Troilus Gold Project Technical Data Report – Quantification of Greenhouse Gases

FINAL REPORT

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June 23, 2025

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1 Introduction

The Troilus Gold Corporation (Troilus) Mine project (the Project) is a mining operation that will take place in central Quebec, at the site of a former mine. The mine will primarily produce gold (Au), along with copper (Cu) and silver (Ag). The Project has been developed in collaboration with BluMetric Environmental Inc. As part of the environmental and social impact assessment (ESIA), an assessment of the greenhouse gas (GHG) emissions generated by the Project activities has been conducted. This analysis considers the construction phase, operation phase, and decommissioning phase of the Project, and includes substantive GHG sources expected to occur from the Project including from stationary fuel combustion equipment, transportation, blasting, land-use change, and electricity consumption.

The Troilus Mine was originally an open-pit operation that produced gold, copper, and silver from 1996 to 2009. The mine ceased production in 2009, after which the mill was sold and shipped to Mexico, and the main camp facilities were dismantled by the end of 2010. Despite this, much of the site's infrastructure was left in place after the mine's closure.

The new Troilus Mine Project will span a period of 24 years, including 2 years of construction activities (Year -2 to Year -1) and 22 years of operation activities (Year 1 to Year 22), and followed by decommissioning activities (Year 22+). The first two years will be mainly dedicated to construction, but mining operations will take place simultaneously.

2 Methodology

The GHG emissions associated with the Project were assessed in consideration of the following guidance documents:

- Les Changements Climatique Et L'Évaluation Environmentale: Guide à l'intention de l'intiateur de projet (the Guide) (Ministère de L'Environnment et de la Lutte Contre les Changements Climatiques (MELCC), 2021): This guide describes how climate change should be considered as part of the Project's environmental impact assessment.
- Guide de quantification des émissions de gaz à effet de serre (Quantification Document) (MELCC, 2025) : This guide presents the methodologies to quantify GHG emissions from the Project.

The Guide describes the GHGs that are quantified and reported in units of carbon dioxide equivalent (CO_2e) using their respective global warming potentials (GWPs). These values represent the relative climate change impact of each gas compared to carbon dioxide and are applied in GHG calculations to standardize emissions across different GHGs in tonnes of carbon dioxide equivalent (CO_2e). The applicable GHGs and GWP values from the Guide and Quantification Document are summarized in Table 1.

Table 1 : List of GHGs subject to reporting and global warming potentials.

GHG Type	GWP
Carbon dioxide (CO_2)	1
Methane (CH_4)	28
Nitrous oxide (N_2O)	265
Sulphur hexafluoride (SF_6)	23,500
Nitrogen Trifluoride (NF_3)	16,100
Hydrofluorocarbon (HFC)	various [1]
Perfluorocarbon (PFC)	various [1]
Notes: [1] See the Quebec Greenhouse Gas Inventory 1990-2022 for the latest GWP values.	

For this assessment, the GHGs expected to be released from the Project activities include CO_2, CH_4, and N_2O. Other GHGs are not expected to be relevant to any Project activities above negligible quantities and are therefore excluded from further consideration in this assessment.

The methodology prescribed by the Guide to assess the Project GHG emissions is as follows:

1. Determine the source categories that apply to the Project. Sources that account for less than 3% of the Project total annual emissions are considered negligible and may be excluded.

   As described in the Guide and the Quantification document, the GHG source categories that are generally relevant to mining projects are listed below.

- Stationary fuel combustion: GHG emissions from energy production in the form of electricity, heat, or steam using stationary combustion systems (e.g., furnaces, boilers, heaters).
- Transportation: GHG emissions related to any mobile equipment typically used at a facility or installation site for transporting or carrying material, workers, or used to carry out construction and operation activities.
- Industrial process: Emissions from certain industrial processes that produce GHGs directly and whose primary purpose is not to provide energy. This category of GHG emissions includes emissions resulting from chemical reactions produced during a specific process (e.g., CO_2 from the calcination of limestone), emissions generated by the use of fossil fuels as raw materials or chemical reagents (e.g., metallurgical coke used as a reducing agent), and resulting from the direct emission of certain GHGs. E.g. ore processing, etc.
- Land-use change: GHG emissions and removals resulting directly from human activity related to land use, land-use change, and forestry, excluding agriculture. This includes tree clearing and removal of wetlands.
- Blasting: GHG emissions (CO_2) from explosives containing fossil fuel-based carbon during detonation.
- Indirect emissions from electricity consumption: Indirect GHG emissions related to the third-party generation of electricity that is purchased and consumed by the project owner.
- Wastewater and wastewater treatment: CH_4 and N_2O emissions from municipal and industrial wastewater treatment and from untreated wastewater discharge.

2. Choose technologies and practices that reduce GHG emissions through an evaluation of technologies and practices relevant to the Project activities.
    a. The Guide Annex 2 provides examples of technologies and practices relevant to mining projects. These serve to inform the evaluation of technologies and practices in Section 4.
3. Once the technologies selected, quantify the GHG emissions for each source, sink, and reservoir in accordance with the Quantification Document.
4. Present the results as follows:
    a. Present the GHG emissions on an annual basis.
    b. Group the GHG emissions into stationary fuel combustion, transportation, industrial process, and other emissions.
    c. Present the GHG emissions into the GHG types (e.g., CO_2, CH_4, N_2O) and in total CO_2e.
    d. GHG emissions from biomass must be presented separately from the other GHG emissions.

3 Project Source Categories

The GHG source categories described in the Guide that are relevant to the Project are listed below, along with their associated sources and activities. The information is based on the process descriptions presented in Chapter 3: Project Description, and other data supplied by Troilus.

- Stationary fuel combustion
  - Diesel combustion from lighting plants
  - Propane combustion for heating for the following mine areas: camp operation, primary and secondary crushing, tertiary crushing, dome tunnel, process plant and high-pressure grinding cylinders (HPGR) area, water treatment plant, plant offices and employees' rooms, warehouse and reagent storage, mining administration (truckshop and workshop), main office and auxiliary buildings, gatehouse and access control.
- Transportation
  - Diesel consumption for off-road vehicles: including but not limited to drills, loaders, dozers, graders, and heavy duty mine trucks
  - Diesel consumption for heavy and light on-road vehicles: including snow plows, water trucks, various other trucks and personnel buses
- Land-use change
  - Disposal of land-cleared biomass
- Blasting
  - Combustion of blasting emulsion containing fossil fuel based carbon
- Electricity consumption
  - Electricity consumption from multiple infrastructure and processes: milling and classification, flotation and concentrate handling, goldroom, tailings handling, concrete thickening and filtration, reagents, water services, air services, fuel storage and distribution, electrical services, buildings, mine services, and other remote infrastructure

The GHG source categories described in the Guide that are excluded from this assessment are listed below, followed by a reason for their exclusion.

- Industrial process: No carbonate containing flux reagents, arc furnaces, or substantive carbon-containing raw materials are part of the Project.
- Wastewater and wastewater treatment: The Project will have domestic wastewater from campsites and an industrial wastewater treatment plant used to reduce suspended solids in the tailings ponds. Given the small size of the campsites (approximately 530 workers) and the type of wastewater treatment plant (aerobic), the GHG emissions resulting from wastewater are estimated to be less than 0.1% of the total annual GHG emissions which is negligible; and as such, they have been excluded from the assessment.

4 Determination of Technologies and Practices

Established and emerging GHG-related technologies and practices in the design of the Project have been identified. The technologies considered for each source category and their evaluated feasibility are presented in Table 2.

The primary GHG mitigation is that most of the Project's infrastructure and processes will be electrified, as described in Section 3. This Project design aligns with Quebec's 2030 plan for green economy which has a priority to electrify Quebec's industries as much as possible (Gouvernement du Quebec, 2020).

Table 2 : Feasibility of Technologies Considered

Source Category	Technology	Feasibility
Stationary Combustion Equipment	Diesel fueled	Technically feasible and currently available.
	Biodiesel blend	In Quebec, a draft regulation is underway to require Quebec petroleum product distributors to achieve, by 2030, a 10% low-carbon content in diesel fuel (Gouvernement du Quebec, 2025). Currently (2023), the regulated biodiesel blend rate is 3%, and the actual blend rate is 5.3% (Navius, 2025). Therefore, a biodiesel blend rate of 5.3% is feasible and available during the construction phase, and a higher blend rate may be available during the operation and decommission phases. Approximately 5% reduction in total emissions is expected from combusting biodiesel blend over regular diesel, as presented in Section 6.
	Propane fueled	Technically feasible and currently available.
	Diesel and propane fueled with carbon capture systems (CCS)	Pre-feasibility studies of carbon removal projects began in Quebec mines in 2024 (Deep Sky, 2024). Although there is potential for CCS development for mines, CCS is not considered technically feasible at this time.
Transportation	Diesel fueled	Technically feasible and currently available.
	Biodiesel blend	In Quebec, a draft regulation is underway to require Quebec petroleum product distributors to achieve, by 2030, a 10% low-carbon content in diesel fuel (Gouvernement du Quebec, 2025). Currently (2023), the regulated biodiesel blend rate is 3%, and the actual blend rate is 5.3% (Navius, 2025). Therefore, a biodiesel blend rate of 5.3% is feasible and available during the construction phase, and a higher blend rate may be available during the operation and decommission phases. Approximately 5% reduction in total emissions is expected from combusting biodiesel blend over regular diesel, as presented in Section 6.

Source Category	Technology	Feasibility
	Renewable diesel	Renewable diesel facilities are planned in Quebec and expected to be running by 2027 (Canada Energy Regulator 2023). Therefore, renewable diesel consumption is not expected to be feasible during the construction phase but may be available during the operation and decommission phase.
	Electric (battery)	Pilot projects exist to test the viability of using electric mining vehicles for mining operations (Propulsion Quebec, 2024). Suitable electric vehicles are not expected to be available at the early stage of the Project but may become available and feasible in the future.
	Compressed Natural Gas (CNG)	CGN vehicles and CGN refueling stations are available in Quebec since 2011 (Énergir, 2025). For CNG use to be feasible, the site should have access to a natural gas pipeline and equipment to compress and dispense the CNG. This is not expected to be feasible for the Project location.
	Hydrogen fueled	Hydrogen-powered trucks in Quebec are being tested in 2024 (Harnois Énergies, 2024). Suitable hydrogen vehicles are not expected to be readily available at the early stage of the Project but may become available and feasible in the future.
Land-use change	Not applicable	No technologies apply to land-use change. See Table 3 for practices relevant to land-use change GHG mitigation.
Blasting	Fossil Fuel-Based Explosives	Technically feasible and available. No alternatives are known to exist.
Electricity	Onsite Generators	Technically feasible and available. The efficiency of industrial diesel generators is around 40% (General Power, 2025).
	Connect to Quebec grid (mainly hydropower)	Technically feasible and available. Hydropower GHG emissions are very low. Based on the Quebec grid emissions intensity and the estimated efficiency of onsite generators, a reduction of 99.7% in emissions from electricity generation is expected from using the Quebec grid over using onsite generators. Using the quantification methodologies presented in Section 5, this results in a 70% reduction in total emissions during the operation phase.

The practices considered for the Project source categories are presented in Table 3. Some practices have a quantified impact on GHG reduction, as noted in the table footnotes, while others cannot be easily estimated. The practices presented are considered feasible for the Project.

Table 3 : Practices Considered

<table>
<tr><th>Source</th><th>Practice</th></tr>
<tr><td>Stationary Combustion Equipment</td><td>Regular maintenance
Energy efficiency measures
Fuel monitoring
Optimal sizing of equipment</td></tr>
<tr><td>Transportation</td><td>Limit speed on secondary roads to 50 km/h
Vehicle maintenance to improve energy efficiency [1]
Acquire mobile equipment that meets Transport Canada's off-road vehicle emission requirements (Tier 4 emission standards), where possible
Implement effective and timely vehicle maintenance to keep equipment in good working condition
Implement an idling policy on-site for mobile equipment and vehicles
Optimize road network design and operational scheduling to reduce transport distances
Raise employee awareness of eco-driving [2]
Use fleet manager
Fuel consumption monitoring
Optimal sizing of equipment
Preference for contractors with more fuel-efficient fleets
Traffic management plan (e.g., bussing)</td></tr>
<tr><td>Land-use change</td><td>Options for disposal of biomass waste [3]
Biomass burning
Biomass chipping and spreading
Storage and Decomposition
Merchantable timber recovery
Limit surface disturbance where possible
Site remediation</td></tr>
<tr><td>Blasting</td><td>Optimization of blasting practices (e.g., type, timing sequence, and blasting patterns)</td></tr>
<tr><td>Electricity</td><td>Measurement of electricity consumption and tracking of energy efficiency</td></tr>
<tr><td colspan="2">Notes:
1 According to the U.S. Department of Energy (USDOE, 2020), energy savings of around 5 to 20% can be achieved through maintenance measures without major investments.

2 According to the Bureau of Energy Efficiency and Innovation (BEIE), eco-driving offers a potential fuel savings of about 10% when practiced consistently (BEIE, 2011).

3 Land clearing activities typically include the removal of living and non-living biomass and potentially carbon-containing soils using heavy construction equipment. Depending on the practices used to manage biomass and soils, carbon dioxide or methane can be released either quickly (within the construction phase) or slowly (over approximately 20 years or more) from disturbed carbon sinks. In general, recovery of merchantable timber provides the longest timeframe for preventing the associated carbon from entering the atmosphere and biomass burning represents the shortest timeframe. Chipping and spreading is a practice that will release carbon dioxide over the construction period, whereas storage and decomposition will result in carbon dioxide and methane emissions over approximately 20 years.</td></tr>
</table>

Table 4 provides the selected options based on the evaluation of technologies and practices presented above. The technologies and practices selected reflect technologies and practices that can be implemented at the start of the construction and operation phases.

Table 4 : Technologies and Practices Selected for the Project

Source Category	Best Available Technology	Best Practices
Stationary Combustion Equipment	• Biodiesel blend • Propane fueled • Connection to electrical grid	• Regular maintenance • Energy efficiency measures • Fuel monitoring • Optimal sizing of equipment
Transportation	• Biodiesel blend	• Limit speed on secondary roads to 50 km/h • Vehicle maintenance to improve energy efficiency • Acquire mobile equipment that meets Transport Canada's off-road vehicle emission requirements (Tier 4 emission standards), where possible • Implement effective and timely vehicle maintenance to keep equipment in good working condition • Implement an idling policy on-site for mobile equipment and vehicles • Optimize road network design and operational scheduling to reduce transport distances • Raise employee awareness of eco-driving • Use fleet manager • Fuel consumption monitoring • Optimal sizing of equipment • Preference for contractors with more fuel-efficient fleets • Traffic management plan (e.g., bussing)
Land-use change	• Not applicable	• Option for disposal of biomass waste: ○ Biomass burning ○ Biomass chipping and spreading ○ Storage and Decomposition ○ Merchantable timber recovery • Limit surface disturbance where possible • Site remediation
Blasting	• Explosives	• Optimization of blasting practices (e.g., type, timing sequence, and blasting patterns)
Electricity	• Connect to Quebec grid	• Measurement of electricity consumption and tracking of energy efficiency

5 Quantification Methodology

The GHG emissions from the source categories were quantified in accordance with the Quantification Document. The general steps are as follows:

1. Identify the sources of GHG emissions.
2. Identify the quantification methods and equations from the Quantification document.
3. Gather the relevant Project data for the quantification. All the information is based on the process descriptions presented in Chapter 3: Project Description, and other data supplied by Troilus.
4. Select the emission factors.
5. Calculate the GHG emissions.

The methodologies are described below for each source categories identified in Section 3.

5.1 Stationary Fuel Combustion

The stationary fuel combustion equipment includes diesel-fueled equipment and propane-fueled equipment as listed in Section 3. The GHG emissions calculation from stationary fuel combustion equipment follows the methodology from the Quantification Document section 3.1 and is summarized below.

1. Use the Quantification Document section 3.1 Equation 2 as shown below.

Equation 2 : GHG Emissions from Stationary Combustion Sources

$$\text{Greenhouse gas emissions} = \sum_{i=1}^{i=n} \text{Amount of fuel i consumed} \times \text{Emission factor}_i$$

2. Determine the stationary equipment that consumes diesel and propane.
3. For each fuel type, determine the annual fuel consumption by aggregating the estimated fuel consumption for each equipment.
4. Determine the emission factors for diesel and propane combustion from the Quantification Document Table 5. The emission factors used for the Project are presented in Table 5.
5. Calculate the GHG emissions for each GHG type for each fuel type by multiplying the annual fuel consumption with the emission factor, as per Equation 2 above.
6. Separate the CO_2 emissions from biodiesel (5.3% blend rate) and from diesel. As prescribed by the Guide, the CO_2 emissions from biodiesel (biomass) are reported separately from the other emissions.
7. Calculate the overall GHG emissions in tonnes of carbon dioxide equivalent (tCO_2e) by multiplying the GHG emissions for each GHG type with their associated GWPs shown in Table 1. The total annual GHG emissions are presented in Section 6.

Table 5 : Emission Factors for Stationary Fuel Combustion Equipment

Fuel Type	Emission Factor for CO_2 (g/L)	Emission Factor for CH_4 (g/L)	Emission Factor for N_2O (g/L)
Diesel	2,681	0.078	0.022
Propane	1,515	0.024	0.108

The following assumptions were made:

- Although a higher biodiesel blend rate may become available during the operation and decommission phases, a 5.3% blend rate is assumed for all the Project phases to be conservative.
- Heating using propane for camp operation is required 100% of the time for January and February and 50% for the remaining months of the year. Heating for the remaining mine areas is required 100% of the time for January and February, 50% of the time for March, November and December, 25% of the time for April, May, September, and October, and 0% of the time for June, July, and August.

5.2 Transportation

The transportation equipment includes diesel combustion from off-road vehicles, heavy on-road vehicles, and light on-road vehicles as listed in Section 3. The GHG emissions calculation from transportation equipment follows the methodology from the Quantification Document section 3.2 and is summarized below.

1. Use the Quantification Document section 3.2 Equation 3 as shown below.

Equation 3 : GHG emissions from the use of mobile equipment

$$\text{Greenhouse gas emissions} = \sum_{i=1}^{i=n} \text{Amount of fuel i consumed } \times \text{Emission factor}_i$$

2. Determine the transportation equipment inventory and their associated mobile equipment type as listed in the Quantification Document Table 6. For the Project, the mobile equipment types are Off-Road (level 1-3), Heavy vehicle (moderate), and Light Truck (moderate).
3. Determine the annual diesel consumption by aggregating the estimated fuel consumption for each mobile equipment type.
4. Determine the emission factors for each mobile equipment type from the Quantification Document Table 6. The emission factors used for the Project mobile equipment are presented in Table 6.
5. Calculate the GHG emissions for each GHG type by multiplying the annual fuel consumption with the emission factors, as per Equation 3 above. The total annual GHG emissions are presented in Section 6.

6. Separate the CO_2 emissions from biodiesel (5.3% blend rate) and from diesel. As prescribed by the Guide, the CO_2 emissions from biodiesel (biomass) are reported separately from the other emissions.

7. Calculate the overall GHG emissions in tonnes of carbon dioxide equivalent (t CO_2e) by multiplying the GHG emissions for each GHG type with their associated GWPs shown in Table 1.

Table 6 : Emission Factors for Diesel Mobile Equipment

Mobile Equipment Type	Emission Factor for CO_2 (g/L)	Emission Factor for CH_4 (g/L)	Emission Factor for N_2O (g/L)
Off-Road (level 1-3)	2,681	0.073	0.022
Heavy vehicle (moderate)	2,681	0.14	0.082
Light Truck (moderate)	2,681	0.068	0.21

The following assumptions were made:

- Although a higher biodiesel blend rate may become available during the operation and decommission phases, a 5.3% blend rate is assumed for all the Project phases to be conservative.

5.3 Blasting

Blasting is used to break rock to access mineral deposits. Blasting generates GHG emissions through the combustion of explosives that contain fossil fuels. The GHG emissions calculation from blasting follows the methodology from the Quantification Document section 3.8 and is summarized below.

1. Use the Quantification Document section 3.8 Equation 6 as shown below.

Equation 6 : GHG Emissions from Explosives Use

$$E_{CO2\_EXP} = M_{EXP} \times FE_{EXP}$$

Where :
E_{CO2_EXP} = Annual CO_2 emissions from the consumption of fossil fuels used in explosives, expressed in tonnes ;
M_{EXP} = Mass of explosive used, in tonnes
FE_{EXP} = CO_2 emission factor of the explosive, in tonnes of CO_2 per tonne of explosive

2. Determine the explosive type. The Project uses emulsion explosive for the blasting activities, as stated in Chapter 3: Project Description.

3. Determine the annual amount of explosive used.

4. Determine the emission factors for the explosive type from the Quantification Document Table 15. The emission factor for emulsion explosive is 0.17 t CO_2/tonnes of explosive.

5. Calculate the CO_2 emissions by multiplying the annual explosive amount with the emission factor, as per Equation 6 above.

6. The total annual GHG emissions are presented in Section 6. Blasting emissions fall under the category of other emissions as described in the Guide.

5.4 Land-use change

The Project is planned over a vast area of natural land. Activities including the construction of buildings, roads, and excavation for mining operations, will lead to the conversion of a portion of natural land either permanently or temporarily. The removal of natural vegetation cover results in CO_2 emissions into the atmosphere through two main mechanisms. The first mechanism is the release of carbon stored in vegetation when trees are cut down and left to decompose. The second mechanism is the reduction in carbon sequestration capacity from loss of the vegetation, which decreases the land's ability to absorb carbon from the atmosphere over a long period. The former is presented below; the latter is presented in Section 6.1.

In accordance with the Guide, land types have been divided into two main categories with different emission factors: forested land and wetlands.

5.4.1 Forested Land

The GHG emissions calculation from forest land clearing follows the methodology from the Quantification Document section 3.11.1 and is summarized below.

1. Use the Quantification Document section 3.11.1 Equation 10 as shown below.

Equation 10 : CO_2 emissions from the loss of forest land carbon stocks

$$\text{GHG Emissions (tonnes\_CO2)} = N_H \times t_{MSh} \times (1 + T_X) \times CC \times 44/12$$

Where :

Tonnes CO_2 = CO_2 emissions due to loss of carbon stocks from deforestation, expressed in tonnes.
N_H = Number of hectares deforested
t_{MSh} = Tonnes of dry matter per hectare
T_X = Ratio of below-ground biomass to above-ground biomass
CC = Carbon content of wood, expressed in tonnes of carbon per tonne of dry matter
44/12 = Molecular weight ratio of CO_2 to carbon

2. Determine the forested land area that will be cleared in hectares (ha).

3. Determine the values for the factors t_{MSh}, T_x and CC for the Project land type. The source of information comes from the Quantification Document Table 17 and is presented in Table 7.

4. Calculate the GHG emissions from loss of forest land in tonnes of CO_2 using Equation 10 above. As instructed in the Quantification Document, CH_4 and N_2O emissions calculations are omitted, because CH_4 emissions are considered negligible, and there is not enough research to determine the N_2O emissions with certainty.

5. The total annual GHG emissions are presented in Section 6. Since forest land falls under biomass, the GHG emissions are presented separately from the other emissions.

The following assumptions were made:

- Although the mitigation practices of merchantable timber recovery and fuel wood recovery (as presented in Section 4) for a portion of the forest biomass will be considered, it is assumed for this assessment that all the carbon stocks in the forested land will be converted into CO_2 and released in the atmosphere through decomposition.
- The forested land area that will be reclaimed after the Project decommission phase is not included in the calculation.

The parameters used in the calculation of land-use change from deforestation activities are presented in Table 7.

Table 7 : Equation 10 parameters for determining CO_2 emissions from deforestation activities

t_{MSh} ($t_{dry\ matter}$/ha)	T_x	CC ($t_C/t_{dry\ matter}$)
104.2	0.24	0.47
Source: • t_{MSh}: Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 : Agriculture, Forestry and Other Land Use. Table 4.7 • T_x: Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 : Agriculture, Forestry and Other Land Use. Table 4.4 • CC: Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 : Agriculture, Forestry and Other Land Use. Default value = 0,47.		

5.4.2 Wetlands

Wetlands may release GHG emissions when disturbed because carbon can be stored in organic matter in the wetland. Emission factors vary among wetland types due to differences in vegetation type and density, soil composition, hydrological conditions, climate, and human intervention. The GHG emissions calculation from wetland land clearing follows the methodology from the Quantification Document section 3.13 and is summarized below.

1. Use the Quantification Document section 3.13 Equation 12 as shown below.

Equation 12: CO_2 Emissions from Wetland Loss

$$E_{CO2} = \sum_{i=1}^{i=n} (P_{MHi} \times SC_{MHi} \times \frac{44}{12})$$

Where:

E_{CO2} = CO_2 emissions attributable to wetland loss, in tonnes of CO_2; P_{MHi} = Loss of wetland type i, in hectares; SC_{MHi} = Carbon stock of wetland type i, in tonnes of C per hectare; 44/12 = Ratio of the molecular mass CO_2 to the molecular mass of C. n = number of wetland types in the Project area.

2. Determine the land-clearing area in hectares (ha) for each wetland type within the Project area.
3. Determine the values for carbon stock SC_{MHi} for each wetland type, as provided in the Quantification Document Table 19.
4. Calculate the GHG emissions from loss of wetlands in tonnes of CO_2 using Equation 12 above.
5. The total annual GHG emissions are presented in Section 6. Since wetlands fall under biomass, the GHG emissions are presented separately from the other emissions.

The following assumptions were made:

- As instructed in the Quantification Document, it can be assumed that the carbon contained in the excavated wetland soil is instantly oxidized and emitted into the atmosphere.
- The wetland area that will be reclaimed after the Project is decommissioned is not included in the calculation.

5.5 Indirect Emissions from Electricity

Electricity will be used by the Project infrastructure and processes, as described in Section 3. Indirect emissions occur from the production of electricity by a third party, when this electricity is purchased and consumed by the Project. In Quebec, electricity is mainly generated from hydropower and these GHG emissions are very low in comparison to other options such as fossil fuels. The indirect GHG emissions calculation from electricity consumption follows the methodology from the Quantification Document section 3.3 and is summarized below.

1. Determine and aggregate the annual power consumption from the infrastructure and processes.
2. Determine the emission factor for generated electricity in Quebec from the ECCC National Inventory Report (NIR) (ECCC, 2025) Table A13-6. The emission factor for electricity generation for Quebec in 2023 is 1.9 g CO_2e/kWh.
3. Calculate the CO_2e emissions by multiplying the total electricity consumption with the emission factor.
4. The total annual GHG emissions are presented in Section 6. Indirect emissions from electricity fall under the category of Other Emissions as described in the Guide.

It is assumed that the emission factor for generated electricity in Quebec will not change substantially over the lifetime of the Project.

6 GHG Emissions Summary

The total annual emissions are presented in Table 8 and Table 9 for the Project construction phase and operation phase, respectively. The peak annual GHG emissions are represented by Year -1 for the construction phase and Year 13 for the operation phase. Year -1 and Year 13 have the highest annual GHG emissions for their respective phases, mainly due to their high level of mobile equipment activity and blasting activity.

Although the emissions from decomposition of biomass from land-use change may occur over a period of several years, land-use change emissions have been conservatively aggregated into one year during the construction phase.

As prescribed by the Guide, CO_2 emissions from biomass must be reported separately from the other emissions. As such, the total annual GHG emissions for each phase are presented without the CO_2 emissions contribution from biodiesel and land-use change.

Table 8 : Peak Annual GHG Emissions for the Project Construction Phase (Year -1)

Source Category	CO_2 (t CO_2e)	CH_4 (t CO_2e)	N_2O (t CO_2e)	CO_2e (t CO_2e)
Stationary Fuel Combustion	2,690	1.4	44	2,735
Transportation	63,754	52	188	63,994
Other Emissions	2,206	-	-	2,271
Blasting	2,206	-	-	2,206
Electricity	-	-	-	64
CO_2 Emissions from Biomass	1,997,954	-	-	1,997,954
Biodiesel	3,590	-	-	3,590
Land-Use Change	1,994,364	-	-	1,994,364
Total Excluding Biomass	68,650	54	232	69,000
Notes : Totals may not add up due to rounding "-" means not applicable				

The Project peak annual GHG emissions during construction, excluding CO_2 emissions from biomass, are expected to be 69,000 t CO_2e.

Table 9 : Peak Annual GHG Emissions for the Project Operation Phase (Year 13)

Source Category	CO_2 (t CO_2e)	CH_4 (t CO_2e)	N_2O (t CO_2e)	CO_2e (t CO_2e)
Stationary Fuel Combustion	18,362	8.3	340	18,710
Transportation	133,509	109	348	133,965
Other Emissions	4,549	-	-	5,737
Blasting	4,549	-	-	4,549
Electricity (indirect)	-	-	-	1,187
CO_2 Emissions from Biomass (Biodiesel)	7,494	-	-	7,494
Total Excluding Biomass	156,420	117	688	158,412

Notes :
Totals may not add up due to rounding
"-" means not applicable

The Project peak annual GHG emissions during operation, excluding CO_2 emissions from biomass, are expected to be 158,412 t CO_2e.

The GHG emissions during the decommission phase are conservatively assumed to be similar to those for the construction phase but without the emissions from land-use change, blasting activities, and electricity consumption. This assumption is conservative because not all infrastructure is expected to be removed at the end of the Project, and the equipment technologies available during decommissioning should be less GHG emission intensive than those available during construction. The Project peak annual GHG emissions during decommission, excluding CO_2 emissions from biomass, are expected to be 66,729 t CO_2e.

The total emissions for the Project lifetime, excluding CO_2 emissions from biomass, are expected to be 2,830,387 t CO_2e over 24 years.

6.1 Carbon Sink Assessment

Land-use change activities also result in a loss of carbon sinks due to the removal of vegetation that could have previously absorbed CO_2 from the atmosphere. The land types of primary concern are forested land and wetlands. The impact on carbon sinks is a separate assessment from the GHG emissions assessment. The results of the carbon sink assessment are not added to or removed from the Project's total GHG emissions, as per the Guide.

6.1.1 Forested Land

The carbon sink impact calculation from land-use change for forested land follows the methodology from the Quantification Document section 3.11.2 and is summarized below.

1. Use the Quantification Document section 3.11.2 Equation 11 as shown below.

Equation 11: Net loss of CO_2 sequestration for Forested Land

$$P_{SEQ} = N_H \times CBA \times (1 + T_X) \times CC \times \frac{44}{12} \times N_A$$

Where :

P_{SEQ} = Loss of CO_2 sequestration capacity over a 100-year period, in tonnes of CO_2
N_H = Number of hectares deforested
CBA = Annual growth rate of above-ground biomass, in tonnes of dry matter per hectare per year
T_x = Ratio of below-ground biomass to above-ground biomass
CC = Carbon content of wood, expressed in tonnes of carbon per tonne of dry matter
44/12 = Molecular weight ratio of CO_2 to carbon
N_A = Number of years considered to assess the net loss of sequestration

2. Determine the land-clearing area in hectares (ha). The area is divided between the permanent area and temporary area that will be reclaimed once the Project is decommissioned.
3. For each land area, determine the values for the factors CBA, T_x and CC. The source of information is provided in the Quantification Document Table 18.
4. Determine the number of years that the carbon sinks are lost. For the permanent land-use change area, the period can be 100 years as prescribed by the Quantification Document section 3.11.2. For the temporary land-use change area, the impact period is also conservatively assumed to be 100 years because, although the temporary area will be reclaimed immediately after the construction phase, the forest will require additional time to develop meaningful carbon sink capacity.
5. Calculate the loss of carbon sink P_{SEQ} in tonnes of CO_2 using Equation 11 above. The resulting carbon sink impact is presented in Table 10.

The following assumptions were made:

- For the permanent land-use change area, the impact period is assumed to be 100 years as prescribed by the Quantification Document section 3.11.2.
- For the temporary land-use change area, the impact period is also conservatively assumed to be 100 years because, although the temporary area will be reclaimed immediately after the construction phase, the forest will require additional time to develop meaningful carbon sink capacity.

Table 10 : Carbon Sink Impact Results for Forest Land

Project Area	Surface Area (ha)	T_x	CC ($t_C/t_{dry\ matter}$)	CBA	N_A (years)	P_{SEQ} (t CO_2)
Permanent	703	0.24	0.47	-0.40	100	-60,079
Temporary	197	0.24	0.47	-0.40	100	-16,818
Total						-76,897

The carbon sink impact on forest land is conservatively estimated as 76,897 t CO_2. That is, as a result of the Project, approximately 76,897 t CO_2e would not be removed from the atmosphere into forests.

6.1.2 Wetlands

Although the Quantification Document mentions that wetlands function as important carbon sinks, no methodology is provided in the Guide to quantify a wetland's carbon sink ability. However, the Quantification Document allows the use of calculation methods other than those presented in the Guide. The carbon sink impact calculation from land-use change for wetlands follows the methodology from the ECCC Strategic Assessment of Climate Change (SACC) Technical Guide (SACC Technical Guide) (ECCC, 2021) and is summarized below.

1. Use the SACC Technical Guide section 4.1 Equation 5 as shown below.

Equation 5: Estimated Carbon Sink Impact for Wetlands

$$CSI = \sum_{i,j}((NatFlux - PostDFlux)_{i,j} \times T_{i,j} \times A_{i,j})$$

Where :

CSI = the estimated carbon sink impact (t C)
NatFlux = the natural annual carbon accumulation rate of the land being impacted (t C ha-1 y-1)
PostDFlux = the post-disturbance (i.e. post conversion) flux rate impacted by the project (t C ha-1 y-1)
T = the time interval (years)
A = the land area (ha)
i = the land-use class
j = the disturbance activity for each phase of the project (construction, operation, decommission including, for instance, site restoration or reclamation)

2. Determine the land-clearing area in hectares. The area is divided between the permanent area and temporary area that will be reclaimed once the Project is decommissioned.

3. For each area, determine the number of years, T, that the carbon sinks are lost. For the permanent land-use change area, the period can be 100 years as prescribed by the SACC Technical Guide Annex D. For the temporary land-use change area, the impact period is also conservatively assumed to be 100 years because, although the temporary area will be reclaimed immediately after the

construction phase, the wetlands will require additional time to develop meaningful carbon sink capacity.

4. Determine the values for NatFlux and PostDFlux. The NatFlux value is obtained from the SACC Technical Guide (Table 31) for the Boreal Shield region (based on the Reporting Zones presented in ECCC NIR Report Figure 6-1 (ECCC, 2025)) where the Project is located. The most conservative value (for rich fen) from the set was selected (-0.33 t C/ha-year). The PostDFlux value is 0 because it is conservatively assumed that the post-disturbance land will no longer act as a carbon sink.
5. Calculate the carbon sink impact, CSI, in tonnes of CO_2 using Equation 5 above. The resulting carbon sink impact is presented in Table 11.

The following assumptions were made:

- For the permanent land-use change area, the impact period is assumed to be 100 years as prescribed by the SACC Technical Guide Annex D.
- For the temporary land-use change area, the impact period is also conservatively assumed to be 100 years because, although the temporary area will be reclaimed immediately after the construction phase, the wetlands will require additional time to develop meaningful carbon sink capacity.
- The PostDFlux value is 0 because it is assumed that the post-disturbance land will no longer act as a carbon sink.

Table 11 : Carbon Sink Impact Results for Wetlands

Project Area	Surface Area (ha)	Natflux (t C/ha/y)	PostDFlux (t C/ha/y)	N_A (years)	CSI (t CO_2)
Permanent	339	-0.33	0	100	-41,035
Temporary	124	-0.33	0	100	-15,044
Total					-56,079

The carbon sink impact on wetlands is conservatively estimated as 56,079 t CO_2. That is, because of the Project, approximately 56,079 t CO_2e would not be removed from the atmosphere in wetlands.

6.1.3 Total Carbon Sink Impact

The result from the total carbon sink impact is obtained by summing the impact from the forest land (Table 10) and from the wetlands (Table 11). The total carbon sink impact is conservatively estimated as 132,976 t CO_2. That is, because of the Project, approximately 132,976 t CO_2e would not be removed from the atmosphere into forests and wetlands.

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