

AtkinsRéalis



Hydro One Networks Inc.

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Project No.: 700123

North Shore Link

Greenhouse Gas Assessment

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1. Introduction

This report assesses the potential effects of the proposed North Shore Link Project (the Project) on the Hydro One Networks Inc. (Hydro One) greenhouse gas (GHG) emissions inventory. This report also aims to assess how the Project may affect climate change within provincial and federal borders.

The Project is subject to a Class Environmental Assessment for Transmission Facilities (Hydro One, 2024a), under Ontario's *Environmental Assessment Act* (EA Act), which requires Hydro One to characterize the existing environment; identify and evaluate alternatives; conduct consultation and engagement; assess potential environmental effects and propose mitigation measures; and document study findings. Accordingly, the outcomes of this GHG Emissions Assessment will be documented in the Project's Environmental Study Report (ESR).

1.1 Project Overview

The proposed Project will involve the installation of a new double-circuit 230-kilovolt (kV) transmission line between existing Mississagi Transformer Station (TS) located near Wharncliffe in the District of Algoma to Third Line TS in the City of Sault Ste. Marie, as shown in **Figure 1-1**. The Project also involves work at the connecting stations to facilitate the new transmission line, including an expansion at both stations. In addition, to support the overall operation of the transmission system, an expansion of Algoma TS located east of Algoma Mills in the Township of the North Shore will be required to accommodate additional station equipment.

The Project will be approximately 105 kilometres (km) in length. The Project consists of the following components:

- Construction, operation, and maintenance of a new double-circuit 230 kV transmission line and associated infrastructure (e.g., transmission structures, conductors, insulators, and associated hardware) between Mississagi TS and Third Line TS.
- Expansion at Mississagi TS to connect the new transmission line, and expansion at Algoma TS to accommodate new station equipment to support overall transmission system operation.
- Access and ancillary components (e.g., temporary and permanent access roads, storage and laydown areas).

The width of the transmission line right-of-way (ROW) will be approximately 46 metres (m); however, it may vary as it is influenced by several design components including tower height, span length, conductor size, line security, and location. The exact ROW width will be confirmed once the design phase is complete. Design will include:

- Overhead lines constructed using guyed tangent lattice towers;
- Transmission structures (self-supporting tangent lattice towers, angle lattice tower);
- Steel pole structures;
- Phase conductors and sub-conductors;
- Insulator assemblies;
- Skywires, grounding wires, and grounding systems.

Construction is planned to begin in 2027, with the transmission line entering service by 2029.



As outlined in its annual sustainability reports, Hydro One is committed to adapt itself towards the impacts of climate change. As such, Hydro One transmits and distributes electricity that is approximately 87% clean or carbon-emission free (Hydro One, 2024b). In 2021, Hydro One announced its plans to achieve net-zero GHG emissions by 2050, with an interim target of a 30% emissions reduction by 2030, relative to 2018 baseline levels. In support of these commitments, Hydro One established plans and mitigation targets to reduce their most significant emission sources and agreed on annual emission reduction targets. The following are examples of Hydro One initiatives to achieve these objectives:

- Fleet electrification
- Reduce sulfur hexafluoride (SF₆) losses by improving repair timelines and gas-handling procedures, and by continuing to work with standard bodies and vendors to explore available alternatives.

The pathways and actions towards achieving such targets are not considered in this assessment to avoid an underestimation of the potential GHG emissions associated with the Project. Where appropriate, the commitments will be considered qualitatively to demonstrate the potential to reduce emissions.

Guidance documents such as *Considering Climate Change in the Environmental Assessment Process* (MOECC, 2017) and *Incorporating Climate Change Considerations in Environmental Assessment: General Guidance for Practitioners* (FPTCCCEA, 2003) require climate change to be addressed through the following considerations during an environmental assessment (EA):

- How will potential changes in climate and extreme weather events affect the Project (including supporting and/or ancillary facilities and infrastructure)?
- How will the construction of the Project affect climate change (e.g., the Project's contribution to climate through the emission of GHGs)?

This report addresses the second item by quantifying GHG emissions associated with the construction of the Project. It follows the general framework provided in *Ontario Regulation (O. Reg.) 390/18 Greenhouse Gas Emissions: Quantification, Reporting, and Verification* (Government of Ontario, 2018), which is also aligned with quantification methods outlined in the *Draft Technical Guide Related to the Strategic Assessment of Climate Change* (SACC) (ECCC, 2021).

1.2 Input from Engagement

No comments or concerns related to the GHG assessment were raised by Indigenous communities during consultation sessions.

1.3 Information Sources

Information about the GHGs baseline (i.e., current annual GHG emissions in Ontario and Canada) was collected from the Environment and Climate Change Canada (ECCC) National Inventory Report (NIR) 1990-2024: Greenhouse Gas Sources and Sinks in Canada (ECCC, 2026). The NIR is the most recent annual dataset on emissions of all categories occurring in Ontario, which also contains many inputs and emission factors relevant to all GHG emission sources, including those relevant to the Project. The *2006 International Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories* (IPCC, 2006) and *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories* (IPCC, 2019) were also consulted for GHG emissions related to land use changes.

For the purposes of the ESR, sufficient information was deemed to be available from these references to assess the potential effects of the Project on GHGs.



1.4 Criteria and Indicators

Criteria are components of the environment that are considered to have economic, social, biological, conservation, aesthetic, or ethical value. Indicators are an aspect or characteristic of a criterion that, if changed as a result of the Project, may demonstrate a physical, biological, or socio-economic effect. Criteria and indicators selected for the assessment of Project effects on GHGs, and the rationale for their selection, are provided in **Table 1-1**.

Table 1-1: Greenhouse Gases Criteria and Indicators

Criteria	Rationale	Indicator	Measurement of Potential Effects
GHGs	- Track and minimize GHG emissions where possible to support Ontario's climate goals. - Hydro One commitment to avoid or minimize emissions of GHGs. - Hydro One corporate commitment to achieve net-zero GHG emissions by 2050, with a target to achieve a 30% GHG emissions reduction by 2030.	- Change in the emissions of: - Carbon dioxide (CO₂); - Nitrous oxide (N₂O); - Methane (CH₄); and - Sulfur hexafluoride (SF₆).	- Quantification of projected construction emissions of CO₂, N₂O, and CH₄ expressed in units of equivalent CO₂ (CO₂e). - Quantification of projected emissions from transmission stations and maintenance activities during the operation phase.

GHGs comprise prominently the following chemical species: CO₂, CH₄, N₂O, SF₆, perfluorocarbons (PFCs), and hydrofluorocarbons (HFCs). For reasons explained in **Section 2.1**, only CO₂, CH₄, and N₂O are emitted from the sources considered in this assessment. Therefore, the indicators for the GHGs criteria can be defined as follow:

- Estimated total fossil CO₂ emissions:** Emissions of CO₂ originating from fossil fuel combustion are expressed on an annual basis in tonnes of CO₂e per year (t CO₂e/yr). Fossil CO₂ has a Global Warming Potential (GWP) of 1, as specified in the IPCC 6th Assessment Report (IPCC, 2021).
- Estimated total CH₄ emissions:** Emissions of CH₄ are expressed on an annual basis in t CO₂e/yr. CH₄ has a GWP of 29.8 for fossil fuel sources and 27 for non-fossil fuel sources, as specified in the IPCC 6th Assessment Report (2021).
- Estimated total N₂O emissions:** Emissions of N₂O are expressed on an annual basis in t CO₂e/yr. N₂O has a GWP of 273, as specified in the IPCC 6th Assessment Report (2021).
- Estimated total biogenic CO₂ emissions:** Emissions of CO₂ originating from biomass combustion are expressed on an annual basis in t CO₂e/yr. Biogenic CO₂ has also a GWP of 1, but is accounted separately from fossil CO₂ emissions.

2. Greenhouse Gas Emission Scope

2.1 Temporal Boundaries

The Project will span three phases:

- **Construction:** The period from the start of construction to the start of operation (approximately two years). Emissions expected during the construction phase will include sources of fuel combustion associated with the vehicles, mobile equipment, helicopters, and stationary combustion equipment (e.g., generator sets and water pumps). Land clearing activities comprising the removal of carbon stock from the ground, the loss of carbon sink (e.g., loss of CO₂ sequestration potential from vegetation), and the management of removed vegetation (e.g., burning) are also part of construction phase GHG emissions inventory.
- **Maintenance and Operation:** The period from the start of operation through to the end of the Project's life. GHG emission sources during the operational phase will include fuel combustion for maintenance vehicles and equipment, ongoing loss of the carbon sink removed during construction, and fugitive emissions through the electricity transmission and distribution. These fugitive emissions include line losses (i.e., loss of energy through the transmission of electricity), and SF₆ and PFC emissions from transmission and distribution equipment.
- **Retirement:** The period from the end of the Project's life and start of retirement activities through to the end of final land reclamation.

The highest annual emissions throughout the Project's life will occur during the construction phase, primarily due to land clearing. As such, only emissions from the construction phase are considered in this assessment. Without details and schedules on land clearing activities at this point, the one-time loss from the removal of vegetation (approximately 503 hectares [ha]) is assumed to take place all in one year, as a measure of conservatism, but also to allow for the vehicles and mobile equipment to access the ROW. Additionally, sources of fuel combustion associated with the construction machinery will be greater (e.g., at least an order of magnitude) than the number of vehicles and equipment typically required for the transmission line maintenance program during the operation phase.

Moreover, Hydro One reported SF₆ losses from switchgears at their transmission facilities in Ontario that amounted to 30,000 t CO₂e in 2022 (Government of Ontario, 2026). Considering that Hydro One operates at least 200 transmission stations across the province, this amounts to 150 tCO₂e per station in average. With the Project modifying three existing stations, additional SF₆ emissions from these stations during the operation phase can certainly be expected to be lower than 500 tCO₂e per year, which represents less than 1% of the highest annual total expected during the construction phase (refer to **Section 4.1.1**).

In addition, Hydro One is actively assessing corporate emissions associated with both transmission line losses and from SF₆ and PFCs outside of the Project's Class EA. In collaboration with third parties, such as electricity generators, equipment suppliers, and regulators, Hydro One is developing operational practices and standards to minimize emissions, where mitigation measures are within the control of Hydro One. These initiatives are to mitigate not only fugitive emissions, but all emissions associated with Hydro One operations.

The potential effects and mitigation measures associated with the operational and retirement phases were not quantified as part of this assessment, as the construction phase is expected to generate the highest annual GHG emissions associated with the Project. Construction activities involve fuel combustion from heavy equipment, on-road vehicles, and material transportation, and these emissions are consistently recognized and accounted for in both provincial and federal GHG inventories. In addition,



since the Project is expected to operate for an indefinite period, the timing of retirement/decommissioning is not known at this time.

2.2 Spatial Boundaries

GHG emissions are global by nature. As such, the Project’s GHG assessment is not bounded by a Project-specific study area. Rather, the Project’s GHG emissions are compared against Ontario-wide and Canada-wide GHG emissions inventories to examine how the Project may affect each of them.

2.3 Emission Sources

According to the ISO 14064-1 standard, a GHG emissions source is classified as either a direct source, an indirect source from purchased energy, or another indirect source.

- **Direct GHG emissions:** Emissions occurring from sources that are owned or controlled by a proponent (e.g., generators, vehicles, land clearing/burning, loss of a carbon sink, and fugitive emissions).
- **Indirect GHG emissions from purchased energy:** Emissions from the generation of purchased electricity, heating, and cooling consumed by the proponent.
- **Other indirect GHG emissions:** Emissions that are a consequence of a proponent’s activities but occur from sources not financially or operationally controlled by that proponent (e.g., emissions from waste disposal; extraction and production of purchased fuel and materials; business travel).

For the purpose of accounting and reporting construction-phase emissions, the GHG emissions estimates focused exclusively on sources directly attributable to the Project (**Table 2-1**). Consistent with the federal GHG reporting requirements for individual projects, estimation of other indirect emissions are not required (ECCC, 2025). Indirect emissions associated with purchased electricity are expected to be negligible during construction and, therefore, are considered out of scope for this assessment.

Table 2-1: Project Sources of GHG Emissions

GHG Emission Source during Construction
▪ Diesel combustion from mobile equipment (e.g., excavators, loaders, drill rigs, cranes, wire puller and tensioners, and forest logging equipment); ▪ Diesel combustion from equipment categorized as stationary (e.g., portable generator, water pump, and chain saws); ▪ Diesel combustion from heavy-duty vehicles for the transportation of construction materials and for the mobilization/demobilization of construction equipment to/off site; ▪ Gasoline combustion from light-duty vehicles for crew transportation; ▪ Aviation fuel combustion from aircrafts for air travel by crew members; ▪ Aviation fuel combustion from helicopters during construction; and ▪ Land clearing (carbon stock removal, loss of carbon sink, and wood burning).



2.3.1 Exclusions

Given the breadth of activities required to build the new transmission line, emissions from other sources may occur but are excluded considering that they would be negligible when compared to the main emission sources listed in **Table 2-1**. The following potential GHG emission sources are therefore excluded from the analysis:

- A portion of timber from clearing activities will be harvested, processed, and transported to mills. Hauling of the timber related to these activities is limited compared to the overall picture.
- Diesel consumption from all-terrain vehicles is not included due to their low horsepower and usage compared to other mobile equipment.
- Carbon loss from disturbed soil during excavation including transportation of soil between sites for reuse during backfilling, grading, and restoration. If relevant, drainage of wet organic soil and hauling of excess and unsuitable soil to licensed facilities are also excluded.
- Vegetation left in place to degrade over time resulting in the emissions of small amounts of biogenic CO₂ (e.g., wood not recovered or not burned).
- Periodic maintenance activities of equipment are expected to be minimal relative to the GHG emissions generated from the construction activities.
- Electricity usage from the grid during construction is a possibility, but the indirect emissions for the production of this electricity will be marginal compared to the total.



3. Greenhouse Gas Baseline Conditions

The baseline conditions of GHG emissions serve as the basis to examine the potential effects of the Project on global warming and climate change in the provincial context (Ontario) and federal context (Canada). As such, the latest reported GHG emissions data and factors according to the ECCC NIR (ECCC, 2026) were used to characterize the Project's baseline conditions for GHG emissions.

For 2024, approximately 685 Mt CO₂e were reported nationally, with Ontario accountable for about 23% of these emissions (**Table 3-1**). The primary sources of GHG emissions in Canada and Ontario are from anthropogenic sources that include the energy sector (including stationary combustion sources, transportation and fugitive sources), which accounted for 81% and 74% of Canada's and Ontario's total GHG emissions in 2024, respectively.

Given that the NIR provides annual inventories, the Project's potential effect on GHG emissions was examined solely according to the construction phase during which highest annual emissions will occur. As per NIR emission categories most relevant to the construction phase, a total of 18 and 4.3 Mt CO₂e were emitted nationally in 2024 due to a combination of off-road transportation, manufacturing, and mining/construction activities, and land converted into settlements, respectively. The province of Ontario accounts for 15% of these emissions when put together.

Table 3-1: Baseline GHG Emissions Relevant to the Project

Jurisdiction	Relevant NIR Category ⁽¹⁾	GHG Emissions (Mt CO ₂ e) ⁽²⁾
Canada-wide 2024 GHG emissions	Total (all sources)	685
	Off-road Manufacturing, Mining and Construction within the Transport category	18
	Land Converted into Settlements within the Land use, land use change and forestry category	4.3
Ontario-wide 2024 GHG emissions	Total (all sources)	158
	Off-road manufacturing, mining, and construction within the Transport category	4.1
	Land Converted into Settlements within the Land use, land use change and forestry category	-0.6 ⁽³⁾

Notes:

1. Corresponds to the main GHG category (and smallest sub-category) from ECCC NIR 1990:2024 relevant to **Table 2-1** sources.
2. Mt CO₂e = megatonnes of carbon dioxide equivalent.
3. A negative value is indicative of higher CO₂ uptake from the atmosphere by land relative to emissions specific to the "Land converted into settlements" category.



4. Potential Effects, Mitigation Measures, and Net Effects

4.1 Potential Effects

4.1.1 Construction Phase

The primary sources of GHG emissions during the construction phase are the effects of land clearing (i.e., introducing a loss of carbon stock, a loss of carbon sink, and the burning of cleared wood), and fossil fuel combustion from construction activities, including off-road equipment and on-road vehicles.

Land Clearing

According to preliminary estimations, a total of 503 ha is expected to be cleared, as follows:

- 25 ha of vegetation that will be cut and burned on site.
- 235 ha of trees are expected to be cleared and produce merchantable log or chips.
- 243 ha will be cleared, chipped, or mulched and expected to be left in place along the ROW.

Land clearing also represents a loss of carbon sink associated with normal vegetation growth. The highest loss of carbon sequestration capacity occurs immediately following land clearing and grubbing, when little or no vegetation regrowth has yet occurred. Vegetation regrowth within the ROW is expected during the operation phase.

A summary of input data required for the land clearing and wood burning calculations is provided in **Table 4-1**. Details of values used in the GHG Emissions Assessment are provided in **Appendix A**.

Table 4-1: Data Used for Land Clearing Emission Calculations

Emission Source	Data Used in Annual Emission Calculations	References
Carbon Stock Removal from Land Clearing	▪ Total area of vegetation to be cleared; ▪ Types and amount of vegetation to be removed (land cover includes shrubland, coniferous/mixed/deciduous/transitional forests and swamps), including: ▫ Mean above-ground dry biomass content; ▫ Below-to-above-ground biomass ratio; and ▫ Carbon fraction in wood.	IPCC 2019 Refinement to the 2006 IPCC Guidelines for National GHG Inventories and Draft Technical Guide Related to the SACC (ECCC, 2021)
Carbon Sink Loss from Land Clearing ^{(1) (2)}	▪ Total area of vegetation to be cleared; ▪ Types and amount of vegetation to be removed (land cover includes shrubland, coniferous/mixed/deciduous/transitional forests and swamps), including: ▫ Mean above-ground dry biomass growth rate; ▫ Below-to-above-ground biomass ratio; and ▫ Carbon fraction in wood.	

Table 4-1 (Cont'd): Data Used for Land Clearing Emission Calculations

Emission Source	Data Used in Annual Emission Calculations	References
Wood Burning	▪ Area of vegetation to be cleared for pile and burn only; ▪ Types and amount of vegetation to be removed for pile and burn only (land cover includes shrubland, coniferous/mixed/deciduous/transitional forests and swamps), including: ▫ Mean above-ground dry biomass content; ▫ Carbon fraction in wood; and ▫ Wood burning CH₄ and N₂O emission factors.	

Notes:

1. This source accounts for the loss of annual removal of CO₂ from the atmosphere. Since the construction stage is expected to span approximately 2 years, GHG emissions as a result of sink loss was calculated over that period. Sink loss will continue over the years, however, it is not covered in this assessment as the operational phase accounts to a lesser amount comparing to the GHG emissions during the construction stage. Since CO₂ from tree burning emissions is not from a fossil fuel source, CO₂ generated from this source is categorized as biogenic (CO₂ bio).
2. It is understood that temporary disturbances of vegetation will be reclaimed and that compatible vegetation will be allowed within the ROW. This revegetation would slightly compensate the carbon sink loss from tree clearing incurred during construction. However, for the purpose of this assessment, it is assumed that little or no vegetation regrowth will occur during the construction phase.

Fuel Consumption

GHG emissions totals from construction activities were calculated based on fuel consumption estimates for diesel, gasoline, and turbo fuel, as listed in **Table 4-2**, in combination with published emission factors from the NIR 1990-2024 (ECCC, 2026). The volumes were calculated based on preliminary estimates with consideration for the equipment on site, the equipment models where available, the expected time on site, the number of trips to transport material and workers to site, and the origin of material/workers. Further details on values used in the GHG Emissions Assessment are provided in **Appendix A**.

Table 4-2: Total Fuel Consumption Estimated for the Construction Phase

Emission Source	Fuel Type	Total volume (Litres [L])	Applicable Emission Factors Reference
Stationary fuel combustion equipment	Diesel (B3)	59,738	ECCC NIR 1990:2024 (Annex A6.1.6)
Off-road mobile equipment	Diesel (B3)	1,221,395	ECCC NIR 1990:2024 (Annex A6.1.15)
Crew vehicles including light-duty trucks	Gasoline (E10)	458,973	
Heavy-duty transport trucks including mobilization/demobilization	Diesel (B3)	1,099,153	
Air travel and aerial work including wiring	Turbo fuel	1,913,560	



Total GHG Emissions

The estimated total GHG emissions during the construction phase of the Project are summarized in **Table 4-3**, while the highest projected annual GHG emissions are compiled in **Table 4-4**. In all, the Project is expected to generate 164,208 t CO₂e of GHG emissions during the construction phase, with an annual maximum of 153,255 t CO₂e o.

Table 4-3: Summary of Estimated GHG Emissions during Construction

Source	GHG Emissions (t CO ₂ e)						Percent Contribution
	CO ₂	CH ₄	N ₂ O	Total	CO ₂ b	Total (incl. CO ₂ b)	
Fuel Consumption	12,039	14	129	12,182	248	12,430	7.6%
Land Clearing (carbon stock removal)	0	0	0	0	142,771	142,771	87%
Land Clearing (carbon sink loss)	0	0	0	0	7,975	7,975	4.9%
Land Clearing (wood burning)	0	701	331	1,032	0	1,032	<1%
Total	12,039	715	460	13,214	150,994	164,208	100%



Table 4-4: Summary of Highest Projected Annual Greenhouse Gas Emissions

Source	Highest Year GHG Emissions (t CO ₂ e)						Percent Contribution	Rationale
	CO ₂	CH ₄	N ₂ O	Total	CO ₂ b	Total (including CO ₂ b)		
Fuel Consumption	7,223	9	77	7,309	149	7,458	4.9%	Assuming that 60% of the fuel will be consumed during the first year of the two-year construction period.
Land Clearing (carbon stock removal)	0	0	0	0	142,771	142,771	93%	Assuming all biomass cleared in the first year.
Land Clearing (carbon sink loss)	0	0	0	0	1,994	1,994	1.3%	Assuming all biomass cleared within the first half of the year resulting in sink loss during the second half of the year.
Land Clearing (wood burning)	0	701	331	1,032	0	1,032	< 1%	Assuming all wood burning will be carried out during the first year.
Total	7,223	709	409	8,341	144,913	153,255	100%	



4.1.2 Maintenance and Operation

The present assessment does not provide quantified estimates on GHG emissions to be expected during the maintenance and operation phase, as indicated in **Section 2.1**. It is understood that the Project is a transmission project, is not a power generation project and, as such, its maintenance and operation would not result in significant GHG emissions.

During its lifespan, GHG-related emissions are expected to be limited to SF₆ and/or PFC losses from switchgears at stations, transmission line losses, and fuel consumption from vehicles and equipment used for routine and unscheduled maintenance of the Project components. Transmission line losses relate to indirect GHG emissions for the production of the electrical energy dissipated as heat during transmission. According to the latest NIR prepared by ECCC annually, this electrical loss translates to about 5 g CO₂e per kWh of consumed electricity in Ontario in average.

In all, the Project is expected to generate less than 10,000 t CO₂e per year during operation and maintenance.

4.2 Mitigation Measures

The following mitigation measures align the Project with Hydro One's corporate commitment to achieve net-zero GHG emissions by 2050 and to reduce corporate emissions by 30% (compared to 2018 values) by 2030:

- Hydro One will work with Sustainable Forest Licence holders to find other uses for the merchantable timber rather than burning it.
- Temporary disturbances will be reclaimed, and compatible vegetation will be allowed to regrow within the ROW.
- Where reasonable and practicable, vehicles and equipment will be turned off when not in use, unless weather and/or safety conditions dictate the need for them to remain turned on and in a safe operating condition.
- Hydro One with their contractor(s) will keep equipment well maintained to maximize fuel efficiency.
- Multi-passenger vehicles will be used to transport personnel, where practicable.
- Electric or hybrid vehicles will be used for operation and maintenance activities where possible.
- Hydro One with their contractor(s) will prepare and implement a Dust Control/Air Quality Plan prior to construction which measures may also help in mitigating GHG emissions.

4.3 Net Effects

Net effects are described as residual effects after the implementation of effective mitigation measures. Although integration of mitigation measures will help reduce GHG emissions from the Project, they will not be eliminated; thus, the GHG emissions from the construction activities phase are considered a net effect for the purposes of this assessment.

Based on the inputs and in **Appendix A**, in the first year of construction, which would have the Project's highest level of GHG annual emissions, the Project would represent less than 0.1% of the Ontario-total and approximately 0.022% of the Canada-wide total, as presented in **Table 4-5**. Specifically to the NIR construction category, the Project would add an equivalent of 0.18% and 0.041% to the Ontario-total and the Canada-wide total GHG emissions during a year, respectively (**Table 4-5**). Comparing land use



related emissions (land converted into settlements), the Project's highest annual GHG emissions would represent 2.9% of Canada's related total in 2024 (**Table 4-5**).

Table 4-5: Potential Impact of the Project on Ontario's and Canada's Annual GHG Emissions Inventories

	NIR Total	NIR Construction Category	NIR Land Use Category
Project Highest Annual GHG Emissions ⁽¹⁾	153,255 t CO ₂ e	7,458 t CO ₂ e	145,797 t CO ₂ e
Comparison to Ontario-Total	0.096%	0.18%	n/a ⁽²⁾
Comparison to Canada-wide Total	0.022%	0.041%	2.9%

Notes:

1. The project's emissions are represented using the highest projected annual emissions during the construction stage and include associated biogenic CO₂ emissions from carbon stock removal.
2. Not applicable, since the annual GHG emissions are negative in Ontario.

Based on the comparison between the Project's highest projected annual GHG emissions, and the federal and provincial annual GHG emissions inventories (see **Table 4-5**), the magnitude of the Project's net effect on both provincial and federal GHG emission levels is low based on a conservative assessment.

In summary, the net effect of the Project on GHG emissions is anticipated to be not significant.

5. References

- Environment and Climate Change Canada (ECCC). 2021. Technical guide related to the Strategic Assessment for Climate Change (SACC): Guidance on quantification of net GHG emissions impact on carbon sinks, mitigation measures, net-zero plan and upstream GHG assessment, August 2021 Available at: www.strategicassessmentclimatechange.ca/.
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APPENDICES

Appendix A. Calculation Note

A.1 Greenhouse Gas Assessment Methodology

A.1.1 Introduction

Greenhouse gases (GHGs) are defined as gases that trap radiation, essentially heating the atmosphere. The most common GHGs are carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), and sulphur hexafluoride (SF₆). GHG emissions occur because of various natural and anthropogenic activities, with the combustion of fossil fuels being the most widely attributed anthropogenic source.

The calculated GHG emissions described herein are based on conservative inputs that may overestimate the actual emissions. Future GHG reporting requirements for the Project should be based on actual annual emission totals, not those reported in this document.

A.1.2 Identification of Greenhouse Gas Emission Sources

The assessment of potential Project effects on GHG emissions considers impacts that will occur during the construction phase only, as the annual GHG emissions over the lifespan of the Project are anticipated to be highest during this phase. During construction, the Project will generate CO₂, CH₄, and N₂O from the combustion of fossil fuels by engines in vehicles, mobile equipment, helicopters, etc., as well as from land clearing (**Table A-1**). The GHG emissions were estimated accordingly based on information provided by Hydro One and their construction contractor with regard to the type and number of equipment expected on site and use durations during the two-year construction period, along with other useful information required in calculations.

Table A-1: Greenhouse Gas Emission Sources during Construction

GHG Emission Source	GHGs Involved
Fuel consumption	CO ₂ , CH ₄ , N ₂ O
Land use change (carbon stock removal from clearing)	Biogenic CO ₂
Land use change (carbon sink loss from clearing)	Biogenic CO ₂
Land use change (wood combustion from clearing)	CH ₄ , N ₂ O

A.1.3 Greenhouse Gas Emissions Calculations

This subsection provides information on the methods used to calculate emissions from fuel consumption, and land use change.



A.1.3.1 Fuel Consumption

Emission rates of fuel consumption are calculated as follows.

Mobile Land Equipment and Stationary Combustion Equipment with Engines

$$E_{k,i} = P_k \times LF_k \times UF_k \times BSFC_k \times T_k \times EF_i \times GWP_i / 10^6 \quad (1)$$

$E_{k,i}$ total emissions of GHG i (i = CO₂, CH₄, or N₂O) for equipment k (t CO₂e)

P_k rated power of equipment k (hp)

LF_k average engine load factor of equipment k (-)

UF_k actual usage factor of equipment k during time on site (-)

$BSFC_k$ brake-specific fuel consumption of equipment k (L/hp-h)

T_k total time on site for equipment k (h)

EF_i emission factor for GHG i (i = CO₂, CH₄, or N₂O) for the combustion of diesel fuel (g/L)

GWP_i global warming potential for GHG i (t CO₂e/t)

$P_k \times LF_k \times BSFC_k \times UF_k \times T_k$ is used to estimate the volume of diesel fuel expected to be consumed for one equipment, which are added together so to obtain a total which is provided in **Table A-2**.

Crew Vehicles

$$E_{k,i} = D_k \times FC_k \times N_k \times EF_i \times GWP_i / 10^6 \quad (2)$$

$E_{k,i}$ total emissions of GHG i (i = CO₂, CH₄, or N₂O) for vehicle k (t CO₂e)

D_k average distance travelled daily for vehicle k (km/day)

FC_k specific fuel consumption for vehicle k (L/km)

N_k number of days using vehicle k (day)

EF_i emission factor for GHG i (i = CO₂, CH₄, or N₂O) for the combustion of gasoline (g/L)

GWP_i global warming potential for GHG i (t CO₂e/t)

$D_k \times FC_k \times N_k$ is used to estimate the volume of gasoline expected to be consumed for one vehicle, which are added together so to obtain a total which is provided in **Table A-2**.

Heavy-Duty Trucks for Transportation of Construction Materials

$$E_{k,i} = \frac{M_k}{P_k} \times D_k \times FC \times EF_i \times GWP_i / 10^6 \quad (3)$$

$E_{k,i}$ total emissions of GHG i (i = CO₂, CH₄, or N₂O) for conveyed material using route k (t CO₂e)

M_k total amount of conveyed material using route k (m³ of material)

P_k average truck payload for conveyed material using route k (m³/ trip)

D_k one-way distance for conveyed material using route k (km one-way/trip)



FC fuel consumption rate of heavy-duty trucks (L/km one-way)
 EF_i emission factor for GHG i (i = CO₂, CH₄, or N₂O) for the combustion of diesel by trucks (g/L)
 GWP_i global warming potential for GHG i (t CO₂e/t)

$\frac{M_k}{P_k} \times D_k \times FC$ is used to estimate the volume of diesel fuel expected to be consumed for trucking along one route, which are added together so to obtain a total which is provided in **Table A-2**.

Land Mobilization and Demobilization of Construction Equipment

$$E_{k,i} = N_k \times D_k \times FC \times EF_i \times GWP_i / 10^6 \quad (4)$$

E_{k,j} total emissions of GHG i (i = CO₂, CH₄, or N₂O) for equipment category k (t CO₂e)
 N_k total number of trucks transporting equipment category k (-)
 D_k distance to travel for transporting equipment category k (km one-way)
 FC fuel consumption rate of heavy-duty trucks (L/km one-way)
 EF_i emission factor for GHG i (i = CO₂, CH₄, or N₂O) for the combustion of diesel by trucks (g/L)
 GWP_i global warming potential for GHG i (t CO₂e/t)

$N_k \times D \times FC$ is used to estimate the volume of diesel fuel expected to be consumed for trucking one equipment category, which are added together so to obtain a total which is provided in **Table A-2**.

Air Travel

$$E_i = N \times D \times FC \times EF_i \times GWP_i / 10^6 \quad (5)$$

E_{k,j} total emissions of GHG i (i = CO₂, CH₄, or N₂O) for air travel (t CO₂e)
 N total number of passenger-trips (psg)
 D distance travelled by air to site (km)
 FC specific fuel consumption rate for airplanes (L/psg-km)
 EF_i emission factor for GHG i (i = CO₂, CH₄, or N₂O) for the combustion of turbo fuel (g/L)
 GWP_i global warming potential for GHG i (t CO₂e/t)

$N \times D \times FC$ is used to estimate the volume of turbo fuel expected to be consumed for the air travelling of people to site from one origin, which are added together so to obtain a total which is provided in **Table A-2**.

Wiring Using Helicopters

$$E_{k,i} = T_k \times UF_k \times FC_k \times EF_i \times GWP_i / 10^6 \quad (6)$$

E_{k,j} total emissions of GHG i (i = CO₂, CH₄, or N₂O) for helicopter k (t CO₂e)



T_k	total time on site for helicopter k (h)
UF_k	actual usage factor of helicopter during time on site (-)
FC_k	specific fuel consumption rate for helicopter k (L/h)
EF_i	emission factor for GHG i (i = CO ₂ , CH ₄ , or N ₂ O) for the combustion of turbo fuel (g/L)
GWP_i	global warming potential for GHG i (t CO ₂ e/t)

$T_k \times UF_k \times FC_k$ is used to estimate the volume of turbo fuel expected to be consumed for one helicopter, which are added together so to obtain a total which is provided in **Table A-2**.

A.1.3.2 Land Clearing

The following equations are applied based on IPCC's approach (2006, 2019) which objective is to assess the variation of carbon in forest biomass at a macroscopic level. The loss of forest (carbon reservoir) corresponds to CO₂ that has been captured over the years and be re-released in the atmosphere, at least in part. No field measurements specific of the study area in terms of biomass carbon density were carried out and so the present calculations rely on default values provided by the IPCC.

Carbon Stock Removal

$$E_k = S_k \times AG_k \times (1 + BG_k) \times CF \times 44/12 \quad (7)$$

E_k	total emissions associated with biogenic CO ₂ for sector k (t CO ₂ e)
S_k	vegetated area to be cleared for sector k (ha)
AG_k	above-ground living biomass density for sector k (t dry/ha)
BG_k	below-ground to above-ground biomass ratio applicable to sector k (-)
CF	carbon content in dry wood (t C/t dry)

Carbon Sink Loss

$$E_k = S_k \times SG_k \times (1 + BG_k) \times CF \times 44/12 \times T \quad (8)$$

E_k	total loss associated with biogenic CO ₂ for sector k (t CO ₂ e)
S_k	vegetated area to be cleared for sector k (ha)
SG_k	above-ground living biomass annual growth for sector k (t dry/ha/yr)
BG_k	below-ground to above-ground biomass ratio (-)
CF	carbon content in dry wood (t C/t dry)
T	sink loss duration (yr)



Wood Burning

$$E_{k,i} = S_k \times AG_k \times EF_i \times GWP_i / 10^3 \quad (9)$$

$E_{k,i}$ total emissions of GHG i ($i = \text{CH}_4$, or N_2O) for sector k (t CO_2e)

S_k vegetated area to be cleared for sector k which is slated for wood burning (ha)

AG_k above-ground living biomass density for sector k (t dry/ha)

EF_i applicable emission factor for GHG i ($i = \text{CH}_4$, and N_2O) (kg/t dry)

GWP_i global warming potential for GHG i (t $\text{CO}_2\text{e/t}$)

A.1.4 Greenhouse Gas Emissions Assessment Inputs

Table A-2 documents the data sources used to estimate the GHG emissions for the Project.

Table A-2: Greenhouse Gas Emissions Assessment Data Sources

Emission Source	Parameter	Value	Unit	Data Source
Fuel Consumption	Total diesel consumption from mobile equipment	1,221,395	L	Calculated based on information provided by construction contractors regarding the number of equipment on site, the equipment models when available, the expected time on site, the number of trips to transport material and workers to site, and the origin of material/workers.
	Total diesel consumption from stationary equipment	59,738	L	
	Total gasoline consumption from crew vehicles	458,973	L	
	Total diesel consumption from heavy-duty trucks	847,505	L	BSFC and LF from Eq. (1) taken from the US EPA Nonroad model.
	Total diesel consumption for land mobilization and demobilization	251,648	L	UF from Eq. (1) and (6) attributed as 25%, 50%, or 75% depending on expected level of usage on site per equipment type.
	Total turbo fuel consumption for air travel	232,054	L	D from Eq. (2) estimated at 125 km per day per vehicle.
	Total turbo fuel consumption for helicopters	1,681,506	L	FC from Eq. (2) based on typical fuel economy for a Ford F-150 and F-250.
				FC from Eq. (3) and (4) based on typical fuel consumption for heavy-duty trucks (0.39 L/km one-way with payload, and 0.78 L/km one-way for round-trip).



Table A-2 (Cont'd): Greenhouse Gas Emissions Assessment Data Sources

Emission Source	Parameter	Value	Unit	Data Source
Mobile Land Equipment	CO ₂ EF for diesel combustion	2,598	g CO ₂ /L	Off-road diesel > 19kW (all tiers) emission factor in Table A6.1-15 of NIR 1990-2024: GHG Sources and Sinks in Canada (ECCC, 2026). Note: assuming that the overall stock of diesel used contains 3.1% of biodiesel in average. Therefore, the CO ₂ emission factor is multiplied by 0.969. The biogenic CO ₂ emission factor is using the biodiesel emission factor and multiplied by 0.031.
	CH ₄ EF for diesel combustion	0.073	g CH ₄ /L	
	N ₂ O EF for diesel combustion	0.12	g N ₂ O/L	
	CO ₂ b EF for diesel combustion	77	g CO ₂ b/L	
Stationary Combustion Equipment	CO ₂ EF for diesel combustion	2,598	g CO ₂ /L	Diesel – Refineries and Others emission factor in Table A6.1-6 of NIR 1990-2024: GHG Sources and Sinks in Canada (ECCC, 2026). Note: assuming that the overall stock of diesel used contains 3.1% of biodiesel in average. Therefore, the CO ₂ emission factor is multiplied by 0.969. The biogenic CO ₂ emission factor is using the biodiesel emission factor and multiplied by 0.031.
	CH ₄ EF for diesel combustion	0.078	g CH ₄ /L	
	N ₂ O EF for diesel combustion	0.022	g N ₂ O/L	
	CO ₂ b EF for diesel combustion	77	g CO ₂ b/L	
Crew Vehicles	CO ₂ EF for gasoline combustion	2,088	g CO ₂ /L	Light-duty Gasoline Trucks (oxidation catalysts) emission factor in Table A6.1-15 of NIR 1990-2024: GHG Sources and Sinks in Canada (ECCC, 2026). Note: assuming that the overall stock of gasoline used contains 9.5% of ethanol in average. Therefore, the CO ₂ emission factor is multiplied by 0.905. The biogenic CO ₂ emission factor is using the ethanol emission factor and multiplied by 0.095.
	CH ₄ EF for gasoline combustion	0.43	g CH ₄ /L	
	N ₂ O EF for gasoline combustion	0.20	g N ₂ O/L	
	CO ₂ b EF for gasoline combustion	143	g CO ₂ b/L	

Table A-2 (Cont'd): Greenhouse Gas Emissions Assessment Data Sources

Emission Source	Parameter	Value	Unit	Data Source
Transport Trucks	CO ₂ EF for diesel combustion	2,597	g CO ₂ /L	Heavy-duty Diesel Vehicles (moderate control) emission factor in Table A6.1-15 of NIR 1990-2024: GHG Sources and Sinks in Canada (ECCC, 2026). Note: assuming that the overall stock of diesel used contains 3.1% of biodiesel in average. Therefore, the CO ₂ emission factor is multiplied by 0.969. The biogenic CO ₂ emission factor is using the biodiesel emission factor and multiplied by 0.031.
	CH ₄ EF for diesel combustion	0.14	g CH ₄ /L	
	N ₂ O EF for diesel combustion	0.082	g N ₂ O/L	
	CO ₂ b EF for diesel combustion	77	g CO ₂ b/L	
Air Travel and Helicopters	CO ₂ EF for turbo fuel combustion	2,560	g CO ₂ /L	Aviation Turbo Fuel emission factor in Table A6.1-15 of NIR 1990-2024: GHG Sources and Sinks in Canada (ECCC, 2026).
	CH ₄ EF for turbo fuel combustion	0.018	g CH ₄ /L	
	N ₂ O EF for turbo fuel combustion	0.071	g N ₂ O/L	
Land use Change: Carbon Stock Removal	Total surface area cleared (S _k)	503	ha	For calculation of total carbon stock removal.
	Average above-ground biomass affected by disturbance (AG _k)	128.9	t dry/ha	Table 4.7 of IPCC 2019 Refinement to the 2006 IPCC Guidelines for National GHG Inventories Vol 4, Chapter 4. Temperate Continental Forest; secondary >20 years.
	Ratio of below-ground to above-ground biomass (BG _k)	0.277	—	Table 4.4 of IPCC 2019 Refinement to the 2006 IPCC Guidelines for National GHG Inventories Vol 4, Chapter 4. Temperate Continental Forest >125 tonnes/ha.
	Carbon fraction of dry wood (CF)	0.47	t C/t dry	Table 4.3 of IPCC 2006 Vol 4, Chapter 4. Boreal forest with all parts (broad-leaves and conifers).

Table A-2 (Cont'd): Greenhouse Gas Emissions Assessment Data Sources

Emission Source	Parameter	Value	Unit	Data Source
Land use Change: Carbon Sink Loss	Total surface area cleared (S_k)	503	ha	
	Average annual above-ground biomass growth (SG_k)	3.6	t dry/ha/y	Table 4.12 of IPCC 2019 Refinement to the 2006 IPCC Guidelines for National GHG Inventories, Vol 4, Chapter 4. Temperate Continental Forest; secondary >20 years.
	Ratio of below-ground to above-ground biomass (BG_k)	0.277	—	Table 4.4 of IPCC 2019 Refinement to the 2006 IPCC Guidelines for National GHG Inventories Vol 4, Chapter 4. Temperate continental forest >125 tonnes/ha.
	Loss of growth period (T)	2	years	Assumes sink loss of two years during the construction stage.
Land use Change: Wood Burning	Total surface area cleared (S_k)	25	ha	Area for which the wood is projected to be burned.
	CH ₄ EF for wood biomass burning	6.3	t CH ₄ /t dry	Assuming 1% of carbon converted into CH ₄ as per ECCC SACC guidelines.
	N ₂ O EF for wood biomass burning	0.29	t N ₂ O/t dry	Assuming N ₂ O equivalent to 0.017% of CO ₂ as per ECCC SACC guidelines.
Global Warming Potentials (GWP)	CO ₂	1	t CO ₂ e/t CO ₂	IPCC AR6 (2021).
	CH ₄ (non-fossil)	27	t CO ₂ e/t CH ₄	
	CH ₄ (fossil)	29.8	t CO ₂ e/t CH ₄	
	N ₂ O	273	t CO ₂ e/t N ₂ O	

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