutant Regulation. In addition, the use of seal gas and vapour combustors will reduce methane emissions to meet requirements in the Drilling and Production Regulation.

8.4 Existing Management Plans

The following are TCE and Coastal GasLink management plans that focus on air emissions management:

- Coastal GasLink Pipeline: Section 06 Atmospheric Environment Environmental Assessment Certificate application (2014)
- Coastal GasLink Environmental Management Plan (EMP)
- Coastal GasLink Greenhouse Gas Emissions Management Plan (2016)
- Fugitive Emissions Management Plan (2025)

8.5 Operations Plans and Procedures

8.5.1 Commissioning Plan

Once construction of the turbine compressors is complete, the commissioning program will begin which requires several hours for running each of the turbine compressor units including the following:

- Complete testing of all safety systems
- Confirming all alarms and shutdowns
- Anti-surge testing
- Engine vibration testing
- Performance testing
- Compressor mapping
- Emissions testing
- Engine baseline run

For the PPUs, commissioning will also require testing of each generator and engine package including the following:

- Complete testing of safety systems
- Confirmation of all alarms and shutdowns
- Engine vibration testing
- Emissions testing
- Load bank testing and ramping

Once testing of the PPUs is complete they will be utilized to supply power to the compressor station.

8.5.2 Maintenance Start-up and Shutdown Plan

Coastal GasLink will follow the requirements of the Drilling and Production Regulation, including the recommendations in the Flaring and Venting Reduction Guideline in the operation and maintenance of this compressor station.

- At start-up, some venting will be necessary while air is purged from the system and gas is brought back into the system. These events are short-term.
- Certain planned maintenance events will result in necessary venting of natural gas to atmosphere, and it is expected that these events could happen approximately every 1 to 5 years or as critical maintenance requires. For these types of maintenance events the compressor station will be blown down to remove natural gas from the work areas. Gas from the unit and from station piping will be vented to atmosphere. These blowdown events are short-term.

9 Monitoring Programs and Reporting

9.1 Monitoring

CGL will install two passive monitors for the quarterly measurement of NO_2 (in ppb) along or near the facility fenceline. The monitoring program will follow the passive monitoring siting requirements outlined in the B.C. Field Sampling Manual (BC ENVP, 2020). Siting of the passive monitors will take into consideration the dispersion modelling results, prevailing wind direction, proximity to the onsite equipment and to sensitive receptors. CGL may modify or discontinue the monitoring program with written approval from BCER.

9.2 Stack Testing

9.2.1 Turbine Engines

CGL will complete an initial performance test for each combustion turbine proposed within six months of the turbine commencing normal operations. Testing will be completed to demonstrate compliance with the NO_X emission limits outlined in the WDA. Thereafter, the combustion turbines will undergo a NO_X-emission performance test once per calendar year. The initial and annual tests will be completed in accordance with the ECCC *Guidelines for the Reduction of Nitrogen Oxide Emissions from Natural Gas-fuelled Stationary Combustion Turbines* (ECCC, 2017).

9.2.2 Rich Burn Primary Power Unit Generator Drivers

CGL will complete a post catalytic converter emission test on the proposed PPU drivers after the initial break in period and every 8,600 hours of run time. The testing for the PPU drivers will be conducted in accordance with the *B.C. Field Sampling Manual* (BC ENVP, 2020).

The MSAPR prescribes testing and emission reporting requirements for stationary engines (ECCC, 2016). A rich-burn engine is defined as one which has a less than 4% oxygen content in the exhaust determined by volume on a dry basis. The rich burn PPU drivers will comply with the MSAPR NO_X emission values for a rich-burn engine and regular performance tests as outlined in MSAPR (ECCC, 2016).

9.3 Venting

The Project has identified six venting locations. Venting has not been quantified for the WDA because it will be managed under the *Drilling and Production Regulation* (BCER, 2010).

9.4 Reporting

CGL will prepare an annual report including periods of commissioning, starting-up and shutting down of compressor drivers and PPU/APU, passive monitoring program, stack testing results and NO_2 emissions resulting from the switching events.

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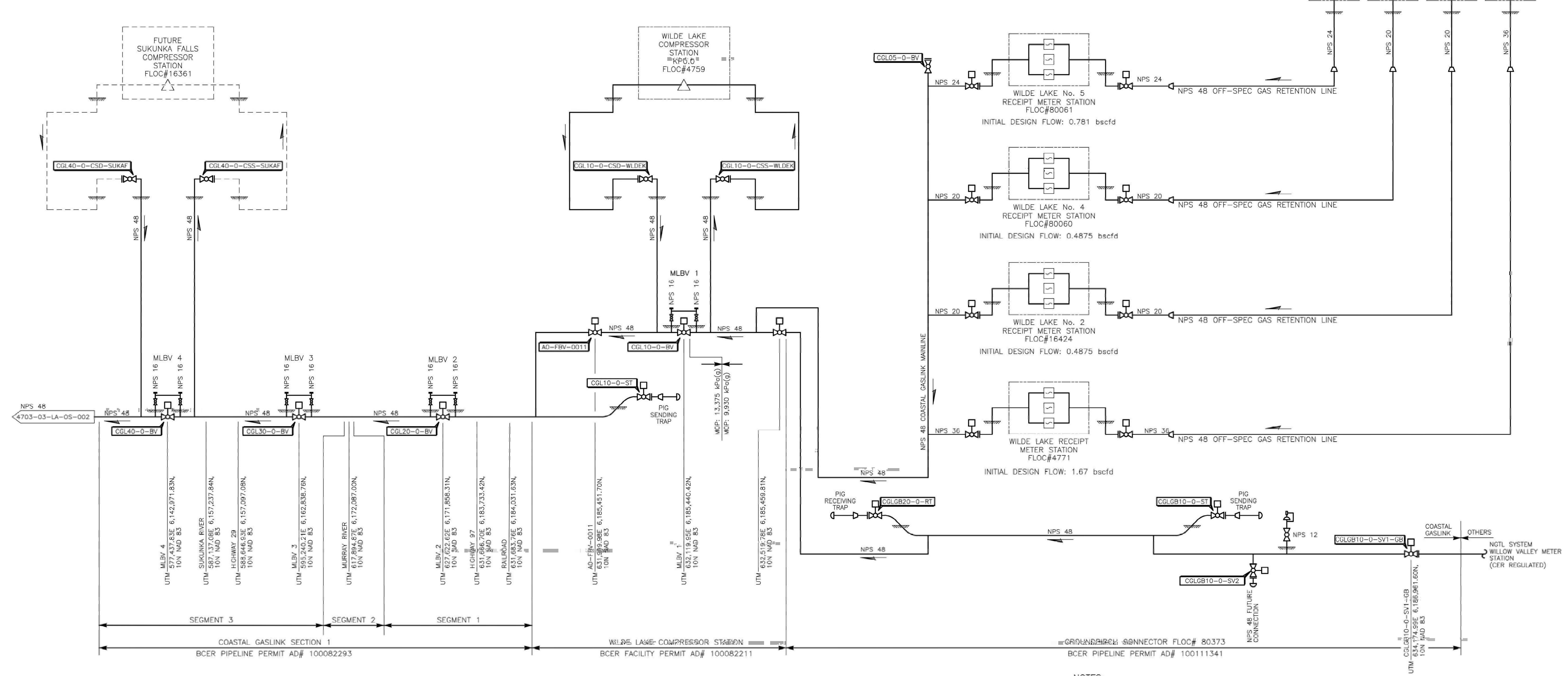
Appendix A System Flow Diagrams for Coastal GasLink

COMPRESSOR UNIT CONFIGURATION													
CASE	DESCRIPTION	TOTAL VOLUME	CGL TOTAL	CGL TOTAL	WILDE LAKE	SUKUNKA FALLS	MOUNT BRACEY	RAGGOON LAKE	CLEAR CREEK	SEGUNDO LAKE	PARROTT LAKES	TITANIUM PEAK
		(bcf/d)	STATIONS	UNITS	UNITS		UNITS	FUTURE				
~~BASE~~	~~TRAINS 1 & 2~~	~~2.1~~	~~1~~	~~2+1~~	~~2+1~~							
2.5 bscfd	TRAINS 1 & 2 + CEDAR	2.5	2	4+2	2+1	FUTURE	2+1	03A				

NOTES:

1) UNIT ISO RATED AT 33MW



THE SEAL AND SIGNATURE OF THE UNDERSIGNED ON THIS DRAWING CERTIFIES THAT THE DESIGN INFORMATION CONTAINED IN THESE DRAWINGS ACCURATELY REFLECTS THE ORIGINAL DESIGN AND THE MATERIAL DESIGN CHANGES MADE DURING CONSTRUCTION THAT WERE BROUGHT TO THE UNDERSIGNED'S ATTENTION. THESE DRAWINGS ARE INTENDED TO INCORPORATE ADDENDA, CHANGE ORDERS, AND OTHER MATERIAL DESIGN CHANGES, BUT NOT NECESSARILY ALL SITE INSTRUCTIONS.

THE UNDERSIGNED DOES NOT WARRANT OR GUARANTEE, NOR ACCEPT ANY RESPONSIBILITY FOR, THE ACCURACY OR COMPLETENESS OF THE AS-CONSTRUCTED INFORMATION SUPPLIED BY OTHERS CONTAINED IN THE DRAWINGS, BUT DOES, BY SEALING AND SIGNING, CERTIFY THAT THE AS-CONSTRUCTED INFORMATION, IF ACCURATE AND COMPLETE, PROVIDES AN AS-CONSTRUCTED SYSTEM WHICH SUBSTANTIALLY COMPLIES IN ALL MATERIAL RESPECTS WITH THE ORIGINAL DESIGN INTENT.

NOTES:

1. SWEET NATURAL GAS SERVICE. MAX LICENSED H2S 20ppm.
2. MAXIMUM OPERATING PRESSURE 13,375 kPa(g) OR 9,930 kPa(g) AS NOTED.
3. PIPELINE WAS DESIGNED, CONSTRUCTED, AND TESTED CONSIDERING CLASS LOCATION BOUNDARIES THAT REFLECT ANTICIPATED FUTURE DEVELOPMENT. UNLESS OTHERWISE NOTED, LOCATION CLASSES LISTED REFLECT THE AS-CONSTRUCTED CLASS. CURRENT CALCULATED CLASS IS NOT SHOWN AND IS DETERMINED ACCORDING TO THE COMPANY'S INTEGRITY MANAGEMENT PLAN.
4. PIPELINE, PIPELINE ASSEMBLIES, AND FACILITIES ARE DESIGNED, CONSTRUCTED, AND TESTED TO LOCATION CLASS 1 EXCEPT WHERE NOTED. LINE PIPE (GENERAL) SPECIFICATION (LEAST WALL THICKNESS).
   - CLASS 1: NPS 48 x 18.5mmwt x Gr. 550, DSAW, CSA Z245.1 CAT II M5C
   - CLASS 2: NPS 48 x 20.6mmwt x Gr. 550, DSAW, CSA Z245.1 CAT II M5C
   - CLASS 3: NPS 48 x 26.5mmwt x Gr. 550, DSAW, CSA Z245.1 CAT II M5C
5. ALL INTERMEDIATE MAINLINE BLOCK VALVES ARE NON-TELEMETERED.
6. ALL MAINLINE BLOCK VALVES AT FUTURE COMPRESSOR STATIONS INCLUDE TELEMETRY FOR UPSTREAM AND DOWNSTREAM PRESSURE.

REFERENCE DRAWINGS	
DRAWING No	TITLE
4703-03-LA-OS-002	COASTAL GAS LINK OPERATING SCHEMATIC

REV No	DATE	DESCRIPTION	PROJECT CODE	DRAFTER	DRAFTING CHECKER	DESIGNER	DESIGN CHECKER	PROJECT MANAGER	COMPANY
00	2015-03-02	ISSUED FOR BID	2207464/2207465	DD					STANTEC
01	2017-07-05	RE-ISSUED FOR BID	2207464/2207465	JS					TRANSCANADA
02	2020-08-28	ISSUED FOR CONSTRUCTION	M.000955	ET	DS	JW	SF	JW	TC ENERGY
03	2024-05-09	ISSUED FOR RECORD	M.000955	DS	JL	JWW	CH	JW	TC ENERGY
03A	2025-03-04	ISSUED FOR PERMIT	M.002347	DS	JL	SF	SM	CC	TC ENERGY

PROFESSIONAL ENGINEER/RPT | PERMIT/ ENG. APPROVAL | DATE

EGBC Permit to Practice #1001012

2025-03-20

REV. NO. | DATE | PERMIT NUMBER:

Coastal GasLink

GENERAL INFORMATION – COASTAL GASLINK PIPELINE PROJECT

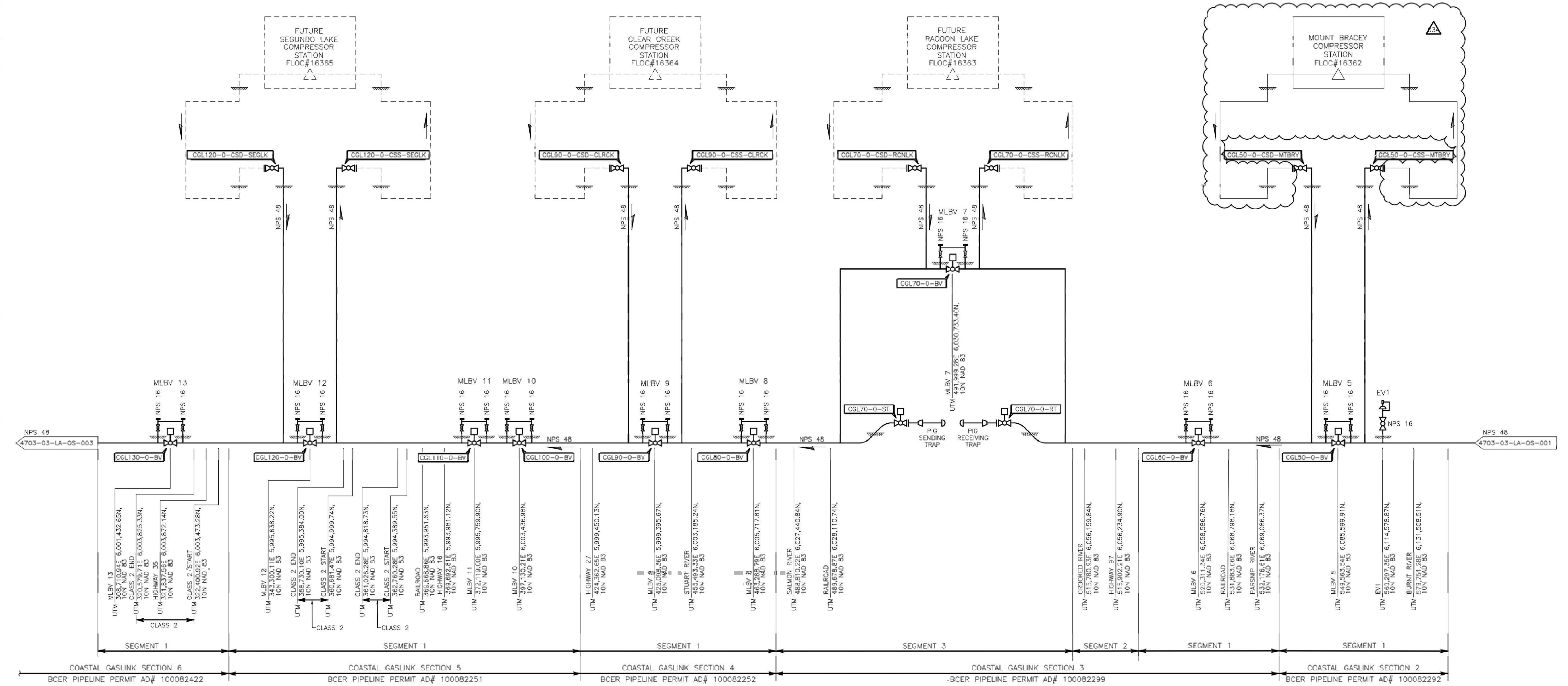
FLOC# 4703 | ENG STATION: | DISC# 03

COASTAL GASLINK OPERATING SCHEMATIC

SCALE N.T.S. | DWG# 4703-03-LA-OS-001 | REV 03A

TC_B1_CGL.DWG 707X1000

CADD DRAWING: DO NOT MAKE MANUAL REVISIONS



THE SEAL AND SIGNATURE OF THE UNDERSIGNED ON THIS DRAWING CERTIFIES THAT THE DESIGN INFORMATION CONTAINED IN THESE DRAWINGS ACCURATELY REFLECTS THE ORIGINAL DESIGN AND THE MATERIAL DESIGN CHANGES MADE DURING CONSTRUCTION THAT WERE BROUGHT TO THE UNDERSIGNED'S ATTENTION. THESE DRAWINGS ARE INTENDED TO INCORPORATE ADDENDA, CHANGE ORDERS, AND OTHER MATERIAL DESIGN CHANGES, BUT NOT NECESSARILY ALL SITE INSTRUCTIONS.

THE UNDERSIGNED DOES NOT WARRANT OR GUARANTEE, NOR ACCEPT ANY RESPONSIBILITY FOR, THE ACCURACY OR COMPLETENESS OF THE AS-CONSTRUCTED INFORMATION SUPPLIED BY OTHERS CONTAINED IN THE DRAWINGS, BUT DOES, BY SEALING AND SIGNING, CERTIFY THAT THE AS-CONSTRUCTED INFORMATION, IF ACCURATE AND COMPLETE, PROVIDES AN AS-CONSTRUCTED SYSTEM WHICH SUBSTANTIALLY COMPLIES IN ALL MATERIAL RESPECTS WITH THE ORIGINAL DESIGN INTENT.

1. SWEET NATURAL GAS SERVICE. MAX LICENSED H_2S 20ppm.
2. MAXIMUM OPERATING PRESSURE 13,375 kPa(g).
3. PIPELINE WAS DESIGNED, CONSTRUCTED, AND TESTED CONSIDERING CLASS LOCATION BOUNDARIES THAT REFLECT ANTICIPATED FUTURE DEVELOPMENT. UNLESS OTHERWISE NOTED, LOCATION CLASSES LISTED REFLECT THIS AS-CONSTRUCTED CLASS. CURRENT CALCULATED CLASS IS NOT SHOWN AND IS DETERMINED ACCORDING TO THE COMPANY'S INTEGRITY MANAGEMENT PLAN.
4. PIPELINE, PIPELINE ASSEMBLIES, AND FACILITIES ARE DESIGNED, CONSTRUCTED, AND TESTED TO LOCATION CLASS 1 EXCEPT WHERE NOTED. LINE PIPE (GENERAL) SPECIFICATION (LEAST WALL THICKNESS).
   - CLASS 1: NPS 48 x 18.5mmwt x Gr. 550, DSAW, CSA Z245.1 CAT II M5C
   - CLASS 2: NPS 48 x 20.6mmwt x Gr. 550, DSAW, CSA Z245.1 CAT II M5C
   - CLASS 3: NPS 48 x 26.5mmwt x Gr. 550, DSAW, CSA Z245.1 CAT II M5C
5. ALL INTERMEDIATE MAINLINE BLOCK VALVES ARE NON-TELEMETERED.
6. ALL MAINLINE BLOCK VALVES AT FUTURE COMPRESSOR STATIONS INCLUDE TELEMETRY FOR UPSTREAM AND DOWNSTREAM PRESSURE.

REFERENCE DRAWINGS

DRAWING No	TITLE
4703-03-LA-OS-001	COASTAL GAS LINK OPERATING SCHEMATIC
4703-03-LA-OS-003	COASTAL GAS LINK OPERATING SCHEMATIC

REVISION / APPROVAL

REV No	DATE	DESCRIPTION	PROJECT CODE	DRAFTER	DRAFTING CHECKER	DESIGNER	DESIGN CHECKER	PROJECT MANAGER	COMPANY
00	2015-03-02	ISSUED FOR BID	2207464/2207465	DD					STANTEC
01	2017-07-05	RE-ISSUED FOR BID	2207464/2207465	JS					TRANSCANADA
02	2020-08-28	ISSUED FOR CONSTRUCTION	M.000955	ET	DS	JW	SF	JW	TC ENERGY
03	2024-05-09	ISSUED FOR RECORD	M.000955	DS	JL	JWW	CH	JW	TC ENERGY
03A	2025-03-04	ISSUED FOR PERMIT	M.002347	DS	JL	SF	SM	CC	TC ENERGY

PROFESSIONAL ENGINEER/RPT | PERMIT/ ENG. APPROVAL | DATE

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — 50385 — 2025-03-20

EGBC Permit to Practice #1001012

REV. NO. | DATE | PERMIT NUMBER:

Coastal GasLink

GENERAL INFORMATION – COASTAL GASLINK PIPELINE PROJECT

FLOC# 4703 | ENG STATION: | DISC# 03

COASTAL GASLINK OPERATING SCHEMATIC

SCALE N.T.S. | DWG# 4703-03-LA-OS-002 | REV 03A

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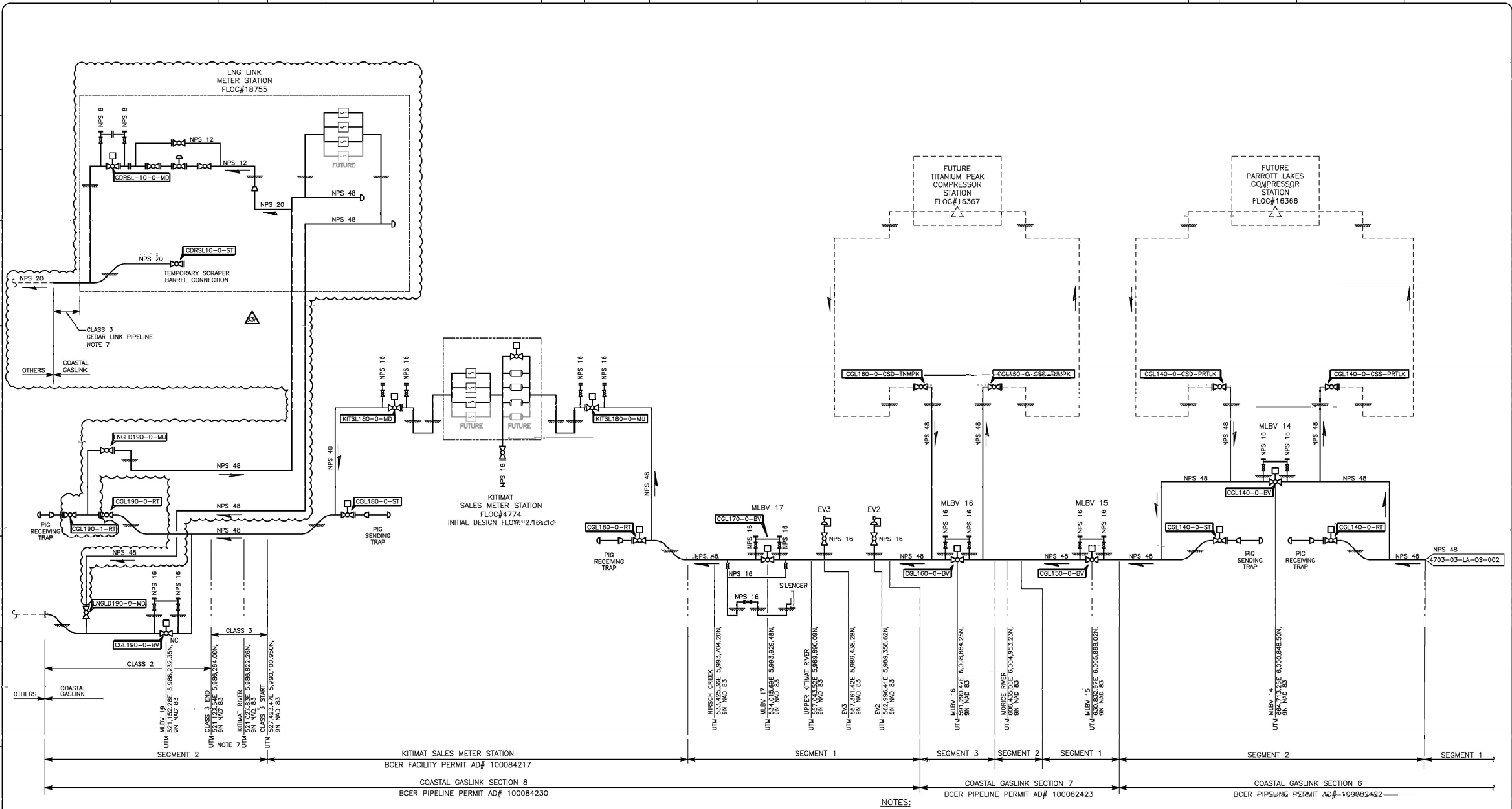

NOTES:

1. SWEET NATURAL GAS SERVICE. MAX LICENSED H2S 20ppm.
2. MAXIMUM OPERATING PRESSURE 13,375 kPa(g).
3. PIPELINE WAS DESIGNED, CONSTRUCTED, AND TESTED CONSIDERING CLASS LOCATION BOUNDARIES THAT REFLECT ANTICIPATED FUTURE DEVELOPMENT. UNLESS OTHERWISE NOTED, LOCATION CLASSES LISTED REFLECT THIS AS-CONSTRUCTED CLASS. CURRENT CALCULATED CLASS IS NOT SHOWN AND IS DETERMINED ACCORDING TO THE COMPANY'S INTEGRITY MANAGEMENT PLAN.
4. PIPELINE, PIPELINE ASSEMBLIES, AND FACILITIES ARE DESIGNED, CONSTRUCTED, AND TESTED TO LOCATION CLASS 1 EXCEPT WHERE NOTED. LINE PIPE (GENERAL) SPECIFICATION (LEAST WALL THICKNESS):
   - CLASS 1: NPS 48 x 18.5mmwt x Gr. 550, DSAW, CSA Z245.1 CAT II M5C
   - CLASS 2: NPS 48 x 20.6mmwt x Gr. 550, DSAW, CSA Z245.1 CAT II M5C
   - CLASS 3: NPS 48 x 26.5mmwt x Gr. 550, DSAW, CSA Z245.1 CAT II M5C
   - CLASS 3 (CEDAR LINK PIPELINE): NPS 20 x 15.1mmwt x Gr. 483, DSAW, CSA Z245.1 CAT II M45C
5. ALL INTERMEDIATE MAINLINE BLOCK VALVES ARE NON-TELEMETERED.
6. ALL MAINLINE BLOCK VALVES AT FUTURE COMPRESSOR STATIONS INCLUDE TELEMETRY FOR UPSTREAM AND DOWNSTREAM PRESSURE.
7. END OF CLASS 3 CALCULATED BASED ON DISTANCE FROM OCCUPIED BUILDINGS.

THE SEAL AND SIGNATURE OF THE UNDERSIGNED ON THIS DRAWING CERTIFIES THAT THE DESIGN INFORMATION CONTAINED IN THESE DRAWINGS ACCURATELY REFLECTS THE ORIGINAL DESIGN AND THE MATERIAL DESIGN CHANGES MADE DURING CONSTRUCTION THAT WERE BROUGHT TO THE UNDERSIGNED'S ATTENTION. THESE DRAWINGS ARE INTENDED TO INCORPORATE ADDENDA, CHANGE ORDERS, AND OTHER MATERIAL DESIGN CHANGES, BUT NOT NECESSARILY ALL SITE INSTRUCTIONS.

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REFERENCE DRAWINGS

DRAWING No	TITLE
4703-03-LA-OS-002	COASTAL GAS LINK OPERATING SCHEMATIC

REVISION

REV No	DATE	DESCRIPTION	PROJECT CODE	DRAFTER	DRAFTING CHECKER	DESIGNER	DESIGN CHECKER	PROJECT MANAGER	COMPANY
00	2015-03-02	ISSUED FOR BID	2207484/2207465	DD					STANTEC
01	2017-07-05	RE-ISSUED FOR BID	2207484/2207465	JS					TRANSCANADA
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03	2024-05-09	ISSUED FOR RECORD	M.000955	DS	JL	JWW	CH	JW	TC ENERGY
03A	2025-03-04	ISSUED FOR PERMIT	M.002347	DS	JL	SF	SM	CC	TC ENERGY

PROFESSIONAL ENGINEER/RPT | PERMIT/ ENG. APPROVAL | DATE

2025-03-20

EGBC Permit to Practice #1001012

REV. NO. | DATE | PERMIT NUMBER:

Coastal GasLink

GENERAL INFORMATION – COASTAL GASLINK PIPELINE PROJECT

FLOC# 4703 | ENG STATION: | DISC# 03

COASTAL GASLINK
OPERATING SCHEMATIC

SCALE N.T.S. | DWG# 4703-03-LA-OS-003 | REV 03A

TC_B1_CGL.DWG 707X1000

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CGC16362-STC-EN-RPRT-0002 Rev 0 IFU

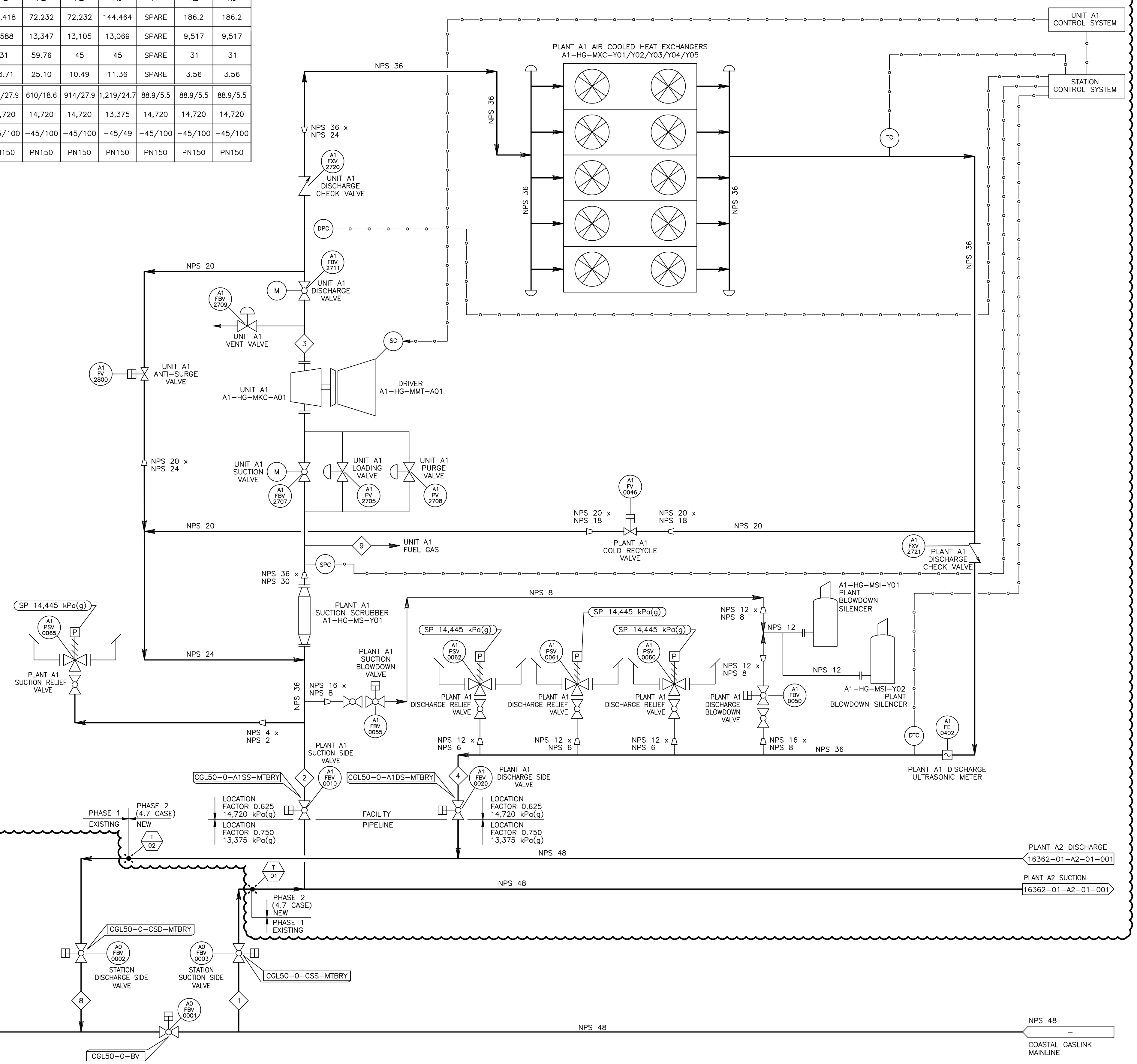
Appendix B Process Flow Diagrams for Coastal GasLink

	1	2	3	4	5	6	7	8	9	10	11
UNIT	A0	A1	A1	A1	A2	A2	A2	A0	A1	A2	A3
4.7 bcf/d FLOW RATE (E3 Sm ^{3}/day)	144,836	SPARE	SPARE	SPARE	72,418	72,232	72,232	144,464	SPARE	186.2	186.2
4.7 bcf/d OPERATING PRESSURE kPa(g)	9,635	SPARE	SPARE	SPARE	9,588	13,347	13,105	13,069	SPARE	9,517	9,517
4.7 bcf/d OPERATING TEMPERATURE (°C)	31	SPARE	SPARE	SPARE	31	59.76	45	45	SPARE	31	31
4.7 bcf/d VELOCITY (m/s @ OPER. P&T)	14.70	SPARE	SPARE	SPARE	13.71	25.10	10.49	11.36	SPARE	3.56	3.56
PIPE SIZE/WALL THICKNESS (mm/mm)	1,219/24.7	914/27.9	610/18.6	914/27.9	914/27.9	610/18.6	914/27.9	1,219/24.7	88.9/5.5	88.9/5.5	88.9/5.5
DESIGN PRESSURE kPa(g)	13,375	14,720	14,720	14,720	14,720	14,720	14,720	13,375	14,720	14,720	14,720
DESIGN TEMPERATURE (°C)	−45/49	−45/100	−45/100	−45/100	−45/100	−45/100	−45/100	−45/49	−45/100	−45/100	−45/100
PRESSURE CLASS	PN150	PN150	PN150	PN150	PN150	PN150	PN150	PN150	PN150	PN150	PN150

	12	13	14
UNIT	A3	A3	A3
4.7 bcf/d FLOW RATE (E3 Sm ^{3}/day)	72,418	72,232	72,232
4.7 bcf/d OPERATING PRESSURE kPa(g)	9,588	13,347	13,105
4.7 bcf/d OPERATING TEMPERATURE (°C)	31	59.76	45
4.7 bcf/d VELOCITY (m/s @ OPER. P&T)	13.71	25.1	10.49
PIPE SIZE/WALL THICKNESS (mm/mm)	914/27.9	610/18.6	914/27.9
DESIGN PRESSURE kPa(g)	14,720	14,720	14,720
DESIGN TEMPERATURE (°C)	−45/100	−45/100	−45/100
PRESSURE CLASS	PN150	PN150	PN150

NATURAL GAS COMPOSITION

COMPONENT	LEAN GAS MOL %	RICH GAS MOL %
NITROGEN	1.301	0.310
HELIUM	0.000	0.000
CARBON DIOXIDE	0.431	0.210
METHANE	95.891	90.811
ETHANE	1.739	5.962
PROPANE	0.421	1.714
ISO−BUTANE	0.066	0.347
n−BUTANE	0.083	0.347
ISO−PENTANE	0.022	0.087
n−PENTANE	0.017	0.087
HEXANE	0.029	0.070
HEPTANE	0.000	0.055
TOTAL:	100.00	100.00
MOLECULAR WEIGHT (g/MOL):	16.79	17.94
SPECIFIC GRAVITY (AIR=1.0):	0.580	0.619



NOTES:

SYSTEM: GAS PIPELINE

NPS 48 COASTAL GASLINK MAINLINE
DESIGN PRESSURE: 13,375 kPa(g)
DESIGN TEMPERATURE: −45°C/49°C

DESIGN CODE: CSA−Z662−23 (ALL PIPE SIZES)
TEST TYPE/PRESSURE: HYDROSTATIC MAXIMUM: 17,500 kPa(g)
MINIMUM: 16,800 kPa(g)

SYSTEM: HIGH PRESSURE GAS

NPS 36 COASTAL GASLINK MOUNT BRACEY COMPRESSOR STATION
DESIGN PRESSURE: 14,720 kPa(g)
DESIGN TEMPERATURE: −45°C/100°C

DESIGN CODE: CSA−Z662−23 (ALL PIPE SIZES)
PROTECTION: A1−PSV−0060 SP=14,445 kPa(g)
A1−PSV−0061 SP=14,445 kPa(g)
A1−PSV−0062 SP=14,445 kPa(g)
A1−PSV−0065 SP=14,445 kPa(g)
TEST TYPE/PRESSURE: HYDROSTATIC MAXIMUM: 22,800 kPa(g)
MINIMUM: 22,100 kPa(g)

GENERAL NOTES:

1. FLOW RATES AND TEMPERATURE PARAMETERS FROM TRANSCANADA FACILITY ENGINEERING DATASHEET CGX4703−CGP−M−DS−0002 REV 8 (2023−03−10), AND MOUNT BRACEY TEMPERATURE UPDATE MEMO CGC16362−CGP−ENG−MEM−0001 (2023−10−23).
2. FLOW TABLE REPRESENTS AVERAGE WINTER CAPACITY DESIGN CASE USING THE LEAN GAS COMPOSITION.

CONTROL MODE LEGEND:

DTC − DISCHARGE TEMPERATURE CONTROL (UNIT SPEED CONTROL)
DPC − DISCHARGE PRESSURE CONTROL
SPC − SUCTION PRESSURE CONTROL
SC − SPEED CONTROL
TC − TEMPERATURE CONTROL (COOLER FAN CONTROL)

LEGEND:

PIPING
SOFTWARE
PHASE 2 (4.7 CASE)

REFERENCE DRAWINGS

DRAWING No	TITLE
STDS(CGL)−01−00−00−005	PIPING SYMBOLS AND LEGEND SHEET 1
STDS(CGL)−01−00−00−006	PIPING SYMBOLS AND LEGEND SHEET 2
16362−01−A2−01−001	PLANT A2 PROCESS FLOW DIAGRAM
16362−01−A3−01−001	PLANT A3 PROCESS FLOW DIAGRAM

REVISION / APPROVAL

REV No	DATE	DESCRIPTION	PROJECT CODE	DRAFTER	DRAFTING CHECKER	DESIGNER	DESIGN CHECKER	PROJECT MANAGER	COMPANY
00	2020−09−18	ISSUED FOR CONSTRUCTION − PHASE 2 (4.7 CASE)	M.000987	DS	RD	MB	DF	JM	STANTEC
01	2023−03−20	RE−ISSUED FOR CONSTRUCTION − POST IFC UPDATES	M.000987	DS	SC	WRP	MRB	LY	STANTEC
02	2024−04−16	RE−ISSUED FOR CONSTRUCTION − DESIGN ENHANCEMENTS	M.000987	MP	SC	[signature]	MRB	[signature]	STANTEC

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PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA M. R. BAILEY # 49800
Stantec Permit #1002862
Apr. 18 2024

REV. NO. | DATE | PERMIT NUMBER:

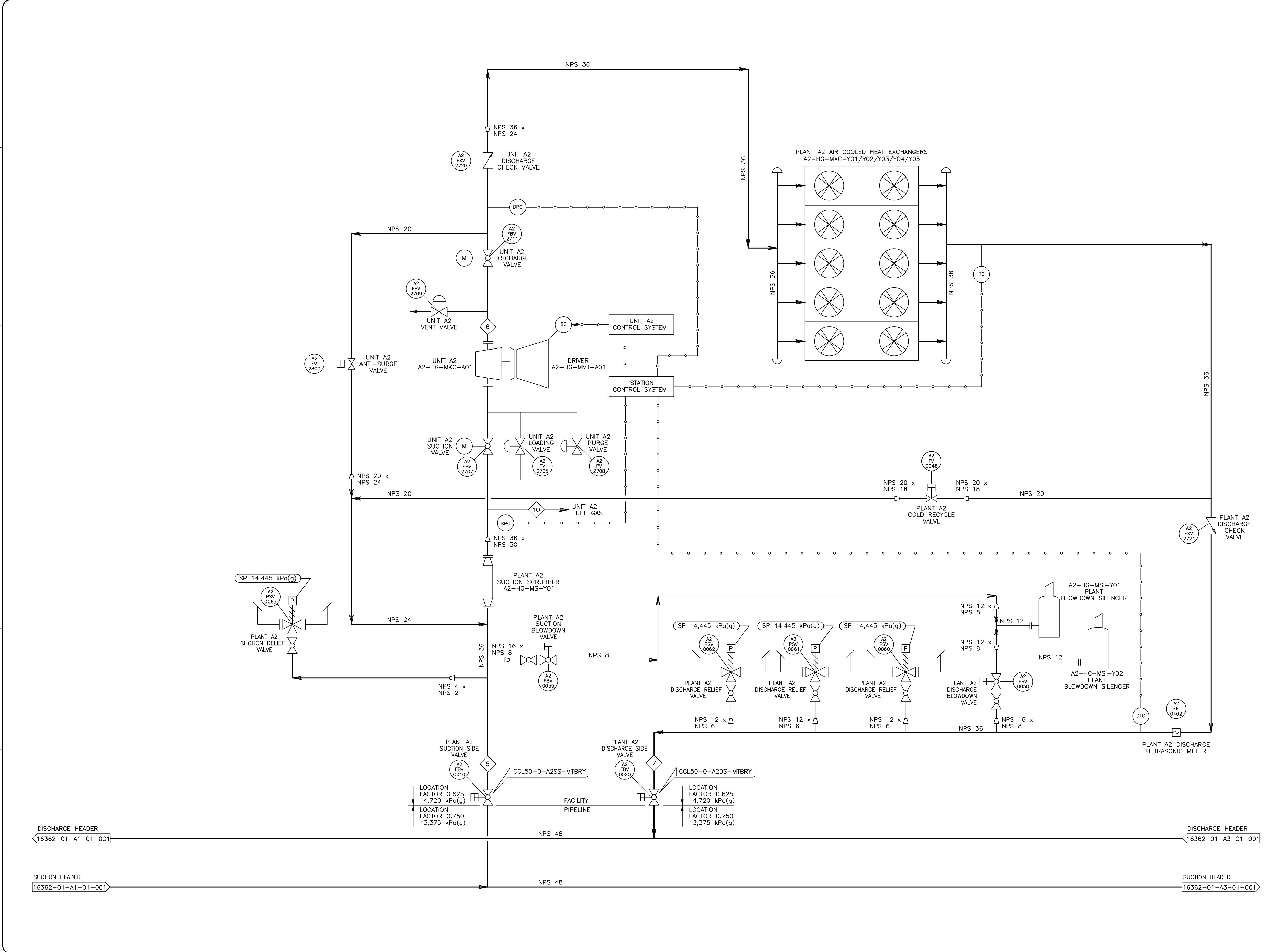
Coastal GasLink

MOUNT BRACEY COMPRESSOR STATION

FLOC# 16362 | ENG STATION: | DISC# 01

PLANT A1
PROCESS FLOW DIAGRAM

SCALE N.T.S. | DWG# 16362−01−A1−01−001 | REV 02



NOTES:

SYSTEM: GAS PIPELINE

NPS 48 COASTAL GASLINK MAINLINE
DESIGN PRESSURE: 13,375 kPa(g)
DESIGN TEMPERATURE: –45°C/49°C (02)

DESIGN CODE: CSA–Z662–23 (ALL PIPE SIZES)
TEST TYPE/PRESSURE: HYDROSTATIC MAXIMUM: 17,500 kPa(g)
MINIMUM: 16,800 kPa(g)

SYSTEM: HIGH PRESSURE GAS

NPS 36 COASTAL GASLINK MOUNT BRACEY COMPRESSOR STATION
DESIGN PRESSURE: 14,720 kPa(g)
DESIGN TEMPERATURE: –45°C/100°C (02)

DESIGN CODE: CSA–Z662–23 (ALL PIPE SIZES)
PROTECTION: A2–PSV–0060 SP=14,445 kPa(g)
A2–PSV–0061 SP=14,445 kPa(g)
A2–PSV–0062 SP=14,445 kPa(g)
A2–PSV–0065 SP=14,445 kPa(g)
TEST TYPE/PRESSURE: HYDROSTATIC MAXIMUM: 22,800 kPa(g)
MINIMUM: 22,100 kPa(g)

CONTROL MODE LEGEND:

DTC – DISCHARGE TEMPERATURE CONTROL (UNIT SPEED CONTROL)
DPC – DISCHARGE PRESSURE CONTROL
SPC – SUCTION PRESSURE CONTROL
SC – SPEED CONTROL
TC – TEMPERATURE CONTROL (COOLER FAN CONTROL)

LEGEND:

PIPING
SOFTWARE

REFERENCE DRAWINGS

DRAWING No	TITLE
STDS(CGL)–01–00–00–005	PIPING SYMBOLS AND LEGEND SHEET 1
STDS(CGL)–01–00–00–006	PIPING SYMBOLS AND LEGEND SHEET 2
16362–01–A1–01–001	PLANT A1 PROCESS FLOW DIAGRAM
16362–01–A3–01–001	PLANT A3 PROCESS FLOW DIAGRAM

REVISION			APPROVAL							
REV No	DATE	DESCRIPTION	PROJECT CODE	DRAFTER	DRAFTING CHECKER	DESIGNER	DESIGN CHECKER	PROJECT MANAGER	COMPANY
00	2020–09–18	ISSUED FOR CONSTRUCTION – PHASE 2 (4.7 CASE)	M.000987	DS	RD	MB	DF	JM	STANTEC
01	2023–03–20	RE–ISSUED FOR CONSTRUCTION – POST IFC UPDATES	M.000987	DS	SC	WRP	MRB	LY	STANTEC
02	2024–04–16	RE–ISSUED FOR CONSTRUCTION – DESIGN ENHANCEMENTS	M.000987	MP	SC	WRP	MRB	[signature]	STANTEC

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PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA M. R. BAILEY # 49800
Stantec Permit #1002862
Apr. 18 2024

REV. NO. | DATE | PERMIT NUMBER:

Coastal GasLink

MOUNT BRACEY COMPRESSOR STATION

FLOC# 16362 | ENG STATION: | DISC# 01

PLANT A2 PROCESS FLOW DIAGRAM

SCALE N.T.S. | DWG# 16362–01–A2–01–001 | REV 02

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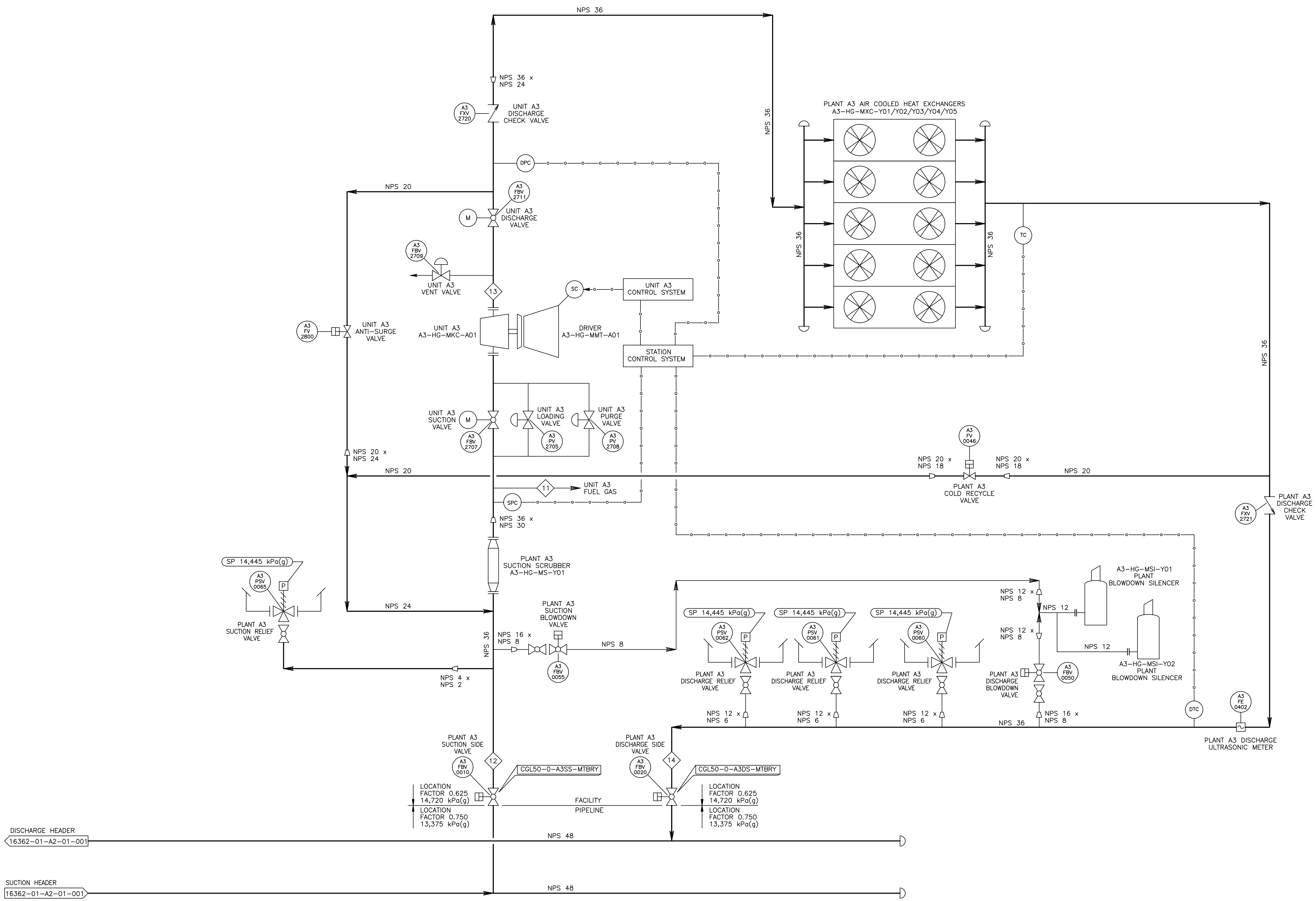

NOTES:

SYSTEM: GAS PIPELINE

NPS 48 COASTAL GASLINK MAINLINE
DESIGN PRESSURE: 13,375 kPa(g)
DESIGN TEMPERATURE: −45°C/49°C (02)

DESIGN CODE: CSA-Z662-23 (ALL PIPE SIZES)
TEST TYPE/PRESSURE: HYDROSTATIC MAXIMUM: 17,500 kPa(g)
MINIMUM: 16,800 kPa(g)

SYSTEM: HIGH PRESSURE GAS

NPS 36 COASTAL GASLINK MOUNT BRACEY COMPRESSOR STATION
DESIGN PRESSURE: 14,720 kPa(g)
DESIGN TEMPERATURE: −45°C/100°C (02)

DESIGN CODE: CSA-Z662-23 (ALL PIPE SIZES)
PROTECTION: A3-PSV-0060 SP=14,445 kPa(g)
A3-PSV-0061 SP=14,445 kPa(g)
A3-PSV-0062 SP=14,445 kPa(g)
A3-PSV-0065 SP=14,445 kPa(g)
TEST TYPE/PRESSURE: HYDROSTATIC MAXIMUM: 22,800 kPa(g)
MINIMUM: 22,100 kPa(g)

CONTROL MODE LEGEND:

DTC – DISCHARGE TEMPERATURE CONTROL (UNIT SPEED CONTROL)
DPC – DISCHARGE PRESSURE CONTROL
SPC – SUCTION PRESSURE CONTROL
SC – SPEED CONTROL
TC – TEMPERATURE CONTROL (COOLER FAN CONTROL)

LEGEND:

PIPING
SOFTWARE

REFERENCE DRAWINGS

DRAWING No	TITLE
STDS(CGL)-01-00-00-005	PIPING SYMBOLS AND LEGEND SHEET 1
STDS(CGL)-01-00-00-006	PIPING SYMBOLS AND LEGEND SHEET 2
16362-01-A2-01-001	PLANT A2 PROCESS FLOW DIAGRAM

REV No	DATE	DESCRIPTION	PROJECT CODE	DRAFTER	DRAFTING CHECKER	DESIGNER	DESIGN CHECKER	PROJECT MANAGER	COMPANY
00	2020-09-18	ISSUED FOR CONSTRUCTION – PHASE 2 (4.7 CASE)	M.000987	DS	RD	MB	DF	JM	STANTEC
01	2023-03-20	RE-ISSUED FOR CONSTRUCTION – POST IFC UPDATES	M.000987	DS	SC	WRP	MRB	LY	STANTEC
02	2024-04-16	RE-ISSUED FOR CONSTRUCTION – DESIGN ENHANCEMENTS	M.000987	MP	SC	[signature]	[signature]	[signature]	STANTEC

PROFESSIONAL ENGINEER/RPT

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA M. R. BAILEY # 49800
Stantec Permit #1002862
Apr. 18 2024

PERMIT/ ENG. APPROVAL

DATE

REV. NO. | DATE | PERMIT NUMBER:

Coastal GasLink

MOUNT BRACEY COMPRESSOR STATION

FLOC# 16362 | ENG STATION: | DISC# 01

PLANT A3
PROCESS FLOW DIAGRAM

SCALE N.T.S. | DWG# 16362-01-A3-01-001 | REV 02

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Appendix C Air Quality Technical Data Report

Air Quality Technical Data Report for Cedar Link Project: Mount Bracey Compressor Station

June 16, 2025

Prepared for:
Coastal GasLink Pipeline Ltd.

Prepared by:
Stantec Consulting Ltd.

Project Number:
123515132

CGC16362-STC-EN-RPRT-0001
Rev 1
Issued for Use

Limitations and Sign-off

This document entitled Air Quality Technical Data Report for Cedar Link Project: Mount Bracey Compressor Station was prepared by Stantec Consulting Ltd. ("Stantec") for the account of Coastal GasLink Pipeline Ltd. (the "Client") to support the application to the British Columbia (BC) Energy Regulator (BCER) for a Waste Discharge Authorization (WDA) (the "Application") for the Mount Bracey Compressor Station (the "Project").

Prepared by: Chuen, Katie — Digitally signed by Chuen, Katie Date: 2025.06.16 15:10:39 -07'00'

Signature

Katie Chuen, B.Sc.
Environmental EIT

Printed Name and Title

Reviewed by:  Digitally signed by Hauk, April Date: 2025.06.16 15:01:16 -07'00'

Signature

April Hauk, B.Sc., EP
Air Quality Associate

Printed Name and Title

Approved by: Reid Allan Person -- P.Eng. - EGBC — Digitally signed by Reid Allan Person -- P.Eng. - EGBC Date: 2025.06.16 16:32:44 -06'00'

Signature

Reid Person, M.Eng.,
P.Eng.(AB,BC,SK)
Principal Air Quality Engineer

Printed Name and Title

Table of Contents

Limitations and Sign-off i

Acronyms / Abbreviations iv

1 Introduction 1
- 1.1 Project and Site Description 1

2 Methods 2
- 2.1 Study Area Boundaries 2
- 2.2 Level of Assessment 4
- 2.3 Applicable Objectives for Air Quality 4
- 2.4 Other Regulatory Criteria 6
- 2.5 Regional Atmospheric Conditions 6
  - 2.5.1 Climate and Meteorology 6
  - 2.5.2 Baseline Air Quality 7
- 2.6 Emission Inventory Overview 11
  - 2.6.1 Project-Alone Case 11
  - 2.6.2 Application Case 12
- 2.7 Dispersion Modelling Methodology 12
  - 2.7.1 Dispersion Model Selection 12
  - 2.7.2 Meteorology 13
  - 2.7.3 Modelling Domain, Receptors, Land Use, and Terrain 14
  - 2.7.4 Oxides of Nitrogen to Nitrogen Dioxide Conversion 15
  - 2.7.5 Secondary Particulate Formation and Particle Deposition 15
  - 2.7.6 Building Plume Downwash Effects 16

3 Results 18
- 3.1 Project-Alone Case 18
- 3.2 Application Case 19

4 Summary 21
- 4.1 Findings of the Project-Alone Case Modelling 21
- 4.2 Findings of the Application Case Modelling 21

5 Conclusions 22

6 References 23

List of Tables

Table 2.1 Applicable Air Quality Criteria 5
Table 2.2 Criteria from Other Jurisdictions (Critical Levels) 6
Table 2.3 Summary of Nearby Long-Term Monitoring Stations 8
Table 2.4 288-Value Array NO_2 Baseline Summary 9
Table 2.5 Summary of Baseline Consistent with the Guideline 10
Table 2.6 Project-Alone Case Emission Summary 12
Table 2.7 Equipment Specific and Emission Weighted In-Stack Ratios 15
Table 3.1 Project-Alone Case Dispersion Modelling Results for Compressor Station 18
Table 3.2 Application Case Dispersion Modelling Results for Compressor Station 20

List of Figures

Figure 2.1 Mount Bracey Compressor Station Location and Study Area 3
Figure 2.2 Mount Bracey Compressor Station CALMET Wind Rose 13
Figure 2.3 Mount Bracey Compressor Station Plot Plan 17

List of Appendices

Appendix A Model Plan

Appendix B CALMET

Appendix C CALPUFF

Appendix D Isopleth Maps

Appendix E Modelling Results using Ambient Ratio Method 2 (ARM 2)

Acronyms / Abbreviations

µg/m^3	microgram per cubic metre
AQO	Air Quality Objective
ARM2	Ambient Ratio Method 2
BC	British Columbia
BC ENV	British Columbia Ministry of Environment and Climate Change Strategy
bcf/d	billion cubic feet per day
°C	degrees Celsius
CAAQS	Canadian Ambient Air Quality Standards
CAC	criteria air contaminant
CCME	Canadian Council of Ministers of Environment
CER	Canadian Energy Regulator
CGL	Coastal GasLink
cm	centimetres
CO	carbon monoxide
ECCC	Environment and Climate Change Canada
K	Kelvin
km	kilometre
KP	Kilometre post
kW	kilowatt
m	metre
m/s	metres per second
m asl	metres above sea level
m E	Easting (metres)

MMscf	million standard curbic feet
m N	Northing (metres)
NAD83	North American Datum of 1983
NO_2	nitrogen dioxide
NOx	oxides of nitrogen
OLM	ozone limiting method
$PM_{2.5}$	fine particulate matter
SO_2	sulphur dioxide
t/y	tonnes per year
$\mu g/m^3$	microgram per cubic metre
U.S.	United States
U.S. EPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
TDR	Technical data report
WDA	Waste Discharge Authorization
WRF	Weather Research and Forecasting Model

1 Introduction

Coastal GasLink Pipeline Ltd. (CGL) retained Stantec Consulting Ltd. (Stantec) to conduct air dispersion modelling and prepare a technical data report to support the application to the British Columbia (BC) Energy Regulator (BCER) for a Waste Discharge Authorization (WDA) for the Mount Bracey Compressor Station (CS) (the Project).

This technical data report (TDR) provides details on the methods and results of the air quality dispersion modelling and evaluates changes in air quality associated with the emissions from the Project.

1.1 Project and Site Description

CGL constructed and will operate a natural gas pipeline (the CGL pipeline) from the area near the community of Groundbirch (approximately 40 km west of Dawson Creek, British Columbia [BC]) to the LNG Canada Development Inc. (LNG Canada) liquified natural gas (LNG) export facility (LNG Canada export facility) near Kitimat, BC. CGL will leverage this existing infrastructure with the construction of the Cedar Link Project; a connector pipeline, a meter station and a new compressor station (Mount Bracey) to enable the delivery of an additional 0.4 billion cubic feet per day (bcf/day) of natural gas from the CGL pipeline to the Cedar LNG Project, a proposed floating LNG facility in Kitimat, BC.

The Mount Bracey CS is located at the CGL pipeline Kilometer Post (KP) 163 in the Regional District of Fraser - Fort George (Figure 2.1). Construction of the Project commenced in 2024 and will be in service in 2028.

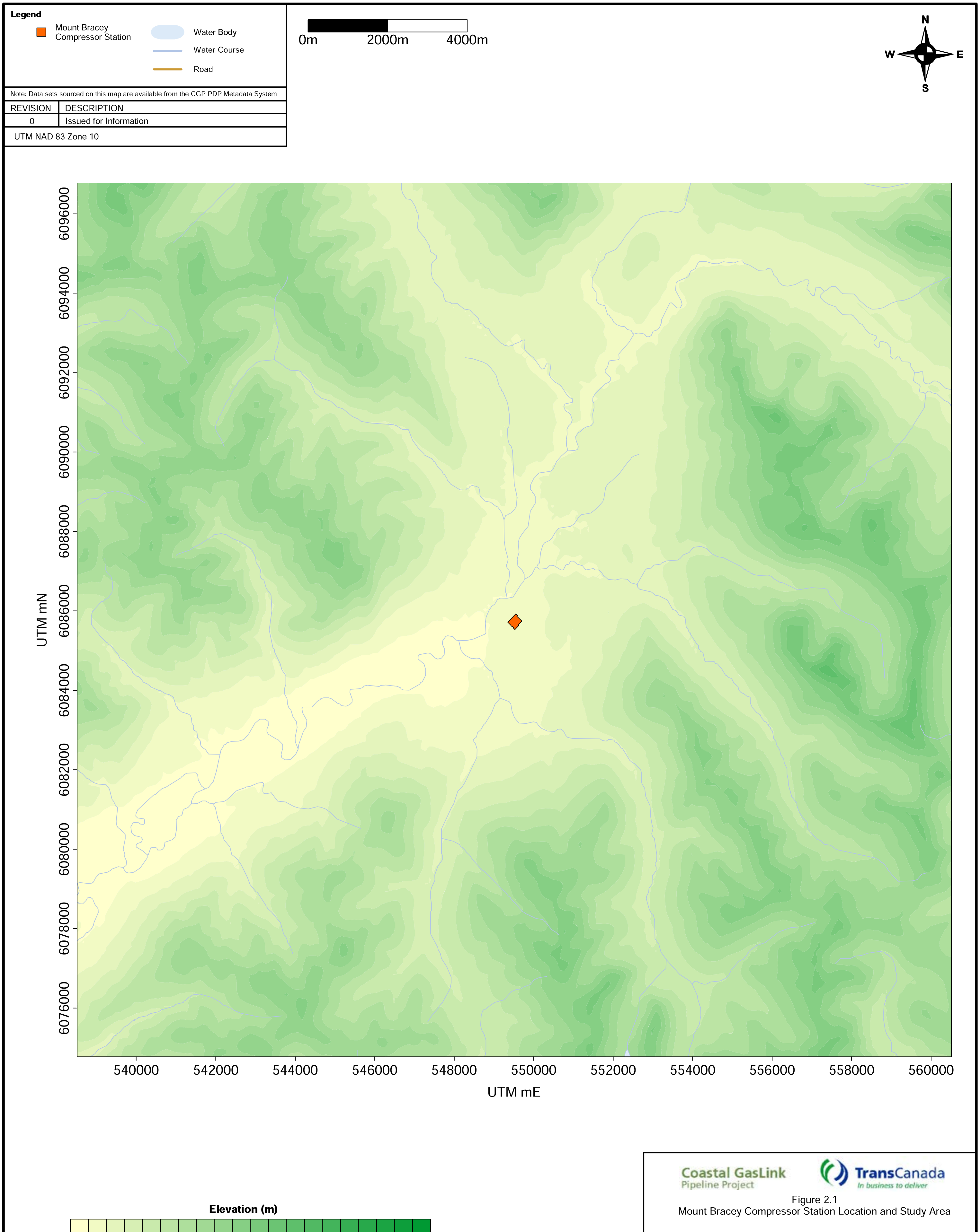
2 Methods

2.1 Study Area Boundaries

The local and regional study areas presented in this TDR represent the areas covered by the air quality dispersion modelling assessment. This assessment allows for an understanding of the environment in support of the Project-specific effects assessment and the cumulative effects assessment. This includes study of both existing air quality and the predicted effects of the Project plus operation of foreseeably planned and approved regional projects.

The dispersion of emissions from the Project are dictated by local meteorology, which is influenced by the surrounding complex terrain. There is a combined local and regional study area for the purposes of this air quality assessment. This area is hereafter referred to as the study area. The Project is located in BC's Interior Plateau, near the Anzac River, approximately 25 km to the northeast of the community of Anzac, BC. The dominant land cover in this rural remote region is evergreen forest, with some deciduous forest. Evergreen forest dominates in the immediate vicinity of the Mount Bracey CS. Terrain in the region is complex ranging from approximately 700 to over 2,400 m above sea level (asl). Higher terrain occurs near the northeast and lower terrain to the southwest. The Universal Transverse Mercator (UTM) coordinates of the Project center is 549,576 m E and 6,085,740 m N, Zone 10 (NAD 83). The facility is located approximately 838 m asl.

The study area for the Mount Bracy CS is defined by a 22 km by 22 km CALPUFF modelling domain selected to assess the potential effects of emissions from the Project on the surrounding air quality. Figure 2.1 illustrates the study area and the local terrain in the domain. The modelling domain (study area) capture the most important Project-related effects, including locations where predicted concentrations decrease to approximately 10%, or less, of the British Columbia Air Quality Objectives (AQOs) on a Project-alone basis (see Section 3.1).



Coastal GasLink Pipeline Project

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Figure 2.1
Mount Bracey Compressor Station Location and Study Area

February 2025

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2.2 Level of Assessment

The British Columbia Ministry of Environment and Climate Change Strategy (BC ENV) Air Quality Dispersion Modelling Guideline (Guideline) (BC ENV, 2022a) defines three levels of air quality assessment that vary in the degree of detail and scope. Sections 1.5 and 2.2 of the Guideline (BC ENV, 2022a) indicate that a Level 3 modelling assessment using the CALPUFF modelling system is appropriate for modelling air emissions associated with the Project due to the wind flow in the region and multiple emission sources. Dispersion modelling methods for this assessment followed the Guideline (BC ENV, 2022a).

2.3 Applicable Objectives for Air Quality

Effects on air quality are determined, in part, by comparing predicted concentrations of criteria air contaminants (CACs) to the Air Quality Objectives (AQOs). The AQOs are a suite of ambient air quality criteria that have been developed provincially and nationally to inform decisions on the management of air contaminants (BC ENV, 2021a). The AQOs are used to gauge current and historical air quality and guide decisions on environmental impact assessments and authorizations. In British Columbia, the BC ENV have stated that the British Columbia AQOs are applicable beyond the facility fenceline (BC ENV, 2020); (BC ENV, 2016). Where exceedances of the AQO are predicted through dispersion modelling, the BC ENV considers the context of magnitude, frequency, timing, and proximity to sensitive receptors. Should there be exceedances of the AQO, the BC ENV would manage these in accordance with the federal Air Zone Management Framework (Canadian Council of Ministers of Environment (CCME, 2019)) for improvements in air quality across the affected area and would include all important sources (BC ENV, 2020).

The CACs considered in this assessment as the key pollutants emitted to the atmosphere at the Mount Bracey CS are nitrogen dioxide (NO_2), fine particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), sulphur dioxide (SO_2) and carbon monoxide (CO). The applicable regulatory criteria for the CACs are shown in Table 2.1.

The BC AQOs for NO_2 are based on the Canadian Ambient Air Quality Standards (CAAQS), announced by the Government of Canada in 2017 (Canadian Environmental Protection Act (CEPA), 2017) for the year 2020. The CCME (CCME, 2019) has stated that achievement of the CAAQS is determined on an airshed and air zone basis using air quality monitoring data over broad geographical areas. The CAAQS were not developed to be applied to determine the acceptability of individual projects and facilities and were not developed to be used as fenceline 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)).

British Columbia ENV has not stated if the 2025 CAAQS will be adopted as BC AQOs. Regulatory agencies have expressed an interest in referencing objectives other than the AQO in assessments. Specifically, they are interested in referencing the Canadian Ambient Air Quality Standards (CAAQS) for other years (CCME, 2021). The 2025 CAAQS are considered in this assessment for information purposes. Effects on air quality are evaluated using the BC AQO. The regulatory criteria for NO_2, $PM_{2.5}$, SO_2 and CO applicable to this assessment are shown in Table 2.1.

Table 2.1 Applicable Air Quality Criteria

CAC	Averaging Interval	AQO ($\mu g/m^3$) [a]	2025 CAAQS ($\mu g/m^3$) [b]
NO_2	1-hour	113[c]	79
	Annual	32[d]	23
$PM_{2.5}$	24-hour	25[e]	27
	Annual	8[f]	8.8
SO_2	1-hour	183[g]	170
	Annual	13[h]	11
CO	1-hour	14,300	-
	8-hour	5,500	-

Notes:

[a] BC ENV 2021a

[b] CCME 2021 (CCME, 2021). The other regulatory criteria are for the year 2025 for nitrogen dioxide (NO_2) and sulphur dioxide (SO_2), and 2020 for respirable particulate matter ($PM_{2.5}$). The statistical forms for each are the same as those for the AQO

[c] Achievement for 1-hour NO_2 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, and then the average of the three annual values.

[d] Achievement for annual NO_2 is based on the average of all 1-hour average concentrations over a single calendar year.

[e] Achievement for $PM_{2.5}$ is based on annual 98th percentile of daily average, average over one year

[f] Achievement for $PM_{2.5}$ is based on annual average, average over one year

[g] Achievement for 1-hour SO_2 is based on 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, and then the average of the three annual values.

[h] Achievement for SO_2 is based on the average of 1-hour concentrations averaged over one year

Source: BC ENV 2020

2.4 Other Regulatory Criteria

Other criteria important for assessment of potential air quality effects have been included. This assessment includes the critical levels listed in the International Cooperative Programme on Modelling and Mapping of Critical Levels and Loads and Air Pollution Effects, Risks and Trends (CLRTAP (Convention on Long-range Transboundary Air Pollution), 2004).

The critical levels employed in this assessment are presented in Table 2.2. They consider the annual average concentrations for NO_X. Note that the NO_X parameter is "NO_X as NO_2" ($NO_X = NO + NO_2$), and not NO_2 alone.

Table 2.2 Criteria from Other Jurisdictions (Critical Levels)

CAC	Averaging Interval	Critical Level (µg/m^3)	Vegetation Note
NO_X as NO_2	Annual	30	Protective of 95% of species at a 95% confidence level
Source: (CLRTAP (Convention on Long-range Transboundary Air Pollution), 2004)			

Should exceedances of the critical levels be predicted a suitable management and monitoring plan will be discussed in the Application.

2.5 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.

2.5.1 Climate and Meteorology

2.5.1.1 Climate

Climate is defined as the weather conditions prevailing in an area over a long-time interval. The regional climate of the study area is continental, with long cold winters and short warm summers. Annual average precipitation is low in the interior plains (GoC, 2015).

The climate of the Mount Bracey CS site is characterized using the 30-year Environment and Climate Change Canada (ECCC) Canadian Climate Normals (1991–2020) for Mackenzie (Composite) climate station (ECCC, 2024). The Mackenzie (Composite) climate station is comprised of three climate stations – Mackenzie Airport, Mackenzie and Mackenzie A. The long-term data from the Mackenzie (Composite) climate station, represents a combination of the data from the three climate stations that are joined together to create a 30-year (1991 to 2020) data series for this location. Canadian Climate Normals are calculated by the ECCC using the recommended methods for validity established by the World

Metrological Organization (WMO) (ECCC, 2023). The Mackenzie Airport, Mackenzie, and Mackenzie A climate stations are located approximately 72 km southwest of the Mount Bracey CS and their elevations range from 690 to 694 m asl.

2.5.1.1.1 Air Temperature

The daily average temperature in Mackenzie (Composite) is 3.2 degrees Celsius (°C). January is the coldest month, and July is the warmest (-9.8°C and 15.8°C, respectively, daily average temperature). Extreme temperatures vary from -45°C (January 26,1997) to 35.8°C (July 13, 2007).

2.5.1.1.2 Precipitation

The average annual precipitation in Mackenzie (Composite) is 608.7 millimetres (mm). November is the wettest month (70.3 mm), and April is the driest (29.1 mm). The extreme daily precipitation is 50.2 mm (June 9, 2017) and the extreme snow depth is 124 cm (February 28,1994).

2.5.1.2 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 (BC ENV, 2022a) requires the application of at least three years of meteorological data as input for dispersion modelling and recommends use of a BC ENV-supplied Weather Research and Forecasting (WRF) meteorological dataset. The WRF model allows for the dynamical spatial and temporal downscaling of reanalysis datasets to predict site-specific meteorological conditions more accurately. Hourly-averaged meteorological data from BC ENV were applied as input to CALMET and CALPUFF based on the WRF model output for the years 2011–2015, developed by Exponent (Exponent Inc., 2021). These meteorological data were used in dispersion modelling and are discussed in Section 2.7.2, and presented in detail in the CALMET Appendix (Appendix B).

2.5.2 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 understand the cumulative changes to air quality. This is especially important when comparing model predictions to the air quality objectives. The cumulative air quality is calculated by accounting for the contribution from all sources except the source or sources being modelled (called “baseline”) and adding that to the predicted increment from the Project.

The cumulative air quality is given by:

Cumulative = Baseline + Predicted Increment from the Project

The Guideline ((BC ENV, 2022a): Section 8.1) states that baseline may be determined from air quality monitoring data or may be estimated from modelling other 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
- Modelled baseline

In this work, baseline air quality is determined by monitoring data. The baseline values are derived from the most recent and representative years of ambient air quality data in BC ENV's annual summaries of British Columbia ambient air quality data (BC ENV, 2024a). Baseline concentrations for selected substances were established based on data from three existing monitoring stations that are considered representative of the Project study area.

A summary of the representative long-term monitoring station locations and CACs considered in the development of these values are provided in Table 2.3. The monitoring station selected for each parameter is the most representative location with respect to the Project.

Table 2.3 Summary of Nearby Long-Term Monitoring Stations

Monitoring Station	Elevation (m asl)	Location (UTM NAD83)			Data Period [a]	CACs Monitored			
		m E	M N	Zone		NO_2	SO_2	$PM_{2.5}$	CO
Blueberry First Nation School	675	616,089	6,285,782	10	6/23/2016 to 11/29/2017	x	-	-	-
Pine River Hasler	602	564,672	6,162,659	10	2021 to 2023	-	x	-	-
Peace Valley Attachie Flat Upper Terrace	480	597,982	6,232,937	10	2019 to 2021	-	-	x	-
Kamloops Brocklehurst	347	683,824	5,619,419	10	2010	-	-	-	x

Notes:
M asl = metres above sea level; UTM = Universal Transverse Mercator; NO_2 = nitrogen dioxide; SO_2 = sulphur dioxide; $PM_{2.5}$ = respirable particulate matter; CO = carbon monoxide
[a] Data periods for calculating baseline air quality

The Blueberry First Nation School monitoring data are derived from the most recent and representative years of ambient air quality data in BC ENV's annual summaries of British Columbia ambient air quality data (BC ENV, 2024a). The NO_2 Guidance (BC ENV, 2022b) provides three options to add baseline. Based on the emission sources at the Mount Bracey CS, the 288-value array was used to represent baseline (Table 2.4).

Table 2.4 288-Value Array NO_2 Baseline Summary

Hour of Day	NO_2 Baseline Value ($\mu g/m^3$)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	13.9	13.2	8.5	3.2	3.0	5.3	3.0	3.2	4.7	5.6	16.5	12.4
1	13.0	5.8	13.2	2.8	34.0	5.3	2.8	3.4	3.9	5.1	16.2	12.0
2	13.2	7.9	9.4	7.7	11.8	5.3	3.0	3.9	4.1	5.1	15.6	13.0
3	12.0	5.8	10.9	5.5	6.6	4.7	3.0	3.9	3.2	4.1	13.7	13.7
4	12.4	8.8	10.5	4.7	8.6	4.1	3.8	4.1	3.0	3.9	11.5	14.5
5	13.0	6.2	7.9	4.9	9.4	3.8	3.0	5.5	2.6	3.9	11.8	18.4
6	11.5	6.8	6.4	6.6	7.5	3.0	2.8	9.2	2.4	3.9	10.0	16.7
7	10.5	8.1	8.1	5.8	2.6	3.6	3.2	7.3	3.0	7.9	10.2	17.1
8	11.3	8.6	7.7	4.3	2.8	3.6	3.6	3.9	2.3	7.1	12.4	17.7
9	10.5	15.8	9.6	3.2	3.2	3.0	4.9	3.9	3.4	7.0	13.0	19.4
10	7.3	8.5	7.9	4.5	2.6	4.1	3.0	4.5	3.2	6.0	9.8	14.9
11	6.2	8.3	6.8	3.8	1.9	3.4	4.5	4.9	3.8	5.6	10.2	11.1
12	8.1	7.5	5.6	3.4	2.3	2.1	3.2	4.9	3.2	5.3	9.8	10.3
13	8.5	8.3	4.7	3.0	2.6	2.1	3.8	4.3	1.9	4.1	9.2	9.0
14	8.1	9.0	4.7	1.5	2.1	2.4	2.1	3.9	1.5	3.8	9.2	8.6
15	10.3	12.0	5.5	3.4	2.1	1.7	2.8	3.2	1.1	3.8	12.4	9.0
16	12.6	12.6	6.0	3.6	2.3	2.1	2.1	3.4	1.5	4.5	15.8	11.5
17	19.4	10.7	7.3	2.4	1.7	2.3	1.3	3.2	1.7	4.1	16.9	14.5
18	21.2	19.0	9.6	2.6	4.7	3.0	1.3	3.6	3.0	4.9	16.5	12.8
19	21.2	17.3	19.6	4.1	2.4	3.0	2.1	3.4	3.8	4.5	15.4	16.7
20	22.9	17.1	10.3	7.0	3.8	2.8	3.4	1.9	3.4	6.8	12.6	12.8
21	20.5	18.6	9.8	6.2	7.9	4.1	3.4	3.2	4.3	6.4	13.2	12.2
22	16.7	16.7	10.3	4.3	4.5	5.3	4.7	3.0	4.9	5.8	8.6	11.7
23	16.2	15.6	9.2	4.7	4.1	5.3	3.2	3.2	4.3	4.9	14.9	11.8

Notes:

Blueberry First Nation School monitoring data for 2016 to 2017 (BC ENV, 2024).

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

Table 2.5 summarizes high percentile baseline values consistent with section 8.1.4 of the Guideline (BC ENV, 2022a). With this approach, baseline is characterized as a large increment of measured values (i.e., 99th and 98th percentile of the daily one-hour maximum values for sulphur dioxide and nitrogen dioxide, respectively, the 98th percentile for other hourly and daily averages, and the mean values for annual averages). These values are expected to conservatively represent the greatest effects of all local industrial sources, natural background concentrations (globally and regionally), plus minor sources not modelled in the base case (local home heating, vehicle emissions, food preparation, and road dust).

Table 2.5 Summary of Baseline Consistent with the Guideline

CAC	Averaging Period	Baseline Concentration [a] ($\mu g/m^3$)
NO_2 [b]	1-hour [c]	16.6
	Annual [d]	2.1
SO_2 [e]	1-hour [f]	11.5
	Annual [g]	0.9
$PM_{2.5}$ [h]	24-hour [i]	18.6
	Annual [j]	4.5
CO [k]	1-hour [l]	515.2
	8-hour [l]	515.2

Notes:

a Baseline air quality data was developed by Stantec from BC Air Data Archive Website and British Columbia ENV 1998-2023 summary spreadsheets (BC ENV, 2024b). Conversions from ppb or ppm to $\mu g/m^3$ assume standard conditions of 25°C and 101.325 kPa.

b **NO_2:** The database for NO_2 observations used for baseline at Blueberry First Nation School are for 6/23/2016 to 11/28/2017.

c **NO_2:** The 1-hour baseline NO_2 concentration was determined based on the 98th percentile of the daily 1-hour maximum concentrations over for 2017 (BC ENV, 2024b). This value is provided here for characterizing existing conditions. Baseline NO_2 concentrations used for dispersion modelling are provided in the 288-value array in Table 2.4

d **NO_2:** The annual NO_2 baseline concentration was determined based on the average of 1-hour values between 6/23/2016 and 11/28/2017.

e **SO_2:** The British Columbia ENV summary database for SO_2 observations at Pine River Hasler are for 2021 - 2023.

f **SO_2:** The 1-hour baseline SO_2 concentration was determined based on the daily 1-hour maximum concentrations, followed by the calculation of the 99th percentile for each year, and then averaged over the 3-year period.

g **SO_2:** The annual SO_2 baseline concentration was determined based on the average of annual mean values for the 3-year period.

h **$PM_{2.5}$:** The British Columbia ENV summary database for $PM_{2.5}$ observations at Peace Valley Attachie Flat Upper Terrace are for 2019 - 2021.

i **$PM_{2.5}$:** The 24-hour $PM_{2.5}$ baseline concentration was determined based on average of the 98th percentile values for the 24 hour averaging interval over the 3-year period.

j **$PM_{2.5}$:** The annual $PM_{2.5}$ baseline concentration was determined based on the average of the annual mean values over the 3-year period.

k **CO:** The British Columbia ENV summary database for CO observations at Kamloops Brocklehurst is for 2010, which is the most recent year.

l **CO:** The 1-hour and 8-hour baseline CO concentrations were determined based on the 98th percentile of 1-hour CO concentrations for 2010.

2.6 Emission Inventory Overview

The dispersion modelling assessment considered two modelling scenarios:

Project-Alone Case: This modelling scenario includes two gas-fired turbines (compressor drivers), three gas-fired power generators, three seal gas combustors and six glycol heaters, all operating at emission rates consistent with full equipment capacity. Units designated as infrequent, backup or emergency equipment (i.e., one standby gas-fired turbine) will be depicted in the modelling exercise as not operating.

Application Case: This modelling scenario includes emissions from the Project-Alone Case plus the Baseline.

2.6.1 Project-Alone Case

The Project-Alone Case emission rates are based on the conservative assumption that the continuous operating sources at the Mount Bracey CS operate at their maximum rated capacity simultaneously. The Project will have a total of three gas-fired turbines, four gas-fired generators, six glycol heaters, and three seal gas vapour combustors. During normal operations, The Project-Alone Case modelling scenario includes emissions from two BHGE PGT25+ gas turbines, and three Waukesha gas generators, six glycol heaters, and three seal gas vapour combustors. One gas-fired turbine and one gas-fired generator are used as backup therefore are depicted as not operating in the model. Project-Alone Case emissions are summarized in Table 2.6.

The NO_X emission rate for the gas-fired turbines (25 ppm NO_X at 15% O_2) meet the requirements of the Canadian Guidelines for Reduction of Nitrogen Oxide Emissions for Natural Gas-fuelled Stationary Combustion Turbines (ECCC, 2017). For the gas fired generators, an emission rate of 1.0 g/kWh was used in the assessment, as provided by CGL. This is lower than the originally proposed 2.7 g/kWh in the modelling protocol, which was based on federal *Multi-Sector Air Pollutant Regulations* compliance limit. The 1.0 g/kWh rate more accurately represents the engines that will be installed at the site.

The NO_X emission rate for the glycol heaters is based on U.S. EPA AP-42 (1998) emission factor for small uncontrolled heaters (0.098 lb/MMBtu) (U.S. EPA, 1998). Based on the heat input capacity of the glycol heaters they are not required to meet emission limits for heaters under the *Multi-Sector Air Pollutant Regulations.*

Table 2.6 Project-Alone Case Emission Summary

Project-Alone Case	Emission Rate (t/y)			
	NO_X	SO_2	$PM_{2.5}$	CO
Two (2) Gas-Fired Turbines [a]	164.9	8.2	2.0	144.5
Six (6) Glycol Heaters	4.5	0.2	0.1	3.8
Three (3) Gas-Fired Generators	22.3	0.4	0.3	5.1
Three (3) Seal Gas Combustors	1.8	0.1	0.03	1.5
Project-Alone Case Total	193.5	8.8	2.4	154.9

Notes:
Sum of individual equipment may not add up to total due to rounding
[a] One gas-fired turbine and one generator are on standby are not included in total.

2.6.2 Application Case

The Application Case includes emissions from the Project-Alone Case plus the Baseline.

2.7 Dispersion Modelling Methodology

Effects of Project-operation CAC 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 (BC ENV, 2022a).

2.7.1 Dispersion Model Selection

Following the Guideline (BC ENV, 2022a) a Level 3-type assessment was conducted. The CALPUFF modelling system (J.S. Scire, 2000) used included the following components:

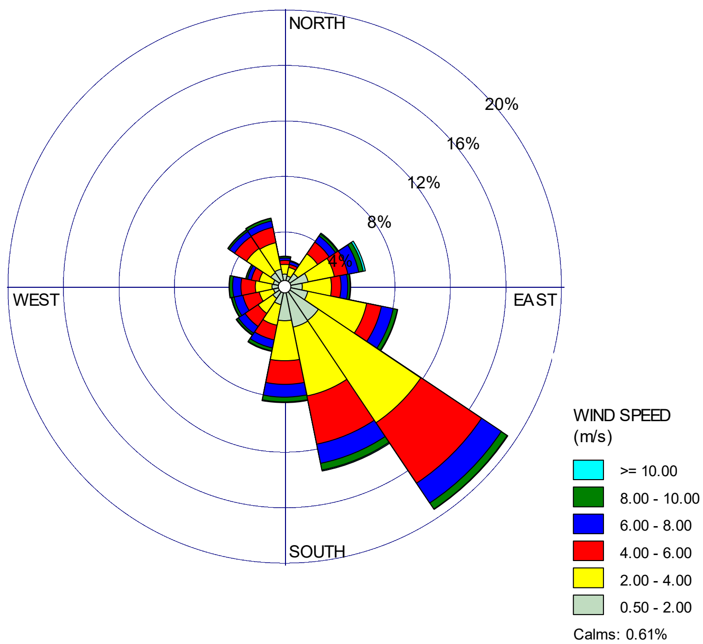
- CALMET v6.5.0 for the meteorological model
- CALPUFF v7.2.1 for the dispersion model

The CALPUFF modelling was conducted for a five-year interval dictated by the availability of prognostic meteorological data for the years 2011–2015. Stantec developed post-processing tools were used in this assessment which provide predicted concentrations at modelled receptors for applicable regulatory averaging intervals.

2.7.2 Meteorology

For this assessment, the CALMET model was run in WRF-only mode by using BC ENV WRF 4 km data for the period of January 1, 2011 to December 31, 2015. There are no surface and upper air stations within or near the CALMET domain. Figure 2.2 is a wind rose for the Site derived from the 2011–2015 CALMET data set. It generally indicates surface patterns are dominated by winds from southeast.

Figure 2.2 Mount Bracey Compressor Station CALMET Wind Rose



2.7.3 Modelling Domain, Receptors, Land Use, and Terrain

Study area boundaries were established to focus the scope of the assessment and to enable a meaningful analysis of potential effects on air quality arising from the Project. It was determined that a 22 km by 22 km area centred on the Project is sufficient to determine the effect of Project emissions on air quality. The study area boundaries enclose the concentration contours attributable to the Project that are greater than 10% of the applicable regulatory criteria in accordance with the Guideline (BC ENV, 2022a).

The CALPUFF Appendix (Appendix C) details how the modelling was performed, consistent with the Guideline (BC ENV, 2022a).

Ground-level air concentrations on and outside the plant boundary were predicted according to the Guideline (BC ENV, 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 Project boundary
- 50 m spacing for the 3.5 km by 3.5 km area centered on the Project
- 250 m spacing for the 14 km by 14 km area centered on the Project
- 500 m spacing for the 22 km by 22 km area centered on the Project

The “plant boundary” is the term used in the Guideline ((BC ENV, 2022a): section 7.3) to describe a line of receptors that demarcates the potential for public access and therefore public versus worker exposure. Often the highest predicted concentrations are on or very close to the Project boundary. The boundary for this assessment is defined as the compressor station fenceline, where access to the Mount Bracey CS 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.

The described grid comprises 9,278 receptor locations. The extent of the receptor grid is considered sufficient to indicate the magnitude and spatial variation of the ground-level concentrations resulting from the Project emissions. The maximum concentrations are resolved within a spatial resolution of 50 m since the maxima occur on the plant boundary.

A map of the CALPUFF domain (22 km by 22 km) and gridded receptors is provided in Appendix C.

There are no permanent residents in the vicinity of the Project; therefore there are no sensitive receptors for the Mount Bracey assessment. Three temporary trapping and hunting camps near the Project have been identified within 1.5 km of the Project. The camps are not occupied permanently; however, there is a potential for exposure to pollutants while the camp is occupied. Therefore, the temporary camps have been included in the receptor grid as a receptor of interest.

2.7.4 Oxides of Nitrogen to Nitrogen Dioxide Conversion

Oxides of nitrogen (NO_X) are primarily comprised of NO and NO_2. Only NO_2 concentrations have applicable AQOs. Therefore, it is important to be able to estimate the portion of the predicted concentrations of NO_X that are comprised of NO_2. For this assessment, the NOx concentrations will be predicted using the CALPUFF model. The NOx to NO_2 conversion will be carried out using the ozone limiting method (OLM) consistent with Section 3.2.1.3.1 and Appendix C of the Guidance for NO_2 Dispersion Modelling in British Columbia (NO_2 Guidance) (BC ENV, 2022b). The northeast BC ozone data array provided in Appendix C of the NO_2 Guidance will be used for the conversion of NO_X to NO_2 (BC ENV, 2022b). As CALPUFF does not have the capability to apply stack-specific unique in-stack ratio (ISR) values, a NO_X emission weighted average ISR value was applied based upon the Project NO_X emissions and recommended ISR values provided in Appendix B of the NO_2 Guidance. Table 2.7 presents a summary of the source-specific recommended ISR, total Project NO_X emissions for each equipment class, and the emission weighted average ISR of 0.100 that was used to carry out the NO_X to NO_2 conversion. In addition, modelling results using the Ambient Ratio Method 2 (ARM 2) to convert predicted NO to NO_2 are provided in Appendix E.

Table 2.7 Equipment Specific and Emission Weighted In-Stack Ratios

Equipment Class	Fuel Type	Recommended ISR [a]	Total Project NOx Emissions (t/y)	Emission Weighted ISR
Turbine	Natural Gas	0.065	165	0.100
Reciprocating IC Engine [b]	Natural Gas	0.187	60.3	
Boiler/Heater [c]	Natural Gas	0.100	6.3	

Notes:
[a] The ISR is the in-stack-ratio of NO2/NOX and can vary from 0 to 1. A value of 1 indicates 100% of NOX is NO2.
[b] The ISR for the reciprocating internal combustion engine will be used for the gas-fired generator.
[c] The ISR for the boiler will be used for the vapour seal gas combustor.

The emission weighted ISR is calculated as follows:

Emission weighted ISR =

(Turbine ISR × Turbine NO_X emissions) + (Reciprocating IC Engine ISR ×Reciprocating IC Engine NO_X emissions) + (Boiler/Heater ISR × [Seal Gas Combustor + Heaters] NO_X emissions) / Total Project NO_X emissions

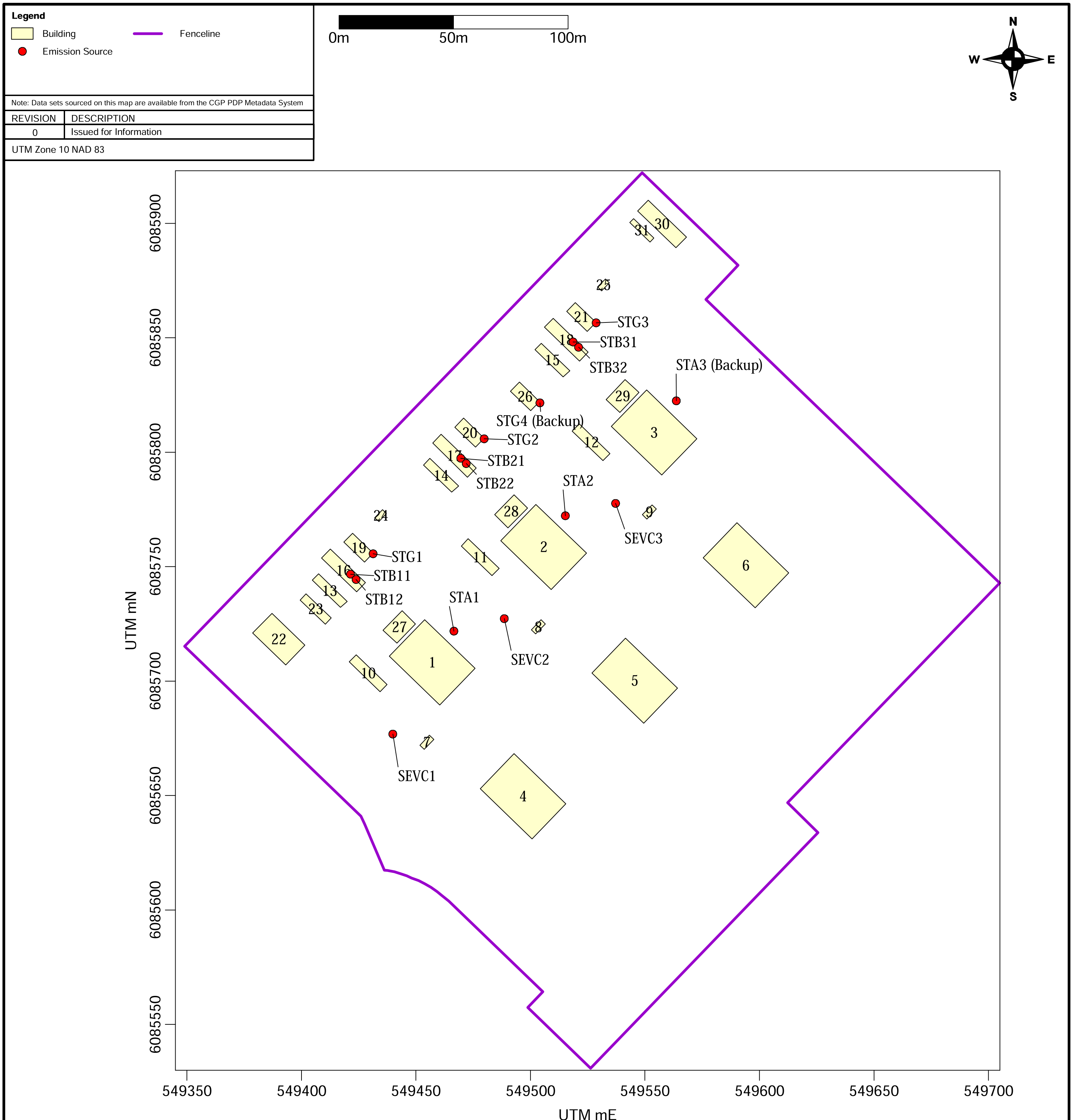
2.7.5 Secondary Particulate Formation and Particle Deposition

The remoteness of the facility location and the relatively modest quantities of chemically reactive emissions limit the usefulness of invoking chemical transformations and particle deposition. CALPUFF options for depicting chemical transformations and particle deposition are not employed in this assessment.

2.7.6 Building Plume Downwash Effects

Buildings or other solid structures can affect the flow of air near a source and may induce building downwash effects caused by eddies on the downwind side. Downwash effects have the potential to reduce plume rise and affect dispersion.

It has been determined that there is potential for building downwash. Building downwash was modelled consistent with section 7.6 in the Guideline (BC ENV, 2022a). For sloped or peaked roofs, the building height is equivalent to halfway between the trough and the peak, consistent with BC ENV direction. The emission sources, buildings, and structures that were considered in the downwash modelling are shown in Figure 2.3.



1-3	Compressor Buildings for Unit A1, A2, and A3
4-6	Air Cooled Heat Exchangers for Unit A1, A2, and A3
7-9	Utility Gas Enclosures for Unit A1, A2, and A3
10-12	Local Control Module Buildings for Unit A1, A2, and A3
13-15	Electrical Buildings for Unit A1, A2, and A3
16-18	Mechanical Buildings for Unit A1, A2, and A3
19-21	APU Buildings for Unit A1, A2, and A3
22	Heated Storage Building
23	Personnel Building
24	Drum Rack Building 1
25	Drum Rack Building 2
26	Unit A0 Stand-By PPU Building
27-29	Air Intakes for Unit A1, A2, and A3
30	Living Quaters
31	Fresh Water and Drain Tank Building

STB11	Unit A1 Boiler Exhaust 1
STB12	Unit A1 Boiler Exhaust 2
STB21	Unit A2 Boiler Exhaust 1
STB22	Unit A2 Boiler Exhaust 2
STB31	Unit A3 Boiler Exhaust 1
STB32	Unit A3 Boiler Exhaust 2
STG1	Unit A1 Gen. Skid Exhaust 1
STG2	Unit A2 Gen. Skid Exhaust 2
STG3	Unit A3 Gen. Skid Exhaust 3
STG4	Unit A0 Gen. Skid Exhaust (Backup)
STA1	Compressor Unit A1 Exhaust
STA2	Compressor Unit A2 Exhaust
STA3	Compressor Unit A3 Exhaust (Backup)
SEVC1	Seal Gas Combustor 1
SEVC2	Seal Gas Combustor 2
SEVC3	Seal Gas Combustor 3

Coastal GasLink Pipeline Project
TC Energy

Figure 2.3
Mount Bracey Compressor Station Plot Plan

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3 Results

Dispersion modelling is used to predict the maximum NO_2, $PM_{2.5}$, SO_2 and CO concentrations for the Project-Alone Case and Application Case. The assessment for Mount Bracey CS is based on several conservative assumptions including the following:

- Adding a substantial baseline concentration to existing source predictions assumes baseline is always elevated.
- Modelled emission sources (except as noted for the gas-fired turbine) are assumed to operate at maximum emission rates and maximum power output simultaneously and continuously.
- Maximum predicted concentrations portray occurring during adverse dispersion meteorology over a five-year period.

Baseline values are added to the Application Case. These predictions are presented in tabular form and discussed in the following sections. Isopleth figures showing predicted concentrations (by case) are presented in Appendix D.

3.1 Project-Alone Case

Project-Alone Case emission scenario consists of all continuous emission sources at Mount Bracey CS with the exception of one gas turbine and one gas generator assumed to be in standby. Predicted NO_2, SO_2, $PM_{2.5}$, and CO concentrations are presented in Table 3.1, and Figures D-1 and Figure D-8 (Appendix D).

Table 3.1 Project-Alone Case Dispersion Modelling Results for Compressor Station

CAC	Averaging Period	Maximum Predicted Concentrations (µg/m^3)	BC AQO (µg/m^3)	CAAQS 2025 (µg/m^3)	Percentage of British Columbia AQO (%)
NO_2	1-hour	62.0	113	79	55
	Annual	12.9	32	23	40
SO_2	1-hour	3.1	183	170	2
	Annual	0.5	13	11	4
$PM_{2.5}$	24-hour	0.7	25	27	3
	Annual	0.2	8	8.8	3
CO	1-hour	95.3	14,300	-	1
	8-hour	41.1	5,500	-	1

Note:
Achievement for each parameter and time averaging interval is as described in the notes section of Table 2.1.

The maximum 98th percentile of the predicted daily one-hour maximum ground-level NO_2 concentration for the Project-Alone Case is 60.4 μg/m^3, which is less than the BC AQO. Figure D-1 and Figure D-2 (Appendix D) shows that this maximum occurs on the Project north plant boundary. The maximum predicted annual average ground-level NO_2 concentration is 12.9 μg/m^3, which is less than the BC AQO. Figure D-3 and Figure D-4 (Appendix D) shows that this maximum occurs on the Project north plant boundary.

The maximum 99th percentile of the predicted daily one-hour maximum ground-level SO_2 concentration for the Project-Alone Case is 3.1 μg/m^3, which is less than the BC AQO. Figure D-5 (Appendix D) shows that this maximum occurs on the Project north plant boundary. The maximum predicted annual average ground-level SO_2 concentration is 0.5 μg/m^3, which is less than the BC AQO. Figure D-6 (Appendix D) shows that this maximum occurs on the Project north plant boundary.

The maximum 98th percentile of the predicted daily maximum ground-level $PM_{2.5}$ concentration for the Project-Alone Case is 0.7 μg/m^3, which is less than the BC AQO. Figure D-7 (Appendix D) shows that this maximum occurs on the Project west plant boundary. The maximum predicted annual average ground-level $PM_{2.5}$ concentration is 0.2 μg/m^3, which is less than the BC AQO. Figure D-8 (Appendix D) shows that this maximum occurs on the Project north plant boundary.

The maximum 99th percentile of the predicted daily one-hour maximum ground-level CO concentration for the Project-Alone Case is 95.3 μg/m^3, which is less than BC AQO. The maximum predicted 8-hour average ground-level CO concentration is 41.1 μg/m^3, which is less than the BC AQO.

As the temporary camp was included in the receptor grid, modeling results show that predicted concentrations at this location is below the BC AQO.

3.2 Application Case

Application Case emission scenario consists of all continuous emission sources at the Mount Bracey CS plus the baseline concentrations. The predicted concentrations for the Application Case are based on normal operation with sources operating at 100% of rated capacity for each equipment plus the baseline. Predicted NO_2, SO_2, $PM_{2.5}$, and CO concentrations are presented Table 3.2, and Figures D-9 through D-16 (Appendix D).

Table 3.2 Application Case Dispersion Modelling Results for Compressor Station

CAC	Averaging Period	Maximum Predicted Concentrations (µg/m³)	Baseline (µg/m³)	Maximum Predicted Concentration Including Baseline (µg/m³)	BC AQO (µg/m³)	CAAQS 2025 (µg/m³)	Percentage of British Columbia AQO (%)
NO_2	1-hour	62.0	288-value array (Table 2.4)	76.7	113	79	68
	Annual	12.9	2.1	15	32	23	47
SO_2	1-hour	3.1	11.5	14.6	183	170	8
	Annual	0.5	0.9	1.4	13	11	11
$PM_{2.5}$	24-hour	0.7	18.6	19.3	25	27	77
	Annual	0.2	4.5	4.7	8	8.8	59
CO	1-hour	95.3	515.2	610.5	14,300	-	4
	8-hour	41.1	515.2	556.3	5,500	-	10

Note:
Achievement for each parameter and time averaging interval is as described in the notes section of Table 2.1.

The maximum 98th percentile of the predicted daily one-hour maximum ground-level NO_2 concentration for the Application Case is 76.7 µg/m³, which is less than the BC AQO. Figure D-9 and Figure D-10 (Appendix D) shows that this maximum occurs on the Project north plant boundary. The maximum predicted annual average ground-level NO_2 concentration is 15.0 µg/m³, which is less than the BC AQO. Figure D-11 and Figure D-12 (Appendix D) shows that this maximum occurs on the Project north plant boundary.

The maximum 99th percentile of the predicted daily one-hour maximum ground-level SO_2 concentration for the Application Case is 14.6µg/m³, which is less than the BC AQO. Figure D-13 (Appendix D) shows that this maximum occurs on the Project north plant boundary. The maximum predicted annual average ground-level SO_2 concentration is 1.4 µg/m³, which is less than the BC AQO. Figure D-14 (Appendix D) shows that this maximum occurs on the Project north plant boundary.

The maximum 98th percentile of the predicted daily maximum ground-level $PM_{2.5}$ concentration for the Application Case is 19.3 µg/m³, which is less than the BC AQO. Figure D-15 (Appendix D) shows that this maximum occurs on the Project west plant boundary. The maximum predicted annual average ground-level $PM_{2.5}$ concentration is 4.7 µg/m³, which is less than the BC AQO. Figure D-16 (Appendix D) shows that this maximum occurs on the Project north plant boundary.

The maximum 99th percentile of the predicted daily one-hour maximum ground-level CO concentration for the Application Case is 610.5 µg/m³, which is less than BC AQO. The maximum predicted 8-hour average ground-level CO concentration is 556.3 µg/m³, which is less than the BC AQO.

As the temporary camp was included in the receptor grid, modeling results show that predicted concentrations at this location is below the BCAQO.

4 Summary

The purpose of this TDR is to describe the details on the methods and results of the air dispersion modelling assessment. The objective of this study is to document predicted changes to air quality near the Project associated with the addition of Project emission sources.

To evaluate the air quality effects associated with the proposed Project, CAC emissions are estimated and dispersion modelling is used to predict maximum expected ground-level CAC concentrations. The findings of the Project-Alone Case and Application Case with respect to the applicable regulatory criteria are summarized below:

4.1 Findings of the Project-Alone Case Modelling

The Project-Alone Case represents typical operation and includes two gas-fired turbines, three gas-fired generators, three seal gas combustors, and six glycol heaters, all operating at maximum emission rates consistent with full equipment capacity. The backup turbine and generator are depicted as not operating. The predicted ground-level concentrations for NO_2, SO_2, $PM_{2.5}$ and CO for the Project-Alone Case are all less than the BC AQO (Table 3.1). Modeling results showed that the receptor of interest, the temporary camp included in the receptor grid, had predicted concentrations below the BC AQO.

4.2 Findings of the Application Case Modelling

The Application Case includes emissions from the Project-Alone Case plus baseline. The predicted ground-level concentration for NO_2, SO_2, $PM_{2.5}$ and CO for the Application Case are all less than the applicable regulatory criteria (Table 3.2). Modeling results showed that the receptor of interest, the temporary camp included in the receptor grid, had predicted concentrations below the BC AQO.

5 Conclusions

CGL is proposing to add the Mount Bracey CS as part of the Cedar Link Project. Typical operation at Mount Bracey CS include two gas-fired turbines, three gas-fired generators, three seal gas combustors, and six glycol heaters. The backup turbine and generator are depicted as not operating. The maximum predicted ground-level concentrations of NO_2, SO_2, $PM_{2.5}$, and CO, are less than the BC AQO (Table 3.1 and Table 3.2).

The conclusions of this assessment are based on several conservative assumptions which results in confidence that effects are likely overestimated. The assessment assumes the concurrence of maximum, sustained emission rates, and evaluates a long record of meteorological data to consider adverse meteorological conditions. Based upon the model prediction, it is concluded that air quality in the vicinity of the Project is expected to remain acceptable relative to the BC AQO.

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Appendices

Appendix A Model Plan

Dispersion Modelling Plan

Dispersion Modelling Plan for Mount Bracey Compressor Station Project

June 16, 2025

Prepared for:

Coastal GasLink Pipeline Ltd.
450 1 St SW
Calgary, AB T2P 5H1

Prepared by:

Stantec Consulting Ltd.

Project Number: 123515132

CGC16362-STC-EN-PLAN-0001
Rev 2
Issued for Use

Review and Sign-off

This document entitled Dispersion Modelling Plan was prepared by Stantec Consulting Ltd. ("Stantec") for the account of Coastal GasLink Pipeline Ltd. (the "Client") to support the application to the British Columbia (BC) Energy Regulator (BCER) for a Waste Discharge Authorization (WDA) (the "Application") for the Mount Bracey Compressor Station (the "Project").

Digitally signed by Hauk, April
Date: 2025.06.16 14:20:08 -07'00'

Prepared by: ______________________

April Hauk, B.Sc., EP

2025-Jun-16

Digitally signed by Blancher, Patrick
Date: 2025.06.16 14:36:57 -06'00'

Reviewed by: ______________________

Patrick Blancher, B.Sc.

Reid Allan Person -- P.Eng. - EGBC

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Date: 2025.06.16 14:58:09 -06'00'

Approved by: ______________________

Reid Person, M.Eng., P.Eng.(AB,BC,SK)

Table of Contents

Review and Sign-off i
Abbreviations iv
1 Dispersion Modelling Plan 1
2 General 2
3 Project Description and Geographic Setting 4
4 Dispersion Model 5
4.1 Selected Dispersion Model 5
4.2 Default Switch Settings 5
4.3 CALPUFF Receptors 7
4.3.1 Gridded Receptors 7
4.3.2 Sensitive Receptors 9
5 Planned Model Output: Air Quality Assessment Needs 10
6 Emission Sources and Characteristics 12
6.1 Contaminants Emitted for Each Emission Scenario 12
6.2 Emission Inventory 12
6.3 Model Emission Scenarios 17
6.4 Source Emission Rate Variability 18
7 Applicable Air Quality Objectives 19
7.1 British Columbia Air Quality Objectives 19
7.2 Other Regulatory Criteria 21
8 Baseline Concentration 23
9 Building Downwash 27
10 Geophysical Data Input 29
10.1 Topography and Land Use Data 29
10.1.1 Surface Characteristics 29
10.2 Meteorological Data Input (For Level 2 and 3 Assessments Only) 31
10.2.1 Surface Meteorological Data 31
10.2.2 Upper-Air Meteorological Data 31
10.3 Numerical Weather Prediction Model Output 31
11 Treatments 33
11.1 NO to NO_2 Conversion 33
11.2 Chemical Transformation 34
11.2.1 Secondary Particulate Formation 34
11.3 Particle Deposition 34
11.4 Stagnation 34
11.5 Plume Condensation (Fogging) and Icing 35
12 Quality Management Program 36
12.1 Model Input Data 36
12.2 Model Output Data 36
13 BCER Review of Plan and Revisions 37
14 References 38

List of Tables

Table 6.1 Stack Parameters and Emission Rates for the Proposed Equipment 13
Table 6.2 Summary of Emission Sources for each Modelling Scenario at Mount Bracey CS 17
Table 6.3 Emissions Summary for each Modelling Scenario 18
Table 7.1 British Columbia Air Quality Objectives 20
Table 7.2 2025 Canadian Air Quality Standards 21
Table 7.3 Criteria from Other Jurisdictions (Critical Levels) 21
Table 8.1 Summary of Monitoring Stations Locations and Substances Monitored 24
Table 8.2 Summary of Baseline CAC Concentrations [a] 25
Table 8.3 288-Value Array NO_2 Baseline Summary using Blueberry First Nation School Monitoring Data 26
Table 9.1 Building Dimensions 27
Table 11.1 Equipment Specific and Emission Weighted In-Stack Ratios 33

List of Figures

Figure 4.1 CALMET Model Domain and Terrain 6
Figure 4.2 CALPUFF Receptor Grid for Mount Bracey Compressor Station (KP 163) 8
Figure 6.1 Simplified Plot Plan for Mount Bracey Compressor Station (KP 163) 16
Figure 10.1 CALMET Land Use Classification 30
Figure 10.2 Comparison of Measured and Predicted Surface Winds at ECCC Mackenzie Airport Weather Station (2011–2015) 32

List of Appendices

Appendix A CALMET Model Options and Land Use Characterization Parameters

Appendix B Emissions Inventory

Abbreviations

the Application	The application to the British Columbia (BC) Energy Regulator (BCER) for a Waste Discharge Authorization (WDA)
AFB	absolute fractional bias
AQO	Air Quality Objective
BC	British Columbia
BCER	British Columbia Energy Regulator
ENV	British Columbia Ministry of Environment and Climate Change Strategy
°C	degrees Celsius
CAAQS	Canadian Ambient Air Quality Standards
CCME	Canadian Council of Ministers of the Environment
CEC	Commission for Environmental Cooperation
CO	carbon monoxide
CGL	Coastal GasLink
g/s	grams per second
ISR	In-stack ratio
K	Kelvin
km	kilometre
KP	Kilometre post
kW	kilowatt
m	metre
m/s	metres per second
m asl	metres above sea level
m E	Easting (metres)

m N	Northing (metres)
NAD83	North American Datum of 1983
NO_2	nitrogen dioxide
NO_X	nitrous oxide
OLM	Ozone limiting method
$PM_{2.5}$	fine particulate matter with an aerodynamic diameter less than equal to 2.5 micrometres
the Project	the Mount Bracey Compressor Station
SO_2	sulphur dioxide
t/d	tonnes per day
$\mu g/m^3$	microgram per cubic metre
UTM	Universal Transverse Mercator
US EPA	United States Environmental Protection Agency
WDA	Waste Discharge Authorization
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 Ministry of Environment and Climate Change Strategy (British Columbia ENV; (BC ENV, 2022a)). Text in *italics* is provided as part of the British Columbia ENV 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 British Columbia ENV template related to other dispersion modelling systems (i.e., AERMOD) have been removed.

2 General

Date: 16-June-2025

Facility Name: Mount Bracey Compressor Station

Company: Coastal GasLink Pipeline Ltd.

Company Contact: Lara Smandych

Location:
Latitude: 54.9162°N Northing: 6,085,740 m N Zone 10
Longitude: -122.2266°E Easting: 549,576 m E Zone 10

Air Quality Consultant and Contact Name:

Stantec Consulting Ltd.
April Hauk
(250) 852-5921
April.Hauk@stantec.com

Stantec Consulting Ltd.
Reid Person
403-781-4159
Reid.Person@stantec.com

BCER Contact Name(s):
Rachel Butler
250-794-5220
Rachel.Butler@bc-er.ca

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

A Level 3 Assessment will be conducted to assess the air quality consequences of emissions as a result of operation of the Mount Bracey Compressor Station (CS) (the Project). Section 2.2.2 of the British Columbia Air Quality Dispersion Modelling Guideline (the Guideline) (BC ENV, 2022b) indicates that a Level 3 assessment is appropriate for modelling the Project's emission sources. This is due to the complex topography and wind flows in the region and the multiple emission sources.

The Project is being evaluated for a British Columbia Waste Discharge Authorization (WDA). The air quality assessment will be conducted using the CALPUFF modeling system. The CALMET module will use Weather Research Forecast (WRF) data as input.

Does this plan follow a modelling approach that is similar to the approach taken in a previous air quality assessment already reviewed and accepted by the Ministry? If so, provide the project name and Ministry contact:

This plan follows an air dispersion modelling approach typical of several recent compressor station modelling exercises conducted by Stantec in northeast British Columbia, but the modelling methodology described here is specific to the Mount Bracey Compressor Station.

3 Project Description and Geographic Setting

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

Coastal GasLink Pipeline Ltd (CGL) constructed and will operate a natural gas pipeline (the CGL pipeline) from the area near the community of Groundbirch (approximately 40 km west of Dawson Creek, British Columbia [BC]) to the LNG Canada Development Inc. (LNG Canada) liquified natural gas (LNG) export facility (LNG Canada export facility) near Kitimat, BC. CGL will leverage this existing infrastructure with the construction of the Cedar Link Project; a connector pipeline, a meter station and a new compressor station (Mount Bracey) to enable the delivery of an additional 0.4 billion cubic feet per day (bcf/day) of natural gas from the CGL pipeline to the Cedar LNG Project, a proposed floating LNG facility in Kitimat, BC.

The Mount Bracey CS is located at the CGL pipeline Kilometer Post (KP) 163 in the Regional District of Fraser - Fort George (Figure 4.1). Construction of the Project commenced in 2024 and will be in service in 2028.

The purpose of this dispersion model plan is to support the application to the British Columbia (BC) Energy Regulator (BCER) for a Waste Discharge Authorization (WDA) for the Project.

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 is located at an elevation of 854 m above sea level (asl). The higher elevations are towards the southwest and west portions of the CALMET domain and the lowest elevations are in the southwest portions of the domain. Terrain in the region is complex ranging from approximately 700 to over 2,600 m asl.

The dominant land cover in this rural remote region is evergreen forest, with some deciduous forest. Evergreen forest dominates in the immediate vicinity of the Project. The nearest settlement is the community of Anzac, located 25 km to the southwest.

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 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

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

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 ENV 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 (BC ENV 2022b).
- The CALMET 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:* CALMET domain map for the Project is provided in Figure 4.1. There are no surface meteorological stations in this domain (Figure 4.1). There are no upper air stations within or nearby the CALMET domain. See Section 10.2 for more information.
- *Anticipated grid resolution:* 500 (m)
- *Number of grids in X and Y direction:* NX = 100, NY = 100

Legend

Compressor Station

Water Course

Road

Water Body

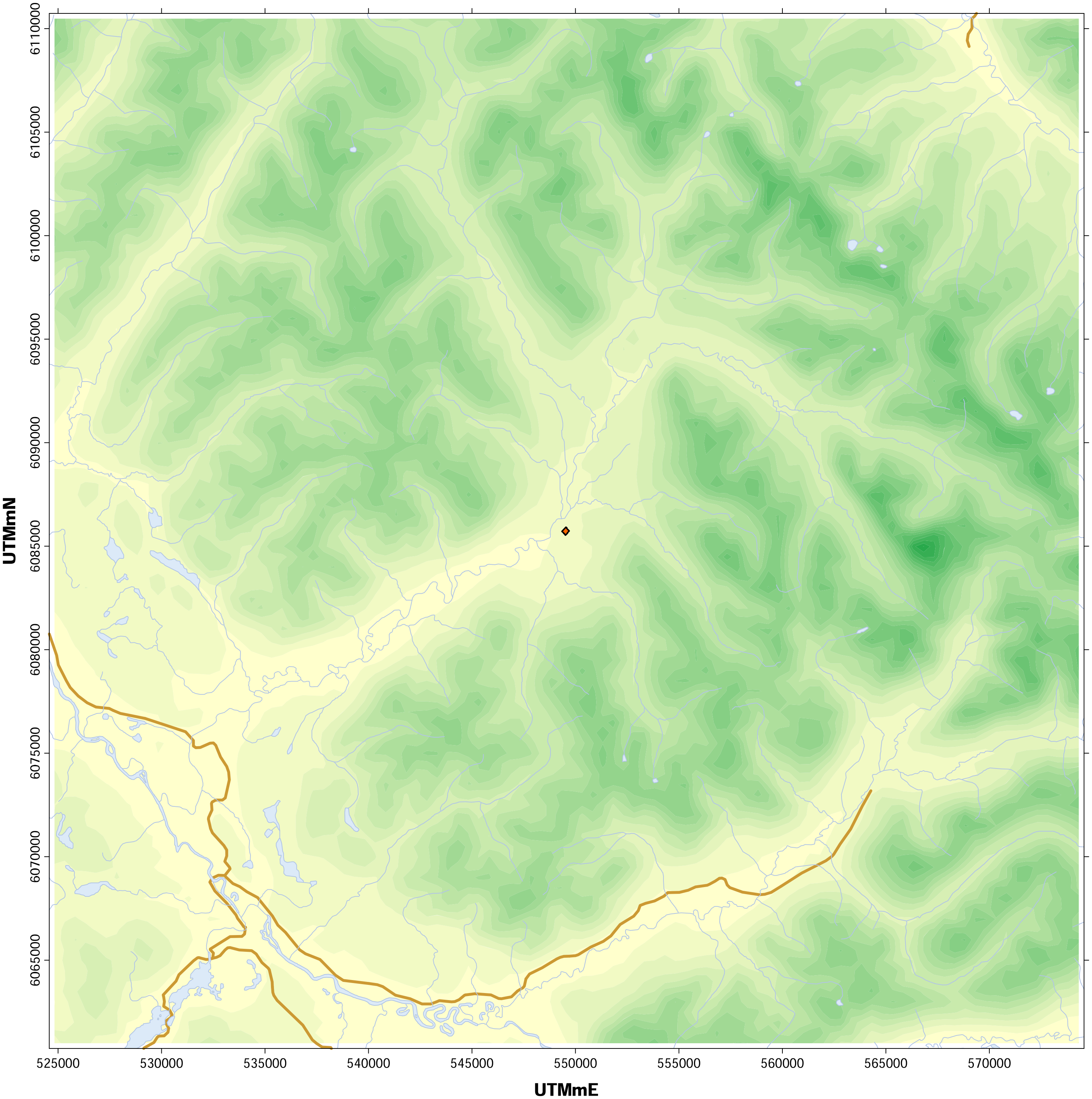
Note: Data sets sourced on this map are available from the CGP PDP Metadata System

REVISION	DESCRIPTION
0	Issued for Information

UTM NAD 83 Zone 10

0m 10000m 20000m

N W E S



Elevation (m)

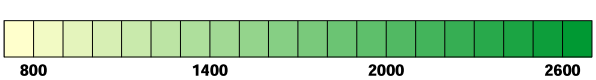


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Figure 4.1
CALMET Model Domain and Terrain

November 2024

4.3 CALPUFF Receptors

4.3.1 Gridded Receptors

For the CALPUFF model

Proposed receptor grid spacing for the Project assessment (see Section 7.2 in the Guideline (BC ENV 2022b):

- 20 m receptor spacing along the Project boundary
- 50 m spacing for the 3.5 km x 3.5 km area centered on the Project
- 250 m spacing for the 14 km x 14 km area centered on the Project
- 500 m spacing for the 22 km x 22 km area centered on the Project

The described grid comprises 9,307 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.

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 4.2.

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

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

Legend

- Compressor Station
- Grid Receptor
- Temporary Trapping /Hunting Camp
- Water Body
- Water Course
- Road

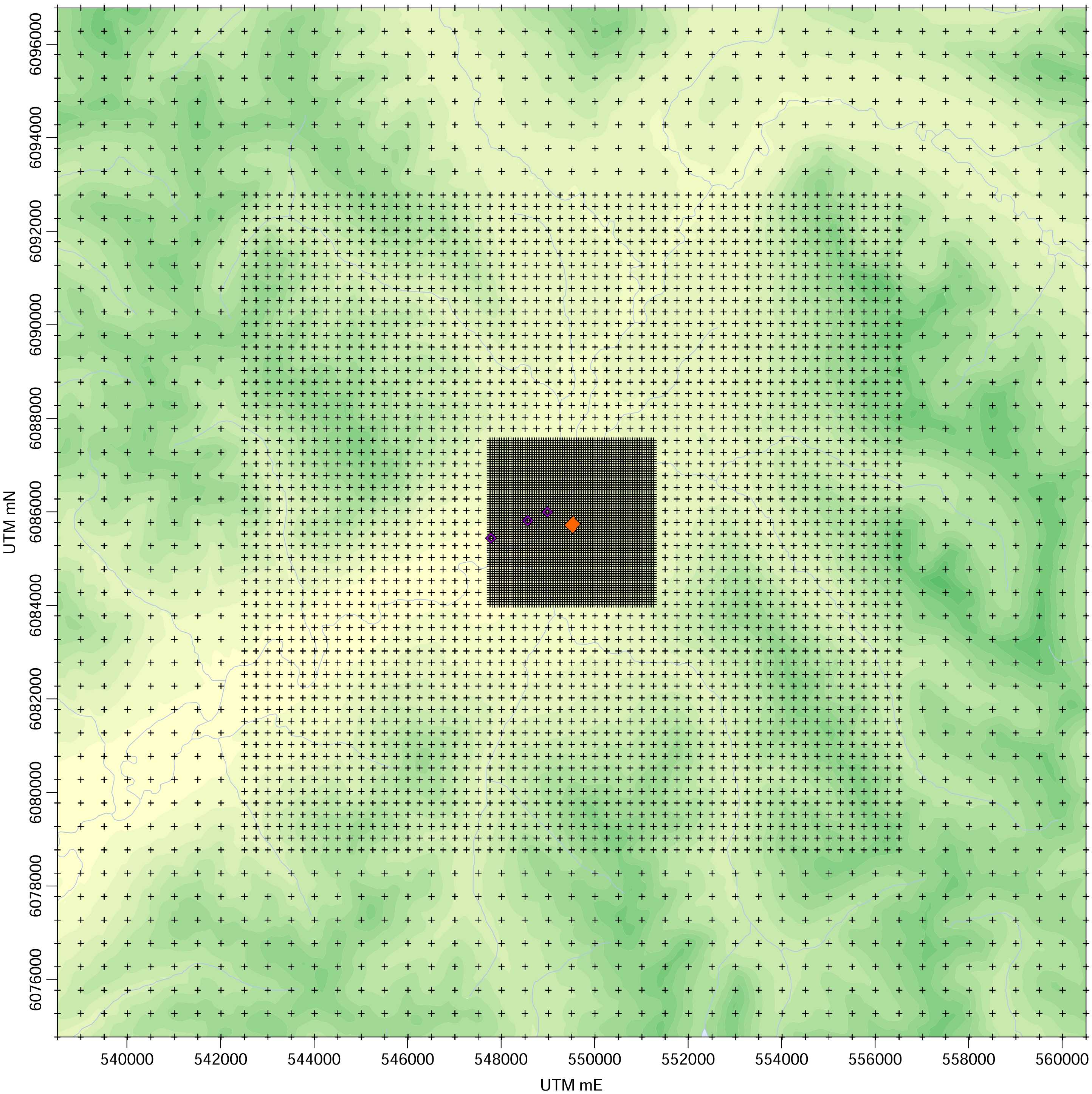
Note: Data sets sourced on this map are available from the CGP PDP Metadata System

REVISION	DESCRIPTION
0	Issued for Information

UTM NAD 83 Zone 10

0m 2000m 4000m

N E S W



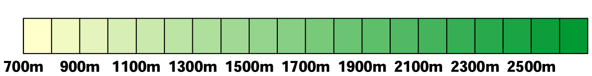


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Figure 4.2
CALPUFF Receptor Grid for Mount Bracey Compressor Station (KP 163)

December 2024

Rev 0

STANTEC:\\ca0002-ppfss02\shared_projects\123513381\disciplines\air_quality\Grids\Mount_Bracey_KP163\MountBracey_KP163_receptors.srf

4.3.2 Sensitive Receptors

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

There are no permanent residents in the vicinity of the Project, therefore there are no sensitive receptors for the Project assessment. Three temporary trapping and hunting camps near the Project have been identified within 1.5 km of the Project. The camps are occupied temporarily during the year but there is a potential for exposure to pollutants while the camp is occupied. Therefore, the temporary camps have been included in the receptor grid as a receptor of interest, but are not considered sensitive receptors because they are not permanently occupied.

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)

Model output for the Project will include predicted ground-level concentrations for nitrogen dioxide (NO_2), sulphur dioxide (SO_2), 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. Large scale NO_2 isopleth maps will be provided with the predicted NO_2 concentrations for the entire modelling domain.

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

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

Figures will include spatial distribution maps of maximum predicted concentrations for NO_2, 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 air quality objective (AQO) (i.e., maximum predicted 3-year average of the 98^{th} percentile of the daily 1-hour maximum nitrogen dioxide concentration). Spatial distribution maps for SO_2 and CO will not be presented unless predicted concentrations are greater than 50% of the AQO.

If exceedances of the applicable regulatory criteria are predicted, the list of receptors that exceed the metric and figures showing the frequency (i.e., % of hours) of exceedance will be included.

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

Tables of maximum predicted concentrations for NO_2, SO_2, $PM_{2.5}$, and CO equivalent to the statistical form of the applicable AQO (i.e., maximum predicted 3-year average of the 98^{th} percentile of the daily 1-hour maximum nitrogen dioxide concentration) will be provided. If exceedances are predicted, the areal extent, frequency, and meteorological circumstances associated with those exceedances will be investigated.

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

Tables of air quality parameters will be provided for the receptors of interest (Figure 4.2).

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 assessment.

Switching events, in which the standby compressor or power generator are brought up to full power and an operating compressor or power generator are then ramped down, will be discussed in the Technical Assessment Report. Due to the short duration (less than20 minutes per event) and limited data available to quantify emissions under reduced loads, it is not practical to incorporate these events into dispersion modelling. Switching events emissions will be compared to steady state operations qualitatively to support a discussion of air emissions associated with these events. Switching events are anticipated to occur less than 50 times per year.

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

Figures will be provided for study area (Facility: 50 km by 50 km) if complex spatial distribution of concentrations is predicted in the vicinity of the Project, additional figures for the near-field will be investigated.

Special output required for vegetation, health risk or visibility assessments

Effects on human health, and visibility, are not assessed for the Project. There are no sensitive receptors nearby to warrant a human health study. 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 sources consist of those from the combustion of fuel gas. The Project's emissions include oxides of nitrogen (NO_x), SO_2, $PM_{2.5}$ and CO. These substances will be carried forward in each model scenario discussed below. For each model scenario and for the substances modelled, the source type is Point (P).

6.2 Emission Inventory

The proposed operations will include three gas-fired turbines, four gas-fired generators, three seal gas combustors and six glycol heaters on site. Two turbines will operate at any given time, the third turbine is standby. The third standby plant's ancillary equipment (specifically the generators, glycol heaters, and seal gas combustor) will run at all times to maintain the standby plant in a state of readiness. The fourth generator (A0, Building #26 on the plot plan) will only run when one of the other three generators are not running. It may be used to backfeed any of the plants if the generator is out of service for maintenance or due to failure.

There will be a domestic (food) waste incinerator onsite, but it is not considered a continuous source, and therefore, is not including in modelling.

Emission factors for NO_X and CO are provided by CGL, vendor data or based on AP-42 published emission factors (Table 6.1). The sulphur content in source fuel gas for the Project is provided by CGL for the emission sources included in the assessment. For the $PM_{2.5}$ emission factors, a more up-to-date study by Canadian Energy Partnership for Environmental Innovation (CEPEI) was used (CEPEI, 2024).

Maximum emission rates are applied in the CALPUFF modelling.

Design information for the Project including building dimensions, stack heights and diameters are based on site layout and configuration provided by CGL.

Table 6.1 presents the stack parameters, emission rates and source of data for the proposed equipment. Stack parameters and emission rates for the gas-fired turbines, gas-fired generators and the glycol heaters are provided by CGL. The emission rates presented in Table 6.1 are for each unit. The cumulative emissions are presented in Section 6.3.

Table 6.1 Stack Parameters and Emission Rates for the Proposed Equipment

Source Identification		BHGE PGT25+ Gas Turbine	Source of Data	Waukesha Gas Generator L5794GSI	Source of Data	Seal Gas Vapour Combustors	Source of Data	Auxiliary Utility Glycol Heaters	Source of Data
Unit Description		Continuous	CGL	Continuous	CGL	Continuous	CGL	Continuous	CGL
Number of units		2 (+1 Standby)	CGL	3 (+1 Standby)	CGL	3	CGL	6	CGL
Source Type		Point	CGL	Point	CGL	Point	CGL	Point	CGL
Capacity – Heat Input (based on HHV)	MMBtu/hr	290	Stantec [b]	9.47	Stantec [b]	1.5	CGL	1.92	CGL
	GJ/hr	306	Stantec [b]	9.99	Stantec [b]	1.6	Stantec [b]	2.03	Stantec [b]
	kW	85,000	Stantec [b]	2,775	Stantec [b]	N/A	N/A	563	CGL
Output Rating (Assume LHV)	MMBtu/hr	N/A	Stantec [b]	N/A	N/A	N/A	N/A	1.47	Stantec [b]
	GJ/hr	111	Stantec [b]	3.06	Stantec [b]	N/A	N/A	1.55	Stantec [b]
	kW	30,900	CGL	850	CGL	N/A	N/A	431	CGL
Fuel Type		Fuel Gas	CGL	Fuel Gas	CGL	Fuel Gas	CGL	Fuel Gas	CGL
Fuel Gas Consumption Rate	$10^3 m^3/d$	188.8	Stantec [b]	6.2	Stantec [b]	0.99	Stantec [b]	1.25	Stantec [b]
Sulphur Content [b]	ppmv	22.0	CGL	22.0	CGL	22.0	CGL	22.0	CGL
Exhaust Gas Flow Rate	kg/s	82.9	CGL	0.93	Vendor Data [c]	N/A	N/A	N/A	N/A
Exhaust Gas MW	kg/kmol	28.5	CGL	N/A	N/A	N/A	N/A	N/A	N/A
Exhaust Gas H_2O Content	%	4.3	CGL	N/A	N/A	N/A	N/A	N/A	N/A
Exhaust Gas O_2 Content (dry condition)	%	16.1	Stantec [d]	N/A	N/A	N/A	N/A	N/A	N/A
Rain Cap	Yes/No	No	CGL	No	CGL	No	CGL	Yes	CGL
Release Direction		Vertical	CGL	Vertical	CGL	Vertical	CGL	Vertical	CGL
Stack Height	m	14.5	CGL	8.5	CGL	4.2	CGL	6.8	CGL
Stack Diameter	m	2.6	CGL	0.305	CGL	1.58	CGL	0.559	CGL
Maximum Exit Velocity	m/s	38.2	Stantec	37.2	Stantec	0.36	CGL	1.45	Stantec [b]
Exit Temperature	°C	494.4	CGL	580.6	Vendor Data [c]	63	CGL	258	Stantec
	K	768	Stantec	854	Stantec	336	CGL	531	Stantec [b]
NO_X	ppmv@ 15% O_2 and dry	25 [a]	CGL	N/A	N/A	N/A	N/A	N/A	N/A
NO_X	g/kW-hr	N/A	N/A	1.00	CGL	N/A	N/A	N/A	N/A
NO_X	lb/MMBtu	N/A	N/A	N/A	N/A	0.098	AP-42 (Table 1.4-1) [e]	0.098	AP-42 (Table 1.4-1) [e]
CO	ppmv @ 15% O_2 and dry	36 [a]	CGL	N/A	N/A	N/A	N/A	N/A	N/A
CO	g/hp-hr	N/A	N/A	0.17	CGL	N/A	N/A	N/A	N/A
CO	lb/MMBtu	N/A	N/A	N/A	N/A	0.082	AP-42 (Table 1.4-1) [e]	0.082	AP-42 (Table 1.4-1) [e]
$PM_{2.5}$ (CEPEI 2024) [d]	g/GJ (fuel input, HHV)	0.38	CEPEI (CEPEI 2024)	1.11	CEPEI (CEPEI 2024)	0.637	CEPEI (CEPEI 2024)	0.637	CEPEI (CEPEI 2024)
NO_X	t/d	0.226	Stantec [b]	0.0204	Stantec [b]	1.64E-03	Stantec [b]	2.05E-03	Stantec [b]
SO_2	t/d	0.011	Stantec [b]	0.0004	Stantec [b]	5.96E-05	Stantec [b]	7.45E-05	Stantec [b]
CO	t/d	0.198	Stantec [b]	0.0047	Stantec [b]	1.38E-03	Stantec [b]	1.72E-03	Stantec [b]
$PM_{2.5}$	t/d	0.003	Stantec [b]	0.0003	Stantec [b]	2.48E-05	Stantec [b]	3.10E-05	Stantec [b]
NO_X	g/s	2.614	Stantec [b]	0.2361	Stantec [b]	0.019	Stantec [b]	0.0237	Stantec [b]
SO_2	g/s	0.130	Stantec [b]	0.0043	Stantec [b]	0.001	Stantec [b]	0.0009	Stantec [b]

Source Identification		BHGE PGT25+ Gas Turbine	Source of Data	Waukesha Gas Generator L5794GSI	Source of Data	Seal Gas Vapour Combustors	Source of Data	Auxiliary Utility Glycol Heaters	Source of Data
CO	g/s	2.291	Stantec [b]	0.0538	Stantec [b]	0.016	Stantec [b]	0.0199	Stantec [b]
$PM_{2.5}$	g/s	0.032	Stantec [b]	0.0031	Stantec [b]	0.0003	Stantec [b]	0.0004	Stantec [b]

Notes:
[a] Provided by CGL
[b] Calculated by Stantec
[c] Manufacturer data for Waukesha Gas Generator L5794GSI (Innio, 2019), (CGL, 2019)
[d] Source: (CEPEI, 2024)
[e] Source: (U.S. EPA, 1998)
The emission rates provided are for each unit, not cumulative. The cumulative emissions are presented in Section 6.3.

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.

Legend

Building

Fenceline

Emission Source

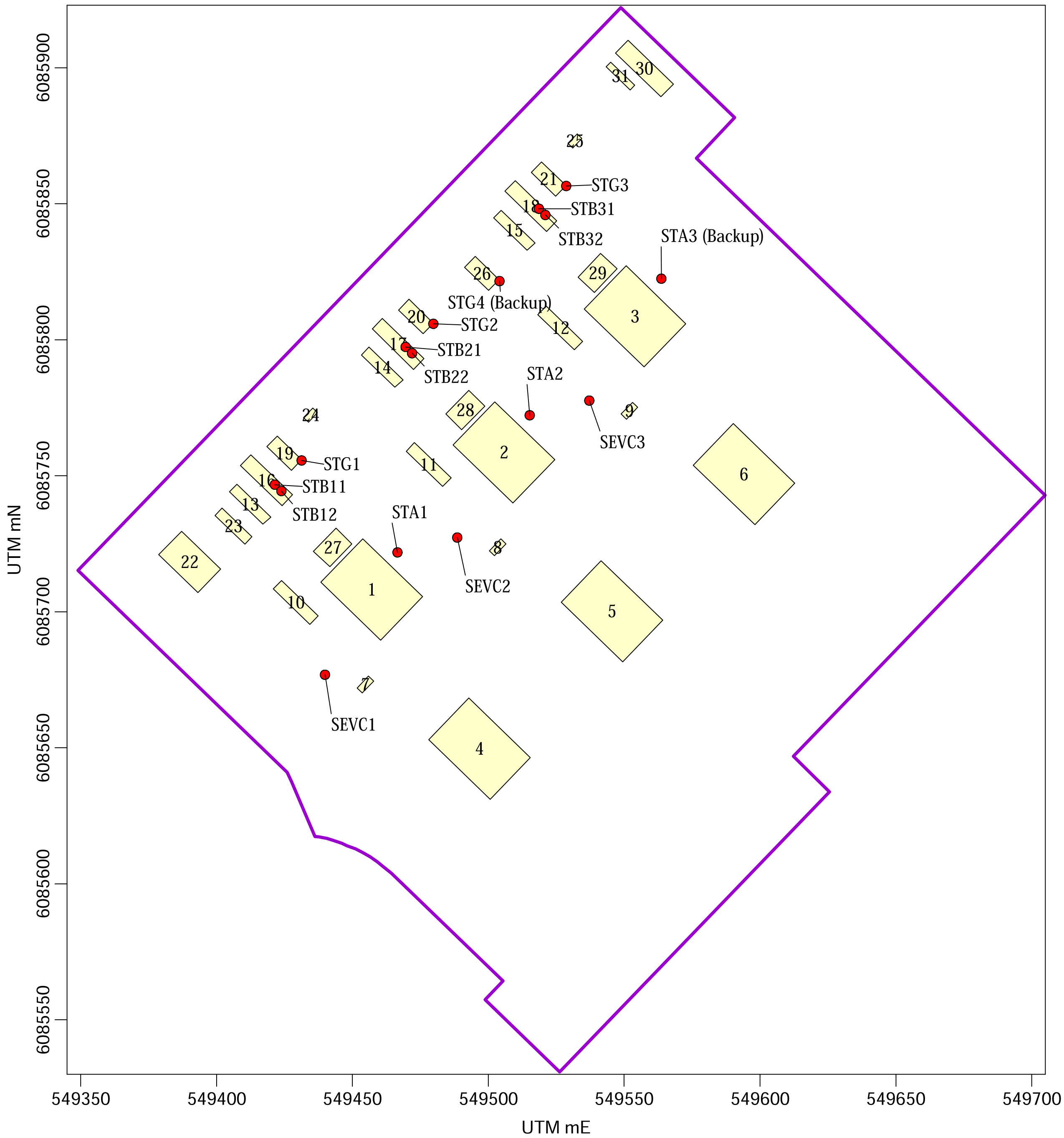
Note: Data sets sourced on this map are available from the CGP PDP Metadata System

REVISION	DESCRIPTION
0	Issued for Information

UTM Zone 10 NAD 83

0m 50m 100m

N W E S



1-3	Compressor Buildings for Unit A1, A2, and A3
4-6	Air Cooled Heat Exchangers for Unit A1, A2, and A3
7-9	Utility Gas Enclosures for Unit A1, A2, and A3
10-12	Local Control Module Buildings for Unit A1, A2, and A3
13-15	Electrical Buildings for Unit A1, A2, and A3
16-18	Mechanical Buildings for Unit A1, A2, and A3
19-21	APU Buildings for Unit A1, A2, and A3
22	Heated Storage Building
23	Personnel Building
24	Drum Rack Building 1
25	Drum Rack Building 2
26	Unit A0 Stand-By PPU Building
27-29	Air Intakes for Unit A1, A2, and A3
30	Living Quaters
31	Fresh Water and Drain Tank Building

STB11	Unit A1 Boiler Exhaust 1
STB12	Unit A1 Boiler Exhaust 2
STB21	Unit A2 Boiler Exhaust 1
STB22	Unit A2 Boiler Exhaust 2
STB31	Unit A3 Boiler Exhaust 1
STB32	Unit A3 Boiler Exhaust 2
STG1	Unit A1 Gen. Skid Exhaust 1
STG2	Unit A2 Gen. Skid Exhaust 2
STG3	Unit A3 Gen. Skid Exhaust 3
STG4	Unit A0 Gen. Skid Exhaust (Backup)
STA1	Compressor Unit A1 Exhaust
STA2	Compressor Unit A2 Exhaust
STA3	Compressor Unit A3 Exhaust (Backup)
SEVC1	Seal Gas Combustor 1
SEVC2	Seal Gas Combustor 2
SEVC3	Seal Gas Combustor 3

Coastal GasLink Pipeline Project

TC Energy

Figure 6.1
Simplified Plot Plan for
Mount Bracey Compressor Station (KP 163)

Dec3 2024

Rev 0

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.

Two scenarios have been identified to examine the air quality implications of the Project: the Project-Alone Case and the Application Case. There are no facilities near the Project, therefore, Base Case is not modelled.

Project-Alone Case: The Project will have a total of three gas turbines, four gas generators, six glycol heaters, and three seal gas vapour combustors. During normal operations, The Project-Alone Case modelling scenario includes emissions from two BHGE PGT25+ gas turbines, and three Waukesha gas generators, three seal gas vapour combustors and six heaters. Occasionally, the stand-by turbine or generator will become operational to take the load off an operating unit so that the operating unit can be shut down (Section 5). These switching events (when three turbine units or four generators are operating) are infrequent (i.e., less than 50 events per year), and short duration, lasting less than 20 minutes. Because of the infrequent and short duration of the switching event, the emissions (with all three turbines or all four generators running) will not be included in the modelling but will be discussed qualitatively in the Technical Assessment Report. Emission rates for the Project-Alone Case are assumed to be consistent with the hourly, daily, and annual rates for full equipment capacity. A summary of emissions is shown in Table 6.1. Units designated as backup, emergency, or on standby will be depicted in the modelling exercise as not operating.

Application Case will include the sources from the Project-Alone Case, with baseline concentrations added (Table 8.2). The term “baseline” is being used to describe existing air quality conditions and the contribution from existing sources not included in the modelling (Section 8).

The modelling scenarios are summarized in Table 6.2 and the summary of scenario emissions is presented in Table 6.3.

Table 6.2 Summary of Emission Sources for each Modelling Scenario at Mount Bracey CS

Equipment	Project-Alone Case	Application Case
BHGE PGT25+ Gas Turbine (2 units)	x	x
Waukesha Gas Generator L5794GSI (3 units)	x	x
Seal Gas Vapour Combustor (3 units)	x	x
Glycol Heaters (6 units)	x	x
Baseline	N/A	x

Table 6.3 Emissions Summary for each Modelling Scenario

Modelling Scenario	Emissions (tonnes/year)			
	NO_X	SO_2	$PM_{2.5}$	CO
Project-Alone Case, Total	231	8.8	2.4	155
Application Case, Total [a]	231	8.8	2.4	155

Notes:
[a] The Application Case, Total emissions represent the emissions resulting from the Project-Alone Case plus baseline concentrations.

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.

‘During normal operations, there is no variability in source emission rates associated with Project emission sources. See unit switching events description in Section 5.

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

Reduced capacity emission scenarios are not applicable for normal operations. Equipment is assessed as operating at 100% capacity continuously.

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

There are no batch processes associated with the Project.

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. (BC ENV 2022b)*.*

During normal operations, there is no variability in source emission rates associated with Project emission sources.

7 Applicable Air Quality Objectives

7.1 British Columbia 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 British Columbia ENV have stated that the British Columbia AQOs are applicable beyond the facility fence line ((BC ENV, 2016), (BC ENV, 2020)). Where exceedances of the AQO are predicted through dispersion modelling, the British Columbia ENV considers the context of magnitude, frequency, timing, and proximity to sensitive receptors. Should there be exceedances of the AQO, the British Columbia ENV 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 ((BC ENV, 2020)).

The regulatory criteria in British Columbia for NO_2, SO_2, $PM_{2.5}$ and CO applicable to this assessment are shown in Table 7.1 (BC ENV, 2021a).

The AQOs for NO_2 are 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. They are not intended 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 7.1 British Columbia Air Quality Objectives

Substance	Averaging Interval	British Columbia Air Quality Objective ($\mu g/m^3$)
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 NO_2 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 NO_2 is based on the average of all 1-hour average concentrations over a single calendar year

[c] Achievement for 1-hour SO_2 is based on 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 SO_2 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: (BC ENV, 2021a)

British Columbia ENV has not stated if the 2025 CAAQS will be adopted. Regulatory agencies have expressed an interest in referencing objectives other than the AQO assessments. Specifically, they are interested in referencing the Canadian Ambient Air Quality Standards (CAAQS) for other years (CCME, 2021). The 2025 CAAQS are provided in this assessment for information purposes. Effects on air quality will be evaluated using the British Columbia AQO (BC ENV, 2021a). The regulatory criteria applicable to this assessment are shown in Table 7.2 which lists the CAAQS for the year 2025 for NO_2 and SO_2, and 2020 for $PM_{2.5}$.

Table 7.2 2025 Canadian Air Quality Standards

Substance	Averaging Interval	Air Quality Objective ($\mu g/m^3$)
NO_2	1-hour	79[a]
	Annual	23[b]
SO_2	1-hour	170[c]
	Annual	11[d]
$PM_{2.5}$	24-hour	27
	Annual	8.8

Notes:

The other regulatory criteria are for the year 2025 for NO_2 and SO_2, and 2020 for $PM_{2.5}$. The statistical forms for each are the same as for the applicable regulatory criteria Table 7.1.

[a] Achievement for 1-hour NO_2 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 NO_2 is based on the average of all 1-hour average concentrations over a single calendar year

[c] Achievement for 1-hour SO_2 is based on 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 SO_2 is based on the average of 1-hour concentrations averaged over one year.

Source: (CCME, 2021)

7.2 Other Regulatory Criteria

Other criteria important for assessment of potential air quality effects have been included. For this assessment it includes the critical levels listed in the International Cooperative Programme on Modelling and Mapping of Critical Levels and Loads and Air Pollution Effects, Risks and Trends (CLRTAP (Convention on Long-range Transboundary Air Pollution), 2004).

The critical levels employed in this assessment are presented in Table 7.3. They consider the annual average concentrations for NO_X. Note that the NO_X parameter is "NO_X as NO_2" ($NO_X = NO + NO_2$), and not NO_2 alone.

Table 7.3 Criteria from Other Jurisdictions (Critical Levels)

CAC	Averaging Interval	Critical Level ($\mu g/m^3$)	Vegetation Note
NO_X as NO_2	Annual	30	Protective of 95% of species at a 95% confidence level
SOURCE: (CLRTAP (Convention on Long-range Transboundary Air Pollution), 2004)			

Should exceedances of the critical levels be predicted a suitable management and monitoring plan will be discussed in the Application.

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)
_____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 (BC ENV, 2022b)) states that baseline may be determined from air quality monitoring data or may be estimated from modelling other 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 this Project, baseline will be determined by an ambient monitoring station from representative monitoring stations at different locations. 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.

Measured concentrations for NO_2, SO_2, $PM_{2.5}$, and CO were reviewed for a number of existing continuous monitoring stations in British Columbia that were deemed representative of the study area by considering similarities in emission sources (i.e., industrial, transportation, home heating), terrain influence, and meteorology. The monitoring stations reviewed included Blueberry First Nation School, Pine River Hasler, Peace Valley Attachie Flat Upper Terrace, and Kamloops Brocklehurst.

The Blueberry First Nation School monitoring location, is located 212 km northeast of the Project and considered conservative and representative for background NO_2 concentrations, including influences from rural residential heating and traffic, with little to no influence from a major industrial NO_X emission source. The Pine River Hasler monitoring station is located 76 km north of the Projectand is used to assess baseline ambient concentrations for SO_2. This monitoring station is considered representative of the area due to its rural location. The Peace Valley Attachie Flat Upper Terrace monitoring station is located 156 km northeast of the Projectand provided the $PM_{2.5}$ baseline ambient data. This monitoring station is considered representative of the area due to its rural location. The Kamloops Brocklehurst monitoring station located 491 km south-southeast of the Projectand was used to assess baseline ambient concentrations for CO. It is noted that the Kamloops Brocklehurst continuous monitoring station is within an urban area, therefore, their measured background concentrations are expected to be generally higher than what is typical for the remote areas where the Project is located. There is limited CO monitoring in British Columbia and no CO monitoring in rural areas.

Continuous monitoring data are derived from the most recent and representative years of ambient air quality data in British Columbia ENV's annual summaries of British Columbia ambient air quality data (BC ENV, 2024). Data from monitoring stations is used in the baseline determination if the quarterly data validity meets or is greater than the minimum 75% threshold. A summary of monitoring station locations and substances reviewed are provided in Table 8.1.

Table 8.1 Summary of Monitoring Stations Locations and Substances Monitored

Monitoring Station	Elevation (m asl)	Location (UTM NAD83)			Data Period	Substances Monitored			
		m E	m N	Zone		NO_2	SO_2	$PM_{2.5}$	CO
Blueberry First Nation School	675	616,089	6,285,782	10U	6/23/2016 to 11/29/2017	x	-	-	-
Pine River Hasler	602	564,672	6,162,659	10U	2021 to 2023	-	x	-	-
Peace Valley Attachie Flat Upper Terrace	480	597,982	6,232,937	10U	2019 to 2021	-	-	x	-
Kamloops Brocklehurst	347	683,824	5,619,419	10U	2010	-	-	-	x

Section 8.1.4 of the Guideline (BC ENV, 2022b) recommends developing baseline values using high percentile values which characterize baseline as a large increment of measured values (i.e., the 98^{th} percentile for other substances hourly and daily averages, and the mean values for annual averages). These values represent the greatest effects of all local industrial sources, natural background concentrations (globally and regionally), plus minor sources (local home heating, vehicle emissions, food preparation, and road dust). Baseline concentrations for the Project air quality assessment are provided in Table 8.2.

The NO_2 Guidance (BC ENV, 2022c) provides three options to add baseline NO_2 to dispersion modelling predictions. For the this work the 288-value array option is used. This array is comprised of the first highest measured value for each hour in each month, then average over the monitoring period. The

Blueberry First Nation School monitoring data is used to derive the 288-value array and are from the most recent and representative years of ambient air quality data obtained from the British Columbia Air Data Archive Website (BC ENV, 2024). The 288-value array carried through as the baseline values are presented in Table 8.3.

Table 8.2 Summary of Baseline CAC Concentrations [a]

Substance	Averaging Period	Baseline Concentration ($\mu g/m^3$)
NO_2 [b]	1-hour [c]	16.6
	Annual [d]	2.1
SO_2 [e]	1-hour [f]	11.5
	Annual [g]	0.9
$PM_{2.5}$ [h]	24-hour [i]	18.6
	Annual [j]	4.5
CO [k]	1-hour [l]	515.2
	8-hour [l]	515.2

Notes:

[a] Baseline air quality data was developed by Stantec from BC Air Data Archive Website and British Columbia ENV 1998-2023 summary spreadsheets (BC ENV, 2024). Conversions from ppb or ppm to $\mu g/m^3$ assume standard conditions of 25°C and 101.325 kPa.

[b] **NO_2:** The database for NO_2 observations used for baseline at Blueberry First Nation School are for 6/23/2016 to 11/28/2017.

[c] **NO_2:** The 1-hour baseline NO_2 concentration was determined based on the 98th percentile of the daily 1-hour maximum concentrations over for 2017 (BC ENV, 2024). This value is provided here for characterizing existing conditions. Baseline NO_2 concentrations used for dispersion modelling are provided in the 288-value array in Table 8.3.

[d] **NO_2:** The annual NO_2 baseline concentration was determined based on the average of 1-hour values for 6/23/2016 to 11/28/2017.

[e] **SO_2:** The British Columbia ENV summary database for SO_2 observations at Pine River Hasler are for 2021 - 2023.

[f] **SO_2:** The 1-hour baseline SO_2 concentration was determined based on the daily 1-hour maximum concentrations, followed by the calculation of the 99th percentile for each year, then averaged over the 3-year period.

[g] **SO_2:** The annual SO_2 baseline concentration was determined based on the average of annual mean values for the 3 year period.

[h] **$PM_{2.5}$:** The British Columbia ENV summary database for $PM_{2.5}$ observations at Peace Valley Attachie Flat Upper Terrace are for 2019 - 2021.

[i] **$PM_{2.5}$:** The 24-hour $PM_{2.5}$ baseline concentration was determined based on average of the 98th percentile values for the 24 hour averaging interval over the 3-year period.

[j] **$PM_{2.5}$:** The annual $PM_{2.5}$ baseline concentration was determined based on the average of the annual mean values over the 3-year period.

[k] **CO:** The British Columbia ENV summary database for CO observations at Kamloops Brocklehurst is for 2010, which is the most recent year.

[l] **CO:** The 1-hour and 8-hour baseline CO concentrations were determined based on the 98th percentile of 1-hour CO concentrations for 2010.

Table 8.3 288-Value Array NO_2 Baseline Summary using Blueberry First Nation School Monitoring Data

Hour of Day	NO_2 Baseline Value ($\mu g/m^3$)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	13.9	13.2	8.5	3.2	3.0	5.3	3.0	3.2	4.7	5.6	16.5	12.4
1	13.0	5.8	13.2	2.8	34.0	5.3	2.8	3.4	3.9	5.1	16.2	12.0
2	13.2	7.9	9.4	7.7	11.8	5.3	3.0	3.9	4.1	5.1	15.6	13.0
3	12.0	5.8	10.9	5.5	6.6	4.7	3.0	3.9	3.2	4.1	13.7	13.7
4	12.4	8.8	10.5	4.7	8.6	4.1	3.8	4.1	3.0	3.9	11.5	14.5
5	13.0	6.2	7.9	4.9	9.4	3.8	3.0	5.5	2.6	3.9	11.8	18.4
6	11.5	6.8	6.4	6.6	7.5	3.0	2.8	9.2	2.4	3.9	10.0	16.7
7	10.5	8.1	8.1	5.8	2.6	3.6	3.2	7.3	3.0	7.9	10.2	17.1
8	11.3	8.6	7.7	4.3	2.8	3.6	3.6	3.9	2.3	7.1	12.4	17.7
9	10.5	15.8	9.6	3.2	3.2	3.0	4.9	3.9	3.4	7.0	13.0	19.4
10	7.3	8.5	7.9	4.5	2.6	4.1	3.0	4.5	3.2	6.0	9.8	14.9
11	6.2	8.3	6.8	3.8	1.9	3.4	4.5	4.9	3.8	5.6	10.2	11.1
12	8.1	7.5	5.6	3.4	2.3	2.1	3.2	4.9	3.2	5.3	9.8	10.3
13	8.5	8.3	4.7	3.0	2.6	2.1	3.8	4.3	1.9	4.1	9.2	9.0
14	8.1	9.0	4.7	1.5	2.1	2.4	2.1	3.9	1.5	3.8	9.2	8.6
15	10.3	12.0	5.5	3.4	2.1	1.7	2.8	3.2	1.1	3.8	12.4	9.0
16	12.6	12.6	6.0	3.6	2.3	2.1	2.1	3.4	1.5	4.5	15.8	11.5
17	19.4	10.7	7.3	2.4	1.7	2.3	1.3	3.2	1.7	4.1	16.9	14.5
18	21.2	19.0	9.6	2.6	4.7	3.0	1.3	3.6	3.0	4.9	16.5	12.8
19	21.2	17.3	19.6	4.1	2.4	3.0	2.1	3.4	3.8	4.5	15.4	16.7
20	22.9	17.1	10.3	7.0	3.8	2.8	3.4	1.9	3.4	6.8	12.6	12.8
21	20.5	18.6	9.8	6.2	7.9	4.1	3.4	3.2	4.3	6.4	13.2	12.2
22	16.7	16.7	10.3	4.3	4.5	5.3	4.7	3.0	4.9	5.8	8.6	11.7
23	16.2	15.6	9.2	4.7	4.1	5.3	3.2	3.2	4.3	4.9	14.9	11.8

Notes:

Blueberry First Nation School monitoring data for 2016 to 2017 (BC ENV, 2024).

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), and 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 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.

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

Table 9.1 Building Dimensions

Building ID	Description	Length (m)[a]	Width (m)[a]	Height (m)[b]
Mount Bracey CS				
1	Unit A1 Compressor Building	30.7	22.3	15.5
2	Unit A2 Compressor Building	30.7	22.3	15.5
3	Unit A3 Compressor Building	30.7	22.3	15.5
4	Unit A1 Air Cooled Heat Exchangers	32.9	21.4	7.3
5	Unit A2 Air Cooled Heat Exchangers	32.9	21.4	7.3
6	Unit A3 Air Cooled Heat Exchangers	32.9	21.4	7.3
7	Unit A1 Utility Gas Enclosure	6.1	1.7	4.1
8	Unit A2 Utility Gas Enclosure	6.1	1.7	4.1
9	Unit A3 Utility Gas Enclosure	6.1	1.7	4.1
10	Unit A1 Local Control Module Building	18.7	4.4	4.6
11	Unit A2 Local Control Module Building	18.7	4.4	4.6
12	Unit A3 Local Control Module Building	18.7	4.4	4.6

Building ID	Description	Length (m)[a]	Width (m)[a]	Height (m)[b]
13	Unit A1 Electrical Building	17.4	4.0	4.5
14	Unit A2 Electrical Building	17.4	4.0	4.5
15	Unit A3 Electrical Building	17.4	4.0	4.5
16	Unit A1 Mechanical Building	21.3	5.5	6.4
17	Unit A2 Mechanical Building	21.3	5.5	6.4
18	Unit A3 Mechanical Building	21.3	5.5	6.4
19	Unit A1 APU Building	12.5	5.5	6.2
20	Unit A2 APU Building	12.5	5.5	6.2
21	Unit A3 APU Building	12.5	5.5	6.2
22	Heated Storage Building	20.0	12.0	4.5
23	Personnel Building	15.2	3.8	3.6
24	Drum Rack Building 1	4.8	2.4	4.0
25	Drum Rack Building 2	4.8	2.4	4.0
26	Unit A0 Standby PPU Building	12.2	5.5	6.2
27	Unit A1 Compressor Building Air Intake	12.0	8.2	11.0
28	Unit A2 Compressor Building Air Intake	12.2	8.2	11.0
29	Unit A3 Compressor Building Air Intake	12.2	8.2	11.0
30	Living Quarter	23.3	6.6	11.0
31	Fresh Water and Drain Tank Building	12.3	2.4	11.0

Notes:
[a] Based on the most recent Mount Bracey CS plot plan layout
[b] Building height is the average of peak and eave, estimated or based on site data provided by CGL.

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:

- *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 (BC ENV, 2022b).

The 30 m resolution CEC land cover data (CEC, 2020) is employed by CALMET to develop a 500 m resolution land use file. Figure 10.1 illustrates the land-use classes in the CALMET model domain for the Project. Based on the 500 m CALMET grid resolution data, the domain is comprised of 67.0% evergreen forest, 13.4% deciduous forest, 8.4% rangeland, 7.2% mixed forest, 1.9% shrub rangeland, 1.6% barren land, 0.5% water, and 0.1% perennial snow or ice.

Translation table of 30 m resolution CEC Land Cover Categories to CALMET Categories and seasonal CALMET land-use characterization parameters tables are included in Appendix A.

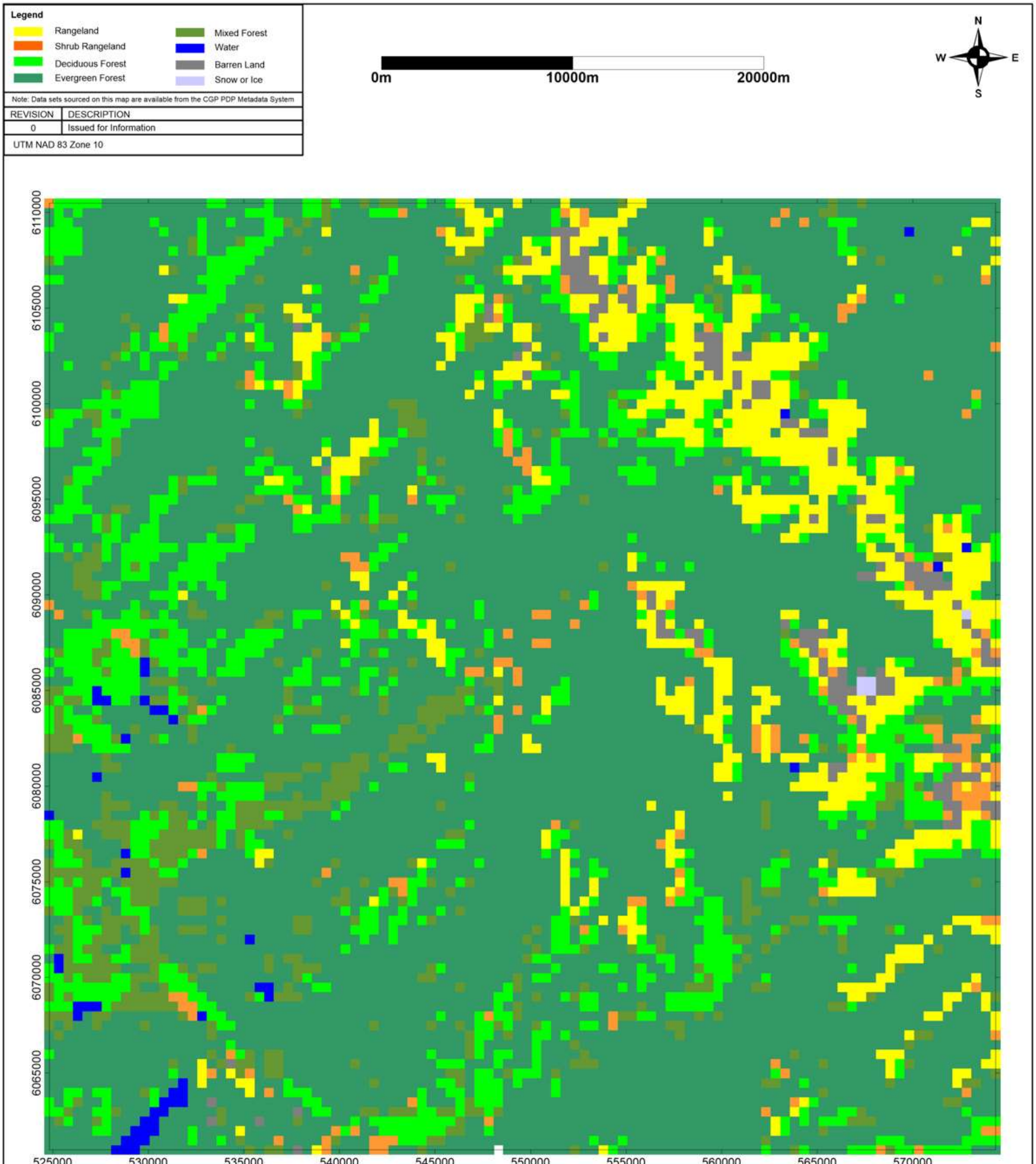


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Figure 10.1
CALMET Land Use Classification

November 2024

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

10.2.1 Surface Meteorological Data

Surface meteorological data will not be used in this assessment because there are no surface meteorological stations within the model domain.

10.2.2 Upper-Air Meteorological Data

Upper air meteorological data will not be used in this assessment because CALMET will derive upper air information from the WRF numerical weather model data.

10.3 Numerical Weather Prediction Model Output

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

BC ENV 2011-2015 4 km grid Weather Research Forecast (WRF) output.

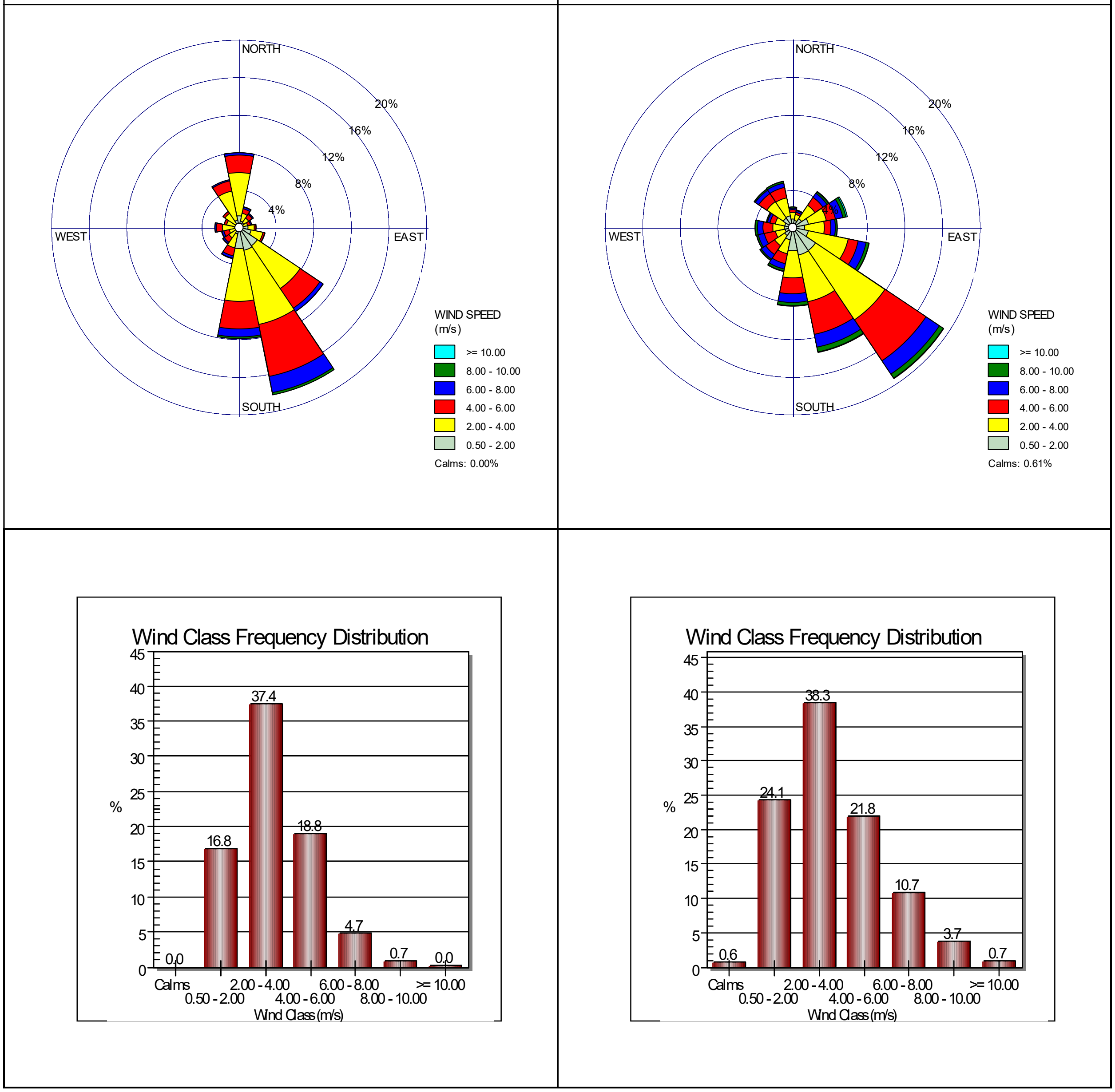
CALMET: Surface and upper station data are not available. Modelling will proceed in WRF-only mode.

Figure 10.2 compares the wind roses generated for the Environment and Climate Change Canada (ECCC) Mackenzie Airport weather station from the WRF model predictions with the wind rose for the same location based on measurements for the five-year period from 2011 to 2015. Mackenzie Airport weather station is the nearest ECCC weather station with valid hourly winds measurements for the 2011-2015 period. Both measured and predicted wind roses show good agreement with the most frequent winds are from southeast and south.

Since the WRF model predictions and measurements are reasonably similar for Mackenzie Airport weather station that are located approximately 71 km west of to the Project site, the WRF model predictions are expected to be representative of meteorological conditions in the model domain. CALMET makes further fine scale adjustments to the wind field to account for terrain and land cover influence.

Figure 10.2 Comparison of Measured and Predicted Surface Winds at ECCC Mackenzie Airport Weather Station (2011–2015)

Measured (2011-2015)	BC ENV WRF (2011-2015)



11 Treatments

11.1 NO to NO_2 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 [BC ENV 2022d]). *Specify the considerations given to ambient concentrations, characteristics of modelled sources, and availability of relevant monitoring data when selecting the NO_2 modelling method indicated above.*

OLM:

- *Indicate which O_3 dataset is used and explain the basis for selecting the O_3 dataset.*
    - *If a single site representative hourly O_3 dataset corresponding to the meteorological period is used, specify the method of data substitution used for addressing data gaps, provide the dataset, and include the completeness statistics (e.g., number of years, percent complete per quarter).*
- *If non default equilibrium ratios are used, specify and provide rationale.*
- *Specify and provide rationale for in-stack ratio(s) used. If multiple NO_X sources are modelled, provide justification for how the ISR(s) is/are selected.*

The NOx concentrations will be predicted using the CALPUFF model. The NOx to NO_2 conversion will be carried out using the ozone limited method (OLM) consistent with Section 3.2.1.3.1 and Appendix C of the Guidance for NO_2 Dispersion Modelling in British Columbia (NO_2 Guidance) (BC ENV, 2022c). The northeast BC ozone data array provided in Appendix C of the NO_2 Guidance will be used for the conversion of NO_X to NO_2 (BC ENV, 2022c). As CALPUFF does not have the capability to apply stack-specific unique in-stack ratio (ISR) values, CGL is proposing to use weighted average ISR values based upon the project NO_X emissions and recommended ISR provided in Appendix B of the NO_2 Guidance. Table 11.1 presents a summary of the recommended ISR, total project NO_X emissions for each equipment class and the emission weighted average ISR of 0.100 that will be used to carry out the NO_X to NO_2 conversion.

Table 11.1 Equipment Specific and Emission Weighted In-Stack Ratios

Equipment Class	Fuel Type	Recommended ISR[a]	Total Project NOx Emissions (t/y)	Emission Weighted ISR
Turbine	Natural Gas	0.065	165	0.100
Reciprocating IC Engine [b]	Natural Gas	0.187	60.3	
Boiler/Heater [c]	Natural Gas	0.100	6.3	

Notes:
[a] The ISR is the in-stack-ratio of NO_2/NO_X and can vary from 0 to 1. A value of 1 indicates 100% of NO_X is NO_2.
[b] The ISR for the reciprocating internal combustion engine will be used for the power generator.
[c] The ISR for the boiler will be used for the vapour seal combustor.

The emission weighted ISR is calculated as follows:

Emission weighted ISR =

(Turbine ISR x Turbine NO_X emissions) + (Reciprocating IC Engine ISR x Reciprocating IC Engine NO_X emissions) + (Boiler/Heater ISR x [Seal Gas Combustor + Heaters] NO_X emissions)

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 (BC ENV, 2022b) will be used. Ammonia and hydrogen peroxide concentrations, nighttime loss and formation rates for nitrates and sulphates are not applicable for this assessment due to the remoteness of the Facility location and the relatively modest quantities of chemically reactive emissions (NO_X and SO_2). Chemical transformations and particle deposition are not employed in this assessment. Ozone is only used in the OLM calculations as discussed in Section 11.1.

11.2.1 Secondary Particulate Formation

CALPUFF model will not be used to predict secondary inorganic $PM_{2.5}$ formation attributable to precursor SO_2 and NO_X emissions.

11.3 Particle Deposition

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

As coarse particulate emissions are expected to be small to negligible, deposition and plume depletion is not modelled.

11.4 Stagnation

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

This assessment employs the CALPUFF dispersion modelling system. CALPUFF is a non-steady-state puff model which simulates dispersion under near-calm and calm conditions (i.e., can treat zero wind speeds). The assessment will summarize frequency of calm conditions.

11.5 Plume Condensation (Fogging) and Icing

Indicate if this will be included (Section 10.6).

Plume condensation and freezing (Fogging and Icing) is not selected as an option because the combustion source plumes have substantial buoyancy and momentum, and they are not particularly moisture laden. Condensing or freezing plumes near ground level are not expected.

12 Quality Management Program

12.1 Model Input Data

Indicate the tests that will be undertaken to assure the quality of the inputs, for geophysical data, meteorological data, NWP data.

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.
- WRF raw data quality assurance and quality control checks (annual wind rose, monthly temperature comparison with the Mackenzie Airport weather station). These checks will be completed using both 2011-2013 raw WRF files.
- 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.

Note: Model input and output files will be submitted to the British Columbia ENV upon request.

12.2 Model Output Data

For CALMET/CALPUFF applications, provide a list of the tests conducted to confirm the quality of the model output (intermediate pre-processing files and concentration/deposition predictions). With respect to the pre-processed files that are prepared for CALPUFF input, there are several tests listed in Section 9.1.1 and 9.1.2 to check the output from the pre-processing utility programs to confirm that they have been properly processed. The quality of the meteorological outputs will be tested to ensure that specific data treatments have been applied properly. For CALMET output there are several tests listed in Section 9.1 in the Guideline (BC ENV 2022b) *to test the quality of the generated meteorological fields.*

The model inputs for this assessment include emission sources (locations and elevation) and emission characteristics, geographic and land use data, and meteorological data. All 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 outputs will be tested to check that specific data treatments have been applied properly. The CALMET Appendix for the technical data report will include plots and graphs as listed in Section 12.1.

13 BCER 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 BCER as necessary. An updated Dispersion Modelling Plan may be necessary. The BCER may ask for additional dispersion modelling scenarios or changes to modelling methodology based on the review of the initial modelling results

Ministry Acceptance of Plan

Name: ______________________________

Date: ______________________________

14 References

BC ENV. (2016, November). *New National Air Quality Standards for SO2.* Retrieved from https://www2.gov.bc.ca/assets/gov/environment/air-land-water/air/reports-pub/fs_so2_caaqs.pdf

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Appendix A CALMET Model Options and Land Use Characterization Parameters

Table A.1 Mount Bracey CS Project Specific CALMET Model Options

Parameter	Default	Project	Comment
Wind Field Model Options:			
IEXTRP	-4	1	No extrapolation is done for no-obs mode model run
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	-	N/A	Maximum radius of influence over land in the surface layer (km) – no surface stations used
RMAX2	-	N/A	Maximum radius of influence over land aloft (km) – no surface stations used
Other Wind Field Input Parameters:			
TERRAD	-	5	Radius of influence of terrain features (km)
R1	-	N/A	Relative weighting of the first guess field and observations in the surface layer (km) – no surface stations used
R2	-	N/A	Relative weighting of the first guess field and observations in the layers aloft (km) – no surface station used
Relative Humidity Parameters:			
IRHPROG	0	1	Use RH from WRF/3D file
Temperature Parameters:			
ITPROG	0	2	Use WRF/3D for surface and upper air temperature data

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	Water Body	51	Water
19	Snow and Ice	90	Perennial Snow or Ice

Table A.3 CALMET Land-use Characterization and Associated Geophysical Parameters for the Season 1 (Mid-Summer)

30 m Resolution CEC Land Cover 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	Water
19	0.200	0.700	0.500	0.150	0.000	0.000	90	Snow and Ice

Notes:
For latitude 55° to 60° N, Season 1 (Mid-Summer) = July; W/m^2 = watts per square metre

Table A.4 CALMET Land-use Characterization and Associated Geophysical Parameters for Season 2 (Autumn)

30 m Resolution CEC Land Cover 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	Water
19	0.200	0.700	0.500	0.150	0.000	0.000	90	Snow and Ice

Notes:
For latitude 55° to 60° N, Season 2 (Autumn) = August and September; W/m^2 = watts per square metre

Table A.5 CALMET Land-use Characterization and Associated Geophysical Parameters for Season 3 (Winter 1)

30 m Resolution CEC Land Cover 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	Water
19	0.200	0.700	0.500	0.150	0.000	0.000	90	Snow and Ice

Notes:
For latitude 55° to 60° N, Season 3 (Winter 1) = October; W/m^2 = watts per square metre

Table A.6 CALMET Land-use Characterization and Associated Geophysical Parameters for Season 4 (Winter 2)

30 m Resolution CEC Land Cover 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	Water
19	0.200	0.700	0.500	0.150	0.000	0.000	90	Snow and Ice

Notes:
For latitude 55° to 60° N, Season 4 (Winter 2) = November, December, January, February, March, and April; W/m^2 = watts per square metre

Table A.7 CALMET Land-use Characterization and Associated Geophysical Parameters for Season 5 (Transitional Spring)

30 m Resolution CEC Land Cover 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	Water
19	0.200	0.700	0.500	0.150	0.000	0.000	90	Snow and Ice

Notes:
For latitude 55° to 60° N, Season 5 (Transitional Spring) =May and June; W/m^2 = watts per square metre

Appendix B Emissions Inventory

B.1 Operational Phase Emission Calculations

Detailed NO_X, SO_2, CO and $PM_{2.5}$ emission calculations are provided for the Project. Fuel gas-fired emission sources include three fuel gas BHGE PGT25+ turbines, three fuel gas Waukesha L5794GSI engine, three seal gas vapour combustors and six utility glycol heaters.

Calculation inputs and natural gas emission factors used for the proposed Project sources are provided in Section 6 of the Dispersion Modelling Plan.

BHGE PGT25+ Gas Turbine

$$NOx\ emission\ rate\ (t/d) = \left(Exhaust\ gas\ flow\ rate\ \left(\frac{kmole}{s}\right)\right) * \frac{NOx\ content\ (ppmv)}{10^6} * NOx\ MW\ \left(\frac{kg}{kmol}\right) * * Unit\ conversion\ \left(\frac{3600\ s}{1\ h}\right) * Unit\ conversion\ \left(\frac{24\ h}{1\ d}\right) * Unit\ conversion\ \left(\frac{1\ tonne}{10^3 kg}\right)$$

$$SO_2\ emission\ rate\ (t/d) = \left(Fuel\ consumption\ \left(\frac{10^3 m^3}{d}\right)\right) * Unit\ Conversion\ (10^3) * \frac{SO_2\ content\ (ppmv)}{10^6} * SO_2\ MW\ \left(\frac{kg}{kmol}\right) * molar\ volume\ \frac{kmol}{m^3} * Unit\ conversion\ \left(\frac{1\ tonne}{10^3 kg}\right)$$

$$CO\ emission\ rate\ (t/d) = \left(Exhaust\ gas\ flow\ rate\ \left(\frac{kmole}{s}\right)\right) * \frac{CO\ content\ (ppmv)}{10^6} * CO\ MW\ \left(\frac{kg}{kmol}\right) * * Unit\ conversion\ \left(\frac{3600\ s}{1\ h}\right) * Unit\ conversion\ \left(\frac{24\ h}{1\ d}\right) * Unit\ conversion\ \left(\frac{1\ tonne}{10^3 kg}\right)$$

$$PM_{2.5}\ emission\ rate\ (t/d) = PM_{2.5}\ emission\ factor\ \left(\frac{g}{GJ}\right) * Heat\ input\ (HHV)\ \left(\frac{GJ}{h}\right) * Unit\ conversion\ \left(\frac{24\ h}{1\ d}\right) * Unit\ conversion\ \left(\frac{1\ tonne}{10^6 g}\right)$$

Waukesha Gas Generator L5794GSI

$$NOx\ emission\ rate\ (t/d) = (Power\ rating\ (LHV)(hp)) * NOx\ emission\ factor\ \left(\frac{g}{hp * hr}\right) * Unit\ conversion\ \left(\frac{24\ h}{1\ d}\right) * Unit\ conversion\ (\frac{1\ tonne}{10^6 g})$$

$$CO\ emission\ rate\ (t/d) = (Power\ rating\ (LHV)(hp)) * CO\ emission\ factor\ \left(\frac{g}{hp * hr}\right) * Unit\ conversion\ \left(\frac{24\ h}{1\ d}\right) * Unit\ conversion\ (\frac{1\ tonne}{10^6 g})$$

The SO_2 and $PM_{2.5}$ emission calculation approaches for the gas generators are the same as for the gas turbines.

Seal Gas Vapour Combustors

$$NOx\ emission\ rate\ (t/d) = \left(NOx\ emission\ factor\ \left(\frac{lb}{MMBtu}\right)\right) * Heat\ Input\ \left(\frac{MMBtu}{h}\right) * Unit\ Conversion\ \left(\frac{lb}{kg}\right) * Unit\ conversion\ \left(\frac{3600\ s}{1\ h}\right) * Unit\ conversion\ \left(\frac{24\ h}{1\ d}\right) * Unit\ conversion\ (\frac{1\ tonne}{10^3 kg})$$

$$CO\ emission\ rate\ (t/d) = \left(CO\ emission\ factor\ \left(\frac{lb}{MMBtu}\right)\right) * Heat\ Input\ \left(\frac{MMBtu}{h}\right) * Unit\ Conversion\ \left(\frac{lb}{kg}\right) * Unit\ conversion\ \left(\frac{3600\ s}{1\ h}\right) * Unit\ conversion\ \left(\frac{24\ h}{1\ d}\right) * Unit\ conversion\ (\frac{1\ tonne}{10^3 kg})$$

The SO_2 and $PM_{2.5}$ emission calculation approaches are the same as for the gas turbines and the gas generators.

Utility Glycol Heaters

The NO_X and CO emission calculation approaches for the heaters are the same as for the seal gas vapour combustors. The SO_2 and $PM_{2.5}$ emission calculation approaches are the same as for the gas turbines, the gas generators and the seal gas vapour combustors.

Appendix B CALMET

Table of Contents

B.1 Introduction B.1
B.2 CALMET Application B.1
B.3 Model Domain B.1
B.4 Topography and Land Cover B.4
B.4.1 Topography B.4
B.4.2 Land-Cover Data B.4
B.5 Meteorological Inputs B.12
B.6 BC ENV 2011–2015 WRF Data B.12
B.7 CALMET Predictions B.16
B.7.1 Predicted Surface Winds Field B.16
B.7.2 Predicted Winds at Project Site B.20
B.7.3 Predicted Surface Temperatures B.22
B.7.4 Predicted Mixing Heights B.22
B.7.5 Predicted Atmospheric Stability Class B.23
B.8 CALMET Model Options B.26
B.9 References B.33

List of Tables

Table B.1 CALMET Model Domain (50 km by 50 km) Coordinates B.2
Table B.2 Five Seasons Applied in CALMET Modeling for the Latitude of 50° to 55° N B.5
Table B.3 CALMET Land-use Characterization and Associated Geophysical Parameters for the Season 1 (Mid-Summer) B.6
Table B.4 CALMET Land-use Characterization and Associated Geophysical Parameters for Season 2 (Autumn) B.7
Table B.5 CALMET Land-use Characterization and Associated Geophysical Parameters for Season 3 (Winter 1) B.8
Table B.6 CALMET Land-use Characterization and Associated Geophysical Parameters for Season 4 (Winter 2) B.9
Table B.7 CALMET Land-use Characterization and Associated Geophysical Parameters for Season 5 (Transitional Spring) B.10
Table B.8 Predicted Stability Class Frequency Distributions (%) at the Project Site (2011-2015) B.24
Table B.9 CALMET Model Options Groups 0 and 1 ..... B.26
Table B.10 CALMET Model Options Group 2: Grid Control Parameters B.27
Table B.11 CALMET Model Options Group 3: Output Options B.28
Table B.12 CALMET Model Options Group 4: Meteorological Data Options B.29
Table B.13 CALMET Model Option Group 5: Wind Field Options and Parameters B.29
Table B.14 CALMET Model Option Group 6: Mixing Height, Temperature and Precipitation Parameters B.32

List of Figures

Figure B.1 Terrain in CALMET Model Domain B.3
Figure B.2 Land-use Classes in CALMET Model Domain B.11
Figure B.3 BC ENV WRF 4km Grids within CALMET Model Domain B.13
Figure B.4 Comparison of Measured and Predicted Surface Winds at ECCC Mackenzie Airport Weather Station (2011–2015) B.14
Figure B.5 Comparison of Measured and Predicted Monthly Average Temperature at ECCC Mackenzie Airport Weather Station (2011–2015) B.15
Figure B.6 Predicted Surface Wind Field for Unstable Conditions (1100 LST July 7, 2015) B.17
Figure B.7 Predicted Surface Wind Field for Stable Conditions (1700 LST January 14, 2015) B.18
Figure B.8 Predicted Surface Wind Field for High Winds Conditions (1600 LST November 16, 2015) B.19
Figure B.9 CALMET Predicted Wind Roses at 4 Levels at the Project Site (2011–2015) B.21
Figure B.10 CALMET Predicted Monthly Average Surface Temperature at the Project Site (2011–2015) B.22
Figure B.11 CALMET Predicted Mean Diurnal Mixing Heights at the Project Site (2011–2015) B.23
Figure B.12 Frequency of Predicted Seasonal PG Stability Class at the Project Site (2011 to 2015) B.25

B.1 Introduction

This appendix provides an overview of the meteorological information used for the dispersion modelling completed for the proposed Mount Bracey Compressor Station (the Project) air quality assessment. The CALMET modelling was completed by following the British Columbia (BC) Air Quality Dispersion Modelling Guideline (the Guideline) (BC ENV, 2022). This 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 three-year period is consistent with the Guideline (BC ENV, 2022). The Weather Research and Forecasting (WRF) model was selected as the prognostic model for this assessment. The 2011–2015 WRF 4 km grid data were obtained from BC ENV (BC ENV, 2021).

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.

A 50 km by 50 km CALMET model domain at 500 m grid resolution was selected for the assessment (see Section C.3). With this grid spacing, it was possible to maximize run time and file size efficiencies while still capturing large-scale terrain feature influences on wind flow patterns.

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 BC ENV WRF 4 km dataset for the years 2011–2015 (BC ENV, 2021) 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.

B.3 Model Domain

The CALMET domain adopted for the Project extends from approximately north of 54.6394 degrees latitude to 55.1377 degrees latitude, and from west of 122.6187 degrees longitude to 121.8301 degrees longitude as shown in Figure B.1. The CALMET Domain covers a 50 km by 50 km (2,500 km2) area. The extents (described above in decimal degrees) are provided in Table B.1 as UTM coordinates.

Table B.1 CALMET Model Domain (50 km by 50 km) Coordinates

Domain Corner	Location (UTM NAD 83, Zone 10)	
	East (m)	North (m)
Southwest	524576	6060740
Northwest	524576	6110740
Northeast	574576	6110740
Southeast	574576	6060740

Legend

Mount Bracey Compressor Station

Water Course

Road

Water Body

Note: Data sets sourced on this map are available from the CGP PDP Metadata System

REVISION	DESCRIPTION
0	Issued for Information

UTM NAD 83 Zone 10

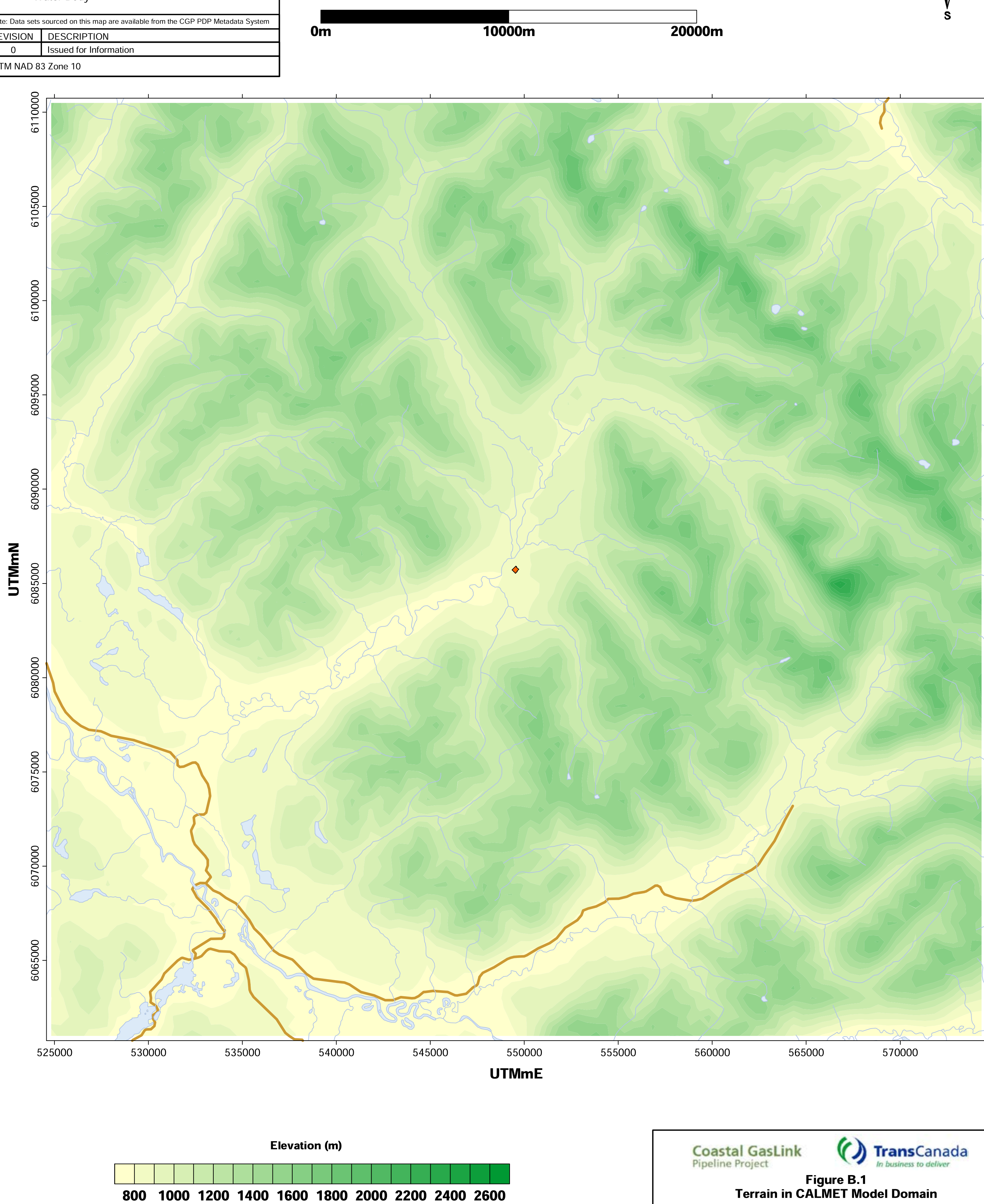

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Figure B.1
Terrain in CALMET Model Domain

January 2025

B.4 Topography and Land Cover

B.4.1 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) (NRCan, 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.

A general overview of the terrain within the CALMET domain is presented in Figure B.1. Terrain in the region is complex with elevations ranging from 717 to 2,403 meters above sea level (m asl). The base elevation at the proposed Project site is approximately 838 m asl.

B.4.2 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. Five seasons (shown in Table B.2) were determined based on Table 4.5 of the Guideline (BC ENV, 2022). Table B.3 to Table B.7 provide 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 (BC ENV, 2022) and CALMET User Guide (Scire et al. 2000). The latter was used in the absence of a specific recommendation in the Guideline (BC ENV, 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.3 to Table B.7.

Land-use classes in the CALMET model domain is presented in Figure B.2. Based on the 500 m grid resolution data, the domain is comprised of 67.0% evergreen forest, 13.4% deciduous forest, 8.4% rangeland, 7.2% mixed forest, 1.9% shrub rangeland, 1.6% barren land, 0.5% water, and 0.1% perennial snow or ice.

Table B.2 Five Seasons Applied in CALMET Modeling for the Latitude of 50° to 55° N

Season	BC ENV 2022 guideline definitions	Months
1	Midsummer with lush vegetation	June and July
2	Autumn with cropland that has not been harvested	August and September
3	Winter 1, later autumn after frost, no snow on the ground	October
4	Winter 2, snow on the ground and subfreezing	November, December, January, February, March and April
5	Transitional spring with partially green short annuals	May

Table B.3 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	Water
19	0.200	0.700	0.500	0.150	0.000	0.000	90	Snow and Ice

NOTES:
For latitude 50o to 55o N, Season 1 (Mid-Summer) = June and July; W/m^2 = watts per square metre

Table B.4 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/m²)	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	Water
19	0.200	0.700	0.500	0.150	0.000	0.000	90	Snow and Ice

NOTES:
For latitude 50° to 55° N, Season 2 (Autumn) = August and September; W/m² = watts per square metre

Table B.5 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	Water
19	0.200	0.700	0.500	0.150	0.000	0.000	90	Snow and Ice

Notes:
For latitude 50° to 55° N, Season 3 (Winter 1) = October; W/m^2 = watts per square metre

Table B.6 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	Water
19	0.200	0.700	0.500	0.150	0.000	0.000	90	Snow and Ice

Notes:
For latitude 50° to 55° N, Season 4 (Winter 2) = November, December, January, February, March, and April; W/m^2 = watts per square metre

Table B.7 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	Water
19	0.200	0.700	0.500	0.150	0.000	0.000	90	Snow and Ice

Notes:
For latitude 50° to 55° N, Season 5 (Transitional Spring) =May; W/m^2 = watts per square metre

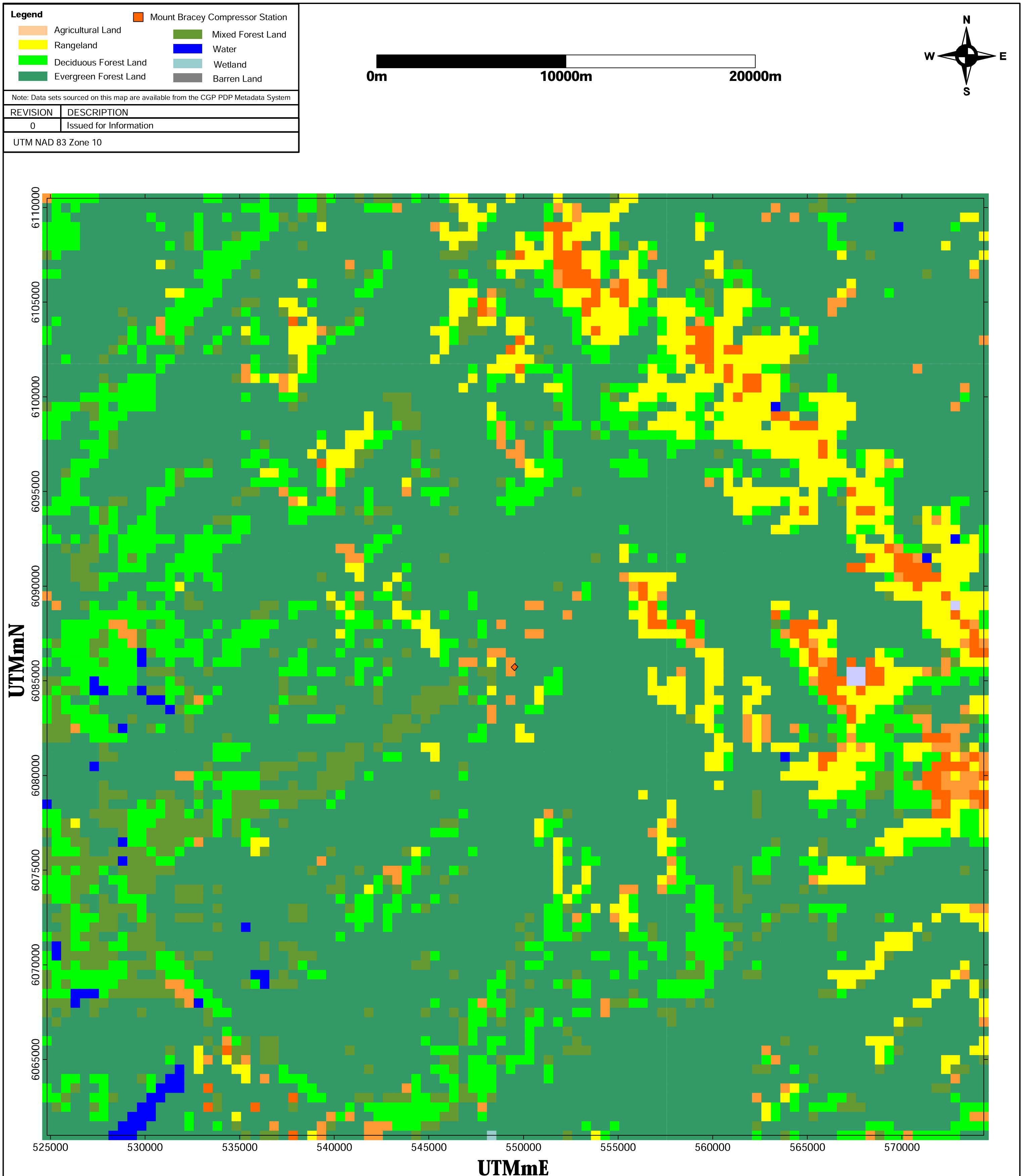

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Figure B.2
Land-Use Classes within CALMET Model Domain

January 2025

B.5 Meteorological Inputs

The CALMET model requires the input of surface and upper air meteorological fields. For this application, CALMET model was run in no-obs mode (BC ENV, 2022) by using WRF (BC ENV, 2021) model output for the period of January 1, 2011, to December 31, 2015. There are no valid hourly surface and upper air data stations within the 50km by 50km CALMET model domain.

B.6 BC ENV 2011–2015 WRF Data

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 (BC ENV, 2022), the outputs are predictions that may not necessarily be representative for the study area. For this reason, BC ENV recommends that WRF data users assess the representativeness of the WRF output at their particular location (BC ENV, 2022).

Figure B.3 shows the BC ENV WRF grid point locations based on 4 km grid resolution within the 50 km by 50 km CALMET model domain.

The Environment and Climate Change Canada (ECCC) Mackenzie Airport weather station was used to determine the representativeness of the WRF data. This station is located approximately 72 km to the northwest 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 three-year period from 2011 to 2015.

Figure B.4 compares the wind roses generated for the Mackenzie Airport station from the WRF model predictions with the wind rose for the same location based on measurements. Both measured and predicted wind roses show good agreement with the most frequent winds are from southeast and south.

Figure B.5 compares the monthly average surface temperatures from the WRF model predictions with measurements at the Mackenzie Airport station. The WRF model predictions show good agreement with observations throughout the three-year period.

Since the WRF model predictions and measurements are similar for the location of the Mackenzie Airport station that is located close to the Project site, the WRF model predictions should also be representative of meteorological conditions in the model domain.

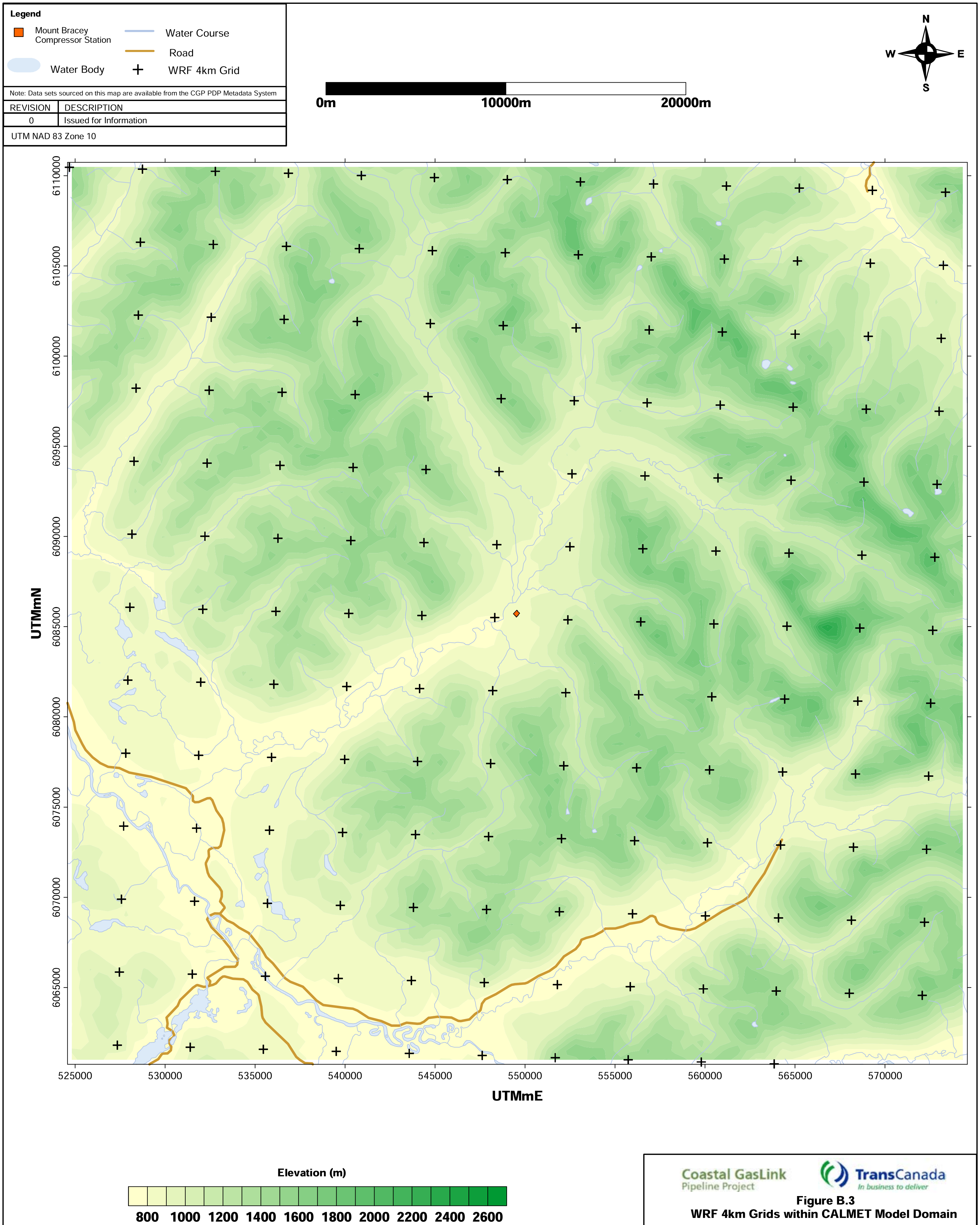

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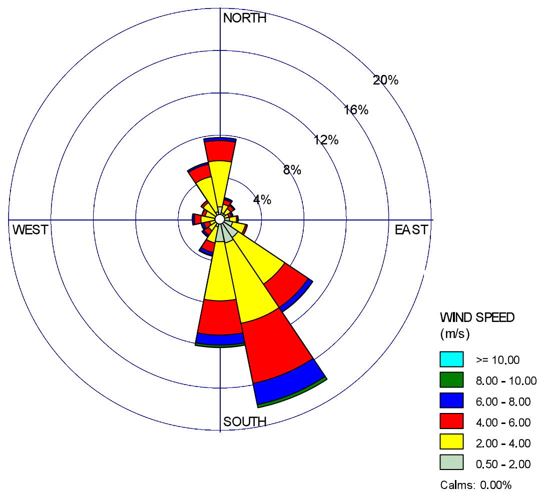
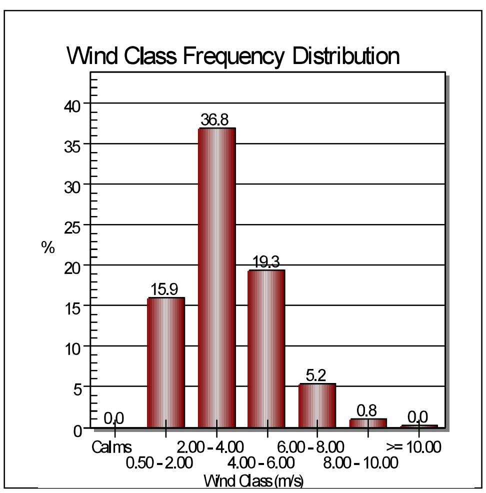
Figure B.3
WRF 4km Grids within CALMET Model Domain

January 2025

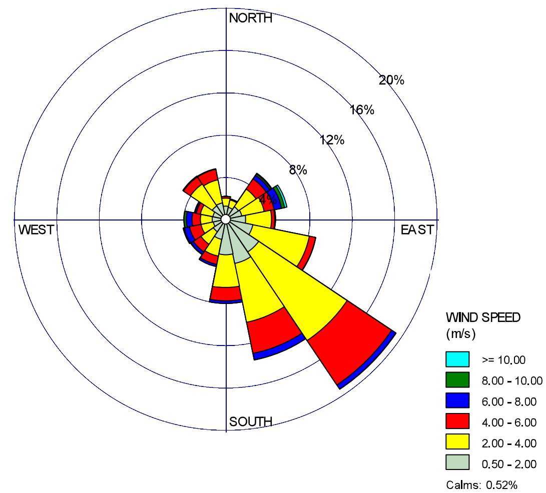
Figure B.4 Comparison of Measured and Predicted Surface Winds at ECCC Mackenzie Airport Weather Station (2011–2015)

Measured





Predicted (BC ENV WRF 4 km)



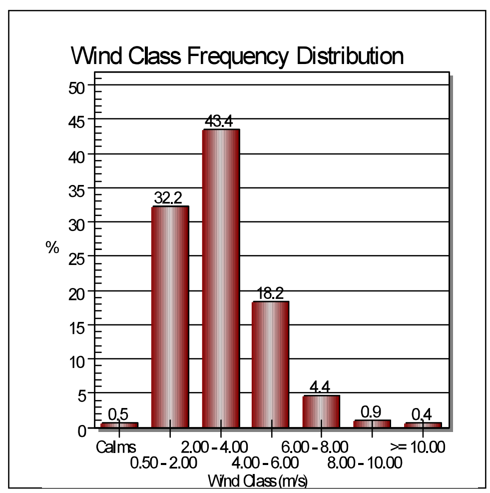
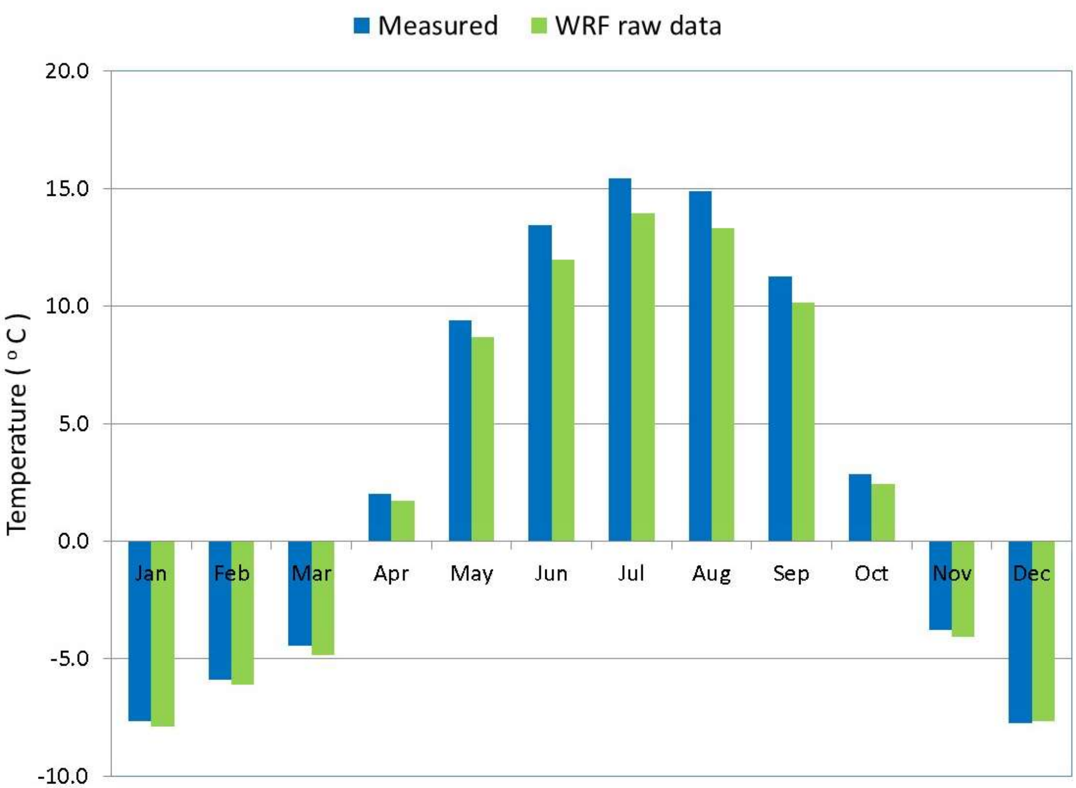


Figure B.5 Comparison of Measured and Predicted Monthly Average Temperature at ECCC Mackenzie Airport Weather Station (2011–2015)



B.7 CALMET Predictions

In order to assess the value of the WRF-CALMET model approach for this assessment, CALMET output 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.7.1 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.6 shows the wind field as a vector plot at 1100 LST on July 7, 2015, for convective (i.e., unstable) conditions (PG class B). Winds in most part of the domain tend to be from the southwest. In the north and east parts of domain, winds were mainly from west. The predicted winds at the Project site are mainly from the southwest.
- Figure B.7 shows the wind field as a vector plot at 1700 LST on January 14, 2015, for stable conditions (PG class F). The winds in the north and east parts of the domain tend to be from the south, whereas those in the south and middle of the domain tend to be lighter and less organized. The predicted winds at the Project site are mainly from the southeast.
- Figure B.8 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 southeast and south across most of the domain. The predicted winds at the Project site are mainly from the southeast with wind speed of 11.1 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 50 km by 50 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.

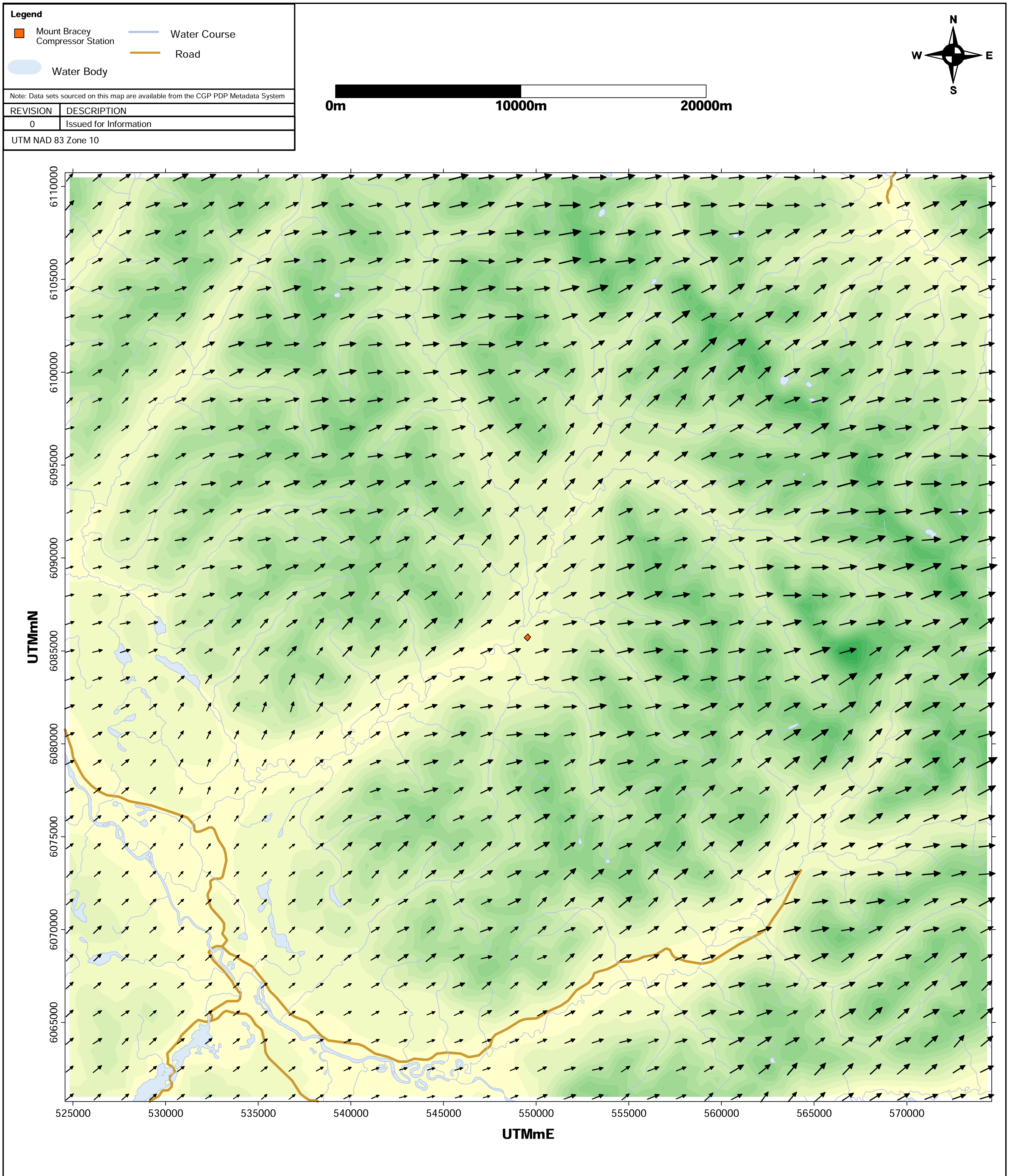


Figure B.6
Predicted Surface Wind Field for Unstable Conditions
(1100 LST July 7, 2015)

January 2025

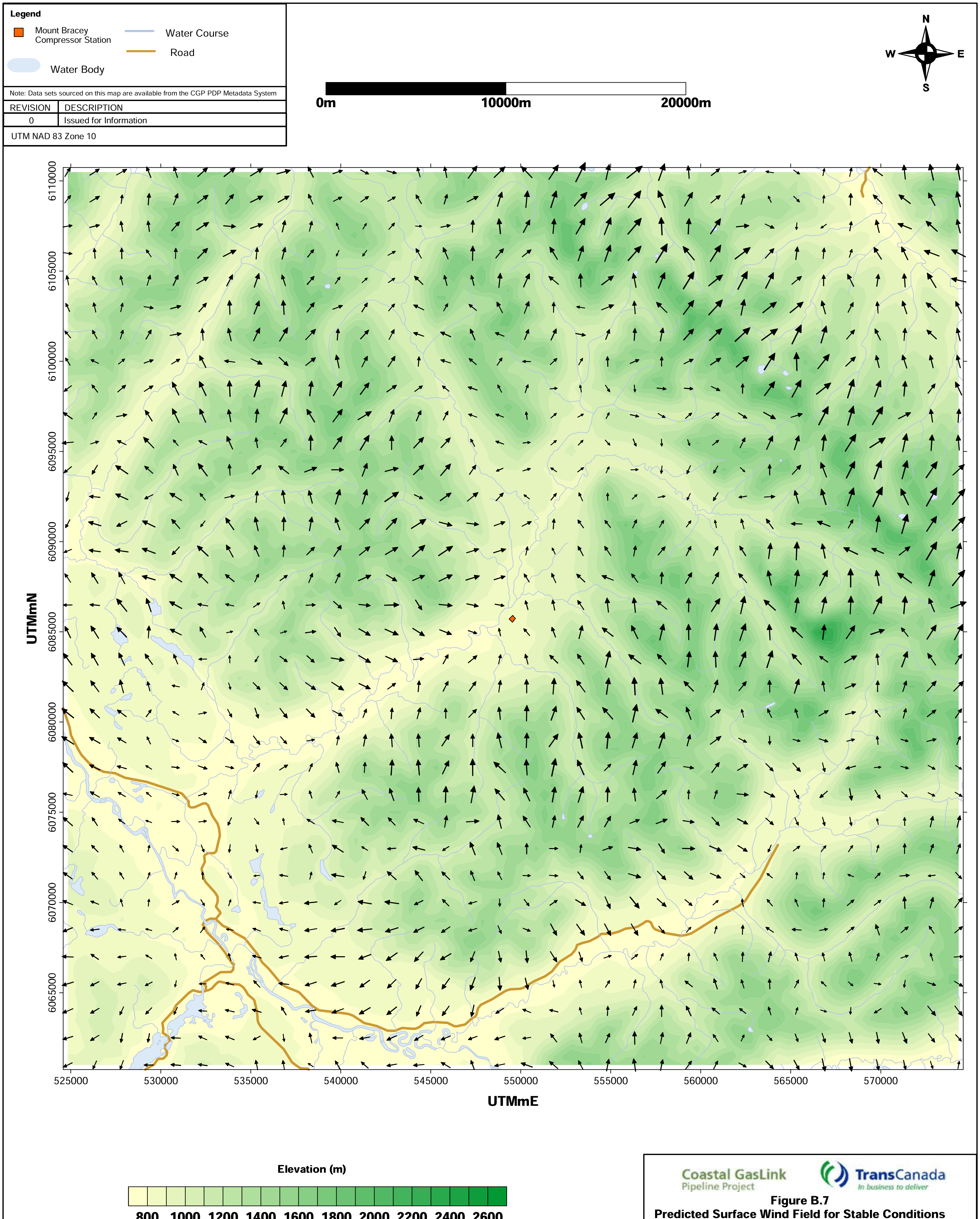


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Figure B.7
Predicted Surface Wind Field for Stable Conditions
(1700 LST January 14, 2015)

January 2025

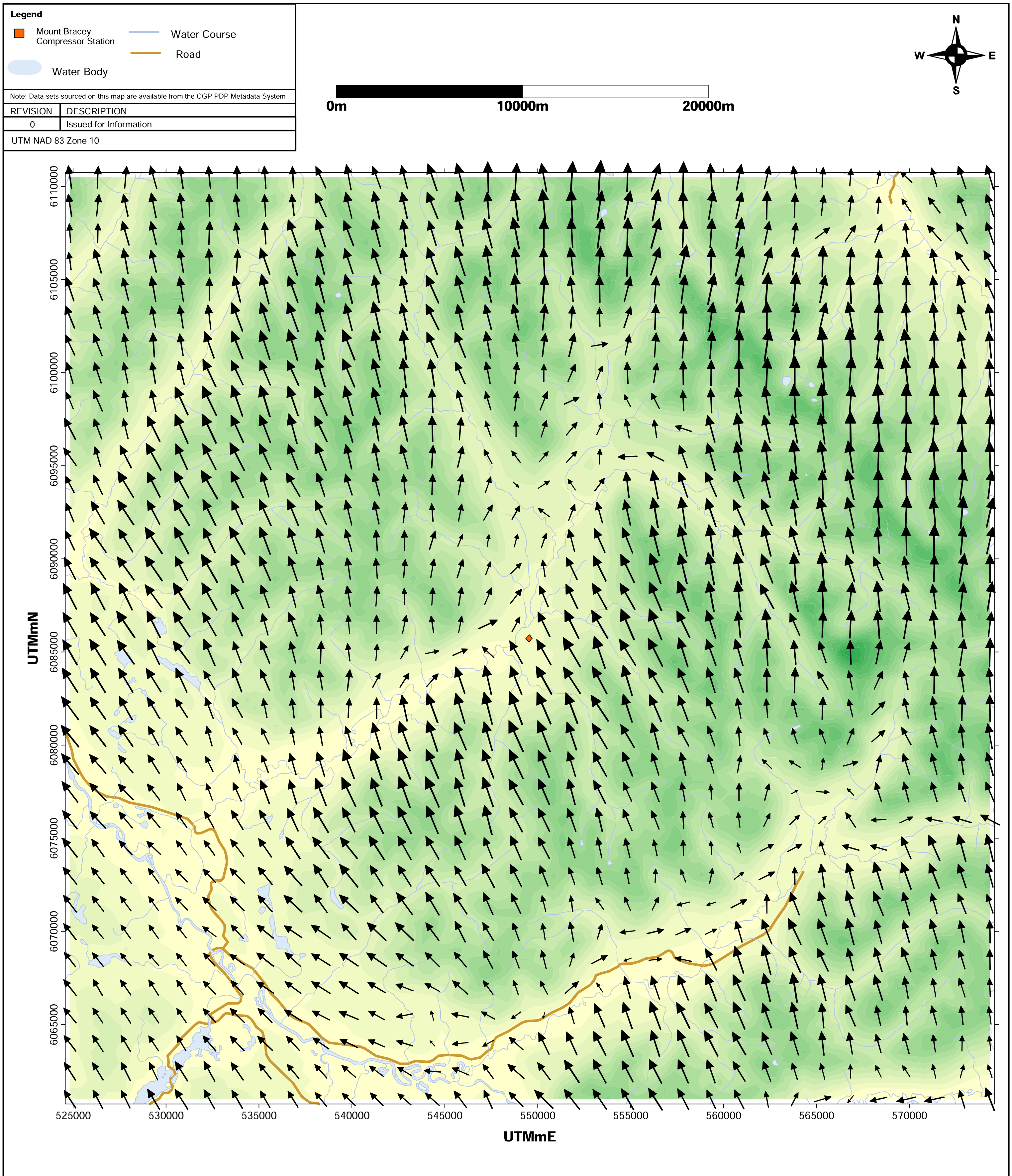

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Figure B.8
Predicted Surface Wind Field for High Winds Conditions (1600 LST November 16, 2015)

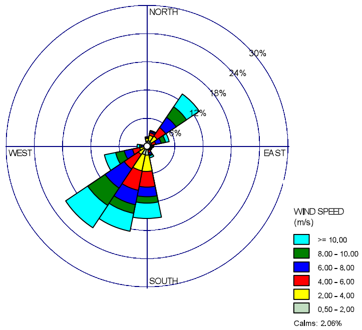
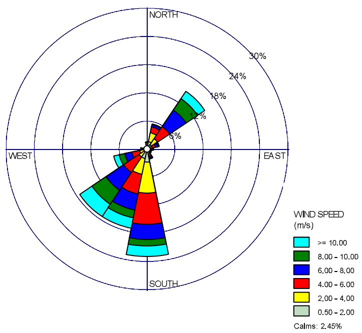
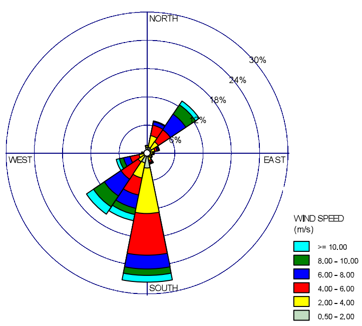
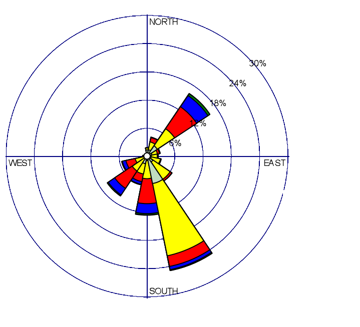
January 2025

B.7.2 Predicted Winds at Project Site

Figure B.9 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 10 m level, winds are mainly from southeast and northeast.
- At 60 m level, winds are mainly from south.
- At 100m and 200 m levels, winds are mainly from southwest and south.
- Wind speed increases with increasing height above the ground

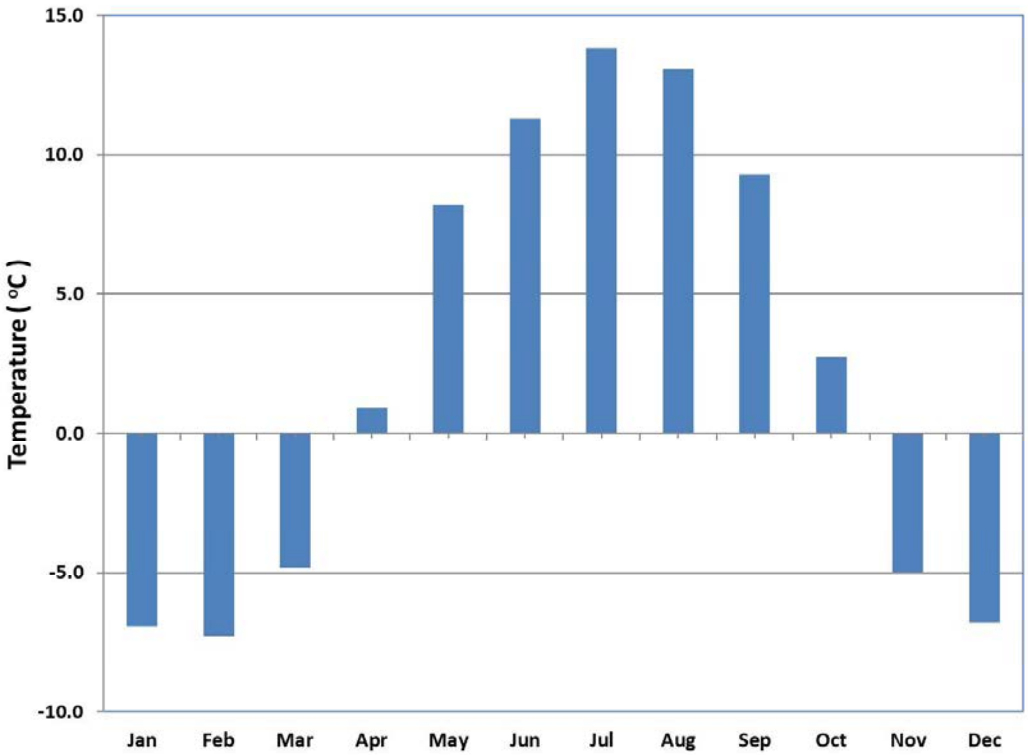
Figure B.9 CALMET Predicted Wind Roses at 4 Levels at the Project Site (2011–2015)

	**200 m**
	**100 m**
	**60 m**
	**10 m**

B.7.3 Predicted Surface Temperatures

Figure B.10 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.10 CALMET Predicted Monthly Average Surface Temperature at the Project Site (2011–2015)



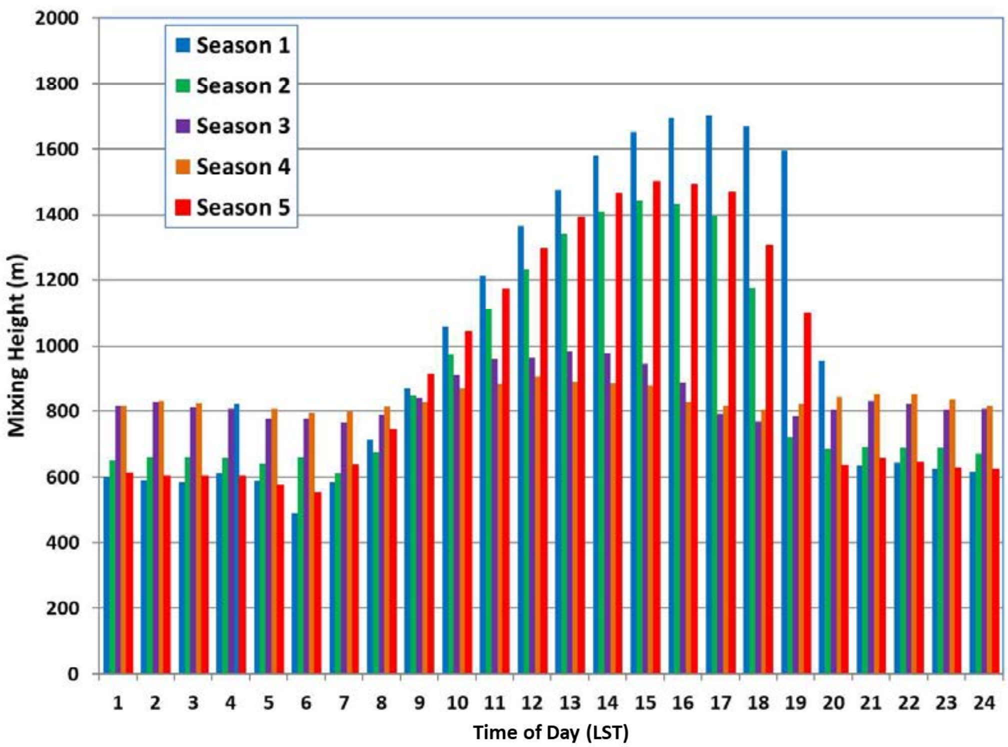
B.7.4 Predicted Mixing Heights

CALMET predicted mean diurnal mixing heights extracted at the Project Site for 2011–2015 are provided in Figure B.11. 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 1,702 m.
- Season 2 (autumn): The mean maximum afternoon values are about 1,442 m.
- Season 3 (winter 1): The mean maximum afternoon values are about 982 m.
- Season 4 (winter 2): The mean maximum afternoon values are about 905 m.
- Season 5 (transitional spring): The mean maximum afternoon values are about 1,500 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.11 CALMET Predicted Mean Diurnal Mixing Heights at the Project Site (2011–2015)



B.7.5 Predicted Atmospheric Stability Class

Table B.8 shows the seasonal predicted stability class frequency distributions for the Project site for 2011–2015. Figure B.12 shows the frequency distributions of predicted seasonal PG stability classes at the Project site on a diurnal basis

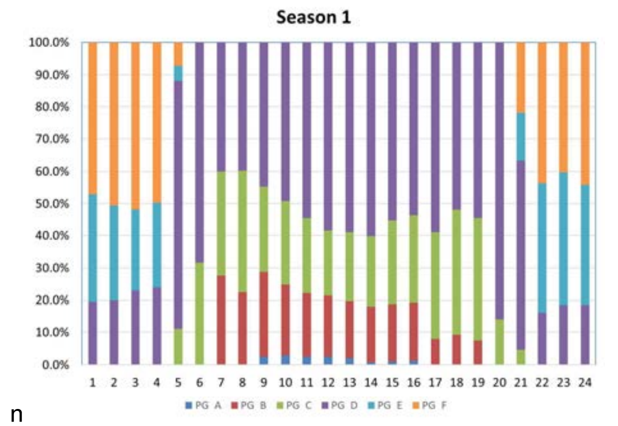
- The neutral condition (Stability Class D) is the most frequent class and is associated with overcast conditions or high wind speed condition.
- Unstable conditions (Stability Classes A, B and C) are more frequent during the summer and spring seasons, and are associated with daytime periods, clear skies and low wind speeds.
- Stable conditions (Stability Classes E and F) are more frequent during the winter and fall seasons, and are associated with nighttime periods, clear skies and low wind speeds.

Table B.8 Predicted Stability Class Frequency Distributions (%) at the Project Site (2011-2015)

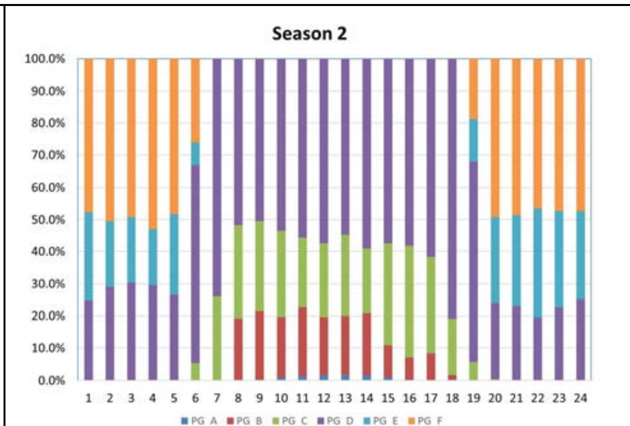
	Number of Hours	A	B	C	D	E	F
Season 1	9120	0.7	9.6	18.1	46.2	10.5	14.8
Season 2	5520	0.3	6.8	13.6	45.5	11.6	22.2
Season 3	7320	0.0	1.2	7.5	61.3	7.4	22.6
Season 4	12624	0.0	0.9	5.6	64.5	8.9	20.1
Season 5	9240	0.3	6.6	15.6	48.2	9.0	20.3
2011–2015	43824	0.2	4.7	11.6	54.3	9.4	19.7

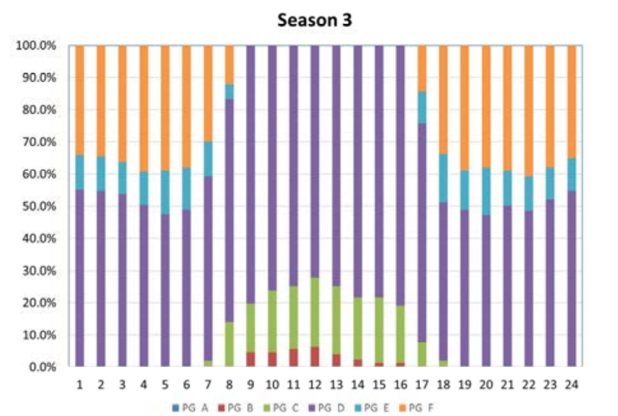
Note:
Definitions of five seasons refer to Table B.2.

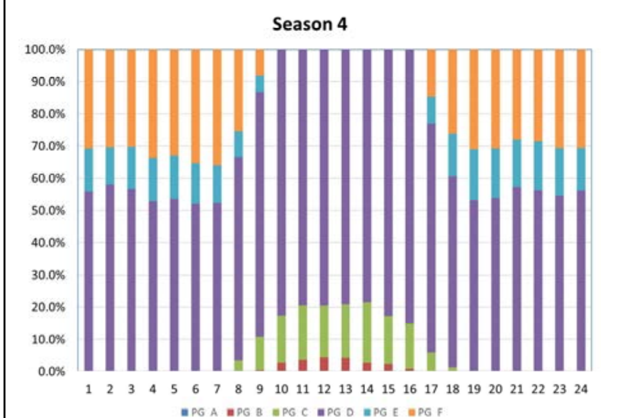
Figure B.12 Frequency of Predicted Seasonal PG Stability Class at the Project Site (2011 to 2015)

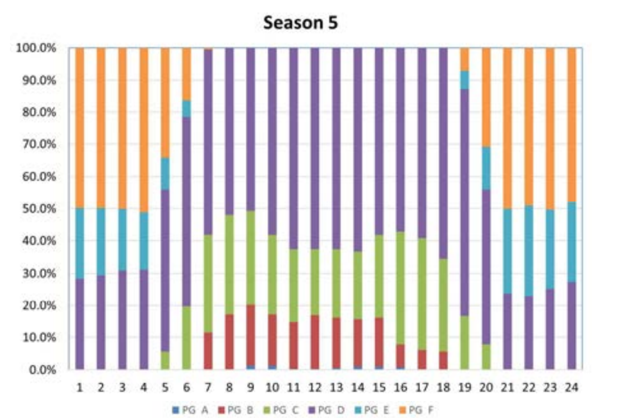


n









NOTE:

Definitions of five seasons refer to Table B.2

B.8 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.9 to Table B.14.

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 *Guidelines* (BC 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.13 and others are left to professional judgment (indicated by green shading in Table B.13).

Table B.9 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	-	0	Number of overwater met stations
MM3D	-	60	Number of CALWRF 3D.DAT files (one for each day)
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.10 CALMET Model Options Group 2: Grid Control Parameters

Parameter	Default	Project	Comment
PMAP	UTM	UTM	Map projection
IUTMZN	-	10	UTM Zone
UTMHEM	N	N	Hemisphere for UTM projection
DATUM	WGS-84	NAR-C	Datum-region for output coordinate
NX	-	100	No. X grid cells
NY	-	100	No. Y grid cells
DGRIDKM	-	0.5	Grid spacing (km)
XORIGKM	-	524.576	Reference coordinate of SW corner of grid cell (1,1) -X coordinate (km)
YORIGKM	-	6060.740	Reference coordinate of SW corner of grid cell (1,1) -Y coordinate (km)
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.11 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
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

Parameter	Default	Project	Comment
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.12 CALMET Model Options Group 4: Meteorological Data Options

Parameter	Default	Project	Comment
NOOBS	0	2	Use WRF 3D files (CALWRF format) for surface and upper air data
Number of Surface & Precipitation Meteorological Stations:			
NSSTA	-	0	Number of surface stations
NPSTA	-	Not applicable	Number of precipitation stations
Cloud Data Options:			
MCLOUD	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.13 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	1	No extrapolation is done
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

Parameter	Default	Project	Comment
IGFMET	0	0	Use coarse CALMET fields as initial guess fields
Radius of Influence Parameters:			
LVARY	F	F	Use varying radius of influence
RMAX1	-	Not applicable	Maximum radius of influence over land in the surface layer (km)
RMAX2	-	Not applicable	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	-	Not applicable	Relative weighting of the first guess field and observations in the surface layer (km)
R2	-	Not applicable	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
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)

Parameter	Default	Project	Comment
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.14 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)
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

Parameter	Default	Project	Comment
ICOOL	0	0	COARE cool skin layer computation
Relative Humidity Parameters:			
IRHPROG	0	1	3D relative humidity from observations or from prognostic data
Temperature Parameters:			
ITPROG	0	2	3D temperature from observations or from prognostic data
IRAD	1	1	Interpolation type
TRADKM	500	500	Radius of influence for temperature interpolation (km)
NUMTS	-	Not Applicable	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

B.9 References

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Appendix C CALPUFF

Table of Contents

C.1 Introduction C.1

C.2 CALPUFF Model C.1
C.2.1 Model Initialization C.1
C.2.2 Model Options C.6

C.3 References C.14

List of Tables

Table C.1 CALPUFF Study Area Coordinates (22 km by 22 km) C.2
Table C.2 Buildings Included in Dispersion Modelling C.4
Table C.3 Input Groups in the CALPUFF Control C.6
Table C.4 Input Group 1: General Run Control Parameters C.7
Table C.5 Input Group 2: Technical Options C.7
Table C.6 Input Group 3: Species List C.9
Table C.7 Input Group 4: Map Projection and Grid Control Parameters C.9
Table C.8 Input Group 5: Output Option C.10
Table C.9 Input Group 12: Diffusion/Computational Parameters C.11
Table C.10 Input Group 13: Point Source Parameters C.13
Table C.11 Input Group 20: Discrete Receptor Information C.14

List of Figures

Figure C.1 Gridded Receptors Applied in Dispersion Modelling C.3

C.1 Introduction

Ambient air quality models are used to predict air quality changes (i.e., changes to ambient concentrations) associated with proposed emission sources. This appendix discusses the selection and application of the primary dispersion model that was used for the air quality assessment of the proposed Mount Bracey Compressor Station (the Project).

C.2 CALPUFF Model

The CALPUFF modelling system is used to assess air quality changes due to the Project. The core of this system consists of a meteorological model CALMET, and a transport and dispersion model CALPUFF. Appendix B to the Air Quality Technical Report (Technical Report) discusses the CALMET meteorological model in detail.

CALPUFF is a non-steady-state Gaussian puff dispersion model capable of simulating the effects of time and space-varying meteorological conditions on contaminant transport, transformation, and removal (Scire et al. 2000). This model requires time-variant two- and three-dimensional meteorological data output from CALMET, as well as information regarding the relative location and nature of the emission sources modelled. The following sections provide a discussion of the available and implemented model options. Output from the CALPUFF model includes ground-level concentrations of the contaminant species considered.

At the time of the assessment, the most recently available version of the CALPUFF model was selected (i.e., Version 7.2.1 [Level 150618]). The following section describes the application of the CALPUFF model specific to the Project.

C.2.1 Model Initialization

C.2.1.1 CALPUFF Study Area

The CALPUFF model requires the user to define a domain where the emissions sources are identified and quantified, the meteorological conditions are characterized, and the locations where the air quality changes are to be predicted. It was determined that a 22 km x 22 km area centered on the Project site is sufficient to determine the effect of Project emissions on air quality. The selected area encloses the concentration contours due to the Project that are 10% of the applicable regulatory criteria in accordance with the British Columbia Air Quality Dispersion Modelling Guideline (the Guideline) (BC ENV 2022a). Table C.1 identifies the CALPUFF study area coordinates for this assessment.

Table C.1 CALPUFF Study Area Coordinates (22 km by 22 km)

Domain Corner	Location (UTM NAD 83, Zone 10)	
	East (m)	North (m)
Southwest	538576	6074740
Northwest	538576	6096740
Northeast	560576	6096740
Southeast	560576	6074740

C.2.1.2 Meteorological Data

The CALMET model requires the input of surface and upper air meteorological fields. For this application, CALMET model was run in hybrid mode (BC ENV 2022a) by using surface observations and WRF (BC ENV 2021) model output for the period of January 1, 2011 to December 31, 2015. There are no upper air stations within or nearby the CALMET domain.

C.2.1.3 Emissions and Source Characteristics

CALPUFF was used to simulate the transport and dispersion of emissions from the proposed Project sources. Section 2.6 of the Technical Data Report provides emission source characteristics and emission rates for the Project sources used for this assessment.

C.2.1.4 Receptor Grids

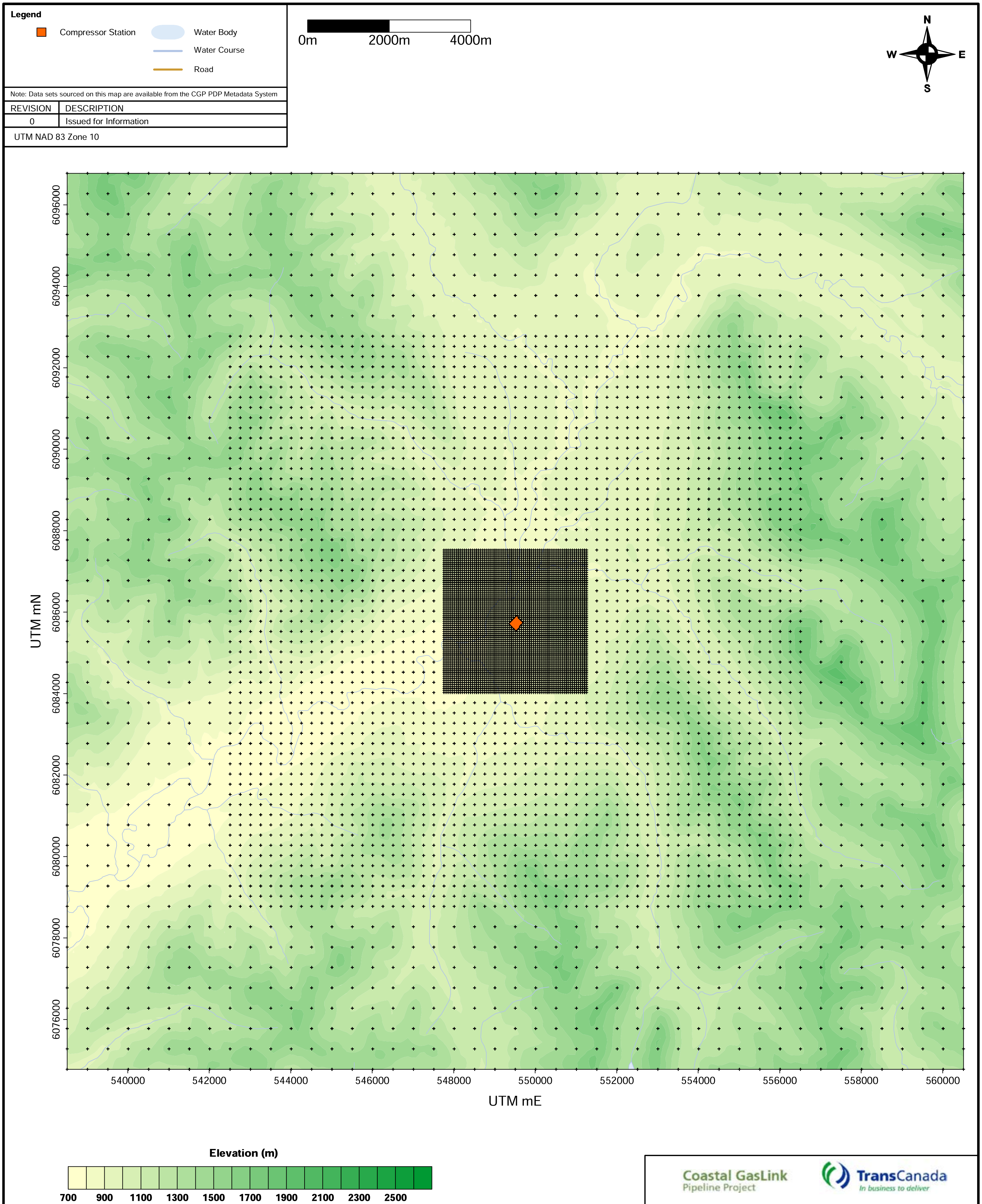
Multiple receptor grids centered on the Project site were established for the purposes of dispersion modelling. Figure C.1 shows the nested receptor points that were used. The receptors are based on the following spacing:

- 20 m receptor spacing along the compressor station facility boundary
- 50 m spacing for the 3.5 km by 3.5 km area centered on the Project site
- 250 m spacing for the 14 km by 14 km area centered on the Project site
- 500 m spacing for the 22 km by 22 km area centered on the Project site

The described grid comprises 9,278 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.

C.2.1.5 Sensitive Receptors

There are no permanent residents in the vicinity of the Project, therefore there are no sensitive receptors for the Mount Bracey assessment.



Coastal GasLink Pipeline Project

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Figure C.1
Gridded Receptors Applied in Dispersion Modelling

December 2024

Rev 0

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C.2.1.6 Building Downwash

Buildings or other solid facility structures may affect the flow of air in the vicinity of an emission source and cause building downwash effects on the plume (e.g., eddies on the downwind side), which have potential to reduce plume rise and affect dispersion. For dispersion modelling purposes, building downwash effects are considered for all stacks by using the U.S. EPA Building Profile Input Program (BPIP). Building downwash effects are modelled in CALPUFF using the Plume Rise Model Enhancement (PRIME) downwash algorithm which uses building profile parameters obtained from BPIP (Scire et al. 2000).

Table C.2 shows building information associated with the Project.

Table C.2 Buildings Included in Dispersion Modelling

Building ID	Description	Length (m)[a]	Width (m)[a]	Height (m)[b]
Mount Bracey Compressor Station				
1	Unit A1 Compressor Building	30.7	22.2	15.4
2	Unit A2 Compressor Building	30.7	22.2	15.4
3	Unit A3 Compressor Building	30.7	22.2	15.4
4	Unit A1 Air Cooled Heat Exchangers	31.5	21.2	7.3
5	Unit A2 Air Cooled Heat Exchangers	31.5	21.2	7.3
6	Unit A3 Air Cooled Heat Exchangers	31.5	21.2	7.3
7	Unit A1 Utility Gas Enclosure	6.1	2.6	4.1
8	Unit A2 Utility Gas Enclosure	6.1	2.6	4.1
9	Unit A3 Utility Gas Enclosure	6.1	2.6	4.1
10	Unit A1 Local Control Module Building	18.7	4.4	3.5
11	Unit A2 Local Control Module Building	18.7	4.4	3.5
12	Unit A3 Local Control Module Building	18.7	4.4	3.5
13	Unit A1 Electrical Building	17.4	4.0	4.0
14	Unit A2 Electrical Building	17.4	4.0	4.0
15	Unit A3 Electrical Building	17.4	4.0	4.0
16	Unit A1 Mechanical Building	21.3	5.5	6.4
17	Unit A2 Mechanical Building	21.3	5.5	6.4
18	Unit A3 Mechanical Building	21.3	5.5	6.4
19	Unit A1 APU Building	12.5	5.5	6.2
20	Unit A2 APU Building	12.5	5.5	6.2
21	Unit A3 APU Building	12.5	5.5	6.2
22	Heated Storage Building	20.0	12.0	4.5
23	Personnel Building	15.2	3.8	3.6
24	Drum Rack Building 1	4.8	2.4	4.0

Building ID	Description	Length (m)[a]	Width (m)[a]	Height (m)[b]
25	Drum Rack Building 2	4.8	2.4	4.0
26	Unit A0 Standby PPU Building	12.2	5.5	6.2
27	Unit A1 Compressor Building Air Intake	12.0	8.2	11.0
28	Unit A2 Compressor Building Air Intake	12.2	8.2	11.0
29	Unit A3 Compressor Building Air Intake	12.2	8.2	11.0
30	Living Quarter	23.3	6.6	11.0
31	Fresh Water and Drain Tank Building	12.3	2.4	11.0

Notes:
[a] Based on the most recent Mount Bracey Compressor Station plot plan layout
[b] Building height is the average of peak and eave, estimated or based on site data provided by CGL.

C.2.1.7 Terrain Effects

The CALPUFF model was used to estimate concentrations for each contaminant species considered, at each receptor location. Since some of these receptors were located in terrain elevations greater than the emission sources, terrain effects were considered. To account for the possible distortion of the plume trajectory over elevated terrain, the Partial Plume Path Adjustment Method (PPPAM) was used to modify the height of the plume.

The PPPAM employs a plume path coefficient (PPC) to adjust the height of the plume above the ground. As recommended by the CALPUFF developers (Scire et al. 2000), the default PPC values used are 0.5, 0.5, 0.5, 0.5, 0.35, and 0.35 for the corresponding Pasquill-Gifford stability classes A, B, C, D, E, and F (Pasquill 1961).

C.2.1.8 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 British Columbia ENV recommendations (i.e., Table 7.1 in the Guideline (BC ENV 2022a).

C.2.1.9 NO_X to NO_2 Conversion

The Guideline identifies several NOx to NO_2 conversion approaches: the total conversion method (TCM) that assumes all NOx is converted to NO_2; the ambient ratio method (ARM); the ozone limiting method (OLM) using representative ozone measurements; and the CALPUFF predictions based on the RIVAD/ISORROPIA approach.

In this assessment, the OLM approach, described in Section 3.2.1.2 and Appendix A of the Guidance for NO_2 Dispersion Modelling in British Columbia (NO_2 Guidance) (BC ENV 2022b), was applied for NOx to NO_2 conversion. The northeast BC ozone data array provided in Appendix C of the NO2 Guidance was used in the OLM calculations (BC ENV 2022b).

C.2.2 Model Options

The model developer provides the CALPUFF user with numerous options to address a range of user needs. Table C.3 to Table C.11 provide a summary of the CALPUFF model options that were selected for this assessment. The input groups recommended default value per the Guideline (BC ENV 2022a) that are applicable to this assessment are indicated by grey shading in Table C.6 and Table C.10. Model default values as recommended by the United States Environmental Protection Agency (US EPA 1998) are presented for comparative purposes. In most cases, these default values are used. Table 7.1 of the Guideline (BC ENV 2022a) also indicates specific values to be used instead of the default values. Some of the recommendations are mandatory (indicated by orange shading in Table C.5) and others are left to professional judgment (indicated by green shading in Table C.5).

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	No
8	Dry deposition parameters for particles	No
9	Miscellaneous dry deposition for parameters	No
10	Wet deposition parameters	No
11	Chemistry parameters	No
12	Misc. Diffusion and computational parameters	Yes
13	Point source parameters	Yes
14	Area source parameters	No
15	Line source parameters	No
16	Volume source parameters	No
17	Flare source control parameters (variable emissions file)	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 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	-	4	Number of chemical species
NSE	-	4	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.5 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 per British Columbia ENV Guideline (2022)
MSHEAR	0	0	Vertical wind shear is not modelled
MSPLIT	0	0	Puff splitting not used

Parameter	Default	Project	Comments
MCHEM	0 or 6	0	Chemical transformation not modeled
MAQCHEM	0	0	Aqueous phase transformation not modeled
MLWC	1	Not applicable	Liquid Water Content flag (MLWC)
MWET	1	0	Wet removal not modelled
MDRY	1	0	Dry deposition not 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 British Columbia ENV Guideline (2022)
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 σy and σz 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 (simulates AERMOD-type dispersion, averaging the balance between up- and down-drafts in vertical column).
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	0	0	Do not test options specified to see if they conform to regulatory values per British Columbia ENV Guideline (2022)

Notes:
Orange shading = mandatory recommendations
Green shading = based on professional judgment

Table C.6 Input Group 3: Species List

CSPEC	Modelled[1]	Emitted[2]	Dry Deposition[3]	Output Group Number
SO_2	1	1	0	0
NO_x	1	1	0	0
$PM_{2.5}$	1	1	0	0
CO	1	1	0	0

Notes:
[1] 0 = no, 1 = yes
[2] 0 = no, 1 = yes
[3] 0 = none, 1 = computed-gas, 2 = computed particle, 3 = user-specified

Table C.7 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	-	10	UTM zone
UTMHEM	N	N	Northern Hemisphere for UTM projection
DATUM	-	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	-	100	Number of X grid cells in meteorological grid
NY		100	Number of Y grid cells in meteorological grid
NZ	-	12	Vertical grid definition: Number of vertical layers
DGRIDKM	-	0.5	Grid spacing (km) to match CALMET (see Attachment C)
ZFACE	-	0, 20, 40, 80, 120, 280, 520, 880, 1,320, 1,820, 2,380, 3,000 and 4,000	Vertical grid definition: Cell face heights (m). Selected to match CALMET (Attachment C)
XORIGKM	-	524.576	Reference X coordinate for SW corner of grid cell (1,1) of meteorological grid (km)
YORIGKM	-	6060.740	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	-	100	X index of the upper right corner of the computational grid
JECOMP	-	100	Y index of the upper right corner of the computational grid
LSAMP	T	F	Sampling grid is not used
IBSAMP	-	1	X index of lower left corner of the sampling grid
JBSAMP	-	1	Y index of lower left corner of the sampling grid
IESAMP	-	100	X index of upper right corner of the sampling grid
JESAMP	-	100	Y index of upper right corner of the sampling grid
MESHDN	1	1	Nesting factor of the sampling grid

Table C.8 Input Group 5: Output Option

Parameter	Default	Project	Comments
ICON	1	1	Output file CONC.DAT containing concentrations is created
IDRY	1	0	Output file DFLX.DAT containing dry fluxes not created
IWET	1	0	Output file WFLX.DAT containing wet fluxes not created
IT2D	0	0	2D Temperature
IRHO	0	0	Density
IVIS	1	0	0 = Output file containing relative humidity data is not created
LCOMPRS	T	T	Do not perform data compression in output file
IQAPLOT	1	1	Create a standard series of output files suitable for plotting
IPFTRAK	0	0	Puff locations and properties not reported to PFTRAK.DAT file for postprocessing
IMFLX	0	0	Do not calculate mass fluxes across specific boundaries
IMBAL	0	0	Mass balances for each species are not reported hourly
INRISE	0	0	Not create a file with plume properties for each rise increment, for each model timestep
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 print interval in hours
IDFRQ	1	1	Dry flux print interval in hours
IWFRQ	1	1	Wet flux print interval in hours
IPRTU	1	3	Units for line printer output are in μg/m^3 for concentration and μg/m^2/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

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	0	0	0	0	0
NO_x	0	1	0	0	0	0	0	0
$PM_{2.5}$	0	1	0	0	0	0	0	0
CO	0	1	0	0	0	0	0	0

Table C.9 Input Group 12: Diffusion/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 calculate 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. 1998) 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
XMXLEN	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
SZCAP_M	5.0E06	5.0E06	Maximum sigma z in metres to avoid numerical problem in calculating time or distance

Stability Class	Parameter			
	Minimum turbulence velocities sigma-v (SVMIN)		Minimum turbulence velocities sigma-w (SWMIN)	
	Minimum turbulence (σ_v) (m/s)		Minimum turbulence (σ_v) (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

Parameters	Default	Project	Comments
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 5)
PTG0	0.020	0.020	Potential temperature gradient for Stability Class E stability [K/m]
	0.035	0.035	Potential temperature gradient for Stability Class F [K/m]
Parameters	**Default**	**Project**	**Comments**
PPC	0.50	0.50	Plume Path Coefficient (Stability class A)
	0.50	0.50	Plume Path Coefficient (Stability class B)
	0.50	0.50	Plume Path Coefficient (Stability class C)
	0.50	0.50	Plume Path Coefficient (Stability class D)
	0.35	0.35	Plume Path Coefficient (Stability class E)
	0.35	0.35	Plume Path Coefficient (Stability class 5)

Parameters	Default	Project	Comments
SL2PF	10	10	Slug-to-puff transition criterion factor equal to sigma y/length of slug
NSPLIT	3	3	Number of puffs that result every time a puff is split
IRESPLIT	0,0,0,0,0,0,0,0,0,0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0	0,0,0,0,0,0,0,0,0,0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0	Time(s) of day when split puffs are eligible to be split once again
ZISPLIT	100	100	Minimum allowable last hour's mixing height for puff splitting
ROLDMAX	0.25	0.25	Maximum allowable ratio of last hour's mixing height and maximum mixing height experienced by the puff for puff splitting
NSPLITH	5	5	Number of puffs that result every time a puff is horizontally split
SYSPLITH	1	1	Minimum sigma-y of puff before it may be horizontally split
SHSPLITH	2	2	Minimum puff elongation rate due to wind shear before it may be horizontally split
CNSPLITH	1.0E-7	1.0E-7	Minimum concentration of each species in puff before it may be horizontally split
EPSSLUG	1.00E-04	1.00E-04	Fractional convergence criterion for numerical SLUG sampling iteration
EPSAREA	1.00E-06	1.00E-06	Fractional convergence criterion for numerical AREA sampling iteration
DRISE	1.0	1.0	Trajectory step length for numerical rise
HTMINBC	500	500	Minimum height (m) to which BC puffs are mixed as they are emitted (MBCON = 2 ONLY)
RSAMPBC	10	10	Search radius (km) around a receptor for sampling nearest BC puff
MDEPBC	1	1	Concentration is adjusted for depletion

Table C.10 Input Group 13: Point Source Parameters

Parameters	Default	Project	Comments
NPT1	-	Varies (see details in Section 2.5 of Technical Data Report)	Number of point sources with constant stack parameters or variable emission rate scale factors
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
Notes: Point source parameters are given in Appendix B. '-' symbol indicates that the parameter was not applicable to the Project assessment.			

Table C.11 Input Group 20: Discrete Receptor Information

Parameter	Default	Project	Comments
NREC	-	9,278	Number of non-gridded receptors

C.3 References

BC ENV. 2022a. British Columbia Air Quality Dispersion Modelling Guideline. British Columbia Ministry of Environment and Climate Change Strategy, August 2022.

BC ENV. 2022b. Guidance for NO_2 Dispersion Modelling in British Columbia. July 2022. Available at: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/air/reports-pub/modelling_guidance_nitrogen_dioxide.pdf

BC ENV. 2021. 2011–2015 WRF 4-km grid dataset. Available at: https://www2.gov.bc.ca/gov/content/environment/air-land-water/air/air-quality-management/modelling/wrf-data

Pasquill F. 1961. The estimation of the dispersion of wind-borne material. Meteorological Magazine, 90: 33-48.

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.

U.S. EPA. 1998. 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

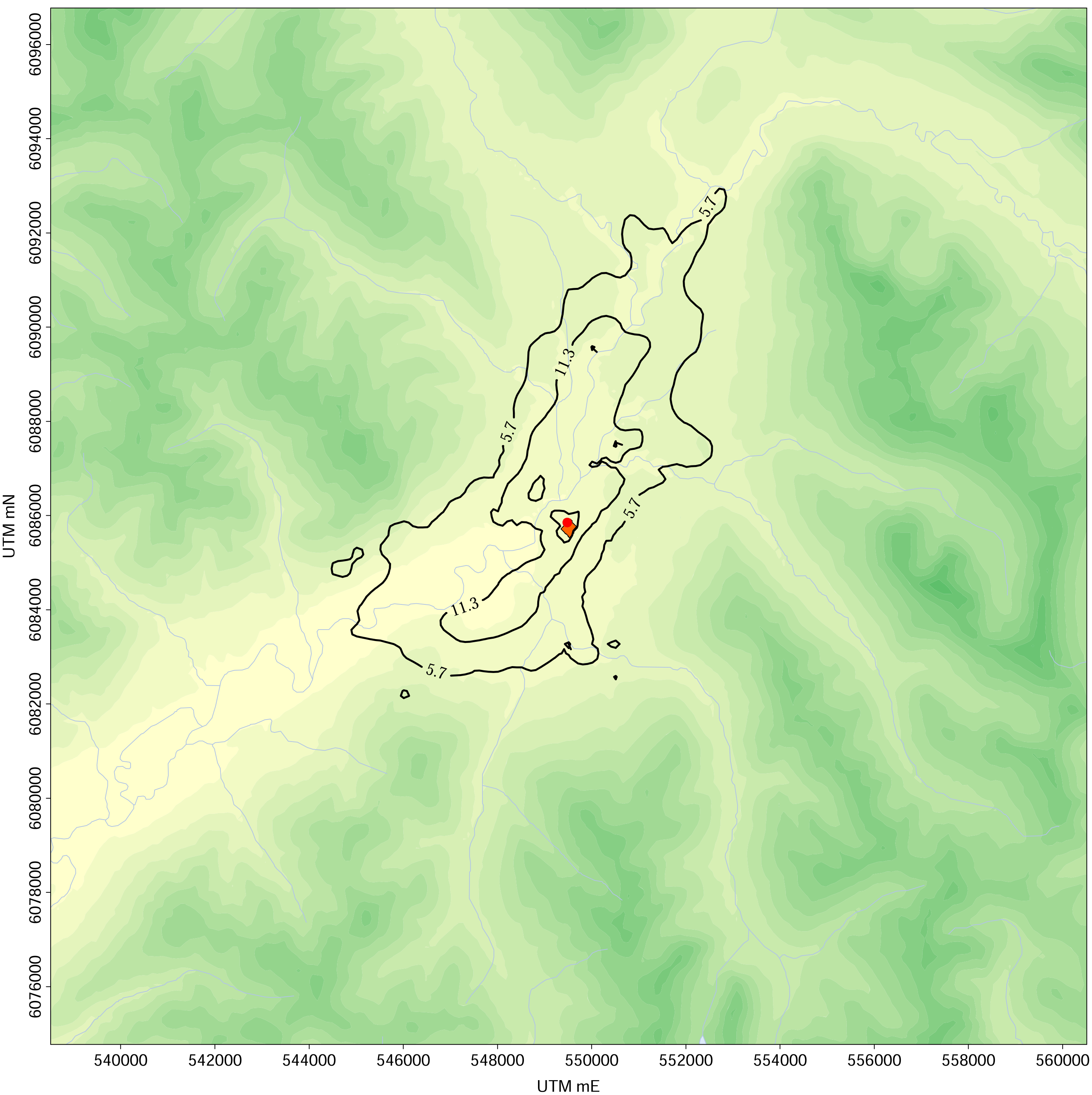
Legend

- Compressor Station
- Water Body
- Water Course
- Road

Note: Data sets sourced on this map are available from the CGP PDP Metadata System

REVISION	DESCRIPTION
0	Issued for Information

UTM NAD 83 Zone 10



Maximum 1-hour Average 98th Daily Maximum NO_2 Concentration: 62.0 μg/m³

1-hour NO_2 BC AQO: 113 μg/m³

Contour Levels: 5.7, 11.3, 28.3, 56.5 μg/m³

Baseline: Not Included

Elevation (m)

700 900 1100 1300 1500 1700 1900 2100 2300 2500

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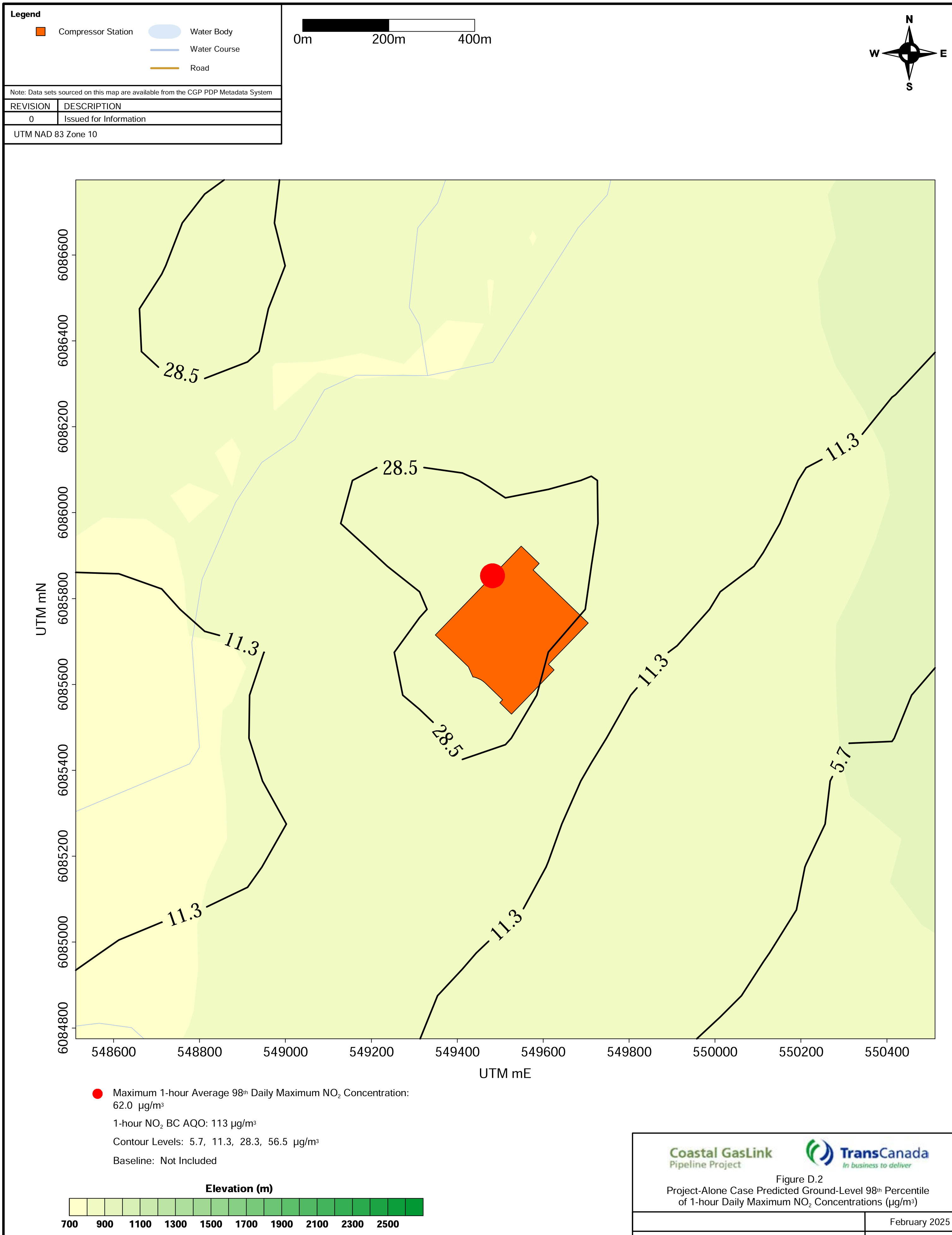
Figure D.1
Project-Alone Case Predicted Ground-Level 98th Percentile of 1-hour Daily Maximum NO_2 Concentrations (μg/m³)

February 2025

Rev 0

STANTEC:\\ca0002-ppfss02\shared_projects\123513381\disciplines\air_quality\Grids\Mount_Bracey_KP163\MountBracey_KP163_receptors.srf



Coastal GasLink Pipeline Project

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Figure D.2
Project-Alone Case Predicted Ground-Level 98th Percentile of 1-hour Daily Maximum NO_2 Concentrations (µg/m³)

February 2025

Rev 0

STANTEC:\\ca0002-ppfss02\shared_projects\123513381\disciplines\air_quality\Grids\Mount_Bracey_KP163\MountBracey_KP163_receptors.srf

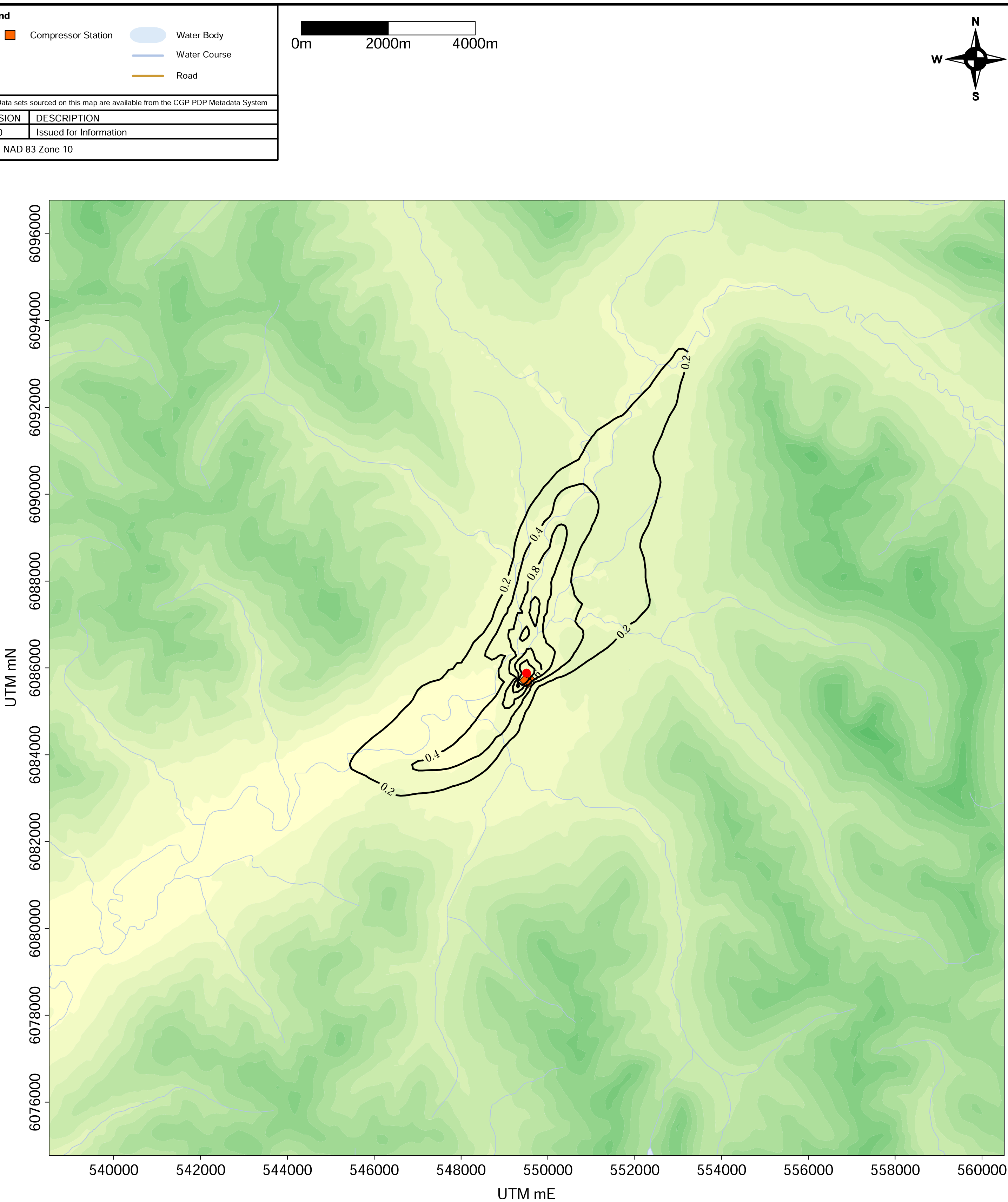
Legend

Compressor Station
Water Body
Water Course
Road

Note: Data sets sourced on this map are available from the CGP PDP Metadata System

REVISION	DESCRIPTION
0	Issued for Information

UTM NAD 83 Zone 10



Maximum Annual Average NO_2 Concentration: 12.9 µg/m³

Annual NO_2 BC AQO: 32 µg/m³

Contour Levels: 0.2, 0.4, 0.8, 1.6, 3.2, 8 µg/m³

Baseline: Not Included

Elevation (m)

700 900 1100 1300 1500 1700 1900 2100 2300 2500

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Figure D.3
Project-Alone Case Predicted Ground-Level Annual NO_2 Concentrations (µg/m³)

February 2025

Rev 0

STANTEC:\\ca0002-ppfss02\shared_projects\123513381\disciplines\air_quality\Grids\Mount_Bracey_KP163\MountBracey_KP163_receptors.srf

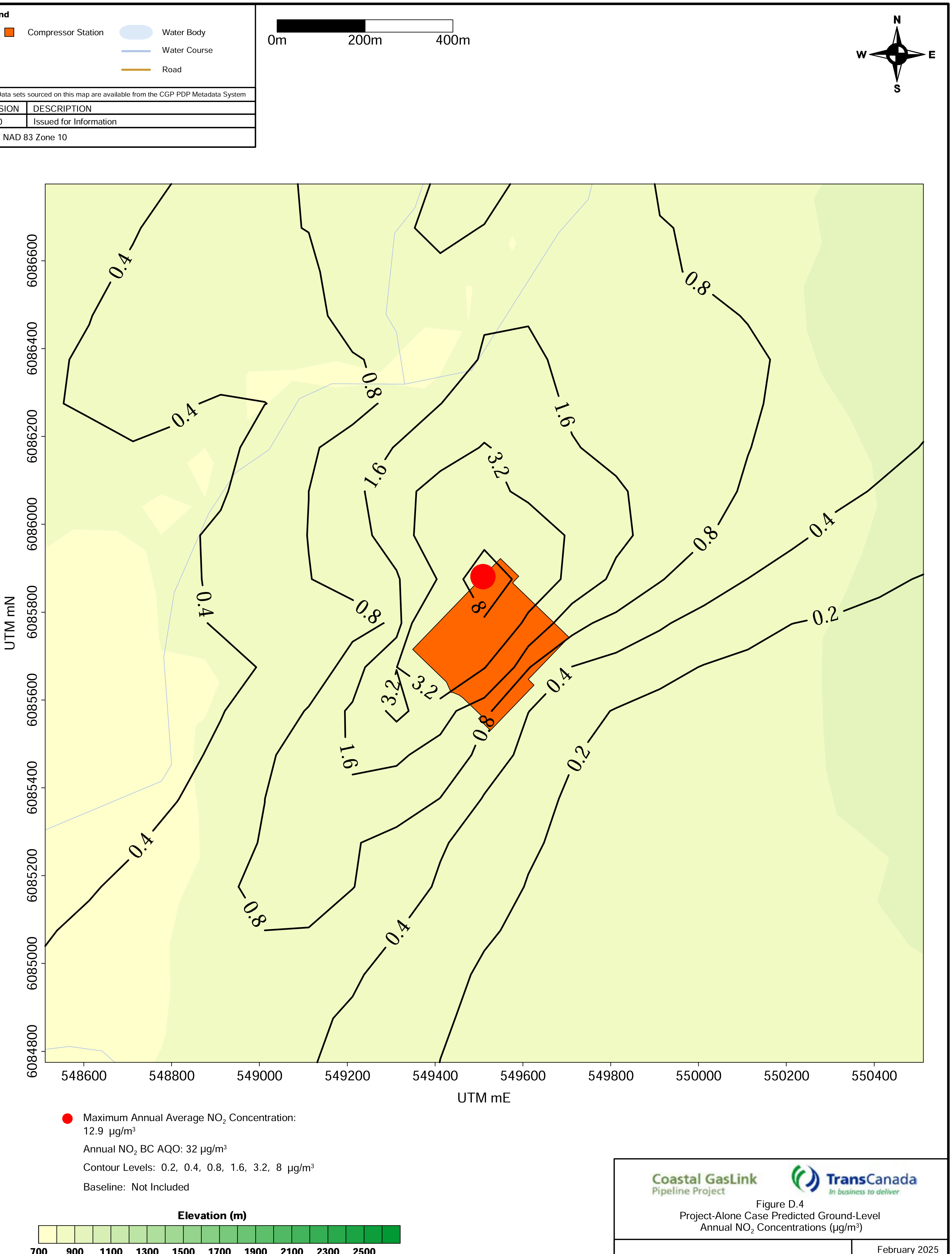

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Figure D.4
Project-Alone Case Predicted Ground-Level Annual NO_2 Concentrations (µg/m³)

February 2025

Rev 0

STANTEC:\\ca0002-ppfss02\shared_projects\123513381\disciplines\air_quality\Grids\Mount_Bracey_KP163\MountBracey_KP163_receptors.srf

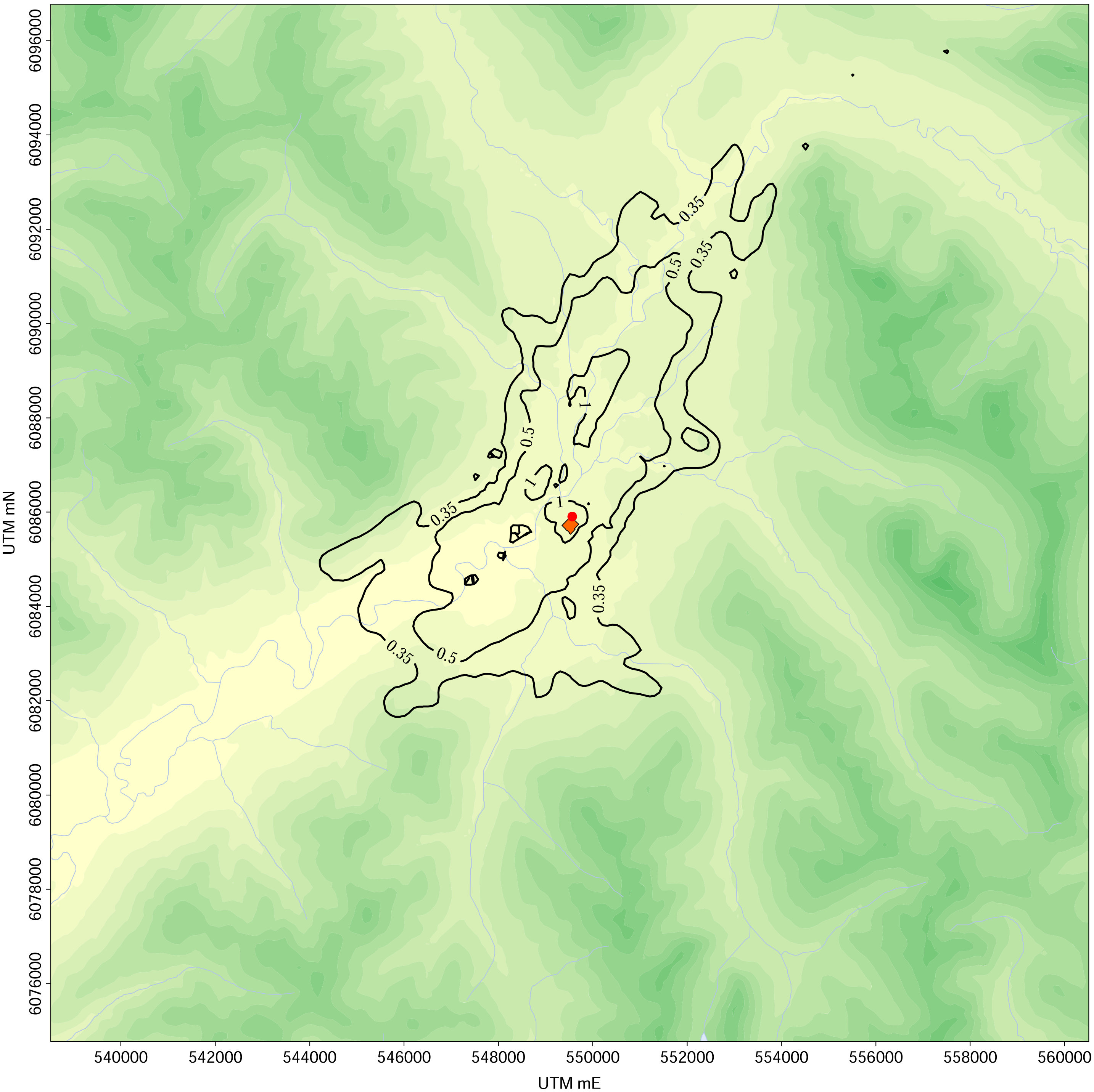
Legend

Compressor Station
Water Body
Water Course
Road

Note: Data sets sourced on this map are available from the CGP PDP Metadata System

REVISION	DESCRIPTION
0	Issued for Information

UTM NAD 83 Zone 10



Maximum 1-hour Average 99th Daily Maximum SO_2 Concentration: 3.1 µg/m³

1-hour SO_2 BC AQO: 183 µg/m³

Contour Levels: 0.35, 0.5, 1 µg/m³

Baseline: Not Included

Elevation (m)

700 900 1100 1300 1500 1700 1900 2100 2300 2500

Coastal GasLink Pipeline Project
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Figure D.5
Project-Alone Case Predicted Ground-Level 99th Percentile of 1-hour Daily Maximum SO_2 Concentrations (µg/m³)

February 2025

Rev 0

STANTEC:\\ca0002-ppfss02\shared_projects\123513381\disciplines\air_quality\Grids\Mount_Bracey_KP163\MountBracey_KP163_receptors.srf

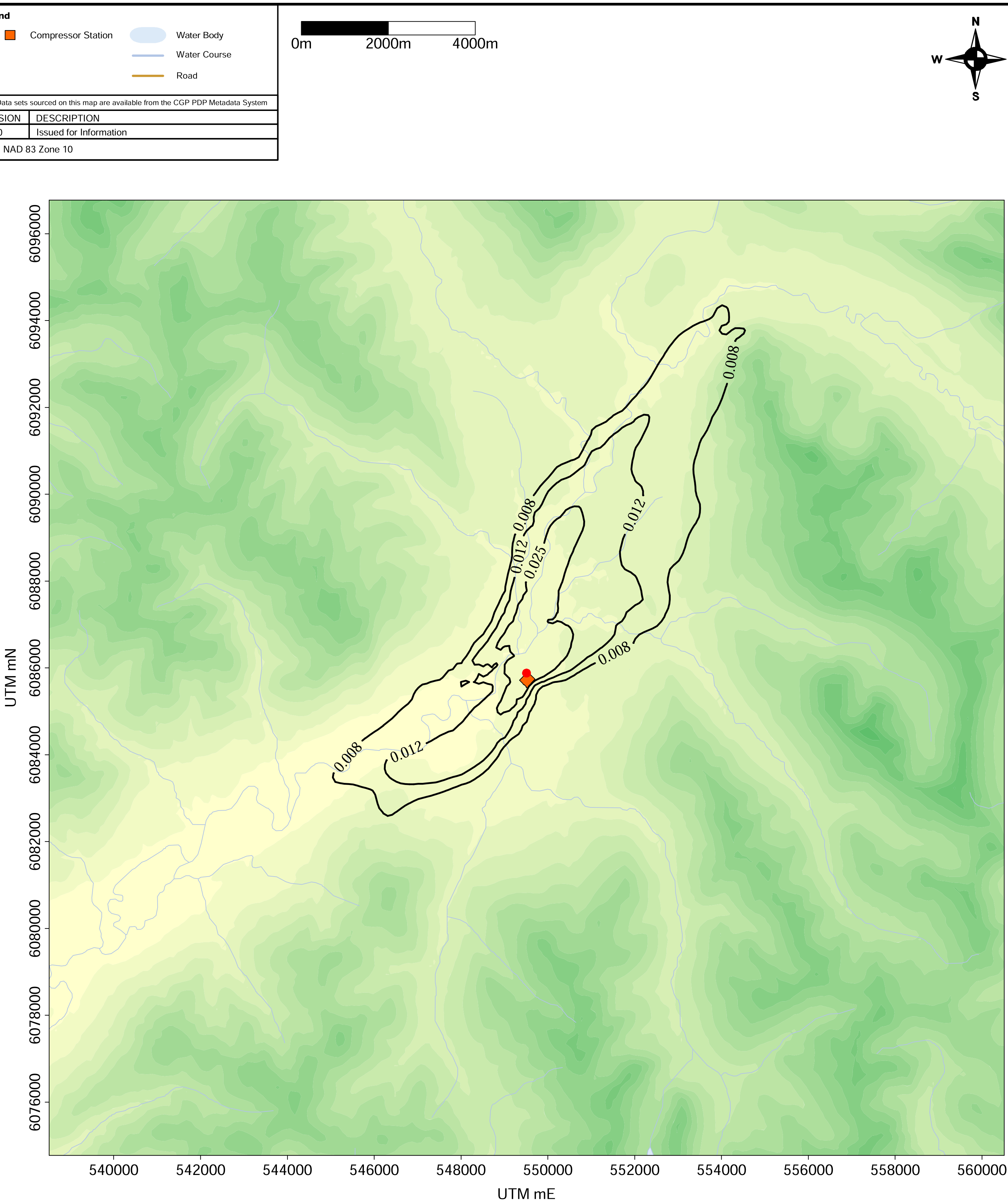
Legend

Compressor Station
Water Body
Water Course
Road

Note: Data sets sourced on this map are available from the CGP PDP Metadata System

REVISION	DESCRIPTION
0	Issued for Information

UTM NAD 83 Zone 10



Maximum Annual Average SO_2 Concentration: 0.5 µg/m³

Annual SO_2 BC AQO: 13 µg/m³

Contour Levels: 0.008, 0.012, 0.025 µg/m³

Baseline: Not Included

Elevation (m)

700 900 1100 1300 1500 1700 1900 2100 2300 2500

Coastal GasLink Pipeline Project

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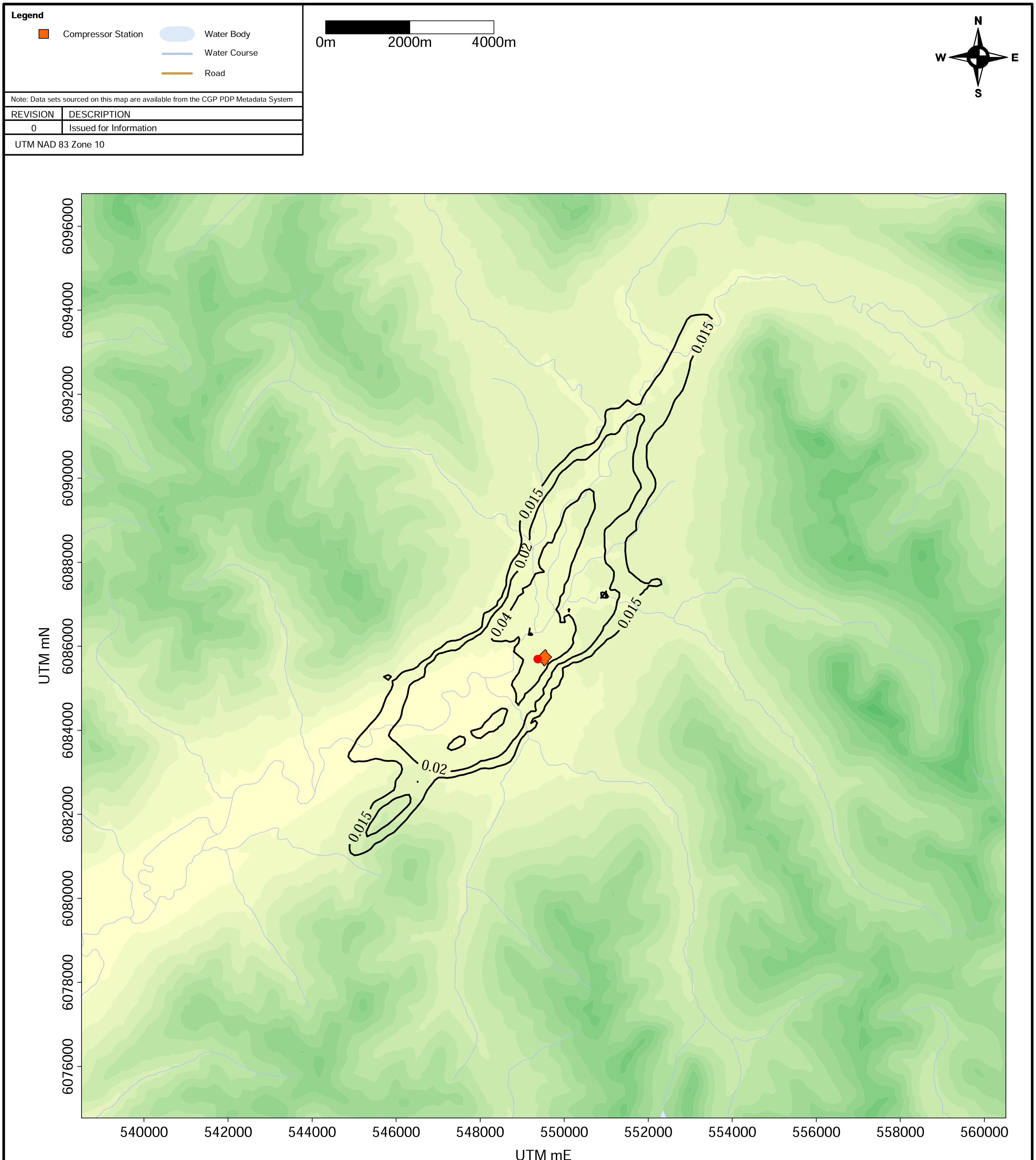
Figure D.6
Project-Alone Case Predicted Ground-Level Annual SO_2 Concentrations (µg/m³)

February 2025

Rev 0

STANTEC:\\ca0002-ppfss02\shared_projects\123513381\disciplines\air_quality\Grids\Mount_Bracey_KP163\MountBracey_KP163_receptors.srf



Maximum 24-Hour Average 98th $PM_{2.5}$ Concentration: 0.7 µg/m³

24-hour $PM_{2.5}$ BC AQO: 25 µg/m³

Contour Levels: 0.015, 0.02, 0.04 µg/m³

Baseline: Not Included

Elevation (m)

700 | 900 | 1100 | 1300 | 1500 | 1700 | 1900 | 2100 | 2300 | 2500

Coastal GasLink Pipeline Project

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Figure D.7
Project-Alone Case Predicted Ground-Level
98th Percentile 24-hour Average $PM_{2.5}$ Concentrations (µg/m³)

February 2025

Rev 0

Legend

Compressor Station

Water Body

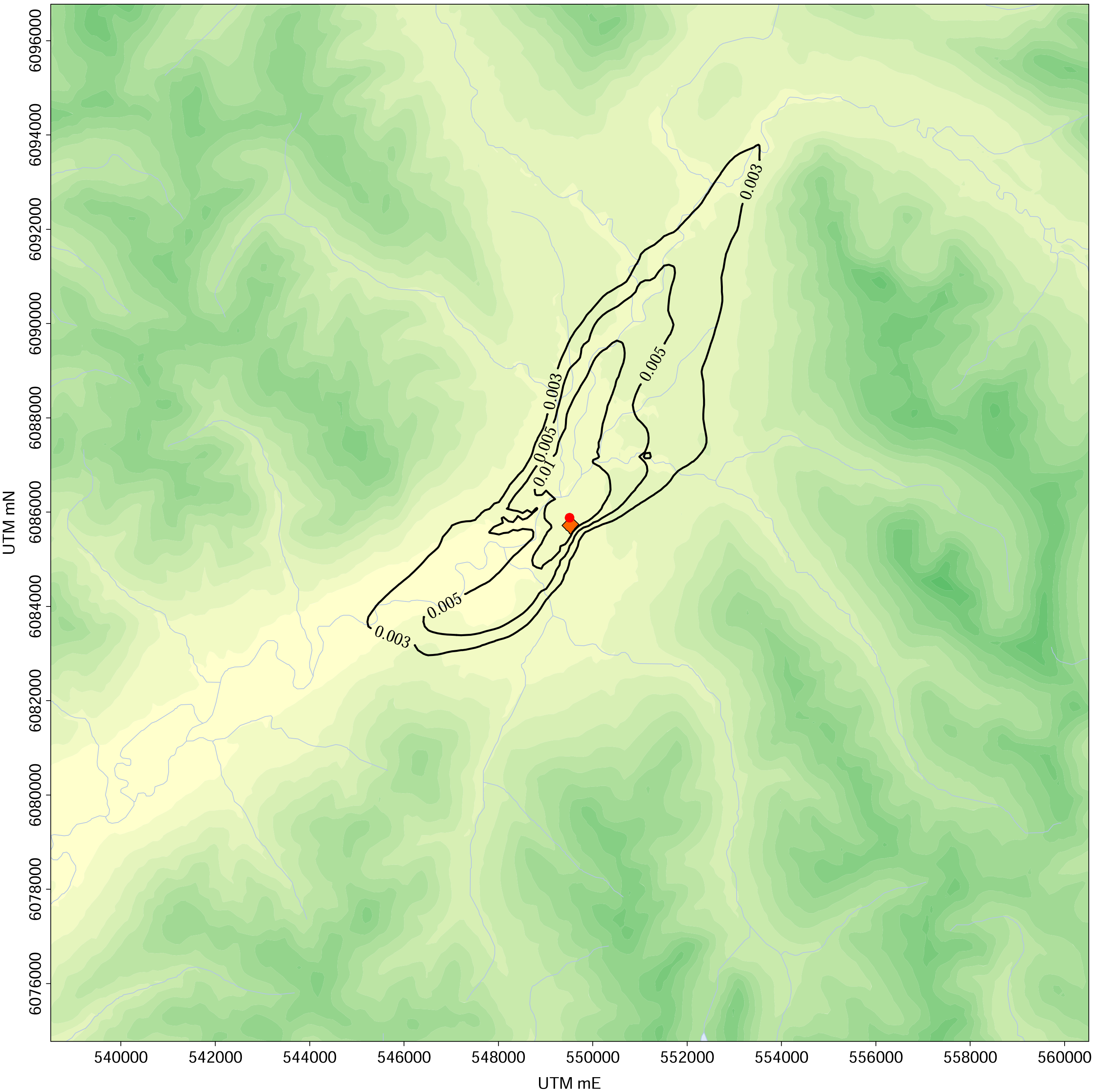
Water Course

Road

Note: Data sets sourced on this map are available from the CGP PDP Metadata System

REVISION	DESCRIPTION
0	Issued for Information

UTM NAD 83 Zone 10



Maximum Annual Average $PM_{2.5}$ Concentration: 0.2 μg/m³

Annual $PM_{2.5}$ BC AQO: 8 μg/m³

Contour Levels: 0.003, 0.005, 0.01 μg/m³

Baseline: Not Included

Elevation (m)

700 900 1100 1300 1500 1700 1900 2100 2300 2500

Coastal GasLink Pipeline Project

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Figure D.8
Project-Alone Case Predicted Ground-Level Annual Average $PM_{2.5}$ Concentrations (μg/m³)

February 2025

Rev 0

STANTEC:\\ca0002-ppfss02\shared_projects\123513381\disciplines\air_quality\Grids\Mount_Bracey_KP163\MountBracey_KP163_receptors.srf

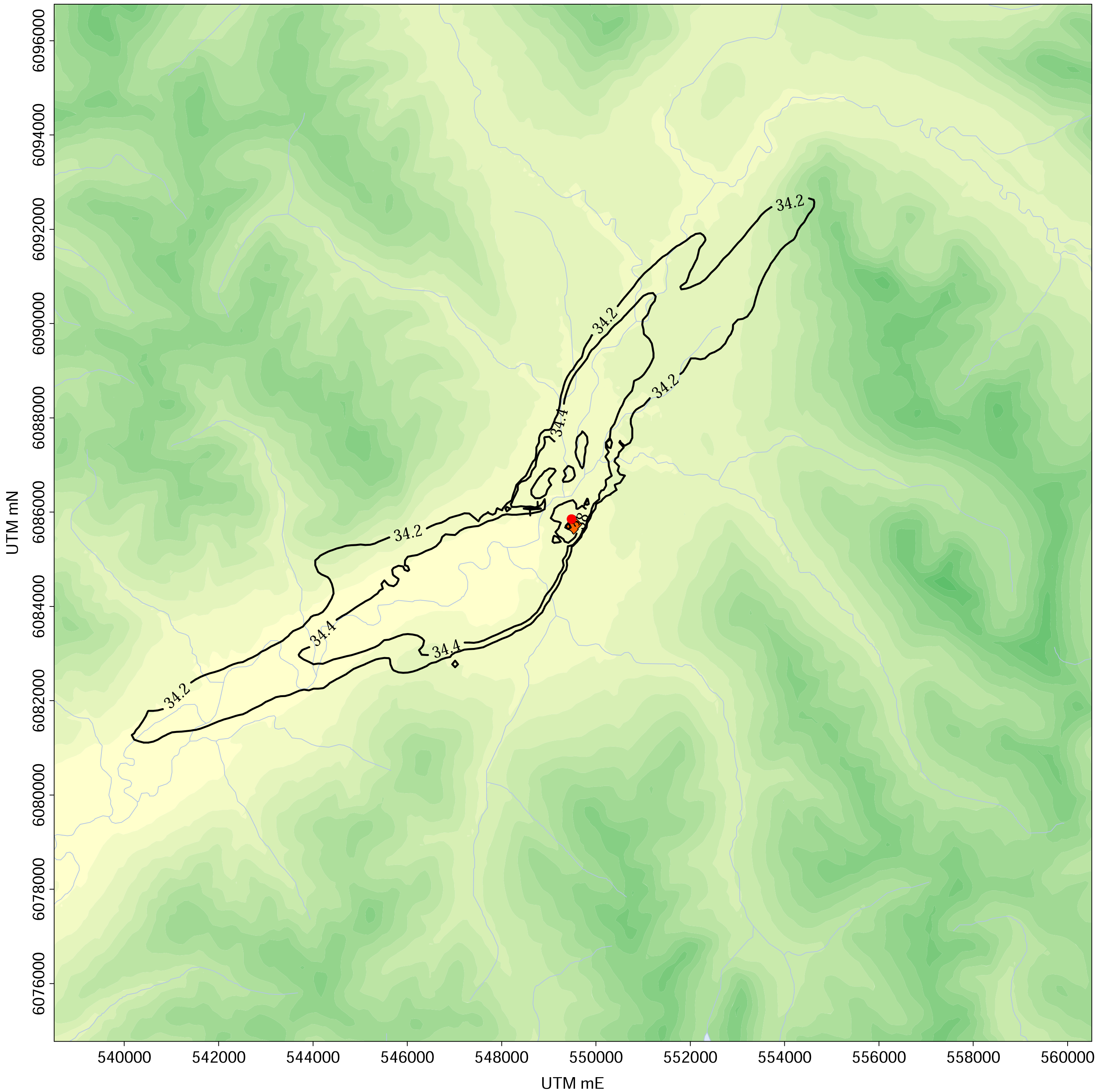
Legend

- Compressor Station
- Water Body
- Water Course
- Road

Note: Data sets sourced on this map are available from the CGP PDP Metadata System

REVISION	DESCRIPTION
0	Issued for Information

UTM NAD 83 Zone 10



● Maximum 1-hour Average 98th Daily Maximum NO_2 Concentration: 76.7 µg/m³

1-hour NO_2 BC AQO: 113 µg/m³

Contour Levels: 34.2, 34.4, 38, 56.5 µg/m³

Baseline: 288 array baseline from Blueberry First Nation School station Added

Elevation (m)

700 900 1100 1300 1500 1700 1900 2100 2300 2500

Coastal GasLink Pipeline Project

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Figure D.9
Application Case Predicted Ground-Level 98th Percentile of 1-hour Daily Maximum NO_2 Concentrations (µg/m³)

February 2025

Rev 0

STANTEC:\\ca0002-ppfss02\shared_projects\123513381\disciplines\air_quality\Grids\Mount_Bracey_KP163\MountBracey_KP163_receptors.srf

Legend

Compressor Station

Water Body

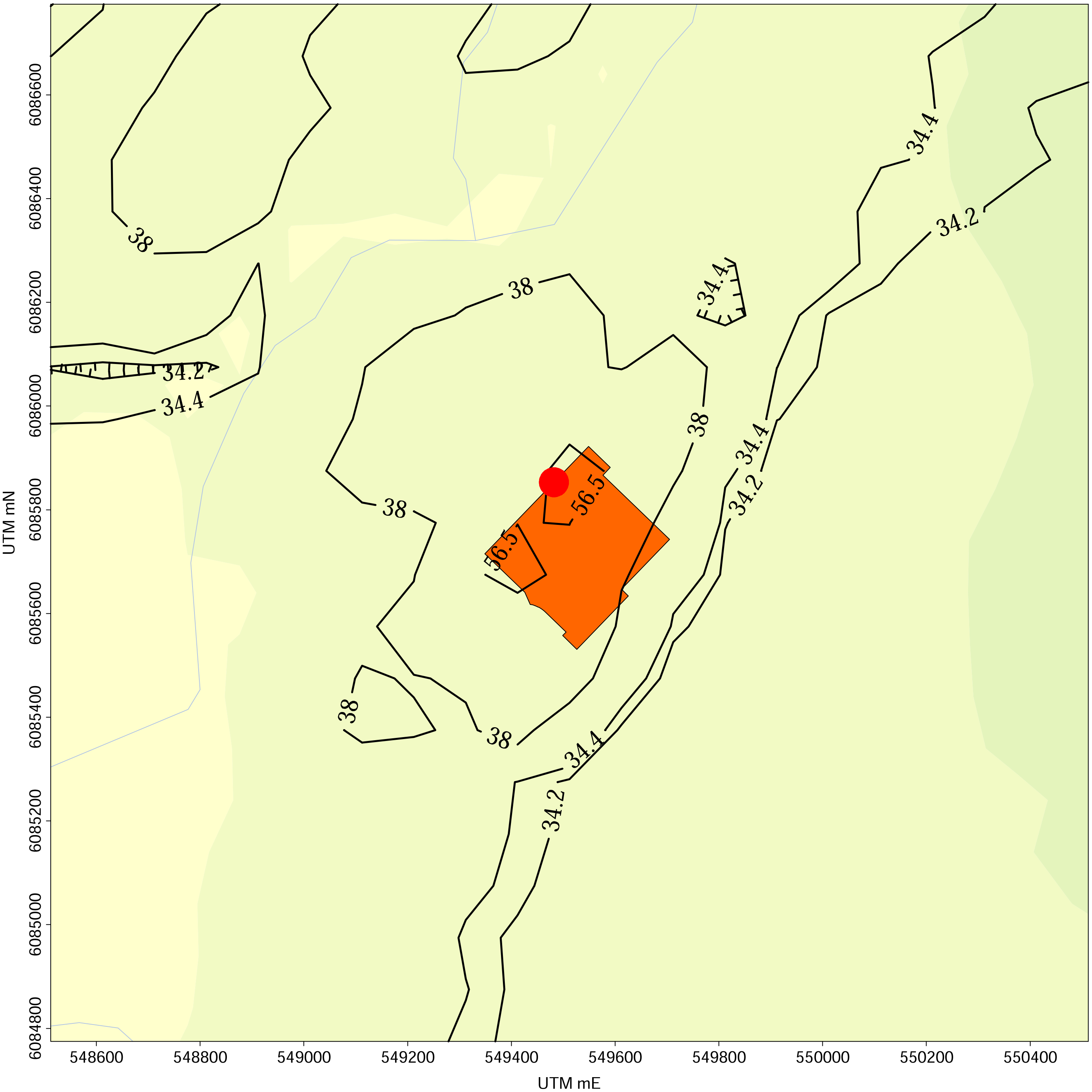
Water Course

Road

Note: Data sets sourced on this map are available from the CGP PDP Metadata System

REVISION	DESCRIPTION
0	Issued for Information

UTM NAD 83 Zone 10



Maximum 1-hour Average 98th Daily Maximum NO_2 Concentration: 76.7 μg/m³

1-hour NO_2 BC AQO: 113 μg/m³

Contour Levels: 34.2, 34.4, 38, 56.5 μg/m³

Baseline: 288 array baseline from Blueberry First Nation School station Added

Elevation (m)

700	900	1100	1300	1500	1700	1900	2100	2300	2500

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Figure D.10
Application Case Predicted Ground-Level 98th Percentile of 1-hour Daily Maximum NO_2 Concentrations (μg/m³)

February 2025

Rev 0

STANTEC:\\ca0002-ppfss02\shared_projects\123513381\disciplines\air_quality\Grids\Mount_Bracey_KP163\MountBracey_KP163_receptors.srf

Legend

Compressor Station

Water Body

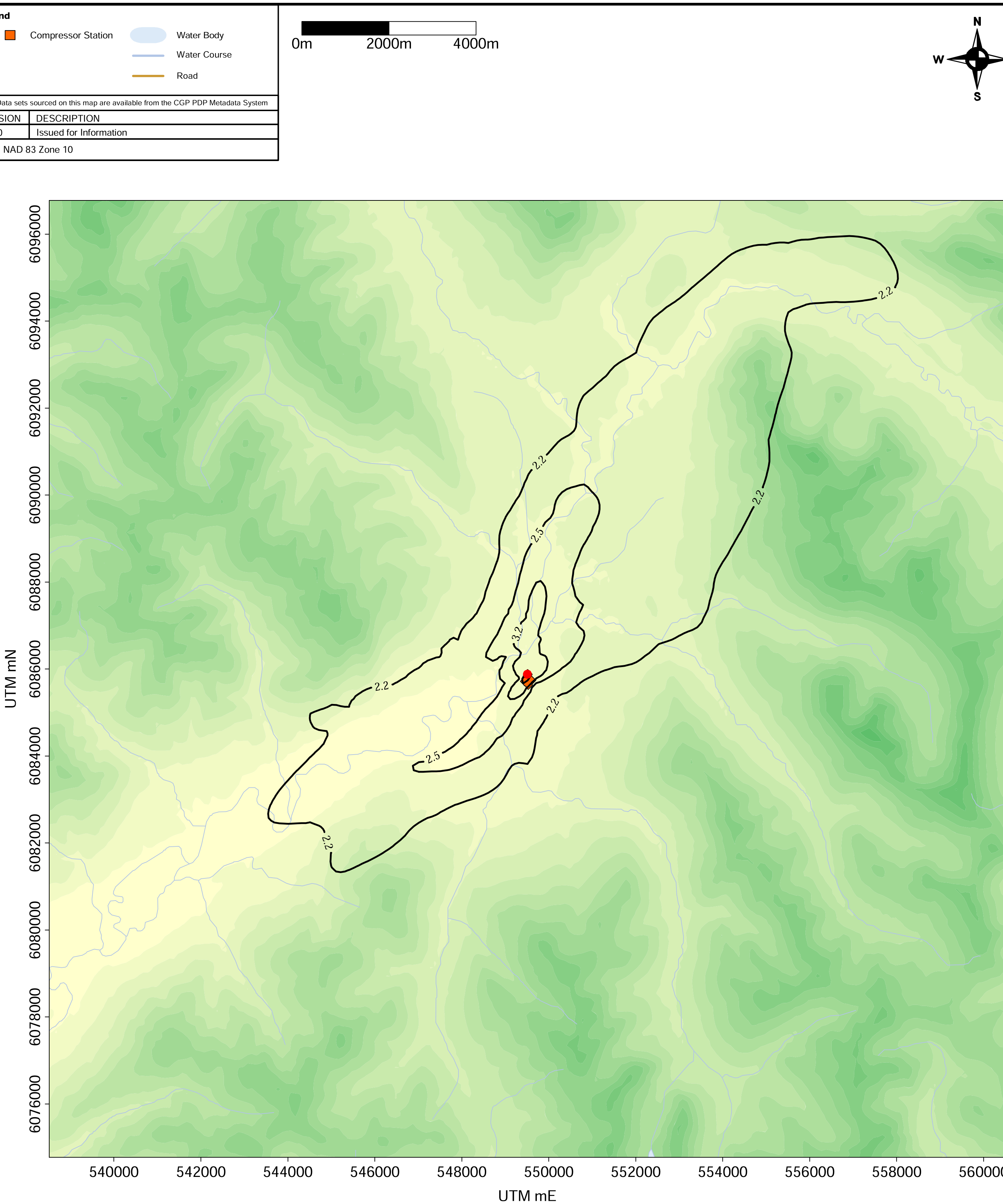
Water Course

Road

Note: Data sets sourced on this map are available from the CGP PDP Metadata System

REVISION	DESCRIPTION
0	Issued for Information

UTM NAD 83 Zone 10



Maximum Annual Average NO_2 Concentration: 15.0 μg/m³

Annual NO_2 BC AQO: 32 μg/m³

Contour Levels: 2.2, 2.5, 3.2, 8, 16 μg/m³

Baseline: 2.1 μg/m³

Elevation (m)

700 900 1100 1300 1500 1700 1900 2100 2300 2500

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Figure D.11

Application Case Predicted Ground-Level Annual NO_2 Concentrations (μg/m³)

February 2025

Rev 0

STANTEC:\\ca0002-ppfss02\shared_projects\123513381\disciplines\air_quality\Grids\Mount_Bracey_KP163\MountBracey_KP163_receptors.srf

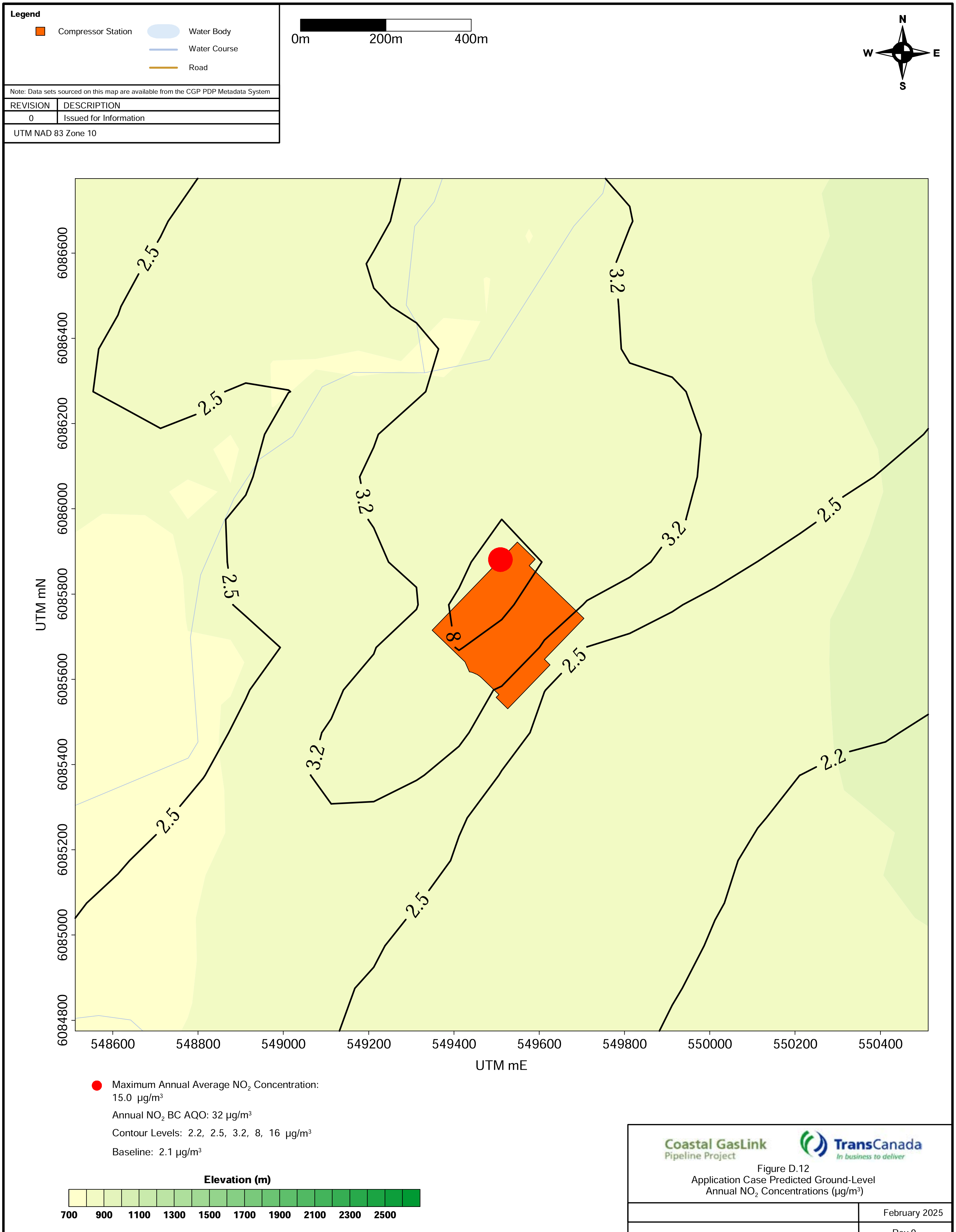

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Figure D.12
Application Case Predicted Ground-Level Annual NO_2 Concentrations (µg/m³)

February 2025

Rev 0

STANTEC:\\ca0002-ppfss02\shared_projects\123513381\disciplines\air_quality\Grids\Mount_Bracey_KP163\MountBracey_KP163_receptors.srf

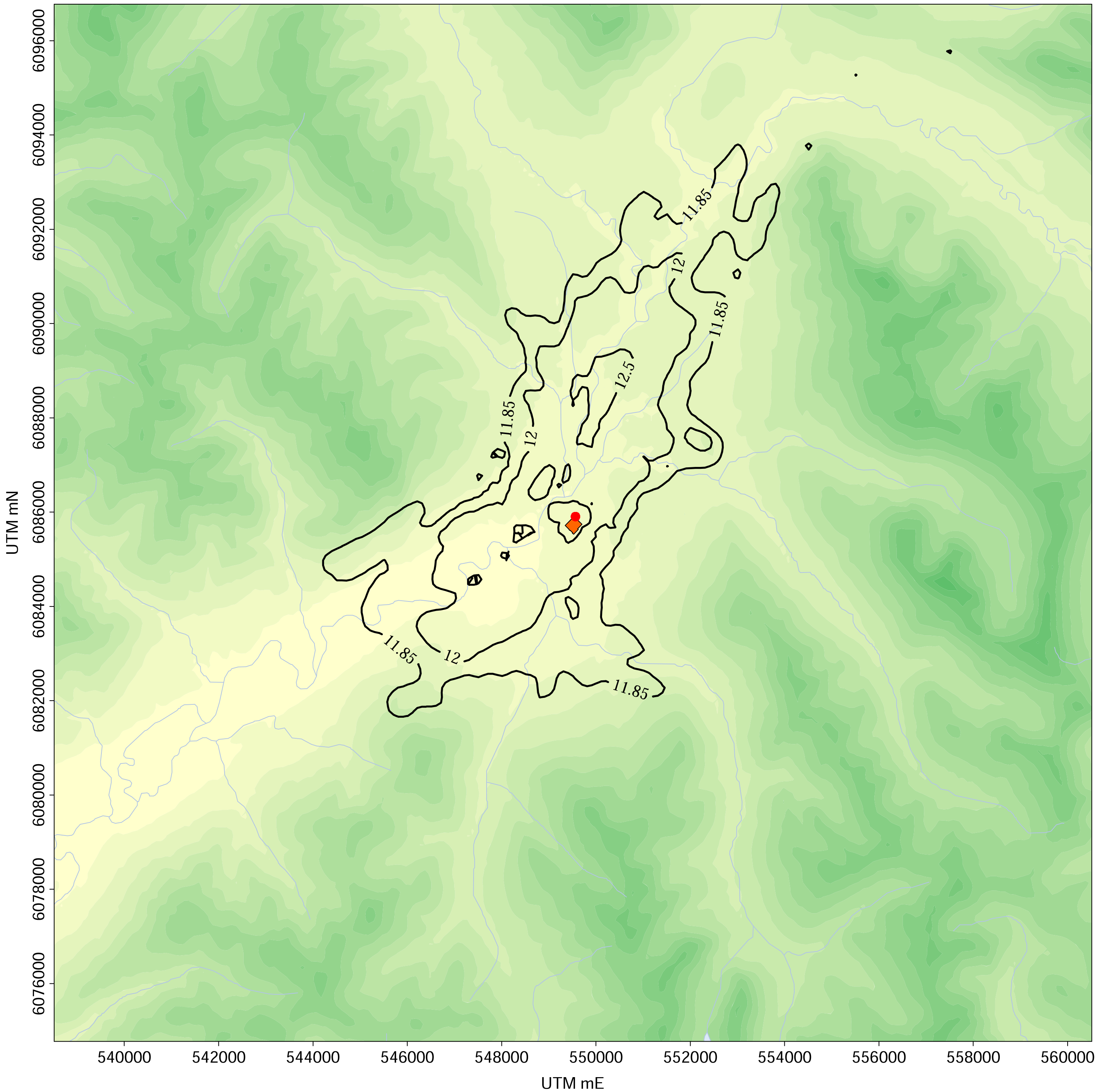
Legend

Compressor Station | Water Body | Water Course | Road

Note: Data sets sourced on this map are available from the CGP PDP Metadata System

REVISION	DESCRIPTION
0	Issued for Information

UTM NAD 83 Zone 10



Maximum 1-hour Average 99th Daily Maximum SO_2 Concentration: 14.6 μg/m³

1-hour SO_2 BC AQO: 183 μg/m³

Contour Levels: 11.85, 12, 12.5 μg/m³

Baseline: 11.5 μg/m³

Elevation (m)

700 900 1100 1300 1500 1700 1900 2100 2300 2500

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Figure D.13
Application Case Predicted Ground-Level 99th Percentile of 1-hour Daily Maximum SO_2 Concentrations (μg/m³)

February 2025

Rev 0

STANTEC:\\ca0002-ppfss02\shared_projects\123513381\disciplines\air_quality\Grids\Mount_Bracey_KP163\MountBracey_KP163_receptors.srf

Legend

Compressor Station

Water Body

Water Course

Road

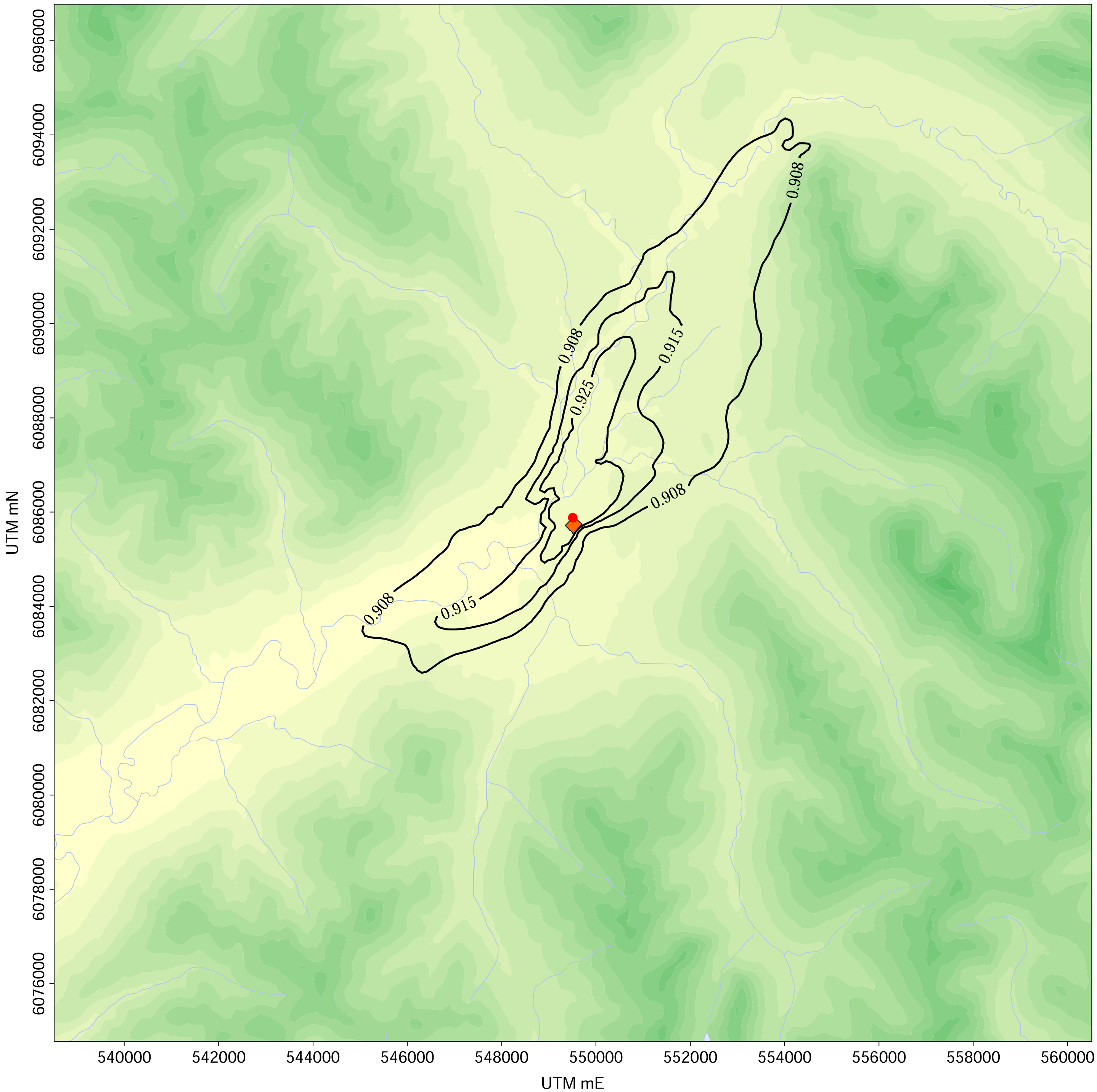
Note: Data sets sourced on this map are available from the CGP PDP Metadata System

REVISION	DESCRIPTION
0	Issued for Information

UTM NAD 83 Zone 10

0m 2000m 4000m

N E S W



Maximum Annual Average SO_2 Concentration: 1.4 μg/m³

Annual SO_2 BC AQO: 13 μg/m³

Contour Levels: 0.908, 0.915, 0.925 μg/m³

Baseline: 0.9 μg/m³

Elevation (m)

700 900 1100 1300 1500 1700 1900 2100 2300 2500

Coastal GasLink Pipeline Project

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Figure D.14
Application Case Predicted Ground-Level Annual SO_2 Concentrations (μg/m³)

February 2025

Rev 0

STANTEC:\\ca0002-ppfss02\shared_projects\123513381\disciplines\air_quality\Grids\Mount_Bracey_KP163\MountBracey_KP163_receptors.srf

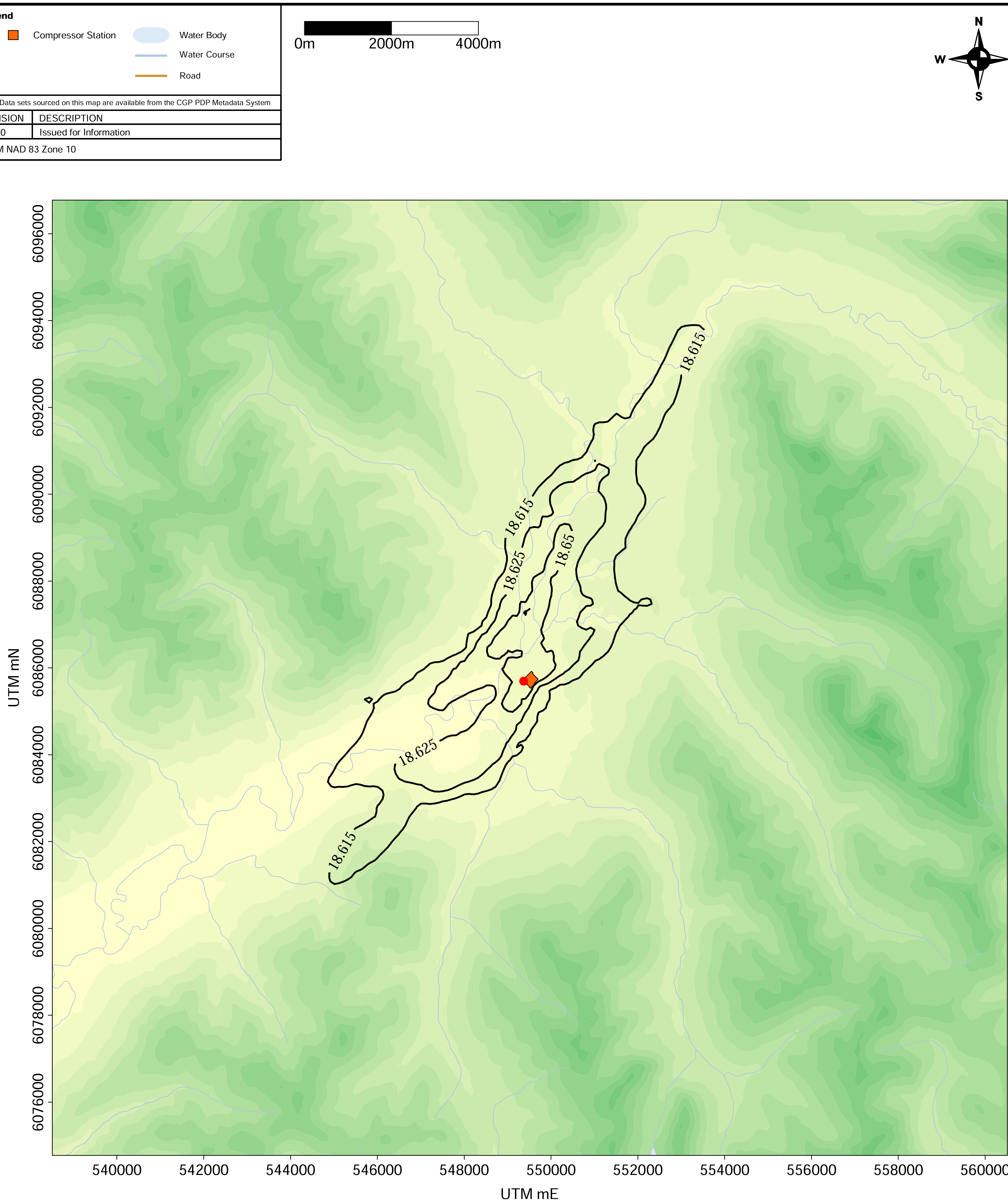
Legend

- Compressor Station
- Water Body
- Water Course
- Road

Note: Data sets sourced on this map are available from the CGP PDP Metadata System

REVISION	DESCRIPTION
0	Issued for Information

UTM NAD 83 Zone 10



Maximum 24-Hour Average 98th $PM_{2.5}$ Concentration: 19.3 µg/m³

24-hour $PM_{2.5}$ BC AQO: 25 µg/m³

Contour Levels: 18.615, 18.625, 18.65 µg/m³

Baseline: 18.6 µg/m³

Elevation (m)

700 900 1100 1300 1500 1700 1900 2100 2300 2500

Coastal GasLink Pipeline Project

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Figure D.15
Application Case Predicted Ground-Level
98th Percentile 24-hour Average $PM_{2.5}$ Concentrations (µg/m³)

February 2025

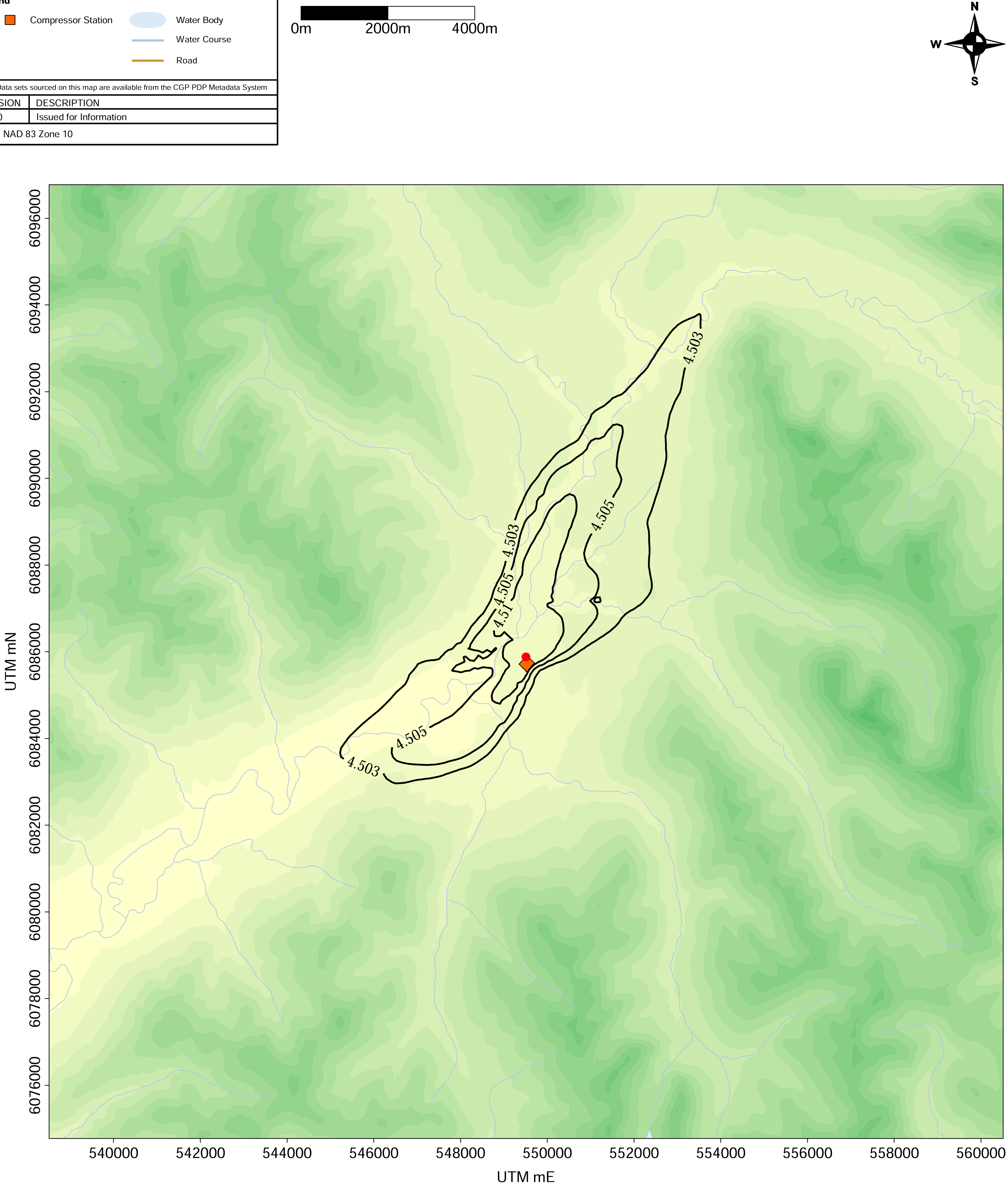
Rev 0

Legend		
Compressor Station	Water Body	
	Water Course	
	Road	

Note: Data sets sourced on this map are available from the CGP PDP Metadata System

REVISION	DESCRIPTION
0	Issued for Information

UTM NAD 83 Zone 10



Maximum Annual Average $PM_{2.5}$ Concentration: 4.7 μg/m³

Annual $PM_{2.5}$ BC AQO: 8 μg/m³

Contour Levels: 4.503, 4.505, 4.51 μg/m³

Baseline: 4.5 μg/m³

Elevation (m)

700 900 1100 1300 1500 1700 1900 2100 2300 2500

Coastal GasLink Pipeline Project | TransCanada In business to deliver

Figure D.16
Application Case Predicted Ground-Level Annual Average $PM_{2.5}$ Concentrations (μg/m³)

February 2025

Rev 0

STANTEC:\\ca0002-ppfss02\shared_projects\123513381\disciplines\air_quality\Grids\Mount_Bracey_KP163\MountBracey_KP163_receptors.srf

Appendix E Modelling Results using Ambient Ratio Method 2 (ARM 2)

Table of Contents

E.1 Introduction E.1
E.1.1 NO_X to NO_2 Conversion E.1
E.1.2 Results E.1

E.2 REFERENCES E.3

List of Tables

Table E.1 Project-Alone Case Dispersion Modelling Results for Compressor Station E.2
Table E.2 Application Case Dispersion Modelling Results for Compressor Station E.2

E.1 Introduction

The Guidance for NO_2 Dispersion Modelling in British Columbia (BC ENV, 2022c outlines several approaches for NOx to NO_2 conversion, including the Total Conversion Method (TCM, the Ambient Ratio Method (ARM, the Ozone Limiting Method (OLM using representative ozone measurements, and CALPUFF predictions based on the RIVAD/ISORROPIA approach.

Section 3 of the Air Quality Technical Data Report (TDR presents the primary dispersion modelling results for the predicted maximum NO_2, $PM_{2.5}$, SO_2 and CO concentrations for the Project-Alone Case and Application Cases for the proposed Mount Bracey Compressor Station (the Project. The NO_2 concentrations are based upon the OLM approach for NOx to NO_2 conversion. Appendix C to the TDR provides details on the selection and application of CALPUFF, the primary dispersion model that was used for the air quality assessment, including the OLM approach was applied for NOx to NO_2 conversion.

This appendix presents additional modeling results using the Ambient Ratio Method 2 (ARM 2 as an alternative NOx to NO_2 conversion approach. All other dispersion model selections and applications remain unchanged from those outlined in Appendix C.

E.1.1 NO_X to NO_2 Conversion

ARM 2 was developed in 2013 for the American Petroleum Institute and U.S. EPA. The ARM 2 refines the original ARM by applying a varying ambient ratio NO_2 to NO_X as a function (6th order polynomial equation) of total NO_X concentration based upon a dataset of measurements from monitoring stations in British Columbia (BC ENV, 2022c). The NO_2 Guidance (BC ENV, 2022c) provides several ambient ratio functions depending on the location of a project in BC, including for coastal, industrial, rural, urban, and all sites. For this work, as the Project is located in a rural area with few nearby emission sources, the rural curve is used for the Project model cases.

E.1.2 Results

The predicted maximum NO_2 concentrations for the Project-Alone Case and Application Case are presented in the following sections. Other than the use of ARM2, all other assumptions remain unchanged from those outlined in Section 3 of the TDR.

E.1.2.1 Project-Alone Case

The Project-Alone Case emission scenario consists of all continuous emission sources at Mount Bracey Compressor Station with the exception of one gas turbine assumed to be in standby. Predicted NO_2 (ARM 2 approach) concentrations are presented in Table E.1.

Table E.1 Project-Alone Case Dispersion Modelling Results for Compressor Station

CAC	Averaging Period	Maximum Predicted Concentrations ($\mu g/m^3$)	BC AQO ($\mu g/m^3$)	CAAQS 2025 ($\mu g/m^3$)	Percentage of British Columbia AQO (%)
NO_2 (ARM 2 approach)	1-hour	60.4	113	79	53
	Annual	14.5	32	23	45
Note: Achievement for each parameter and time averaging interval is as described in the notes section of Table 2.1 in the TDR.					

The maximum 98th percentile of the predicted daily one-hour maximum ground-level NO_2 concentration for the Project-Alone Case is 60.4 $\mu g/m^3$, which is less than the BC AQO. Figure E-1 and Figure E-2 shows that this maximum occurs on the Project north plant boundary The maximum predicted annual average ground-level NO_2 concentration is 14.5 $\mu g/m^3$, which is less than the BC AQO. Figure E-3 and Figure E-4 shows that this maximum occurs on the Project north plant boundary.

E.1.2.2 Application Case

The Application Case emission scenario consists of all continuous emission sources at the Mount Bracey Compressor Station plus the baseline concentrations. The predicted concentrations for the Application Case are based on normal operation with sources operating at 100% of rated capacity for each equipment plus the baseline. Predicted NO_2 are presented Table E.2

Table E.2 Application Case Dispersion Modelling Results for Compressor Station

CAC	Averaging Period	Maximum Predicted Concentrations ($\mu g/m^3$)	Baseline ($\mu g/m^3$)	Maximum Predicted Concentration Including Baseline ($\mu g/m^3$)	BC AQO ($\mu g/m^3$)	CAAQS 2025 ($\mu g/m^3$)	Percentage of British Columbia AQO (%)
NO_2 (ARM 2 approach)	1-hour	60.4	288-value array (Table 2.4 of the TDR)	74.2	113	79	66
	Annual	14.5	2.1	16.6	32	23	52
Note: Achievement for each parameter and time averaging interval is as described in the notes section of Table 2.1 of the TDR.							

The maximum 98th percentile of the predicted daily one-hour maximum ground-level NO_2 concentration for the Application Case is 74.2 $\mu g/m^3$, which is less than the BC AQO. Figure E-5 and Figure E-6 shows that this maximum occurs on the Project north plant boundary. The maximum predicted annual average ground-level NO_2 concentration is 16.6$\mu g/m^3$, which is less than the BC AQO. Figure E-7 and Figure E-8 shows that this maximum occurs on the Project north plant boundary.

E.2 REFERENCES

BC ENV. (2022c, July. *Guidance for NO2 Dispersion Modelling in British Columbia.* Retrieved from https://www2.gov.bc.ca/assets/gov/environment/air-land-water/air/reports-pub/modelling_guidance_nitrogen_dioxide.pdf

Appendix D Dispersion Modelling Plan

Dispersion Modelling Plan

Dispersion Modelling Plan for Mount Bracey Compressor Station Project

June 16, 2025

Prepared for:

Coastal GasLink Pipeline Ltd.
450 1 St SW
Calgary, AB T2P 5H1

Prepared by:

Stantec Consulting Ltd.

Project Number: 123515132

CGC16362-STC-EN-PLAN-0001
Rev 2
Issued for Use

Review and Sign-off

This document entitled Dispersion Modelling Plan was prepared by Stantec Consulting Ltd. ("Stantec") for the account of Coastal GasLink Pipeline Ltd. (the "Client") to support the application to the British Columbia (BC) Energy Regulator (BCER) for a Waste Discharge Authorization (WDA) (the "Application") for the Mount Bracey Compressor Station (the "Project").

Prepared by: Digitally signed by Hauk, April Date: 2025.06.16 14:20:08 -07'00'

April Hauk, B.Sc., EP

Reviewed by: Digitally signed by Blancher, Patrick Date: 2025.06.16 14:36:57 -06'00'

Patrick Blancher, B.Sc.

Approved by: Reid Allan Person -- P.Eng. - EGBC Digitally signed by Reid Allan Person -- P.Eng. - EGBC Date: 2025.06.16 14:58:09 -06'00'

2025-Jun-16

Reid Person, M.Eng., P.Eng.(AB,BC,SK)

Table of Contents

Review and Sign-off i

Abbreviations iv

1 Dispersion Modelling Plan 1

2 General 2

3 Project Description and Geographic Setting 4

4 Dispersion Model 5
4.1 Selected Dispersion Model 5
4.2 Default Switch Settings 5
4.3 CALPUFF Receptors 7
4.3.1 Gridded Receptors 7
4.3.2 Sensitive Receptors 9

5 Planned Model Output: Air Quality Assessment Needs 10

6 Emission Sources and Characteristics 12
6.1 Contaminants Emitted for Each Emission Scenario 12
6.2 Emission Inventory 12
6.3 Model Emission Scenarios 17
6.4 Source Emission Rate Variability 18

7 Applicable Air Quality Objectives 19
7.1 British Columbia Air Quality Objectives 19
7.2 Other Regulatory Criteria 21

8 Baseline Concentration 23

9 Building Downwash 27

10 Geophysical Data Input 29
10.1 Topography and Land Use Data 29
10.1.1 Surface Characteristics 29
10.2 Meteorological Data Input (For Level 2 and 3 Assessments Only) 31
10.2.1 Surface Meteorological Data 31
10.2.2 Upper-Air Meteorological Data 31
10.3 Numerical Weather Prediction Model Output 31

11 Treatments 33
11.1 NO to NO_2 Conversion 33
11.2 Chemical Transformation 34
11.2.1 Secondary Particulate Formation 34
11.3 Particle Deposition 34
11.4 Stagnation 34
11.5 Plume Condensation (Fogging) and Icing 35

12 Quality Management Program 36
12.1 Model Input Data 36
12.2 Model Output Data 36

13 BCER Review of Plan and Revisions 37

14 References 38

List of Tables

Table 6.1 Stack Parameters and Emission Rates for the Proposed Equipment 13
Table 6.2 Summary of Emission Sources for each Modelling Scenario at Mount Bracey CS 17
Table 6.3 Emissions Summary for each Modelling Scenario 18
Table 7.1 British Columbia Air Quality Objectives 20
Table 7.2 2025 Canadian Air Quality Standards 21
Table 7.3 Criteria from Other Jurisdictions (Critical Levels) 21
Table 8.1 Summary of Monitoring Stations Locations and Substances Monitored 24
Table 8.2 Summary of Baseline CAC Concentrations [a] 25
Table 8.3 288-Value Array NO_2 Baseline Summary using Blueberry First Nation School Monitoring Data 26
Table 9.1 Building Dimensions 27
Table 11.1 Equipment Specific and Emission Weighted In-Stack Ratios 33

List of Figures

Figure 4.1 CALMET Model Domain and Terrain 6
Figure 4.2 CALPUFF Receptor Grid for Mount Bracey Compressor Station (KP 163) 8
Figure 6.1 Simplified Plot Plan for Mount Bracey Compressor Station (KP 163) 16
Figure 10.1 CALMET Land Use Classification 30
Figure 10.2 Comparison of Measured and Predicted Surface Winds at ECCC Mackenzie Airport Weather Station (2011–2015) 32

List of Appendices

Appendix A CALMET Model Options and Land Use Characterization Parameters

Appendix B Emissions Inventory

Abbreviations

the Application	The application to the British Columbia (BC) Energy Regulator (BCER) for a Waste Discharge Authorization (WDA)
AFB	absolute fractional bias
AQO	Air Quality Objective
BC	British Columbia
BCER	British Columbia Energy Regulator
ENV	British Columbia Ministry of Environment and Climate Change Strategy
°C	degrees Celsius
CAAQS	Canadian Ambient Air Quality Standards
CCME	Canadian Council of Ministers of the Environment
CEC	Commission for Environmental Cooperation
CO	carbon monoxide
CGL	Coastal GasLink
g/s	grams per second
ISR	In-stack ratio
K	Kelvin
km	kilometre
KP	Kilometre post
kW	kilowatt
m	metre
m/s	metres per second
m asl	metres above sea level
m E	Easting (metres)

m N	Northing (metres)
NAD83	North American Datum of 1983
NO_2	nitrogen dioxide
NO_X	nitrous oxide
OLM	Ozone limiting method
$PM_{2.5}$	fine particulate matter with an aerodynamic diameter less than equal to 2.5 micrometres
the Project	the Mount Bracey Compressor Station
SO_2	sulphur dioxide
t/d	tonnes per day
$\mu g/m^3$	microgram per cubic metre
UTM	Universal Transverse Mercator
US EPA	United States Environmental Protection Agency
WDA	Waste Discharge Authorization
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 Ministry of Environment and Climate Change Strategy (British Columbia ENV; (BC ENV, 2022a)). Text in *italics* is provided as part of the British Columbia ENV 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 British Columbia ENV template related to other dispersion modelling systems (i.e., AERMOD) have been removed.

2 General

Date: 16-June-2025

Facility Name: Mount Bracey Compressor Station

Company: Coastal GasLink Pipeline Ltd.

Company Contact: Lara Smandych

Location:
Latitude: 54.9162°N Northing: 6,085,740 m N Zone 10
Longitude: -122.2266°E Easting: 549,576 m E Zone 10

Air Quality Consultant and Contact Name:

Stantec Consulting Ltd.
April Hauk
(250) 852-5921
April.Hauk@stantec.com

Stantec Consulting Ltd.
Reid Person
403-781-4159
Reid.Person@stantec.com

BCER Contact Name(s):
Rachel Butler
250-794-5220
Rachel.Butler@bc-er.ca

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

A Level 3 Assessment will be conducted to assess the air quality consequences of emissions as a result of operation of the Mount Bracey Compressor Station (CS) (the Project). Section 2.2.2 of the British Columbia Air Quality Dispersion Modelling Guideline (the Guideline) (BC ENV, 2022b) indicates that a Level 3 assessment is appropriate for modelling the Project's emission sources. This is due to the complex topography and wind flows in the region and the multiple emission sources.

The Project is being evaluated for a British Columbia Waste Discharge Authorization (WDA). The air quality assessment will be conducted using the CALPUFF modeling system. The CALMET module will use Weather Research Forecast (WRF) data as input.

Does this plan follow a modelling approach that is similar to the approach taken in a previous air quality assessment already reviewed and accepted by the Ministry? If so, provide the project name and Ministry contact:

This plan follows an air dispersion modelling approach typical of several recent compressor station modelling exercises conducted by Stantec in northeast British Columbia, but the modelling methodology described here is specific to the Mount Bracey Compressor Station.

3 Project Description and Geographic Setting

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

Coastal GasLink Pipeline Ltd (CGL) constructed and will operate a natural gas pipeline (the CGL pipeline) from the area near the community of Groundbirch (approximately 40 km west of Dawson Creek, British Columbia [BC]) to the LNG Canada Development Inc. (LNG Canada) liquified natural gas (LNG) export facility (LNG Canada export facility) near Kitimat, BC. CGL will leverage this existing infrastructure with the construction of the Cedar Link Project; a connector pipeline, a meter station and a new compressor station (Mount Bracey) to enable the delivery of an additional 0.4 billion cubic feet per day (bcf/day) of natural gas from the CGL pipeline to the Cedar LNG Project, a proposed floating LNG facility in Kitimat, BC.

The Mount Bracey CS is located at the CGL pipeline Kilometer Post (KP) 163 in the Regional District of Fraser - Fort George (Figure 4.1). Construction of the Project commenced in 2024 and will be in service in 2028.

The purpose of this dispersion model plan is to support the application to the British Columbia (BC) Energy Regulator (BCER) for a Waste Discharge Authorization (WDA) for the Project.

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 is located at an elevation of 854 m above sea level (asl). The higher elevations are towards the southwest and west portions of the CALMET domain and the lowest elevations are in the southwest portions of the domain. Terrain in the region is complex ranging from approximately 700 to over 2,600 m asl.

The dominant land cover in this rural remote region is evergreen forest, with some deciduous forest. Evergreen forest dominates in the immediate vicinity of the Project. The nearest settlement is the community of Anzac, located 25 km to the southwest.

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 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

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

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.

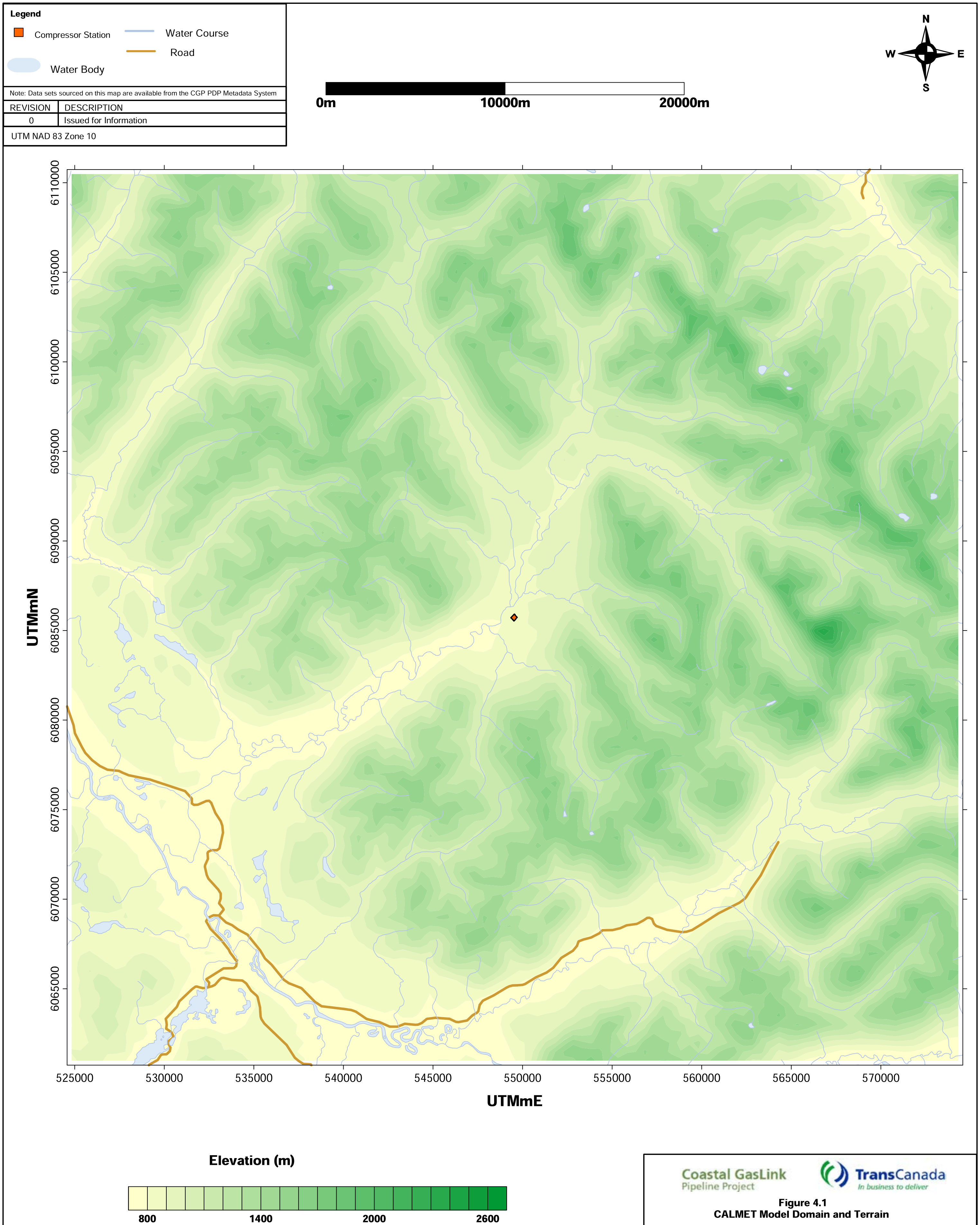
4.2 Default Switch Settings

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 ENV 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 (BC ENV 2022b).
- The CALMET 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:* CALMET domain map for the Project is provided in Figure 4.1. There are no surface meteorological stations in this domain (Figure 4.1). There are no upper air stations within or nearby the CALMET domain. See Section 10.2 for more information.
- *Anticipated grid resolution:* 500 (m)
- *Number of grids in X and Y direction:* NX = 100, NY = 100



Coastal GasLink Pipeline Project

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Figure 4.1
CALMET Model Domain and Terrain

November 2024

4.3 CALPUFF Receptors

4.3.1 Gridded Receptors

For the CALPUFF model

Proposed receptor grid spacing for the Project assessment (see Section 7.2 in the Guideline (BC ENV 2022b):

- 20 m receptor spacing along the Project boundary
- 50 m spacing for the 3.5 km x 3.5 km area centered on the Project
- 250 m spacing for the 14 km x 14 km area centered on the Project
- 500 m spacing for the 22 km x 22 km area centered on the Project

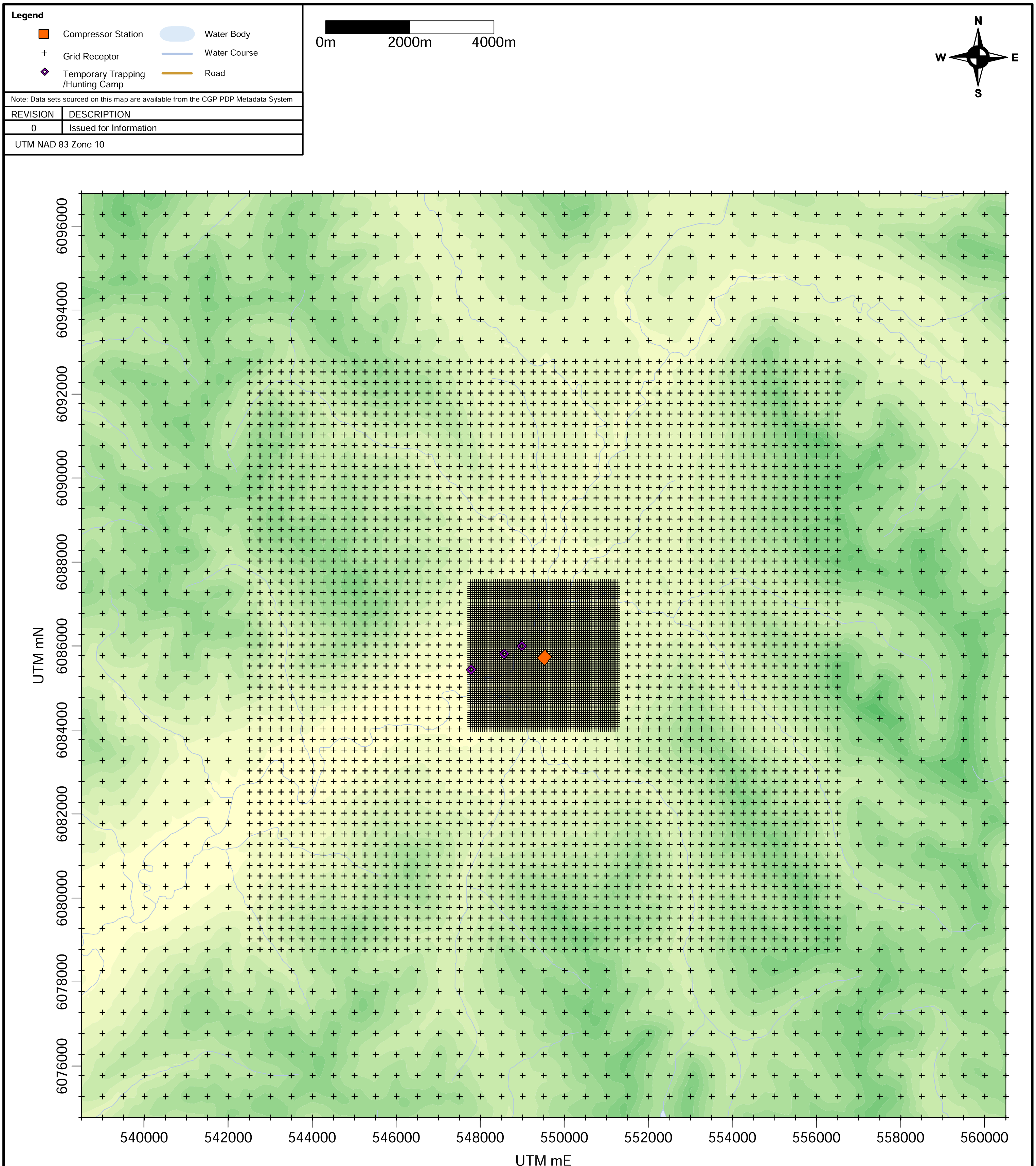
The described grid comprises 9,307 receptor locations. This extent of the receptor grid is considered sufficient to indicate the magnitude and spatial variation of the predicted concentrations resulting from the Project emissions.

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 4.2.

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

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



Note: Data sets sourced on this map are available from the CGP PDP Metadata System

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Figure 4.2
CALPUFF Receptor Grid for Mount Bracey Compressor Station (KP 163)

December 2024

Rev 0

STANTEC:\\ca0002-ppfss02\shared_projects\123513381\disciplines\air_quality\Grids\Mount_Bracey_KP163\MountBracey_KP163_receptors.srf

4.3.2 Sensitive Receptors

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

There are no permanent residents in the vicinity of the Project, therefore there are no sensitive receptors for the Project assessment. Three temporary trapping and hunting camps near the Project have been identified within 1.5 km of the Project. The camps are occupied temporarily during the year but there is a potential for exposure to pollutants while the camp is occupied. Therefore, the temporary camps have been included in the receptor grid as a receptor of interest, but are not considered sensitive receptors because they are not permanently occupied.

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)

Model output for the Project will include predicted ground-level concentrations for nitrogen dioxide (NO_2), sulphur dioxide (SO_2), 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. Large scale NO_2 isopleth maps will be provided with the predicted NO_2 concentrations for the entire modelling domain.

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

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

Figures will include spatial distribution maps of maximum predicted concentrations for NO_2, 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 air quality objective (AQO) (i.e., maximum predicted 3-year average of the 98^{th} percentile of the daily 1-hour maximum nitrogen dioxide concentration). Spatial distribution maps for SO_2 and CO will not be presented unless predicted concentrations are greater than 50% of the AQO.

If exceedances of the applicable regulatory criteria are predicted, the list of receptors that exceed the metric and figures showing the frequency (i.e., % of hours) of exceedance will be included.

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

Tables of maximum predicted concentrations for NO_2, SO_2, $PM_{2.5}$, and CO equivalent to the statistical form of the applicable AQO (i.e., maximum predicted 3-year average of the 98^{th} percentile of the daily 1-hour maximum nitrogen dioxide concentration) will be provided. If exceedances are predicted, the areal extent, frequency, and meteorological circumstances associated with those exceedances will be investigated.

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

Tables of air quality parameters will be provided for the receptors of interest (Figure 4.2).

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 assessment.

Switching events, in which the standby compressor or power generator are brought up to full power and an operating compressor or power generator are then ramped down, will be discussed in the Technical Assessment Report. Due to the short duration (less than20 minutes per event) and limited data available to quantify emissions under reduced loads, it is not practical to incorporate these events into dispersion modelling. Switching events emissions will be compared to steady state operations qualitatively to support a discussion of air emissions associated with these events. Switching events are anticipated to occur less than 50 times per year.

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

Figures will be provided for study area (Facility: 50 km by 50 km) if complex spatial distribution of concentrations is predicted in the vicinity of the Project, additional figures for the near-field will be investigated.

Special output required for vegetation, health risk or visibility assessments

Effects on human health, and visibility, are not assessed for the Project. There are no sensitive receptors nearby to warrant a human health study. 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 sources consist of those from the combustion of fuel gas. The Project's emissions include oxides of nitrogen (NO_x), SO_2, $PM_{2.5}$ and CO. These substances will be carried forward in each model scenario discussed below. For each model scenario and for the substances modelled, the source type is Point (P).

6.2 Emission Inventory

The proposed operations will include three gas-fired turbines, four gas-fired generators, three seal gas combustors and six glycol heaters on site. Two turbines will operate at any given time, the third turbine is standby. The third standby plant's ancillary equipment (specifically the generators, glycol heaters, and seal gas combustor) will run at all times to maintain the standby plant in a state of readiness. The fourth generator (A0, Building #26 on the plot plan) will only run when one of the other three generators are not running. It may be used to backfeed any of the plants if the generator is out of service for maintenance or due to failure.

There will be a domestic (food) waste incinerator onsite, but it is not considered a continuous source, and therefore, is not including in modelling.

Emission factors for NO_X and CO are provided by CGL, vendor data or based on AP-42 published emission factors (Table 6.1). The sulphur content in source fuel gas for the Project is provided by CGL for the emission sources included in the assessment. For the $PM_{2.5}$ emission factors, a more up-to-date study by Canadian Energy Partnership for Environmental Innovation (CEPEI) was used (CEPEI, 2024).

Maximum emission rates are applied in the CALPUFF modelling.

Design information for the Project including building dimensions, stack heights and diameters are based on site layout and configuration provided by CGL.

Table 6.1 presents the stack parameters, emission rates and source of data for the proposed equipment. Stack parameters and emission rates for the gas-fired turbines, gas-fired generators and the glycol heaters are provided by CGL. The emission rates presented in Table 6.1 are for each unit. The cumulative emissions are presented in Section 6.3.

Table 6.1 Stack Parameters and Emission Rates for the Proposed Equipment

Source Identification		BHGE PGT25+ Gas Turbine	Source of Data	Waukesha Gas Generator L5794GSI	Source of Data	Seal Gas Vapour Combustors	Source of Data	Auxiliary Utility Glycol Heaters	Source of Data
Unit Description		Continuous	CGL	Continuous	CGL	Continuous	CGL	Continuous	CGL
Number of units		2 (+1 Standby)	CGL	3 (+1 Standby)	CGL	3	CGL	6	CGL
Source Type		Point	CGL	Point	CGL	Point	CGL	Point	CGL
Capacity – Heat Input (based on HHV)	MMBtu/hr	290	Stantec [b]	9.47	Stantec [b]	1.5	CGL	1.92	CGL
	GJ/hr	306	Stantec [b]	9.99	Stantec [b]	1.6	Stantec [b]	2.03	Stantec [b]
	kW	85,000	Stantec [b]	2,775	Stantec [b]	N/A	N/A	563	CGL
Output Rating (Assume LHV)	MMBtu/hr	N/A	Stantec [b]	N/A	N/A	N/A	N/A	1.47	Stantec [b]
	GJ/hr	111	Stantec [b]	3.06	Stantec [b]	N/A	N/A	1.55	Stantec [b]
	kW	30,900	CGL	850	CGL	N/A	N/A	431	CGL
Fuel Type		Fuel Gas	CGL	Fuel Gas	CGL	Fuel Gas	CGL	Fuel Gas	CGL
Fuel Gas Consumption Rate	$10^3m^3/d$	188.8	Stantec [b]	6.2	Stantec [b]	0.99	Stantec [b]	1.25	Stantec [b]
Sulphur Content [b]	ppmv	22.0	CGL	22.0	CGL	22.0	CGL	22.0	CGL
Exhaust Gas Flow Rate	kg/s	82.9	CGL	0.93	Vendor Data [c]	N/A	N/A	N/A	N/A
Exhaust Gas MW	kg/kmol	28.5	CGL	N/A	N/A	N/A	N/A	N/A	N/A
Exhaust Gas H_2O Content	%	4.3	CGL	N/A	N/A	N/A	N/A	N/A	N/A
Exhaust Gas O_2 Content (dry condition)	%	16.1	Stantec [d]	N/A	N/A	N/A	N/A	N/A	N/A
Rain Cap	Yes/No	No	CGL	No	CGL	No	CGL	Yes	CGL
Release Direction		Vertical	CGL	Vertical	CGL	Vertical	CGL	Vertical	CGL
Stack Height	m	14.5	CGL	8.5	CGL	4.2	CGL	6.8	CGL
Stack Diameter	m	2.6	CGL	0.305	CGL	1.58	CGL	0.559	CGL
Maximum Exit Velocity	m/s	38.2	Stantec	37.2	Stantec	0.36	CGL	1.45	Stantec [b]
Exit Temperature	°C	494.4	CGL	580.6	Vendor Data [c]	63	CGL	258	Stantec
	K	768	Stantec	854	Stantec	336	CGL	531	Stantec [b]
NO_X	ppmv@ 15% O_2 and dry	25 [a]	CGL	N/A	N/A	N/A	N/A	N/A	N/A
NO_X	g/kW-hr	N/A	N/A	1.00	CGL	N/A	N/A	N/A	N/A
NO_X	lb/MMBtu	N/A	N/A	N/A	N/A	0.098	AP-42 (Table 1.4-1) [e]	0.098	AP-42 (Table 1.4-1) [e]
CO	ppmv @ 15% O_2 and dry	36 [a]	CGL	N/A	N/A	N/A	N/A	N/A	N/A
CO	g/hp-hr	N/A	N/A	0.17	CGL	N/A	N/A	N/A	N/A
CO	lb/MMBtu	N/A	N/A	N/A	N/A	0.082	AP-42 (Table 1.4-1) [e]	0.082	AP-42 (Table 1.4-1) [e]
$PM_{2.5}$ (CEPEI 2024) [d]	g/GJ (fuel input, HHV)	0.38	CEPEI (CEPEI 2024)	1.11	CEPEI (CEPEI 2024)	0.637	CEPEI (CEPEI 2024)	0.637	CEPEI (CEPEI 2024)
NO_X	t/d	0.226	Stantec [b]	0.0204	Stantec [b]	1.64E-03	Stantec [b]	2.05E-03	Stantec [b]
SO_2	t/d	0.011	Stantec [b]	0.0004	Stantec [b]	5.96E-05	Stantec [b]	7.45E-05	Stantec [b]
CO	t/d	0.198	Stantec [b]	0.0047	Stantec [b]	1.38E-03	Stantec [b]	1.72E-03	Stantec [b]
$PM_{2.5}$	t/d	0.003	Stantec [b]	0.0003	Stantec [b]	2.48E-05	Stantec [b]	3.10E-05	Stantec [b]
NO_X	g/s	2.614	Stantec [b]	0.2361	Stantec [b]	0.019	Stantec [b]	0.0237	Stantec [b]
SO_2	g/s	0.130	Stantec [b]	0.0043	Stantec [b]	0.001	Stantec [b]	0.0009	Stantec [b]

Source Identification		BHGE PGT25+ Gas Turbine	Source of Data	Waukesha Gas Generator L5794GSI	Source of Data	Seal Gas Vapour Combustors	Source of Data	Auxiliary Utility Glycol Heaters	Source of Data
CO	g/s	2.291	Stantec [b]	0.0538	Stantec [b]	0.016	Stantec [b]	0.0199	Stantec [b]
$PM_{2.5}$	g/s	0.032	Stantec [b]	0.0031	Stantec [b]	0.0003	Stantec [b]	0.0004	Stantec [b]

Notes:
[a] Provided by CGL
[b] Calculated by Stantec
[c] Manufacturer data for Waukesha Gas Generator L5794GSI (Innio, 2019), (CGL, 2019)
[d] Source: (CEPEI, 2024)
[e] Source: (U.S. EPA, 1998)
The emission rates provided are for each unit, not cumulative. The cumulative emissions are presented in Section 6.3.

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.

Legend

Building

Fenceline

Emission Source

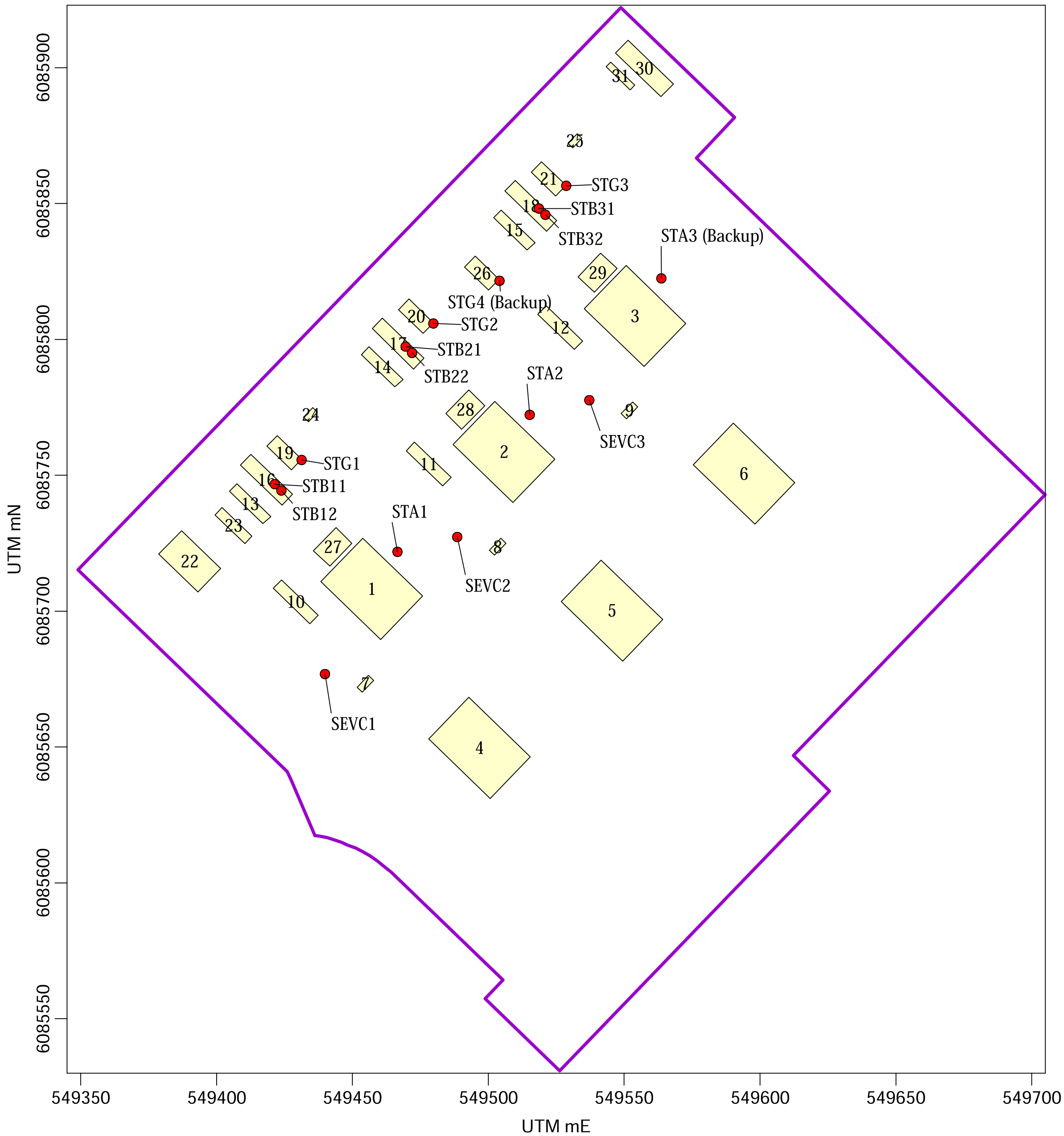
Note: Data sets sourced on this map are available from the CGP PDP Metadata System

REVISION	DESCRIPTION
0	Issued for Information

UTM Zone 10 NAD 83

0m 50m 100m

N E S W



1-3	Compressor Buildings for Unit A1, A2, and A3
4-6	Air Cooled Heat Exchangers for Unit A1, A2, and A3
7-9	Utility Gas Enclosures for Unit A1, A2, and A3
10-12	Local Control Module Buildings for Unit A1, A2, and A3
13-15	Electrical Buildings for Unit A1, A2, and A3
16-18	Mechanical Buildings for Unit A1, A2, and A3
19-21	APU Buildings for Unit A1, A2, and A3
22	Heated Storage Building
23	Personnel Building
24	Drum Rack Building 1
25	Drum Rack Building 2
26	Unit A0 Stand-By PPU Building
27-29	Air Intakes for Unit A1, A2, and A3
30	Living Quaters
31	Fresh Water and Drain Tank Building

STB11	Unit A1 Boiler Exhaust 1
STB12	Unit A1 Boiler Exhaust 2
STB21	Unit A2 Boiler Exhaust 1
STB22	Unit A2 Boiler Exhaust 2
STB31	Unit A3 Boiler Exhaust 1
STB32	Unit A3 Boiler Exhaust 2
STG1	Unit A1 Gen. Skid Exhaust 1
STG2	Unit A2 Gen. Skid Exhaust 2
STG3	Unit A3 Gen. Skid Exhaust 3
STG4	Unit A0 Gen. Skid Exhaust (Backup)
STA1	Compressor Unit A1 Exhaust
STA2	Compressor Unit A2 Exhaust
STA3	Compressor Unit A3 Exhaust (Backup)
SEVC1	Seal Gas Combustor 1
SEVC2	Seal Gas Combustor 2
SEVC3	Seal Gas Combustor 3

Coastal GasLink Pipeline Project

TC Energy

Figure 6.1
Simplified Plot Plan for
Mount Bracey Compressor Station (KP 163)

Dec3 2024

Rev 0

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.

Two scenarios have been identified to examine the air quality implications of the Project: the Project-Alone Case and the Application Case. There are no facilities near the Project, therefore, Base Case is not modelled.

Project-Alone Case: The Project will have a total of three gas turbines, four gas generators, six glycol heaters, and three seal gas vapour combustors. During normal operations, The Project-Alone Case modelling scenario includes emissions from two BHGE PGT25+ gas turbines, and three Waukesha gas generators, three seal gas vapour combustors and six heaters. Occasionally, the stand-by turbine or generator will become operational to take the load off an operating unit so that the operating unit can be shut down (Section 5). These switching events (when three turbine units or four generators are operating) are infrequent (i.e., less than 50 events per year), and short duration, lasting less than 20 minutes. Because of the infrequent and short duration of the switching event, the emissions (with all three turbines or all four generators running) will not be included in the modelling but will be discussed qualitatively in the Technical Assessment Report. Emission rates for the Project-Alone Case are assumed to be consistent with the hourly, daily, and annual rates for full equipment capacity. A summary of emissions is shown in Table 6.1. Units designated as backup, emergency, or on standby will be depicted in the modelling exercise as not operating.

Application Case will include the sources from the Project-Alone Case, with baseline concentrations added (Table 8.2). The term “baseline” is being used to describe existing air quality conditions and the contribution from existing sources not included in the modelling (Section 8).

The modelling scenarios are summarized in Table 6.2 and the summary of scenario emissions is presented in Table 6.3.

Table 6.2 Summary of Emission Sources for each Modelling Scenario at Mount Bracey CS

Equipment	Project-Alone Case	Application Case
BHGE PGT25+ Gas Turbine (2 units)	x	x
Waukesha Gas Generator L5794GSI (3 units)	x	x
Seal Gas Vapour Combustor (3 units)	x	x
Glycol Heaters (6 units)	x	x
Baseline	N/A	x

Table 6.3 Emissions Summary for each Modelling Scenario

Modelling Scenario	Emissions (tonnes/year)			
	NO_X	SO_2	$PM_{2.5}$	CO
Project-Alone Case, Total	231	8.8	2.4	155
Application Case, Total [a]	231	8.8	2.4	155

Notes:
[a] The Application Case, Total emissions represent the emissions resulting from the Project-Alone Case plus baseline concentrations.

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.

‘During normal operations, there is no variability in source emission rates associated with Project emission sources. See unit switching events description in Section 5.

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

Reduced capacity emission scenarios are not applicable for normal operations. Equipment is assessed as operating at 100% capacity continuously.

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

There are no batch processes associated with the Project.

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. (BC ENV 2022b)*.*

During normal operations, there is no variability in source emission rates associated with Project emission sources.

7 Applicable Air Quality Objectives

7.1 British Columbia 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 British Columbia ENV have stated that the British Columbia AQOs are applicable beyond the facility fence line ((BC ENV, 2016), (BC ENV, 2020)). Where exceedances of the AQO are predicted through dispersion modelling, the British Columbia ENV considers the context of magnitude, frequency, timing, and proximity to sensitive receptors. Should there be exceedances of the AQO, the British Columbia ENV 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 ((BC ENV, 2020)).

The regulatory criteria in British Columbia for NO_2, SO_2, $PM_{2.5}$ and CO applicable to this assessment are shown in Table 7.1 (BC ENV, 2021a).

The AQOs for NO_2 are 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. They are not intended 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 7.1 British Columbia Air Quality Objectives

Substance	Averaging Interval	British Columbia Air Quality Objective (μg/m^3)
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 NO_2 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 NO_2 is based on the average of all 1-hour average concentrations over a single calendar year

[c] Achievement for 1-hour SO_2 is based on 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 SO_2 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: (BC ENV, 2021a)

British Columbia ENV has not stated if the 2025 CAAQS will be adopted. Regulatory agencies have expressed an interest in referencing objectives other than the AQO assessments. Specifically, they are interested in referencing the Canadian Ambient Air Quality Standards (CAAQS) for other years (CCME, 2021). The 2025 CAAQS are provided in this assessment for information purposes. Effects on air quality will be evaluated using the British Columbia AQO (BC ENV, 2021a). The regulatory criteria applicable to this assessment are shown in Table 7.2 which lists the CAAQS for the year 2025 for NO_2 and SO_2, and 2020 for $PM_{2.5}$.

Table 7.2 2025 Canadian Air Quality Standards

Substance	Averaging Interval	Air Quality Objective ($\mu g/m^3$)
NO_2	1-hour	79[a]
	Annual	23[b]
SO_2	1-hour	170[c]
	Annual	11[d]
$PM_{2.5}$	24-hour	27
	Annual	8.8

Notes:

The other regulatory criteria are for the year 2025 for NO_2 and SO_2, and 2020 for $PM_{2.5}$. The statistical forms for each are the same as for the applicable regulatory criteria Table 7.1.

[a] Achievement for 1-hour NO_2 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 NO_2 is based on the average of all 1-hour average concentrations over a single calendar year

[c] Achievement for 1-hour SO_2 is based on 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 SO_2 is based on the average of 1-hour concentrations averaged over one year.

Source: (CCME, 2021)

7.2 Other Regulatory Criteria

Other criteria important for assessment of potential air quality effects have been included. For this assessment it includes the critical levels listed in the International Cooperative Programme on Modelling and Mapping of Critical Levels and Loads and Air Pollution Effects, Risks and Trends (CLRTAP (Convention on Long-range Transboundary Air Pollution), 2004).

The critical levels employed in this assessment are presented in Table 7.3. They consider the annual average concentrations for NO_X. Note that the NO_X parameter is “NO_X as NO_2” ($NO_X = NO + NO_2$), and not NO_2 alone.

Table 7.3 Criteria from Other Jurisdictions (Critical Levels)

CAC	Averaging Interval	Critical Level ($\mu g/m^3$)	Vegetation Note
NO_X as NO_2	Annual	30	Protective of 95% of species at a 95% confidence level
SOURCE: (CLRTAP (Convention on Long-range Transboundary Air Pollution), 2004)			

Should exceedances of the critical levels be predicted a suitable management and monitoring plan will be discussed in the Application.

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)
_____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 (BC ENV, 2022b)) states that baseline may be determined from air quality monitoring data or may be estimated from modelling other 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 this Project, baseline will be determined by an ambient monitoring station from representative monitoring stations at different locations. 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.

Measured concentrations for NO_2, SO_2, $PM_{2.5}$, and CO were reviewed for a number of existing continuous monitoring stations in British Columbia that were deemed representative of the study area by considering similarities in emission sources (i.e., industrial, transportation, home heating), terrain influence, and meteorology. The monitoring stations reviewed included Blueberry First Nation School, Pine River Hasler, Peace Valley Attachie Flat Upper Terrace, and Kamloops Brocklehurst.

The Blueberry First Nation School monitoring location, is located 212 km northeast of the Project and considered conservative and representative for background NO_2 concentrations, including influences from rural residential heating and traffic, with little to no influence from a major industrial NO_X emission source. The Pine River Hasler monitoring station is located 76 km north of the Projectand is used to assess baseline ambient concentrations for SO_2. This monitoring station is considered representative of the area due to its rural location. The Peace Valley Attachie Flat Upper Terrace monitoring station is located 156 km northeast of the Projectand provided the $PM_{2.5}$ baseline ambient data. This monitoring station is considered representative of the area due to its rural location. The Kamloops Brocklehurst monitoring station located 491 km south-southeast of the Projectand was used to assess baseline ambient concentrations for CO. It is noted that the Kamloops Brocklehurst continuous monitoring station is within an urban area, therefore, their measured background concentrations are expected to be generally higher than what is typical for the remote areas where the Project is located. There is limited CO monitoring in British Columbia and no CO monitoring in rural areas.

Continuous monitoring data are derived from the most recent and representative years of ambient air quality data in British Columbia ENV's annual summaries of British Columbia ambient air quality data (BC ENV, 2024). Data from monitoring stations is used in the baseline determination if the quarterly data validity meets or is greater than the minimum 75% threshold. A summary of monitoring station locations and substances reviewed are provided in Table 8.1.

Table 8.1 Summary of Monitoring Stations Locations and Substances Monitored

Monitoring Station	Elevation (m asl)	Location (UTM NAD83)			Data Period	Substances Monitored			
		m E	m N	Zone		NO_2	SO_2	$PM_{2.5}$	CO
Blueberry First Nation School	675	616,089	6,285,782	10U	6/23/2016 to 11/29/2017	x	-	-	-
Pine River Hasler	602	564,672	6,162,659	10U	2021 to 2023	-	x	-	-
Peace Valley Attachie Flat Upper Terrace	480	597,982	6,232,937	10U	2019 to 2021	-	-	x	-
Kamloops Brocklehurst	347	683,824	5,619,419	10U	2010	-	-	-	x

Section 8.1.4 of the Guideline (BC ENV, 2022b) recommends developing baseline values using high percentile values which characterize baseline as a large increment of measured values (i.e., the 98^{th} percentile for other substances hourly and daily averages, and the mean values for annual averages). These values represent the greatest effects of all local industrial sources, natural background concentrations (globally and regionally), plus minor sources (local home heating, vehicle emissions, food preparation, and road dust). Baseline concentrations for the Project air quality assessment are provided in Table 8.2.

The NO_2 Guidance (BC ENV, 2022c) provides three options to add baseline NO_2 to dispersion modelling predictions. For the this work the 288-value array option is used. This array is comprised of the first highest measured value for each hour in each month, then average over the monitoring period. The

Blueberry First Nation School monitoring data is used to derive the 288-value array and are from the most recent and representative years of ambient air quality data obtained from the British Columbia Air Data Archive Website (BC ENV, 2024). The 288-value array carried through as the baseline values are presented in Table 8.3.

Table 8.2 Summary of Baseline CAC Concentrations [a]

Substance	Averaging Period	Baseline Concentration ($\mu g/m^3$)
NO_2 [b]	1-hour [c]	16.6
	Annual [d]	2.1
SO_2 [e]	1-hour [f]	11.5
	Annual [g]	0.9
$PM_{2.5}$ [h]	24-hour [i]	18.6
	Annual [j]	4.5
CO [k]	1-hour [l]	515.2
	8-hour [l]	515.2

Notes:

[a] Baseline air quality data was developed by Stantec from BC Air Data Archive Website and British Columbia ENV 1998-2023 summary spreadsheets (BC ENV, 2024). Conversions from ppb or ppm to $\mu g/m^3$ assume standard conditions of 25°C and 101.325 kPa.

[b] **NO_2:** The database for NO_2 observations used for baseline at Blueberry First Nation School are for 6/23/2016 to 11/28/2017.

[c] **NO_2:** The 1-hour baseline NO_2 concentration was determined based on the 98th percentile of the daily 1-hour maximum concentrations over for 2017 (BC ENV, 2024). This value is provided here for characterizing existing conditions. Baseline NO_2 concentrations used for dispersion modelling are provided in the 288-value array in Table 8.3.

[d] **NO_2:** The annual NO_2 baseline concentration was determined based on the average of 1-hour values for 6/23/2016 to 11/28/2017.

[e] **SO_2:** The British Columbia ENV summary database for SO_2 observations at Pine River Hasler are for 2021 - 2023.

[f] **SO_2:** The 1-hour baseline SO_2 concentration was determined based on the daily 1-hour maximum concentrations, followed by the calculation of the 99th percentile for each year, then averaged over the 3-year period.

[g] **SO_2:** The annual SO_2 baseline concentration was determined based on the average of annual mean values for the 3 year period.

[h] **$PM_{2.5}$:** The British Columbia ENV summary database for $PM_{2.5}$ observations at Peace Valley Attachie Flat Upper Terrace are for 2019 - 2021.

[i] **$PM_{2.5}$:** The 24-hour $PM_{2.5}$ baseline concentration was determined based on average of the 98th percentile values for the 24 hour averaging interval over the 3-year period.

[j] **$PM_{2.5}$:** The annual $PM_{2.5}$ baseline concentration was determined based on the average of the annual mean values over the 3-year period.

[k] **CO:** The British Columbia ENV summary database for CO observations at Kamloops Brocklehurst is for 2010, which is the most recent year.

[l] **CO:** The 1-hour and 8-hour baseline CO concentrations were determined based on the 98th percentile of 1-hour CO concentrations for 2010.

Table 8.3 288-Value Array NO_2 Baseline Summary using Blueberry First Nation School Monitoring Data

Hour of Day	NO_2 Baseline Value ($\mu g/m^3$)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	13.9	13.2	8.5	3.2	3.0	5.3	3.0	3.2	4.7	5.6	16.5	12.4
1	13.0	5.8	13.2	2.8	34.0	5.3	2.8	3.4	3.9	5.1	16.2	12.0
2	13.2	7.9	9.4	7.7	11.8	5.3	3.0	3.9	4.1	5.1	15.6	13.0
3	12.0	5.8	10.9	5.5	6.6	4.7	3.0	3.9	3.2	4.1	13.7	13.7
4	12.4	8.8	10.5	4.7	8.6	4.1	3.8	4.1	3.0	3.9	11.5	14.5
5	13.0	6.2	7.9	4.9	9.4	3.8	3.0	5.5	2.6	3.9	11.8	18.4
6	11.5	6.8	6.4	6.6	7.5	3.0	2.8	9.2	2.4	3.9	10.0	16.7
7	10.5	8.1	8.1	5.8	2.6	3.6	3.2	7.3	3.0	7.9	10.2	17.1
8	11.3	8.6	7.7	4.3	2.8	3.6	3.6	3.9	2.3	7.1	12.4	17.7
9	10.5	15.8	9.6	3.2	3.2	3.0	4.9	3.9	3.4	7.0	13.0	19.4
10	7.3	8.5	7.9	4.5	2.6	4.1	3.0	4.5	3.2	6.0	9.8	14.9
11	6.2	8.3	6.8	3.8	1.9	3.4	4.5	4.9	3.8	5.6	10.2	11.1
12	8.1	7.5	5.6	3.4	2.3	2.1	3.2	4.9	3.2	5.3	9.8	10.3
13	8.5	8.3	4.7	3.0	2.6	2.1	3.8	4.3	1.9	4.1	9.2	9.0
14	8.1	9.0	4.7	1.5	2.1	2.4	2.1	3.9	1.5	3.8	9.2	8.6
15	10.3	12.0	5.5	3.4	2.1	1.7	2.8	3.2	1.1	3.8	12.4	9.0
16	12.6	12.6	6.0	3.6	2.3	2.1	2.1	3.4	1.5	4.5	15.8	11.5
17	19.4	10.7	7.3	2.4	1.7	2.3	1.3	3.2	1.7	4.1	16.9	14.5
18	21.2	19.0	9.6	2.6	4.7	3.0	1.3	3.6	3.0	4.9	16.5	12.8
19	21.2	17.3	19.6	4.1	2.4	3.0	2.1	3.4	3.8	4.5	15.4	16.7
20	22.9	17.1	10.3	7.0	3.8	2.8	3.4	1.9	3.4	6.8	12.6	12.8
21	20.5	18.6	9.8	6.2	7.9	4.1	3.4	3.2	4.3	6.4	13.2	12.2
22	16.7	16.7	10.3	4.3	4.5	5.3	4.7	3.0	4.9	5.8	8.6	11.7
23	16.2	15.6	9.2	4.7	4.1	5.3	3.2	3.2	4.3	4.9	14.9	11.8

Notes:
Blueberry First Nation School monitoring data for 2016 to 2017 (BC ENV, 2024).
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), and 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 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.

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

Table 9.1 Building Dimensions

Building ID	Description	Length (m)[a]	Width (m)[a]	Height (m)[b]
Mount Bracey CS				
1	Unit A1 Compressor Building	30.7	22.3	15.5
2	Unit A2 Compressor Building	30.7	22.3	15.5
3	Unit A3 Compressor Building	30.7	22.3	15.5
4	Unit A1 Air Cooled Heat Exchangers	32.9	21.4	7.3
5	Unit A2 Air Cooled Heat Exchangers	32.9	21.4	7.3
6	Unit A3 Air Cooled Heat Exchangers	32.9	21.4	7.3
7	Unit A1 Utility Gas Enclosure	6.1	1.7	4.1
8	Unit A2 Utility Gas Enclosure	6.1	1.7	4.1
9	Unit A3 Utility Gas Enclosure	6.1	1.7	4.1
10	Unit A1 Local Control Module Building	18.7	4.4	4.6
11	Unit A2 Local Control Module Building	18.7	4.4	4.6
12	Unit A3 Local Control Module Building	18.7	4.4	4.6

Building ID	Description	Length (m)[a]	Width (m)[a]	Height (m)[b]
13	Unit A1 Electrical Building	17.4	4.0	4.5
14	Unit A2 Electrical Building	17.4	4.0	4.5
15	Unit A3 Electrical Building	17.4	4.0	4.5
16	Unit A1 Mechanical Building	21.3	5.5	6.4
17	Unit A2 Mechanical Building	21.3	5.5	6.4
18	Unit A3 Mechanical Building	21.3	5.5	6.4
19	Unit A1 APU Building	12.5	5.5	6.2
20	Unit A2 APU Building	12.5	5.5	6.2
21	Unit A3 APU Building	12.5	5.5	6.2
22	Heated Storage Building	20.0	12.0	4.5
23	Personnel Building	15.2	3.8	3.6
24	Drum Rack Building 1	4.8	2.4	4.0
25	Drum Rack Building 2	4.8	2.4	4.0
26	Unit A0 Standby PPU Building	12.2	5.5	6.2
27	Unit A1 Compressor Building Air Intake	12.0	8.2	11.0
28	Unit A2 Compressor Building Air Intake	12.2	8.2	11.0
29	Unit A3 Compressor Building Air Intake	12.2	8.2	11.0
30	Living Quarter	23.3	6.6	11.0
31	Fresh Water and Drain Tank Building	12.3	2.4	11.0

Notes:
[a] Based on the most recent Mount Bracey CS plot plan layout
[b] Building height is the average of peak and eave, estimated or based on site data provided by CGL.

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:

- *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 (BC ENV, 2022b).

The 30 m resolution CEC land cover data (CEC, 2020) is employed by CALMET to develop a 500 m resolution land use file. Figure 10.1 illustrates the land-use classes in the CALMET model domain for the Project. Based on the 500 m CALMET grid resolution data, the domain is comprised of 67.0% evergreen forest, 13.4% deciduous forest, 8.4% rangeland, 7.2% mixed forest, 1.9% shrub rangeland, 1.6% barren land, 0.5% water, and 0.1% perennial snow or ice.

Translation table of 30 m resolution CEC Land Cover Categories to CALMET Categories and seasonal CALMET land-use characterization parameters tables are included in Appendix A.

Legend

- Rangeland
- Shrub Rangeland
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Water
- Barren Land
- Snow or Ice

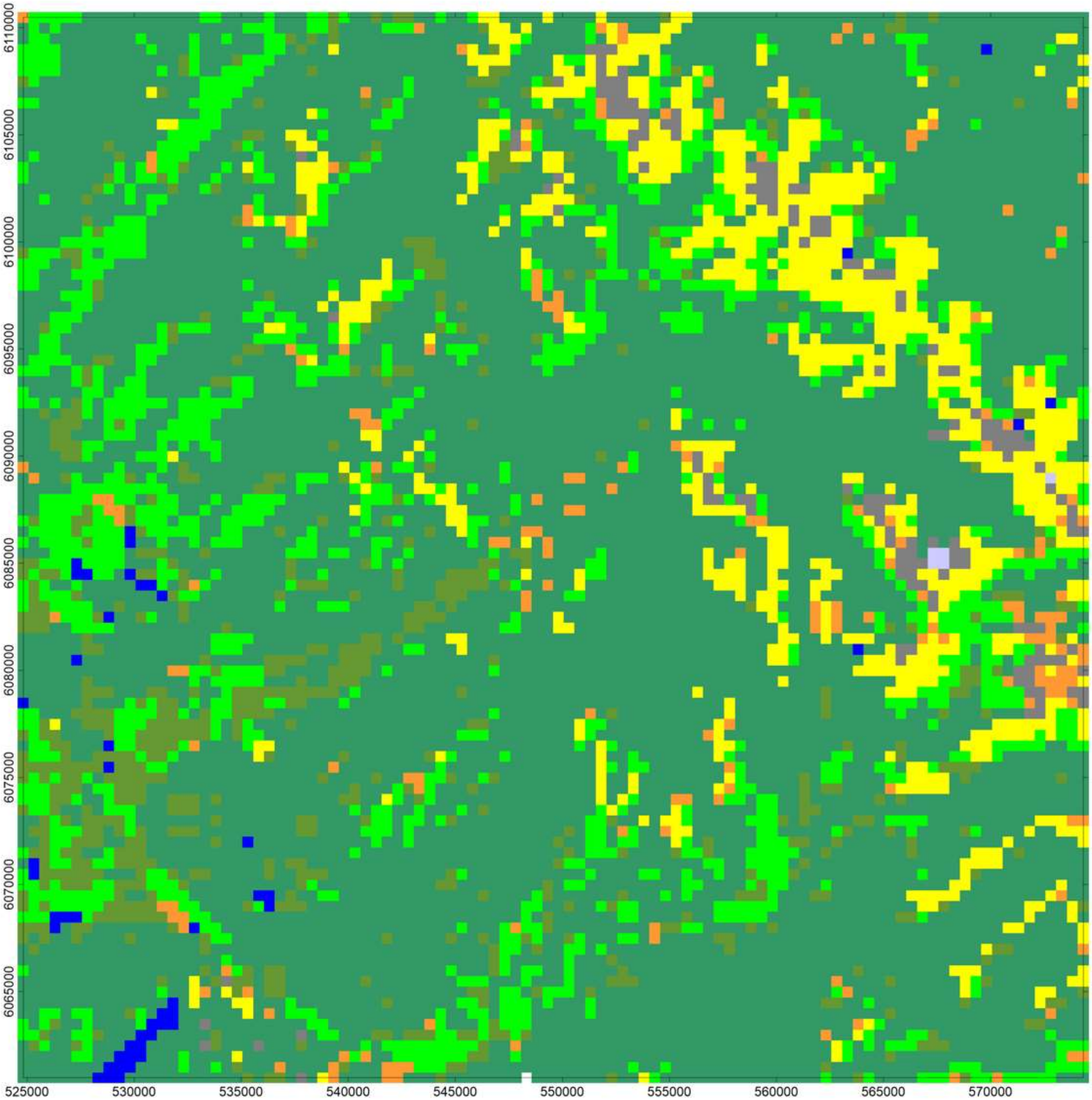
Note: Data sets sourced on this map are available from the CGP PDP Metadata System

REVISION	DESCRIPTION
0	Issued for Information

UTM NAD 83 Zone 10

0m 10000m 20000m

N W E S



Coastal GasLink Pipeline Project

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Figure 10.1
CALMET Land Use Classification

November 2024

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

10.2.1 Surface Meteorological Data

Surface meteorological data will not be used in this assessment because there are no surface meteorological stations within the model domain.

10.2.2 Upper-Air Meteorological Data

Upper air meteorological data will not be used in this assessment because CALMET will derive upper air information from the WRF numerical weather model data.

10.3 Numerical Weather Prediction Model Output

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

BC ENV 2011-2015 4 km grid Weather Research Forecast (WRF) output.

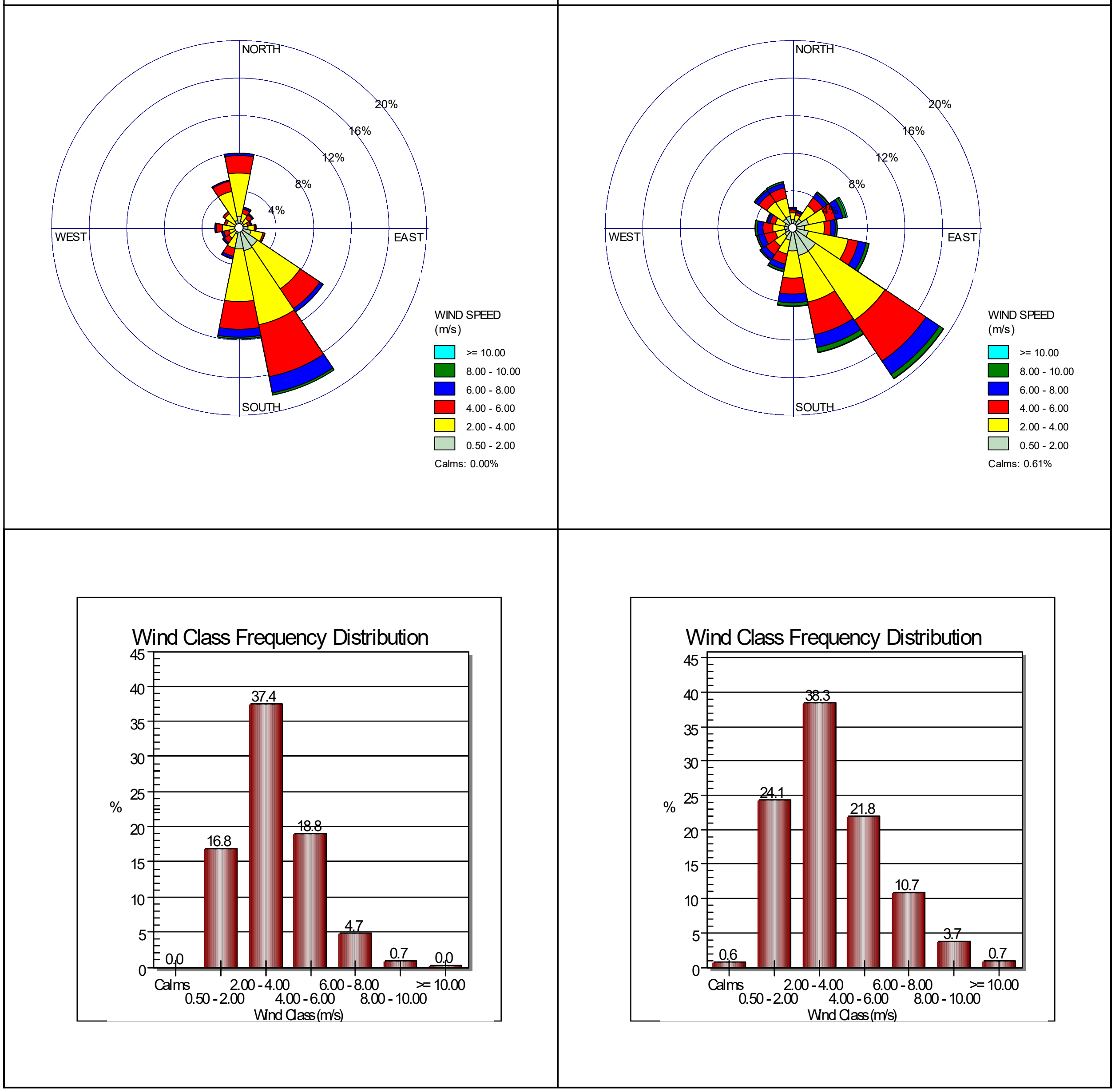
CALMET: Surface and upper station data are not available. Modelling will proceed in WRF-only mode.

Figure 10.2 compares the wind roses generated for the Environment and Climate Change Canada (ECCC) Mackenzie Airport weather station from the WRF model predictions with the wind rose for the same location based on measurements for the five-year period from 2011 to 2015. Mackenzie Airport weather station is the nearest ECCC weather station with valid hourly winds measurements for the 2011-2015 period. Both measured and predicted wind roses show good agreement with the most frequent winds are from southeast and south.

Since the WRF model predictions and measurements are reasonably similar for Mackenzie Airport weather station that are located approximately 71 km west of to the Project site, the WRF model predictions are expected to be representative of meteorological conditions in the model domain. CALMET makes further fine scale adjustments to the wind field to account for terrain and land cover influence.

Figure 10.2 Comparison of Measured and Predicted Surface Winds at ECCC Mackenzie Airport Weather Station (2011–2015)

Measured (2011-2015)	BC ENV WRF (2011-2015)



11 Treatments

11.1 NO to NO_2 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 [BC ENV 2022d]). *Specify the considerations given to ambient concentrations, characteristics of modelled sources, and availability of relevant monitoring data when selecting the NO_2 modelling method indicated above.*

OLM:

- *Indicate which O_3 dataset is used and explain the basis for selecting the O_3 dataset.*
    - *If a single site representative hourly O_3 dataset corresponding to the meteorological period is used, specify the method of data substitution used for addressing data gaps, provide the dataset, and include the completeness statistics (e.g., number of years, percent complete per quarter).*
- *If non default equilibrium ratios are used, specify and provide rationale.*
- *Specify and provide rationale for in-stack ratio(s) used. If multiple NO_X sources are modelled, provide justification for how the ISR(s) is/are selected.*

The NOx concentrations will be predicted using the CALPUFF model. The NOx to NO_2 conversion will be carried out using the ozone limited method (OLM) consistent with Section 3.2.1.3.1 and Appendix C of the Guidance for NO_2 Dispersion Modelling in British Columbia (NO_2 Guidance) (BC ENV, 2022c). The northeast BC ozone data array provided in Appendix C of the NO_2 Guidance will be used for the conversion of NO_X to NO_2 (BC ENV, 2022c). As CALPUFF does not have the capability to apply stack-specific unique in-stack ratio (ISR) values, CGL is proposing to use weighted average ISR values based upon the project NO_X emissions and recommended ISR provided in Appendix B of the NO_2 Guidance. Table 11.1 presents a summary of the recommended ISR, total project NO_X emissions for each equipment class and the emission weighted average ISR of 0.100 that will be used to carry out the NO_X to NO_2 conversion.

Table 11.1 Equipment Specific and Emission Weighted In-Stack Ratios

Equipment Class	Fuel Type	Recommended ISR[a]	Total Project NOx Emissions (t/y)	Emission Weighted ISR
Turbine	Natural Gas	0.065	165	0.100
Reciprocating IC Engine [b]	Natural Gas	0.187	60.3	
Boiler/Heater [c]	Natural Gas	0.100	6.3	

Notes:
[a] The ISR is the in-stack-ratio of NO_2/NO_X and can vary from 0 to 1. A value of 1 indicates 100% of NO_X is NO_2.
[b] The ISR for the reciprocating internal combustion engine will be used for the power generator.
[c] The ISR for the boiler will be used for the vapour seal combustor.

The emission weighted ISR is calculated as follows:

Emission weighted ISR =

(Turbine ISR x Turbine NO_X emissions) + (Reciprocating IC Engine ISR x Reciprocating IC Engine NO_X emissions) + (Boiler/Heater ISR x [Seal Gas Combustor + Heaters] NO_X emissions)

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 (BC ENV, 2022b) will be used. Ammonia and hydrogen peroxide concentrations, nighttime loss and formation rates for nitrates and sulphates are not applicable for this assessment due to the remoteness of the Facility location and the relatively modest quantities of chemically reactive emissions (NO_X and SO_2). Chemical transformations and particle deposition are not employed in this assessment. Ozone is only used in the OLM calculations as discussed in Section 11.1.

11.2.1 Secondary Particulate Formation

CALPUFF model will not be used to predict secondary inorganic $PM_{2.5}$ formation attributable to precursor SO_2 and NO_X emissions.

11.3 Particle Deposition

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

As coarse particulate emissions are expected to be small to negligible, deposition and plume depletion is not modelled.

11.4 Stagnation

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

This assessment employs the CALPUFF dispersion modelling system. CALPUFF is a non-steady-state puff model which simulates dispersion under near-calm and calm conditions (i.e., can treat zero wind speeds). The assessment will summarize frequency of calm conditions.

11.5 Plume Condensation (Fogging) and Icing

Indicate if this will be included (Section 10.6).

Plume condensation and freezing (Fogging and Icing) is not selected as an option because the combustion source plumes have substantial buoyancy and momentum, and they are not particularly moisture laden. Condensing or freezing plumes near ground level are not expected.

12 Quality Management Program

12.1 Model Input Data

Indicate the tests that will be undertaken to assure the quality of the inputs, for geophysical data, meteorological data, NWP data.

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.
- WRF raw data quality assurance and quality control checks (annual wind rose, monthly temperature comparison with the Mackenzie Airport weather station). These checks will be completed using both 2011-2013 raw WRF files.
- 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.

Note: Model input and output files will be submitted to the British Columbia ENV upon request.

12.2 Model Output Data

For CALMET/CALPUFF applications, provide a list of the tests conducted to confirm the quality of the model output (intermediate pre-processing files and concentration/deposition predictions). With respect to the pre-processed files that are prepared for CALPUFF input, there are several tests listed in Section 9.1.1 and 9.1.2 to check the output from the pre-processing utility programs to confirm that they have been properly processed. The quality of the meteorological outputs will be tested to ensure that specific data treatments have been applied properly. For CALMET output there are several tests listed in Section 9.1 in the Guideline (BC ENV 2022b) *to test the quality of the generated meteorological fields.*

The model inputs for this assessment include emission sources (locations and elevation) and emission characteristics, geographic and land use data, and meteorological data. All 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 outputs will be tested to check that specific data treatments have been applied properly. The CALMET Appendix for the technical data report will include plots and graphs as listed in Section 12.1.

13 BCER 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 BCER as necessary. An updated Dispersion Modelling Plan may be necessary. The BCER may ask for additional dispersion modelling scenarios or changes to modelling methodology based on the review of the initial modelling results

Ministry Acceptance of Plan

Name: ______________________________

Date: ______________________________

14 References

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Appendix A CALMET Model Options and Land Use Characterization Parameters

Table A.1 Mount Bracey CS Project Specific CALMET Model Options

Parameter	Default	Project	Comment
Wind Field Model Options:			
IEXTRP	-4	1	No extrapolation is done for no-obs mode model run
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	-	N/A	Maximum radius of influence over land in the surface layer (km) – no surface stations used
RMAX2	-	N/A	Maximum radius of influence over land aloft (km) – no surface stations used
Other Wind Field Input Parameters:			
TERRAD	-	5	Radius of influence of terrain features (km)
R1	-	N/A	Relative weighting of the first guess field and observations in the surface layer (km) – no surface stations used
R2	-	N/A	Relative weighting of the first guess field and observations in the layers aloft (km) – no surface station used
Relative Humidity Parameters:			
IRHPROG	0	1	Use RH from WRF/3D file
Temperature Parameters:			
ITPROG	0	2	Use WRF/3D for surface and upper air temperature data

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	Water Body	51	Water
19	Snow and Ice	90	Perennial Snow or Ice

Table A.3 CALMET Land-use Characterization and Associated Geophysical Parameters for the Season 1 (Mid-Summer)

30 m Resolution CEC Land Cover 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	Water
19	0.200	0.700	0.500	0.150	0.000	0.000	90	Snow and Ice

Notes:
For latitude 55° to 60° N, Season 1 (Mid-Summer) = July; W/m^2 = watts per square metre

Table A.4 CALMET Land-use Characterization and Associated Geophysical Parameters for Season 2 (Autumn)

30 m Resolution CEC Land Cover 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	Water
19	0.200	0.700	0.500	0.150	0.000	0.000	90	Snow and Ice

Notes:
For latitude 55° to 60° N, Season 2 (Autumn) = August and September; W/m^2 = watts per square metre

Table A.5 CALMET Land-use Characterization and Associated Geophysical Parameters for Season 3 (Winter 1)

30 m Resolution CEC Land Cover 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	Water
19	0.200	0.700	0.500	0.150	0.000	0.000	90	Snow and Ice

Notes:
For latitude 55^o to 60^o N, Season 3 (Winter 1) = October; W/m^2 = watts per square metre

Table A.6 CALMET Land-use Characterization and Associated Geophysical Parameters for Season 4 (Winter 2)

30 m Resolution CEC Land Cover 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	Water
19	0.200	0.700	0.500	0.150	0.000	0.000	90	Snow and Ice

Notes:
For latitude 55º to 60º N, Season 4 (Winter 2) = November, December, January, February, March, and April; W/m^2 = watts per square metre

Table A.7 CALMET Land-use Characterization and Associated Geophysical Parameters for Season 5 (Transitional Spring)

30 m Resolution CEC Land Cover 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	Water
19	0.200	0.700	0.500	0.150	0.000	0.000	90	Snow and Ice

Notes:
For latitude 55º to 60º N, Season 5 (Transitional Spring) =May and June; W/m^2 = watts per square metre

Appendix B Emissions Inventory

B.1 Operational Phase Emission Calculations

Detailed NO_X, SO_2, CO and $PM_{2.5}$ emission calculations are provided for the Project. Fuel gas-fired emission sources include three fuel gas BHGE PGT25+ turbines, three fuel gas Waukesha L5794GSI engine, three seal gas vapour combustors and six utility glycol heaters.

Calculation inputs and natural gas emission factors used for the proposed Project sources are provided in Section 6 of the Dispersion Modelling Plan.

BHGE PGT25+ Gas Turbine

$$NOx\ emission\ rate\ (t/d) = \left(Exhaust\ gas\ flow\ rate\ \left(\frac{kmole}{s}\right)\right) * \frac{NOx\ content\ (ppmv)}{10^6} * NOx\ MW\ \left(\frac{kg}{kmol}\right) * * Unit\ conversion\ \left(\frac{3600\ s}{1\ h}\right) * Unit\ conversion\ \left(\frac{24\ h}{1\ d}\right) * Unit\ conversion\ \left(\frac{1\ tonne}{10^3 kg}\right)$$

$$SO_2\ emission\ rate\ (t/d) = \left(Fuel\ consumption\ \left(\frac{10^3 m^3}{d}\right)\right) * Unit\ Conversion\ (10^3) * \frac{SO_2\ content\ (ppmv)}{10^6} * SO_2\ MW\ \left(\frac{kg}{kmol}\right) * molar\ volume\ \frac{kmol}{m^3} * Unit\ conversion\ \left(\frac{1\ tonne}{10^3 kg}\right)$$

$$CO\ emission\ rate\ (t/d) = \left(Exhaust\ gas\ flow\ rate\ \left(\frac{kmole}{s}\right)\right) * \frac{CO\ content\ (ppmv)}{10^6} * CO\ MW\ \left(\frac{kg}{kmol}\right) * * Unit\ conversion\ \left(\frac{3600\ s}{1\ h}\right) * Unit\ conversion\ \left(\frac{24\ h}{1\ d}\right) * Unit\ conversion\ \left(\frac{1\ tonne}{10^3 kg}\right)$$

$$PM_{2.5}\ emission\ rate\ (t/d) = PM_{2.5}\ emission\ factor\ \left(\frac{g}{GJ}\right) * Heat\ input\ (HHV)\ \left(\frac{GJ}{h}\right) * Unit\ conversion\ \left(\frac{24\ h}{1\ d}\right) * Unit\ conversion\ \left(\frac{1\ tonne}{10^6 g}\right)$$

Waukesha Gas Generator L5794GSI

$$NOx\ emission\ rate\ (t/d) = (Power\ rating\ (LHV)(hp)) * NOx\ emission\ factor\ \left(\frac{g}{hp * hr}\right) * Unit\ conversion\ \left(\frac{24\ h}{1\ d}\right) * Unit\ conversion\ (\frac{1\ tonne}{10^6 g})$$

$$CO\ emission\ rate\ (t/d) = (Power\ rating\ (LHV)(hp)) * CO\ emission\ factor\ \left(\frac{g}{hp * hr}\right) * Unit\ conversion\ \left(\frac{24\ h}{1\ d}\right) * Unit\ conversion\ (\frac{1\ tonne}{10^6 g})$$

The SO_2 and $PM_{2.5}$ emission calculation approaches for the gas generators are the same as for the gas turbines.

Seal Gas Vapour Combustors

$$NOx\ emission\ rate\ (t/d) = \left(NOx\ emission\ factor\ \left(\frac{lb}{MMBtu}\right)\right) * Heat\ Input\ \left(\frac{MMBtu}{h}\right) * Unit\ Conversion\ \left(\frac{lb}{kg}\right) * Unit\ conversion\ \left(\frac{3600\ s}{1\ h}\right) * Unit\ conversion\ \left(\frac{24\ h}{1\ d}\right) * Unit\ conversion\ (\frac{1\ tonne}{10^3 kg})$$

$$CO\ emission\ rate\ (t/d) = \left(CO\ emission\ factor\ \left(\frac{lb}{MMBtu}\right)\right) * Heat\ Input\ \left(\frac{MMBtu}{h}\right) * Unit\ Conversion\ \left(\frac{lb}{kg}\right) * Unit\ conversion\ \left(\frac{3600\ s}{1\ h}\right) * Unit\ conversion\ \left(\frac{24\ h}{1\ d}\right) * Unit\ conversion\ (\frac{1\ tonne}{10^3 kg})$$

The SO_2 and $PM_{2.5}$ emission calculation approaches are the same as for the gas turbines and the gas generators.

Utility Glycol Heaters

The NO_X and CO emission calculation approaches for the heaters are the same as for the seal gas vapour combustors. The SO_2 and $PM_{2.5}$ emission calculation approaches are the same as for the gas turbines, the gas generators and the seal gas vapour combustors.